Experience of Policy Instruments for Energy Efficiency in Buildings in the Nordic Countries

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Executive Summary

The Nordic countries have often been seen as "fore-runners" of energy efficiency in buildings in terms of both 1) the implementation of policy instruments and 2) the evaluation of actual effects. 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, Finnish way, Danish way, and Norwegian way. An important challenge is how we can learn from Nordic experiences and improve the implementation and evaluation of policy instruments for energy efficiency.

To do so we have to answer the following questions:

- What experience do we have in the different Nordic countries?
- What can we learn from each other?
- What experience do we actually have in evaluating results?

The aim of this study is to make a compilation (or inventory) of policy instruments for energy efficiency in buildings in the Nordic countries, report the results of evaluations of such instruments, and analyse and discuss how to advance the important learning processes related to policy instruments for energy efficiency. The study focuses on policy instruments for energy efficiency in the building sector, including building codes, subsides, labels and declarations, information campaigns, and taxes. Policy instruments for appliances within buildings are a secondary consideration in the study.

In ***Sweden***, energy efficiency has been an important issue on the Swedish Government energy policy agenda since the 1970s. Several policy instruments for energy efficiency have been implemented, with a focus on building codes, subsidies and support schemes, and information activities (particularly through Local Energy Advisors and Regional Energy Offices). However, there has been a limited focus on regular evaluation of impacts. Rather what we see is an "ad hoc" approach to evaluations. The most significant change in building regulations occurred in the 1988 revision, when there was a shift from requirements related to specific components to requirements for the functioning and efficiency of entire buildings. This alteration has meant it is very challenging to verify calculations, and some studies show that energy efficiency improvements in buildings have slowed down considerably in Sweden since the 1990s.

Energy savings have been a key priority in ***Denmark*** for many years, and their promotion and implementation are a central element in Danish energy policy. In terms of policy instruments, there has been a long commitment to building regulations and energy labelling of buildings. Building codes are to be tightened in 2010 and 2015, and 2 classes of low energy buildings have been defined. The energy labelling of buildings dates back to 1979, and new requirements were implemented in 2006 in line with the EU Directive (2002/91/EC) on the energy performance of buildings. In 2008, a major evaluation was conducted on the overall savings effort in Denmark. This is the most comprehensive evaluation on energy efficiency ever conducted in the Nordic countries. It provides an in-depth analysis of policy measures and their impacts, as well as key recommendations for improving energy efficiency.

In ***Norway***, there has been a long history of large amounts of hydropower, resulting in limited efforts on energy efficiency, exemplified by the fact there are no national energy efficiency

targets. Furthermore, based on this research, there appear to be very few evaluations of policy instruments in regards to energy efficiency. Some studies even suggest that new office buildings in Norway are in fact less energy efficient than older, existing buildings, and that the energy use in buildings constructed before 1931 is lower than buildings established after 1997. However, more recently, there has been increased emphasis by the Norwegian Government to reduce dependence on hydropower by decreasing demand for electricity and diversifying supply options, particularly related to the building sector. The Norwegian Government has also proposed building codes with stricter regulations on energy efficiency.

There is a long tradition in ***Finland*** on voluntary energy efficiency agreements and energy audits. Evaluations of these activities suggest the impacts have been quite impressive, and there appears to be strong commitment by the Finnish Government to new extensive energy conservation agreement schemes. Additionally, energy expert training schemes and the promotion of energy service companies can be described as innovative approaches. Additionally, some in-depth evaluations have been recently completed in 2009. 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. The second is an evaluation of the effects of the EU Directive (2205/32/EC) on ecodesign requirements for energy-using products in Finland.

The main conclusions from this research process for Sweden are as follows:

- An overall observation from this study is that Sweden appears to be "slowing down" its energy efficiency ***activities*** in the building sector, while Denmark, Finland and Norway are all "speeding up". Denmark, in particular is leading the way both on implementing a combination of strong and innovative policy instruments, and undertaking comprehensive evaluations.

- It is the conclusion of this study that Sweden lacks influential ***organisations*** to promote energy efficiency – both in terms of information, training and networking activities for diverse actors (e.g. the Electricity Saving Trust in Denmark), and a concerted research and innovation effort (e.g. the Research Centre on Zero-Emission Buildings in Norway).

- Today, there is no strategic evaluation approach with a focus on how to improve learning rather there are sporadic or "ad hoc" ***evaluations***. Sweden can still greatly improve in designing, implementing and applying policy instruments for energy efficiency. It is important that Sweden conducts regular and comprehensive evaluations that feed back into the policy-making process.

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1 Introduction and Background

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, behavioural measures can also contribute to a more efficient use of energy (COM, 2006b).

Despite the great interest for energy efficiency from a range of actors in the EU and worldwide, only a fraction of energy efficiency gains has been achieved (EEW, 2009; IEE, 2008; COM, 2005). The reason for why investments in energy efficiency are not made, even though they are cost-effective, can be explained by a number of barriers. The main barriers identified in the literature (e.g. IPCC, 2007; WEC, 2008; WBCSD, 2007; Deringer et al., 2004; Lausten, 2008) include:

- Energy prices do not include externalities such as environmental and social impacts.
- Knowledge and information on energy efficiency is limited.
- 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 (i.e. "split incentives").
- 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 (see Box 1). These EU Directives provide important drivers for all Member States.

The Nordic countries 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

[1] It is important to state there is no standard definition for policy or policy instruments. Broadly speaking, ***public policy*** can be understood as "whatever governments chose to do or not to do" (Dye, 1976). The term ***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). Finally, ***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).

energy taxes. However, the choice of instruments and the experiences differs between the countries (NEP, 2008; Ryden, 2006).

Box 1: EU Directives relevant to energy efficiency and buildings

Directive 2002/91/EC on the energy performance of buildings
The EU Directive (2002/91/EC) on the energy performance of buildings was adopted in December 2002. It is considered a very important legislative component of energy efficiency activities in the EU designed to meet commitments to reduce GHG emissions and to respond to energy supply security concerns. The principal objectives of the EU Directive are to improve the energy performance of buildings within the EU through cost effective measures, and to promote the convergence of building standards towards those of Member States which already have ambitious levels. Measures in the EU Directive include: a methodology for calculating the energy performance of buildings; application of performance standards on new and existing buildings; declaration (or certification) schemes for all buildings; and regular inspection and assessment of boilers, and heating and cooling installations. In 2008, a recast version of the EU Directive was developed to clarify and simplify certain provisions, extend the scope of the EU Directive, strengthen some of its provisions so that their impact is more effective, and to provide for the leading role of the public sector. Further improvements are expected.

The EU Directive states that non-residential buildings, when they are renovated, must be brought to the level of efficiency of new buildings. This requirement is a very important action due to the slow turnover and renovation cycle of buildings, and considering that major renovations to older buildings may occur several times before they are finally removed from the building stock (IPCC, 2007). In many ways, this represents a pioneering effort in terms of energy efficiency policy because it is one of the few policies worldwide to target existing, older buildings. The energy declarations or certificates are intended to address the landlord/tenant problem of "split incentives" through the transfer of information on the relative energy performance of buildings and apartments. Information from the energy certification process must be made available for new and existing commercial buildings and for dwellings when they are constructed, sold, or rented (IPCC, 2007).

Directive 2006/32/EC on energy end-use efficiency and energy services
The EU adopted a framework for energy end-use efficiency and energy services in an EU Directive (2006/32/EC) in 2006. The main aspects include an indicative energy savings target for Member States, obligations on national public authorities as regards to energy savings and energy efficient procurement, and measures to promote energy efficiency and energy services. According to the EU Directive, all Member States must submit a National Energy Efficiency Action Plan (NEEAP) to the European Commission. In the NEEAP, Member States should show how they intend to reach the 9% indicative energy savings target by 2016. An NEEAP describes the energy efficiency improvement measures that are aimed at achieving the savings targets set out in the EU Directive.

Directive 2005/32/EC on establishing a framework for the setting of ecodesign requirements for energy-using products
Ecodesign aims at reducing the environmental impact of products, including energy consumption throughout their entire life cycle. The production, distribution, use and end-of-life management of energy-using products (or EuPs) is associated with a considerable number of impacts on the environment. The EU Directive (2005/32/EC) adopted in 2005 establishes a framework for ecodesign requirements (such as energy efficiency requirements) for all EuPs in the residential, tertiary and industrial sectors. The EU Directive does not introduce directly binding requirements for specific products, but does define conditions and criteria for setting requirements regarding environmentally relevant product characteristics and allows them to be improved quickly. In principle, the EU Directive applies to all EuPs (except vehicles for transport) and covers all energy sources.

To improve our knowledge in how to design, implement and apply policy instruments in an effective and efficient way we need to learn from earlier experiences. In this respect, learning from Nordic policy intervention seems relevant. To do so we have to answer the following questions: What experience do we have in the different Nordic countries? What can we learn from each other? What experience do we actually have in evaluating results?

The aim of this study is to make a compilation (or inventory) of policy instruments for energy efficiency in buildings in the Nordic countries, report the results of evaluations of such instruments, and analyse and discuss how to advance the important learning processes related to policy instruments for energy efficiency. The study focuses on policy instruments for energy efficiency in the building sector and includes all types of policy instruments – regulatory, administrative, economic and informative. Policy instruments for appliances within buildings are a secondary consideration in the study.

The report describes and reviews each of the Nordic countries separately. Each section is structured with 1) a brief introduction to the institutions and programmes for energy efficiency in the particular country, 2) an overview of specific policy instruments for energy efficiency in the building sector and key findings from evaluations, 3) a description of the action plans for energy efficiency, and finally 4) a general discussion of major issues and the future outlook in the respective countries. The main emphasis of this study is on the experiences of different policy instruments.

The study is based on the analysis of information and experiences collected through written and oral sources from a range of organizations.[2] The report is written for the Centre for Energy and Resource Efficient Construction and Facilities Management (CERBOF) and actors in the energy market, the construction industry and relevant authorities and associations, in Sweden and the Nordic countries.

[2] The majority of documentation on energy efficiency and buildings is in the native languages of the respective Nordic countries. Large efforts have been made in this research to translate important information, and make direct contact with key stakeholders and organisations in specific countries, which could verify information and provide deeper insights into policy instruments, and specifically evaluations.

2 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. In parallel, evaluations have been performed, however, on an "ad hoc" basis.

2.1 Institutional Framework

Over the years the institutional framework of energy efficiency in Sweden has changed. Today, the Swedish Energy Agency (Energimyndigheten) is the main authority responsible for energy research and is also active in the implementation of energy policy defined by the Swedish Government. The Swedish Board of Housing, Building and Planning (Boverket) is the central government authority for town and country planning, management of land and water resources, building and housing – and is also active in the implementation of energy policies (in particular building codes, building declarations and subsidies relevant to energy efficiency).

Since 1975 a number of energy research programs have been launched, all including different aspects of energy efficiency. A number of authorities are, and have been, responsible for these programs. The Swedish Energy Agency is responsible for long-term and overall energy research and the Swedish Research Council (Formas) is responsible for research related to the built environment (in 2001 Formas replaced Byggforskningsrådet). Moreover, the Swedish Consumer Agency (Konsumentverket), the Swedish Environmental Protection Agency (Naturvårdsverket) and municipalities have energy-related undertakings related to energy efficiency in the building sector.

The national program for energy efficiency has developed over time. In 2006, in its Bill entitled "A National Programme for Energy Efficiency and Energy-Smart Construction" (2005/06: 145), the Swedish Government agreed 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 addition, dependence on fossil fuels in the built environment should be broken. In 2009, the Swedish Government presented the Bill called "An Integrated Climate and Energy Policy" (2008/09:163) introducing a goal of 20% energy efficiency (i.e. decrease in energy intensity) until 2020.

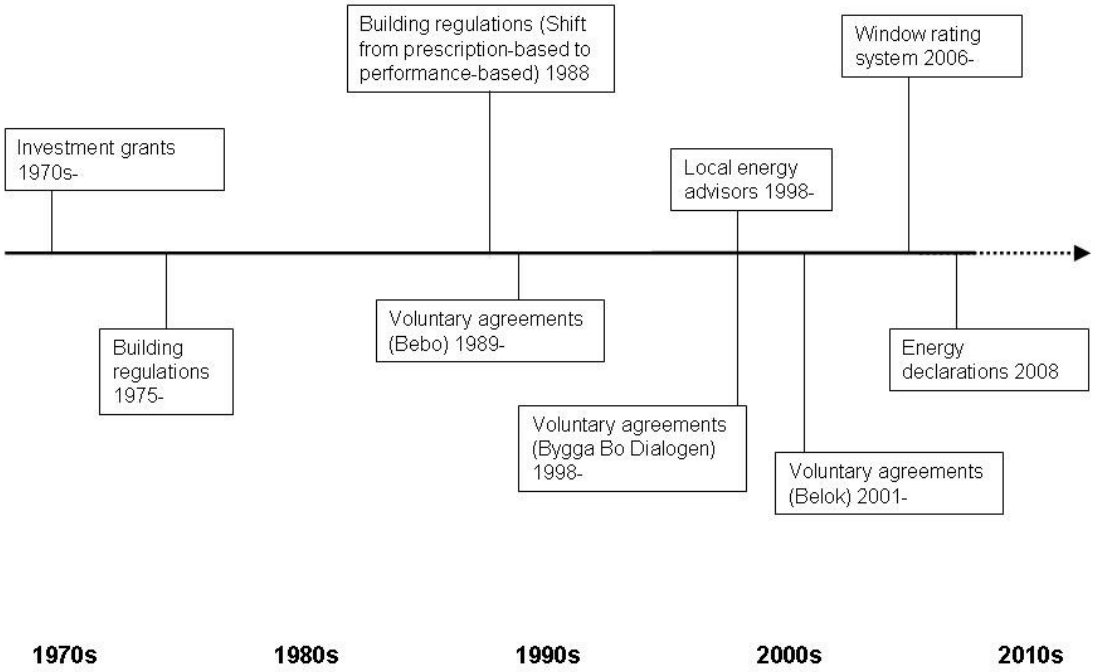
An important task of the Swedish Government will be to adapt the Swedish energy efficiency program and legislation to the EU policy agenda, particularly the EU Directive (2002/91/EC) on the energy performance of buildings. Additionally, in accordance with the EU Directive (2006/32/EC) on energy end-use efficiency and energy services, the Swedish Government has submitted its National Energy Efficiency Action Plan (NEEAP) and also produced the report "A More Energy-Efficient Sweden" (SOU 2008:25).

A number of evaluations have been performed over time and results have been presented in, for example, UNFCCC (2006a) and the IEA (Neij, 2004).

2.2 Policy Instruments

A range of policy instruments have been, and are utilised, to influence energy conservation and management in buildings (see Figure 1). These are listed below along with key findings and comments from evaluations.

Figure 1: Timeline of key policy instruments in Sweden



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

Building regulations: The first national building regulations in Sweden were introduced in 1956, and in 1975 the first requirements on energy efficiency were included (Smeds, 2004). Over time, the requirements related to energy efficiency that have been revised on several occasions (see Box 2). The most significant change occurred in the 1988 revision, when there was a shift from prescription based codes to performance based codes (i.e. from requirements related to specific equipment to requirements for the functioning and efficiency of entire buildings). With this revision, the requirements for energy efficiency could be achieved by different means. However, the performance based codes require exact and complicated calculations to show that the requirements are fulfilled. Due to this, it has become more challenging to verify that the requirements are fulfilled (Smeds, 2004).

Box 2: Main changes in building regulations relevant to energy efficiency in Sweden

1975	After the oil crises in 1973, there was the introduction of legislation on buildings called SBN 75. In 1977, the supplement to SBN 75 on energy efficiency came into force. The focus for SBN 75 was on components, giving the required k-values for different building components. For example, walls 0.3 W/m^2K, roofs 0.2 W/m^2K, floors (slab) 0.3 W/m^2K, and windows (frame and glass) 2.0 W/m^2K.
1984	A special committee on energy use was established by the Swedish Government called Elanvändningskommitten (ELAK). This committee suggested that stricter building codes be applied for dwellings heated by direct electric resistance heating. For these houses, k-values of 0.17 W/m^2K and mechanical ventilation with heat recovery was required.
1988	A major shift occurred from prescription-based (on components) to performance-based on buildings. This meant that an average U-value for the whole building was calculated, allowing more freedom in design and construction. This development required more detailed, and at times, complicated calculations by designers and architects in order to show that the U-value requirement for the whole building was fulfilled. A consequence of this approach was that it was much harder for a local housing committee to control if calculations were correct. The average U-value ($U_{m,krav}$) was calculated as follows, where A_f is the window area and A_{om} is the envelop area facing the interior. $$U_{m,krav} = 0{,}18 + 0{,}95 \frac{A_f}{A_{om}}$$
2002	Some minor changes occurred to the formula above. Specifically U_m,krav was altered to be F_s,krav $=0{,}16+0{,}81A_f/A_{om}$
2006	This building code set minimum standards on the energy performance of new buildings and existing buildings subject to major renovations. Compared to the previously component U-values and then the system average U-value, this building code defined the required level of energy demand for residential buildings at 110 kWh/m^2 in the southern zone of Sweden and 130 kWh/m^2 in the northern zone. As stated, two climate zones were introduced. Furthermore, to improve energy efficiency, regulation systems must be in place in buildings for the supply of heating and cooling. Alternative regulations for small buildings also provide the option to apply component specific U-values rather than the overall energy demand of buildings.
2008	Minor changes occurred in the 2008 revisions of the building code, including that three climate zones were introduced. Maximum power was introduced and electrically heated buildings were defined. Residential buildings with heating systems other than electric are as follows: northern zone is 150 kWh/m^2; middle zone is 130 kWh/m^2; and southern zone is 110 kWh/m^2. Residential buildings with electric heating are as follows: northern zone is 95 kWh/m^2; middle zone is 75 kWh/m^2; and southern zone is 55 kWh/m^2.

