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Climate and eco-adaptation in housing and construction – local transition strategies

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Abstract

Introduction

Transition of the construction and housing sector is a main national challenge both in relation to climate and a broader sustainability agenda. In Denmark 40% of the energy consumption is related to housing, and construction and retrofitting of buildings involves a substantial resource drain, high volumes of waste and use of a high amount of chemicals. In addition, climate changes raise new construction demands. Taken all together we need to redefine housing and construction technologies and practices. This redefinition is also required to maintain a competitive construction industry.

The analytic approach in the paper is anchored in a conception of construction and housing sector as socio-technical systems (Geels 2004, Bergek et al. 2005, Jacobsson/Bergek 2004) understood as technologies, actors, network and institutional frameworks. Transition requires new configurations in these elements, and processes of transition is perceived as an interplay of socio-technical regimes, socio-political landscapes and socio-technical experiments /niches (Geels 2004, Kemp/Loorbach 2003). Transition processes are complex. The construction and housing sector in particular is characterised by high complexity; a transition to new technology paths involves a concurrent and distributed change of technologies, actors, competences and perceptions, both in relation to product chains, project processes and living practices.

Within this framework, the paper focuses on local socio-technical projects and experiments of sustainable construction and housing in Denmark; how have they emerged and become specific configured places of niche experiments for sustainable transition and learning; and what have been the roles for municipalities (regional authorities) in these projects and niche experiments? Subsequently, we reflect upon the options for municipalities in developing local strategies taking on roles as transition agents. The studies have been conducted within the framework of the KIBS-project Klimaændringer og Innovation i Byggeriet region Sjælland [Climate changes and innovation in construction. Region Zealand]¹

On a general level the paper asserts a transition approach, where attention is given to staging bottom up localised experiments as transition arenas, opposed to centrally devised transition management processes operating with national transition arenas (Kemp/Loorbach 2006, Kern/Smith 2008).

On a more specific level, the aim of this paper is to unfold and discuss if and how local policies may support niches for experimental eco-oriented building, and facilitate translation from such

¹ The project is performed by the authors of this article and supported by Vækstforum Sjælland, see www.klimabyggeri.dk

niches to mainstream construction, in a way that can redirect the sector towards more sustainable building technology and architecture.

In the paper we are going to address four themes

- An outline of the Danish arena for action and socio-technical experiments in sustainable construction and housing, i.e. the construction sector, innovation policies and greening efforts. (We are leaving other relevant-to-the-subject areas unaddressed, such as (energy) administration of public buildings and overall energy- and heating planning.
- Regions and municipalities as actors in the transition process
- Emerging new roles, programs and policies in municipalities.
- Experiences of local niche projects and initiatives

The article is concluded with an outline of possible local actions and initiatives for niche developments and for upgrading the socio-technical regimes in a more sustainable direction.

Theoretical framework

It has become widely recognised (e.g. EU commission 2008), that the challenge of sustainability demands profound changes in our production and consumption systems. Most promising approaches are focused on systemic changes; changing the dominant technological regimes and technology systems. The objective is a pervasive change of socio-technical systems – also including changes of values and practices in civic society.

Basically innovation processes *within* the dominant socio-technical regimes are visualised as incremental and system optimising; more radical innovations are supposed to take place on the fringe of the regimes. The dynamics of the dominant socio-technical regime in relation to green innovation have been studied by economists and innovation researchers, addressing the question of how the consumer and institutional demands for greening of industry and cleaner products may influence innovation (Porter/Linde 1995). The studies of eco-modernisation suggest that the economy may adapt to these requirements by interplay of regulation, institutional dynamics, public awareness and corporate commitment (Gouldson/Murphy 1997, Søndergaard et al. 2003, Holm et al. 2008). Focus has been on the relations between regulation and industry, on institutional reflexivity and on the role of frontrunners and early adopters for the development of low-impact technologies. Frontrunner companies can gain future advantages by early adoption of new, low-impact technologies, by creating eco-friendly products and subsequently influencing environmental and technical standards in their favour, which in turn will impact the rest. Regulation can thus deliberately use frontrunners for pulling the market by setting and enforcing strict rules and standards, frame R&D clean-tech programmes, support innovative green product chain management and enhance environmental communication among stakeholders and companies.

Along the line of Martin Jänicke's (2000) original anticipation of ecological modernisation, changes in some companies or single technologies will not spur sustainable transitions or structural changes of more complex technology systems within the dominant regimes. Thus, we may find ecological modernisation paths as scattered examples of cleaner construction materials, environmental management in construction companies, energy saving light bulbs or architectural constructions enhancing use of solar heating. But in order to make a step for more sustainable construction, transition of the whole socio-technical system of housing/dwelling is required.

Deliberation and niche formation

Departing from this understanding, planning and policy studies have raised the question, how we can understand the preconditions for the emerging of more sustainable transition processes and how we deliberately may conduct such processes (Kemp/Rotmans 2001, VoB/ Kemp 2006). A multi level model has been suggested, where regime shift processes are understood as interplay between socio-technical regimes, socio-political landscapes and niches (Geels 2004, Kemp/Rotmans 2001). The dominant regime may be changed by innovative processes performed by networks of the regime actors, driven by dynamics on the different dimensions of the regime, e.g. industry, policy, science, markets. These processes may be influenced by changes in the landscape, creating new conditions for development, making a space for new technology systems, and by ideas and inspiration from niches being translated and adopted by innovative actors in the dominant regime (Geels 2004).

Thus, one of the instruments for sustainable transition can be niche management, i.e. creating and supporting niches for experimentation and maturation of new technologies (Kemp et al. 1998), so they can be adopted by innovative mainstream companies and organisations and disseminated in the dominant regime.

These lines of thought, in turn, have posed questions of the relationship between niche development and changes in the dominant regime. How are niche processes initiated and supported? Which learning processes takes place in the niches? What are the dynamics between niches and dominant regimes? Which learning and transition processes happen in the dominant regimes in the interplay with niche technologies? (Kemp/Loorbach 2006)

Smith (2003, 2007) has studied the eco-housing movement in UK and demonstrated how they make up a socio-technological context which on main parameters differs from the mainstream construction sector; and he has asserted that such settings provide a particular fertile setting for fostering more radical technological solutions adapted to meet the challenge of sustainability.

