How Energy Efficiency Fails in the Building Industry

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Abstract

This paper examines how energy efficiency fails in the building industry based on many years of research into the integration of energy efficiency in the construction of buildings and sustainable architecture in Norway. It argues that energy-efficient construction has been seriously restrained by three interrelated problems: (1) deficiencies in public policy to stimulate energy efficiency, (2) limited governmental efforts to regulate the building industry, and (3) a conservative building industry. The paper concludes that innovation and implementation of new, energy-efficient technologies in the building industry requires new policies, better regulations and reformed practices in the industry itself.

Keywords:

Energy efficiency, building industry, energy policy

Introduction

Modern life is lived in and in-between buildings. Buildings form the confines of work and leisure, eating and sleeping, passion and boredom. Thus, the design of buildings is important, functionally as well as aesthetically. In addition, buildings are durable; most structures are used for a long time, some even for several hundred years. Buildings can be certainly demolished, but this is expensive. Therefore, building decisions have long-term consequences, particularly for the environment and the consumption of energy.

In this article, our focal point is the social and political management of the construction of energy efficiency of buildings. Buildings represent around 40 per cent of onshore energy usage. During the last 30 years, the building sector has increased its energy consumption more than any other sector in Norway. In the OECD area, the building sector's share of total energy consumption remains high, between 25 and 40 per cent, and the building sector's share of total energy consumption is growing (OECD 2003). Thus, while Norway is on the high end, it does not differ substantially from the general OECD pattern. The Norwegian experience can therefore serve as a case study with wider European implications.

Obviously, many technological solutions are available to help make buildings much more energy efficient than they are today. Buildings may even become energy producers. However, there seems to be considerable pessimism about whether these opportunities will be harnessed. One obvious factor underlying this pessimism is that building development in Norway seems to be going in the wrong direction: statistics show that new office buildings are actually less efficient than old ones. For example, the relative energy use in buildings constructed before 1931 is lower than in those built after 1997.[1] What features have produced this development? Why do energy efficiency policies seem to fail in the building industry?

We must remember that the sector under scrutiny is large, at least relatively speaking. Norway is a small country with 4.7 million inhabitants; still, there are about 3.7 million buildings in the country. This includes 2.2 million private homes, 0.4 million holiday homes and 1.1 million office and industrial buildings. The building and construction industry has a capital turnover of about 230 billion Norwegian kroner, a little less than € 30 billion, and it employs more than 140.000 persons.[2] In relative terms, the number of buildings and the size of the building and construction industry in Norway are equivalent to those in other OECD countries.

For more than three decades, the Norwegian government has used varying strategies to promote energy efficiency in building design. As suggested above, the achievements may at best be described as modest. Why is that so? To begin with, the issue of energy efficiency of buildings needs to be understood as related to a complex sociotechnical system where diverse actors act at the intersection of industry and market structures, institutions of governance, innovation systems, evaluation practises, supplier-user chains, designer and engineering practises, etc. Thus, there are many potential sources of failure, and the challenges in providing a comprehensive analysis of the situation are formidable.

In this article, we have chosen to focus on issues related to the implementation of the concept as well as the technologies of energy efficiency, understanding implementation as an assemblage of policy-making, market processes, and professional and industrial practices. Our approach is based on the observation that available technologies and architectural and engineering knowledge allows construction of buildings that are highly energy efficient (Andresen et al. 2007). Moreover, we believe that the supply side deserves the most attention since it is easier to achieve energy efficiency by influencing and regulating a limited number of supply side actors rather than by controlling a huge variety of demand side constituencies. Our research has identified three main obstacles to construction of energy-efficient buildings: (1) deficiencies in public policies to stimulate energy efficiency, (2) restrained governmental efforts to regulate the building industry, and (3) conservative practices in the building industry. In the following sections, we will analyse each of these obstacles to provide a more detailed understanding of why the obstacles exist and how they might be overcome.

The analysis is based on 15 years of research into energy efficiency and buildings and a series of case studies related to sustainable architecture (Ryghaug 2003), HVAC engineers (Hubak 1998), user involvement in the design of office buildings (Bye 2008), the application of environmental criteria in building design (Moe 2006) and energy efficiency in Norwegian energy policy (Sørensen 2007). All together, the analysis is based on interviews with some 150 actors in the Norwegian building sector, including architects, consulting engineers, suppliers, policy-makers, building owners, and users. In addition, documents related to energy policy and planning and construction of buildings (including drawings) have been analysed. Through long-term research collaboration with engineers and architects, we have also had ample opportunity to observe and learn about challenges related to the development and implementation of new technologies.

