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Report

Policy framework for the interaction between buildings and the energy system in Norway

WP4 INTERACT

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ABSTRACT

This report provides an assessment of the impacts of the current policy and regulatory framework upon efficient energy usage, management of increased energy surpluses, storage and exchanges in and between buildings in Norway. There is currently a reinforced focus and priority towards energy efficiency in buildings. Yet, there are no explicit policy measures in place which directly aim at stimulating more energy storage and exchange. An important economic barrier is related to the ownership and management of energy infrastructure, both for district heating and electricity. The regulation of third-party access and deliveries to district heating, which is now in its beginning given recent amendments in the legislation, as well as the forthcoming regulation for plus customers (or 'prosumers') of electricity, can be seen as first steps in this regard. What kind of costs and/or benefits this will imply for producers and consumers are not fully clarified. Still, innovative pilot projects hosted by municipalities, as well as the building industry's approach to low-energy building concepts, may jointly add force to the impulse stemming from the EU legislation, towards a more 'interactive' Norwegian policy framework.

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Table of contents

Glossary

DHC District heating and cooling

EE Energy efficiency, see definition below.

End-use versus supply-side energy efficiency – energy efficiency can target both (a) modes of energy supply and (b) modes of energy consumption. The first targets e.g. loss-reductions within power generation or improved efficiency in industrial activities and whereas the latter targets e.g. efficiency in consumption by appliances and buildings (IEA 2012)

Energy conservation – implies meeting our needs with less energy consumption. It is measured in terms of reduced energy units alone or the ration of before and after energy consumption. The main difference between energy conservation and energy efficiency is that reducing energy demand is the primary goal of energy conservation while improved energy efficiency aims to reduce the energy consumed in delivering a given energy service. (IEA 2012)

Energy efficiency may be defined as the level of energy consumption to provide a given service, and typically refers to an improvement in this relationship. Energy efficiency may be interpreted in a broad sense and include both the technical (e.g. less energy-consuming light bulbs) and non-technical factors (e.g. when a light bulb is used less) contributing to the amount of energy consumed for a given energy service (IEA 2012)

Energy intensity – is a measure of how much energy is required to produce each unit of national revenue. It is generally measured as energy consumed divided by GDP, or in a given *sector as the energy consumed divided by value-added for the sector.* (IEA 2012)

Energy savings – is the estimated energy saved through a particular (energy efficiency improving) measure. This may be difficult to quantify, hence so are the achievement of energy savings objectives. (IEA 2012).

EU EPBD – the EU Directive on Energy Performance of Buildings. The first version was approved by the EU in 2002, the current version called 'recast' was approved in 2010. Norway is committed by this Directive, but has still not processed the 2010 version into Norwegian law. The EU EPBD is a major legislative instrument for the regulation of energy usage in and by buildings.

GHG Green House Gases, e.g. CO_2.

Instrument is in this report understood non-technical approaches that aim to promote the realization of one or more measures that increase energy efficiency.

INTERACT The competence-building research project for the industry 'Efficient interaction between energy demand, surplus heat/cool and thermal storage in building complexes – INTERACT' is a 4-year project (2014-18) with main funding from industrial partners and the Research Council of Norway, and coordinated by SINTEF Energy Research.

Measures are in this study understood as technologies, processes or practices that increase energy efficiency.

"Same with less" versus "more with same" are two important impacts of energy efficiency. Traditionally energy efficiency focus (particular in OECD countries) lies with the use of less energy for the same energy service. It is however important to emphasize that an improvement in energy efficiency can be when either less energy is consumed to provide the same level of services or the same energy is consumed for a higher level of services. (IEA 2012)

TEK is the Norwegian building code ('teknisk forskrift'), a regulation founded on the Planning and Building act. According to the EU Energy Performance of Buildings Directive, this regulation is to be updated every five years. The current TEK was decided in 2010, and is called 'TEK 10'. 'TEK 15' will take effect in 2015, and is currently (December 2014) under preparation by the building authorities.

1. Summary

This report is written as part of the INTERACT project and discusses to what extent and how the current policy and regulatory framework impacts upon efficient solutions for energy usage, management of energy surpluses, storage and exchange in and between buildings in Norway. The assessment includes a specific view on the interface between buildings and the energy system. Main policy barriers for the realization of solutions for energy efficiency in buildings are identified.

There is clearly a reinforced focus and priority towards energy efficiency in Norway, as not least reflected by the latest climate-change policy strategy approved by the Parliament in 2012. This includes a stronger political and industry-based focus on stimulating the phase-in of low-energy building concepts – not least on the background of the EU-based legislation which must be followed up in Norway. In parallel, during the last decade, there has been a clear focus on the further promotion of district heating and other alternatives to electricity-based heating in Norway.

The assessment demonstrates that although there is an increased focus on energy efficiency in buildings, there are no explicit policy measures in place in today's Norway which directly aim at stimulating more energy storage (i.e. thermal storage in this report) and exchange between buildings. In particular, few initiatives have thus far been taken from the political level in order to actually prepare the introduction of smart grid concepts, including more interactive exchange of energy between buildings and the grid, and a higher amount of building-based energy production. Hence, further regulatory changes will be necessary in the near future –given the technological development.

An important economic barrier is related to the ownership and management of energy infrastructure, both for district heating and electricity. The regulation of third-party access and deliveries to district heating, which is now in its beginning given recent amendments in the legislation, as well as the forthcoming regulation for plus customers (or 'prosumers') of electricity, can be seen as the first legislative steps on the road towards a more interactive energy system. What kind of costs and/or benefits this will imply for the society, and eventually for what kind of producers and consumers, is not fully clarified in a Norwegian context. Hence, more interaction and integration between different technical systems will also require increased cooperation and coordination between different policy sectors, not least between the energy and buildings sectors. In order to gain political and societal support for more concrete measures for the transition towards a more interactive energy system, one should, therefore, also address the social and economic dimensions.

A promising part of the emerging societal interest in Norway for energy efficiency is the role played by climate- and energy-oriented municipalities hosting innovative pilot projects. Another very interesting development is the building industry's innovative approach and interest for low-energy building concepts. These two trends could together have a joint impact on the further development of a Norwegian policy framework, adding to the impulse stemming from the EU legislation.

2. Introduction

This report is written as part of the INTERACT project[1] and discusses policy and regulatory approaches to energy efficiency measures in buildings in Norway. In particular, the report centers the discussion around to what extent current measures can induce increased exchange of energy surpluses (heating and cooling) and energy storage (i.e. thermal storage in this report), in and between buildings and building complexes.

Energy efficiency is an important issue also from a societal perspective. Energy efficiency measures may target both *energy supply* and *energy demand and consumption* (end-use versus supply-side energy efficiency (c.f. IEA 2012a)). Buildings account for more than 40% of global energy used (UNEP 2009), and as much as one third of global greenhouse gas emissions, both in the developed and the developing countries (UNEP, 2009). If energy efficiency in the building sector is not improved, the current energy demand in the buildings sector is expected to rise by 50% by 2050 (IEA 2013). Increased energy efficiency in buildings is a win-win climate change abatement measure. By reducing the need and demand for energy through energy conservation and efficiency, resource use and environmental impacts of the buildings may be lowered. This includes the need for new or existing energy projects with possible negative impact on the environment, such as land use and loss of biodiversity. At the same time it represents opportunities for cost reduction for constructors and proprietaries, and potential benefits through the innovation of new concepts.

Figure 1 Combining biodiversity with energy efficient buildings; beehives on the roof of Vulkan Area – an energy efficient building complex project in Oslo with e.g. 50 geothermal wells (Foto Aspelin-Ramm)

Energy efficiency measures can be related to different main technological paths: (1) improved building constructions with improved insulation capacity and thereby reduced need for energy supply; (2) building-integrated or on-site energy production such as photovoltaics (PV) or geothermal energy wells; and (3) improved technical installations in the building, and the management of these. In addition, there is a potential for solutions combining 1, 2 and 3. Finally, there are important potentials related to the (4) exchange and storage of surplus energy in and between the neighbouring buildings and building complexes. The distinction

[1] See Glossary

between these paths or dimensions is, however, not clear-cut, and one can often observe solutions which combine building-based and energy-production- and storage related technical solutions. The present report will focus on how the policy and regulatory framework impact upon these four dimensions within a Norwegian context, and the combination of them.

Policy developments within both the building and energy sectors could influence upon the future interface between buildings and the energy system. It is therefore important to assess how changing trends concerning energy consumption in buildings are affected by the existing and coming regulatory framework. It is, furthermore, important to map and assess how certain regulations function and when – and how this will impact upon both the level of energy efficiency in the building stock, as well as the future energy system.
This problematic is also closely related to erupting smart grid solutions. Consequently, it is important to pinpoint political and regulatory factors which impact upon the very interface between energy consumption and production related to buildings, and the external energy provision towards the buildings.

Different relevant policy guidelines and regulations have anchorage within different policy domains and different technological sectors, economic interests and industrial clusters. This variation implies different regulatory logics and perspectives at the building side, as compared to the energy system. One can observe a lack of coordinated thinking across these sectors. This can both be understood in relation to different techno-economic references, as well as different political concerns and interests. There are few policy analyses assessing this overall problematic within a Norwegian context.

During recent years there has been an increased political focus on energy efficiency in relation to buildings, in Europe. The European Union (EU) decided in 2008 to set a 2020 target of achieving 20 % increase in energy efficiency as compared to 1990. This target was not codified into formalized national commitments. In 2014, the EU target was further raised to 27% by 2030, as compared to the 1990 level, but still no national targets are required.

However, at the same time there has been a reinforced interest by the industrial stakeholders, not least the building and construction sector, to focus on energy efficiency: Technologies and tools in this regard represent cost reductions and opportunities for business development (see e.g. Worrell et al. 2003 and Worrell et al. 2009). From the building and construction industry there is a specific interest for developing more energy efficient building concepts. In addition, there is also a clear focus on the energy saving potential of refurbishing existing buildings. At the same time, there are important trends in the development of smarter energy networks, such as the emergence of smart grid concepts.

Major policy measures developed by the European Union (EU) during recent years have led to major regulatory changes in Norway concerning energy deliverables and energy consumption in relation to buildings. Adding momentum to this issue nationally, the recently published national strategy for R&D, demonstration and commercialization of new energy technologies in Norway (Energi21, 2014), has highlighted both energy efficiency and flexible energy systems as areas of special interest (ibid.).

On this background, and the overall problematic of the INTERACT project, this report addresses the following questions:

To what extent does the current Norwegian policy framework induce energy efficient solutions based on energy usage in buildings, management of energy surpluses, storage and exchange in and between buildings, in Norway?
What are the main policy barriers for the realization of such solutions?

3. Analytical framework

This report employs an analytical approach based on political scientific theories. An important point of departure is 'multi-level governance', a quite wide-ranging concept, but one which captures dynamics between different levels of decision-making. The concept encompasses both public and non-public strategies and actors (c.f. Hooghe & Marks 2003; Pierre & Peters, 2005). In the research literature one will find numerous contributions to different patterns of interaction and causal mechanisms (ibid.). This analytical framework has not least been considered as relevant for studies of environmental governance and the implementation of polices associated with sustainable development (c.f. Jordan 2008; Lafferty 2004).

'Policy coherence' can be considered as a complimentary theoretical approach to 'multi-level governance', by which one analyses the stringency of policy objectives and targets set at different decision-making levels, and within different policy sectors – as well as how they are followed up during the phases of policy implementation and execution (c.f. Nilsson 2012).

On this background – related to governance - one can discern two main dimensions by policy formulation and implementation with relevance for the interface between buildings and the energy system:

1) Various policies, decided at both the EU and national levels, must be followed up and implemented at national and sub-national levels and by both public and non-public actors. This represents an important ***vertical dimension*** of the political system, where decision-making at different levels influences decisions at other levels of decision-making, as well as the actual outcomes.

2) Further, there is a ***horizontal dimension*** related to the interaction between the different policy concerns at the same decision-making level; that is, for example, climate-change mitigation and environment, security of energy supply and competitiveness – to mention but the most prevalent ones. In addition, various other sectorial policy processes and programmes also affect buildings' energy performance and the interface with the energy system.

How policy regulations are followed up and understood at the project level, as a way of actually fulfilling policy targets and the objectives set at the political level, is also crucial as a way of assessing the effectiveness of energy requirements. When studying the implementation and the actual outcomes, it is important to bear in mind the difference between outcomes at different stages (c.f. Vedung 2004): one is how the regulation induces a specific behavior in concerned industries; another aspect is to what extent the regulation actually leads to a better state of environment. In this report we are primarily focusing on the former dimension: That is, we focus on how the current policy framework can be understood and considered vis-à-vis the technical and economic practice the building owners and property developers have to relate to.