Smith (2007) finds, that such niche experiments not need to be strategic projects aiming at technology transformation, but their impact derives from their existence as exemplars, demonstrating technical and social feasibility and being 'icons' to movements. The learning processes in these niches are based on values and cognitive conceptions of housing that differs from the main stream processes and lead to rather different technologies. He asks the question how learning between niches and mainstream occur. How can knowledge and perceptions gained from such socio-technical experimentation in e.g. eco-housing diffuse to the conventional construction and housing sector? Smith (2007) points to that these dissemination processes take place as acts of selection and interpretation. Even successful options may be rejected both for market and cognitive reasons. However, transfer occurs not only as technical elements, but also as problem framing and second order learning.

Brown/Vergragt (2003, 2008) have similarly defined a concept of bounded socio-technical experiments (BSTE), which come close to niche definition, but whereas economic niches may be independent on place or locality, BSTE are more situated and focussed experiments in scope, place and time. BSTE's are discussed to identify how they may contribute to systemic development in a broader scale. In previous studies (Brown et al. 2003:294), they have determined the criteria of evaluating success of BSTE as:

1. *Diffusion of the results of an experiment, in the form of a new technology, product, or service, to a larger scale where it is a commercial as well as environmental success;*
2. *Capturing the interest of consumers, businesses and societal institutions, which leads to further experimentation in the same type of technology and social arrangements, and additional investments;*
3. *Branching out into a new application or nucleating a new, different experiment;*
4. *Occurrence of higher order learning within the BSTE-oriented coalition and beyond it, and the society at large*

Accordingly, the role of niches may range from maturation of single technology-systems to demonstrating and developing new technological trajectories built on alternative problem framings and underlying values, where not only the technologies, but also the problem framing and values may be transferred to the mainstream development.

What are niches? “*These niches are spaces where networks of actors experiment with, and mutually adapt greener organizational forms and eco-friendly technologies. Analysis of these greener ‘socio-technical configurations’ has inspired normative claims for niches as significant sites of learning and network building relevant for sustainable technology policy more widely*” (Smith, 2007). The niche definition ranges somewhat imprecisely from socio-technical spaces for experiments with technologies, e.g. hydrogen engines in handicap vehicles, to larger holistic changes challenging socio-technical systems. Also niches differ along the line of radicality in break with dominant regimes, e.g. from the close-to-mainstream development of low energy consuming dwellings where only small adjustments in design and architecture is at stake to expand insulation use, to alternative eco-villages - communities built on values and principles that differ from mainstream construction and villages. In a transition theoretical school of thought we prefer a concept of niches that cover efforts in changing more profound socio-technical systems, including standards, norms, perceptions, technologies, networks. However this do include the deliberative shaping of places for diverse producer-user groups experiments with selected technology devices in real-life situations.

In all cases there is a need for policies to support niches, put regimes under tension and facilitate translation (Smith 2007). These policies can be performed at international, national and regional levels. In this paper we will address the possibilities at the local level for municipalities and local actors to develop policies and strategies that can support the development of niches for socio-technical experiments with an aim of influencing the mainstream building sector in direction of sustainability.

Studying locally, situated niches

In our study of the processes in the Danish construction and housing sector we will relate changes in technologies and practices to shifts in the socio-political landscape, but in particular we will take interest into how local projects and initiatives have served the function as socio-technical experimentations, where combinations of new technologies and living practices are unfolded and developed into alternative options.

It can be described as situated *transition places*, where cooperative housing communities, user driven eco-settlements, institutional funds eventually in interaction with specific municipalities have defined contextualised socio-technical experiments (Brown et al. 2004, Brown/Vergragt 2008). Also municipalities may have invited actors of the construction industry to participate in materialising such situated learning processes. They are labelled situated to grasp that each of the

emergent projects/initiatives on the one hand are developed in unique situations, on the other hand become particular situations of social and technical learning and development. These ‘situations’ are emerging in a ‘clash’ between groups of external actors’, structural and institutional conditions of the sector and the local political and organisational (municipality) system. The ‘situated’ also includes the fact that the process takes place in specific local space². The argument is that it is worth examining the formation of such places, and further that municipalities have played and can play an decisive role in how (whether) these situations develops and are utilised. The purpose of niche experimentation concerning scale and place may vary a lot, and to which degree local producers and institutions may be involved.

Focus is on this constitutive process (and roles taken by municipalities and regions), while processes of dissemination and influence of the dominant regime are left out of the scope of this study, even though we reflect upon various efforts in the niche projects to influence the dominant regime.. We shall track how these local projects/initiatives are shaped as situated transition places, on the one hand in interplay with the dominant regime (a structuration relation), on the other hand as localised interactions of actors.

The Danish construction sector in a eco-energy transition perspective

The Danish construction sector has been characterised as extremely conservative and non-innovative. While most other sectors have been strongly influenced by environmental management and eco-products, the construction sector have been left almost untouched by ecological demands. There are only a few “eco-houses”, mainly with focus on energy aspects, e.g. photovoltaic on the rooftop etc., while other sectors have significant segments for organic food, swan-labelled washing powder etc. The main influence from environmental considerations has come from the energy crisis, leading to strict rules in the building regulation and experimentation and development in the dominant regime (0-energy house, growth of insulation companies, thermo-windows).

Eco-housing movement

From early 1970'ties a movement of alternative living grew in Denmark as well as many other countries. Lively experimentation and new ideas of lifestyle, food, building techniques, clothing etc. grew up. Many of the ideas from this cultural movement diffused to everyday life and later coming initiatives of local Agenda 21 projects as well as national and regional campaigns of energy and water savings, green areas in cities, environmental management in institutions etc.

