Policy Instruments for Energy Efficiency in Buildings: Experiences and Lessons from the Nordic Countries

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ABSTRACT

The Nordic countries have often been seen as "fore-runners" of energy efficiency in buildings – in both the implementation of policy instruments and the evaluation of effects. Since the 1970s, the Nordic countries have introduced a range of policy instruments for energy conservation in buildings. The choice of instruments and experiences, however differs between countries. The aim of this study is to review policy instruments for energy efficiency in buildings in the Nordic countries as well as to analyse how to advance related learning processes. The study discusses traditional and innovative policy instruments, organisational matters, and policy evaluations.

An overall observation from this study is that Sweden is "slowing down" its energy efficiency activities in the building sector, while Denmark, Finland and Norway are all "speeding up". Denmark is leading the way on implementing policy instruments, which are long-term, strategic, innovative and well-supported by the organisational structure. This study also concludes that energy efficiency often lacks influential organisations to "drive" efforts forwards – in terms of information, networking, research and innovation. Finally, there is often no strategic approach to evaluations in the Nordic countries with a focus on how to improve learning.

Introduction

Energy efficiency has for many years been advocated as a way to diminish environmental impacts, reduce GHG emissions, and create a more secure energy system (WEA, 2000; IPCC, 2007). In the EU, the building sector stands for approximately 35% of total energy use (UNEP & CEU, 2007) and the savings potential of cost effective measures in this sector has been estimated to at least 20% by 2020 (COM, 2006a), if all cost-effective investments were implemented. In addition to improved efficiency through investments in new technologies, efforts to affect behavioural change can also contribute to a more efficient use of energy (COM, 2006b).

Despite the great interest in energy efficiency expressed by a range of actors in the EU and worldwide, only a fraction of energy efficiency gains has been achieved (EEW, 2009; COM, 2005). "The annual improvement in energy efficiency in the 1990's was 1.4% per year, but this rate has declined since and is now stationary at 0.5%, showing current efforts are proving insufficient" (COM, 2005). The reasons why apparently cost effective investments in energy efficiency are not made are well documented in the literature (e.g. IPCC, 2007; WEC, 2008; WBCSD, 2007; Deringer et al., 2004; Lausten, 2008) and include:

- Energy prices do not include externalities such as environmental and social impacts.
- Knowledge and information on energy efficiency is limited.
- "Split incentives"- i.e. goals and incentives are not the same for those who invest in energy-using technology and the actors who pay the actual cost of energy.
- There are uncertainties and risks associated with new (energy efficient) technology.
- There are uncertainties surrounding the actual energy savings and its value.
- Transaction costs (i.e. the costs for collecting information, negotiating contracts, evaluating options etc.) can be high.
- The process of change to increase energy efficiency involves many players and it is complex.

To overcome and eliminate barriers to energy efficiency a number of policy instruments have been introduced.[1] Experience in policy instruments for energy efficiency in the building sector goes back to the 1970s and today more than 30 different types of policy instruments are in use all around the world (UNEP & CEU, 2007; IEA 2005a, 2005b). In recent years, a number of EU Directives have been established by the European Commission that aim to influence energy use in buildings. These EU Directives provide important drivers for all Member States.

The Nordic countries (i.e. Denmark, Finland, Norway and Sweden) have often been seen as "fore-runners" of energy efficiency in the building sector in terms of implementation of policy instruments and evaluations of their actual effects (NORDEN, 2008a, 2008b, 2008c). Over several decades the Nordic countries have introduced a number of policy instruments for a more efficient use of energy in buildings, e.g. building codes, subsides, labels and declarations, information campaigns and energy taxes. However, the choice of instruments and the experiences differs between the countries (NEP, 2008; Ryden, 2006). To design, implement and apply effective policy instruments a close study of past experiences is crucial. In this respect, learning from the Nordic countries is worthwhile and relevant to ensure that the public policy process truly contributes to overcoming the barriers requiring the implementation of such policy instrument(s) (Mundaca, 2008). To do so we have to answer the following questions: What experience do we have in the different Nordic countries – in implementing and evaluating policy instruments? What can we learn from each other?

The aim of this study is to perform a meta-analysis of implemented policy instruments for energy efficiency in buildings in the Nordic countries and their evaluations, and to analyse and discuss how to advance the important learning processes related to these instruments. The study describes experiences of different policy instruments from each of the Nordic countries separately. The analysis and discussion is based on an inventory of policy instruments for energy efficiency in the building sector and their evaluations, and an overview of institutional and organisational structures.[2] The analysis is based on the information and experiences collected through written and oral sources from a range of organizations.

[1] It is important to state there is no standard definition for policy or policy instruments. ***Public policy*** can be understood as "whatever governments chose to do or not to do" (Dye, 1976). ***Energy policy*** can be described as the "approach in which a given actor (public or private) determines to take action concerning energy production, distribution and consumption" (Mundaca, 2008). ***Policy instruments*** can be understood as "the set of techniques by which government authorities wield their power in attempting to ensure support and affect or prevent social change" (Verdung, 1998).

[2] The paper is based on a more extensive report written for the Centre for Energy and Resource Efficient Construction and Facilities Management (CERBOF).

Background and Analysis

Since the 1970s, the Nordic countries have introduced a range of policy instruments for energy conservation in buildings. Interestingly, there are contrasting policy "styles" and experiences across the Nordic countries – to the extent that we can talk about a Swedish way with the use of extensive subsidies, a Finnish way with focus on voluntary measures, a Danish way by actively implementing different types of policy instruments including their evaluations, and a Norwegian way with the focus on training and education. Policy instruments for energy efficiency in buildings in the Nordic countries and the evaluations of such instruments will be analyzed and discussed to see how to advance important learning processes related to policy instruments for energy efficiency. The study focuses on a) traditional policy instruments, including building codes, regulations, subsides and taxes, supported by information campaigns and education b) innovative policy instruments, such as initiatives for networking between diverse actors in the building sector, high performance building codes as a voluntary option, technology procurement, labels, declarations, and professional trainings on energy efficiency, c), policy evaluations and d) organisational matters.