4. Political framework and policy drivers for energy efficiency, related to the interface buildings-energy system

In this chapter we will present and discuss the major policy processes for energy efficiency, and – more specifically – focusing the ones that can be related to the connection between buildings and various parts of the energy system (i.e. electricity grids and district heating infrastructure). We have termed this the 'interface' between two technical systems (buildings, energy).

In Norway, the level of greenhouse gas (GHG) emissions from the building sector is very modest. In 2010, emissions from heating and other energy consumption in the building sector, including emissions from district heating, amounted to only 3-4 per cent of the total GHG emissions (Kommunal- og regionaldepartementet 2012: 74). Nonetheless, the Norwegian building industry is increasingly focusing on reducing their 'carbon footprint' and employing a life cycle perspective on construction and maintenance of buildings (see for example Norwegian Green Building Council 2012). In this perspective, the origins of the energy supplied to the buildings become a crucial focus. The estimation of the amount of GHG emissions associated with electricity imports to Norway, given the country's connection to a wider Nordic and European electricity market has become a contested area for debate during recent years. From an energy system perspective, on the other hand, a major concern is how to ensure a stable and secure energy provision to all end users, based on renewable sources and in a cost-efficient manner (c.f. NOU 2012: 9). These perspectives and concerns are not necessarily mutually exclusive, but they are not by force mutually compatible or coordinated. As we will discuss further below in this chapter, there are different policy objectives stemming from different policy areas which will impact upon the interface between buildings and the energy system in Norway.

We start with a brief, principal overview of the *interaction* alternatives for a building and the energy system. Then we provide an overview of the recent and ongoing policy processes and strategies with relevance, from the EU and Norway.

4.1 Technical interfaces and potentials for increased energy interaction between buildings, and between buildings and the energy system

An overall question is whether and how relevant political discussions are related to an understanding of the position of the building vis-à-vis the grid and the energy system. Furthermore, what is the prevalent understanding of this interface, and are there several competing understandings?

One perspective is to focus on the building and the major strategic decisions building owners can make when projecting a new building, or refurbishing an existing one – with respect to energy efficiency. Given today's technological opportunities one can install 'building-based' energy-producing facilities which can contribute to a higher degree of energy 'self-sufficiency' of the building. This can be balanced with provision from external energy sources via grids. This can be both electricity and/or district heating. The actual weighting of these possibilities, and the decision on the actual mix to choose are generally influenced by a number of factors: costs related to investment and maintenance – and the cost-sharing with the renters and users of the building; as well as regulations and provisions related to the locality of the building. For the latter dimension there are both national and municipal regulations to be taken into consideration. Another perspective is, as briefly mentioned above, how to delimit the building's 'carbon footprint'; how to estimate the current and future GHG emissions associated with the building (construction, maintenance and demolition). However, there may be different incentives related to the abovementioned solutions aiming at the owner, developer, facility manager and tenant respectively. Since such incentives can suffer from a lack of coordination, this may also reduce the potential value of the chosen solutions (see, aslo 4.4.1).

4.2 Major policy drivers towards energy efficiency and increased energy storage and interaction

The major political foundation for targeting increased energy efficiency – not least through the EU directives - is climate-change mitigation. Hence, one employs an understanding of more energy efficient buildings as a vehicle to reduce greenhouse gas emissions. Building on this perspective, a major research and development focus within the building sector – with clear implications for the interface with the energy system, is the concept of ‘zero-emission buildings’.

In the perspective of achieving the level of 'zero-emission building' (zero GHG emissions stemming from construction, operation an demolition of a building over the whole life cycle), which is now the ultimate goal for many European building and construction companies, one has pointed to the potential of developing on-site and building-based, renewable energy supply facilities. That is, PV or solar thermal panels integrated in the facade or on the top of the buildings, biomass-based micro-CHP facilities, heat pumps, wind power, and geothermal energy with thermal storage potential. Hence, in order to avoid the uncertainties as to the origin of the electricity provided through the traditional energy system such as the NordPool-based market, it has emerged a focus on increasing the use of 'local' energy produced on-site.

A focus on local energy provision can also be supplemented with a focus on more 'traditional' measures for energy efficiency. That is, energy efficiency can be understood as measures improving a building's technical qualities, including insulation, building tightness, and the operation and quality of the technical installations and systems. As briefly mentioned above, energy efficiency is also dependent on how the building is actually used (the operational mode). For this aspect, user behavior is in focus, and incentives related to organization, economy and knowledge can be equally important as the more technical dimensions addressing energy efficiency.

Yet, even for the best low-energy buildings a connection to and interface with a wider energy provision system will still be necessary – not least in peak load situations. Hence, the consequences for the energy system of an emerging number of more 'self-supplying' buildings are also worth closer scrutiny.

Given the challenges in balanced local energy production, there is also a potential for creating an efficient energy supply system in between buildings and within specific areas, both industrial and residential, by reinforcing the infrastructure for exchanges of energy surpluses and storage potential. A major question which then emerges, and which we will the highlight in this report, is therefore to what extent the political and regulatory framework actually induces or hampers the establishment of such infrastructures.

4.3 The potential for industrial innovation and new market opportunities

The reinforced focus on low-energy buildings and energy efficiency as ways of reaching climate-change mitigation objectives also creates a potential for business development at the interface between singular buildings and building complexes, and the energy system. Low-energy building concepts and the process towards zero-energy and energy-positive buildings also lead to the question of how to handle the energy surpluses generated by these buildings. Moreover, building-based energy production facilities stand out as a guideline and recommendation when realizing nearly-zero energy and energy positive buildings (c.f. Dar et al. 2013). Hence, the question arises as to who should benefit from, or gain the profits generated by the energy surpluses.

Another less highlighted issue in the Norwegian political debate is the question of how building complexes and districts can be considered as joint contributors to the objectives of zero-energy and energy positive buildings. Here, other countries have more examples and cases which relate to different energy policy settings. Norway's energy situation with relatively abundant sources of renewable hydropower and relatively low electricity prices has not been conducive for an industrial drive towards low-energy building complexes and districts.

We will in the following section highlight some major themes in the international literature and recommendations promoted for energy efficiency measures with respect to the question: To what extent are these focusing interaction and storage?

4.4 Selection of international recommendations on energy efficiency measures and the implementation of these

Measures are in this study defined as *"technologies, processes or practices that increase energy efficiency"* . Instrument is defined as "*non-technical approaches that aim to promote the realization of one or more measures that increase energy efficiency*".

Policy instruments may be further divided into three categories; regulatory, economic and informative. Regulatory instruments are " undertaken by governmental units to influence people by means of formulated rules and directives which mandate receivers to act in accordance with what is ordered in these rules and directives" (Bemelmans-Videc et al., 1998: 31). Economic policy instruments involves either "...the handing out or the taking away of material resources, be they in cash or in kind. Economic instruments make it cheaper or more expensive in terms of money, time, effort, and other valuables to pursue certain actions." (Bemelmans-Videc et al., 1998: 32). Economic instruments can be discount campaigns, tax credits, funding, loan, and grants in various forms that can be targeted at different areas, different populations etc. Informative instruments, or "moral suasion", covers attempts at influencing people through the transfer of knowledge, the communication of reasoned argument, and persuasion" (Bemelmans-Videc et al., 1998: 33).

No single regulatory instrument or policy is "best" for all purposes; pragmatic choice depends on context (Wiener, 1999; Bemelsmans-Videc, Rist & Vedung, 1998); national/regional/local learning and/or transfer of best practices based on international recommendations must therefore be adapted to the national/regional/local context. Still, we will here present extracts from recommendations from some major actors working to improve energy efficiency; the United Nations Environment Programme (UNEP), the International Energy Agency (IEA), and the U.S. Environmental Protection Agency (EPA).

Energy efficiency may stand for using less energy for the same service (lowering the energy intensity), or providing a higher level of service using the same energy (IEA 2012a). Measures and instruments may target end-use and/or supply side of energy, and both sides must be addressed in order to create holistic solutions. In the following sub-chapters we have gathered some findings from international research on energy efficiency instruments and measures, and how to implement them.

4.4.1 Energy efficiency instruments and measures

The Sustainable Building and Climate Initiative (SBCI) is a UNEP-hosted partnership between the UN and public and private stakeholders in the building and construction sector. In the following table major barriers to energy efficiency issues in the building sector and instruments and measures to meet these (i.e. remedies) have been identified.

Table 1 Barriers to energy efficiency issues in the building sector, and possible instruments and measures to meet barriers, adapted after (UNEP SBCI 2009), (UNEP SBCI 2014)

Barrier categories	Definition	Examples	Possible abatement instruments and measures
Economic/ financial barriers	Ratio of investment cost to value of energy savings	Higher costs for more efficient equipment (incl. technological/ first-mover risk). Lack of financing, economic incentives, internalization of external costs (e.g. environmental, health)	Fiscal and economic instruments e.g. tax rebates, Kyoto Flexibility Mechanisms, subsidized loans, regulatory instruments. Energy price subsidies.
Hidden costs/ benefits	Cost and risks (real/ perceived) not captured in financial flows	Costs and risks due to potential incompatibilities, performance risks, transaction costs etc.	Appliance standards, building codes (to overcome high transaction costs), classifications of engineering, procurement, construction. Public leadership programs
Market failures	Market structures and constraints preventing a consistent trade-off between specific energy efficiency investment and energy saving benefits	Building design process limitations, fragmented market structure. Landlord/tenant split and misplaced incentives Administration and regulatory barriers (e.g. incorporation of distributed generation). Imperfect information. Unavailability of energy efficiency equipment locally. Suboptimal supply-chain relationships, tender processes	Fiscal instruments and incentives Product standards Regulatory-normative and -informative Economic instruments Technology transfer, mechanisms Green/sustainable private and public procurement
Behavioral and organizational barriers	Behavioral characteristics of individuals and companies that hinder energy efficiency technologies and practices	Ignorance of small energy saving opportunities Disregard for the whole life costs Organizational failures (e.g. internal split incentives for owner, developer, facilities manager, tenants for green use) Lack of communication and leadership	Support, information, voluntary action Voluntary agreements Information and training programs Green facilities management Benchmarking and follow-up Green leases Green criteria in asset valuation
Information barriers	Lack of information provided on energy saving potentials	Lacking awareness of consumers, building managers, construction companies, and politicians. Lack of knowledge and trust.	Awareness raising campaigns, training of building professionals, regulatory-informative
Political and structural barriers	Structural characteristics of political, economic, energy system which make efficiency investment difficult	Lack of policy Financial risk Lack of incentives	Enhance implementation of standards, incentive more progressive public and private policy encouraging EE building design (e.g. incentives in permitting process, alternative procurement models, favorable financing terms, green performance guarantees). Enhance international cooperation and technology transfer, public leadership.

Although we in this report particularly highlight the political and structural barriers, the last category in the above table, these conditions are also associated with and related to information barriers and market failures.

4.4.2 Implementing instruments and measures

The U.S Environmental Protection Agency (U.S. EPA) has established a list with ten goals and key steps important for implementation of energy efficiency instruments and measures in electricity services (DOE/EPA 2008, p. 2-5):

1) Cost-effective energy efficiency must be established as a high-priority resource, through e.g. identification of potential, energy efficiency goals and targets integrated into state and regional energy resource plan, policies in process or in place
2) Develop process to align utility and other program administrator incentives such that efficiency and supply resources are on level playing field, through e.g. removing utility and other program administrator discentives, and establishing incentives for energy efficiency
3) Establish cost-effectiveness tests which reflect long-term resource value of energy efficiency
4) Establish evaluation, measurement and verification mechanisms
5) Establish effective energy efficiency delivery mechanisms, through e.g. clear establishment of administrator(s) for energy efficiency programs, stable (multi-year) and sufficient funding in place consistent with energy efficiency goals, strong public education programs, energy efficiency program administrator engaged in developing and sharing program best practices at the regional and/or national level
6) Develop state policies to ensure robust energy efficiency practices, through e.g. routine review of state policies and updating of building codes, effectively enforcing building codes (evaluations on code enforcement are today little available and also dated and assess the enforcement landscape very differently), state appliance standards in place, strong state and local government lead-by example programs in place.
7) Align customer pricing and incentives to encourage investment in energy efficiency, through e.g. rates examined and modified considering impact on customer incentives to pursue energy efficiency, mechanisms in place to reduce consumer disincentives for energy efficiency (e.g. including financing mechanisms)
8) Establish state of the art billing systems, through e.g. consistent information to customers on energy use, costs of energy use, and options for reducing costs. There is a hope that e.g. further advanced metering infrastructure (AMI) roll-out and increased efforts to benchmark building energy use, progress will be able to be measured.
9) Implement state of art efficiency information sharing and delivery systems, through e.g. investments in advanced metering, smart grid infrastructure, data analysis and two-way communication to enhance energy efficiency.
10) Implement advanced technologies, through e.g. policies to remove barriers to combined heat and power, measure progress on policy for integration of advanced technologies

Furthermore, the U.S. EPA has highlighted which changes technology, policy and program practices for energy efficiency should be watched, see Table 3 under.