Source: Smeds, 2004; Neij & Öfverholm, 2002; BBR 2006; BBR 2008

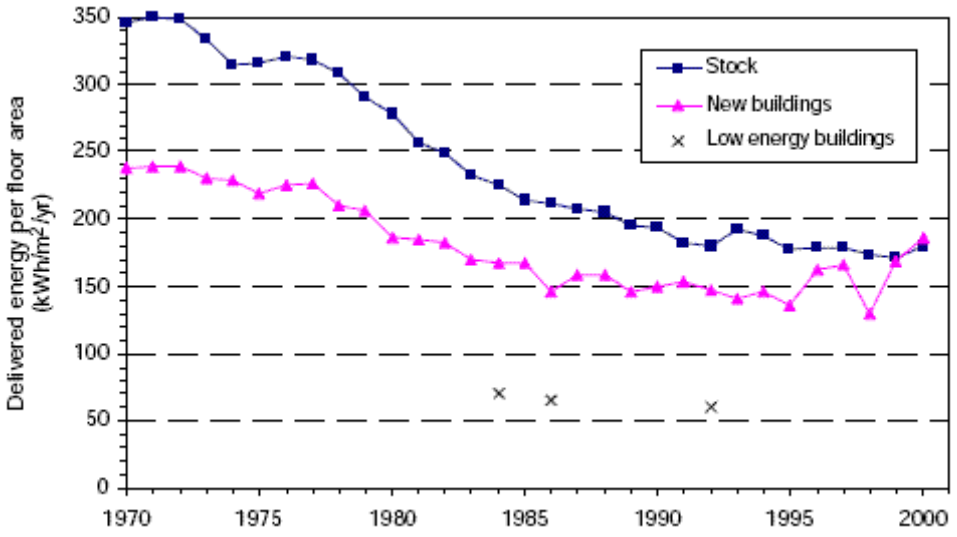
According to Swedish building regulations, constructions which are erected or renovated shall comply with technical requirements concerning (among others) energy efficiency and thermal insulation. When dealing with alterations, the requirements are the same as erections. However, the requirements shall be carried out with consideration to the proportions of the alteration and the standard of the building (including for example cultural values). The requirements should be satisfied in regard to the part added or altered. If an alteration to a building other than an addition considerably extends the working life of a building or causes a

substantial change in the use of the building, the requirements shall be satisfied also with regard to those parts of the building which, without being subjected to the alteration, are indirectly affected. In practice, it is not always easy to tell which requirements apply in an individual case. For alterations, there are no detailed regulations, only general recommendations. The Swedish Board of Housing, Building and Planning are therefore conducting a project to define more detailed regulations for alterations to buildings. The idea is to provide guidelines on how to understand the requirements in an individual case – not to define the exact requirements for all types of buildings and situations.

In recent years, voluntary building standards are being introduced in Sweden, such as for passive houses and mini-energi-hus. Moreover, municipalities have been developing programmes to support more energy efficient buildings. Miljöbyggprogram Syd (www.miljobyggprogramsyd.se) is an example of such a programme where municipalities are working together supporting more energy efficient and in general more sustainable buildings. The programme is being developed by Malmö City, Lund City and Lund University.

The development of the building codes in Sweden has not been accompanied with the development of any strategic evaluation plans. We assume that the Swedish Government and relevant agencies are confident that the requirements are fulfilled, and it has always been the full responsibility of the contractor that building regulations are fulfilled. However, studies have shown that the measured energy consumption in houses built in the 1990s could be 50-100% higher than under the calculated energy use (Elmroth, 2002). Moreover, Nässen & Holmberg (2005) show the energy use in general for multi-dwelling buildings has increased in recent years (see Figure 2). Moreover, they show that the total stock has improved much faster than new buildings, and even achieved similar levels in recent years.

Figure 2: The development of delivered energy use for heating per floor area of multi-dwelling buildings in Sweden



Source: Nässen & Holmberg (2005)
Note: The stock represents all heated floor area in a certain year. The curve for new buildings shows the energy use in the year of completion. Examples of low-energy buildings are included to illustrate the gap to Best Available Technologies.

Energy declarations: As explained, the EU Directive (2002/91/EC) on the energy performance of buildings includes a number of major actions with energy declarations as a key component. Energy declarations require that owners of detached houses, apartment buildings and commercial premises provide information on the energy use of buildings (Swedish Ministry of Sustainable Development, 2006b). The purpose is to encourage energy efficiency and good indoor conditions in buildings. Under Swedish legislation, buildings will be subject to inspections, and certain information about the energy use and indoor environment of buildings will be certified in an energy declaration when buildings are constructed, sold or rented out (Hjorth, 2008). An energy declaration (Swedish Ministry of Sustainable Development, 2006b) includes the following information:

- the amount of energy that is used in a building each year to meet the needs associated with normal use of the building (e.g. energy performance);
- that the mandatory performance inspection of the ventilation system has been carried out;
- whether radon measurement has been carried out in the building;
- a reference value to be able to compare and assess the energy performance of the building; and
- proposals for appropriate energy efficiency measures in the building.

Only authorised energy experts can carry out energy declarations. With the help of information from building owners, energy experts perform the energy certification process. The energy experts examine the data provided and develop cost effective draft measures. The energy experts send the energy declaration to the Swedish National Board of Housing, Building and Planning, and give the building owner a report with the summary to be set up as information. Only approved companies, accredited by the Swedish Board for Accreditation and Conformity Assessment (SWEDAC) may carry out energy declarations.

Energy declarations can be described as an informative tool. The idea is that building owners will be able to reduce the costs of energy use through the measures proposed in the energy declaration. Examples of possible measures that could be included in an energy declaration are additional insulation and energy efficient windows, more efficient lighting, control equipment, and a more efficient heating system. For owners of buildings that rate high in terms of energy efficiency and a good indoor environment, the energy declaration could be a valuable sales argument. Furthermore, the energy declaration will have an economic value for anyone who buys a building as it is valid for 10 years from when it is drawn up (IEA, 2008a).

Owners of single-family homes will require an energy declaration if anyone constructs a new building or has a building constructed on their behalf, and if a building is sold. Energy declarations of these buildings began in January 2009. If a building is sold on within 10 years from the time when the energy declaration was made, no new certification is required (Swedish Ministry of Sustainable Development, 2006b). Owners of rented housing and cooperative housing (i.e. mainly multi-dwelling buildings and buildings containing non-residential premises) will also have to ensure there is an energy declaration for the building if it is not more than 10 years old. Energy declarations for multi-dwelling buildings came into force in 2008. Finally, the most recent energy declaration must be available in a clearly visible place in the building (Swedish Ministry of Sustainable Development, 2006b).

As energy declarations have just started in Sweden, there are no in-depth evaluations thus far. However, this is a policy instrument where evaluations will play an important role for improving the design and implementation over time.

Taxes: In Sweden, taxes have been used since the 1950s on fuels, electricity, carbon dioxide, sulphur, and nitrogen oxide. Price increases achieved by taxes provide incentives for energy efficiency. Taxes are both generic and horizontal (e.g. energy and carbon taxes), but have also been applied to defined areas (Swedish Energy Agency, 2008).

The effect of taxes on energy efficiency has been evaluated several times (Neij, 2007). The results show that Swedish energy taxes have contributed funds to the general expenses of the State, and provided incentives for energy efficiency. In the housing and service sector, taxes have been shown to contribute to a more efficient use of energy and influenced the choice of heating systems (Swedish Environmental Protection Agency & Swedish Energy Agency, 2006). Taxes are described as a cost-effective instrument for energy efficiency. However, it is also recognised that the use and design of taxes for energy efficiency may be limited by other social and distributional aspects, with the result that taxes are not always sufficient, and therefore cannot be applied as the only policy instrument to achieve goals on energy efficiency (Neij, 2007).

Investment grants: Grants, loans and similar support mechanisms are primarily associated with the introduction of new technologies or systems. Such incentives have been excessively used in Sweden for decades, but are generally only available for limited periods of time (see Table 1). 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	Number 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

The subsidies applied in Sweden have not been evaluated in any strategic manner, but 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 by the Swedish Board of Housing, Building and Planning (2008) shows that the economic resources of the aid seem to be well adapted to its demand.

Information and education: Over the years a number of campaigns for energy efficiency have been applied. In 2007, in connection with the EU Directive (2002/91/EC) on the energy performance of buildings, and the EU Directive (2006/32/EC) on energy end-use efficiency and energy services, an energy efficiency home consumer campaign was launched in Sweden. The campaign provided information about energy declarations and addresses both individual homeowners and owners of multi-dwelling buildings and premises as well as other relevant key players (Swedish Energy Agency, 2008). The Swedish Environmental Protection Agency (www.naturvardsverket.se) also published an information and educational campaign called Climate Facts (Klimatfakta) in 2008. It provides informative packages of facts, and questions and answers about climate change. All material is free for use, and can be used to create training programs and presentations.

In most cases there have been no evaluations of the effectiveness of information and education. One reason is that the cost of evaluations is usually relatively high in relation to the cost of the actual information. Despite the lack of evaluations, there is agreement among many actors that educational 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.

Local energy advisors: Since 1998, the Swedish Energy Agency has supported a network of Local Energy Advisors (LEAs) in all local governments across Sweden. They provide the general public, small companies and organisations with advice and information on energy efficiency and renewable energy. They are supported by Regional Energy Offices (REOs) that provide training and coordinate information activities (Swedish Energy Agency, 2008). The idea of the LEAs and REOs is that increased awareness should translate into actual investments by households, organisations and companies.

As part of the program the Swedish Energy Agency has continuously been monitoring the progress, primarily through an annual survey to LEAs and the public about how well local energy advice is working. The focus has been on the activities of the LEAs rather than on the effects. The LEAs have also been evaluated by complementing external evaluators. Early evaluations were conducted in 1999, 2000, 2002 and 2003 (e.g. COWI, 1999; COWI, 2000; Reje Management, 2000). These evaluations provided some additional information of market effects (i.e. changes in the knowledge and behaviour of consumers due to the municipal information centres). The qualitative analysis of Reje Management (2000) claims that the activity has no effect on the use of electricity.

In the AID-EE project (www.aid-ee.org), Khan (2006) provides an evaluation of LEAs and REOs from the first period (1998-2002) and the second period (2003-2007). At the time of the evaluation, there was about 220 LEAs working in the 290 municipalities (some work for several municipalities) in Sweden. Khan (2006) argues that it is not possible to reach any quantitative conclusions about the success or failure of the programme regarding net impact, effectiveness and cost efficiency, since the data on these outcomes do not exist. Furthermore, the programme did not have any targets regarding these aspects. When it comes to softer and qualitative aspects the results are mixed and it can be debated whether the programme is successful or not.

On the positive side the following outcomes can be brought forward:

- Local energy advice has been established in all municipalities in Sweden and some municipalities work very actively with local energy advice and see it as an integrated part of their energy policy.
- The LEAs are relatively well known to the public.
- The LEAs receive good support from the Swedish Energy Agency and REOs, in the form of information material, courses and co-ordination. In many regions networks between LEAs have been established.
- Those households who use the service of LEAs are satisfied and seem to be influenced by the advice when they make decisions about investments and their energy use.
- The programme functions well in its role as a complement to other policy tools, such as subsidies, tax reductions, and labelling programmes.

On the negative side the following comments can be made:

- There are large differences regarding the commitment of municipalities. The general picture is that municipalities do not give much support to LEAs, neither in financial terms nor in other types of support. While this makes the job of LEAs more difficult it also casts some doubts on the long-term sustainability of local energy advice.
- LEAs feel that they need more education and training in order to be able to carry out the tasks that are required.
- Not very many people actually use the service of LEAs.
- The net impacts of the programme are very uncertain.

Instruments for improving networking: A number of voluntary associations have been developed to support a more efficient use of energy, for example, Bygga Bo Dialogen (www.byggabodialogen.se), Bebo (www.bebostad.net) and Belok (www.Belok.se). The main focus of these associations is to improve energy efficiency through improved networking and co-operation. These initiatives can be described briefly as follows:

- Initiated in 1998, the Bygga Bo Dialogen is a form of co-operation between companies, municipalities, national and local authorities, and the Swedish Government. The common goal is a sustainable building and property sector before 2025 in the areas of the indoor environment, the use of energy, and the use of natural resources. Some of the cities involved include Stockholm, Malmö, Göteborg, Karlstad, Kalmar, etc. Examples of organisations involved in the co-operation include Electrolux, Svenska Bostäder, Akademiska Hus, etc. The participants run many projects in their everyday work of spatial planning, new construction, refurbishment, project management and property management. Low energy concepts in both new construction and refurbishments are prominent on the agenda.
- Initiated in 2001, Belok is a collaboration between the Swedish Energy Agency and the largest property owners in Sweden with a focus on commercial premises. It operates several development projects focusing on energy efficiency and environmental issues. The vision of Belok is to be the leading group of property owners, via the implementation of various projects that can pinpoint ways to significantly reduce energy use in buildings. The energy used will also largely be based on renewable energy sources. The mission is to support promising energy efficient products, systems and methods, and to create the necessary conditions for implementation.
- Bebo is a collaboration between the Swedish Energy Agency and some of the largest property owners in Sweden with a focus on housing. The group concentrates on energy efficiency and environmental issues. It has been operating since 1989 and has been active in several successful activities, such as technology procurement. Operations have been carried out within particular areas of refrigerators/freezers, washing and drying equipment, ventilation systems, fan assemblies for existing buildings, stairwell lighting, electric motors and individual metering and billing of heat and hot water. Reductions of energy use and annual costs of 30-50% have been achieved for individual projects.

Evaluations of Belok reveal that it is working mainly in the areas of market transformation and technology procurement, and it is not aiming at short-term savings. It is therefore a long-term endeavour, which makes it difficult to determine its impact, effectiveness and cost-

efficiency in quantitative terms (Nilsson, 2006). 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 investment. A key success factor has been that dedicated and motivated individuals have been involved from the start. A weakness of Belok is that little attention has been paid to evaluation of activities (Nilsson, 2006). Bertelsen (2007) suggests that all new projects under Belok propose measurable targets. Another important task for Belok could be to develop simple and cost-effective evaluation methods (Bertelsen, 2007).

Technology procurement: Technology procurement is a policy measure intended to assist the development of new energy efficient technology. As it involves a tendering procedure, it is a form of competition between manufacturers. The main application areas include heating and control systems, domestic hot water systems, ventilation, white goods, lighting etc. Since the 1990s, 56 technology procurement projects within the energy field have been carried out by the Swedish Energy Agency (2008) and its forerunners. This has been achieved through combinations of policy instruments.

Technology procurement has had the ambition to coordinate and support the interaction between buyers and manufacturers. In theory and practice, there are many benefits of technology procurement that relate to innovation. Technology procurement can eliminate barriers to market entry and market expansion, help to reduce uncertainty for both users and manufacturers, and contribute to coordination and collaboration between key players in the market. Public procurement can also be seen as an important tool for the introduction of new technologies. Public procurement provides a good base for the introduction of new technologies, which can then be introduced in other sectors.

Technology procurement can be considered as a policy instrument utilised to stimulate market changes and to promote the spread of new and efficient technologies (across products, systems and processes). Some current technology procurement projects in Sweden include demand controlled ventilation in new apartment buildings, control and monitoring systems for properties, climate screen integrated systems for solar shading and daylight penetration (Swedish Energy Agency, 2008).

Energy labelling: Across the EU there is energy labelling of white goods. Furthermore, information on energy consumption for home electronics and office electronics are to some extent provided through the Energy Star (www.eu-energystar.org) and TCO labelling (originally this was called Tjänstemännens Centralorganisation) on information technology and other types of office equipment (www.tcodevelopment.com).

Evaluations indicate a huge effect of these labelling schemes on energy efficiency. The Swedish Consumer Agency estimates that mandatory energy labelling of domestic appliances, which has existed since 1995 in the EU, has contributed to a 25-35% drop in the average energy consumption of new domestic appliances, and forced some of the “worst” appliances off the market (UNFCCC, 2006a).

Labelling of windows: In January 2004, an invitation to all window manufacturers was made by the Swedish Energy Agency regarding a voluntary energy efficiency labelling scheme. Collaboration started in January 2006 with 10 manufacturers or 35% of the market (Kiss, 2008). The agreed method was U-values or heat losses through windows with a rating system from A to G. The rating levels were set at 0.9 W/m^2K for A and 1.5 W/m^2K for G. 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 (www.energifonster.nu). Windows can therefore receive an EQ mark on their labels if they pass requirements on energy or E and quality or Q.

Voluntary agreements: The Swedish Energy Agency (2008) points to activities across the EU in terms of the voluntary agreements between government and manufacturers, which take a variety of forms, such as industry covenants, negotiated agreements, codes of conduct, and benchmarking and monitoring schemes. Examples include the Green Light Programme (www.eu-greenlight.org) and EU actions for reduction of standby losses and efficiency improvements of washing machines and cold appliances (IEA, 2008a).

2.3 Action Plans

As stipulated in the EU Directive (2006/32/EC) on energy end-use efficiency and energy services all Member States must submit an action plan on energy efficiency. The National Energy Efficiency Action Plan (NEEAP) for Sweden was submitted in 2007. It highlighted that work on energy efficiency has been going on for several decades. A large number of measures have already been implemented and helped to reduce energy consumption. In 2007, the Swedish Energy Agency conducted an appraisal of policy instruments whose effects may be credited in accordance with the EU Directive (2006/32/EC) on energy end-use efficiency and energy services. The Swedish Energy Agency also calculated the energy savings associated with these policy instruments. The Commission of Inquiry reviewed and supplemented the analysis by the Swedish Energy Agency for the NEEAP.