The 1970s environmental crisis and growing environmental awareness led to an alternative, experimental culture. New alternative settlements grew up which had networks across the world. Here both new forms of living together and new ecological construction techniques were developed and tested at the grassroots level. The alternative Christiania community, the collective community movement, organic farmers and technical entrepreneurs experimented with organic farming, ecological housing and sustainable energy. The 1980s had many of these ideals and understandings of environmental and energy problems spread to broader segments of the population, which was amplified by the municipal local experiments with urban ecology, renewable energy, waste and resident democracy (Læssøe 2000, Holm/Stauning 2007).

² Brown/Vergragt (2008:112) label such experiments as 'bounded', to emphasise that they are bounded in terms of space and/or numbers (small) of actors involved and in time.

In the 1990s, new types of collective community settlements and urban environments for ordinary citizens emerged, based on more simple holistic ideas of self supply, social care, democracy and cheaper construction. The significant examples, where ecological materials and self constructors were at stake, are the Dyssekilde settlement in Torup, Hjortshøj Cooperative, Munksøgård in Roskilde and DR-Friland at Djursland. Other projects involved experiments on a private basis, sometimes with public support, for example building solar cells on the roof, using new materials of insulation, using natural paints and avoid PVC, etc., within the framework of existing buildings. These experiments were driven by socio-technical entrepreneurs, dedicated scientists, artisans, self-builders and small contractors in construction (see Marsh et al. 2000, Schmitz-Günther 2000).

A large number of support programs, campaigns, and experiments were initiated in the 1990's within an ecological modernization program regime, of the social democratic government supported by the Danish Socialist party. Accordingly we here saw a political landscape change that favored the interplay of new actors and networks in experimenting on housing technologies and settlements.

Since a new liberal government took over in 2001, the governance initiatives for locally and national opening for eco-housing movements experimentations were wiped out. Still, the self grown eco-villages and socio-green settlements have continued to be established, and low energy housing, renewable energy systems, ecological materials have become more stable technology systems among them.

National eco-energy construction related policies and programs

In general the Danish construction and housing sector has not adopted a transition program for more sustainable construction and dwellings, even though we have seen the before mentioned social movement's and political efforts of this kind since the 1970's. Jensen/Gram-Hanssen (2007:373) in their examination of ecological modernisation processes of construction in Denmark concludes that central policies of development of the construction sector have been based on a voluntary approach, but without convincing results in terms of co-ordinated efforts or ability to establish goals of sustainability. Progress in mainstream construction, in their opinion, has primarily been driven by top-down regulation (e.g. construction codes)

The 1970s energy crisis led to attempts in high-tech experiments in low energy consuming buildings and stop for open fireplace and panoramic windows. But the main impact was in the development of tougher standards for insulation in Danish building regulation, and new building styles which took account of energy consumption. In parallel, a few energy-saving products for use in dwellings were developed as the first generation of energy windows, energy saving light bulbs, etc. Accordingly, an early development track in the established construction sector was an adjustment to the requirements of energy conservation, as driven by innovation, research, standards and regulatory efforts (Gram-Hansen and Jensen 2005).

In the 1990s, an ecological modernization discourse and strategy (Holm/Stauning 2002, Holm et.al., 2007) included efforts to promote a wide range of regulatory actions, research and pilot projects, and developing methods to support eco-buildings (Jensen/Gram-Hanssen 2007). The Urban and Housing Ministry in 1995 launched an action plan for urban ecology with various initiatives to promote ecological construction. An R&D development and testing program for alternative insulation was launched in 1999 that gave impetus to a number of experimentation, testing and research.. There was a wide range of retrofitting projects, urban ecology experimental projects and buildings with different ecological features, often with a background in networking between the

public housing sector, retrofitting companies, municipalities, consultants and residents (Jensen et al 1998). Methods were developed to analyze and make visible the materials resource use and environmental costs in buildings and constructing: Life cycle analysis, environmental review, environmental labeling, energy measurements etc. Using new forms of governance of self-regulation, voluntary agreements and partnerships occurred; for example a so-called Product Panel for the construction sector (Construction Panel in 2001, see Remmen 2007), and a program for eco design partnerships in urban development. Finally, technical standards have been an instrument to promote eco-conversion of buildings, including voluntarily agreed green standards, including environmental assessment methods, the green certificate, green accounts, the Nordic Swan, energy and eco-labels. These measures were assessed, only to have had little impact on mainstream construction (Jensen and Gram-Hansen 2007).

Current trends in energy- and climate related politics and initiatives in construction

Part of the problem has been that the Danish construction industry the last decade has benefited from a booming construction market leaving few incentives to adopt new technologies and practices. The landscape development of economic crisis and political concern on the climate agenda, however, have changed this situation and have put the dominant regime of construction and housing under pressure:

- Low energy and passive houses and energy retrofitting of residential and public buildings are identified as new social demands and markets, as energy prizes rises and as consumers and the media recently (2008) is paying much more attention to climate change after a 7 year period of green backlash.
- Construction and housing is currently being enrolled into (national/EU) programs of climate adaptation, implying also a systemic perspective on housing and construction, where change of energy performance of houses is seen as a part of an overall transition to low carbon energy systems (e.g. Regeringen 2008).

Compared to a number of other European countries, the Danish construction industry has been a late starter in a transition to more sustainable construction. In particular in relation to the passive house concept, the construction material industry has been a laggard – and this lack of responsiveness has been visible.

In political agreements on housing, public institutions and the supported sector of cooperative societies were given a broad (undefined) obligation to undertake experimental projects, e.g. in energy and resource saving. Cooperative societies undertaking such projects had the option to apply for supplementary funding at the ‘Ministry of welfare’, but in general there were no central funding of experiments (Erhvervs- og byggestyrelsen, 2007:12). Accordingly, national Danish policies have not compensated for this inability of the market to bring forward new technologies and sustainable way of living

As part of the reorganisation of the real estate financing market, two private funding institutions (RealDania, Byggefonden Kuben) was created with the obligation to support project with construction and the build environment. These funds, in particular RealDania, have made funding of experimental projects of more sustainable construction and housing part of their policy. They have served as the main central funding institution of such projects since 2000³. Examples of the

³”. ... especially RealDania have entered the stage as a particularly powerful agent with the ability to instigate long term initiatives on a level, which by far exceeds the resources, which traditionally have been provided from the state to

activities of RealDania are local projects such as ‘Fremtidens parcelhus’ [The detached house of the future] (Municipality of Køge) and the new settlement of Stenløse Syd (see below).