Table 2 Changes to watch in evolving technology, policy and program practices for energy efficiency adapted after (DOE&EPA 2008, p. ES-8)

Policy area	Changes to watch
Evaluation, measurement and verification	- Development of national standards including requirements for independent verification - Development of how smart grid technologies may be used in evaluation, measurement and verification of energy efficiency - Requirements for national and regional carbon programs
Demand response, advanced metering, and smart grids	- New technologies, including smart grid technologies (e.g. advanced meters and smart appliances/controls) - The collection, analysis and use of data to enhance energy efficiency - New customer interfaces and increased interoperability
Regional resource planning	- Regional value of energy efficiency identified
Building energy efficiency expertise/workforce	- Cross-sectoral development and use of energy efficiency curriculum, including various segments of the workforce - The development and use of training and certification programs
Integration of R&D, building codes, appliance standards, and market transformation efforts	- Coordination between multiple levels (regional and national) and efforts

Low-carbon policies, including energy efficiency policies, often provide a whole range of additional environmental, social and economic benefits (Smith 2013). These often overlooked co-benefits can help to offset the financial cost of the technology and boost its political acceptability (Smith 2013). The International Energy Agency (IEA) highlighted in IEA 2012 how benefits from energy efficiency programs often are evaluated only on the basis of the energy savings they deliver. Hence, the full value of energy efficiency improvements in both national and global economies may be significantly underestimated, which again may lead to suboptimal energy efficiency policies and communication to increase public acceptance (ibid.). The table under demonstrates an example of socioeconomic benefits with proposed typology (individual/sectoral/national/international) resulting of energy efficiency improvement, such as e.g. insulating a building. These are benefits forming arguments for energy efficiency that is transferrable across borders.

Table 3 Example multiple benefits at different levels of the economy from energy efficient improvement adapted after (IEA 2012a)

International	GHG emissions reductions (e.g. depending on energy mix used to heat buildings, reduced heat demand may lead to reduced GHG emissions) Moderated energy prices (e.g. "more for same" or "more for less" may reduce demand, see definition in Glossary of this report) Natural resource management (e.g. including whole life cycle assessment) Development goals (e.g. connected to resource efficiency)
National	Job creation (e.g. within energy efficient technology development) Reduced energy-related public expenditures Energy security (reduced demand may improve energy security depending on energy mix and national reliance on import/export) Macroeconomic effects
Sectoral	Industrial productivity and competitiveness (e.g. "more for same" or "more for less", as well as green business may give and competitive advantage) Energy provider and infrastructure benefits Increased asset values
Individual	Health and wellbeing (e.g. better insulated buildings) Poverty alleviation (energy access and energy affordability) Increased disposable income

Especially the sectoral level benefits are relevant to the framework in INTERACT, i.e. the benefits the residential and industrial sector (IEA 2012a);

- **Industrial productivity and competitiveness** e.g. increased profit, consistency and improvement in quality and output, reduced capital and operating costs and reductions in scrap and energy use. These aspect may positively affect the competitiveness of industry at large, especially when taking into account the multiple benefits in the overall industrial sector (see e.g. Lilly and Pearson, 1999; Pearson and Skumatz, 2002)
- **Energy provider and infrastructure benefits**. Energy providers have the benefits of being able to provide better energy services to customers, reducing operating costs and improving profit margins (see e.g. DOE&EPA 2006). This is both a strong argument and an explanation why many utilities are already pursuing ambitious demand-side management measures.
- **Increased asset values.** "Green" buildings have increased resale value and rental rates, and offer a wider array of benefits beyond asset values: such as higher occupancy rates, improved comfort, lower operating expenses and lower capitalization rates and higher productivity gains.

4.4.3 Summary

Key points from the international reports on energy efficiency:

- Barriers to energy efficiencies are multiple, as are the policy instruments and measures suggested by e.g. UNEP SBCI. Measures and instruments to overcome barriers to energy efficiency must fit the national, regional and local context; best practice in one country or region may not be a best practice in another.

- Proper management and coordination of instruments and measures, including evaluation, measurement and verification mechanisms, are crucial for a successful implementation. Energy efficiency encompasses all sectors using energy. Efforts must be monitored and coordinated with a cross-sectoral approach, such as e.g. electricity distribution (incl. demand response, advanced metering, smart grids) and the building sector.
- Whereas measures and instruments from one specific country are not always transferable to other national contexts, arguments of multiple benefits arising from energy efficiency measures and instruments can be. Multiple benefits may be used as leverage for policy and decision makers for applying remedies to identified barriers, and are worth identifying both for policy and decision makers.

4.5 Relevant policy strategies of the European Union (EU)

The EU has decided a number of important policy directives which have had a concrete influence on Norwegian policy regulations and guidelines affecting the interface between buildings and the energy system.

The EU energy-climate package, approved in 2008, is often considered to be the major framework for the EU priority of reducing energy consumption and increasing the use of renewable energy (Skjærseth 2013). The very focus on low-emitting buildings only using renewable energy is therefore very much in line with the quint-essential logic of the 2008 package, and the '20-20-20 by 2020 targets'[2]. These targets were: 20 % less emissions of greenhouse gases, 20 % more renewable energy used, and 20 % more efficient energy usage – all targets by 2020, and compared to the level in 1990 (European Union 2009). Recently, this framework has been updated towards 2030, whereby the EU is set to achieve 40 per cent reduction of GHG emissions with respect to the 1990 level, which is to be reviewed according to the outcome of the international negotiations within the UNFCCC framework. The EU has also decided to achieve 27 per cent more renewable energy production and higher energy efficiency – respectively, as compared to the 1990 level (ENDS Europe Daily 2014). However, the 27 % target for energy efficiency is not set to be legally binding for the Member States; it is a so-called 'indicative target'. That is, the various national measures initiated should jointly contribute the overall fulfilment of this target (ibid.).

Although the EU has made major strategic decisions during the last years, including energy efficiency as a major target in the energy-climate package, the origins for a policy focus on low-energy buildings can be found some years in advance (Rasmussen et al. 2006); not least in the EU Energy Performance of Buildings Directive (EPBD), which was decided in 2002. The Directive sets the framework for introducing policy instruments to promote reduced energy consumption in buildings, as well as their carbon footprint. The Directive prescribes measures both for energy efficiency, including provisions for buildings' insulation and more energy effective operation of technical installations, as well as increased 'energy flexibility'. The latter factor implies an obligation for larger buildings to be designed for more than one source of energy supply. In a Norwegian context, this has been interpreted as a way of preparing for an increased use of non-electric heating and cooling, including district heating, in order to reduce the traditional usage of electricity-based panel ovens (Knudsen et al. 2008: 256).

Furthermore, a major instrument in order to stimulate building of new low-energy buildings, as well as energy-efficient upgrading of existing buildings, is the EPBD requirement of establishing national schemes for energy certification of buildings. We will below further assess the Norwegian follow-up of this specific provision. The EPBD was 're-casted' in 2010, on the background of the EU 20-20-20 program. The updated

[2] The EU 2020 targets were adopted in 2008, with effect from 2009 (European Union 2009).

version of the EPBD reinforces the overall target and ambition by stipulating that all new buildings by 2020 should be 'close-to-zero energy buildings'. This is actually a new concept 'invented' by the EU decision-making bodies, as a compromise between the various policy ambitions. No exact, technical definition of the concept is, however, provided by the Directive. The EU has 'delegated' the definition challenge to the national level – but has signaled that it will provide some minimum criteria to be followed, but which is yet to be decided. Some have interpreted the concept as to somewhat lower energy consumption than by the 'passive house level' – in addition to 100 % renewable energy provision (c.f. Arnstad et al. 2010). However, this has not settled politically.

Since the 1980's, several EU directives pertaining to energy efficiency in products and industrial processes have been launched (Ruud et al. 2011). However, a broader framework directive setting overall targets for energy efficiency at the national level – in line with the Renewable energy Directive's national targets, has been formulated as a follow-up of the EU 20-20-20. The EU energy efficiency Directive was decided in 2012, but no national targets were set.

On the other hand, the EU focus on a more effective European market for electricity and gas, as well as a reinforced European security of supply through provisions for more cross-national infrastructure and energy exchange, can also be seen as a way of strengthening the traditional 'large-scale' energy system – whereby more self-sufficient and energy-producing buildings could be considered 'counter-productive'.

To summarize, the EU has demonstrated a strong political willingness to prioritize energy efficient buildings and stimulate the development of low-energy building concepts. On the other hand, the EU energy-climate policy complex – as well as other relevant policy domains, does not coherently point towards a unified vision for the building-energy interface.

4.6 National policy strategies

Several analytical contributions have pointed to Norway's relatively fragmented and market-based approach to electricity production and distribution (Knudsen et al. 2008; Brekke & Sataøen 2012; Claes & Vik 2011). The building and construction sector is also fragmented – not only in Norway, but also within the EU (Rasmussen et al. 2006; Boasson 2009). In addition, energy efficiency in Norway is not a specifically well-established policy field. Given traditionally low electricity prices, it seems to have been politically uninteresting to introduce efficiency measures since low prices are not inducing changed consumption patterns and energy saving by the consumers. At the same time, the EU directives mentioned above have lead Norwegian politicians to set more ambitious targets, and have generally contributed to a stronger political and industrial interest for energy efficiency in buildings. Moroever, energy and electricity represent costs which can be reduced by e.g. industrial companies. Hence, energy efficiency measures in a Norwegian context could also benefit from organizational measures taken by the individual building owner or tenant in order to reduce their costs.

As a way of handling a more organizational and competence-oriented way to energy efficiency in buildings, the Government in 2007 established *Lavenergiprogrammet* (the Low Energy Program (LEP)). Coordinated by a small secretariat, this organizational body is governed by the major players from the buildings sector, as well as representatives from the energy sector. The LEP focuses on competence-building measures – acknowledged by the fact that low-energy buildings are difficult to realize with the traditional approach to construction – not least a 'silo-oriented' project organization. That is, the lack of multi- professional coordination in building projects has become a major reason for building-quality shortcomings in general. Lack of coordination is a very critical hurdle when to obtain tighter, more ambitious energy performance levels.

During the period 2008-10 the Norwegian Government also initiated a number of commissions and expert reports to consider more ambitious, stringent and coherent energy efficiency policies for buildings. The Arnstad commission (2010) recommended a target of reducing the energy consumption stemming from buildings in Norway, from 80 TWh p.a. to 70 TWH p.a. by 2020 (Arnstad et al. 2010).

From a political angle, however, there has been a very limited focus on the consequences of a potentially increased number of low-energy buildings for the energy system as a whole. Reflecting the very limited number ofpolicy strategy documents focusing on the Norwegian energy system as a whole, there is currently no overall political framework within which to assess the different possibilities and concerns arising from a changing interface between buildings and the energy grids.

In addition to a politically driven reinforced focus on buildings and energy, the Norwegian building and construction industry – in line with their European colleagues, are increasingly engaged in developing low-energy building concepts and components. As will be highlighted in section 5 below, the industry has itself recently developed and promoted an environmental certification scheme, with a strong emphasis of renewable energy supply and energy efficiency; the BREEAM-nor scheme (Norwegian Green Building Council 2012).

Finally, it is worth mentioning that the national research funding is of importance, and that an increased scientific interest for the concepts of zero-energy and zero-emission buildings are influencing both policy formulation, and the industrial and market interest and willingness to invest. The Norwegian research center for zero-emission buildings (ZEB), one of eleven research centers for environmentally friendly energy, is of particular importance in this regard. See also: http://zeb.no/

From an energy system perspective, the National Smart Grid Centre addresses the energy exchange between buildings and the electricity grid. Much of the research thus far has focused on technology and technical solutions for metering and obtaining a more dynamic exchange, in addition to communication strategies which can engage customers to become more active. There has been less focus on how costs and benefits should be distributed between different stakeholders and segments of the society; how this is to be solved politically – and within what kind of regulatory and institutional framework. See also: http://smartgrids.no/

4.6.1 Norwegian climate policy

The current Norwegian climate policy is based on cross-political agreements in Parliament, the first one from 2008 – and the updated one from 2012. The former Government's White Paper on climate policy (Miljøverndepartementet 2012) was approved by the Stortinget/Parliament in June 2012. The main targets, stipulating a 40% reduction in emissions by 2020 compared to 1990 levels and that Norway will be carbon neutral by 2050, are maintained. Similarly, the goal of cutting 2/3 of the total emission reductions domestically is also maintained. Some of the most important measures were: Increased CO_2 tax on the petroleum production on the Continental shelf; a new Climate and energy fund; and increased investments in public transport. The new Climate and Energy Fund is an extended version of the Energy Fund administered by Enova since 2002. Enova will also manage the extended Climate and Energy fund.