We will start out by discussing some theoretical issues related to the implementation of new ideas and new technologies in the building industry.

We will then analyse some general Norwegian efforts at energy efficiency governance, before moving on to more particular efforts directed at the building industry. Finally, we will explore features of the building industry and its practices that seem to inhibit the increase in energy standards that are needed, not the least to combat global warming.

Implementing new technologies

The building industry seems to offer some unique characteristics and barriers to improvement. According to OECD (2003, ch. 4), this includes the long-lived nature of its products, the extended supply chain, discrepancies between owners and users, the spatially fixed nature of products and production processes, the heterogeneity of buildings, high capital costs, and dominance by a large number of small firms. This contributes to the fact that it has proven difficult to establish effective policy measures to achieve greater energy efficiency. Manseau and Seaden (2001) summarise a large international review of public policies to support innovation in construction by noting that "[i]t appears that most of currently available public policy instruments in support of innovation have not been of great use to the construction industry" (394).

Guy and Shove (2000) note how energy efficiency policies and researchers working with energy efficiency have tended to view 'non-technical' aspects of energy performance as obstacles and barriers to technological progress. However, they argue that there is a need to consider in a more concrete fashion the way that the building industry actually works:

> As our analysis of the contexts of decision-making and the realities of building practice suggest, accepted theories of technical change fail to take into account the routine complexities of social action (…). [T]echincal change is a social process and … more or less energy-efficient choices are made in response to changing opportunities and pressures. It is not simply a question of transferring technologies upon people. Instead, knowledgeable actors creatively adopt and adapt strategies and practices that suit their changing circumstances. Sometimes these favour energy efficiency, sometimes not (Guy and Shove 2000: 133).

This line of thought resonates with Latour's (1987) arguments in his presentation of the translation model of innovation. He criticises the perception of the spreading of innovations as a process where stable objects are transferred from its centre of development to arenas of use. In contrast, the translation model characterizes the innovation process as shaped by the strategies of the innovating actors and their ability to convince potential users that they may gain from the new technology. Thus, from this perspective, to get innovations implemented is an interactive process between innovators and users – a process that, if successful, may reshape relationships in a field like the building industry in fundamental ways. This reshaping may involve redefinitions of actors' roles and relations, introduction of new work practices, new goals and standards, etc. The scope of actual changes will of course vary and has to be studied by analysing concrete instances.

Like Guy and Shove (2000), we believe that the translation model will provide an adequate point of departure for the analysis of innovation with respect to energy efficiency, also because this model allows us to deal with energy efficiency as an idea with considerable interpretative flexibility, meaning that there are several ways of understanding and acting on the phenomenon. As we shall see, the concept of interpretative flexibility is particularly pertinent when we turn to the analysis of Norwegian policy to stimulate energy efficiency.

A fuzzy formula: Energy efficiency in the iron cage of economics

In principle, the building industry may be affected by general energy efficiency measures as well as instruments tailored to the industry. We will begin by looking at the anatomy of the Norwegian policy for increased energy efficiency and conservation, as well as some of its deficiencies with respect to achieving increased energy standards of buildings.

Arguably, the Norwegian approach to energy efficiency has been shaped by the country's relatively rich supply of energy (Aune 2007, Sørensen 2007). Already in the wake of the so-called oil crisis in 1973, the reformed government policy was based on the premise that to save energy was not an end in itself; rather, the aim was to improve the profitability of the production and use of energy. The result was that policy-makers framed the energy efficiency issue to emphasize economic features rather than energy conservation: energy efficiency measures should be profitable.[3]

Thus, the dominant energy efficiency policy in Norway is primarily based on the idea that energy should be used in an economically optimal way. This formula was represented in the name given to the policy – 'energy-economizing' (in Norwegian: 'Energiøkonomisering', abbreviated ENØK). The Norwegian abbreviation ENØK was used in most policy contexts as the signifier of energy efficiency efforts from 1980 and onwards; thus, we will use ENØK to name the policy, rather than a clumsy and not very meaningful English translation.

