En vej til flere og illigere energibesparelser

En evaluering af samtlige danske energispareaktiviteter

Teknisk bilagsrapport V1:

Komparativt studie af energispareaktiviteter i udvalgte lande

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Udarbejdet af konsortiet bestående af Ea Energianalyse, NIRAS, RUC og 4-Fact

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Forord

Dette dokument er en af flere tekniske bilagsrapporter til en evaluering er udført for Energistyrelsen med baggrund i aftalen mellem regeringen og S, DF, R og SF af 10. juni 2005 om den fremtidige energispareindsats og aftalen af 21. februar 2008 mellem regeringen og S, DF, SF, R og NA om den danske energipolitik i årene 2008-2011.

I 2005-aftalen blev det fastlagt, at der i 2008 skal gennemføres en samlet vurdering af den danske energispareindsats og de opnåde resultater med henblik på at sikre, at virkemidlerne er tilstrækkelige og organiseringen af indsatsen er effektiv i forhold til de aftalte mål. Og i energiaftalen fra februar 2008 blev det præciseret, at den samlede evaluering af energibesparelsesindsatsen skal gennemføres inden udgangen af 2008 og forelægges til drøftelse mellem parterne i aftalen senest 1. februar 2009.

Energistyrelsen udbød den 13. marts 2008 evalueringsprojektet, og et konsortium bestående af Ea Energianalyse, Niras, Institut for Samfund og Globalisering (RUC) og 4-fact blev valgt til at gennemføre opgaven. Det konkrete grundlag for projektet er konsortiets projektbeskrivelse af 21. april 2008.

Arbejdet har været forankret i en styregruppe og endvidere har Koordinationsudvalget for energibesparelser og en række øvrige interessenter bidraget med information og kommentarer. I styregruppen deltog Peder Andersen, Økonomisk institut, Københavns Universitet, Lars J Nilsson, Environmental and Energy Systems Studies, Lund University, Olaf Rieper, AKF samt Peter Bach og Renato Ezban, Energistyrelsen.

Ud over nærværende tekniske bilagsrapport forligger der en række af andre tekniske bilag, som tilsammen dokumenterer de gennemførte analyser, som ligger til grund for evalueringens hovedrapport og bilagsrapport.

Den foreliggende rapport er forfattet på engelsk af hensyn til arbejdsprocessen, da hovedforfatteren er udenlandsk.

Contents

1. Comparing Denmark

How does Denmark compare to other countries in terms of energy efficiency achievements i.e. reduced energy consumption per activity and how effective have the policy instruments been to promote such energy efficiency achievements? To answer the question we will look at Denmark in two ways.

- The macro-perspective, which we call ***Comprehensiveness;*** each of the countries selected will be looked upon as a whole to find out how their programmes cover their sectors and how they perform. What policy-approaches have been used?
- The micro-perspective, which we call ***Mirroring;*** each of the selected measures in Denmark will be compared to a similar in the other selected countries.

For the ***comprehensive*** perspective we will first compare how the sectors and energy intensity have developed and briefly discuss how the policies were composed and packaged. To this end we will make use of an IEA method to frame “policy packages”.

For the ***mirroring*** we will choose examples from Europe as well as the US that show similarities to Danish measures (virkemidler). They don’t have to be exact copies but could have used similar approaches or targeted the same type of actors in a way that is of interest for Denmark to consider.

The macro-perspective will tell us how the pieces fit together and whether the coverage of e.g. sectors and agents is sufficient to deliver a harmonised result where all opportunities have been exploited. The micro-perspective will tell us if there are alternatives to the measures used and indicate whether these measures could be re-designed for greater achievements.

The following set of countries for comparison has been selected.

Table 1: Countries selected for comparison (justification)

	Main resources		
Country	**Production (electricity)**	**Production (heat)**	**Reason for selection**
Sweden	Nuclear and hydro	Biofuel	**Closely related context (culture, co-operation, traditions) and direct grid-connection**
Norway	Hydro	Electricity	**See above**
Finland	Nuclear and coal (CHP)	Natural gas and coal	**See above**
The Netherlands	Natural gas , coal, wind	Natural Gas	**Similarity in use of CHP**
Spain	Coal, natural gas, nuclear, wind	NA	**Similarity in high proportion of wind and biofuel**
Austria	Natural gas and hydro	Natural gas and biofuel	**Similarity in renewable energy for heating**
Italy	Natural gas	Natural gas	**Experimenting with policy measures**
United States	Examples picked from both federal administration and applications in single states when appropriate.		