In 2010, emissions from heating and other energy consumption related to the building sector, as well as emissions from district heating, amounted to only 5 per cent of the total GHG emissions. Emissions in the building sector mainly originate from the use of fuel oil and other petroleum products in heat production. Emissions from district heating come from the combustion of waste, oil and gas. Emissions from buildings have been reduced by about 30 percent since 1990 due the phasing out of fossil fuels for heating, while emissions from district heating have increased (Kommunal- og regionaldepartementet 2012).

Two key actions from the White Paper on the climate policy with regard to measures for buildings was to increase efforts to phase out oil heating in smaller plants, and to focus particularly on energy efficiency. Fossil-based energy provision in buildings; that is, building-based oil furnace installations are to be completely phased out from all existing buildings by 2020, and is banned from installation as base load in new buildings – from 2010 (as part of the current Building code).

Furthermore, the White Paper presented an action plan for energy efficiency, with the goal of reducing total energy consumption substantially in the building sector in 2020. The Government said it would:

- Intensify the energy requirements of the building code to passive house level in 2015 and nearly zero energy level in 2020. Provisions that define the passive and nearly zero energy level will be determined later. Studies of economic and health outcomes and expertise in the construction industry will serve as a basis for the decision on requirements. These targets are in line with the requirements of the re-cast EU EPBD Directive.
- Introduce requirements for building components related to existing buildings and clarify which constructions and components these requirements will apply to. This will be done on the basis of, among other things, an assessment of energy impacts and costs.
- Ensure that the Government as a builder and property owner is a driving force for energy efficiency and phasing out of fossil fuels in buildings.

Furthermore, the Parliament's Energy and Environment Committee demanded that the former red-green government proposed a quantified target for increased level of energy efficiency in buildings. The former Government announced Norway’s such a tareget in 2012, based on the Parliament's request (Olje- og energidepartementet 2012a). The measures are to enable an aggregated level of savings corresponding to 15 TWh in the consumption by buildings by 2020 – as compared to the level of 2012 (ibid.). The government's unspecified target for 2040 was 'that the energy consumption in buildings is to be substantially lower than today' (ibid.). The former government's follow-up of this was not approved by the then opposition, but the former opposition, now current conservative government has not yet signalled any follow-up on this.

More concrete measures for buildings related to building-based energy generating facilities, as well as the role of surpluses from buildings, have thus far not been discussed as a part of the climate policy strategy or its follow-up. Neither has this been the case with electricity grid connection to buildings, changes in district heating provision – or smart grids. At the same time, some regulatory changes are now planned – related to smart grid development; see chapters 3.5.3 and 4.5.

4.6.2 Norwegian building policies

Traditionally, there has not been a coherent strategy for the building policy field in Norway. The sector's energy consumption and production is governed by a broad range of policy directives based on different political-administrative mandates (Rasmussen et al. 2006). This is still the case after several years of critique for the fragmented political-regulatory framework of the sector (Arnstad et al. 2010; Lavenergiutvalget 2009). The Ministry of local government and modernization is currently the main responsible for the sector's policy framework – including the technical requirements, as well as governing public buildings and their roles as eventual role models.

The former government put in 2012 forward a White paper on a building policy, led by this Ministry. The White Paper on building policy (St. meld. 28, 2011-12), was then the first one to treat the building policy sector as a whole (Kommunal- og regionaldepartementet 2012). It was approved by the Storting/Parliament in December 2012. A main goal according to the Norwegian White Paper on building policy is to reduce energy use in buildings considerably by 2020, in line with the EU EPBD Directive. This white paper echoed the white paper on climate policy in this regard (see above): That is, reinforcement of the energy requirements of the building code (TEK) for new buildings to 'passive house level' in 2015, and 'close to zero energy level' in 2020. The provisions that define 'passive' and 'close to zero' energy levels, respectively, were – however – not specified in the White Paper. These are to be further developed with inputs from experts (see section 4.2).

4.6.3 Norwegian policies on grid development

A White Paper concerning the further development of the electricity grid was put forward from the former Government in 2011 (Olje- og energidepartementet 2012b). The white paper focuses mainly on the national grid. However, the part of the regional network whose purpose is to transport power over longer distances, for example from an area with high production to an area of high consumption is also included. The local distribution grid is not a focus in this White Paper. The distribution grid covers the local networks that distribute electricity to the end users (households, services and industry). Major power generation plants are connected to the national grid, whereas smaller production units can be linked to either the regional grid (smaller wind farms and small hydro) or distribution grid (less small hydro). Small consumers are connected to the distribution network whereas large consumers such as the energy-intensive industry can be directly linked to the regional or national grid.

The white paper does not consider or assess the potential of more differentiated tariffs and price incentives as a way of influencing energy consumption. Such differentiated incentives could also be a way of stimulating the introduction of smart metering systems, and smart grids. With a more flexible energy distribution system, based on economic incentives, it could also be possible to reduce the need for new grid extensions – and thereby reduced investments for society.

In sum, there are no concrete measures mentioned with regard to energy efficiency in buildings, smart grid or district heating. However, the possibility for the restructuring of energy use away from electricity for heating is mentioned. This may be relevant for both residential and non-residential buildings, and the industry. District heating will normally be able to deliver heat to customers without the use of electricity, even on the coldest winter days. As district heating will limit the growth of electricity consumption, when oil-fired combustion is phased out, it is pointed out that investments in district and local heating will help to limit the growth in electricity consumption and that this normally will also be beneficial for the power balance.

Smart grid and energy efficiency are mentioned in the White paper, but only on a general level. In particular, there is a need to consider what affects peak vs. base load periods, and where – so as to provide a more robust basis for analysing future needs for grid development. In this perspective, it is important to achieve an improved understanding of the implications of increased energy efficiency and the prospect of a more differentiated interaction between buildings and the energy system.

4.6.4 Smart grid policy development in Norway

An important dimension in the development of smart grids is the potential supply of renewable energy from building-based facilities; that is, from traditional *energy users*. Hence, the consumer also becomes a producer, what is referred to as a ‘prosumer’, a novel actor concept within the energy system (Bremdal et al. 2011). Although holistic perspectives are possible, the concept of 'smart grids' triggers different visions and ideas by different actors (Stephens et al. 2013). The consumer's motivation to engage in a smart grid development is not necessarily parallel to or compatible with the ones of an energy provider or a technology developer (ibid.). It has been mentioned that consumer flexibility and prosumer orientation are both closely related to the philosophy that advocates new building concepts, such as zero-energy houses and plus-house concepts (Bremdal et al. 2011). Different visions associated with the 'prosumer' concept can also be related to different perspectives on the interface between the the energy system and the end users, building based energy production and more traditional utility oriented perspectives (Ruud & Knudsen 2014).

The EU has recommended targets and standards as to the implementation of smarter energy networks in the Member States within the coming decade (European Commission 2012). In Norway, the major policy instrument thus far associated with the phase-in of smart grids is the compulsory installation of smart metering devices in buildings: There is a binding target of full implementation of smart meters in all buildings in Norway by 1. Jan. 2019.[3]

However, there has been a very limited political and regulatory focus on smart grids and measures related to prosumer development in Norway (Ruud & Knudsen 2014). This can be seen in line with the very limited number of overall policy strategy documents focusing on the Norwegian energy system as a whole (ibid.). Hence, there is currently no overall political framework within which to assess the different possibilities and concerns arising from the development of smart grids (ibid.).

As mentioned above, the White Paper on grid policy, unanimously approved by the Parliament in 2012, focused mainly on the national grid (Olje- og energidepartementet 2012b/Mld St. 14.). The distribution grid – being the locus of the smart grid concept, is not a concern in this White Paper. On a more general level, the need to consider what affects peak vs. base load periods, and where – so as to provide a more robust basis for analysing future needs for grid development, is emphasized (ibid.). Nevertheless, the white paper does not assess differentiated tariffs as a way of influencing energy consumption. Such differentiated incentives could also be a way of stimulating an effective use of new smart metering systems, particularly managing peak load situations. The branch organisation for energy production and distribution, Energi Norge (Energy Norway) – in line with its European counterpart Eurelectric, opts for such differentiated tariffs in Norway (Energiteknikk 2014).

At the same time, no building has yet been constructed in Norway that is totally de-linked from the wider energy system - apart from summerhouses, many of which employ PV for their small electricity demand. Even for low-energy consuming buildings, a connection to external supplies will be necessary to maintain security of supply. However, the development of smart grids can lead to reduced need of expanding the electricity grid, which represents a potential for a large conflict not least due to siting. Ideally, smart grids will result in more precise dimensioning of needed amounts of electricity, by improved metering and local management, thereby improving the overall energy efficiency in society at large. There is a growing number of decentralized solutions, but still the consequences for the energy system of an emerging number of more 'self-supplying' buildings are not very clear.

4.6.5 Policies for geo-thermal heating in Norway

Regulations and actual permissions for geo-thermal heating vary from municipality to municipality, and also where in the municipality the drilling for energy wells can take place. Some municipalities regulate drilling through making it mandatory to apply for authorization for such work in parts of the municipality. Some municipalities also require a digging notice. These regulations are based on the municipalities land use and planning authority, according to the Planning and Building Act (c.f. Lovdata 2013c). Other municipalities, on the contrary, do not require authorizations at all. Drilling shall, however, always be reported to a national database of energy wells. In municipalities with such regulations in place, the company performing the drilling is responsible for the accomplishment of the requirements.

The number of facilities for geothermal energy provision is increasing in Norway, in relation both to residential and industrial buildings. There is no specific, public support scheme in place in order to promote

[3] Further information (in Norwegian): http://www.nve.no/no/Nyhetsarkiv-/Nyheter/Ny-krav-til-AMS-innforing/

such solutions, but Enova provides support for energy conversion measures which can also include geothermal energy provision and related facilities (including heat pumps) (see also section 5.6.1.).

5 Relevant regulatory measures and incentive arrangements in Norway

We will here further examine regulations and incentives aimed at governing energy efficiency in buildings, and the interface – eventually interaction – between buildings and the energy system.

5.1 Follow-up of EU Directives

Major EU initiatives and legislation were briefly introduced above. In this section we will take a closer look at how they these regulations require follow-up by Norway, and the steps that have been taken thus far in order to implement the legislation within a national context. The table below describes EU's policy and regulation development process, as well as where in the process Norwegian stakeholders can influence the outcome (NVE 2014b).

Table 4 EU's policy and regulation development process - phases and possibilities for influencing (influence in green) (NVE 2014b)

Preparatory studies – run by an EU consultant. Dependent on input from stakeholders **(e.g. industry!)**	**First draft Working Document** Directorate-General (DG) Energy & DG Enterprise & Industry & DG Environment	**Consultation Forum** Working Document is debated by EU and EFTA member stakes, EU stakeholders	**Regulatory Committee** Draft Regulation **Voting by EU member states**	**Parliament & Council** **Commission** **Official Journal of the EU** Approval and publishing in EU Journal	**Transition period** from entry into force to mandatory
Ca. 24 months	**Ca. 6 months**	**Ca. 6 months**	**Ca. 6 months**	**Ca. 6 months**	**Ca. 12 months**
Around 5 years					

A general observation from a Norwegian and EEA Agreement perspective on how to promote interests vis-à-vis policy and legislative decisions to be taken by the EU institutions, is the importance of focusing on the early phases of the decision-making process. At this stage the EU Commission prepares and formulates a proposal for a legislative act, and is quite positive to receiving input on how to design the legislation in order to effectively obtain the targets set for the policy area in question. Since Norway is not a part of the actual decision-making within the EU Council and Parliament, it is mainly in this preparatory phase that Norwegian stakeholders can try to influence or modify legislation – based on their specific expertise and (scientifically) informed inputs (c.f. Ruud & Knudsen 2009).