Sweden

Energy efficiency has been an important issue on the Swedish Government energy policy agenda since the 1970s. Over the years, several policy instruments for energy efficiency have been implemented, with a focus on building codes, subsidies and information activities (see Figure 1). In parallel, evaluations have been performed, however, on an "ad hoc" basis.

(a) Many of them have been traditional policy instruments, including, for example, subsidies, building codes and taxes. *Grants, loans and subsidies* have been excessively used in Sweden for decades, but generally available for limited periods of time and rarely evaluated, never in a strategic manner. The long history of grants shows the historical commitment by the Swedish Government to such policy instruments.

Table 1: Investment grants for energy efficiency in buildings 1977-2010 in Sweden

Year	No. of Years	Grants	Main Comments
1977-1979	2	35%	Grants on approval, but not more than 3000 SEK per apartment. Loans with 100% of approved cost reduction to the grant. Interest subsidy for loans for the remaining cost.
1979-1980	1	35%	Grants on approval, but not more than 3000 SEK per apartment. Loans with 100% of approved cost reduction to the grant. Interest subsidy for loans for the remaining cost, not for housing.
1980-1981	1	35%	Grants on approval, but not more than 3000 SEK per apartment. State loans with 30% of the approved cost reduction to the grant. Interest subsidy to 30% of the approved cost of energy measures.
1981-1983	2	0%	No cash aid but interest aid of 30% of the approved cost for energy measures.
1983-1984	1	0%/15%	Interest aid of 30% of the approved cost for energy measures. Also, 15% aid for insulation measures.
1984-1985	1	15-30%	Different aid for different types of measures.
1985-1986	1	10%	Aid for insulation measures. Interest aid under regulation after standard or approved costs (different for different measures).

1986-1987	1	10%	Aid for insulation measures. Interest aid under the new regulation, depending on whether energy measures are implemented separately or through conversion.
1987-1993	7	30%	Interest aid of 30% for approved costs for energy measures.
1995-1997	3	30%	Aid to maintenance measures including energy measures.
1998-2000	3	30%	Tax deductions for energy measures, but not more than 12000 SEK per apartment.
2000-	n.a.	n.a.	Various grants are available for the installation of solar heating systems for space heating and/or domestic hot water supply.
2004-2008	5	30%	Small house owners who install energy efficient windows receive a 30% tax reduction on costs, which exceed 10000 SEK and can be a maximum of 10000 SEK per house.
2004-2008	5	30%	There are grants for the installation of biofuel-fired boilers in new detached houses. Tax reduction of 30% of the costs, which exceed 10000 SEK and can be a maximum of 15000 SEK per house.
2005-2008	4	30%/70%	Owners of premises used for public activities could apply for grants for conversion of heating systems from electricity or fossil fuels to biofuels, district heating and heat pumps. This was 30% tax reduction up to 10 MSEK per building. There were also grants for energy efficiency improvements, and the installation of solar cells. This was 70% tax reduction up to 5 MSEK per building.
2006-2010	5	30%	Owners of properties with direct electric heating can receive a grant for the cost of conversion to district heating, heat pumps or biofuel-fired boilers until 2010. This involves 30% of material and work costs up to 30000 SEK per dwelling. The grant was also available to those replacing oil-fired heating for a limited period, which was 30% of material and work costs, up to 14000 SEK per dwelling.

Source: Based on Neij & Öfverholm, 2002 for 1977-2000, and Swedish Energy Agency & Swedish Environmental Protection Agency, 2008 for 2000-2010

CO_2 taxes have been shown to contribute to a more efficient use of energy and also influenced the choice of heating systems. Evaluation of energy taxes shows that the ”price increase” of electricity and fuel between 1991-2001 resulted in 5% reduction of energy use (Swedish Environmental Protection Agency & Swedish Energy Agency, 2006). However, it is also recognised that the use and design of taxes for energy efficiency may be limited by other social and distributional aspects (Neij, 2007). *Building codes* have a long history in Sweden; the requirements related to energy efficiency have been revised on several occasions over time. However, the development of these codes has not been accompanied with the development of any strategic evaluation plans. Studies have shown that the measured energy consumption in houses built in the 1990s have been 50-100% higher than the calculated energy use (Elmroth, 2002). It seems that Swedish building codes have not achieved the intended results. As a result, the revised building codes of 2006 have recommended measurement of actual energy use.

(b) A number of innovative policy instruments have also been applied in Sweden including networking initiatives, technology procurement, and voluntary standards. Bygga Bo Dialogen, Bebo and Belok are all examples of *voluntary associations* working for greater energy efficiency through improved networking. Bygga Bo Dialogen is a cooperation between companies, municipalities, national and local authorities and the Swedish Government with a goal to establish a sustainable building and property sector before 2025. Bebo and Belok are collaborations between the Swedish Energy Agency and the largest property owners in Sweden. Bebo has been active since 1989 in activities, such as technology procurement, with reductions of energy use and annual costs of 30-50% in individual projects. Belok has the mission to support promising energy efficient products, systems and methods, and to create the necessary conditions for implementation. Nilsson (2006) concludes that Belok is “poised to have a

considerable impact in the longer term". Belok is also considered an inexpensive mechanism and a very good initiative.

On *technology procurement*, since the 1990s, 56 new energy efficient technologies have been introduced, most of them related to energy efficiency in buildings. These technology procurement projects have been coordinated by the Swedish Energy Agency (2008). The main application areas include heating and control systems, domestic hot water systems, ventilation, white goods, and lighting. *Labelling* of windows as voluntary standards is also an area of action in Sweden. In 2008, window manufacturers representing more than 85% of the market from all Nordic countries signed a voluntary agreement with the Swedish Energy Agency (Energy Window, 2009). The energy rating has also been extended to include other window properties than energy efficiency, such as air tightness and manoeuvrability. In all, many of the policy instruments that have developed over time have a potential to improve.