In the case of housing and services (this sector encompasses construction in its entirety, land-based industries and some service functions with close links to construction, but buildings classed as industrial units are not covered), the impact of actions conducted between 1991 and 1995 until 2005 is estimated at 17.9 (11.5) TWh (the numbers in brackets refers to energy end-use). The impacts of policy instruments already decided upon, and which are expected to be adopted between 2005 and 2016, have been estimated at 19.5 (8.9) TWh. The Commission of Inquiry estimates the total economic potential for energy efficiency improvements in construction up to 2016 to be 41 (25) TWh. Of this total, district heating and fuels account for 16 (14) TWh and electricity for 25 (10) TWh. Housing and services represents the sector with the most significant potential for greater energy efficiency.

A major conclusion in the NEEAP is that more significant energy efficiency improvements will not happen by themselves. Market forces cannot independently meet the need for a reduction in energy use, particularly on the kind of scale required to reduce GHG emissions. Policy instruments of various kinds will be vital to go further. An overarching constraint, raised by the Commission of Inquiry, is that policy instruments must be motivated from a socio-economic perspective.

The Commission of Inquiry has identified some 30 potential policy instruments for all types of energy efficiency improvements. One of the most significant policy instruments in the housing and services sector concerns a programme for more efficient electricity use through conversion of heating systems from electric to district heating, heat pumps and biofuel-fired boilers, and also more efficient use of electricity in households, businesses and operations. A

further proposal is a more rigorous application of the energy certificates for buildings. Specific suggestions for housing and services include:

- Energy certificates/declarations in buildings, continuous development.
- Energy classification of buildings.
- Energy conservation requirements associated with renovation.
- Evaluation and announced gradual tightening-up of the new-build requirements.
- Programme for more energy efficient electricity use.
- Continued promotion of energy services.
- Technology procurement.
- Increased local authority energy advice.
- Programme for more efficient energy use in land-based industries.
- Research, development and demonstration projects.

There are 4 major conclusions and recommendations in the NEEAP that flow out of the evaluations of policy instruments for energy efficiency. These include:

- **Energy certificates:** As stated, energy certificates are high on the list of priorities. They are considered a unique way to formulate "individual action proposals for each house and each property owner" (SOU 2008:25). The Commission of Inquiry calls for continuous reviews and improvements of the system for energy certificates.
- **Public sector:** The Commission of Inquiry perceives a special role for the public sector. It proposes that the State should set a good example via an extensive programme of more efficient energy use in State activities. Furthermore, local authorities and county councils are also identified as important players.
- **Information campaigns:** The dissemination of information on good examples tailored to a diversity of energy users, such as households, property owners and public administrations, is important, especially at an early stage of wider activities on energy efficiency.
- **Overall strategy:** A general principle should be for energy efficiency to be viewed as a central part of the work on climate and energy issues. An overall strategy should encompass improved statistical information, and combined analysis of the impact of policy instruments.

2.4 General Discussion

In Sweden, a package of policy instruments have developed over time and generated energy savings in the building sector. Many instruments have been traditional, including, for example, taxes, building codes and subsidies. 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. 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 investment.

On technology procurement, since the 1990s, 56 technology procurement projects within the energy field have been carried out by the Swedish Energy Agency (2008) and its forerunners. The main application areas include heating and control systems, domestic hot water systems, ventilation, white goods, and lighting. Labelling of windows or 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. As an example, Swedish building codes have not achieved the intended results. Studies have shown that the measured energy consumption in houses built in the 1990s could be 50-100% higher than under the calculated energy use (Elmroth, 2002). As a result, the revised building codes of 2006 have recommended measurement of actual energy use. Another example of potential improvements is the use of subsidies that could be more strategic and designed based on long-term strategic planning rather than on a short term basis.

There is also a diverse and uncertain responsibility on energy efficiency between agencies in Sweden. There is no central responsibility for energy efficiency, and research activities are dispersed. While the Swedish Energy Agency (Energimyndigheten) and the Swedish Board of Housing, Building and Planning (Boverket) are the main agencies working on energy efficiency in Sweden, the Swedish Consumer Agency (Konsumentverket), the Swedish Environmental Protection Agency (Naturvårdsverket) and municipalities also have energy-related undertakings related to energy efficiency in the building sector. 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.

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.

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. We can still greatly improve in designing, implementing and applying policy instruments for energy efficiency. It is 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 for energy efficiency in buildings in Sweden.

3 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.

3.1 Institutional Framework

The Danish Energy Authority (Energi Styrelsen) is responsible to advise the Minister for Transport and Energy, to assist other relevant authorities, and to implement energy policy as well as to conduct assessments of the energy sector. The Electricity Saving Trust (Elsparefonden) was established by law in 1996 as an independent fund with its own board and activities. Amongst its most important tasks is the conversion of electrically heated homes and public buildings to district heating or natural gas. It also employs a product-oriented strategy for the development of more energy efficient appliances, and promotes the use of such appliances via agreements on purchasing policy. The Danish Enterprise and Construction Authority (Erhvervs- og Byggestyrelsen) is responsible for a number of energy-related tasks in the construction sector. Finally, the electricity, gas and district heating companies are charged with promoting energy savings amongst their customers (Danish Energy Authority, 2008).

The overall guidelines for energy conservation activities in Denmark are laid down in the "Act on the Promotion of Savings in Energy Consumption" established in 2000. This Act aims to promote energy savings by consumers with a view to international environmental commitments. To implement the EU Directive (2002/91/EC) on the energy performance of buildings, Danish legislation was enacted in 2005 through an "Act on the Promotion of Energy Savings in Buildings". This Act was followed up by 3 Executive Orders on the following: 1) the inspection of ventilation and air conditioning systems in buildings; 2) energy labelling of buildings; and 3) the inspection of boilers and heating installations in buildings.

In the "Agreement on Danish Energy Policy for 2008 to 2011" the main aim is to lower dependence on fossil fuels through achieving energy savings and renewable energy targets. The efforts to save energy are being ramped up 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). For new buildings there shall be a cutback 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 2007, the Danish Government released a policy statement entitled "A Visionary Danish Energy Policy 2025" that contains a number of proposals, including strong commitments to energy efficiency (Danish Ministry of Transport and Energy, 2005b).

A number of documents provide the foundations for Danish policy on energy efficiency, in particular for energy use in buildings. The "Action Plan for Renewed Energy-Conservation" in 2005 called for "ambitious and dynamic energy conservation efforts" (Danish Ministry of Transport and Energy, 2005). The Action Plan highlights the need for a market-based programme on energy efficiency and the public sector as a focal area for energy savings.

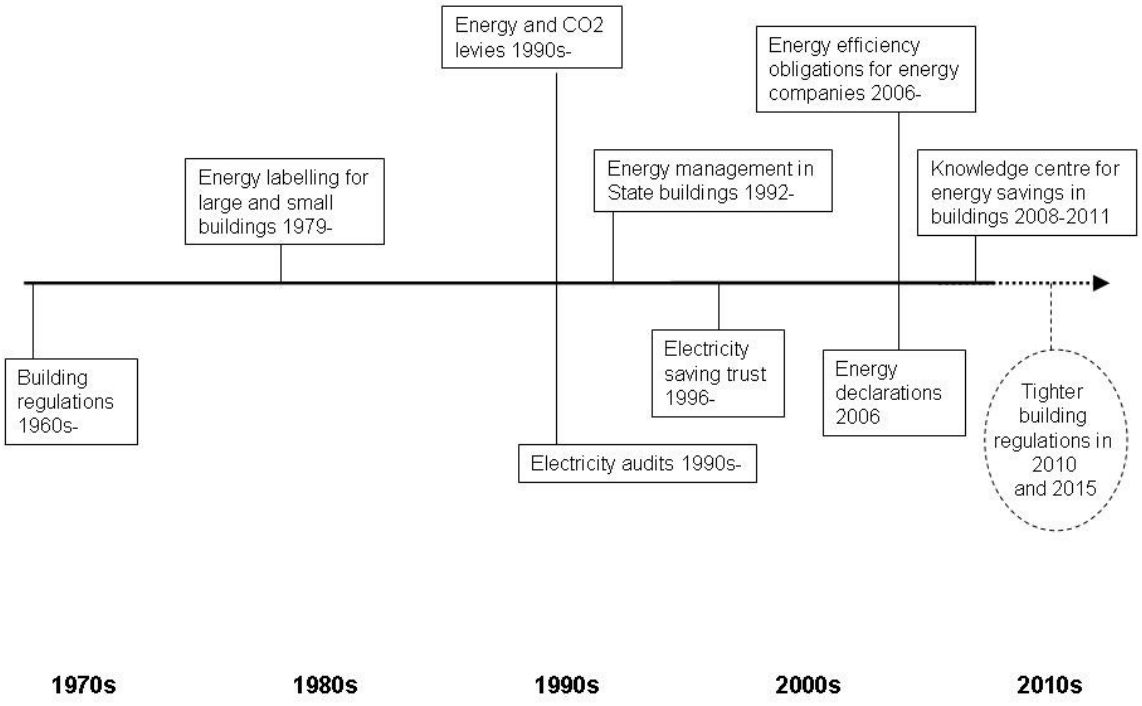
Initiatives discussed in the Action Plan cover: new and existing buildings; commercial enterprises; the public sector; appliances and products; information and behaviour; research and development; and price-sensitive electricity consumption. The "Danish Energy Saving Report" produced in 2003 is also an important document (Danish Ministry of Climate and Energy, 2003).

A number of evaluations have been performed over time and results have been presented in, for example, UNFCCC (2007) and the IEA (Bach et al., 2004). Furthermore, a major, systemic evaluation was conducted in 2008 by Energy Analysis, Niras, RUC and 4-Fact (2008a, 2008b).

3.2 Policy Instruments

In Denmark, there are several policy instruments that stimulate energy efficiency improvements in buildings (see Figure 3). These are listed below along with key findings and comments from evaluations.

Figure 3: Timeline of key policy instruments in Denmark

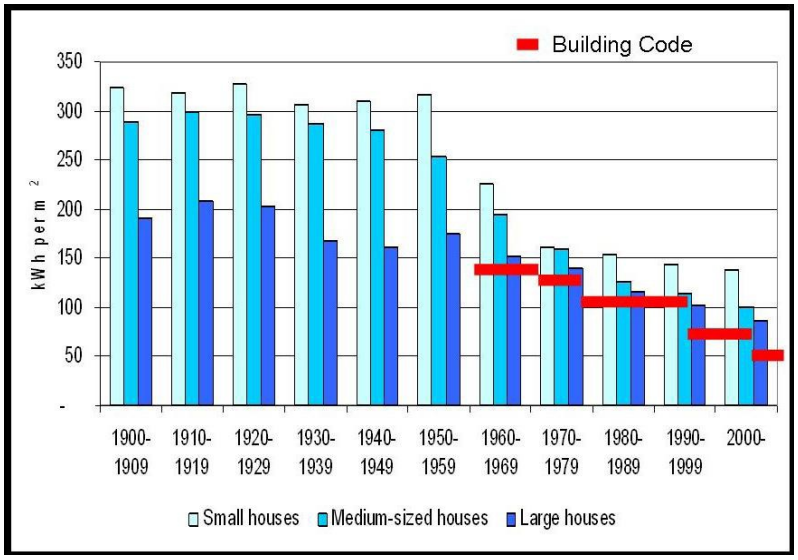


Note: In addition to the policy instruments in the figure, there are also voluntary agreements, education and information, and grants and subsidies.

Building regulations: Energy requirements for new buildings have been increasingly stricter in Denmark since the 1960s (see Figure 4). In more recent times, to implement the EU Directive (2002/91/EC) on the energy performance of buildings, the Danish Government has enacted several new standards, including the present and future figures of maximum heat

demand (see Box 3). Furthermore, Danish building codes set standards for energy properties in facade windows for both new buildings and replacement of windows in existing buildings (Danish Ministry for Economic and Business Affairs & Danish Enterprise and Construction Authority, 2008). The most recently revised building codes also aim to introduce specific requirements in building regulations relating to the replacement of roofs, oil and gas boilers, and changes of heat supply. There are also plans to legislate energy efficiency improvements in new, renovated and existing buildings in 2010 and 2015 (Danish Ministry for Economic and Business Affairs & Danish Enterprise and Construction Authority, 2008).

Figure 4: Energy demands of new buildings in Denmark (1900-2000)



Source: Lausten, 2008

Box 3: Requirements for New Buildings

An energy performance target is the main requirement for all types of buildings heated to at least 15°C. The target is based on the supplied energy needed for operating the building. There are separate targets for housing (not including lighting) and non-domestic buildings (including lighting). The requirements are as follows:

Housing: 70 + 2200/A kWh/m² year
Non domestic: 95 + 2200/A kWh/m² year

In the calculation, A is the gross heated (conditioned) floor area in m².

An extra allowance to the basic target is given to non-domestic buildings with high ventilation requirements, high lighting requirements, long operation hours or a large hot water demand.

The energy framework is supplemented by specific requirements for U-values, minimum boiler efficiency, pipe insulation, heat recovery, fan power efficiency etc. The supplementary requirements are normally not crucial to the design, they are only set as an indication of what is possible.

Source: Aggerholm, 2008

For all types of buildings there are 2 additional classes to the basic requirements of the building codes. These are designed to support the construction of low energy buildings. Class 2 has an energy demand of 75% or less (or 50 kWh/m^2/year) if compared to the basic requirements, and Class 1 has an energy demand of 50% or less (or 35 kWh/m^2/year) if

compared with the basic requirements (Aggerholm, 2008). Class 2 is scheduled to be the basic building code requirement in 2010 and Class 1 in 2015 (Haydock &Arden, 2009). Furthermore, low energy buildings can be exempted from connecting to public works with natural gas or district heating, which is sometimes obligatory. Finally, Denmark has special energy efficiency rules for public buildings as well as rules for maintenance schemes for heating systems or other large energy-consuming installed devices in buildings.

The evaluation by Energy Analysis, Niras, RUC and 4-Fact (2008a) states that building codes in Denmark have been important in reducing energy consumption in new buildings. Greater flexibility has been created by focusing on the overall energy use of buildings rather than individual requirements on building components – but at the same time energy requirements have not always been met (see Figure 4). There are high expectations for the planned tightening of building codes in 2010 and 2015.

Energy labelling for large and small buildings: The energy labelling of buildings in Denmark (dating back to 1979) has developed in the context of a long history of energy saving policy initiatives. Energy labelling was, and still is, seen as an important way to achieve energy savings in both existing and new buildings. Denmark has implemented energy labelling for large buildings (of more than 1,500 m^2) and small buildings, such as one-family houses, apartments and other residential buildings (of less than 1,500 m^2) (Danish Ministry of Climate and Energy, 2008).

In response to the EU Directive (2002/91/EC) on the energy performance of buildings, energy labelling or certification of buildings has been required. In Denmark the former labelling scheme was further developed and a new scheme introduced in 2006. Under this scheme, buildings need an energy label, when they are newly constructed, when they are sold, and if they are rented out. For existing buildings certificates cannot be more than 5 years old. There are 14 classes covered by the labelling scheme, from A1 at the highest level to G2 at the lowest level. New buildings must meet requirements corresponding to a B1 label. A handbook has also been developed for energy consultants establishing labels, in which 2 types of energy saving measures must be identified: immediately feasible ones and those feasible if carried out in addition to ongoing renovation (IEA, 2008b).

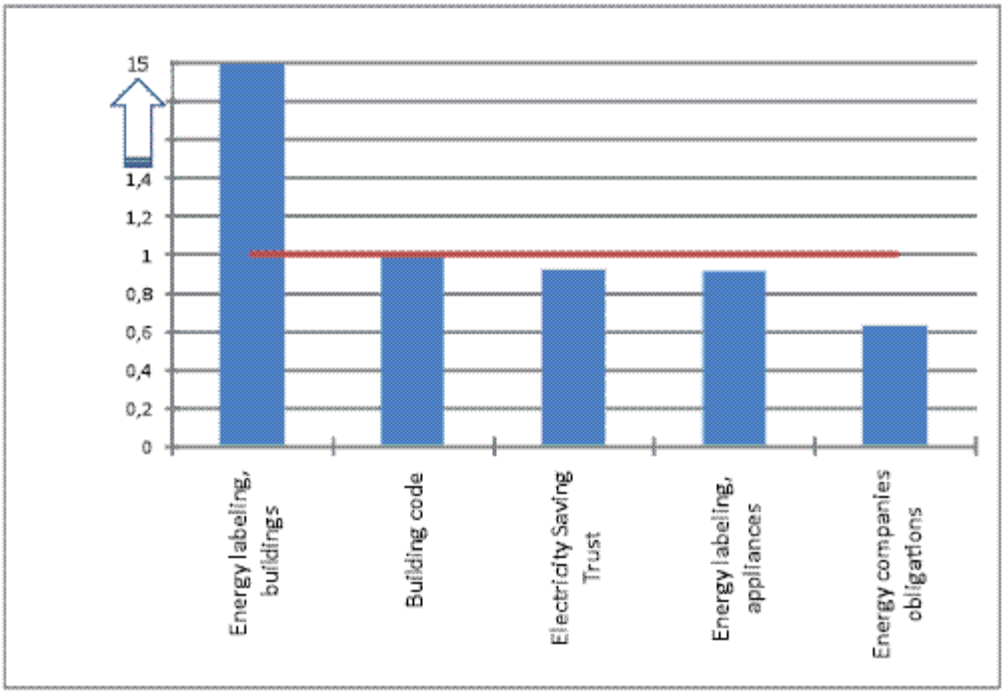
The evaluation by Energy Analysis, Niras, RUC and 4-Fact (2008a) found that the impact of the energy labelling scheme for large and small buildings is at best limited. While labelling has been obligatory, it is not enforced. Another major problem has been the cost-benefit balance (see Figure 5). Put simply, a consultant is required to carry out the labelling process, which 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). In addition, the labelling scheme has been evaluated for 4,000 small buildings focusing on natural gas consumption. The data is from 2002, before the latest legislation, however the conclusion is clear – there is no significant difference in energy efficiency measures taken between houses with or without a label.