The table below demonstrates the internal process in the Norwegian Government for EEA-relevant EU policy and regulation. The EEA relevance of EU policy decisions and regulations is finally decided by mutual agreement between the European Free Trade Association (EFTA) and the EU (Europaportalen 2010). The process starts with the publication in the EU register for Commission acts, and publication in the EUR-Lex database for European Parliament/Council acts (EFTA 2014b). Some efforts have been undertaken in order to make the EEA process more efficient, not least because of a backlog of decisions to be made: As of

18 Aug 2014 a total number of 725 EEA-relevant acts are awaiting incorporation in the EEA agreement (including the Energy Efficiency Directive), and the average time needed between the publication of an EU act in the Official Journal and its entry into force under the EEA Agreement was 16.8 months over the last five years (ibid).

Table 5 Norwegian process for EEA- relevant EU policy and regulation (Europaportalen 2010, EFTA 2014a)

EU	**Preparatory studies** – run by an EU consultant. Dependent on input from stakeholders **(e.g. industry!)**	**First draft Working Document** DG Energy & DG Enterprise & Industry & DG Environment	**Consultation Forum** Working Document is debated by EU and EFTA member stakes, EU stakeholders	**Regulatory Committee** Draft Regulation **Voting by EU member states**	**Parliament& Council Commission Official Journal of the EU** Approval and publishing in EU Journal	**Transition period** from entry into force to mandatory
Norway	**Fact sheet on EU policy and regulation development process** In parallel with EU's preparatory studies of EEA- relevant policy and regulation, draft working document and consultation forum.			**Draft position document** As soon as EU draft of EEA- relevant regulation is ready	**Position document** As soon as EEA-relevant regulation is approved in EU. Norwegian position and recommendation is proposed, as is the need for particular phrasing and claims after the EEA agreement, §103	**Implementation plan** National implemen-tation plan into the Norwegian policy and regulation framework
Time span	**Ca. 24 months**	**Ca. 6 months**	**Ca. 6 months**	**Ca. 6 months**	**Ca. 6 months**	**Ca. 12 months**
Total time	← **Around 5 years** →					

As can be seen in the table above, the periods of influence in the EU process occur at a time where Norwegian process is at a preliminary stage, where the Norwegian ministries inform about the ongoing process through a "fact sheet". The actual position of Norway, as stated by the position document is at the earliest formulated at the time of draft of the regulation.

At later stages in the process, the possibilities to influence are less – as mentioned above, and it is therefore crucial that industrial stakeholders with interests keep themselves informed and push for earlier influence than what is possible through Norway's official position document.

This was the general process in the EU and in Norway for developing and implementing EU Directives with EEA relevance. In the following sub-chapters we will further discuss the EU policy instruments with the most direct relevance for the thematic of INTERACT: That is, the Building Energy Performance Directive, the Energy efficiency Directive, and the Ecodesign and Energy Labelling Directive.

5.1.1 EU Energy Performance of Buildings Directive (EPBD); Norwegian follow-up

As mentioned above, the EU Directive on energy performance of buildings (EPBD) has been considered to be relevant for Norway, as part of the EEA Agreement. The first version of the Directive was finally adopted as a part of Norwegian law in 2010. The most recent version of this directive, the so-called 'recast' decided by the EU in 2010 is, however, not yet finally adopted within the EEA framework, and therefore not yet implemented into the Norwegian legislation.

The EPBD recast of 2010 did not imply any specific requirements concerning energy storage and interaction. However, Article 2 of the Directive reads that for 'nearly zero-energy buildings' should 'the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby' (European Union 2010b).

This could imply that a national definition for nearly zero-energy buildings, which according to the Directive should be the norm for new buildings by 2020, will eventually include new national incentives for the promotion of energy production on site and in the proximity of the buildings. These national incentives could also include storage and eventually joint measures across neighbouring buildings and building complexes – in order to fulfil the intentions behind the EPB Directive – as articulated by Article 2. Since new requirements have not yet been prepared or proposed from the authorities (an updated building code is expected in advance of 2020 which is the target year for EU's requirement on nearly-zero energy buildings), there is also room for trying to influence the national regulations for the implementation of this directive. Hence, the concerned parties could focus on how to induce coming national building codes and thereby try to argument for an improved framework for energy storage and interaction – also in the light of the recast EU EPBD Directive.

A main instrument, as experienced by most building owners in Norway, is the Energy certification scheme which was introduced as part of the follow-up of this Directive. The scheme is compulsory for all, also the owners of residential buildings.

Other relevant implementation measures taken are more stringent towards the Regulations on technical requirements for building works, i.e. the Building code (Byggteknisk forskrift, TEK): Norway must on the background of the EPBD Directive update its Building Code every 5 years. Additional measures which have been introduced in order to strengthen energy efficiency in the follow-up of the Directives, is the strengthening of financial instruments through Enova and Husbanken.

The more stringent requirements in the Building code – given the perspective of 2015 and 2020 – were, as mentioned above, announced in the white papers on climate policy and building policy.

5.1.2 EU Energy efficiency Directive and Norwegian follow-up

The Directive 2012/27/EU on energy efficiency, adopted in 2012, establishes a common framework for the promotion of energy efficiency within the Union. The purpose is to ensure the achievement of the Union's 2020 20% target on energy efficiency and further efficiency improvements beyond that date (European Union 2012).

The objective is to have an integrated approach to tap all the existing energy saving potentials, encompassing savings in the energy supply and the end-user sectors (ibid).
The more specific targets to be achieved by the Directive are:

- Member states should set indicative national energy efficiency targets, schemes and programmes, taking into account national circumstances affecting primary energy consumption, such as remaining cost-effective energy-saving potential, changes in energy imports and exports, development of all sources of renewable energies, nuclear energy, carbon capture and storage, and early action.
- Long-term strategies beyond 2020 for mobilising investment in the renovation of residential and commercial buildings.
- Promotion of cogeneration based on useful heat demand in the internal energy market.

Implementation status
The Directive on energy efficiency was adopted by EU on 25 October 2012, but has – as mentioned above – not yet been finally adopted the EEA. Hence, Norwegian codification of the Directive into law has not yet started. It can be assumed that the process on implementing the Directive in the EEA-agreement will be somewhat protracting, depending on the processing time of national governments in the EEA countries. An estimate is 12-18 months after the Directive has been published in the EU Journal, which would have been between 25 Oct 2013 and 25 Apr 2014 (Lavenergiprogrammet 2012). The EEA relevance of this Directive has still not been finally concluded, and as per December 2014, no formal process preparing the transposition into Norwegian law has been started (Europaportalen 2014c).

5.1.3 Energy efficient solutions within the buildings - EU Ecodesign Directive and Energy Labelling Directive and Norwegian follow-up

Two EEA relevant policy tools for energy efficiency in energy-related product[4] are the EU Ecodesign Directive 2009/125/EC and the Energy Labelling Directive 2010/30/EU (European Commission 2009, European Commission 2013c).

The EU Ecodesign Directive is a voluntary environmental labeling system that identifies the ultimate impact of the energy-related product in question on the environment, as well as on consumer health and safety (European Commission, 2010b). It is a framework Directive, which implies that it does not set binding requirements on products itself, but acts through regulations (which are binding), as well as informative and economic instruments adopted on a case by case basis for each product group (European Commission, 2013b) (European Commission, 2010a). Working plan 2012-2014 includes products such as power cables and smart meters, whereas possible future product groups may be e.g. heating controls and power generating equipment below 50 MW (ECEEE 2013). As an EEA-relevant Directive, the Ecodesign Directive was implemented in Norway by "Økodesignforskriften" on 1.3.2011, with amendments 1.1.2012 (NVE 2014b).

[4] 'energy-related product' or 'product' means any good having an impact on energy consumption during use, which is placed on the market and/or put into service in the Union […],of which the environmental performance can be assessed independently; (European Commission, 2010a, p 4)

The Energy Labelling Directive help consumers choosing products and works as an incentive for the industry to develop and invest in energy efficient product design (European Commission 2014b). The Energy Labelling Directive is a framework Directive like the Ecodesign Directive, and it also follows an implementation plan, case by case for the different product groups. As an EEA-relevant Directive, the Energy Labelling Directive was implemented in Norway by "Energimerkeforskriften" on 1.6.2013 (NVE 2014b).

In summary, the two Directives are complementary to one and another; the Energy Labelling Directive addresses the supply side of the market of energy related products (pull – helping consumers choose the most energy efficient products in the market) while the Ecodesign Directive addresses the demand side for energy related products (push – removing the least energy efficient products from the market) (EU Commission 2013c). Together they form one of the most effective policy tools for energy efficiency in the European Union (ibid).

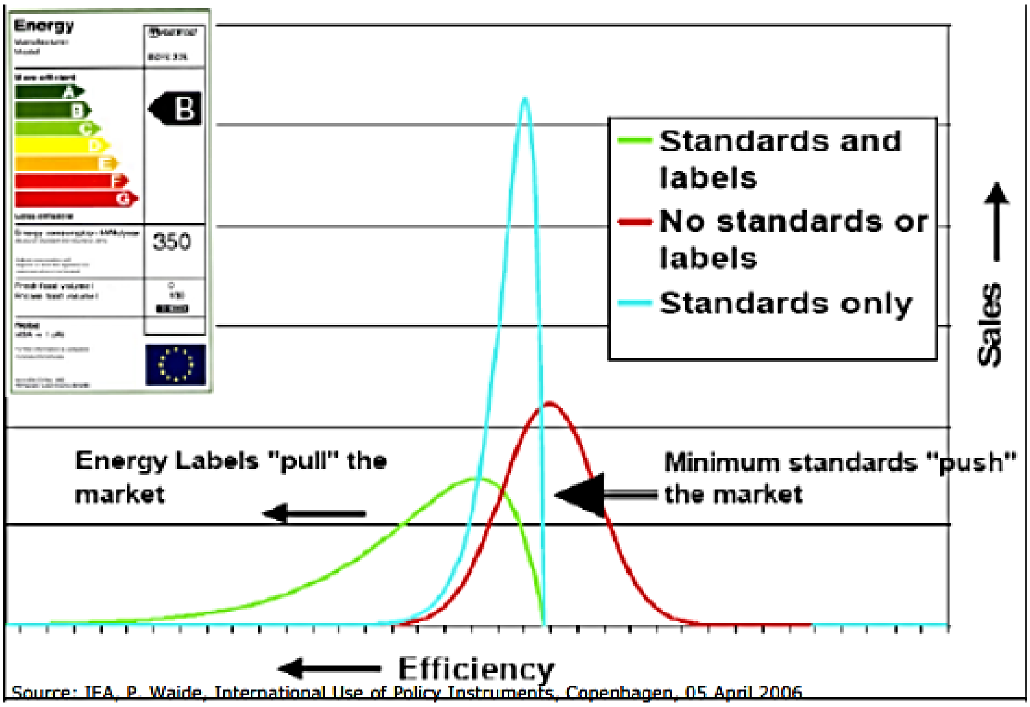

Figure 2 Pull and push instruments for energy efficiency (EU Commission 2013)

Table 6 Energy-related products relevant for INTERACT which are regulated by the Ecodesign and Energy labelling Directives (eceee 2013, European Commission 2007, 2013 d,e, 2014a; EHI 2014, IEA 2012b, Ökopol 2014, NVE 2014c)

Product	Entry into force Eco design regulations	Eco design mandatory from	Entry into force of Energy labelling regulations	Energy labelling mandatory from
Lot 1 Boilers and combiboilers	September 2013	26.09.2015	September 2013, Amendment 2014	26.09.2015
Lot 2 Water heaters	September 2013 (exceptions heaters designed for solid and biomass fuels which had a hearing for regulation 13-14 October 2014)	26.09.2015	September 2013; Amendment 2014	26.09.2015
Lot 10 Room air conditioners	March 2012	01.01.2013	Heat pumps; 2007 Air conditioners; 2011, Amendment 2014	01.01.2013
Lot 10 Residential ventilation	Preparatory study performed		Preparatory study completed for "Comfort fans and Residential ventilation", but no regulation yet	
Lot 11 Circulators in buildings	August 2009, Amendment 2012	01.01.2013		
Lot 11 Electric motors	August 2009 , Amendment 2014	12.08.2009		
Lot 15 Solid fuel small combustion installations	Draft regulation, hearing for regulation 13-14 October 2014		Preparatory study completed, but no regulation yet	
Lot 21 Central heating products using hot air to distribute heat	Preparatory study			

Considering the need of the Norwegian consumers, energy system and industry, NVE has prioritized products which may be used with electricity and/or fossil fuels, and products which are particularly common in Norway or which have a particular utility model in Norway (NVE 2014). Lot 10 Residential ventilation and Lot 11 Circulators in buildings and Electric motors are not amongst NVEs prioritized product groups (see Table 7).