Energy reduction has been the dominating path in the sectors redefinition of construction, a situation which has been reinforced by the climate agenda. The main regulatory instrument enacted by the national construction authorities on energy has been the Building Regulation laying down mandatory restrictions on the level of energy consumption. In the Building Regulation code of 2006 (BR06 2006), tighter limit values (25-30% reduction) were put into force by start of 2006, and the next steps were defined as class II (25 % further reduction) and Class I (50% further reduction) to be implemented in 2010 and 2015. These new classes – defined as the future general standard – have in recent years stimulated projects and construction firms to build class II and Class I settlements and houses. As an effect, the technology to build class I is demonstrated and documented in the Danish construction industry, and many firms now have class I construction programs. This has paved the way for suggestions on an earlier implementation of class I, but so far it has been rejected

The latest ‘Energy Agreement of 21. February 2008’ (Regeringen 2008) included the build environment as a main component. It orchestrated an inter-departmental project on identifying options for energy reduction in buildings including ministries of finance, of economic and business affairs, of climate and energy and of welfare and internal affairs. It was implemented in a broad partnership project including business, stakeholders and experts; the partnership concluded with a strategy document and a list of proposals and initiatives.

The strategy paper (Regeringen 2009) identified a range of initiatives. The stipulated effect of these initiatives is a 6-7 % reduction in energy consumption (compared to no action) in 2020, equivalent to 2% reduction in relation to the consumption in 2006. It takes no major steps, but revises or tightens up existing instruments. Experimental projects are going to be initiated, but no funding have yet been materialised. Main reason for this meagre outcome is that the dominant market approach has been maintained. An example: within refurbishing of existing buildings, only energy saving projects with high return on investment is made part of the action horizon of the strategy plan (Regeringen, 2009:14).. The economic crisis package for supporting the construction industry (a subsidy program) continues this policy line. Suggestions to reserve subsidies for energy saving were blocked internal in the governing coalition. The development exposes a dominant discourse of competitiveness and liberalisation, curbing transition programs (parallel to the situation of the ambitious Dutch energy transition program, Kern/Smith 2006).

Central national policy has not been the driving force for the transition of the Danish construction industry, however there have been some openings allowing local projects and initiatives to explore new paths of development. With no Danish state-driven lead market efforts on sustainable construction and housing, still a growing NGO and public interest in climate related issues as low energy consumption and renewable energy, municipalities and regional authorities are sought for as main actors in spurring a development path. In the remaining part we shall focus on local initiatives of the Danish development, taking particular interest in the role and opportunities of municipalities.

promote the achievement of goals laid down in the national policy of construction and housing.” (Erhvervs- og byggestyrelsen, 2007:23) [translated from Danish]

Municipalities

In the stipulated development of climate and energy programs, municipalities and regional authorities are likely to be ascribed new roles and obligations to drive and support climate and eco-adaptation. To some extent, approximately 1/10 out of the Danish municipalities already have taken on such roles. We have experienced a wide array of municipality strategies and programs on climate adjustments, on climate and eco-adaptation of housing and construction, ranging from local Agenda 21 programs of public involvement, to greenhouse gas accounting and indicator monitoring, abatement in public-private partnerships and local climate/CO₂ reduction programs.

As the building sector has become a major component in climate and energy policies and programs, the work with construction and housing has moved from a dull technical affair in the periphery to become a central policy field of Danish municipalities. It implies a political challenge to municipalities, both in terms of redefining policies on housing and construction, but also to establish the organisational set up and programs enabling cross-sectional integration and external partnerships. The situation at this stage (2009) can best be described as formative stage of experimentation and learning, imitating best practices and designing local adjusted programs.

Below, we are going to analyse a selected sample of these projects. At this stage we shall devote some effort to outline the conditions of municipalities, and how options and roles available to municipalities have developed in recent years.

Local governance culture and landscape for niche experimentation in construction and housing

In relation to the construction sector and urban ecology, local experimentation, ranging back to the late 1980'ties, has played a vital role. Following the government's action plan for 'Environment and Development' in 1988, the Ministry of the Environment initiated a 'Green Municipality' (*Grøn Kommune*) scheme. This scheme, which was scheduled between 1988 and 1992, created cross-sectoral experiments within the local public sectors in order to assess the institutional obstacles for a paradigmatic change and to experiment with new and less costly environmental innovation options. The experiences from these new practical-experimental initiatives influenced the Ministry of the Environment to form a strategy for sustainable development through local master-planning. The initiatives and networks formed an important basis for the subsequent initiation of LA21 projects in the municipalities, which have had a major influence on current municipal efforts of eco-energy, climate and renewable energy in housing and urban ecology. Of most importance is that the experiments revealed a new paradigmatic way for developing a separate path in environmental policy, where supporting bottom-up approaches formed new visions for local development and social mobilisation. New partners were found for a number of environmental areas that were not under the rules of environmental acts and regulations. They formed the basis for a change towards including citizens, NGOs and authorities in more comprehensive and constructive efforts to re-build cities and infrastructures. Resource accounting, quality of city-life and environmental goods became a positive focus, instead of protecting the environment through restrictions on activities

The tradition of a decentralised public administration and the consensus-seeking approach, together with a tradition of 'popular enlightenment' provided a favourable landscape for the implementation of local Agenda 21 in Denmark since 1994. In the same way, the local government's tradition, characterised by public participation in local planning together with a local environmental policy of integrated pollution-control measures (since 1991), has prepared a beneficial milieu among local authorities for the implementation of Rio's LA21 mandate. In addition, the multi-partisan tradition

that incorporates plural interest groups in the design and implementation of local policies, together with a comprehensive number of local, green ‘do-it-yourself’ experiments has made it relatively easier for LA21 officials to initiate LA21 projects with a considerable degree of public interest: During the mid 1990’ies a policy window for *value based* local politics under the LA21 umbrella was detected and developed in Denmark. Front-runner municipalities and counties that previously had been environmentally or socio-culturally active (e.g. in urban ecology projects) began to show interest in supporting combined social and green practical activism for the rebuilding of the community outside the global capital markets. This included, among other things: mobilising clients and citizens in making renewable energy utilities; developing energy-saving measures; renewing urban areas with ecology projects; reducing the amount of traffic, etc. These dispersed environmental activities served in both a horizontal process and by state initiatives to inspire a number of publicly launched initiatives in further initiation of LA21 projects in the municipalities.