Energy and CO_2 taxes: 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). The CO_2 tax is expected to be raised on sectors not subject to CO_2 quotas under the emission allowance trading scheme (from the start of 2008, CO_2 quotas based on the emission allowance trading scheme in the EU have resulted in increased electricity prices for all

electricity consumers in Denmark). 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). The actual taxes paid differ between sectors and end uses. The highest taxes are for electricity use in households and the public sector. Also energy used for heating has high taxes across all sectors (Togeby et al., 2009).

Figure 5: Estimate of socio-economic cost of key policies in Denmark



Source: Togeby et al., 2009
Note: A value of less than 1 indicates that the total cost of energy efficiency is lower that the cost of supplying energy. The figure shows that energy labelling for buildings has a values greater than 1.

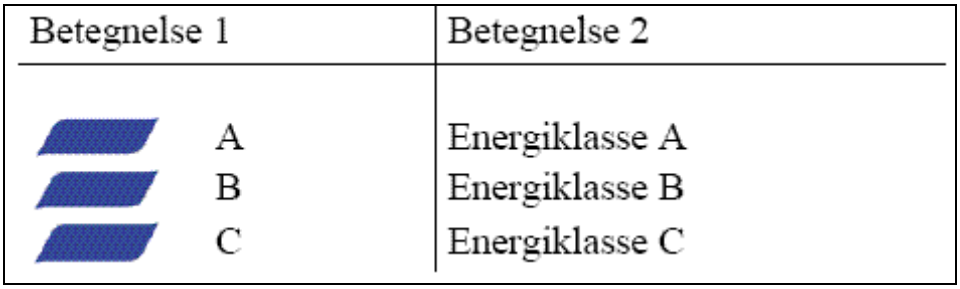
Grants and subsidies: Grants are available for energy efficiency measures (30-40% of the total costs) for private and public enterprises, however, they are not applicable to institutions which are included in appropriation laws or receive other types of public grants (IEA, 2008b). From 1993 until 2003, there was a subsidy scheme which provided the possibility to apply for State assistance for energy saving improvements in buildings occupied by pensioners. The objective of the scheme was to reduce heating costs and thus the cost of heating supplements from the Danish Government. However, better insulation, windows, etc. also resulted in better indoor comfort and improved quality of life for pensioners (UNFCCC, 2007).

Voluntary energy labelling scheme for windows: A number of voluntary agreements exist in Denmark. These agreements (IEA, 2008b) include:

- Trade organisations have entered into a voluntary energy labelling scheme for windows. The companies and products subject to the scheme are regularly checked and companies have to state the energy properties of their products. The scheme categorizes products on a scale from A to C (see Figure 6).

- The Danish Energy Authority, glass industry, glazier trade organisation and the window manufacturer cooperation organisation have entered into an agreement on the phasing out of traditional sealed units and the promotion of energy efficient window solutions. Consequently, energy efficient sealed units have become standard products in Denmark, and a campaign to promote their sales and those of other energy efficient window options has been launched.

Figure 6: Labelling scheme for windows in Denmark



Source: Avasoo, 2007

Electricity Saving Trust: Created in 1996 by the Danish Government, the Electricity Saving Trust coordinates and promotes electricity savings in the public sector and households primarily through information activities but also voluntary agreements and technology procurements. Energy efficiency activities must be carried out in accordance with socio-economic and environmental considerations. A major task had been to reduce the use of electric heating through switching to district heating or natural gas. Energy efficiency appliances and efficient use of appliances have also become a major area of work (Torgeby et al., 2009).

The Electricity Saving Trust has issued purchasing guidelines for public and private sector organisations and companies to purchase energy efficient equipment and appliances, covering office equipment, information and communication technologies, consumer electronics, lighting equipment, ventilation, motors and circular pumps, large appliances, water coolers, and vending machines. The purchasing guidelines apply to the purchase of both new equipment and new components for existing systems. All municipal and government institutions must purchase energy efficient equipment based on the purchasing guidelines (Danish Ministry of Transport and Energy, 2005a). The requirements covering energy efficient purchasing by the municipalities were incorporated in a voluntary agreement concluded in 2007 between the Danish Ministry of Transport and Energy, and Local Government Denmark (IEA, 2008b).

The activities of the Electricity Saving Trust were evaluated by Energy Analysis, Niras, RUC and 4-Fact (2008a). The costs of the Electricity Saving Trust are easily established, however the impacts on energy efficiency are not easily identified. Energy Analysis, Niras, RUC and 4-Fact (2008a) also find that electricity used in households and the public sector has relatively high taxes, and the emission allowance trading scheme also influences energy prices, which creates an incentive for energy savings. Some of the activities of the Electricity Saving Trust with households and the public sector may therefore be unnecessary (Torgeby et al., 2009). An earlier evaluation was also carried out on the Electricity Saving Trust by Rambøll Management (2004).

Education and information: Since 2005, Energy Service Denmark has provided independent energy advice to citizen-based organisations (www.energitjenesten.dk). Working from 12 local/regional offices, the aim is to promote behaviour and decisions that save energy and change energy use to renewable energy sources. The work of Energy Service Denmark is organised around 4 pillars, including: public information; a School Energy Forum (Skolernes Energiforum); a company service for small and medium enterprises; and "green" diplomas to improve and increase energy and environmental certification of institutions, shops, and offices (IEA, 2008b).

Moreover, since 2006, energy companies in Denmark, namely the electricity, gas and district heating companies, have been obliged to realise energy efficiency activities. They have organised campaigns and activities to promote energy efficiency through printed material, information telephone lines, media events and similar. The objective is to increase public awareness of the possibilities for action and diffuse knowledge about energy efficiency. While the obligations are applied to energy companies, the actual activities are often carried out by so-called "daughter" companies, and often combined with other activities. The evaluation by Energy Analysis, Niras, RUC and 4-Fact (2008a) suggests that about 50% of the recorded energy savings would not have been realised without the involvement of the energy companies. Results also appear to indicate that projects are economically attractive both from the customer perspective and the company perspective (Togeby et al., 2009).

Energy management in State buildings: Since 1992, energy management and annual reporting of energy consumption have been mandatory in every building used by the State. This includes central administration and State institutions, defence, and entities like the railways, etc. Local energy managers must be appointed in every institution to work on energy efficiency improvements (UNFCCC, 2007).

Energy Analysis, Niras, RUC and 4-Fact (2008a) show that the public sector has not been able to lead the way on energy efficiency. A statistical analysis of energy consumption in 100 public buildings with a total area of 1 million m^2 indicates an increase in energy consumption per area during the period 2000-2007 of approximately 4% for heat and 10% for electricity (Togeby et al., 2009). However, there appears to be some action on energy efficiency in the public sector through planned renovation projects.

Knowledge Centre for Energy Savings in Buildings: Annual funding of 10 million DKK has been allocated to the establishment of a Knowledge Centre for Energy Savings in Buildings for the period 2008-2011. The consortium selected to run the centre consists of the Danish Technological Institute, the Danish Building Research Institute at Aalborg University, Viegand og Maagøe, and Kommunikationskompagniet. The objective of the centre is to ensure greater awareness in the construction sector of how energy savings in buildings can be achieved, and to ensure greater awareness of the building regulation requirements, and thereby increase actual energy savings. The primary target group is tradesmen, contractors, advisors and consultants as well as smaller enterprises in the construction sector.

Electricity audits: Initiated in the 1990s, the free of charge electricity audits for companies provide information about cost effectiveness of possible measures, and how to best implement energy efficiency. It only partly relates to buildings, as the electricity audits can cover a range of energy efficiency options. The scheme is also only focused on non-residential electricity consumers. The theory behind the program is that in many cases companies need information to begin thinking about energy efficiency, and that such information can stimulate action

(Dyhr-Mikkelsen et al., 2005). An alteration to the electricity audits over the years has been the option for enterprises to choose a complete audit or a partial audit (which concentrates on specific installations or systems). An electricity audit (IEA, 2008b) involves the following aspects:

- an overview of electricity consumption and savings potential;
- a more detailed review of energy use by 13 different categories and a catalogue of energy efficiency ideas;
- a plan for electricity savings;
- a follow-up, typically 6-12 months after the electricity audit; and.
- a report to a common database, where the information remains confidential.

Dyhr-Mikkelsen et al. (2005) analyse an in-depth evaluation, conducted in 2004, on electricity audits. The evaluation employed 3 approaches, including: a review of existing material and a survey of energy auditors; graphic and econometric analyses based on statistical information (macro-level); and 10 case studies of different types of enterprises (micro-level). The evaluation showed that the primary concern of energy auditors was the lack of freedom to contact customers of their own choice, while being measured on cost-effectiveness. The energy auditors agreed that electricity audits are a good opportunity to promote other energy efficiency services. Finally, the energy auditors also predominantly argued that subsidies are important for the implementation of energy efficiency measures (although this is not reflected in responses by the enterprises in the case studies).

In terms of the econometric analyses, the uncertainty around the data quality was a concern. In contrast, the case studies provided an evaluation of the impacts, cost-effectiveness, customer satisfaction, and success/failure factors (Dyhr-Mikkelsen et al., 2005). On average, the enterprises received 5-6 pieces of advice. Of the total 56 pieces of advice, 36 have been implemented. The major reasons for not implementing advice were economic reasons or the advice was no longer relevant. As expected the implemented advice had shorter payback periods than the ones left unimplemented. Few of the enterprises attribute the implementation of energy efficiency measures to subsidies, principally because the subsidies do not influence the payback times (Dyhr-Mikkelsen et al., 2005).

3.3 Action Plans

In 2005, the National Energy Efficiency Action Plan (NEEAP) for Denmark was submitted to the European Commission. It was entitled the "Action Plan for Renewed Energy-Conservation". It argued for "ambitious and dynamic energy conservation efforts" (Danish Ministry of Transport and Energy, 2005). The NEEAP highlights the need for a market-based programme on energy efficiency and the public sector as a focal area for energy savings. Initiatives discussed in the NEEAP cover: new and existing buildings; commercial enterprises; the public sector; appliances and products; information and behaviour; research and development; and price-sensitive electricity consumption.

At the time, a number of "new" initiatives for heat savings in buildings were recommended. These included:

- Tightening of the energy requirements in the building regulations by 25-30% as of 2006.

- Objective of further tightening the energy requirements by approximately 25% as of 2010.
- For new low-energy buildings, abolishment of the obligation to connect to collective energy supply systems and of the ban on electric heating.
- Setting requirements in the building regulations for existing buildings relating to major renovations, change of heat supply, replacement of boilers, windows and roofs.
- Maintain and extend ambitious energy labelling of buildings.
- Network and distribution companies must give higher priority to the achievement of heat savings, for instance by means of more extensive energy labelling. In this context, agreements must be entered into with the construction sector on package and standard solutions.

Further new initiatives in energy-conservation efforts, included:

- Commercial enterprises:
  - Streamlining the consultancy and campaign effort towards commercial enterprises.
  - Promoting the sale of energy services.
- Public sector:
  - Setting requirements for energy-efficient procurement and implementation of profitable energy conservation projects as well as disclosure of electricity consumption in government institutions.
  - Corresponding requirements applicable to municipalities and regions.
- Appliances and products:
  - Upgrading the international effort on energy labelling and on requirements for the efficient use of energy, including for standby use.
  - Promoting transparency of energy consumption and development of advanced energy meters.
- Providing information and influencing behaviour:
  - Enhancing the information effort on energy conservation.
- Research and development and price-elastic consumption:
  - Promoting and targeting research, development and market maturation of energy-efficient technologies.
- Organisation of energy-conservation efforts:
  - Electricity, natural gas, district-heating and oil network and distribution companies must deliver larger savings within current economic frameworks. Monitoring will be introduced and companies will have a large degree of freedom in the choice of methods. With respect to business/industry, some of the actions taken are to be tendered out.
  - A co-ordination committee should be set up to ensure cost-effectiveness of the conservation efforts.

It is interesting to recognise that many of these initiatives and recommendations have been implemented, and expanded on by the Danish Government. As stated, in 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).

3.4 General Discussion

Many policy instruments have been developed over time in Denmark for energy efficiency in buildings. 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 in Denmark. The development of long term plans indicates a strong strategic enforcement of energy efficiency in Denmark. 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.

Innovative policy mechanisms in Denmark include a "voluntary approach" linked to the building codes providing 2 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-benefit 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).

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). 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.

Finally, 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 evaluation was the efforts of energy companies, energy labelling of

buildings, and the Electricity Saving Trust. Building regulations as 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).

4 Norway

Historically, with an abundant supply of hydropower, energy efficiency has not been high on the agenda in Norway, exemplified by 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.

4.1 Institutional Framework

Since 2002, Enova is the main agency that works to stimulate energy efficiency and new renewable energy in Norway. It is a public enterprise owned by the Ministry of Petroleum and Energy. The Norwegian Water Resources and Energy Directorate (Norges Vassdrags- og Energidirektorat) is in charge of the process of implementing the EU Directive (2002/91/EC) on the energy performance of buildings (which Norway decided to implement even though it is outside the EU). Two central elements include certification of buildings and inspection of boilers and air-conditioning systems. The National Office of Building Technology and Administration (Statens Bygningstekniske Etat) has also developed new technical regulations for buildings, increasing the requirements for energy efficiency.

Norway does not have national energy efficiency targets. However, Enova is charged with the task to limit energy use more than would be the case under business as usual. Energy efficiency policy in Norway is based on the 1999 “White Paper on Energy Policy”, and the 2003 “White Paper on Security of Supply” (IEA, 2005). For energy suppliers, the “Energy Act” in 1992 sets out their responsibilities for energy efficiency. A driver for domestic energy policy is to reduce dependence on hydropower by decreasing demand for electricity, and diversifying supply options. Finally, while Norway is not part of the EU, it pays close attention to EU policy and actions on energy efficiency and buildings.

The Norwegian Government has established an Energy Fund for the promotion of renewable energy and energy efficiency measures. In 2007, the capital was 10 billion NOK, and the Norwegian Government has proposed to inject a further 10 billion NOK in 2009. It is based on a levy on the transmission tariff for electricity. The Energy Fund is designed to provide a predictable, long-term framework for the industry engaging in renewable energy and energy efficiency projects, and provide grants and other financial measures in the field (Rosenberg & Espegren, 2006).

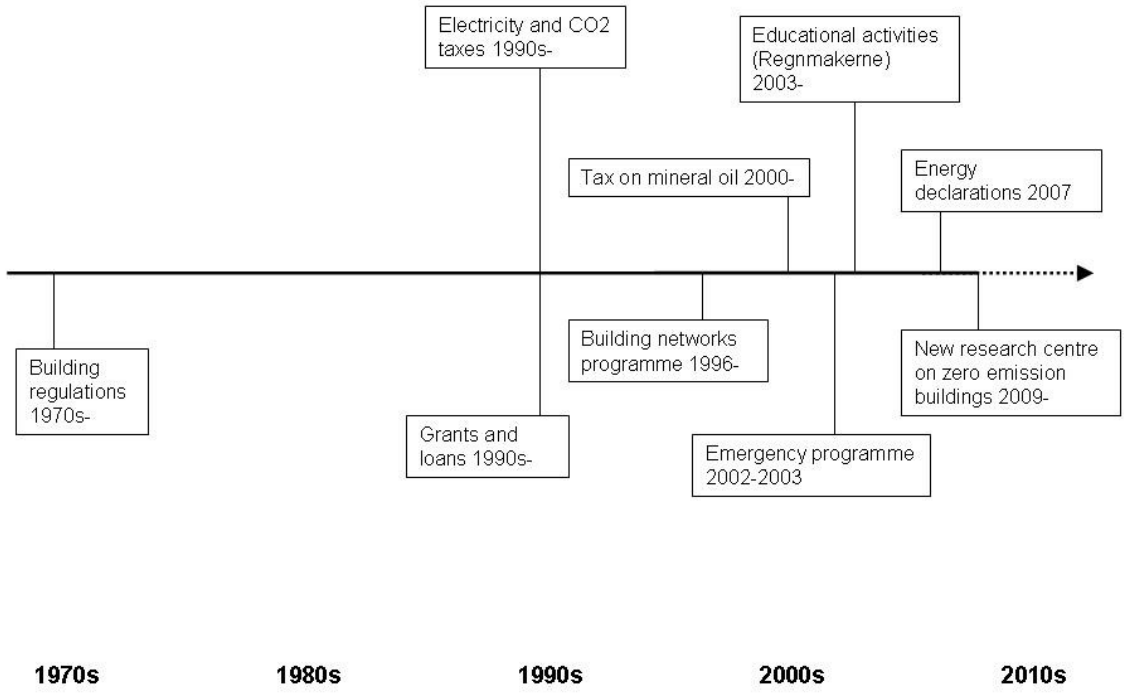
Following responses to the 2007 “White Paper on Climate Policy” a renewed effort on energy efficiency in buildings has been announced as part of the action plan to address global warming in Norway (Nakstad, 2009). The Norwegian Government has suggested a much greater emphasis will be put on altering energy-related practices and systems in the design of buildings, including a proposed ban on oil heaters in new buildings and a resolution that building codes should be revised every 5 years (Norwegian Ministry of Environment, 2007). Furthermore, the Norwegian Government has also recommended increasing economic support for energy efficiency actions, such as research and development as well as demonstration projects (Ryghaug & Sorensen, 2009).