Table 7 NVE's prioritized product groups 2011-2013 relevant to INTERACT (NVE 2014) (Europaportalen 2014a, b)

Product	National status	When did Norwegian stakeholders enter the EU process	Experience (NVE)
Lot 1 Boilers and combiboilers	Positioning document established, see Table 5. The proposed regulations are in line with Norwegian Building regulations (TEK 10)	Consultation Forum	Consultation Forum was too late for shaping the process, preparatory study would have been better!
Lot 2 Water heaters	Positioning document established, see Table 5. Norway is evaluating to ask for particular phrasing for large electrical water heaters to avoid banning from 2018	Consultation Forum	Consultation Forum was too late for shaping the process, preparatory study would have been better!
Lot 15 Solid fuel small combustion installations		Preparatory study phase	Producers participated in the preparatory study, and this including a good cooperation between NVE and Norwegian stakeholders have produced results
Lot 21 Central heating products using hot air to distribute heat		Preparatory study phase	Producers participated in the preparatory study, and this including a good cooperation between NVE and Norwegian stakeholders have produced results

5.2 Norwegian Building code (TEK); current and forthcoming revisions

5.2.1 Status and current regulations

The Norwegian Building (TEK) code is a part of the Planning and Building Act, and regulates all technical requirements concerning built constructions in Norway. The TEK code is regularly updated – not least developing the rules on energy performance and efficiency, in accordance with requirements in the EU Directive on EPBD (see above). The last update of the TEK code was decided in 2010, whereas the next one will take place in 2015. The Norwegian agency for building quality is preparing a proposal for a revised TEK 15, but no such proposal had been published as by December 2014.

When Norwegian buildings are projected, according to the Building code, one must conduct a calculation of the future energy use of the buildings. There are two main approaches, between which the constructor can choose. One way is to consider different measures related to energy consuming aspects of the building; for example, related to the quality of the insulation, and the technical installations in the building. This approach can be termed the 'measure method'.

Alternatively, the TEK code specifies stipulated norms for the specific energy consumption for different building categories. The constructor can decide to fulfill the requirements pre-defined for the appropriate building category. This latter approach can be termed the 'framework method' and will indicate the total net energy need for a building – which will then represent the maximum level of the building's expected energy consumption.

In the current TEK, 'TEK 10', chapter 14 is the most relevant for energy efficiency issues. §14-1 states that buildings should be planned and built in a way that supports low energy demand and environmental energy supply (Lovdata, 2013).

The Building code establishes technical requirements and target figures for heat loss through the building envelope and ventilation, requirements for installed ventilation power, possibilities for temperature regulation during night and weekends, and reduced demand for local cooling (ibid.). A Norwegian standard on energy planning and measuring has to be followed when calculating buildings' energy demand and heat loss[5], and total net energy demand for a building has to follow §14.4-6, defined target energy demand for the different building categories (ibid).

As for the energy supply to buildings, §14.7-8 states that (ibid.);

- Oil heating or fossil fuel for base load usage is not allowed
- Buildings > 500 m² shall cover minimum 60% of the net heat demand with other energy sources than direct-acting electricity or fossil fuel with end-consumer. For buildings <500m2 the figure is 40%. Exceptions will be made if the climatic conditions make it unrealizable, or if the energy demand is < 15'000 kWh/year, or if the requirement will lead to extra costs over the buildings lifetime.
- Buildings which are > 50 m² and not passive houses, yet excepted from the requirements as stated in the above bullet point, shall have a closed fireplace and a chimney for burning bio fuel.

Finally, § 14.8 states that where connection to the district heating grid is compulsory, new buildings should be equipped with heating systems compatible with district heating, so that district heating can be used for heating of rooms, ventilation and hot water. (ibid.)

5.2.2 The coming update towards 'TEK 15'

According to the political signals provided by the White Papers on climate-change mitigation, and building and construction policies, the next version of the TEK – which is to be implemented in 2015, must contain requirements on passive houses. That is, a main purpose of the TEK 15 is to make 'passive house' a compulsory minimum level for all new buildings in Norway – both residential, and industrial and commercial ones (Kommunal- og regionaldepartementet 2012).

[5] *Norsk Standard NS-3031 Beregning av bygninger energiytelse – Metode og data*

There is an ongoing debate, both internationally and nationally, on which specifications should be required as to achieve a 'passive house level'. Currently, there is no universal or international standard which is ready to be employed in different national settings. The level, and implications for 'measures' and 'frameworks' (given the TEK's approaches) is to be defined and regulated nationally.
In Norway, *Standards Norway* has spearheaded processes in formulating Norwegian passive house standards.[6] There are now two passive house standards, one for residential buildings (NS 3700:2013), and one for industrial and commercial buildings (NS 3701: 2012).

As part of the preparation for the update towards TEK15, the responsible public authority in the field, the Directorate for construction and building quality (DibK), has commissioned an expert report on what should constitute the minimum level and requirements for 'passive house' within TEK 15 (Rambøll 2013). On this basis, DibK will issue its recommendations towards the responsible Ministry for regional affairs and modernization, by February 2014.

The commissioned report recommended the scrapping of the 'measure method' for the calculation of energy usage (see above), related to different technical measures (Rambøll 2013). The report recommends the authorities to rely only on energy consumption calculation based on the building category approach; the 'framework method'. Building on this, the report also recommends a differentiated, 'weighed' approach to 'delivered energy'. That is, the energy provision becomes more focused, and local or building-based energy provision systems (CHP, heat pumps, PV etc.) is considered to be more favoured than within the current TEK 10 regime.

However, several critical voices were raised against this recommendation. Not least, the branch organisation for energy production and distribution, Energy Norway, which also commissioned alternative expert reports (Multiconsult 2013). These reports highlight the importance of continuing the focus on the quality of the building construction, and avoid a more differentiated approach to energy provision. Energy Norway stresses the importance of focusing on the buildings' robustness and the need for continued and increased flexibility between building and grid. Furthermore, Energy Norway highlights that national security of supply requires an energy system within which buildings' energy provision can be predicted and planned for on a 'energy system level'. Increased stimulation of building-based and local energy provision systems is considered to reduce this predictability at an overall level (Energi Norge 2013). As of December 2014, no additional reports or assessments have been published by the authorities.

5.3 Norwegian planning and land use regulations: The role of the municipalities

In Norway the municipalities are generally provided with a high degree of discretion to act on land use. The Planning and building Act provides regulations on issues to be covered by the municipal planning, including the land use of the municipalities. Energy installations such as renewable energy production, electricity grids and infrastructure for district heating should all be covered by the overall planning. Based on the overall municipal planning, the municipalities must regulate more specific activities according to specific zoning plans. However, the municipality does not need to issue zoning plans for energy installations and infrastructure, for which the licensing process conducted by the energy regulating authorities are considered to be sufficient.

More specifically, the Planning and Building Act also provides the municipalities with the authority of requiring constructors and property developers to connect to existing district heating systems (Lovdata 2013c). This obligation is, however, only related to areas where a licenced district heating system with

[6] Standards Norway (SN) is a private and independent member organisation, being one of three standardisation bodies in Norway. The organisation is responsible for standardisation activities in all areas, except the electro technical field and the telecommunications field.

infrastructure exists. The municipalities have, however, also the opportunity to exempt from mandatory connection to the district heating system if other energy solutions are more environmentally friendly (ibid.). The background was stated in a law proposition from the former government (Kommunal- og regionaldepartementet 2008) where it was perceived to be unfortunate that the legal framework was perceived to block low energy measures in buildings with several smaller units in the concession areas and that it appeared that the rules were designed on the basis of a different housing/ construction standard than what is expected in the future (ibid.). For this reason, and because the then current district heating legislation was perceived to be a potential obstacle to the construction of more energy efficient homes/buildings, it was decided that municipalities should be obliged to consider the appropriateness of the connection within the concession area where the developer can demonstrate that other solutions have environmental benefits. Energy solutions that can be proven to be just as good from an environmental, energy and economic point of view, can, therefore, be exempted from the requirement for mandatory connection (ibid.).

Finally, in 2009 the then Ministry of the Environment issued a planning instruction for municipalities which requires the municipalities to formulate specific energy and climate plans, based on the Planning and Building Act (Ministry of the Environment 2009). The objective of the instruction is to ensure that the municipalities take the lead in local communities' efforts in mitigating GHG emissions, as well as in inducing more effective energy usage and local energy conversion (ibid.). All other local plans based on the Planning and Building act should, according to this instruction, highlight climate and energy measures. In sum, this instruction provides the municipal authorities with a mandate for strategic decisions on energy production and usage in relation to buildings and building complexes. Most municipalities have by 2014 formulated energy and climate plans, but a major observation is that the municipalities do not possess sufficient capacity to fulfil all the intentions of the instruction, not least related to the technical aspects (c.f. Pedersen & Bruvoll 2014).

In addition to these formal requirements provided by the legislation, it is also worth mentioning that there is a number of development schemes and incentives for alternative municipal planning and development in Norway. An important initiative has been the program called 'Cities of the Future' ('Framtidens Byer'), established in 2008 and governed by the former Ministry of the Environment, now under the auspices of the Ministry of Local Government and Modernisation (Ministry of Local Government and Modernisation 2014). The program has been a co-operation between the Ministry and the municipal authorities of the 13 largest towns in Norway (ibid.). The program has provided research, documentation and some economic support for municipalities with pilot projects on area development, also including alternative energy provision and infrastructure. For example, the municipality of Drammen has been an important part of the project wherein the development of the district of Strømsø has been a pilot project, both within the Cities of the Future and the development program FutureBuilt (ibid.). A part of the Strømsø project has been to develop low energy buildings with on-site renewable energy provision and a project on smart heat deliveries (ibid.). The program Cities of the Future was terminated in October 2014, but the focus on energy benign city development and climate-friendly municipal planning seems to have become more manifest during the recent years, also as a product of this program.

5.4 Energy certification of buildings ("Energimerkeordningen" as required by the EU EPBD)

The energy certification scheme is compulsory, following from the EU EPBD Directive – as described above. The scheme provides country-specific levels for different marks (A-F) regarding the energy efficiency level of buildings. In addition there are colors (red to green) for the amount of renewable energy sources in the energy provision of the building. The scheme is codified into Norwegian law through the Energy certification Regulation, under the Energy Act.

By § 8.1, the owner of a building is obliged to provide a valid energy certificate when selling or letting the property, constructing new buildings, or when the building is a work place or public (Lovdata 2014c). Such an energy certificate is valid for 10 years. The energy authorities regulate the actual requirements providing the basis for an energy mark, and a list of energy saving measures. Work places and public buildings of > 1000 m^2 shall inform the users of the building with a valid energy certificate placed in a visible place (ibid.).

As a way of contributing to improved energy efficiency levels and better 'marks', the energy certification scheme stipulates the formulation of programs of measures for the building: that is, a plan to guide future energy-efficient refurbishments and upgrading of the buildings. However, there are no general criteria for the formulation of these plans – and no measures for the follow-up or control of the eventual plans.

5.5 Regulations on buildings' connection to the energy infrastructure

5.5.1 Electricity grid, including licensing

The Energy Act regulates production, distribution, transformation and sale of electrical energy and district heating in Norway (Lovdata, 2014c). Production, transformation, distribution and sale of electrical energy and district heating require a concession, as does reconstruction or extension of existing installations. Concessionaires of electrical energy are obliged to deliver electricity to the customers belonging to the concession area, whereas concessionaires of district heating are obliged to supply the customers connected to their infrastructure. District heating concessionaires can furthermore be obligated to connect to other district heating grids, if the grids are compatible (ibid.). Metering, settlement and billing for electrical energy is also regulated by the Energy Act (ibid.).

This regulation is an important part of the introduction of smart grids in Norway, as mentioned in chapter 3.5.4. A specific regulation under the Energy Act obliges electricity distributors to install smart metering systems or advanced metering[7] ('AMS'; avanserte måle- og styringsystemer) at each metering point. Exceptions can be made when the energy demand is low and predictable, and when the installation is of significant and documentable disadvantage to the end-user[8]. The mandatory installation of smart meters came with the changes to the regulation 1 July 2011, whereas new provisions on metering data, distribution and presentation of information, storing of metering data and display interface for the end-user will come into force as of 1 January 2019. Finally, by 1 January 2014, the end-user shall have a local access to the metering values and a cost-free access to information of energy use on the internet (ibid).

5.5.2 District heating, including licensing

Due to Norway's exceptional use of electricity for space and water heating, it has been a political goal to promote alternative heating sources (Knudsen et al. 2008). Since 1980 the use of petroleum for stationary purposes has been reduced by about 50 per cent, corresponding with an increase of electricity-based heating (ibid.). Since petroleum used for heating is often connected to water-based heating systems, this can facilitate a conversion to renewable energy. Bioenergy-based heating is competitive when resources are available at low cost and there is a possibility of connecting to a district heating system. Improving the infrastructure for district heating is thus considered to be a key measure.