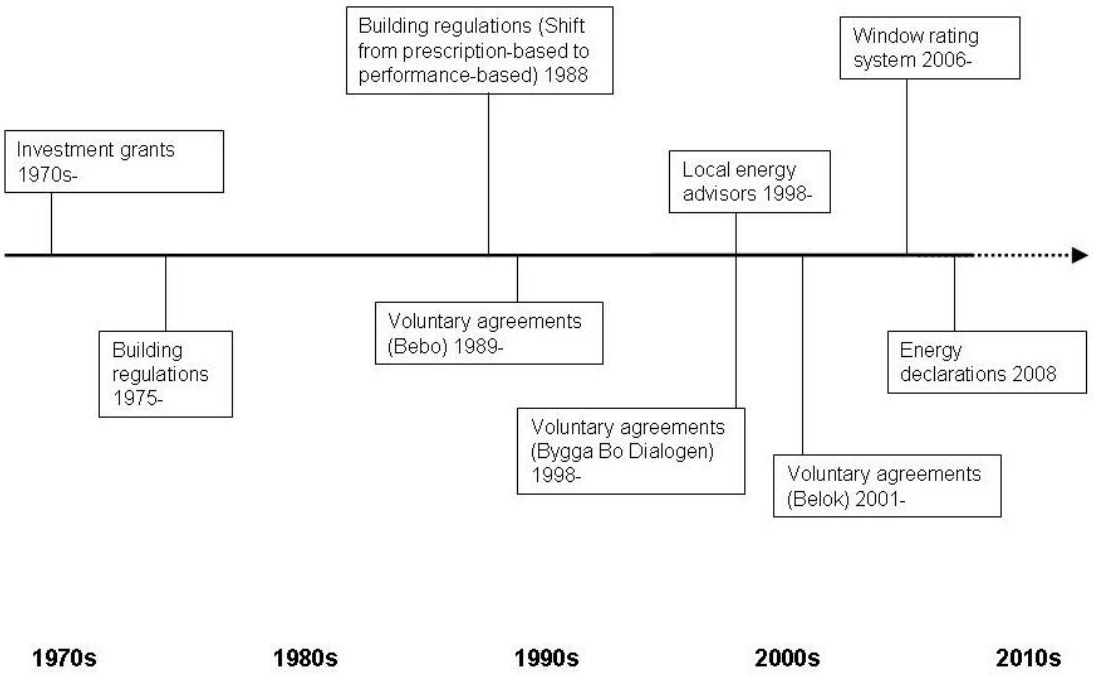

Figure 1: Timeline of key policy instruments implemented in Sweden[3]

(c) A number of evaluations have been performed over time (see for example, UNFCCC (2006a) and the IEA (Neij, 2004)). Today, there is no strategic evaluation approach in Sweden with a focus on how to improve learning; rather there are sporadic or "ad hoc" evaluations.

(d) When it comes to organizational matters, there is a diverse and uncertain responsibility on energy efficiency between agencies in Sweden. While the Swedish Energy Agency (Energimyndigheten) and the Swedish Board of Housing, Building and Planning (Boverket) are the main agencies working on energy efficiency and energy policy implementation in Sweden, the Swedish Consumer Agency (Konsumentverket), the Swedish Environmental Protection Agency (Naturvårdsverket) and municipalities

[3] Note: In addition to the policy instruments in the figure, the government has also developed and applied taxes, and information and education programmes.

also have energy-related undertakings related to energy efficiency in the building sector. The Swedish Energy Agency is responsible for long-term energy research, while the Swedish Research Council (Formas) is responsible for research on built environment. Research related to energy efficiency and the built environment has been carried out by a number of different authorities since the mid 1970, when a number of energy research programs have been launched. In all, there is no central responsibility for energy efficiency, the coordination is weak between responsible agencies and the research activities are dispersed.

In 2006, the Swedish Government stated that energy use in residential buildings and commercial premises should be reduced by 20% by 2020, and 50% by 2050 in relation to energy use in 1995 (Swedish Ministry of Sustainable Development, 2006a). In 2009, the Swedish Government also presented the goal of 20% energy efficiency (i.e. decrease in energy intensity) until 2020. While these are significant goals on energy efficiency, there remains a need for a more strategic and long term approach that can realise such goals. It involves the improvement of design, implementation and application of policy instruments for energy efficiency. It is also important that Sweden conducts regular and comprehensive evaluations that feed back into the policy-making process. Evidence of concrete energy savings and other desirable impacts needs to become an integrated part of policy instruments. As part of the strategic approach, a central organisation responsible for energy efficiency could be a key driver for energy efficiency as such; another solution may be a better coordination between responsible agencies for energy efficiency in buildings in Sweden.

Denmark

Energy savings have been a priority in Denmark for many years, and their promotion and implementation remain a central element in Danish energy policy. There has been a long commitment to building regulations and energy labelling of buildings. Several evaluations have been performed over the years, and in 2008, a systemic evaluation was conducted on the overall savings effort in Denmark.

(a) Many policy instruments have been developed over time in Denmark for energy efficiency in buildings (see Figure 2). In particular, *building regulations* have been used to improve energy efficiency since the 1970s, and there are clear indications for stricter building codes in 2010 and 2015, which effectively sets out a "roadmap" for the building industry. The development of long term plans indicates a strong strategic governmental support of energy efficiency in the country. The evaluation by Energy Analysis, Niras, RUC and 4-Fact (2008a) shows that building codes in Denmark have been important in reducing energy consumption in new buildings – but in reality, the requirements have not always been met.

As with Sweden, *energy and CO_2 taxes* play a significant foundational role in Denmark in terms of promoting energy savings (as well as renewable energy). Throughout the 1990s energy and CO_2 taxes have increased steadily, helping to send price signals to household energy consumption (IEA, 2008b). Without energy taxes it is estimated that energy consumption in Denmark would be at least 10% higher (Danish Ministry of Economic and Business Affairs, 2008).