A number of evaluations have been performed over time and results have been presented in, for example, UNFCCC (2006b) and IEA (2005).

4.2 Policy Instruments

The Norwegian Government has used various strategies to promote energy efficiency in buildings (see Figure 7). These are listed below along with key findings and comments from evaluations.

Figure 7: Timeline of key policy instruments in Norway



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.

Building regulations and emerging certification: Norway has a tradition of energy performance requirements in building regulations (IEA, 2005). Such requirements are defined as minimum standards for energy use in buildings and heat transmissions in building parts. New technical regulations for buildings have been established to increase requirements for energy efficiency. New regulations, including stricter energy standards and new methods to calculate energy demands, were put into force in January 2007 and were fully implemented in August 2009 (IEA, 2008c). Norway has decided to implement the EU Directive (2002/91/EC) on energy performance of buildings (IEA, 2005). This also means energy certification for buildings and energy inspections for heating and cooling installations.

Calculation of the net energy demand is proposed for all building categories as part of the new building code in Norway. The certification process will be based on the same procedure, and the suggested rating system will be based on delivered energy. A new national standard for calculating energy performance in buildings was published in October 2007 (Rode & Isachsen, 2008). In terms of energy efficiency, all buildings must meet a number of

requirements, according to a) energy efficiency performance (see Box 4), or b) the total net energy consumption (see Box 5). Minimum performances according to certain standards c) must not be exceeded in any circumstances (see Box 6). 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.

Box 4: Energy efficiency performance

All buildings must meet the following requirements:

- Total area of glass, windows and doors: a maximum of 20 percent of the heated floor area (sqm)
- U-value – exterior wall: 0.18 W/sqm K
- U-value – roof: 0.13 W/sqm K
- U-value – exposed floors: 0.15 W/sqm K
- U-value – windows and doors: 1.2 W/sqm K
- Standardized value for thermal bridges must not exceed 0.03 W/sqm K for dwellings and 0.06 W/sqm K for other buildings
- Air tightness: 1.5 air changes per hour by 50 Pa pressure difference. For dwellings the value of 2.5 air changes per hour by 50 Pa pressure difference applies
- Heat recovery of ventilation air in ventilation equipment (year mean heat recovery rate): 70 %
- SFP factor (specific fan power):
  - Commercial buildings: 2.0/1.0 kWh/m3s (day/night)
  - Dwellings: 2.5 kWh/m3s
- Automatic equipment for shading or other precautions to avoid the use of local cooling systems
- Lowering of indoor temperature to 19 C for building categories, for which differentiating between night and day and weekend operation is relevant. Sports facilities must reduce the indoor temperature to 17 C at night and weekends.

Deviation from one or more of the above energy requirements is permitted, providing the energy consumption of the building does not increase, due to compensating measures.

Source: Rode & Isachsen, 2008

Research and development: From 2002, the different research and development programmes under the Research Council of Norway were organised into a new programme for 2002-2009 called Energy, Environment, Building and Construction (IEA, 2008c). In 2009, the Norwegian University of Science and Technology was selected to host a new national centre for environment-friendly energy research focused on zero-emission buildings. The Research Centre on Zero-Emission Buildings (www.sintef.no/Projectweb/ZEB/) is an attempt to make a major active effort on environmentally friendly technologies within the building sector. The ambitious vision of centre is to eliminate the GHG emissions caused by buildings, and place Norway in the forefront with respect to research, innovation and implementation within the field of zero-emission buildings.

Taxes: Introduced in 1991, electricity taxes have been applied sporadically to residential, commercial and industrial consumers of electricity. The electricity taxes in Norway have been low in a European perspective. The CO_2 tax is regarded as an important policy instrument to reduce GHG emissions for sectors and activities outside the emissions allowance trading scheme (IEA, 2005). The most significant tax for the building sector, is the tax on mineral oil for heating purposes, which was introduced in 2000 to avert a switch from electricity to

heating oil. Increased tax revenue has been used to support energy efficiency and renewable energy programmes. In 2008, the Norwegian Government indicated a substantial increase of the tax on mineral oil, in order to improve the competitiveness of renewable energy (IEA, 2008c).

Box 5: Total net energy consumption

Total net energy consumption shall not exceed the following limits:

Building category	kWh/sqm heated floor area per year
One family house	125 * 1600/sqm heated floor area
Apartment building	120
Kindergarten	150
Office building	165
School building	135
University	180
Hospital	325
Nursing home	235
Hotel	240
Sports facility	185
Commercial building	235
Culture facility	180
Light industry, workshop	185

Fixed values of user-dependent data and average nation wide climatic data shall be used for energy calculations.

Source: Rode & Isachsen, 2008

Building networks: The Norwegian building networks programme on energy efficiency for the tertiary building sector was established in 1996. The programme has 4 main elements: a holistic and systematic approach to rational use of energy over a period of 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 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).

The Norwegian building networks programme on energy efficiency for the tertiary building sector was evaluated in 2004. The programme showed good results in terms of the number of participants and the estimated resulting savings, although the long-term effects are more uncertain, but would appear to be limited (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.

Box 6: Minimum requirements

The following minimum requirements shall not be exceeded:

	U-value - exterior wall.	U-value - roof and floor facing free air	U-value - windows	Air changes per hour by 50 Pa pressure difference.
Building	0.22 W/sqm K	0.18 W/sqm K	1.6 W/sqm K	3.0

For traditionally constructed dwellings, such as timber log houses, the following minimum energy requirements shall apply:

	U-value - exterior wall.	U-value -roof	U-value - exposed floor area	U-value - windows	Air changes per hour by 50 Pa pressure difference.
Buildings with timber log outer walls	0.60 W/sqm K	0.13 W/sqm K	0.15 W/sqm K	1.4 W/sqm K	-
Leisure dwellings under 150 sqm with timber log outer walls	0.72 W/sqm K	0.18 W/sqm K	0.18 W/sqm K	1.6 W/sqm K	-

Source: Rode & Isachsen, 2008

Information services and educational activities: Enova runs a helpline giving energy savings advice free of charge, as well as distributing information material. Enova is also responsible for a special programme for youth between 9 and 12 years of age, started in 2003, which is called Regnmakerne (www.regnmakerne.no). This program aims to help youth become more aware of energy use and environmental issues (ODYSSEE & MURE, 2008). Enova also supports regular national television advertising campaigns on energy issues. In terms of training and education, there are a number of Enova programmes, including: developing teaching materials and learning concepts; developing an accredited education course for technical personnel and engineers; improving energy planning skills in local municipalities; and training of maintenance personnel in commercial buildings (IEA, 2005).

Energy management in commercial and residential buildings: Enova has defined a goal to reduce the level of energy use in commercial buildings larger than 20,000 m^2 by 100 GWh per year by 2010, and commercial buildings smaller than 20,000 m^2 by 70 GWh per year. Project activities that qualify for funding are, for example, training, dissemination of information, energy management and monitoring (IEA, 2005). For residential buildings, Enova has a programme for both new homes and renovations (IEA, 2008c).

Grants and loans: Private and public building owners can apply for grants for additional costs in planning, implementing and investing in energy efficiency in buildings. For example, the Housing Bank (Husbanken) has administered various loan and grant schemes for energy efficient measures in residential buildings since the 1990s. From 2002, extra loans and grants have been available to home builders who invest in water heating systems based on bioenergy, solar or that use heat pumps (ODYSSEE & MURE, 2008). The Housing Bank has provided support to projects such as developing low-energy housing and passive houses, and environmentally friendly renovations. In 2006, the Norwegian Government introduced grants

for electricity savings in households. Applications for grants could be made for investments in heat pumps, pellet boilers, fireplaces using pellets, and electric control devices (Rosenberg & Espegren, 2006). Enova ran an emergency programme of direct financial support for heat pumps, pellet heating systems and control systems for residential buildings in 2002-2003. This was in response to the precipitation shortage, which affected hydropower.

Evaluation results show that over 47,000 households participated in the emergency programme, and that these households can now save an average of 30% of the electricity used for heating purposes (IEA, 2005). The IEA (2005) argue that the outcomes of this emergency programme suggest that more permanent policy efforts could drive further energy savings. In contrast, evaluations by Rosenberg & Espegren (2006) of the emergency scheme from 2002-2003, indicate that many households surveyed state they would have made the investments in new heating systems even without the support. The large emphasis on information and advice about energy saving measures clearly played a role in investment decisions by households. The support scheme also helped to establish a more stable market for heat pumps, which also has reduced prices (Rosenberg & Espegren, 2006). The market for fire places for pellets remained small, and also sales of electric heating control devices is still small. The subsidy schemes did not appear to have much impact in these areas.

Public procurement: The Ministry for the Environment concentrates on the promotion of "green" public procurement by publishing guidelines on what it considers as "green" goods and services (UNFCCC, 2006b). Technologies and products that are more energy efficient are a high priority for public procurement. Public procurement can be seen as a State policy to provide a base for the introduction of new technologies and systems, which can then be introduced in other sectors.

4.3 Action Plans

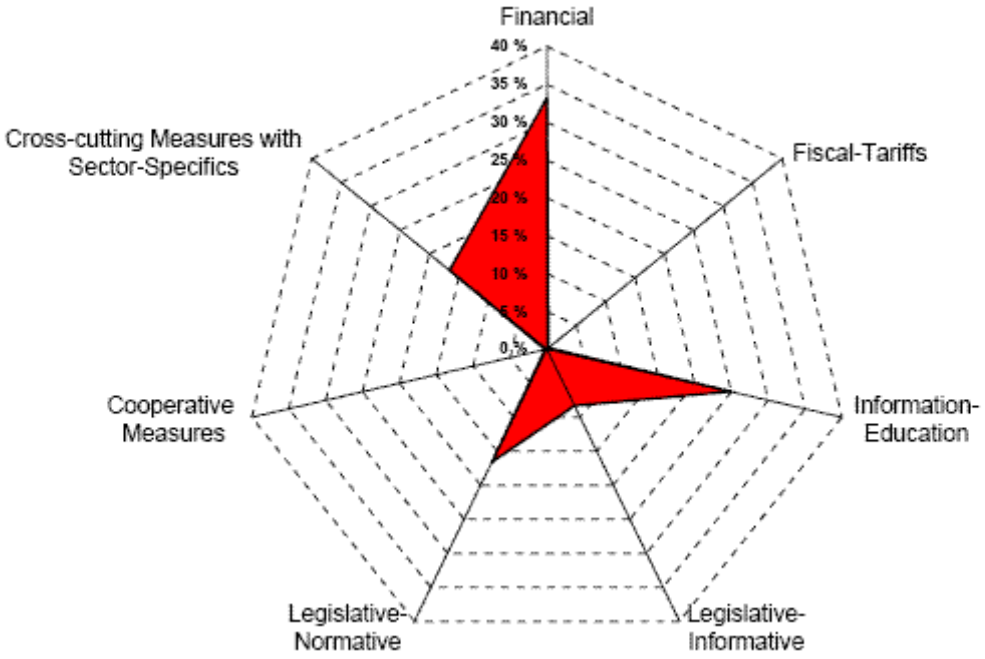
Norway is not a member of the EU, so it has no obligation to produce a National Energy Efficiency Action Plan (NEEAP) as stipulated by the EU Directive (2006/32/EC) on energy end-use efficiency and energy services. However, Norway does review its policy measures for reductions of GHG emissions across all sectors, including buildings, in accordance with the UNFCCC (2006b) and Norway also provides data and analysis of its energy policies through the IEA (2005). Both the UNFCCC (2006b) and IEA (2005) provide recommendations for action.

4.4 General Discussion

In its review of energy policies in Norway, the IEA (2005) commented that energy consumption has traditionally been driven by the abundant availability of cheap and clean hydropower. Historically, this has contributed to the excessive use of electricity for heating demands, and few efforts on energy efficiency. However, since 2006, Norway has shifted from a net exporter to a net importer of electricity in years with average precipitation (IEA, 2005). Norway has a long history of building codes and a number of policy instruments targeting energy efficiency since the middle of the 1990s. In recent years energy efficiency seems to have higher priority and a number of innovative policy instruments have been introduced; for example, tightening of the building codes, impressive efforts on education and communication activities and the establishment of the Research Centre on Zero-Emission Buildings.

Rosenberg & Espegren (2006) carried out an assessment of energy efficiency policies in Norway in 2006. In this work, diagrams were developed in the form of a spider's web with the policy instruments on the spokes of the web. The greater the preference for a particular policy measure, the more the pattern will look like the hands of a clock. While the broader the policy in the sector, the more equally spread the measures on different spokes, so that the pattern resembles different shapes. The diagrams show all on-going measures as of the end of 2006 in Norway. In the residential sector, the financial measures had the largest emphasis. Measures with an informative and educational nature were second (see Figure 8). For the tertiary sector, there was a high share of financial measures. The main legislative and normative measures were building regulations while the main information measures were the building networks (see Figure 9). Overall, there is clearly a very limited spread of policy efforts.

Figure 8: Spider's web for on-going measures in the residential sector in 2006

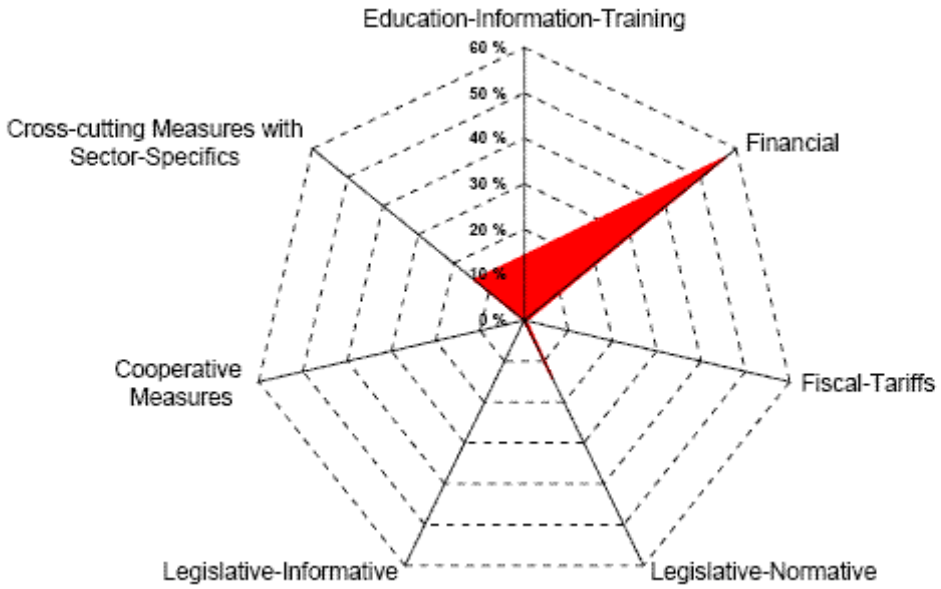


Source: Rosenberg & Espegren, 2006

In terms of organisations, Enova is charged with the task to promote energy efficiency and renewable energy in Norway. 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.

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.

Figure 9: Spider's web for on-going measures in the tertiary sector in 2006



Source: Rosenberg & Espegren, 2006

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 3 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.

As suggested, 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 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.

5 Finland

There is a long tradition in Finland on voluntary energy efficiency agreements and energy audits, which have been assessed as quite successful. Building codes are also being tightened. There is a history of evaluations of policy instruments in Finland. Recently, in 2009, there have been 2 in-depth evaluations related to buildings.

5.1 Institutional Framework

The Ministry of Employment and the Economy is responsible for energy policy. The Ministry of Environment is responsible for legislation in the building sector, such as energy efficiency requirements. Founded in 1993, Motiva (www.motiva.fi) is an independent, non-profit company whose main task is to provide information on the impact of energy conservation and renewable energy to end-users of energy. TEKES (www.tekes.fi), the national technology agency, is the main public financing and expert organisation for research and technological development. The Association of Local and Regional Authorities (Kuntaliitto Kommunförbundet) also plays a key role in energy efficiency measures in municipal buildings and properties.

There are a number of laws relevant to energy efficiency in buildings. The 2000 "Land Use and Building Act" promotes good practices in building, among a range of areas. The Act also affects urban and regional planning activities of municipalities and provinces. There is also the "Act on the Repair and Energy Aid for Housing" from 2003. More recently, in 2007, the Finnish Government approved legislation on the energy efficiency of buildings. This includes the "Act on Building Energy Certification" and the "Act on Inspection of Air-Conditioning Systems", as well as a revision of the "Land Use and Building Act". Finally, in the 1990s, EU membership involved regulations on energy efficiency and domestic appliances, which were laid out in the "Act Governing the Energy Efficiency of Household Appliances" (IEA, 2008d).

An "Action Plan for Energy Efficiency" was issued in 2000 and updated in 2002 (IEA, 2007). The "National Energy and Climate Strategy" was presented by the Finnish Government in 2005. The strategy defines how Finland can meet its obligations to reduce GHG emissions. The strategy contains a target of an additional 5% energy savings by 2015, compared with the expected situation without any new policy efforts (IEA, 2007). Another major document is the National Energy Efficiency Action Plan (NEEAP) submitted to the European Commission in 2007 by the ESD Implementation Group (2007).[3] The NEEAP focuses mostly on measures already implemented or planned. It outlines how Finland will achieve the 9% improvement in energy efficiency by 2016. The NEEAP also includes an assessment of the energy savings effects of the listed measures. There is also an "Energy Conservation Programme" in Finland that covers measures in all sectors of the economy.