The official definition of ENØK emphasises the following criteria:

- Utilisation of the energy that Norway produces and distributes in the most effective way within accepted frames of profitability.
- Reduction of costs when trading one energy carrier for another (substitution).
- Unaltered or lower costs when employing energy with lower quality.[4]

In practice, ENØK has been interpreted in two ways: as a governmental policy proposing incentives to instigate energy efficiency actions and as proposed strategy to be employed by relevant actors to increase energy efficiency within their domain. With respect to the building industry, ENØK has represented a governmental call to be concerned with energy efficiency as well as some incentives to stimulate such activities, in addition to being an overall strategy for doing energy efficiency.. However, as indicated by the above definition, the content of ENØK was ambiguous as a government policy as well as a strategy to be pursued by downstream actors. This was due to the underlying compromise between economists' and engineers' different conceptions of what energy efficiency meant and how it should be perceived, whether economic instruments or technological change should be the main point of departure for policy-making, and how energy savings should be compared to economic savings (Sørensen 2007).

Norway has emphasized the economically optimal uses of energy in ENØK more than public energy conservation efforts have in most other countries. Still, the Norwegian outcome of energy efficiency policy seems to not be very different from that of other countries (Geller at al. 2006). So, how did ENØK affect the building industry? How was the concept appropriated?

To begin with, the implication of the definition of ENØK is that energy efficiency becomes an ambiguous activity because it is not possible to optimise energy use and energy costs at the same time. This made ENØK into a strategic formula that could be interpreted to mean that one should look for ways either to lower energy costs or to save energy. In practice, the first interpretation has dominated among policy-makers, placing energy efficiency so-to-speak in the iron cage of economics. However, as indicated above, a competing engineering interpretation has also focused policies on development and implementation of technologies to achieve energy conservation (Sørensen 2007).

Within the building industry, the ENØK formula of the policy-makers has not been diffused as intended. Rather, what has been appropriated is a vague notion that one should be concerned about energy, at best a motivation to design for increased energy efficiency but without increasing the construction costs (Hubak 1998, Moe 2006). Hubak (1998) observed examples of this in her interviews with heating and ventilation (HVAC) engineers who claimed they were quite eager to implement ENØK. This meant that they tried to suggest technological solutions that would contribute to energy conservation without adding too much to building costs, which was according to their interpretation of ENØK. However, they complained that it was difficult to get such proposals accepted. The HVAC engineers said that, while they could provide fairly accurate assessments of costs, they lacked the necessary information to supply robust calculations of future economic gains for the builder or owner. This made it difficult to produce scenarios that were sufficiently attractive to other actors. Strictly speaking, ENØK could not be implemented because it was not possible for the actors involved to calculate what would be economically optimal solutions.

This problem is closely related to the so-called tenant-owner dilemma (Lovell 2005). Builders and building owners tend not to be so concerned with future energy cost, energy use and related aspects of indoor environment because they will not use the building themselves (Hubak 1998, Ryghaug 2003). Many build as a part of real estate development or to lease the premises afterwards. When they want to reduce economic risks, the obvious strategy is to minimize building costs. As noted above, the costs of achieving a higher energy standard are very noticeable, while the gains are unclear. To make matters worse, someone else will normally realize the savings. In addition, the energy standard weighs less in the stipulation of rent and the assessment of attraction than other qualities of the building, like location, design, accessibility, and size (Lovell 2005).

To sum up, we have argued that the dominant energy efficiency policy in Norway – ENØK – only marginally has affected practices in the building industry. In part, this is due to the underlying – and misleading – idea that actors should undertake so-to-speak a co-optimization of energy efficiency and economic outcome in their decision-making. As we have seen, building industry actors do not engage in such calculations, but some – like the HVAC engineers who want to promote energy conservation – find that their promotion fail because they lack the information they need to provide robust estimates of future gains from investing in a higher energy standard. Moreover, this problem is reinforced by the tenant-owner dilemma. This failure of a general policy effort raises the question about the nature of and effects of instruments tailored to the building industry. What kind of such efforts may be observed, and how may we rate their success?

Achieving energy efficiency through tailored governance?

For obvious reasons, one would usually expect tailored policy measures to be more effective than general instruments. Nevertheless, Norwegian authorities have focused primarily on the general principles of ENØK, demonstrating a strong belief that relevant actors, for example in the building industry, will react according to conventional economic theory to price signals and other financial instruments, thus deciding to increase energy standards when prices increase. As we have seen, this assumption is flawed. Many, probably most, buildings have been planned without much concern for energy efficiency at all and the long-term economic significance of energy-related decisions has been neglected (Hubak 1998). As we have seen, information about future gains is quite imperfect even if energy costs may be estimated, the tenant-owner dilemma makes investments in energy efficiency unattractive to builders, and energy costs constitute a relatively small part of the total rent. To make matters worse, long-term price increases have been clouded by unpredictable fluctuations.