[7] "*Advanced metering is defined as a metering system that records customer consumption (and possibly other parameters) hourly or more frequently and provides for daily or more frequent transmittal of measurements over a communication netweork to a central collection point*" (FERC, 2008;p5)

[8] Norwegian Water Rersources and Energy Directorate can act as a mediator in disputes, and make dispensation in extraordinary cases.

The use of bioenergy as a source for heating purposes is increasing in Norway due to more fluctuating electricity prices (ibid.). In 2005, in total 31 district-heating facilities supplied approximately 4.3. TWh (Ministry of Energy and Petroleum 2013: 30). Energy recovery from waste constituted about half of this heat production, with the rest coming from biofuel, electricity and petroleum. In particular, many new public constructions are now projected with attachment to biomass-based district heating systems, including, in some cases, private dwellings. Such projects of substituting electricity for heating are often financed by the public Energy Fund, managed by Enova.

As mentioned under chapter 4.3, the Planning and Building Act provides the municipalities with the authority of requiring constructors and property developers to connect to district heating systems. This obligation is only related to areas where there is a licenced district heating system with infrastructure.

The payment for district heating is composed of three elements; a connection fee, a fixed yearly fee, and a price for heat use. The price for district heating shall not exceed the price of electrical heating in the area of supply in question (Lovdata 2014c). Customers obliged to connect to a district heating system can appeal the price level or other conditions of delivery to the concession authorities, whereas the concession authorities can oblige the concessionaire to alter the price level and other conditions of delivery. However, where connection to the district heating system is mandatory, the customer is obliged to pay a connection fee and an annual fee, regardless of if the district heat is used or not (Lovdata, 2014c).

5.5.3 Electrical energy

Production, sale and consumption of electrical energy and the income frame for grid companies is strictly regulated (Lovdata 2014a, Lovdata 2014b, Lovdata 2014c). Both production and consumption of electrical energy is an object to both a fixed (effect tariff) and variable (energy tariff) tariff (NVE 2010; NVE 2013b). The market for electrical energy was deregulated in 1990 (nordpoolspot.com), opening up for more competition amongst producers. The grid operator may claim a connection fee for connecting both consumers and producers to the grid, and the claimed cost is a result of the actual cost for the grid operator (NVE 2010). Differing from district heating networks and heat production, the electrical power producer and grid operator are by law obliged to be organized in separate legal entities, hence the producer cannot be the same company as the one owning the grid.

Production of energy by so-called plus customers have a general dispensation from the fixed tariffs (NVE 2013a). Plus customers are defined as residential houses with e.g. PV panels with an energy production normally not exceeding their annual energy demand, but which in singular hours of operation have an energy surplus that can be fed into the grid. Production demanding concession or end-users with delivery to other end-users are not defined as plus customers (ibid). As mentioned in chapter 3.5.4, this regulation can be seen in relation to the emergence of the prosumer role as a part of the smart grid development. The Norwegian energy regulator NVE is currently considering a new regulation on 'plus-costumers' whereby the plus customers or prosumers are supposed to be given the right to exchange up to 100 kW energy surplus from the building to the electricity grid, free of charge (NVE 2014a). This amount is supposed to correspond with 650 m^2 PV panels, for example on a building's roof and/or in the facade (ibid.). A hearing on the proposal for this new regulation was held in October 2014, and the NVE is currently (as of December 2014) in the process of finalizing the regulation.

5.5.4 District heating

District heating is just as electrical energy object to both a fixed and variable tariff, as well as a connection fee (Lovdata 2014c). The market for district heating differs from the electricity market through the mandatory connection to the district heating grid for new buildings in areas where district heating is an available resource, as mentioned earlier (ibid). In order to protect the customers from exaggerated prices from providers with monopoly, the Energy Act has established, by §5-5, that the final price of thermal heating is to be coupled with and never to exceed the current regional price of electricity (ibid.).

5.5.5 Third-party access

There are basically three operations possible in a district heating network, see Figure 3 under.

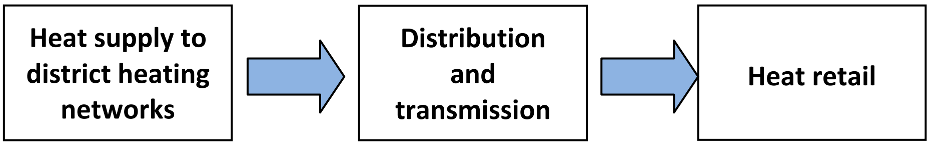

Figure 3 Operations possible in a district heating network

Current discussions are centered on if delivery to end-users by third parties, i.e. heat retail using the network of the district heat operator, shall be allowed (see e.g. Oxera 2014).

In Norway, third-party access to district heating network is regulated through the Energy Act §5-6. Following an amendment of the Energy Act in 2013, the district heating network operator is obliged to negotiate with any third-party requesting access to deliver to the network (third party delivery, TPD) or any third-party requesting access to the network to deliver directly to end-user (third party access, TPA) (Lovdata 2014c). A district heating network operator may however refuse such request due to technical or other reasons (ibid). Third-party access to deliver to the network has been positively received by the district heating companies in Norway, whereas third-party access to the network for a direct delivery to end-users have been a less popular proposal (Norsk Fjernvarme 2013). Arguments against TPA are connected to security of supply and the risk that uncoordinated TPA will reduce positive environmental aspects and not necessarily reduce prices for the end-users (ibid).

Grid operators of electrical grids, on their side, are obliged to accept any third-party requesting access to deliver to the network (Lovdata 2014c), but are allowed to charge the energy producer for the grid investments costs through a connection fee. In practice, low grid capacity and high investment costs for expansion of grid capacity, hence high fees for connecting to the grid, is a normal deal breaker for new energy production projects in Norway. When first connected to the grid, a third-party producer may deliver both to the grid and directly to end-user. A third-party may also be granted access to end-users' automatic meter reading (AMR) installations by authority of the end-user (Lovdata 2011).

Lessons learned "Öppen fjärrvärme" – Fortum's opening to Third Party Delivery
Sweden has a deregulated market, with no national incentives for district heating and cooling (DHC) in place, and no regulation on mandatory connections for customers, as is the case in Norway. Nevertheless, there has been a substantial development of DHC in Sweden, and at competitive prices for the customers, and now also for third party deliveries and suppliers. Third party delivery "Öppen fjärrvärme" – "open district heating" is a project run by Fortum in Stockholm. Any company or business with surplus heat or cooling which are physically located close to Fortum's DHC network may deliver energy into the network at market price conditions (Öppen Fjärrvärme 2014). Through the project, Fortum exposes their DHC production to the market, opening up for the cheapest production to be used to meet the demand load in the network at all times (Fortum Värme 2014). Surplus heat and cooling is thereby a genuine alternative to produced DHC by traditional fuels such as waste and biomass.

Dialogue and co-operation with parties involved has been a key factor to the project success. New DHC networks and extensions of these do not require concessions in Sweden. New projects must be notified to the municipality in question, and an authorization must be given by the municipality for the construction work. Agreements are made with the supplier, and in case the supplier does not own the property, the supplier has to make an agreement with the proprietary. A co-benefit of entering an agreement of supply with customers is a closer relationship with these.

The financing model is that the **supplier pays the costs** for laying the pipes and other technical installations needed for a connection to the network. After construction, the pipes themselves will be the property of Fortum, and a yearly pipe fee (around 500 SEK/m) is paid by the supplier. Piping is only extended over short distances, so a geographical location close to existing DHC network is obligatory. The experience so far has shown that investment costs for smaller installations are difficult to defend, as a certain base cost applies, independent of installation size. Fortum is currently looking into partnerships with technical providers in order to reduce the technical and even operational risk taken by the suppliers. Currently, this risk is managed through a mandatory protocol from Fortum in the supplier agreements, including standards for technical equipment, installation, operation and maintenance. Protocol compliance is tested in a 14 days pilot period before supplier is allowed delivery access.

Suppliers with installations below 10 MW may choose either a **spot price or a production on demand price model**. The spot price is driven by Fortum's alternative price for heating and cooling at the moment, whereas the production on demand price model involves a fixed remuneration per kW installed in addition to a variable tariff coupled to the electricity price. A typical supplier on a spot price model is a supplier with heat or cooling surplus with an intermittent character (e.g. waste heat from industrial processes and heat boilers), whereas the production on demand price model is typically chosen by suppliers with a base load of heat or cooling surplus (e.g. data centres). Spot price suppliers may choose when to deliver, whereas the other group of suppliers delivers on demand from Fortum. Suppliers with installations over 10 MW receive tailored contracts which are negotiated between the parties.

At the moment, suppliers are scattered and not causing any significant effect on Fortum's own production planning. This may change with more and larger suppliers, which may also lead to a more competitive market amongst the suppliers. On the demand side, new buildings have less need for DHC, and in addition, geo-thermal heating, heat pumps and pellets ovens are amongst the competing technologies to DHC.

For more information, also on the pilot studies, see; http://www.oppenfjarrvarme.se/

5.6 Relevant economic incentives and support schemes

5.6.1 Enova

Enova has on the basis of the Energy Fund provided funding schemes for energy efficiency measures in residential houses, cooperative housing, and industry.

Small-scale heat pumps, mostly for residential buildings, have been funded through different schemes and arrangements since 2003. Current funding priority lies on phasing out oil-based heating, supporting the transfer from electrical to alternative renewable heating, such as solar water heating, and heat demand steering system (Enova 2014a). Geo-thermal wells and heat pumps are considered as measures for energy efficiency and the phase-out of oil-based heating, and thereby financially supported (c.f. Enova).

By November 2013 Enova withdrew their support for passive houses as a consequence of success of the support scheme, and with predictions that passive houses will become a requirement in TEK15. Hence, financial support was redundant in order to have a continued development of passive houses. Since the program start in 2010, and the start of passive housing in Norway, Enova has supported more than 400 passive and low-energy construction projects ranging from office buildings, schools, hospitals, homes and other buildings. Currently their support is directed towards funding of energy efficiency measures in existing buildings, together with comprehensive rehabilitation of passive houses- and low energy levels (Teknisk Ukeblad 2013a; Enova 2014b). Zero- and plus houses are specifically defined as eligible options for funding under the scheme of Enova due to their resemblance to passive houses in energy use, however the support program for new technologies in buildings can result in a plus house.

Enova furthermore provides investment support for full scale innovative demonstration projects under real operating conditions which are new to the Norwegian market and contribute to energy efficiency or increased production of renewable energy. One example is the first energy-positive building which is located at Kjørbo in Bærum, where the project – a refurbished office building with solar panels – has received 13 MNOK from this support program (Teknisk Ukeblad 2013b). Moreover, Enova has launched a new program for the development of new buildings. It will target those who have ambitions that go significantly beyond the regulations. Enova will provide support to those who are willing to try out innovative solutions with regard to building structure, technology and energy supply. This means that the ambitions now will be increased beyond that of passive houses and may result in support for zero- and plus houses.

5.6.2 Innovation Norway

Innovation Norway supports, among other activities, the development of more environmentally friendly products and solutions, smart ICT for energy efficiency and green service providers, see e.g. the newly published Green Building Market Report (Innovasjon Norge 2014a). Innovation Norway has several funding schemes supporting research and development relevant for the scope of INTERACT: Funding for environmentally friendly technology development, bioenergy program (thermal heat/bio gas and biomass production), and a Bioeconomy program (Innovasjon Norge 2014b). Innovation Norway funds 25-50% of the R&D activity depending on the content (e.g. division between technology development, competence building and investment activities) and the size of the company (ibid).

5.6.3 The Research Council of Norway

The Research Council of Norway (RCN) supports a broad range of research and development projects for both research institutions and industry by funding for instance projects and research infrastructure, as well as co-operation and networking with international partners including EU-arenas such as European Energy Research Alliance (http://www.eera-set.eu/).

The recently published national strategy for R&D, demonstration and commercialization of new energy technologies in Norway, *Energi 21* (Energi21, 2014) forms the research agenda for energy technology, whereas a similar initiative on buildings, *Bygg21* (Bygg21, 2014) is a guidance for setting priorities within building and infrastructure research. *Energi21* has highlighted energy efficiency and flexible energy systems as areas of special interest, whereas *Bygg21* points to sustainable, functional and adaptable buildings for the future residential and urban areas.

RCN uses several schemes for funding, e.g. researcher projects (no industry involved), competence projects for the industry (20% financial support from the industry) and innovation projects for the industry (between 50-60% in-kind or financial support from the industry). Also larger, strategic research centres are funded, such as e.g. Centre of Environmental Design of Renewable Energy (www.cedren.no) and The Research Centre on Zero Emission Buildings (www.zeb.no). Projects through RCN are typically created through concrete research needs identified by the industry, multiple levels of governance and research and academic institutions.