(b) Innovative policy mechanisms in Denmark include a "*voluntary approach*" linked to the building codes providing two additional classes of low energy buildings. Class 2 has an energy demand of 75% or less (or 50 kWh/m^2/year) if compared to a normal building, and Class 1 has an energy demand of 50% or less (or 35 kWh/m^2/year) if compared with a normal building (Aggerholm, 2008). Furthermore,

Class 2 is scheduled to be the building code requirement in 2010 and Class 1 in 2015 (Haydock & Arden, 2009). Moreover, Denmark highlights the need of knowledge development and has established a *Knowledge Centre* for Energy Savings in Buildings. The knowledge centre supports the stricter building codes by providing training and information to tradesmen, contractors, advisors and consultants as well as small enterprises in the construction sector.

Denmark has had *energy labelling* of buildings since 1979 with new requirements in effect since 2006 in response to the EU Directive (2002/91/EC) on the energy performance of buildings. An important finding of the evaluation by Energy Analysis, Niras, RUC and 4-Fact (2008a) is that the impact of the energy labelling scheme is at best limited. While labelling is obligatory, it is not enforced. A major problem is the cost-revenue balance. Because a consultant is required to carry out the labelling process, it is expensive, and many building owners are not interested in the label or the information provided by the consultant (Togeby et al., 2009). Only about 50% of sold one family houses have the required energy label and a large part of new buildings are also missing the energy label (Togeby et al., 2009).

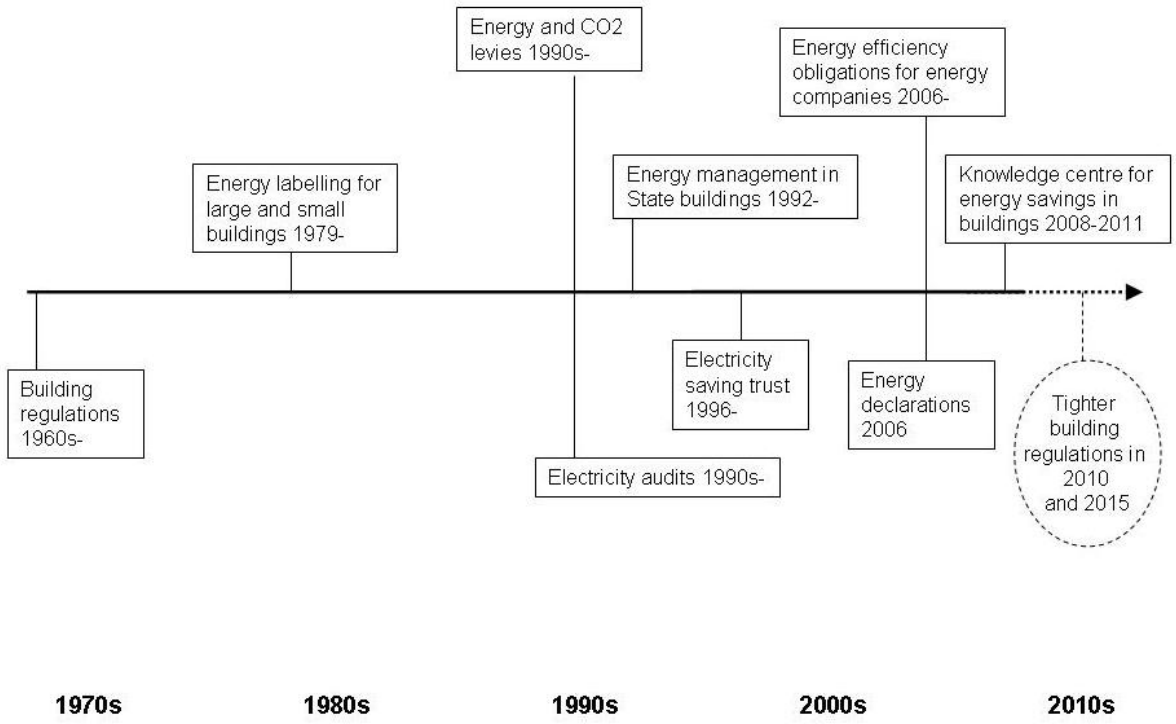

Figure 2: Timeline of key policy instruments implemented in Denmark[4]

(c) Denmark has a strong tradition in evaluations (e.g. Bach et al., 2004; Dyhr-Mikkelsen et al., 2005). In 2008, a major evaluation was conducted by Energy Analysis, Niras, RUC and 4-Fact (2008a, 2008b) which reviewed many previous evaluations and the overall energy savings efforts in Denmark. While evaluations have been conducted on individual policy instruments before, this was the first time an overall assessment had been carried out. The main focus of the ex post evaluation was the efforts of energy companies, energy labelling of buildings, and the Electricity Saving Trust. Building regulations as

[4] Note: In addition to the policy instruments in the figure, there are also voluntary agreements, education and information, and grants and subsidies.

well as equipment and appliance standards were also examined. The core of this evaluation was to assess the cost-effectiveness of policy instruments (i.e. the relationship between costs and savings).

(d) In the long-term, as stated, there are clear commitments in Denmark to tighten building codes, and raise the profile of energy efficiency. From an organisational perspective, the Danish Energy Authority is responsible for implementing (and also evaluating) energy policy. Clearly, the Electricity Saving Trust plays an important role in promoting energy efficiency, although some activities have been evaluated as not always cost-effective (Energy Analysis, Niras, RUC and 4-Fact, 2008a, 2008b). The creation of a Knowledge Centre for Energy Savings in Buildings is also a very important "new" organisation that is expected to provide the necessary support to the building sector in achieving the stricter building codes.