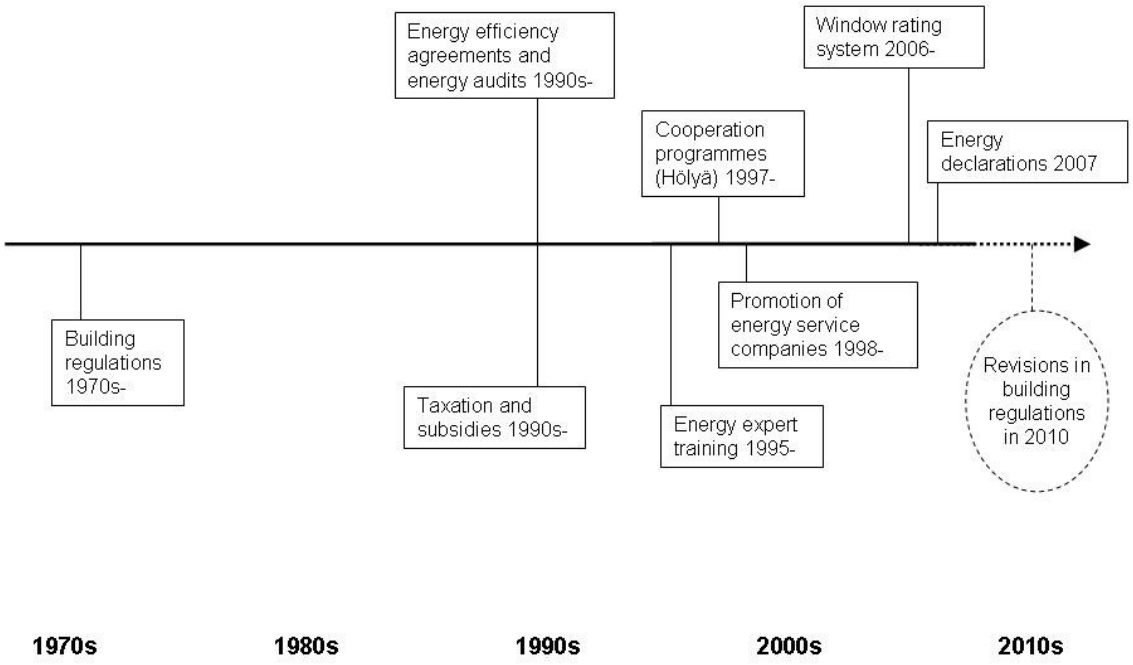
A number of evaluations have been performed over time and results have been presented in, for example, UNFCCC (2006c) and IEA (2007). Recently, in 2009, there have been 2 in-depth evaluations related to buildings – the first on the effects of the 2010 (and possible 2012) building codes, and second on energy-using products in Finland.

[3] ESD stands for Energy Services Directive. The ESD Implementation Group was charged with the responsibility to develop the NEEAP for Finland.

5.2 Policy Instruments

There are a range of policy instruments that have been, and are utilised, to influence energy efficiency in buildings (see Figure 10). These are listed below along with key findings and comments from evaluations.

Figure 10: Timeline of key policy instruments in Finland



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

Building regulations and energy certification: Energy requirements have existed in buildings codes since the 1970s. In 2007, building regulations were updated to comply with the EU Directive (2002/91/EC) on the energy performance of buildings to involve a new calculation methodology and energy performance requirements. The previous update was in 2002, and the next revision is expected in 2010 (ODYSSEE & MURE, 2008). The energy requirements, updated in 2007 and enforced in 2008, are the same for all buildings and include requirements on: maximum U-values; the average insulation level; heat losses of buildings (in terms of building envelope, ventilation and air-tightness); and the calculation of energy demand of buildings (see Figure 11). An important flexibility is that builders can choose to meet the maximum component U-values or meet a comprehensive building envelope standard. An applicant for a building permit has to ensure that the construction will fulfil these requirements. As for renovations of existing buildings, the regulations are only applied as required (IEA, 2008d).

Figure 11: Requirements of New Buildings

Reference values for maximum heat loss	Year 1976	1978	1985	2003	2007	Proposal 2010
Wall, U-value	0,4	0,29	0,28	0,25	0,24	0,14
Ceiling, U-value	0,35	0,23	0,22	0,16	0,15	0,09
Floor, U-value	0,40	0,40	0,36	0,25	0,24	0,14
Window, U-value	2,1	2,1	2,1	1,4	1,4	1
Door, U-value	0,7	0,7	0,7	1,4	1,4	0,7
Air-tightness, n50	6	6	6	4	4	2
Efficiency of the heat recovery (yearly) from the exhaust air	0	0	0	30%	30%	50%

Source: Haakana, 2008

The EU Directive (2002/91/EC) on the energy performance of buildings will be implemented fully in 2009. The new energy certificates in Finland will allow easy comparisons of energy efficiency in buildings (Motiva & Ministry of Trade and Industry, 2006). The energy rating system will classify buildings from A (high energy efficiency) to G (poor energy efficiency) based on their energy consumption. Energy certification is obligatory for new buildings with a building permit since 2008. Other buildings when rented or sold must have an energy performance certificate from 2009. Certificates will not be required for holiday homes or smaller buildings, industrial premises, protected buildings and churches. Certificates will be optional for existing detached houses and residential properties consisting of no more than 6 homes (IEA, 2008d).

Energy certificates can be issued in 3 different ways, including: as part of a property manager's certificate; as a separate energy certificate; or in connection with an energy audit (Haakana, 2008). Building owners can choose which type of energy certificate they want, but the property manager's certificate is only available for housing companies. In Finland, most apartment blocks are owned by housing companies, with people living in their own dwellings as shareholders. The shareholders share the costs generated by energy certification or energy efficiency improvements in the apartment building. Since energy audits are the most detailed alternative to energy certification, the Finnish legislation states that energy certificates can be issued in connection with an energy audit (Haakana, 2008).

In terms of buildings codes in Finland, the IEA (2007) notes that like all Nordic countries, the standards are quite high relative to other European countries. Finland sets maximum building component standards, but also gives builders the option to use a building envelope standard instead, and this provides a 20% cushion (IEA, 2007). This gives flexibility to builders, however this is offset in the loss of overall efficiency. The IEA (2007) recommends that Finland make the flexibility aspect a driving force for energy efficiency improvements, rather than exempting builders from such requirements. In addition, Finland could also tighten its component standards to bring it in line with other Nordic countries.

Energy efficiency agreements and energy audits: Energy efficiency agreements were established in the early 1990s to promote energy conservation. There are agreements across the property and building sector. For example, there are 2 energy efficiency agreements for the municipal sector launched for the period 2008-2016, the first for larger municipalities, and the second for smaller municipalities (ODYSSEE & MURE, 2008). The Association of Local and Regional Authorities signed the new framework agreement. Under the voluntary agreements, municipalities undertake to analyse their own energy consumption and to draw up an action plan on implementing cost-effective efficiency measures. The Ministry of Trade and Industry provides support for energy audits, analyses, and energy conservation investments eligible for subsidies (IEA, 2008d).

Companies and municipalities that join energy efficiency agreements commit to carrying out energy audits on their properties and production plants. Energy audits involve examining the energy use of a site or building, and its energy savings potential, and suggesting measures to increase energy efficiency. This includes calculations of profitability. 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).

As suggested, when companies and communities join energy efficiency agreements they commit to carry out energy audits. Salminen (2009) provides a limited evaluation of the municipal energy conservation agreements in Finland from 1997 to 2007. Even though there have been many objectives that have not been achieved, the coverage of agreements in most municipalities is rather good. However, this is a voluntary measure, and many municipalities lack both personnel and economic resources. A further issue is that the baseline for energy efficiency in buildings is problematic. There is also 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.

In the analysis by Salminen (2009), energy audits are described as playing a central role in energy efficiency agreements. Although achieving challenging targets has proved difficult, primarily because municipalities were sometimes over optimistic. A key objective has been that each municipality would devise an energy efficiency plan within a year of signing an agreement. By the end of 2005, 36 plans were made of a total 85 agreements. This result was less than expected. It was also defined that 80% of buildings would be audited by 2005. Depending on the starting conditions, the share of buildings within each municipality varied. By 2005, the share of audited building stock across all municipalities was 58%. On the positive side, the share of energy audits has increased based on energy efficiency agreements.

In the AID-EE project (www.aid-ee.org), Khan (2006) evaluated energy audits in Finland and concludes that generally this has been a successful programme. Khan (2006) highlights that a core feature of the programme is access to subsidies. In terms of success factors, a number were identified through the evaluation process. These include:

- **Flexible planning approach.** The programme was the first of its kind in Finland and elsewhere. The programme developers had very little prior experience of how to develop a comprehensive auditing programme. A flexible and step-by-step planning approach was therefore essential for success (Khan, 2006).

- **Clear vision of objectives and central elements of the policy instrument.** It was important that programme developers early on had clear visions about the objectives and central elements of the programme. From the start it was clear that training, monitoring, quality control, tools and models would be central elements of the programme (Khan, 2006).
- **Active promotion of the policy instrument.** During the first years of the programme, promotion activities were intense and this created a general awareness and legitimacy of energy auditing in the market (Khan, 2006).
- **Training of auditors.** The establishment of a systemized training scheme for auditors increased the legitimacy of energy audits and this contributed to the quality of audits (Khan, 2006).
- **Co-operation and dialogue with stakeholders.** The programme has been characterized by a co-operative and dialogue oriented planning approach. To a large extent, the adding of new elements to the programme, has come as a result of demands and feedback from stakeholders (Khan, 2006).
- **Changes kept to a minimum.** Though flexibility has been a key aspect of the programme, another important factor has been to make as few changes as possible. Though the programme has been modified continuously, every change has appeared to be analysed carefully and radical changes have been avoided (Khan, 2006).
- **Interlink policy instruments.** Important synergy effects between different energy efficiency policy tools have been utilised. The introduction of the programme by Motiva to support energy service companies was motivated primarily as a way to increase implementation of saving measures identified in energy audits (Khan, 2006).
- **Flexible and competent implementing agency.** An organization, such as Motiva, has been an essential part of the development process. The organisation has had enough resources and relatively free hands to develop the programme. Another further advantage is Motiva is a small organisation, which means short decision paths and more flexibility (Khan, 2006).
- **Long-term political support.** In order to maintain political support it has been vital to be able to show that the programme has lead to "real" results, thus monitoring and information have been central (Khan, 2006).
- **Systematic and thorough monitoring.** A detailed monitoring system has been crucial both to keep track of the development of the programme and to show to decision-makers and the public that the programme achieves real outcomes (Khan, 2006).

Khan (2006) goes on to comment that since the policy instrument was new when it was first implemented, both in Finland and internationally, planning and implementation has been characterized by "trial and error" and "learning by doing". For other countries that implement a similar energy audit programme it could be a smoother process, based on experience in Finland.

Promotion of energy service companies: Motiva is working to promote energy service companies by registering them and providing information on them to potential clients. Such companies are specialists that take responsibility for energy efficiency, including undertaking energy audits, establishing energy plans, and organising financing on behalf of their clients. Much of this work relates to buildings (IEA, 2007). The promotion of energy service companies began in Finland in 1998.

Cooperation programmes: In 2002, the Finnish Oil and Gas Federation, the Oil and Gas Heating Association, the Ministry for Trade and Industry, and the Ministry of the Environment initiated the Höylä II programme to follow on from the Höylä I programme that commenced in 1997. These cooperation programmes aimed at improving the energy performance of oil-heated buildings. The current programme has a target to refurbish 100,000 oil-heated systems by 2010. It is argued that energy savings of 10-30% can be achieved by reconditioning individual heating systems (IEA, 2008d). There is now a Höylä III programme underway.

Taxation and subsidies: Finland introduced a CO_2 tax in 1990. It has changed many times over the years. Besides the fiscal significance, energy taxation is considered a central means to influence energy consumption (UNFCCC, 2006). During 2003-2006, subsidies were available for improving the energy performance in residential buildings. Subsidies have been granted for improving heat insulation of residential buildings, renewing and repairing ventilation and heating systems, and investing in renewable energy technologies (ODYSSEE & MURE, 2008). Modifications of heating systems in small residential building have qualified for subsides since 2006 (ESD Implementation Group, 2007). The use of subsidies will continue as part of the new voluntary energy efficiency agreements for 2008-2016 (NEEAP, 2007). Since 2000, a household tax deduction has been available for labour costs incurred when replacing, upgrading or repairing heating systems in small residential houses. In 2006, amendments were made so that both a household tax deduction and an energy subsidy were available for upgrading heating systems (ESD Implementation Group, 2007).

Research and development: Development of new technology and the promotion of its introduction to the market is directed at sectors that are relevant to Finland. Promotion of energy efficiency and the use of bioenergy are therefore the prominent focal points for research and development (UNFCCC, 2006). The Sustainable Community Technology programme will invest 100 million EUR in the development of sustainable and energy efficient areas and buildings. The programme is designed to encourage research institutes, universities and companies to engage in international collaboration by exchanging information and networking. The programme will also provide opportunities for ambitious research and development projects (IEA, 2008d).

Voluntary approaches: A voluntary approach instead of mandatory boiler inspections has been approved by the Finnish Government for the implementation of the EU Directive (2002/91/EC) on the energy performance of buildings. Inspections will only be compulsory for some types of cooling equipment (IEA, 2008d). Motiva launched a window rating system in 2006, based on a pilot programme in 2004-2005 (IEA, 2007). This can be seen as a voluntary energy labelling scheme for windows, whereby the rating system makes comparisons between windows much easier for consumers.

Energy expert training: In 1995, Motiva and VVO (www.vvo.fi) experimented with an energy expert training scheme for so-called active occupants of rented and partially-owned accommodation. The trained energy experts are responsible to distribute information and spread it among other occupants, the board of the housing company, house manager and maintenance staff (see Figure 12). By 2004, VVO had more that 700 trained energy experts (ESD Implementation Group, 2007). As of today, the training scheme on a national level is not running. Separate housing companies train or obtain training for their experts from other housing companies (VVO is a leading company) or from the expert trainers that were

trained in the previous programme. Impact studies have not been made on the national level. However, the separate companies do evaluate their own "gains" from the work.

Figure 12: Energy expert logo in Finland

Information and communication: A broad-based Climate Forum has been established with the task of promoting awareness of climate change issues. The forum has some 60 members from all sectors of society. Launched in 2002, the Climate Change Communications Programme consists of publicity campaigns to inform the general public about the impacts of climate change, and what can be done to limit climate change (UNFCCC, 2006). The Association of Local and Regional Authorities in Finland is running a climate campaign together with 48 local governments, who represent over 50% of the Finnish population (IEA, 2007). The annual national Energy Awareness Week in Finland aims to increase knowledge and understanding of energy efficiency. Finally, the Energy Efficiency Home campaign provides information to builders and related professionals on how to incorporate energy efficiency into houses (ESD Implementation Group, 2007).

Public procurement: Municipalities are significant procurers of services and products. The Ministry for Trade and Industry has given recommendations on energy efficiency in public procurement. Under the voluntary energy efficiency agreements, municipalities are expected to investigate all option for taking advantage of energy savings through purchasing energy efficient technologies and appliances.

5.3 Actions Plans

In 2007, the National Energy Efficiency Action Plan (NEEAP) for Finland was submitted to the European Commission. It involved an extensive evaluation of the effects of policy instruments already in place and those to be implemented in the near future. The national energy conservation target for Finland of 9% by 2016 equals 17,800 GWh, while the 3% interim target for 2010 is 5,900 GWh (ESD Implementation Group, 2007). The current actions in Finland will produce energy savings of 12,707 GWh by 2016, corresponding to approximately 70% of the required target (see Table 2). A precondition to achieve these savings is that the current national effort is maintained between 2008 and 2016.

The main argument in the NEEAP is that the shortfall between the target of 17,800 GWh and the current estimates of 12,707 GWh can be made up through new extensive energy conservation agreement schemes. The amount of energy savings that voluntary agreements can bring is estimated at 2,800-4,700 GWh. If that is possible by 2016, Finland can ensure 15,500-17,400 GWh of energy savings and effectively meet its target. The evaluation in the NEEAP appears to be quite confident of further success with voluntary agreements and energy audits, particularly in the building sector when combined with a mix of other

supportive policy instruments, such as training of energy experts and promotion of energy service companies.

Table 2: Summary of energy savings effects by sector in Finland

Sector	2007 GWh	2010 GWh	2013 GWh	2016 GWh
Buildings	3960	5934	7863	9573
- Voluntary window labelling scheme	51	222	421	650
- Heat pumps in detached houses	934	1529	2111	2531
- Hölyä I and Hölyä II	1766	2232	2639	2959
- Buildings codes (2003)	1029	1771	2512	3253
- Subsidy scheme for apartment buildings	180	180	180	180
Other	2864	3267	3019	3134
TOTAL	6824	9201	10882	12707

Source: ESD Implementation Group, 2007

Note: This table shows the expected energy savings in the buildings sector with a breakdown across the main policy schemes. The table also shows other expected energy savings.

5.4 General Discussion

There are many policy instruments for energy efficiency in Finland. 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.

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. 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 are expected to play a greater role on energy efficiency activities in the future.

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 2 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 6 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.

In terms of organisation, Motiva plays an important role in Finland by undertaking evaluations of policy instruments. Recently, in 2009, there have been 2 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.

6 Discussion and Conclusions

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.

6.1 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. Moreover, there are high expectations for the 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 by the Swedish Board of Housing, Building and Planning (2008) shows that the economic resources of the aid seem to be 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.

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.