The Research Council also manages a tax incentive scheme, called SkatteFUNN. The scheme is meant to trigger research and development (R&D) projects in companies by providing tax reliefs on in-kind and/or funding of R&D. The criteria for applying are quite loose. The scheme is regulated under the general tax regulation and the regulations on public acquisition, which means that e.g. the size of the company, and co-operation with other companies on the projects will decide how much funding (around 18-20%) it is possible to receive through the tax relief (Forskningsrådet 2014).

5.7. Different methods of measuring energy usage and energy efficiency – as related to different regulations

Since Norway's supply of electricity is mainly based on renewable hydropower, the Norwegian electricity producers are quite critical to the carbon footprint approach towards the measurement of energy supply to Norwegian buildings. At the same time the references and targets for different policy regulations for energy efficiency are different, differing between kWH and CO_2 (c.f. Adapt Consulting 2012). There are also different ways of estimating and measuring primary energy (ibid.).

The main approach to energy savings in the Norwegian Building code is kWH, as to the measures required for saved energy in relation to the building construction. However, there is also a requirement to supply the building with renewable energy, and to ensure that the constructor provides an alternative, renewable source for the heating of the building. The major reference for this requirement is CO_2 (Lovdata 2013; ibid.). As far as the energy labelling system is concerned, the Norwegian follow-up of the EU Bulding Energy Directive, there is also a double reference as is the case for the Building code.

Based on this, and given the building industry's recent orientation towards climate-change mitigation and the optimization of their contribution in this regard, the CO_2 reference has gained additional force during recent years. This is also closely related to the environmental labelling of buildings, not least the BREEAM certification scheme (see also chapter 5).

5.8. Summary: Policy instruments for energy efficiency in Norway

Table 8 Overview policy instruments for energy efficiency in Norway

Instrument	What	Status / Governance level in Norway (national/regional/local)
Regulatory	Norwegian Building code	National
Regulatory	Norwegian planning code	National, but the municipalities set the concrete requirements
Regulatory	Plus customer arrangement	National, to be finally decided in 2015: Allows owners of residential and non-residential buildings to exchange up to 100 kW surplus electricity, based on e.g. PV integrated in the building, to the electricity grid – free of charge.
Regulatory	Third-party access and deliveries to the district heating infrastructure	National, amendment of the Energy Act (2013): Allowing third parties to access and deliver heat to existing district heating infrastructure, depending on the negotiation with the owner of the infrastructure. The DH infrastructure owner is not obliged to provide access, if no agreement is obtained during the negotiations.
Regulatory	EU Energy labelling Directive	NVE has prioritized product groups which they will follow closer than others. National regulations will be established on a product group base as the EU regulation progress develops into mandatory regulations
Regulatory	EU Ecodesign Directive	Same process as for EU Energy labelling Directive
Regulatory	The Energy Act	Regulation of income frame for grid operators, and tariff regimes for grid operators, producers and end-users of energy, including a regulation of district heating market (mandatory connecting and regulation of pricing).
Economic	Enova incentives	Supports investments in more energy efficient heating solutions (i.e. hydronic heating, solar water heating, heat demand steering systems, geo-thermal heating), as well as new technological solutions.
Economic	Innovation Norway	Financial support to energy and environment R&D
Economic	The Research Council of Norway	Several economic instruments, such as financial support to R&D projects, and tax incentive schemes for companies conducting R&D projects.
Informative	Energi21	National strategy on energy technology R&D with energy efficiency as one of the prioritized areas. Priorities of the strategy to be taken into account by the RCN in the funding of R&D projects.
Informative	Bygg21	National strategy on buildings with sustainable, adaptable, functional buildings for the future residential and urban areas.
Informative (economic)	Cities of the Future (finalized in 2014) and FutureBuilt	Development and pilot project program supported by the Government, aiming at alternative urban planning and innovative, low-energy building concepts in Norwegian cities.

6. Industry-based schemes and other measures

The Norwegian building and construction industry (BC) is increasingly being considered, and considering itself, as relevant to the climate-change challenge. This happens despite the fact that Norwegian buildings only to a very limited degree do contribute to the overall amount of national GHG emissions *directly:* Very few buildings emit GHG by their ordinary operations, including energy provision and consumption. However, the Norwegian BC industry has started to employ a carbon footprint approach when projecting and operating buildings. For example, the Norwegian Public Construction and Property Management (Statsbygg) has initiated and developed a carbon footprint calculation tool in a life cycle perspective (klimagassregnskap.no). This methodology is now broadly used by the Norwegian BC industry. This also reflects a broader international tendency: Several schemes for environmental performance standards for buildings have been developed during recent years. The two most prominent ones are 'Green Building Leadership/LEED', developed by the U.S. Green Building Council (U.S Green Building Council 2014). Another one is the scheme calleed 'BRE Environmental Assessment Method' (BREEAM) – developed by the British Building Research Establishment (BRE) from 1990 (British Building Research Establishment 2014).

Norwegian Green Building Council (NGBC) was established in 2010 by leading Norwegian branch organizations and companies. Its main objective is to 'promote the sustainability of Norwegian buildings'. After an internal debate on which environmental building performance scheme to apply for the Norwegian context, the NGBC decided to develop a Norwegian version of the BREEAM scheme. The first version of the BREEAM-Nor scheme was launched in 2011, and has established itself as a leading tool for Norwegian BC actors – in particular, for those who want to demonstrate a specific engagement towards sustainable development and the environment (Norwegian Green Building Council 2012). What 'sustainability' implies in terms of actual practice and performance standards are not further specified, but the focus on GHG emission reductions is substantial.

In order to achieve a BREEAM certification, graded from 'Pass' to 'Outstanding', the construction company and its advisors have to conduct an extensive and thorough evaluation of the project's plans, including a carbon footprint assessment – or a GHG calculation of the building's emissions in a life cycle perspective (ibid.). Statsbygg's klimagassregnskap.no is nominated as a recommended tool in this regard (ibid.). Hence, GHG emissions related to the construction and operation of the building must be calculated as a part of obtaining a BREEAM certification. A critical point in this calculation is the understanding of the composition and quality of the energy delivered to the building, from the energy system.

Norway is a part of a wider energy market, whereby the NordPool system is the marketplace for electricity. Given the physical interconnections and exchange of electricity power between the NordPool countries, as well as between the NordPool area and the neighboring European countries, the original sources for the electricity finally being consumed in relation to Norwegian buildings are variable – also encompassing fossil sources with GHG emissions. However, such 'indirect' emissions are not accounted for by Norwegian authorities – and the actual 'mix' as to the share of fossil fuel-based electricity does not appear on any official Norwegian statistics related to energy consumption in buildings.

In addition to environmental standards for buildings, there are also standards established for the processes of developing, planning and constructing sustainable buildings. An example of such a standard is CEEQUAL (The Civil Engineering Environmental Quality Assessment & Award Scheme), which is a sustainability assessment, rating and awards scheme for the civil engineering (CEEQUAL 2014). The scheme is voluntary, and used by e.g. Skanska, ABB, NCC Construction Sweden, Rambøll and Vattenfall (ibid.) (Skanska 2014). Furthermore, standards for environmental management such as ISO 14000 (ISO 2014) involving e.g. environmental waste management and consumption of energy and materials, is used by e.g. Skanska (Skanska 2014).

7. Assessment: The potential for energy storage and interaction projects given the regulatory framework in Norway

The present report's mapping and assessment of relevant policy strategies, regulatory measures and other policy instruments in Norway, demonstrates that there are no specific measures or incentives explicitly oriented towards energy exchange and energy efficiency between buildings, and within building complexes.

However, the sum of the current policy approach to energy efficiency is increasingly in resonance with a more integrated thinking of buildings and the energy infrastructure. The interface between buildings and energy networks, and the interaction between energy production, distribution and usage is clearly an emerging area of political interest. This interest can in a Norwegian context also be seen on the background of the EU's reinforced focus on energy efficiency and buildings' energy performance over the last decade, in addition to a strongly growing interest and push from the construction and building industry during the recent years.

Adding to this has been the overall climate-change mitigation policy strategy where energy efficiency in the most recent decision (c.f. the cross-party climate agreement approved in Parliament, 2012) appears more prominently than in former climate policy decisions. More specifically, the decisions on phasing out fossil fuelled heating by 2020, and the coming updates of the building code with requirements on passive house and nearly zero-energy levels for new buildings, stand out as strategically important decisions which can also create new and more specific policy measures stimulating energy storage and interaction.

Moreover, the increased focus on city and municipal planning as a part of a climate-change mitigation strategy in Norway, as for example demonstrated by the program Cities of the Future, has also led to a stronger priority of pilot energy projects in Norway's cities. The barriers observed as a part of the district heating structure and other energy-related infrastructure can in certain cases also be overcome by engaging an active dialogue with the interested municipalities.

The recent legal amendment providing a right to negotiate on third-party access and delivery to district heating networks may not be sufficiently strong in order to really induce alternative heating solutions based on building complexes. Nonetheless, this amendment reflects a changing political focus whereby the interface between energy infrastructure and buildings is considered in a far more integrated manner than what was the case not many years ago. The same observation can be made in relation to smart grid development and the possible emergence of a 'prosumer' role, as can be the result of the coming amendment of the plus customer arrangement.

In sum, however, a stronger focus on the potential benefits of more differentiated regulations and incentives could still be considered, if the society and the political authorities really want more innovative solutions for energy storage and interaction, as well as projects which can survive economically. There is a remaining barrier in the way Norwegians consider supply of energy – in the form of electricity, as cheap and abundant. Hence, the overall drivers which are substantially present in other European countries, related to higher energy prices, less security of supply and the need for phasing out fossil fuel-based production, are not present in Norway. In addition, Norwegian building prices for both residential and non-residential buildings are relatively high. Given the current prospects of increased challenges for the Norwegian economy in overall, such concerns may also grow in importance. Hence, additional costs related to energy provision for buildings may not be a very feasible path, given the Norwegian political and societal context. Therefore, new projects for energy storage and interaction should also focus on and clearly communicate how they can contribute to reduced costs, in order to become more politically robust in a long-term perspective.

8. Concluding remarks: Towards 'strategies for viable transition'

Given our analytical focus, as outlined in section 2, we have focused on the degree of coordination and joint policy efforts aiming at energy efficiency, with a specific view on to what extent energy storage and exchange between buildings is incentivized. The present mapping and assessment have indicated that there are no explicit policy measures in place in today's Norway which could induce more energy storage and interaction between buildings. In particular, few concrete initiatives have thus far been taken from the political level in order to actually prepare the introduction of smart grid concepts, including more interactive exchange of energy between buildings and the grid, and a higher amount of building- based energy production. Hence, further regulatory changes will be necessary in the near future –given the technological development.

At the same time, there is clearly a reinforced focus and priority towards energy efficiency in buildings in Norway, as not least reflected by the latest climate-change policy strategy approved by the Parliament in 2012. There has been a strong political focus on stimulating the phase-in of low-energy building concepts during recent years – not least on the background of the EU-based legislation which must be followed up in Norway. In parallel, during the last decade, there has been a clear focus on the further promotion of district heating and other alternatives to electricity-based heating in Norway.

Some barriers will persist, however, both related to differing interests of different economic segments, and the overall political thinking of what is acceptable for the Norwegian society and Norwegian voters. An important economic barrier is related to the ownership and management of energy infrastructure, both for district heating and electricity. The regulation of third-party access and deliveries to district heating, which is now in its beginning given recent amendments in the legislation, as well as the forthcoming regulation for plus customers (or 'prosumers') of electricity, can be seen as the first legislative steps on the road towards a more interactive energy system. At the same time, more interaction and integration between different technical systems will require increased cooperation and coordination between different systems and policy sectors, not least between the energy and buildings sectors. What kind of costs and/or benefits this will imply for the society, and eventually for what kind of producers and consumers, is not fully clarified in a Norwegian context. Hence, in order to gain political and societal support for more concrete measures for the transition towards a more interactive energy system, one should also address the social and economic dimensions.

In sum, increased dynamic between the different technical systems and political-administrative segments such as the building sector and the energy system, will require strong political willingness and a robust cooperation in order to make substantial changes (c.f. Lafferty and Ruud 2008). An important part of the current emerging societal interest in Norway for energy efficiency is the role played by climate- and energy-oriented municipalities focusing on innovative pilot projects. Another very interesting development is the building industry's innovative approach and interest for low-energy building concepts. These two trends could together have a joint impact on the further development of a Norwegian policy framework, adding to the impulse stemming from the EU legislation.

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