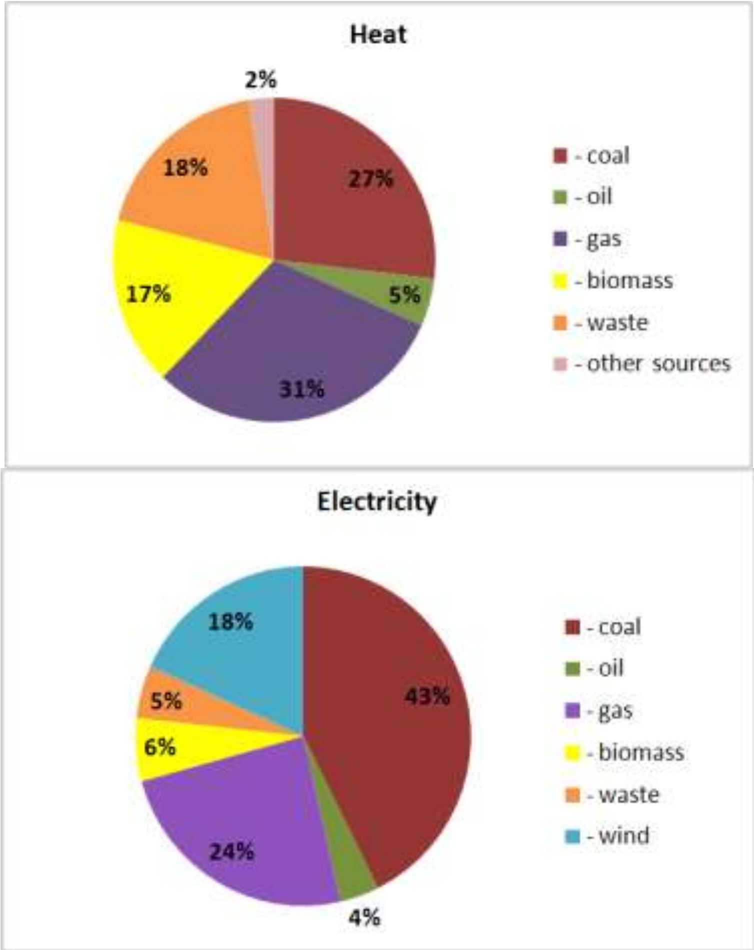
We will begin by looking at the Danish energy profile to further feature the relations to the countries used for the comparisons.

The main part of the information presented in the following is primarily based on various IEA reports. For the full argumentation for the presented findings please consult the relevant IEA report specified in the text or the footnotes.

1.1 The Danish energy profile

The most obvious feature would have to do with physics, i.e. Denmark is heavily dependent on fossil fuels for both heating and electricity. Domestic production of oil and gas outweighs energy imports and does not currently constitute a dependency as it does in many other countries. Despite this Denmark has also managed to develop and make extensive use of renewable resources both for heating (biomass and waste) and for electricity (wind and biomass).

Figure 1: The Danish energy supply for heating and electricity



To find a similar high use of renewable fuels for heating we have to look to the ***Nordic countries***, but to find a similarity in use of fossil fuels we must look southwards in Europe . The country that comes closest to Denmark in terms of relative use of fossil and renewable fuels is ***Austria***.

In a similar search with regards to electricity production ("old" renewables such as hydro excluded) we find that Denmark has no comparison. The closest is ***Spain*** with a high penetration of wind power in the market, especially in the northern provinces of Spain.

Another feature that could merit comparison is the measures themselves. A natural comparison for Denmark would be the Nordic countries because of the size of the countries, the cultural and lingual similarities, geopolitical situation etc. One would assume that countries this close to each other resembled each other in terms of policies and that it would be possible to easily find direct influence in applications.

There are however great differences in the Nordic region in terms of resource basis and in consequence therewith also industrial structure. These differences have implications for how energy problems play out. Denmark has a low end-use of energy and of electricity per capita in a Nordic comparison. ***Austria***, however, seems to be a reasonable object when talking about level in consumption.