Consequently, decisions about energy standards have in most cases been made on the basis of the building codes, which function both as minimum and maximum requirements (Hubak 1998, Moe 2006, Ryghaug 2003). Many interviewees perceived this to be a major problem. For example, a former President of the Norwegian Architect Association argued that the building codes did not provide effective incentives to reduce energy consumption:

> I believe all actors involved are very good at finding exactly what the building codes require. There is no particular drive to do anything [to increase energy efficiency] out of self-interest, and I don't think you will get any further until one starts making stricter demands. And proposes sanctions. I think it is as primitive as that.[5]

Interviewees from property development firms maintained that they usually stuck to the building codes and the required energy standards. Even the Directorate of Public Construction and Property (Statsbygg), the Norwegian government's property manager, pursues the same practice (Hubak 1998:74).

A public energy agency Enova was established in 2001 to be the main government institutions dedicated to offer counselling, information and motivation activities to promote sustainable energy standards in buildings in Norway. Enova personnel have also complained about the building codes. When asked about building codes as instrument of regulating energy consumption, one of the employees of Enova whom we interviewed in 2003, had a good laugh. He stated that the current building codes at that time did not safeguard good energy standards in building. Actually, he found the codes unclear and inadequate and claimed that:

> I personally, have a hypothesis that buildings constructed after 1997, when new building codes were implemented, are more energy demanding than those that were built during the previous decade.[6]

New national building codes were introduced in 2007, effective July 1, 2007.[7] The main objective was to reduce the demand for energy from new houses and buildings by 30 per cent.[8] The new codes included stricter energy standards and new methods to calculate energy demands. Given level of criticism outlined above, it may seem surprising that it took a decade to revise them. Why the process of change was so long-winding is unclear, but the slowness is a strong indication that energy policy actors did not give much attention to such direct regulations. Of course, the revision also involved a complex balancing of diverging points of view from interested parties, but amendments could have been limited to achieve better energy standards.

However, the pace of change seems to quicken. In 2008, the Norwegian government announced greater efforts to change energy-related practices in the design of buildings. This included a proposed ban on oil heaters in new buildings and a resolution that building codes should be revised every five years. The government also has recommended increased economic support to promote energy efficiency actions, including R&D and demonstration projects. The renewed effort was announced as part of Norway's plan of action to address global warming.[9]

Still, it remains to be seen to what extent these measures actually will work, since most of the proposed instruments, like R&D and demonstration projects, actually were suggested in government White Papers throughout the 1980s and 1990s (Sørensen 2007). The fact remains that the building sector, at least until now, has received strikingly little attention from energy policy actors. The argument has been that policy-makers should abstain from promoting particular technologies and designs, giving the building industry autonomy in responding to the main goals of energy efficiency policy. Also, the sector is characterised by an extensive use of standards and the information provided by the building details sheets of the Norwegian building research institute (NBI). Even building codes include mostly functional requirements and thereby allow a relatively large autonomy in the actual design of technical installations (Hubak 1998: 5).

This situation, emphasising autonomy, tends to foster heterogeneous and idiosyncratic local practices resulting from insufficient standardisation. Moe (2006) shows that there are no *established* standards for measuring the energy efficiency of a building, let alone the degree of environmental soundness in the Norwegian building industry. Certainly, the energy consumption of buildings can be measured, and there are some consultant systems available, such as 'Økoprofil' [Eco Profile]. However, none of these assessment methods has achieved any official status in the Norwegian building industry. Actually, contractors who want to build in a sustainable way may choose what criteria for environmentally soundness they want to apply. Consequently, sustainability, including energy efficiency, is unambiguously shaped by local interpretations, priorities and interests, even when a high energy standard is made into an important design criterion. This leads to less efficient implementation of sustainability, since local builders often seem to prioritise in an idiosyncratic manner, using incidental criteria of environmental friendliness of buildings (Moe 2006).

Moreover, energy technologies appear frequently to be selected on the basis of how strongly they *symbolise* energy efficiency, not from calculations to identify optimal solutions of energy consumption (Moe 2006). For example, heat pumps were occasionally selected as part of the energy supply system because of their iconic status as environmentally friendly, even when another technology would have provided greater energy efficiency.