In line with the "Agreement on Danish Energy Policy for 2008 to 2011" the efforts to save energy are being increased with commitments to cut energy consumption by 2% by 2011, compared with 2006 levels. And in 2020, energy use must have fallen by 4% compared to 2006 (IEA, 2008b). Furthermore, for new buildings there will be a reduction in energy consumption by at least 25% in 2010, at least 25% in 2015, and at least 25% in 2020, for a total reduction of at least 75% by 2020 (Danish Ministry of Climate and Energy, 2008). In order to reach these ambitious targets a number of "new" initiatives for heat savings in buildings were recommended in the National Energy Efficiency Action Plan (NEEAP) for Denmark (Danish Ministry of Transport and Energy, 2005). Amongst others, the initiatives include i) tightening of the energy requirements in the building regulations by 25-30% as of 2006 and by app. 25% as of 2010, ii) for new low-energy buildings abolishment of the obligation to connect to collective energy supply systems and of the ban on electric heating, iii) setting requirements in the building regulations for existing buildings relating to major renovations, change of heat supply, replacement of boilers, windows and roofs, and iv) maintain and extend ambitious energy labelling of buildings. There are high expectations for the planned actions, especially for the tightening of the building codes in 2010 and 2015.

Norway

Historically, with an abundant supply of cheap and clean hydropower, energy efficiency has not been high on the agenda in Norway, exemplified by the excessive use of electricity for heating demands and the fact there are no national energy efficiency targets. However, Norway has developed a number of initiatives to support energy efficiency over time. In this study, we only identified a few evaluations.

(a) Norway has a long history of building codes and a number of policy instruments targeting energy efficiency since the middle of the 1990s (see Figure 3). In recent years energy efficiency seems to have higher priority, which brought about tightening the *building code* and impressive efforts on *education and communication* activities.

(b) A number of innovative policy instruments have also been introduced, the *Research Centre* on Zero-Emission Buildings was established. Stricter energy standards and new methods to calculate energy demand were put into force in January 2007 and were fully implemented in August 2009 (IEA, 2008c). According to the new national standard for calculating energy performance in buildings (2007) all buildings must meet a number of requirements, in relation to a) energy efficiency performance, or b) the total net energy consumption (Rode & Isachsen, 2008). Furthermore, buildings should be designed and constructed for a significant part of the energy need for space and water heating to be supplied by alternative energy sources.

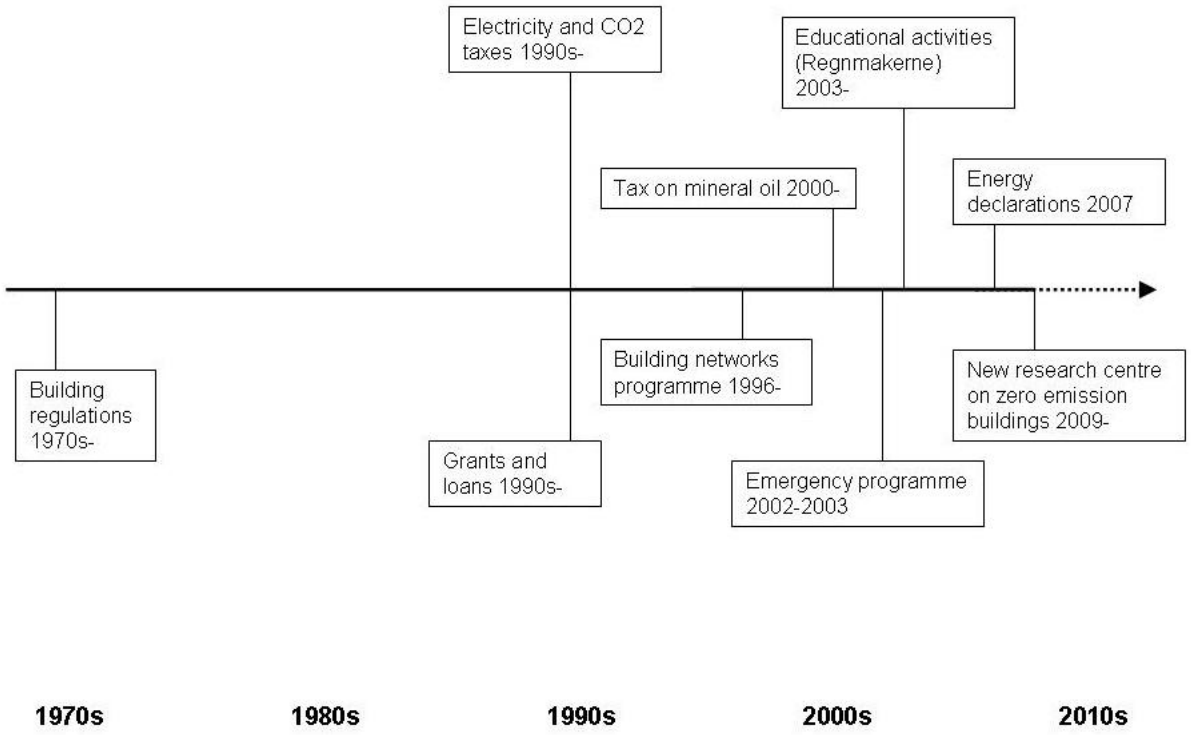

Figure 3: Timeline of key policy instruments implemented in Norway[5]

(c) Rosenberg & Espegren (2006) carried out an assessment of energy efficiency policies in Norway in 2006; overall it shows that there is a very limited spread of policy efforts. In the residential sector, the financial measures had the largest emphasis. Measures with an informative and educational nature were second. The main information measures were the building networks. The program is based on the idea that improved knowledge will result in energy efficiency investments, and the integration of cyclic tasks will ensure continuous focus on energy use (NEE, 2004). It has four main elements: a holistic and systematic approach to rational use of energy over the program duration (1.5 to 2.5 years), coordination of existing energy efficiency core elements and tools in projects, long-term energy performance contracts where building owners commit to energy saving aims, and a forum for building management organisations. The programme was evaluated and showed good results in terms of the number of participants and the estimated resulting savings (NEE, 2004). The major lessons learned include: do not underestimate the time required for the initiation phase; when it comes to marketing, it is important to have "success stories"; and it is vitally important that the organiser of the building networks is able to sense and adapt to the needs of the client, namely the building owner (NEE, 2004). Finally, energy statistics are crucial elements in benchmarking and evaluation processes.