Figure 2: Supply for heating and electricity in compared countries1

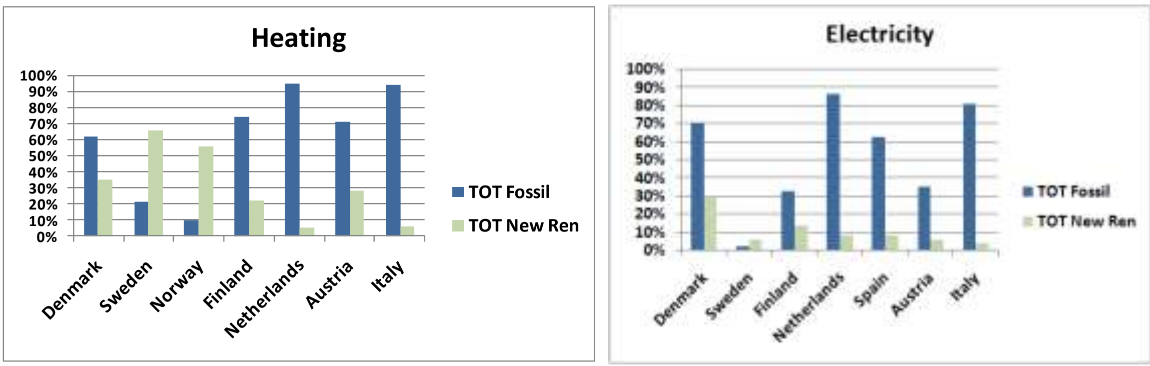
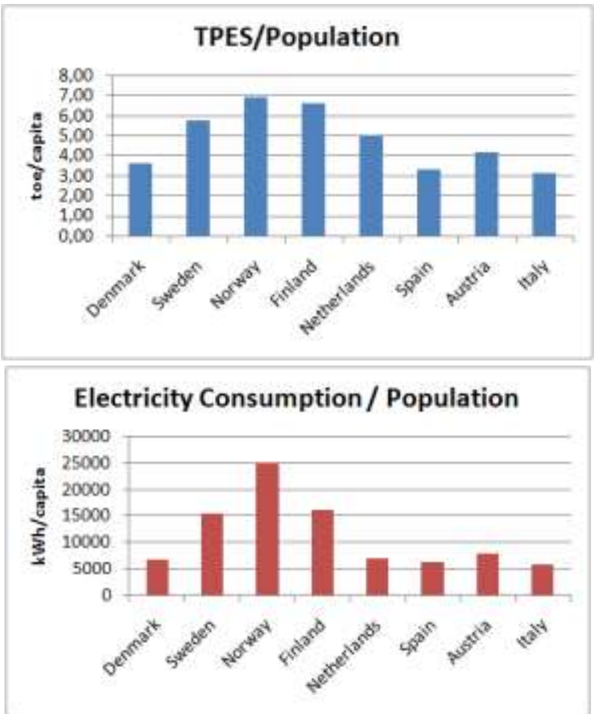


Figure 3: Total Primary Energy Supply (TPES) and electricity consumption per capita in compared countries 2005.2

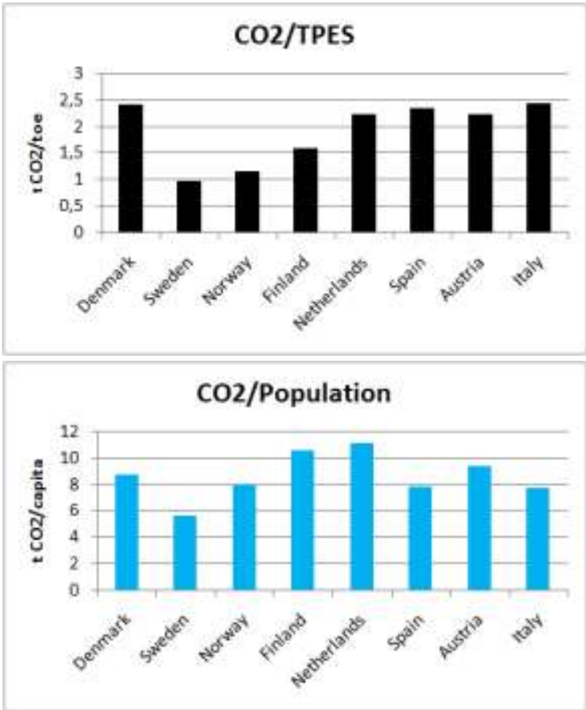


[1] Source: IEA Database OECD 2005 (http://www.iea.org/Textbase/country/24_country.asp). (**Total** Fossil: Coal, Oil and Gas; **Total** New Renewable: Biomass, Waste, Geothermal, Solar PV and thermal, and Tide)