Overall, our studies suggest clearly that energy policy makers have assumed that the economic incentives provided by the relative prices of energy and the overall ENØK message to be concern about energy efficiency should be sufficient to make building industry actors prioritize energy standards of buildings. Policy makers seem to have believed that ENØK policies would translate themselves. As we have seen, this assumption has been wrong (Hubak 1998, Ryghaug 2003, Moe 2006, Sørensen 2007). When building codes were made stricter in 2007, this was mainly due to engineering concerns about a conservation potential not realized. Besides this effort, the government has left to the building industry to take care of these issues. The measures proposed in 2008 may help improve the situation, but policy-makers seem to retain the belief that the industry should have large autonomy to take on the challenges on its own premises. To what extent will the industry really use this autonomy to provide the expected greater energy standards of new buildings? What conditions to translate energy efficiency policies into actual construction practice are actually offered by the existing building actor networks?

Translation challenges of a conservative industry

The building and construction industry in Norway has a low level of investment in R&D and innovation. Thus, it seems obvious to ask whether the industry's innovation falls outside the outside the scope of official statistics or if the industry is not very concerned with innovation. Our evidence points fairly consistently in the latter direction, and this observation has also been made in other studies (Guy and Shove 2000, Manseau and Seaden 2001). What features of the building industry produce such a conservative culture? What translation challenges exists?

A number of institutional characteristics seem to generate conservatism and a lack of priority given to sustainability and energy efficiency in buildings, thus blocking the translation of energy efficiency policies into attractive avenues of action. First, the emphasis on short-term cost efficiency and the high pace in the design process result in an extensive re-use of solutions. It is therefore much more important for the firms to have an overview of earlier designs and solutions so that these can be copied than to have someone to engage with innovation and new technologies. An HVAC consultant articulated this observation in the following way:

> Today, ENØK is more about the traditional reasoning around heat recovery units or type of recovery to use in the ventilation system. Apart from that only very traditional solutions are applied. (…) It is convenient to pull out a solution from the drawer. Then you know what you are doing. You go safely.[10]

Second, the conditions for transfer of new knowledge from research institutions are poor. The building and construction industry in Norway is large and complex and dominated by small and medium-sized enterprises (apart from a few large actors) that cooperate on the design and construction of buildings. As already noted, the innovation activity is modest. In Norway, the building industry scores among the lowest on investments in R&D and innovation activity.[11] This seems to be an international phenomenon. Several studies complain about innovation being slow and lacking in engagement (see, e.g., van Bueren and Priemus 2002, Harty 2005, van Bueren and de Jong 2007). Innovation is to a large extent driven by external suppliers of equipment and tools (Hubak 1998, Harty 2005).

Almost no Norwegian companies in the building industry have separate units responsible for R&D or innovation (Hubak 1998). Thus, there is a lack of people that are engaged in and have the competence required for successful knowledge transfer. As a consequence, the contact with relevant research institutions is weak. This is in accordance with the observations from other countries made by Guy and Shove (2000). In turn, this leads to a lack of emphasis on research in the building trade, because such priorities demand that the industry play an active role in influencing national research policy. In addition, current Norwegian research policy demands that companies put their own funds or resources into R&D to get public support and funding. This represents a negative circle that seriously hampers innovation activity.

The third factor is the contract system and the legal practises in the building industry. Most building projects are subject to juridical contracts that regulate the relationship between a great number of actors regarding remuneration, deliverables, time of delivery, etc.[12] Current legal practises in the building industry in reality demand that all essential planning, including the specification of requirements and criteria for acceptance, happen in the first stage of the building process. In this early phase, actors enter into contracts thereby creating a statutory freezing of the technological quality of the building. Changes occurring after contracts have been signed may result in substantial cost increases because changes cannot be implemented without renegotiation of contracts, according to the current legal regime of the industry. The line of thought underlying this practise is the so-called ‘waterfall philosophy’ that presupposes that projects go through stages in a sequential order, where the first stage involves final planning of the project. This philosophy of project management, embedded in the contract system and shaping the building process, is perceived as a hindrance by many, not the least because initial plans usually are made without broad involvement of the actors in the construction process:

> If we have had the chance to participate earlier in the project, almost from when the first line was drawn, we could have exercised much more influence. After all it is the totality that we are after. We do not want to replace it with technology, but we want to work together with the building in order to get the best possible indoor environment.[13]

The consequence of the established and entrenched contract system is that any innovative thinking must happen in the first stage of design and engineering. This is not conducive to constructing sustainable buildings, since such alternative constructions often require novel approaches and innovation. In addition, waterfall thinking inhibits the utilisation of experiences gained through the project. In this way, there is no doubt that the contract system hampers innovation in construction. This seems to be a considerably larger problem in the building industry than in most other industries.