The local Agenda 21 in Danish municipalities have more recently been transformed towards *private rebuilding efforts*: self generated networks among frontrunner municipalities (such as Dogme 2000), private consultancy based networks with supplementary training, and a division of labour on special focus areas: in-house greening, ecological construction projects, new organising in greater municipalities and regions with beginning far-sighted ends in municipal plan documents identified and called upon as actors in climate and energy programs. Besides, the local Agenda 21 efforts have become embedded in a predominant local politics culture of new public management, where cultural branding and benchmarking have become central modes of operating.

Current local and regional climate and energy politics

Branding and benchmarking programs of local authorities in profiles of energy effectiveness, CO₂ cuts, and climate adaptation have been manifold:

- Contracts with a energy consultancy institution (Elsparerådet) on a so-called curve breaking deal (kurveknækraftalen)
- Campaign programs as ‘energy municipalities of the year’ (Ministry of Climate and energy),
- Agreements with the largest eNGO The Danish Society for Nature Conservation on becoming a “Climate Municipality” with various obligations of measuring, lowering and campaigning.
- Voluntary networks of front runner municipalities benchmark, evaluate and communicate energy- and construction related issues – as the Dogme 2000/Green City network
- The 17 municipalities in region Zealand and the regional county is about to sign a climate policy programme, and will join in for the Covenant of Mayors programme – a formal commitment by the signatory city councils to go beyond the EU objectives in terms of CO₂ reduction, through the implementation of sustainable energy action plans with concrete measures.

Besides this, various efforts to integrate energy- and climate politics in Local planning measures is being developed; such as Plan 09 looking for measures to integrate climate concern and energy cuts in the local district spatial and strategic planning documents. In general this decentralisation has been unfunded. KL has suggested a mandatory elaboration of energy/CO₂ plans of municipalities, but required that such an initiative should be funded from the government. But a liberal tax stop policy has hindered the allocation of resources for this. Central projects have been marginal – only providing general tools (e.g. for mapping/monitoring of CO₂) and surveys (Barriererapporten) – see below.

Within the inter-municipality co-operation (KL) professional networks, addressing climate and energy issues have been set up. KL in general has adopted the climate and energy-agenda as one of its cornerstones.

Local business and ngo actors and eco-energy stakeholders are being included as partners in many of the climate and energy efforts and programmes of the municipalities. This shows a high variety in interaction schemes, ranging from professionalised institutions (Project Zero, Sønderborg) to participatory schemes (climate camp, Herning). Part of this public/private interaction and set-ups is an attempt to establish more room for manoeuvring, than laid down in 'legal framework of municipalities' [Kommunalfuldmagten] and the financial agreement with the Government.

Local projects

Despite hesitating substantial support from central government and competition with other local agendas, there have been a group of local energy and climate (CO₂-reduction) projects, involving in some extend construction and housing. They can be seen as part of a learning process (see below), also in terms of learning about capacities and barriers. A study in relation to local CO₂-reduction (Grontmij/Carl Bro 2009) has revealed that municipalities perceive major problems in the institutional and regulatory framework and the conditions offered by government. In relation to construction and housing, they point to

- Conflicts between establishment of new low-energy settlements and mandatory connection to district heating laid down in a national law of heat distribution
- Lack of instruments (e.g. a stronger building code) and financial room (e.g. low resources in the cooperative housing system (Landsbyggefonden) and limitations for local investments) hamper local refurbishing programs
- Problems of building local capacity for integrated reduction programs.

This includes huge differences in municipality practices, and experiences. In the remaining part we shall in greater detail examine specific experiences of projects/initiatives taken by front runner municipalities, or municipalities, which have been participating in projects driven by social entrepreneurship.

Case studies

The KIBS-project was set up to examine how Region Zealand could integrate climate adapted construction principles in regional business and environment development and stimulate municipal strategies of housing and construction. Within this framework, case studies of local experimental projects and municipality initiatives (both in Zealand and Denmark as such) were undertaken in the period 2007-09 (www.klimabyggeri.dk). In this first phase of the project the aim has been explorative; the objective was to elaborate a mapping of innovative activities in Denmark and Zealand in particular, complemented with more detailed studies of Danish projects of exceptional innovative characteristics. In the next phases the effects and learning processes in the mainstream development from the niches will be pursued. Firstly the integration of experimental construction activities in the municipality strategies, secondly the learning processes and dissemination of innovations and eco-principles in the construction sector.

The first and phase study revealed that the region housed self grown experimental settlements (eco-villages) and buildings, whereas public supported energy- and climate projects were few. The

construction sector in the region is dominated by a few large companies and a big number of very small companies, mostly service. The region can be characterised by the lack of construction material manufacturing companies as well as innovation and technical and architectural expertise. Although some of the municipalities are expanding and building new settlements due to the vicinity to Copenhagen, there has so far not been much focus on the construction sector, nor on sustainable innovations.

This situation can be expected to change in these years due to two important landscape changes:

- The awareness of climate changes and public awareness of renewable and unnecessary energy use. This has led many municipalities to formulate climate and CO₂ reduction policies, where also the CO₂-emissions from buildings are included.
- The financial crisis has developed with two main implications: the construction sector runs out of jobs as the market for new buildings is stagnated so the sector starts to look for new markets, e.g. energy refurbishing and CO₂-neutral and energy-saving installations in the existing building stock (an emergent market as the savings that may be obtained by energy-renovating old buildings become attractive for public- as well as for private building-owners).