[2] Source: IEA Database OECD 2005

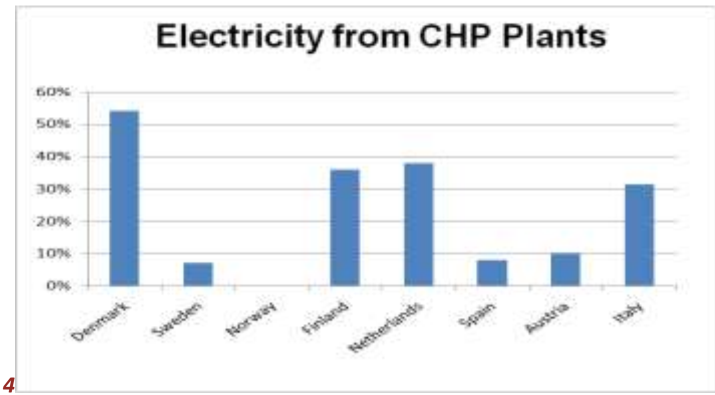
The severity of the Danish challenge becomes more obvious when we look at carbon-intensity of energy use, which is comparable to, and even higher than, that of countries like ***The Netherlands, Spain and Italy***.

Figure 4: Emission of CO2 in Denmark related to TPES and per capita.[3]



Without hydro and nuclear, and with a relative high share of coal for electricity/CHP, Denmark has a high CO_2 emission per primary energy use. The use of wind power, natural gas, waste and biomass cannot outweigh the impact of coal consumption. Denmark has become locked into the use of fossils to an extent that a dedicated and complex strategy is required that aims at both improving energy efficiency and fuel-shift. This is applied most visibly in the use of CHP where the Denmark is challenged by few countries.

Figure 5: Percentage of electricity supplied from CHP in compared countries.



[4]

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[3] Source: IEA Database OECD 2005 (http://www.iea.org/Textbase/country/24_country.asp).

To fully understand the changes in energy use, decomposition into the following three factors is required.

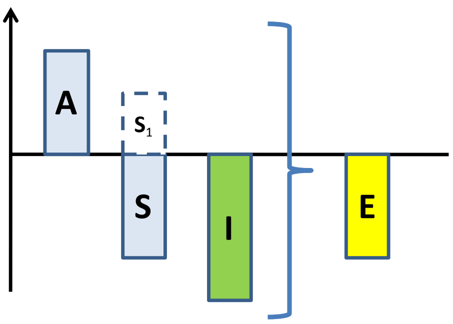
- **A: Activity** (amount, population etc., e.g. number of houses)
- **S: Structure** (sort, type, e.g. size of houses (m^2/house))
- **I: Intensity** (efficiency, e.g. kWh/m^2)

These factors constitute energy use when multiplied together: **E=A*S*I**

Sometimes, and for simplification, the Activity and the Structure are combined and called "Energy Service" = f (A,S) to enable a more clear separation of the pure technology component, which is the Intensity. It is then more obvious that the "service" is the demand for comfort and standard of living.

In absolute numbers the Activity normally increases because more and more people are becoming affluent and can afford to buy more consumer goods. The Structure could go both ways, but industry normally reduces the need for energy per produced unit due to improved productivity. Changes in structure is mostly autonomous but can also be affected by policy actions in terms of e.g. industrial policies that has the aim to modernise the industrial sector. Increased intensity, which is usually prime target for energy policies, is reducing the need for energy.

Figure 6: Decomposition of Energy use (E) into Activity, Structure and Intensity



The pace of the Danish changes in energy intensity has been high but not exceptional in terms of consumption to GDP. It roughly corresponds to the IEA average both in the period 1973-98 and 1990-2005, but with a pronounced lower intensity improvement in the latter period.