In this study, we identified few evaluations of policy instruments, a limited collection of statistics, and strong recommendations from various sources for greater efforts on these fronts. In particular, the IEA (2005) recommends collecting relevant statistics in the building sector to enable easier evaluations of existing policy measures, and the design of more targeted policy instruments. The IEA (2005) also argues that the work by Enova should be evaluated better, particularly in regards to energy efficiency objectives, and that lessons learned from Norway should also be available in translated documents.

[5] Note: In addition to the policy instruments in the figure, there are also information services, energy management in commercial and residential buildings, and energy plans in municipalities.

(d) In terms of organisations, Enova is charged with the task to promote energy efficiency and renewable energy in Norway. It gives free of charge energy savings advice and is responsible for several programmes on energy use and environmental issues, including running youth programmes, supporting television advertising campaigns, developing teaching materials and educational course for professionals in the building sector. The recent establishment of the Research Centre on Zero-Emission Buildings is an attempt to make a major active effort on environmentally friendly technologies within the building sector. This new centre is an exciting development for research on zero-emission buildings in Norway, but also for the Nordic countries. The ambitious vision of the centre is to eliminate the GHG emissions caused by buildings.

The long-term direction for Norway appears to be greater emphasis on energy efficiency, however, many challenges remain. Ryghaug & Sorensen (2009) have investigated how energy efficiency "fails" in the building industry in Norway based on many years of research. The major argument is that three inter-related problems restrain the integration of energy efficiency in the building sector. These include: deficiencies in policy to stimulate energy efficiency; limited governmental efforts to regulate the building industry; and a rather conservative building industry (Ryghaug & Sorensen, 2009). Ryghaug & Sorensen (2009) highlight examples, such as the fact that new office buildings in Norway are less energy efficient than older, existing buildings. The energy use in buildings constructed before 1931 is lower than buildings established after 1997.

There are some signs of change in Norway. For example, the Norwegian Government has proposed building codes with stricter regulations on energy efficiency. Ryghaug & Sorensen (2009) state that such building codes, with appropriate reinforcement, can help to respond to flaws in the market. There is also considerable need to facilitate changes in the dominant modes of collaboration in the building industry, particularly in terms of problematic communication between different actors, and not least the serious problems associated with the builder-tenant-owner dilemma. Finally, Ryghaug & Sorensen (2009) call for greater research and development investments, and that the public sector should take a leadership role on energy efficiency and buildings.

Finland

There is a long tradition in Finland on voluntary energy efficiency agreements and energy audits, which have been assessed as quite successful based on Salminen (2009) and Khan (2006a). Building codes are also being tightened. There is a history of evaluations of policy instruments in Finland. Recently, in 2009, there have been two in-depth evaluations related to buildings.

(a) There are many policy instruments for energy efficiency in Finland (see Figure 4), starting with the traditionally stringent *building codes*. Although, the IEA (2007) comments in a review of energy policies in Finland that despite positive signs it remains unclear if sufficient attention is being paid to energy efficiency in the form of government policies and resources. Furthermore, most efforts appear to be focused on voluntary approaches. However, ex post analysis has been a key aspect of the voluntary agreements and the results are quite impressive. Although ex ante estimates suggested Finland could save a total of 5.5 TWh, the actual estimated savings were 7.1 TWh, which is a 30% increase on what was expected (IEA, 2007). There are a number of advantages to voluntary agreements, especially that schemes and programmes can be tailored to different sectors. However, the IEA (2007) argues that a weakness is that extensive evaluation is required to understand the impacts of such agreements.

(b) Finland does have a number of what can be called innovative policies on energy efficiency. These include the *voluntary energy efficiency agreements, promotion of energy service companies, and energy expert training*. There are energy efficiency agreements across the property and building sector. Companies and municipalities that join energy efficiency agreements commit to carrying out *energy audits* by undertaking analysis on their own energy consumption and its energy savings potential as well as by drawing up an action plan on implementing cost-effective efficiency measures. Finland is considered a leading country on energy audits (Motiva & Ministry of Trade and Industry, 2006). The energy efficiency agreement scheme and energy audits are particularly significant in relation to the national implementation of the EU Directive (2006/32/EC) on energy end-use efficiency and energy services (IEA, 2008d).

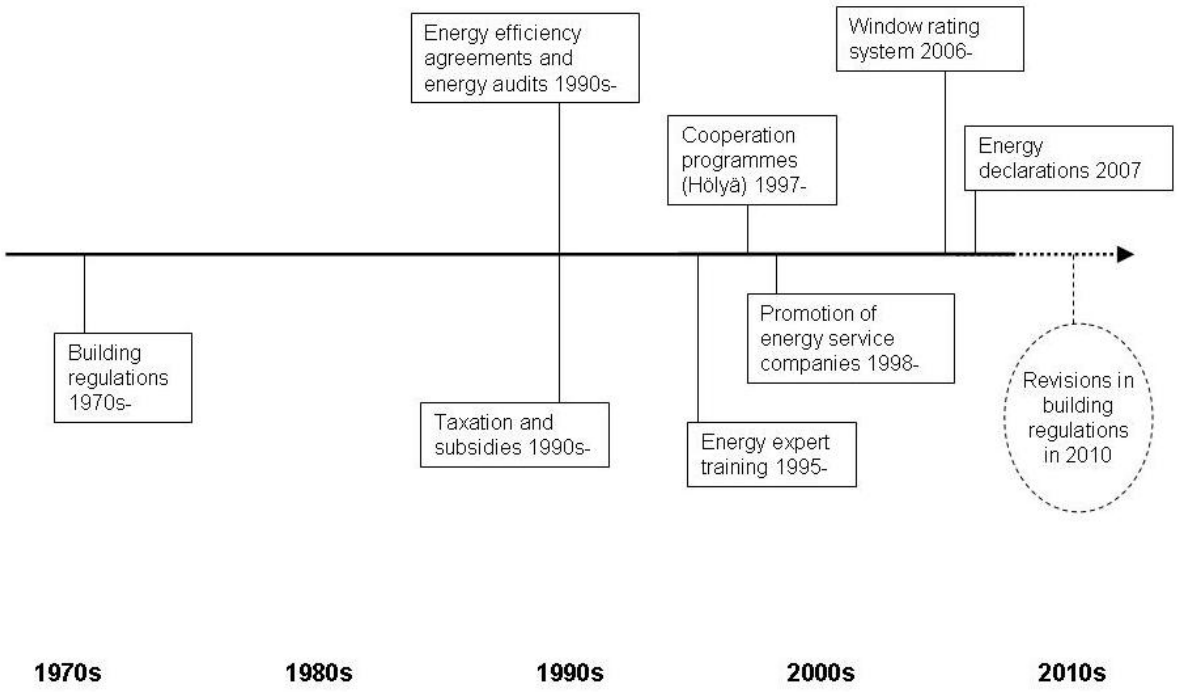

Figure 4: Timeline of key policy instruments implemented in Finland[6]