When local municipalities support innovative construction or refurbishing projects, they hold the potential to combine objectives of environmental and climate strategies with business and development strategies. It may also contribute to a broader local development, as many of the regions municipalities are struggling for attracting well paid tax payers and creative business developments by unfolding new branding efforts in culture etc. and in spatial planning for interesting settlements. Here requirements of a more sustainable development of building technology may be an integrated part in such strategies.

Municipalities an niches of construction

The challenges of combining economic growth, attracting tax payers and handling climate issues have recently become important future political issues for the local communities. Experiences can be gained by looking at the way some front-runners among municipalities have responded to these new issues or have initiated niches for experiments and innovation. These experiences are of interest, both in term of how they have emerged and been organised, and in term of how they have succeeded to stage the experiments in a way, which enabled an integration of niche experiences in mainstream development and thereby influencing it in a more sustainable direction.

We have on a national scale identified different characteristics and a variety in types of niche initiation, besides various aims with niche development.

We can from our survey distinguish niches according to their divergence from main stream development, where some niches can be said to be radically different on many dimensions, others to be different in certain dimensions enabling them to be test-beds for single-issues. Others are only slightly different from mainstream, so to speak embedded in mainstream development, but allowing certain experiments. We can also distinguish niches according to which actors are initiators and how they create the niche. We have seen inhabitants, municipalities, involved companies or involved building owners/developers as initiators of the niches. Often a network of interested actors has cooperated in a project, supported by different funds (EU, private or state funding companies).

Finally we have seen different aims for the tests and innovations that are enabled by the niche: to create a better and more sustainable home, to test a certain technology, to influence producers and consumers, to influence urban planning, and to encourage citizens to live more sustainable.

In general terms, the local projects are specific configurations of technologies, actors and values shaping specific transition places for learning and dissemination. The cases chosen for further analysis have been selected to grasp diversity and give evidence of different kind of situated socio-technical experimentation and learning projects/processes, which have been part of the Danish development⁴. The niche types found for further investigations may be characterized as

1. *The radical niche experimentation*, where individuals or settlement groups try to create their homes from visions of a sustainable & democratic society – eco-villages (e.g. Smith 2007) (Munksøgård, Hallingelille, Fri og fro, Dyssekilde, Koyoto community - see www.klimabyggeri.dk). We will examine Hallingelille community as an example.
2. *The single-issue niche experimentation*, where one or more companies and/or other actors try to establish a real-life test bed and develop certain technologies – a BSTE (Brown/Vergragt 2008) (Hydrogen-supplied houses in Lolland and Herning, solar cells on rooftops and other spectacular technologies in many cities). H2-college in Herning is the example chosen.
3. *Local regulation embedded niches for experimentation* with more strict eco- and energy requirements in rules, plans and technical performance demands to materials, insulation, energy use, water supply etc. in order to put a pressure on the main stream development of business and technology (Middelfart municipality developing ESCO based program for retrofitting of family owned houses, Køge municipality developing construction requirements within the Scandinavian eco-label “the Swan”; Egedal municipality planning housing areas with a number of specific eco and energy requirements, see www.klimabyggeri.dk). Herfølge and Stenløse Syd are chosen examples.
4. *Market embedded niches for experimentation* stemming from large companies or housing co-operations. Companies, cooperative housing societies and public building owners may create niches for socio-technical experiments. (passive construction (Comfort houses/Skibet, Fruehøjgård in Herning, Ringgården in Århus, Skive municipality, Rockwool low energy house experiments). H2-college in Herning is an example.

The interesting question is how municipalities respond to the niches and what role they have played in learning, forming, supporting, upgrading and “translating” (Smith, 2007) the niches to common dwelling regimes..

Municipalities and niches in selected cases

When it comes to construction and housing there has been no tradition in municipalities to participate in niche development or to support experiments, except form a few urban ecology projects in the 1990’s. Therefore many self grown, experimental constructors can tell about many difficulties in getting permissions and agreements on their experiments from local authorities; the officials tend to regard them as extra trouble and see no benefits from their efforts. An early exception was Munksøgård, where Roskilde municipality offered much help, partly because they

⁴ They all represent new constructions. Refurbishing existing buildings, projects of alternative energy sources or intelligent net integration of dwellings etc. are all important projects of redefinition of construction and living practices, but they have not been addressed here.

had planned the whole area to be “green”, partly because they had interests in experimenting with new types of sewage systems.

Hallingelille – self grown radical niche and eco-village. The case of Hallingelille settlement shows how difficult it was for a group that wanted to create an eco-village to find a locality, where they could be accepted. They ended up buying farmland to create a village of only 20 families, where they had dreamed of 100. It was by accident in Ringsted, who had not invited them and had no special interest in their buildings, but were obliging and helpful to them. The village contains an abundance of experimental methods and materials and new ways of organising homes; among other a house for elderly people, built according to passive house requirements, with 8 small apartments and a big common kitchen and dining hall.



Hallingelille is an example of a radical niche; it is different from mainstream settlements on many dimensions, based upon a vision from Permaculture philosophy: common house for eating together, common farming area, biodegradable materials, waste water by root zone purification, non profit, simple living etc. The technology used in the 20 houses is partly elements from mainstream building, partly elements from “alternative building”, e.g. straw as material as the building envelope, hemp for insulation, crop, domes as architectural principle etc., where innovations are created by experiences from other eco-builders. Local materials supplier Egen Vinding & Datter have had an importance for the possibility to build along these technology paths.

The cases of Stenløse Syd and Herfølge are both examples of experimental districts, initiated by the municipality.

Herfølge – Eco labelling and experimenting for opening the market of standard single houses.