Probably, the challenges are made even greater by the currently popular form of concerted engineering, procurement and construction in which the building owner only deals with one actor, the property developer. This arrangement is said to provide good cost control (Hubak 1998), but it gives consulting engineers and architects much less discretion to consider alternative, more sustainable solutions and discuss this with those who normally have the final saying in a building project (Hubak 1998, Ryghaug 2003). One property developer gave the following reason why he preferred this contract practise and the consequent role energy consultants were given:

> I gladly use contracting firms as consultants, also on the tender side, because then I get a simple and straightforward answer … if you engage consultants, it becomes a thick book [laughter] so they often help us to make the tender documents. Then we invite tenders, and broadly speaking we like to have concerted engineering, procurement and construction, which means that we get a price from the contractor, which in his turn has his subcontractors. This way we have one single party with which we sign the contract and who is responsible for the whole building process. And he assigns the architect and the whole package. So then the responsibility to complete the building and the related claims are in the hands of one single actor.[14]

Such contract practises increase the distance between building owner and end users and, according to our interviewees, this complicates the introduction of sustainability issues into the design process. This lack of communication impedes the translation of ENØK to enrol and align actors in a network to do energy efficiency work.

A fourth problem is in the communication among the actors in building projects. A building project is a joint venture where a diversity of actors and professions participate and may influence the energy standard of the resulting building. Potentially, there are many conflicting interests in the building industry because of a diversity of professional traditions, epistemic paradigms, and competences:

> If it [the design of buildings] is filled with conflicts, oh yes, damn it is (…) But there are many things that must be put in place when designing buildings. You do not any longer do it on the site; everything should be planned, measured. So to coordinate in between the professions is a huge task in rather complicated building projects.[15]

In addition, there are cultural conflicts between the professions:

> We [architects] constantly hear the joke about engineers' view of the architect, that 'architects are ok as long as they do not practise.' It has always been a conflict there. And there is a huge conflict between architects and those working on building sites. There, they think that what architects know is just rubbish.[16]

Moreover, communication is complicated by the linguistic diversity among the professions and differences in the way they make representations of buildings (Moe 2006, Ryghaug 2003). An example is the way buildings are visualised. Architects put significant effort into aesthetic visualisations of buildings through drawings, sketches, models and pictures. Engineers also do visualisations, but they are technical drawings used as a point of departure to calculate, for example, heat flows, ventilation needs, constructional load bearing capacity, etc. (Moe 2006).

Architects have traditionally been given the responsibility for co-ordinating the multitude of professions involved (Hubak 1998), which obviously demands a broad outlook and good interdisciplinary communication skills. A widespread perception among architects is fairly self-gratulatory in this respect:

> The architect is the only person in the project with a complete overview. The architect knows the building from a completely different angle than a consulting engineer, because the design process is divided into small parts, so that we draw first and then send the drawings around, and then they [consulting engineers and other actors in the process] do their parts, and we get the drawings back.[17]

Consequently, the lack of successful appropriation of ENØK in the building industry is also due to architects' resistance to the formula. Most architects seem to privilege aesthetics, and they have little knowledge about energy efficiency. The dominant architect discourse has been fundamentally shaped by aesthetical concerns, with form, function and shape as the core issues (Ryghaug 2005). To make matters worse, Norwegian architects tend to find technological measures to achieve energy efficiency to be aesthetically unsatisfactory or even ugly (Ryghaug 2003). The design of ventilation systems is a recurrent example that architects and HVAC engineers struggle with.

In general, Norwegian architects have paid scant attention to sustainable design. Most of them seem not to have recognized sustainability as an aspect that they should relate to, and to an even lesser degree as something they should integrate into their practice. According to our research, most architects primarily want to design according to the dominant aesthetics of the profession. A prominent person in the Norwegian design community commented that 'To most architects it doesn't matter if one recycles and stores the heat if the building doesn't look good'.[18] The underlying idea seems to be that 'Architects should be mostly preoccupied with architecture and design'.[19]

Actually, sustainable architecture has for a long time been associated with fringe groups and a particular building image that breaks with the modernist expressions preferred by most practising architects; thus, this profession has not taken the lead in promoting and translating energy efficiency, rather the opposite. Sustainable design has been ‘domesticated’ (Sørensen 2005) and integrated into architectural practice by a minority only. The majority of Norwegian architects have resisted making sustainability a centrepiece of their profession. Thus, ENØK has been externalised in the dominant framing of architecture. This is another example that shows how policy-makers have failed to translate ENØK and make the underlying ideas attractive to the building industry. The combination of architects’ role as coordinators of building projects and their unsupportive position towards energy efficiency measures represent the fifth obstacle and underpinning of the conservatism of the industry.