(c) Evaluations on municipal agreements show that the coverage of agreements in most municipalities has been rather good; however, the achieving challenging targets has proved difficult mostly due to the following reasons: i) many municipalities lack both personnel and economic resources, ii) setting the baseline for energy efficiency in buildings has been problematic and iii) there was a "split" in responsibilities between the Ministry of Employment and Economy, and the Ministry of the Environment when it comes to regulations and energy efficiency (Salminen, 2009).

In the AID-EE project (www.aid-ee.org), Khan (2006a) evaluated energy audits in Finland and concludes that generally this has been a successful programme. Khan (2006a) highlights that a core feature of the programme is access to subsidies and the success factors include a) a flexible planning approach, b) a clear vision of objectives and central elements of the policy instrument, c) active promotion of the policy instrument, d) training of auditors, e) co-operation and dialogue with stakeholders, f) interlink policy instruments, g) flexible and competent implementing agency, h) long-term political

[6] Note: In addition to the policy instruments in the figure, there are also research and development, voluntary approaches, and information and communication.

support, and i) systematic and thorough monitoring. The policy instrument serves as a good experience of "learning by doing" for countries that implement a similar energy audit programme (Khan, 2006a).

The efforts on energy service companies and energy expert training are difficult to evaluate, but appear to be worthwhile supplementary activities to the voluntary energy efficiency agreements, and building codes and regulations. In particular, energy service companies, taking responsibility for energy efficiency, including undertaking energy audits, establishing energy plans, and organising financing on behalf of their clients, are expected to play a greater role on energy efficiency activities in the future.

(d) In terms of organisation, Motiva plays an important role in Finland by undertaking evaluations of policy instruments. Recently, in 2009, there have been two in-depth evaluations related to buildings. The first is an evaluation concerning the possible energy savings and GHG emission reductions of the 2010 building regulations and the anticipated 2012 building regulations. This evaluation also involves some estimates for the renovation of existing buildings. It was prepared for the Energy Efficiency Committee of the Ministry of Economic Affairs in Finland. The second is an evaluation of the impact of the EU Directive (2205/32/EC) on ecodesign requirements for energy-using products in Finland. The evaluation includes several product groups where either final or draft regulations are available or the background reports provide a good basis for evaluation.

For Finland, the long-term direction appears to be stricter building codes for 2010 and in 2012, and increased attention generally on energy efficiency in buildings. SITRA (www.sitra.fi), the Innovation Fund in Finland, has recently published two reports examining the future of energy efficiency in Finland. The international comparison report called "Energy Efficiency Internationally" gives examples to illustrate the speed of development in the world and states that Finland should promote energy efficiency by creating market mechanisms and by introducing innovative solutions in order to keep up with the development. The report entitled "The Energy Future of Construction" offers six different perspectives of the direction in which the built environment should be developed. The report contains ideas on areas such as constructing low-carbon areas starting with town planning.

Discussion

Traditional Instruments

In general regulatory instruments such as building codes and regulations are viewed as one of the most effective – if enforcement can be ensured (UNEP & CEU, 2007). Building codes in the Nordic countries are also considered as the best in EU (IEA, 2005a). In Denmark, the evaluation conducted by Energy Analysis, Niras, RUC and 4-Fact (2008a) states that building codes have been important in reducing energy consumption in new buildings. There are high expectations for the long-term and strategic tightening of building codes in 2010 and 2015 in Denmark. Finland is also proposing stricter building codes for 2010 and 2012.

In general, economic instruments show diverging results. They can lead to high savings, and can also be helpful to kick-start a market, but they can also be less effective (UNEP & CEU, 2007). With taxes, we can internalize negative externalities, increasing energy prices. However, there are limits on how much taxes can be raised and the impact of higher prices, especially in the longer term. Taxes should be combined with strong advocacy efforts that convey a general knowledge of energy efficiency and provide

specific guidance on how energy efficiency can be realised. Taxes and awareness should then also be combined with instruments that support the introduction of new technologies, such as research and development, technology procurement, public procurement, and strategic investment. Energy taxes have shown to be effective to support energy efficiency in the Nordic countries.

Subsidies and support schemes have been widely applied in Sweden. Although such subsidies have not been evaluated in any strategic manner, there are a few evaluations of investment grants. For example, the support for the conversion from direct electric heating in residential buildings has been evaluated (Swedish Board of Housing, Building and Planning, 2008). This evaluation shows that the economic resources of the aid were well adapted to its demand. There are currently a number of investment grants available in Sweden. The use of subsidies to kick-start markets in comparison with more general support for new technologies over several years should be evaluated. These evaluations will serve with valuable input for subsidy schemes also in other countries, such as Finland where the use of subsidies for improving, renewing and repairing heat insulation and ventilation will continue as part of the new voluntary energy efficient agreements for 2008-2016 (NEEAP, 2007).

In terms of information activities, it is often very difficult to evaluate impacts and say anything substantial about the actual effects. However, this should not undermine the importance of information activities in supporting other policy instruments and raising the profile of energy efficiency in general. Despite the lack of evaluations of information activities, there is agreement among many actors that educational and information efforts are necessary (Neij, 2007). Informative instruments may not always be the most effective instrument to achieve a given goal in a certain time period, but these instruments can make a significant contribution when they are well-designed, and utilised to legitimize, interact and reinforce other policy instruments.