Herfølge district is deliberately planned as an area where architects and standard house constructors can create houses that fulfil a certain set of requirements, enacted in the Scandinavian Swan eco label. All houses must be different, the idea being that the area should be an exhibition of different standard houses fulfilling the requirements from the Swan label. The underlying strategy was to change the market conditions and the socio-technical regime of single family houses: On the one hand the Herfølge project aimed at developing a new Swan label with eco-house-principles and disseminating it among the public and thereby raise demand for Swan-labelled houses and building materials. On the other hand the idea was to put a pressure on constructors and suppliers to the building industry to be able to fulfil requirements, and thereby support changes in their methods and materials also for mainstream buildings. Third, it was also an idea of shaping a niche of eco houses that did not resemble the radical eco-village style of construction, thereby making it attractive to the majority of Danish citizens.



Køge municipality was able to set these requirements as they owned the land area. The idea was developed by the “Det grønne hus” (The green house), which is an independent organisation, supported by the municipality and working closely together, but owned by a number of local organisations. They did all the planning and organisation of the communication of the requirements to the construction sector, which were invited in for reflexive negotiations on eco construction options and for pre-approvals before a public tender. They arranged an exhibition of the incoming proposals and drawings, and they afterwards did a big job in giving advice and informing about the rules of the Swan label. The build houses serves as demonstration objects for the public, and thus it may be labelled a second order learning object.

Stenløse Syd- district planning with eco requirements. Stenløse Syd is a district in Egedal municipality consisting of up to 800 dwellings when fully built. This is also an area where the municipality made a set of eco- and energy requirements for new buildings of relevance to the local community: nature protection, low-energy building and solar heating systems on each building, rain water infiltration on-site, no use of PVC and pressure-creosoted wood to avoid waste problems. The idea was developed in the local Agenda-21 strategy and integrated in the municipality spatial district plan and was regarded an experiment for how to plan and build new districts of the community. The plans for nature, waste water, energy supply and street lamps (diode light) were integrated with the demands to the constructors and owners of the buildings. An immense search process of more sustainable technologies and constructions had taken place by staff members in the municipality, as explorative studies of how to enforce the green construction ideas in juridical binding contracts etc. The actual development of the areas required also deep technical discussions with constructors and entrepreneurs, encouraging companies to look for the alternative technical solutions that were at stake. There was an underlying wish to influence the building sector and the market, and especially to make a show case for normal families of the potentials in normal, but sustainable dwellings. But the main focus was to create a good and sustainable town district.



Stenløse Municipality made a major achievement in influencing the political and regulatory landscape, as they drafted a thorough proposal for enhancing eco construction practise in various ways whereby municipalities may impact construction in a more sustainable matter. By establishing an innovative and smart way for mandatory low energy requirements for new dwellings, on sites owned by Stenløse municipality, they were a frontrunner in showing the options. By lobbying and publishing reports on the issue all municipalities were given the option of drafting district plans, which operated with mandatory energy class demands (e.g. class II, see above) to houses build in the district.

For both Stenløse Syd and Herfølge, follow-up investigations of the people who moved into these houses have shown that they like the way their houses are built and value the energy-saving and nature-protecting aspects, but these aspects were not primary reasons for them to move in – some people didn't even know that these special requirements existed! (Quitza, 2009) So these niches cannot be said to differ from mainstream in all dimensions and represent so to speak niches close to or almost embedded in the mainstream development.

H2-college in Herning- passive house and hydrogen energy technology. The H2-college is an example of a single-issue niche as well as a market-driven niche according to the above mentioned differentiations. The Fruehøjgård Cooperative Housing Society has built a new section of their student apartments as a geothermal heated passive house standard construction. In the same complex they have built a student house with solar cells on the roof top and a hydrogen system in the cellar for provision of electricity. The hydrogen system shall store wind energy and convert it to electricity for the settlement. As a cooperative housing society they have the ability to make a coherent plan for a complex of buildings and use their ownership to create niches for different experiments. They have previously made experiments involving the users of institutions in the planning of a retrofitting of some of their buildings, and they have future plans for a retrofitting a residential building up to passive house standard. Thus, this building experiment is an element in a strategy for this housing society. Furthermore, they participate very actively in a new organisation for greener cooperative houses in order thereby to influence the whole cooperative housing sector.

They tried as part of the experiment to involve Danish standard house companies in developing elements for the passive house body; but nobody were able to do it at the price wanted and nobody were at that time interested in joining the experiment. They had to make the contract with German standard house builders; Germany has a widespread passive house tradition and experienced and industrialised – and cheap – constructors of building elements. The price of the elements were 40% cheaper than the Danish offers, and the whole building ended up 8% cheaper than similar normal buildings around, according to the director of Fruehøjgård. This experiment is thus aiming at a innovation dissemination effect on in the construction sector, in order to make it cheaper and serves also as an “icon” (Smith 2007).

The municipality of Herning has been a partner in the network who was engaged in the building experiment, not as an active part but as an adviser and helper in getting the necessary permissions and contacts etc. Herning has adopted a policy of Green Growth since early nineties, and they have a long history of creating networks and supporting initiatives from local actors. Furthermore, they have participated especially on the hydrogen project, as they have special interests in furthering initiatives on Hydrogen. Since 2002 they have actively worked for Herning as a Hydrogen city and supported networking and activities that could promote knowledge and innovations in hydrogen technology. They have granted the Hydrogen plant at H2-college an amount of money.

Although the municipality has not initiated this niche, they have obviously incorporated it in their own strategy for development of green technology and green institutions. The long tradition for establishing networks, supporting initiatives from local actors and looking for new opportunities and combining the interests of different actors has also been a support for Fruehøjgård: they have easily been able to find interested actors and create cooperation around their projects, especially around the hydrogen plant. Installation of the hydrogen plant can be said to be a single-issue niche,

but there is no single actor interested in producing it, as it is not a mature technology. Therefore it can only be realised by cooperation among a network of actors that are interested in it.

Thus Herning is an example of a municipality who actively practises green niche management as an incorporated element in their development strategy. The way they do it, can be characterised as a kind of social entrepreneurship: they contribute to a local cultural identity as a Green city, they facilitate networking among local actors, they support specific trajectories and try to create niches for their development (hydrogen cars, hydrogen exhibition and development facilities, hydrogen network and domestic hydrogen systems), and they support other local green activities (climate-village, green city centre etc).