The five issues discussed in this section explain why we describe the building industry as conservative and as providing a difficult terrain for translation of energy policy. The focus on short-term efficiency, lack of research and development, contract practises, the communication challenges of interdisciplinary coordination of building projects, and architects unsupportive attitude towards energy efficiency all represent significant stumbling blocks to construct buildings with better energy standards. While there is some overlap with the previously cited report from OECD (2003), the emphasis is different. While Norwegian energy efficiency policy has encountered serious stumbling blocks to success, it has above all met with unsuccessful translations and networks. How should we understand this, and what are the options for improvement?

A tale of unwilling actors or a failing policy?

If the Norwegian policy to improve energy efficiency, ENØK, were to be successful, it should have lent itself effectively to translation. As an effort of governance, it should have been acted upon. As a proposed strategy to improve energy standards of buildings, it should have been implemented. However, our analysis generally show that ENØK only to a modest extent has been translated to create strong networks promoting energy efficiency in buildings. In sum, we have identified three sets of features that inhibit such translation:

- Energy efficiency in buildings is not in demand. The construction of new buildings is dominated by short term and trivial economic arguments that tend to pull the development in direction of building as cheaply as possible. A major problem resides in the asymmetry between builders, who has to cover costs, and users, who may get the benefits.

- Norwegian energy policy has created the oxymoron of ENØK to guide efforts to achieve energy efficiency. In practice, this has resulted in a concern for energy costs and a focus on saving on energy investments rather than energy. In addition, a wary government has chosen general and indirect public regulation activities. Clearly, it has preferred ineffective instruments like information and economic incentives, rather than to engage in effective direct regulations like the making of stricter building codes or using the strong position of public authorities as building owners to push improvements and to act as role models.
- The building industry is dominated by a conservative culture, with a clear lack of engagement in innovation activities. It is characterized by apparently unalterable practises concerning contract regimes, a singular focus on building costs including a preference for cheap advice, low innovation activity, the aesthetic single track-mindedness of architects, and the general lack of interest in buildings' lives after they have been built.

Unfortunately, neither the building industry, nor the political authorities seem to take these challenges seriously, even though a survey from 2006 demonstrates that both architects and consulting engineers attach relatively great importance to energy efficiency.[20] How should we understand this situation, and how might it change? How may one pave the way for more successful translations of energy efficiency, how to make buildings into assemblages of technologies (Latour 2005) that provide increased energy standards?

At a general level, the three reasons why the translation of energy efficiency into building industry actions has failed seem to constitute a set of barriers to innovation and implementation of new technologies. However, as suggested throughout the analysis, the challenges are strategic rather than structural. First, the problem with ENØK is mainly that it has proven difficult to translate into energy efficiency scenarios attractive to actors in the building industry. In general, these actors have not been aligned to pursue energy efficiency. ENØK has been a concept that has invited a focus on cost efficiency rather than energy efficiency, in addition to making industry actors believe that costs and conservation of energy could be optimised simultaneously. We have also observed that energy policy-makers only to a small degree have engaged with the building industry as a concrete challenge of translating policy. The assumption has been that the general ENØK policy would work in the building industry just as everywhere else.

The actual translation of ENØK seems above all to have confirmed the importance of building as cheaply as possible. The strong cost focus in ENØK means that other arguments that could be used to promote better energy standards are rendered less effective. We have also observed considerable resistance to ENØK among architects as well as a dominance of legal and professional practices that complicates innovation. Even if some architects and consulting engineers have voiced an interest in designing energy efficient buildings, most building industry actors have been aligned into a practice where well-known solutions are chosen and novelties avoided in order to keep construction costs as low as possible.

There are some signs of change. First, as we have observed, the Norwegian government has in 2007/2008 proposed an energy efficiency policy with stricter regulations, based on more ambitious building codes and a will to continue to reform these codes to promote the introduction of better energy standards in new buildings. Second, there is a growing concern among architects to engage with sustainability of buildings. Alternative building images have often been linked to two opposing traditions: low-tech and high-tech ecological architecture. The low-tech movement is associated with the use of wooden materials, turf roofs and a style similar to traditional mountain cabins; the high-tech energy buildings with double glass facades or complicated ventilation systems and buildings where technology is thought to be more important than the shape or design. Similar approaches to sustainable buildings are identified by Guy and Farmer (2001). While low-tech sustainability seems less appreciated, there is an increasing interest among architects to promote high-tech ecological ideas (Ryghaug 2007).