Innovative Instruments

Within the Nordic countries a number of innovative policy instruments have been developed over time. Such instruments include initiatives for networking. Cooperation with diverse actors in the building sector is required for increased energy efficiency, particularly for promoting and implementing very low energy buildings. Bygga Bo Dialogen, Bebo and Belok are all examples of voluntary associations in Sweden working for greater energy efficiency through improved networking. Networking initiatives are also considered an inexpensive mechanism.

To further promote enhanced energy efficiency in buildings, high performance building codes as a voluntary option is suggested in several countries. This can be a guideline for those that want to go beyond the average standards and create foundations for greater innovation. There is growing activity across the EU on such strategies to move towards very low energy buildings (Thomsen et al., 2008). In Denmark two classes of low energy buildings has been defined; it provides a clear “roadmap” for the building sector. In addition to this the Nordic countries are developing additional voluntary standards such as for passive houses and “mini-energi-hus”.

Greater and targeted support for professional training or education on energy efficiency for architects, engineers, designers and professionals in the building industry appears to be a necessary foundation for a market for energy efficiency. For example, the Knowledge Centre for Energy Savings in Buildings recently established in Denmark will focus on improving awareness of energy efficiency in the construction sector. It is very difficult to evaluate such efforts. However, we argue that it is vital to

supplement stricter building codes with increased education and training for actors involved in the construction and renovation of buildings. Overall, to further support energy efficiency, the effect and effectiveness of new innovative policy instruments should be deliberately evaluated. Policy evaluation is crucial in verifying results, withdrawing inefficient policies or providing the corrections necessary to improve the performance of policy instruments in order to resolve the problem(s) and secure the policy objective(s) (Mundaca, 2008). If implemented policy instruments do not deliver, corrections should be made and/or additional new instruments should be suggested and duly evaluated.

Organisational Matters

Organisational structures related to energy efficiency are often dispersed in the Nordic countries. One exception may be the Danish Electricity Saving Trust. One way to better coordinate information operations and activities on energy efficiency may be to invest in such an energy trust, as the Electricity Saving Trust in Denmark. This trust would be able to coordinate and strategically work with energy efficiency in general and specifically work with campaigns, subsidies, and provide qualified advice and training for households and enterprises. Furthermore, it could work on coordination between the players on the market. Funding could be through government and private funds or through a fee that is channelled through energy bills.

Dedicated research centres on buildings and energy efficiency, such as the Research Centre on Zero-Emission Buildings established in Norway, appear to be important to create a critical mass of expertise that can carry out regular, in-depth and scientific research and evaluations. This centre is an exciting development for research on zero-emission buildings in Norway, but also for the Nordic countries. The ambitious vision of the centre is to eliminate the GHG emissions caused by buildings. Sweden could also set up such research centres and better coordinate research activities.

For policy instruments to be designed and implemented successfully – resulting in the desired effects – a long term strategy is required that provides clear signals to actors in the building sector. This can stimulate and allow significant investments in energy efficiency and clear organisational responsibilities.

Policy Evaluations

Greater energy efficiency over the long term will require different types of policy instruments at different stages. The choice of instruments and measures requires knowledge, constant evaluation, and timing. Efforts must be strategic, long term and stable but still allow for dynamic conditions. This is a challenge! Evaluations are therefore a key part of major efforts on energy efficiency and buildings. As stated, except for the case of Denmark, where not only individual policy instruments have been evaluated, but for the first time in 2008 overall policy assessment had been carried out (Energy Analysis, Niras, RUC and 4-Fact, 2008a, 2008b), there is no strategic evaluation approach with a focus on how to improve learning. In Finland, both ex ante and ex post evaluations are conducted, mainly concerning the possible energy savings and GHG emission reductions as well as the impact of EU Directives the evaluations are undertaken in a rather sporadic manner. Based on the study, we emphasize the importance of conducting evaluations more regularly and in a more comprehensive manner. We also highlight the significance of that

these evaluations are fed back into the policy-making process. Nordic countries can still greatly improve in designing, implementing and applying policy instruments for energy efficiency.

In this study, we can also see that the vast majority of policy evaluations focus on cost-effectiveness and economic efficiency with less emphasis on innovation effects. Furthermore, across the Nordic countries, existing policy instruments in the whole have had very moderate effects on innovation, typically resulting in incremental changes in existing building practices and diffusion of existing technology. Market transformation, improved networking between diverse actors, and new technologies and systems are vital to realising more significant energy savings in buildings. Evaluations should therefore explicitly investigate innovation effects of policy instruments.

Concluding Remarks

An overall observation from this study is that Sweden appears to be "slowing down" on energy efficiency activities in the building sector, while Denmark, Finland and Norway are all "speeding up". Denmark, in particular is leading the way on implementing a combination of strong, strategic and innovative policy instruments, and undertaking comprehensive evaluations. Energy efficiency often lacks influential organisations to "drive" efforts forwards – both in terms of information, training and networking activities for diverse actors, and a concerted research and innovation effort. There are exceptions, such as the Electricity Saving Trust in Denmark, and the newly established Research Centre on Zero-Emission Buildings in Norway. Finally, there is often no strategic approach to evaluations in the Nordic countries with a focus on how to improve learning.

Many policy instruments have too little focus on systematically demonstrating their effects in terms of actual energy savings. It is vital that the evidence of concrete energy savings and other desirable impacts becomes an integrated part of policy instruments. They should not be viewed as an add-on or at worst a "distraction". Evaluations should be integrated into policy instruments to provide continuous feedback. Modelling and scenario methods should be complemented with other types of methods to validate results and recommendations. A combination of methods is important. There is also a need for better statistical data to undertake thorough and comprehensive evaluations.

Finally, most policy evaluations have little focus on how to improve learning rather what we see are sporadic or "ad hoc" evaluations. For policy instruments to be designed and implemented successfully – resulting in the desired impacts – a long term strategy is required that provides clear signals to actors in the building sector. Strategic policy evaluations are a vital part of efforts on energy efficiency and buildings.

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