6.2 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. Nilsson (2006) argues that Belok is "poised to have a considerable impact in the longer term". 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). Denmark has defined 2 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). This provides a "roadmap" for the building sector in Denmark. In addition to this the Nordic counties 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 evaluated consciously. Moreover, additional new instruments should be suggested and discussed.

6.3 Organisational Matters

Organisational structures related to energy efficiency are often dispersed in the Nordic counties. 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 "sparfond", as the Electricity Saving Trust in Denmark. An energy "sparfond" 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 “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. 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 impacts – 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. The Swedish Government has 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 ambitious goals on energy efficiency, there remains a need for a strategic and long term approach that can realise such goals and clear organisational responsibilities.

6.4 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, there is no strategic evaluation approach in Sweden with a focus on how to improve learning rather what we see are sporadic or “ad hoc” evaluations. Sweden can still greatly improve in designing, implementing and applying policy instruments for energy efficiency. It is therefore important that Sweden conducts regular and more comprehensive evaluations that feed back into the policy-making process.

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.

Many policy instruments have too little focus on systematically demonstrating their impacts 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. And finally, 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.

References

Sweden

Bertelsen, N. (2007) *Evaluation of Belok.*
URL: http://www.en.sbi.dk/

COWI. (1999) *Utvärdering av det första verksamhetsåret inom 1997 års energipolitiska program, Näringsdepartementet* [Evaluation of the first year in the 1997 Energy Policy Program, Ministry of Industry].

COWI. (2000) *Utvärdering av 1997 års energipolitiska program 1998-1999, Näringsdepartementet* [Evaluation of the 1997 Energy Policy Program 1998-1999, Ministry of Industry].

Elmroth, A. (2002) *Energianvändning i teori och praktik i flerbostadshus: En antologi om framtidens styrmedel* [Energy use in theory and practice in multi-residential buildings: An anthology on future instruments].

Energy Window. (2009) *Vill du har mer pengar i plånboken?* [Do you want more money in your wallet?]
URL: http://www.energifonster.nu/

Energy Charter Secretariat. (2006) *In-depth Review of Energy Efficiency Policies and Programmes: Sweden 2006.*
URL: http://www.encharter.org/

Hjorth, H. (2008) *Implementation of the EPBD in Sweden: Status June 2008.*
URL: http://www.buildingplatform.org/

International Energy Agency (IEA). (2008a) *Database of Energy Efficiency Policy Measures for Sweden.*
URL: http://www.iea.org/textbase/pm/

Khan, J. (2006) *Evaluation of the Local Energy Advice Programme in Sweden.*
URL: http://www.aid-ee.org/

Kiss, B. (2008) *Energy Efficiency Window Development: What can we learn from policy intervention?* Lund: Lund University.

Neij, L. (2007) *Barriärer och styrmedel för en effektivare energianvändning.* [Barriers and instruments for energy efficiency].

Neij, L. (2004) *Metoder för utvärdering av klimatpolitiska styrmedel.* [Methods for the evaluation of climate policy instruments]. Report for the Swedish Environmental Protection Agency.

Neij, L. (2004) *Country Report Sweden.* In: International Energy Agency (IEA). Evaluating Energy Efficiency Policy Measures and DSM Programmes. Volume II.
URL: http://dsm.iea.org/

Neij, L. & Öfverholm, E. (2002) *Teknikens bidrag till effektivare energianvändning: En studie av erfarenheter och behov av styrmedel.* [Technology contribution to energy efficiency: A study of experiences and the need for instruments]. In: Boverket, Energimyndigheten and Naturvårdsverket. Effektivare energi I bostäder: En antologi om

framtidens styrmedel. [More efficient energy in housing: An anthology on future instruments].

Nilsson, L. (2006) *Evaluation of Belok.*
URL: http://www.aid-ee.org/

Nässen, J. & Holmberg, J. (2005) Energy efficiency: a forgotten goal in the Swedish building sector? *Energy Policy*, 33: 1037–1051.

ODYSSEE & MURE. (2008) *Energy Efficiency Profile: Sweden.*
URL: http://www.odyssee-indicators.org/

Reje Management. (2000) *Utvärdering av effekterna av informationsåtgärder för att åstadkomma energieffektivisering, Energimynidgheten* [Evaluation of the impact of information measures to achieve energy efficiency, Swedish Energy Agency].

Smeds, J. (2004) *Energy Aspects in Swedish Building Legislation of the 20th Century Concerning Dwellings.* Lund: Lund Institute for Technology.

Swedish Board of Housing, Building and Planning. (2008) *Stödet för konvertering från direktverkande elvärme i bostadshus.* [Support for the conversion from direct electric heating in residential buildings].
URL: http://www.boverket.se/

Swedish Energy Agency. (2008) *Energy in Sweden 2008.*
URL: http://www.swedishenergyagency.se/

Swedish Energy Agency (2001) *Energivärlden 2001* [The Energy World 2001].
URL: http://www.swedishenergyagency.se/

Swedish Energy Agency & Swedish Environmental Protection Agency. (2008) *Styrmedel i kilmatpolitiken.* [Instruments in climate policy].
URL: http://www.energimyndigheten.se/

Swedish Environmental Protection Agency & Swedish Energy Agency. (2006) Ekonomiska styrmedel i miljöpolitiken [Economic instruments in environmental policy].
URL: http://www.energimyndigheten.se/

Swedish Ministry of Sustainable Development. (2006a) *National programme for energy efficiency and energy-smart construction: Fact sheet.*

Swedish Ministry of Sustainable Development. (2006b) *Energy declarations of buildings: Fact sheet.*

United Nations Framework Convention on Climate Change (UNFCCC). (2006a) *Report of the centralised in-depth review of the fourth national communication of Sweden.*
URL: http://unfccc.int/

____ (2008) *Ett energieffektivare Sverige* [A More Energy-Efficient Sweden]. SOU 2008:25, report.

____ (2008) *Ett energieffektivare Sverige: Nationell handlingsplan för energieffektivisering* [An Energy Efficient Sweden: National Action Plan for Energy Efficiency]. SOU 2008:25, attachment.

____ (2008) *Building Regulations.* BBR 2008.

____ (2006) *Building Regulations.* BBR 2006.

Denmark

Aggerholm, S. (2008) *Implementation of the EPBD in Denmark: Status November 2008.*
URL: http://www.buildingplatform.org/

Bach, P., Dyhr-Mikkelsen, K. & Schalburg, R. (2004) *Country Report Denmark.* In: International Energy Agency (IEA). Evaluating Energy Efficiency Policy Measures and DSM Programmes. Volume II.
URL: http://dsm.iea.org/

Danish Ministry of Transport and Energy. (2005a) *Action plan for renewed energy-conservation: Energy conservation and the market.*

Danish Ministry of Transport and Energy (2005b) *Energy Strategy 2025: Perspectives to 2025 and Draft action plan for the future electricity infrastructure.*

Danish Ministry for Economic and Business Affairs & Danish Enterprise and Construction Authority. (2008) *Building Regulations.*
URL: http://www.ebst.dk/

Danish Ministry of Climate and Energy. (2008) *Energy Policy Statement 2008.*
URL: http://www.ens.dk/

Danish Energy Authority. (2003) *Danish Energy Saving Report.*
URL: http://www.ens.dk/

Danish Energy Authority. (2008) *Energy in Denmark 2007.*
URL: http://www.ens.dk/

Dyhr-Mikkelsen, K. Larsen, A. & Bach, P. (2005) *Evaluation of Free-of-Charge Energy Audits.* Proceedings of the ECEEE Summer Study Conference, 30 May - 4 June 2005, Mandelieu La Napoule, France.

Energy Analysis, Niras, RUC & 4-Fact. (2008a) *En vej til flere og billigere energibesparelser: Evaluering af samtlige danske energispareaktiviteter, Rapport* [One way to more and cheaper energy: Evaluation of all Danish energy saving activities].
URL: http://www.ens.dk/

Energy Analysis, Niras, RUC & 4-Fact. (2008b) *En vej til flere og billigere energibesparelser: Evaluering af samtlige danske energispareaktiviteter, Bilagsrapport* [One way to more and cheaper energy: Evaluation of all Danish energy saving activities].
URL: http://www.ens.dk/

International Energy Agency (IEA). (2008b) *Database of Energy Efficiency Policy Measures for Denmark.*
URL: http://www.iea.org/textbase/pm/

Rambøll Management. (2004) *Evaluation of the Electricity Saving Trust.*
URL: http://www.femsek.dk/

Torgeby, M., Dyhr-Mikkelsen, K., Larsen, A., Hansen, M.J. & Bach, P. (2009) *Danish energy efficiency policy: revisited and future improvements.*
URL: http://www.eceee.org/summer_study/

ODYSSEE & MURE. (2008) *Energy Efficiency Profile: Denmark.*
URL: http://www.odyssee-indicators.org/

United Nations Framework Convention on Climate Change (UNFCCC). (2007) *Report of the centralised in-depth review of the fourth national communication of Denmark.*
URL: http://unfccc.int/

Norway

International Energy Agency (IEA). (2005) *Energy Policies of IEA Countries: Norway 2005 Review.*
URL: http://www.iea.org/

International Energy Agency (IEA). (2008c) *Database of Energy Efficiency Policy Measures for Norway.*
URL: http://www.iea.org/textbase/pm/

Nakstad, N.K. (2009) *The Norwegian policies on climate, renewable and energy efficiency in relation to the EU directive proposals, and their implementation in the national energy and climate strategies.* Proceedings of the Nordic Energy Futures Conference, 17 March 2009, Oslo, Norway.

Norwegian Energy Efficiency (NEE). (2004) *Building Networks as an Instrument for RUE in the Tertiary Building Sector.*
URL: http://ec.europa.eu/

Norwegian Ministry of the Environment. (2007) *Norwegian climate policy.*
URL: http://www.regjeringen.no/en/

ODYSSEE & MURE. (2008) *Energy Efficiency Profile: Norway.*
URL: http://www.odyssee-indicators.org/

Rosenberg, E. & Espegren, K.A. (2006) *Energy efficiency policies and measures in Norway 2006.*
URL: http://www.ife.no/

Rode, W. & Isachsen, O.K. (2008) *Implementation of the EPBD in Norway: Status June 2008.*
URL: http://www.buildingplatform.org/

Ryghaug, M. & Sorensen, K.N. (2009) How energy efficiency fails in the building sector? *Energy Policy*, 37: 984-991.

United Nations Framework Convention on Climate Change (UNFCCC). (2006b) *Report of the centralised in-depth review of the fourth national communication of Norway.*
URL: http://unfccc.int/

Finland

ESD Implementation Group. (2007) *National Energy Efficiency Action Plan.*

Khan, J. (2006) *Evaluation of the Energy Audit Programme in Finland.*
URL: http://www.aid-ee.org/

Gynther, L., Halme, K., Laitila, P., Lehenkari, J. & Lievonen, J. (2008) *Energiatehokkuus ja parhaat käytännöt: Tietopohjan ja -tarpeiden kartoitus.* [Energy efficiency and best practices in the public sector: Mapping of basic information and information needs].
URL: http://www.advansis.fi/

Haakana, M. (2008) *Implementation of the EPBD in Finlan: Status August 2008.*
URL: http://www.buildingplatform.org/

International Energy Agency (IEA). (2007) *Energy Policies of IEA Countries: Finland 2007 Review.*
URL: http://www.iea.org/

International Energy Agency (IEA). (2008d) *Database of Energy Efficiency Policy Measures for Finland.*
URL: http://www.iea.org/textbase/pm/

Maijala, J. (2008) *On the way towards more energy efficient buildings and housing areas in Finland and in the EU.* Proceedings of the Nordic Cleantech Seminar, 12 September 2008, Helsinki, Finland.

Motiva & Finnish Ministry of Trade and Industry. (2006) *Energy efficiency in Finland: A competitive approach.*
URL: http://www.motiva.fi/

ODYSSEE & MURE. (2008) *Energy Efficiency Profile: Finland.*
URL: http://www.odyssee-indicators.org/

Salminen, J. (2009) *Municipal energy conservation agreements in Finland.*
URL: http://www.energychange.info/

Sector Research Advisory Board. (2008) *Julkisen sektorin energiatehokkuus: Keskeiset johtopäätökset ja toimenpidesuositukset.* [Public Sector Energy Efficiency: The main conclusions and recommendations].

United Nations Framework Convention on Climate Change (UNFCCC). (2006c) *Report of the centralised in-depth review of the fourth national communication of Finland.*
URL: http://unfccc.int/

Nordic

Nordic Energy Research (NORDEN). (2008a) *Action Plan for Nordic Energy Cooperation 2006-2009.*
URL: http://www.nordicenergy.net/

Nordic Energy Research (NORDEN). (2008b) *The challenges of energy efficiency innovations in the Nordic building sector.*
URL: http://www.norden.org/

Nordic Energy Research (NORDEN). (2008c) *Innovation Systems and Environmental Technologies.*
URL: http://www.norden.org/

Nordic Energy Perspectives (NEP). (2008) *Widened view of energy efficiency and resource management.*
URL: http://www.nordicenergyperspectives.org/

Ryden, B. (eds) (2006) Ten Perspectives on Nordic Energy. *Chapter 13: The energy policies in the Nordic countries.*
URL: http://www.nordicenergyperspectives.org/

European

Avasoo, D. (2007) *The European window labelling challenge.*
URL: http://www.eceee.org/

Commission of the European Communities. (2005) *Green Paper on Energy Efficiency or Doing More With Less.* COM(2005) 265 final.

Commission of the European Communities. (2006a) *Green Paper on a European Strategy for Sustainable, Competitive and Secure Energy.* COM(2006) 105 final.

Commission of the European Communities. (2006b) *Action Plan for Energy Efficiency: Realising the Potential.* COM(2006) 545 final.

Directive 2005/32/EC of the European Parliament and of the Council on establishing a framework for the setting of ecodesign requirements for energy-using products.

Directive 2002/91/EC of the European Parliament and of the Council on the energy performance of buildings.

Directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services.

Energy Efficiency Watch. (2009) *Promoting Energy Efficiency in Europe: Insights, Experiences and Lessons learnt from the National Energy Efficiency Action Plans.*
URL: http://www.energy-efficiency-watch.org/

Intelligent Energy Europe. (2008) *Energy-efficient homes and buildings: The beauty of efficiency.*
URL: http://ec.europa.eu/energy/intelligent/

Lausten, J. (2008) *Energy Efficiency Requirements in Buildings Codes, Energy Efficiency Policies for New Buildings.* Paris: International Energy Agency.

Thomsen, K.E., Wittchen, K.B. & EuroACE. (2008) *European national strategies to move towards very low energy buildings.*
URL: http://www.sbi.dk/

General

Deringer, J., Iyer, M. & Huang, Y.J. (2004) *Transferred Just on Paper? Why Doesn't the Reality of Transferring/Adapting Energy Efficiency Codes and Standards Come Close to the Potential?*
URL: http://gundog.lbl.gov/

Dye, T.R. (1976) *Policy Analysis: What governments do, why they do it, and what difference it makes.* Alabama: University of Alabama Press.

Intergovernmental Panel on Climate Change (IPCC). (2007) Mitigation of Climate Change. *Chapter 6: Residential and Commercial Buildings.*
URL: http://www.ipcc.ch/

International Energy Agency (IEA). (2005a) *Evaluating Energy Efficiency Policy Measures and DSM Programmes. Volume I.*
URL: http://dsm.iea.org/

International Energy Agency (IEA). (2005b) *Evaluating Energy Efficiency Policy Measures and DSM Programmes. Volume II.*
URL: http://dsm.iea.org/

Lausten, J. (2008). *Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for New Buildings.*
URL: http://www.oecd.org/

Mundaca, L. (2008) *Markets for Energy Efficiency.* Lund: Lund University.

United Nations Environment Programme (UNEP) & Central European University (CEU). (2007) *Assessment of policy instruments for reducing greenhouse gas emissions from buildings.*
URL: http://www.unep.org/

Verdung, E (1997) *Public Policy and Policy Evaluation.* New Brunswick: Transaction Publishers.

World Energy Assessment (WEA). (2000) Energy and the Challenge of Sustainability. *Chapter 6: Energy end-use efficiency.*
URL: http://www.undp.org/energy/activities/wea/

World Business Council for Sustainable Development (WBCSD). (2007) *Energy Efficiency in Buildings: Business realities and opportunities.*
URL: http://www.wbcsd.org/

World Business Council for Sustainable Development (WBCSD). (2009) *Energy Efficiency in Buildings: Transforming the Market.*
URL: http://www.wbcsd.org/

World Energy Council (WEC). (2008) *Energy Efficiency Policies around the World: Review and Evaluation.*
URL: http://www.worldenergy.org/

Appendix - Contacts

In this research a number of organisations were contacted for information on evaluations and to discuss findings and the future outlook for respective Nordic countries.

Country	Contact	Organisation	Website
Sweden	Otto Ryding	Swedish Energy Agency	www.swedishenergyagency.se
	Lars Nilsson	Lund University	www.lu.se
	Tomas Berggren	Swedish Energy Agency	www.swedishenergyagency.se
	Ulla Jansson	Lund University	www.lu.se
Denmark	Peter Bach	Danish Energy Authority	www.ens.dk
Finland	Janne Lehenkari	Advansis	www.advansis.fi
	Adriaan Perrels	Government Institute for Economic Research (VATT)	www.vatt.fi
	Per Mickwitz	Finnish Environment Institute (SYKE)	www.environment.fi
	Eva Heiskanen	National Consumer Research Centre	www.ncrc.fi
	Kirsi-Maaria Forssell	Motiva	www.motiva.fi
	Lea Gynther	Motiva	www.motiva.fi
Norway	Andreas Enge	Enova	www.enova.no
	Thea Mørk	Norwegian Energy Efficiency	www.nee.no

Appendix - Databases

In the appendix there are tables of policy measures for energy efficiency in Sweden, Denmark, Norway and Finland from the MURE and IEA databases. The lists of policy measures in the tables are different, reflecting the contrasting definitions of what constitutes policy measures for MURE and the IEA. While there are always concerns over whether such databases are fully up-to-date, they do provide a good overview for comparison of the main policy measures in the Nordic countries. This study has relied on a triangulation of sources in an attempt to ensure the information is based on the latest policy conditions.