Stricter building codes probably hold considerable promise, not least because of the flaws with respect to the market for construction and buildings. We have already noted the lack of symmetry between builders and building users concerning investments versus running costs. If the builder invests in a high energy standard, it represents a visible cost with unclear profits since many other qualities of the building, such as the location, affect the rental prices, much more than the energy standard. It is difficult to imagine that the rental market may be transformed by simple means. None the less, it is possible to contribute to making the energy standard more visible by demanding that such information is available. In addition, it is important to increase the knowledge concerning the significance of different energy standards and to ensure that such knowledge is made accessible for the actors in the rental building and housing market.

Preferably, of course, energy standards should be improved in existing buildings, and one should assume that such possibilities also will be important for newly constructed buildings. Such improvements are facilitated by making new buildings more flexible and thereby easier to change. Most buildings go through rather extensive changes during their life time (Slaughter 2001). However, rebuilding and reconstruction is often unnecessarily expensive because one seldom considers that buildings should be 'learning buildings, thus, being able to learn when they are designed' (Bye 2008, Aune et al. 2007). Thus, the idiom of learning buildings may be useful to further increases of energy standards.

We have characterised the building industry as displaying a conservative culture, pointing to the entrenchment of many practices that inhibit increased energy efficiency of new buildings. Cultures are hard to alter, but a first step could be to create greater awareness of the problems discussed in this paper. Also, there is a need for research that could facilitate changes in the dominant modes of collaboration in the building industry, particularly tied to the problematic communication between different groups of consultants, designers, building managers, etc. Further, the legal tradition in the industry and its contract practice should be made subject of critical analysis, with a view to developing contractual relations that may facilitate innovation and creativity through-out the whole building process.

In general, R&D investments in the building sector should be increased substantially. The government should be much more concerned to support building-related research and promote innovation activities. New knowledge and new technologies are needed to safeguard that future buildings become energy efficient and sustainable. In this regard, it is important to ensure better conditions for professional updating among architects, engineers and other professions in the building industry.

Last, but not at least, public authorities should in general play a more active role. First, they should support increased research efforts and a larger number of initiatives that contribute to diffusion of knowledge and information. Second, the authorities should put much greater emphasis on being a role model for builders who want to increase energy standards by securing a high standard of new public buildings. In this manner, government will also contribute to better framework conditions for innovation. As building owners, public authorities should in general put much more emphasis on energy efficiency, sustainability and building-related flexibility. Finally, to repeat what we see as the most important observation, revisions of the building codes relevant to energy standards should be used much more actively as an instrument to achieve more environmentally sound and energy efficient buildings.

The energy efficiency failures in the building industry are not only a tale of policy failures but also, as we have seen, of unwilling actors. The government, the building industry and its professions have to each take their share of the responsibility of making reforms.

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Notes

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[2] Source: http://www.ssb.no/bygg/ (downloaded 2007-07-02).

[3] NOU 1975:49 *Om tiltak for energiøkonomisering*
[4] St. meld. Nr 37 (1984-85) *Handlingsplan for energiøkonomisering*. p. 14.
[5] Interview with former President of the Norwegian Architect Association, 09.05.01.
[6] Interview with Enova employee, 20.10.03.
[7] http://www.be.no/beweb/regler/regeltop.html (downloaded 2008-10-25)
[8] http://www.regjeringen.no/nb/dep/krd/pressesenter/pressemeldinger/2006/Nye-byggeforskrifter.html?id=104875 (downloaded 2008-10-25).
[9] Ministry of Local Government and Regional Development: *St. prp. nr. 1 (2008-2009) For budsjettåret 2009*, p. 120.
[10] Interview with employee of ‘Daniel Lind Consulting Engineers ‘, 05.06.01.
[11] http://www.forskningsradet.no/servlet/Satellite?cid=1150814058194&pagename=indikatorrapporten%2FPage%2FHovedSide&site=indikatorrapporten (downloaded 2007-07-02).
[12] Jfr. Advokatfirmaet Cappelen og Krefting. 2005. *NS 8405 og byggherrene. En enkel innføring i en vanskelig standard*. Fagbokforlaget, Bergen.

[13] See note 14.
[14] Interview with manager of property development firm, 23.05.01.
[15] Interview with architect" Sundahl", 01.12.99.
[16] Interview with architect "Sundahl", 01.12.99.
[17] Interview with architect "Johnsen", 08.12.00.
[18] Quoted from Ryghaug 2003, p.137
[19] Quoted from Ryghaug 2003, p.119
[20] http://www.arkitektur.no/?nid=6312&cid=1044&iid=8813&pid=10005.-20201 (downloaded 2007-08-10).

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