Discussion

The 4 cases represent different niche types and different aims with the niche experiments, but also different ways of niche management and strategic incorporation in a general strategy of the municipality or involved actors.

	Type	Initiator	Aim	Municipal Strategy	Deliberate regime targeting
Hallingelille /Ringsted	Radical self	Residents	Eco niche development	Non	Eco-villages to be dispersed by but as niches
Herfølge /Køge	Local reg. embedded new energy Standards	Municipal Agenda 21	Market & supplier influence, show case or icon	Part of local A.21 strategy,	Market changes by new eco label, cognitive concepts
Stenløse Syd/Egedal	Local reg. embedded Eco energy Standards	Municipal Agenda 21	Market & supplier influence, open for new type of district planning	Spatial district planning and local A.21 strategy	Market changes by pushing suppliers, spatial planning rules & cognitive concepts
H2-college / Herning	Market embedded, H2 and passive issues	Cooperative housing company	Technology dissemination and Innovation	Assisted by business and green innovation politics	Making a showcase for clean energy supply and pushing for industrial passive house elements

The differences seem to be founded in the local conditions and opportunities and the way a green strategy fits in with the local conditions.

History and capacities in the municipality appears to be important factors for green strategies and niche development. The actively involved municipalities have had a record of very active Agenda-21 coordinators. Two of the cities have a long tradition of green activities from the 90'ies and forward (Køge and Herning). Herning and Egedal/Stenløse has integrated the Agenda-21-activities in the administration and has gained a role of entrepreneurship among the local actors. For Herning it was part of its normal strategy to get involved in the H2-college building. Køge has kept the Agenda-21 activities outside the municipal administration so the ordinary administration was not much influenced by the experiments. Egedal has had Agenda-21 activities as part of the spatial planning politics and administration for several years. Thus the district plan and initiatives for

Stenløse Syd was founded in the normal administrative work of the municipality and could be integrated in general planning and to some extent in practices in related departments.

The local sectoral context, in term of structure and innovativeness of the construction sector, has conditioned the projects. In Herning innovation and clean technology is relevant for many local actors – from wind power companies, energy suppliers to technical schools and bicycle shops. And Herning is a central city for many types of producers, especially machine factories, and small and middle-sized mechanical and electrical producers. Ringsted, Køge and Egedal are all situated at Zealand, where the contact with local construction and housing professionals is not so obvious and there are not as many producers.

Differences in the market for creative houses seem to be important, too. In the cities close to Copenhagen more people are able to pay for expensive houses and more people are interested in ecology and innovative houses than in Herning. Therefore, areas with good facilities, nice surroundings, sound and creative buildings as Hallingelille and Stenløse Syd can find inhabitants, willing to pay the price (Stenløse Syd) or accept the radicality (Hallingelille). Herfølge is situated in a less attractive locality and has in the wake of the crisis experienced problems in selling the houses.

Many other conditions may be important for the involvement of the municipality. But instead of seeing the different conditions as barriers, the policies could take the opposite view: to investigate the local conditions in order to find resources: which conditions can be resources for niche projects of sustainable housing? Do we have certain companies that might be interested? Local energy resources? Creative inhabitants?

The municipality of Odsherred have been a show case for another kind of responsive opening to an eco-village named 'Fri og Fro'. Here the municipality have been inviting members of the community organisation for drafting spatial planning and technical standards and welcomed the community as bringing new dynamics to the region. Roskilde municipality has step by step also played an open role in dialogue with the eco-village Munksøgaard in the period 1996-2000, whereby new approaches to on-site sanitation, water and waste handling, renewable energy supply, and smart integration of nature's space and biodiversity were learned. The municipality have adopted many of the sustainability principles from Munksøgaard into the planning of larger community building sites, e.g. on social cohesion, waste handling, energy supply and energy saving measures.

In these years the municipalities start to respond to the challenges from climate changes and the financial crisis by formulating climate plans and making plans for retrofitting their own buildings and the city as a whole. Many municipalities have taken interesting steps towards formulating strategies including buildings and experiments with new technologies. The front runners seem to compete on ideas for CO₂-reduction, that might give a good brand for the municipality (Climate community, Green growth, Green Cities, energy city etc.). There is also a willingness to learn from others and to give own experiences to others, in networks, at meetings etc.

To create niches and to support local niche-ideas by social entrepreneurship in specific local transition places, can be an important way to support innovation processes towards more sustainable buildings. In these years there are abundant options for creative policies to integrate

efforts on housing, building technology, innovative companies, new technology, city development, CO₂-reduction and climate adaptation in other aspects in holistic niche projects.

Final remarks

In the paper we have described a specific Danish development, where lack of central national initiatives has made the development of sustainable solutions a process led by emerging local projects. Despite this specific context, it is assessed that the observed dynamics have a wider bearing.

Transition programs have to devote attention to local projects and initiatives, and as part of this examine and elaborate on possible roles of local policy agents as municipalities and regional authorities. Construction is a special case, where this becomes an evident task. But it would equally apply to other sectors such as mobility and energy. Transition agendas (e.g. Kemp/Loorbach 2006) often are conceptualised as central staged projects/processes; multi level governance models addressing levels of strategies, tactics (...) and staged experimental activities. Local situated processes are involved (ibid), but the tendency is a focus is transition arenas, processes and actors on the sectoral level. Here, and as Adrian Smith has started with (Smith, 2007) further studies of local transition places may turn out to be a fruitful approach.

In this paper, we have exploited transition roles and opportunities of municipalities by focusing on them as privileged agents in the formation of local situated socio-technical experimental projects - both as possible drivers, and as part of the institutional and path-preserving set up of the dominant regime. However, municipalities can in other ways influence on transition processes, e.g. by being part of the selection environment (as often is the case, also in construction), that includes all such activities as green procurement, energy planning and management, and projecting of public buildings.

In a policy perspective, having municipalities as transition agents would require both changed perceptions and competences/capacities of municipalities. The range and challenge of such a changed perception and practice has been indicated by the case of Stenløse Syd. Taking the role of transition agent would compete with other and more dominant agendas of municipalities.

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