MURE database

MURE (Measures for the Rational Use of Energy) provides information on energy efficiency policies and measures that have been carried out in the Member States of the EU and enables the simulation and comparison at a national level of the potential impact of such measures. It has been designed and developed by a team of European experts, led and co-ordinated by ISIS (Institute of Studies for the Integration of Systems, Rome) and the Fraunhofer Institute for Systems and Innovation Research ISI (Germany). A permanent network of correspondents within energy efficiency agencies established in all EU Member States guarantees the continuous updating of the database.

The tables below provide the following information on policy measures – the name, status, type, starting and ending year, and a semi-quantitative assessment of impact. The policy measures are for the household sector.

IEA database

The Energy Efficiency Policies and Measures database run by the IEA (International Energy Agency) provides information on policies and measures taken or planned to improve energy efficiency. Comprising more than 1,000 records dating back to the year 2000 and sometimes earlier, the database provides a source of information on energy efficiency policy developments. The IEA continuously updates the database and government experts from member countries are regularly provided with the opportunity to review its contents. However, the database may not be a complete listing of all actions taken to improve energy efficiency.

The tables below provide the following information on policy measures – the name, type, targeted sector or area, and year initiated. The policy measures include appliances, buildings, framework policy and multi-sectoral policy.

Policy measures for Sweden (MURE database)

Title	Status	Type	Starting Year	Ending Year	Impact
Tests and trials on domestic appliances	Ongoing	Information/Education	1995		Unknown
Energy and carbon dioxide tax in the household sector	Ongoing	Cross-cutting with sector-specific characteristics	1991		High
Investment grants for solar heating	Ongoing	Financial	2000	2010	Medium
Assignment 2000 (Uppdrag 2000)	Completed	Co-operative Measures	1986	1992	Low
Labelling of domestic appliances and windows	Ongoing	Legislative/Informative	1995		Medium
Investments grants for small scale biofuel-fired heating systems and more energy efficient windows	Ongoing	Fiscal/Tariffs	2006	2008	Low
Building Regulations	Ongoing	Legislative/Normative	1995		Medium
Support for conversion of heating system in household	Ongoing	Financial	2006	2010	Medium
Information campaign on improved energy efficiency	Ongoing	Information/Education	2006	2009	Medium
Energy declarations	Ongoing	Legislative/Informative	2008		Unknown
The Building-Living Dialogue	Ongoing	Unknown	1999		Medium

Policy measures for Sweden (IEA database)

Name	Type	Target	Status	Year
National Energy Efficiency Action Plan	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2008
Energy Efficient Home Consumer Campaign	•Education and Outreach •Policy Processes •RD & D	•Buildings	In force	2007
Commission on Oil Independence: Final Report, Targets Published	•Policy Processes	•Multi-sectoral Policy	Ended	2006
Energy Declaration of Buildings Act - Incentives for Investment in Lower-Energy Buildings	•Education and Outreach •Financial •Policy Processes •Regulatory Instruments	•Buildings	In force	2006
Grants for Conversion, Energy Efficiency and Solar in Public Buildings	•Financial •Incentives/ Subsidies	•Buildings	Ended	2005
Tax Reduction for Environmental and Energy Investments in Public Buildings	•Financial	•Buildings	Ended	2005
Climate Investment Programmes (Klimp)	•Financial •Incentives/ Subsidies	•Multi-sectoral Policy	Ended	2003
Sustainable Municipalities Programme	•Education and Outreach •Incentives/ Subsidies •Policy Processes	•Framework Policy	In force	2001
The Environmental Code	•Regulatory Instruments	•Multi-sectoral Policy	In force	1999
Local Investment Programmes (LIP)	•Financial •Incentives/ Subsidies	•Multi-sectoral Policy	In force	1998 (revised in 2003)

Policy measures for Denmark (MURE database)

Title	Status	Type	Starting Year	Ending Year	Impact
Grant for energy saving measures for pensioners' dwellings	Completed	Financial	1993	2003	High
Energy management for larger buildings	Ongoing	Legislative/Informative	1997		Low
Heat Consulting	Completed	Legislative/Normative	1986	1996	Low
EU energy labelling of electric appliances	Ongoing	Legislative/Informative	2000		Low
Revision of thermal building code (2005/2006)	Ongoing	Legislative/Normative	2006		Low
Agreement on efficient windows	Completed	Financial	2004	2006	Medium
Grid Supplied Heat Planning	Ongoing	Legislative/Normative	2000		Medium
Energy Certificate	Ongoing	Legislative/Informative	1997		Low
Grants for connection of houses built before 1950 to district CHP systems	Completed	Financial	1993	2002	Low
1995 Regulations for New Building	Completed	Legislative/Normative	1995	2006	Medium
Energy labelling of smaller buildings	Completed	Legislative/Informative	1997	2006	Medium
Grants for Energy Savings Products for Household	Ongoing	Financial	1998		Low
Electricity Saving Trust	Completed	Financial	1997		Low
Heat inspection of small oil heat furnaces	Ongoing	Legislative/Normative	1995		Low
Energy requirements for new and existing buildings (substitute by DK8)	Completed	Legislative/Normative	2006	2008	Low
Carbon Dioxide tax	Ongoing	Cross-cutting with sector-specific characteristics	1998		Low
A-pumps	Completed	Information/Education	2007	2008	Medium
Guide for lower electricity consumption	Completed	Information/Education	2007	2007	High
Cheapest-most expensive campaign focusing on electricity savings	Completed	Information/Education	2007	2008	High
My house – the intelligent home	Ongoing	Information/Education	2007		High
Club1000 - 1000 kWh campaign	Ongoing	Information/Education	2007		Medium
The electricity savings label (Elsparemærket)	Ongoing	Information/Education	2006		High
Electricity-saving sockets	Ongoing	Information/Education	2007		Medium

Policy measures for Denmark (IEA database)

Name	Type	Target	Status	Year
Agreement on Danish Energy Policy 2008-2011	•Financial •Incentives/ Subsidies •Policy Processes •Public Investment •RD & D	•Multi-sectoral Policy •Transport	In force	2008
Energy Efficiency Action Plan	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2007
A Visionary Danish Energy Policy 2025	•Policy Processes	•Framework Policy •Multi-sectoral Policy	Superseded	2007
Electricity Saving Trust Purchasing Guidelines	•Education and Outreach •Public Investment •Voluntary Agreement	•Appliances	In force	2006 (updated 2008)
Implementation of EU Energy Performance of Buildings Directive (EPBD)	•Education and Outreach •Regulatory Instruments	•Buildings	In force	2006
Thermal Building Code Revision	•Regulatory Instruments	•Buildings	In force	2006
Action Plan for Renewed Energy Conservation	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2005
Agreement on Energy Saving Initiatives	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2005
Energy Strategy 2025	•Policy Processes	•Framework Policy	Superseded	2005
National Strategy for Sustainable Development	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2002
Natural Gas and Energy Savings Agreement	•Policy Processes	•Multi-sectoral Policy	Superseded	2001
Act on the Promotion of Savings in Energy Consumption	•Policy Processes	•Framework Policy	In force	2000
Climate 2012 - Danish Climate Policy	•Policy Processes	•Framework Policy •Multi-	Superseded	2000

Name	Type	Target	Status	Year
		sectoral Policy		
Promotion of Energy Efficient Electronic Products, The Group for Energy Efficient Appliances (GEEA)	•Education and Outreach •Policy Processes	•Appliances	Ended	2000
Carbon Tax/Green Tax System	•Financial	•Multi-sectoral Policy	In force	1999
Baltic Energy Efficiency Group (BEEG)	•Education and Outreach •Policy Processes	•Buildings •Industry	Ended	1998
Energy Labelling of Larger Buildings (Eco-scheme)	•Regulatory Instruments	•Buildings	Superseded	1996
Energy Labelling of Smaller Buildings	•Regulatory Instruments	•Buildings	Superseded	1996
Green Tax Package 1995	•Financial	•Multi-sectoral Policy	Superseded	1995
Energy Management in State Buildings	•Regulatory Instruments	•Buildings	In force	1992
District Heating and CHP	•Policy Processes	•Buildings	In force	1980s

Policy measures for Norway (MURE database)

Title	Status	Type	Starting Year	Ending Year	Impact
Energy efficiency label scheme for domestic appliances (Energimerking)	Ongoing	Legislative/Informative	1996		Low
Local energy efficiency fund in Oslo (Enøkfondet i Oslo)	Ongoing	Financial	1981		Medium
Environmental taxes	Ongoing	Cross-cutting with sector-specific characteristics	1991		Medium
Building regulations 1987 (Byggeforeskrift 1987)	Completed	Legislative/Normative	1987	1997	Medium
Energy efficient low energy houses (Energibruk i boliger)	Completed	Financial	2003	2004	Low
Energy information helpline (Enovas svartjeneste)	Ongoing	Information/Education	2003		Low
Information and education financed by NVE (Opplæring og informasjon)	Completed	Information/Education	1990	2001	Low
Energy taxes	Ongoing	Cross-cutting with sector-specific characteristics	1975		Medium
Mandatory Energy Efficiency Activities through Regional Energy Efficiency Centres (Lovpålagt enøk - Regionale enøksentra)	Completed	Information/Education	1994	2001	Low
Energy saving loans (Husbanken)	Ongoing	Financial	1996		Low
Grants to electricity savings in households (Elsparetiltak i husholdningene)	Completed	Financial	2003	2003	Low
Energy efficiency label scheme for residential lighting	Ongoing	Legislative/Informative	1999		Low
Building Regulations 1997 (Byggeforskrift 1997)	Completed	Legislative/Normative	1997	2008	Medium
Energy Act on informative billing (Energiloven)	Ongoing	Information/Education	1999		High
Simple Energy Audit (Enøk-sjekken)	Ongoing	Information/Education	1997	2006	Low
Energy performance of buildings (Bygningsenergidirektivet)	Proposed (advanced)	Legislative/Informative			High
Energy efficiency requirements on refrigerators, freezers and their combinations	Ongoing	Legislative/Normative	1999		Medium
EcoBuild support scheme (ØkoBygg-programmet)	Completed	Financial	1998	2002	Medium
Grants for electricity savings in households (Tilskuddsordningen i husholdningene)	Ongoing	Financial	2006		Low
Grants for energy savings in the built environment (Bygg, bolig og anlegg)	Ongoing	Financial	2005		Medium
Educational awareness program for children about energy use and environmental impacts (Regnmakerne)	Ongoing	Information/Education	2003		Low
Minimum energy efficiency standards for boilers	Ongoing	Legislative/Normative	1998		Low
Building regulations 2007 (Byggeforeskrift 2007)	Ongoing	Legislative/Normative	2007		High

Policy measures for Norway (IEA database)

Name	Type	Target	Status	Year
Assistance to Companies Manufacturing Energy Efficient Products	•Education and Outreach •Incentives/ Subsidies	•Buildings	In force	
Implementation of EU Directives on Energy Efficiency	•Regulatory Instruments	•Multi-sectoral Policy	In force	
Regional Energy Efficiency Centres	•Policy Processes	•Multi-sectoral Policy	Ended	
Various Financial Measures for Energy Efficiency Activities	•Incentives/ Subsidies	•Multi-sectoral Policy	Ended	
Energy Fund	•Financial •RD & D	•Multi-sectoral Policy	In force	2007
White Paper on National Climate Policy	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2007
Commission on Low Emissions - Final Strategic Report Published	•Education and Outreach •Incentives/ Subsidies •Policy Processes •Public Investment •Regulatory Instruments	•Buildings •Industry •Transport	In force	2006
Energy Performance of Buildings	•Education and Outreach •Regulatory Instruments •Tradable Permits	•Buildings	In force	2006
Funding for Energy Saving Measures	•Policy Processes	•Buildings	In force	2003
Incentives for Low-energy Housing	•RD & D •Tradable Permits	•Buildings	In force	2002
Informative Electricity Bills	•Education and Outreach	•Multi-sectoral Policy	In force	2002
Renewable Energy & Energy Efficiency Partnership (REEEP)	•Education and Outreach •Incentives/ Subsidies •Policy Processes •Voluntary Agreement	•Multi-sectoral Policy	In force	2002
Energy, Environment, Building and Construction (EMB)	•RD & D	•Multi-sectoral Policy	In force	2001
Enova SF - The Energy Fund	•Policy Processes	•Framework Policy	In force	2001
Standards and Labelling for Household Appliances	•Education and Outreach •Regulatory Instruments	•Appliances	In force	2001
Subsidies for Energy Efficiency and Renewables	•Incentives/ Subsidies	•Multi-sectoral Policy	In force	2001

Name	Type	Target	Status	Year
White Paper on National Climate Policy - National Emissions Trading Scheme	•Policy Processes •Tradable Permits	•Framework Policy	Ended	2001
Fossil Fuel Tax Increases	•Financial	•Appliances •Buildings •Industry •Transport	In force	2000
Electricity Tax	•Financial	•Appliances •Buildings •Industry •Multi-sectoral Policy	In force	1999
White Paper on Energy Policy	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	1999
Baltic Energy Efficiency Group (BEEG)	•Education and Outreach •Policy Processes	•Buildings •Industry	Ended	1998
Energy Efficiency Network for Buildings	•Education and Outreach	•Buildings	In force	1996

Policy measures for Finland (MURE database)

Title	Status	Type	Starting Year	Ending Year	Impact
Window Energy Rating System	Ongoing	Information/Education	2006		High
Procurement competition for energy efficient detached-houses	Completed	Co-operative Measures	2000	2001	Low
Orders for energy management in buildings	Ongoing	Legislative/Normative	1979		Unknown
Orders for indoor climate and ventilation in new buildings	Ongoing	Legislative/Normative	2003		Unknown
Programme for energy conservation in oil-heated buildings, the “Höylä II” programme	Completed	Information/Education	2002	2007	High
Orders for boiler efficiency	Ongoing	Legislative/Informative, Legislative/Normative	1998		Unknown
Thermal insulation ordinance	Ongoing	Legislative/Normative	2010		High
Promotion of wood pellet heating in buildings	Ongoing	Financial	1999		Unknown
Mandatory service book for buildings	Ongoing	Legislative/Informative	1994		Low
Voluntary Energy Conservation Agreement of Municipal and Non-profit Housing Properties of ASRA	Ongoing	Financial	2002	2012	Medium
The Energy Labelling law	Ongoing	Legislative/Informative	1995		Unknown
Energy grant for energy audits and energy efficiency improvements	Ongoing	Financial	2003		Low
Energy Audit Model for Residential Buildings	Ongoing	Legislative/Informative	2003		Unknown
Energy conservation education for inhabitants of buildings, ‘the energy expert’ -education	Completed	Information/Education	1996	2005	Low
Energy Efficient Home Campaign	Completed	Information/Education	2005	2008	Low
Programme for energy conservation in oil-heated buildings, the Höylä III Programme	Ongoing	Information/Education	2007	2016	High
Energy certificates for buildings	Ongoing	Legislative/Informative	2008		Unknown
Household tax deduction	Ongoing	Fiscal/Tariffs			Low

Policy measures for Finland (IEA database)

Name	Type	Target	Status	Year
Long-term Climate and Energy Strategy	•Policy Processes	•Framework Policy	In force	2008
Voluntary Energy Efficiency Agreements for 2008 - 2016	•Voluntary Agreement	•Multi-sectoral Policy	In force	2008
Amendment of the Building Code	•Regulatory Instruments	•Buildings	In force	2007
Implementation of the EU Energy Performance of Buildings Directive	•Regulatory Instruments	•Buildings	In force	2007
National Energy Efficiency Action Plan	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2007
Sustainable community technology programme	•RD & D	•Buildings •Multi-sectoral Policy •Transport	In force	2007
Extension of Voluntary Energy Conservation Agreements	•Voluntary Agreement	•Framework Policy	Superseded	2006
Energy and Climate Policy Strategy	•Policy Processes	•Framework Policy •Multi-sectoral Policy	In force	2005
ClimBus Technology Programme	•Education and Outreach •RD & D	•Multi-sectoral Policy	In force	2004
Energy Grants for Residential Buildings	•Incentives/ Subsidies	•Buildings	In force	2003
Energy Tax Overhaul	•Financial •Incentives/ Subsidies	•Appliances •Buildings •Industry •Transport	Ended	2002
National Climate Strategy	•Financial •Policy Processes	•Framework Policy	Superseded	2001
Promotion of Energy Efficient Electronic Products, The Group for Energy Efficient Appliances (GEEA)	•Education and Outreach •Policy Processes	•Appliances	Ended	2000
Voluntary Agreements for Buildings	•Voluntary Agreement	•Buildings	In force	1999
Baltic Energy Efficiency Group (BEEG)	•Policy Processes	•Buildings •Industry	Ended	1998
Energy Aid	•Incentives/ Subsidies	•Multi-sectoral Policy	In force	1998
Energy Audits	•Incentives/ Subsidies •Regulatory Instruments	•Multi-sectoral Policy	In force	1992

Name	Type	Target	Status	Year
Voluntary Agreements for Industrial, Commercial and Public Organisations	•Voluntary Agreement	•Buildings •Industry	Superseded	1992
Building Code	•Regulatory Instruments	•Buildings	Superseded	1976