[4] Source: The Danish Energy Authority (http://www.ambottawa.um.dk/NR/rdonlyres/C3F9F1D4-BEA9-4C29-A1FD-1D7CC8617B84/0/combinedheat.pdf).

Figure 7: Changes in Total Final Consumption (TFC) decomposed into effects from energy services and intensities.5

Changes in TFC/GDP Decomposed into Changes in Energy Services/GDP and Intensity Effect6, 1973 - 1998

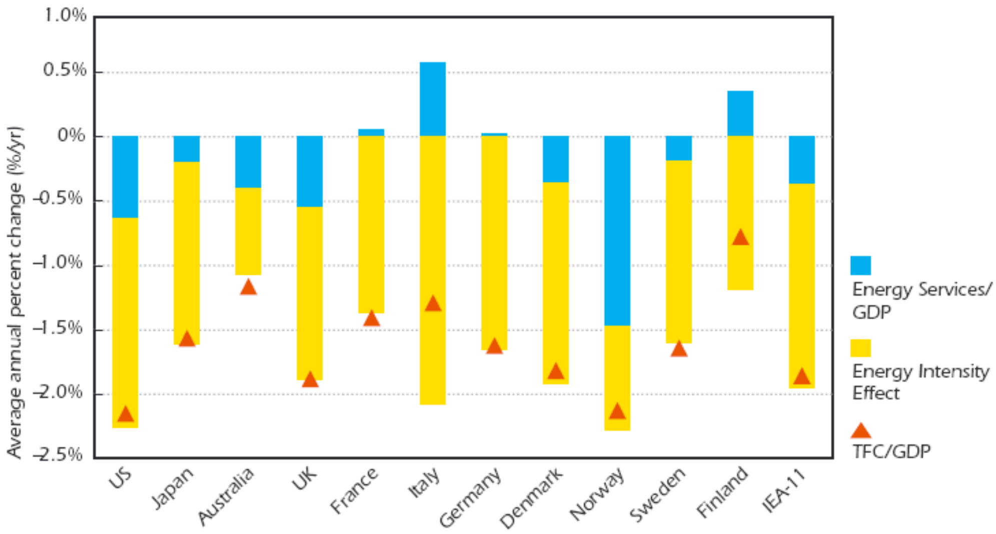
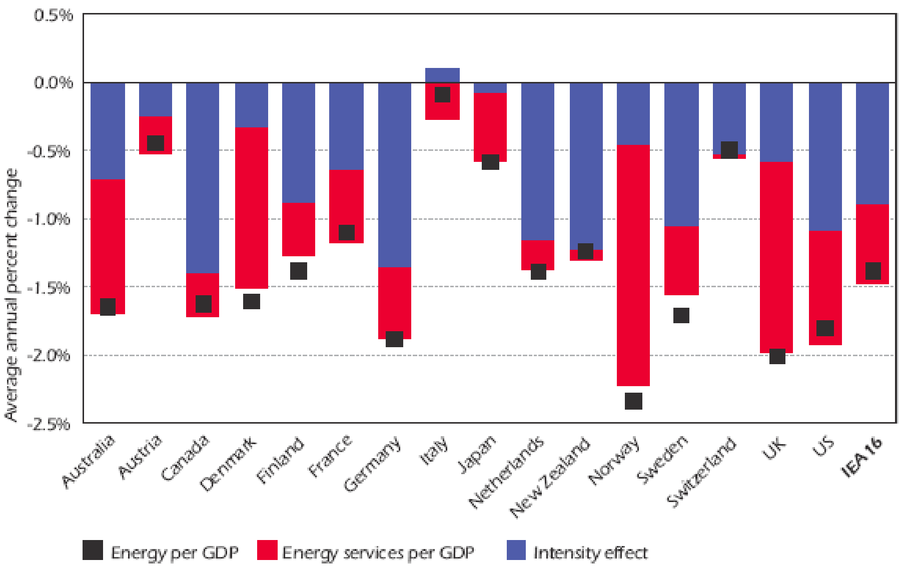


Figure 2.7 ▶ *Changes in TFC/GDP Decomposed into Changes in Energy Services/GDP and Intensity Effect, 1990 - 2005*

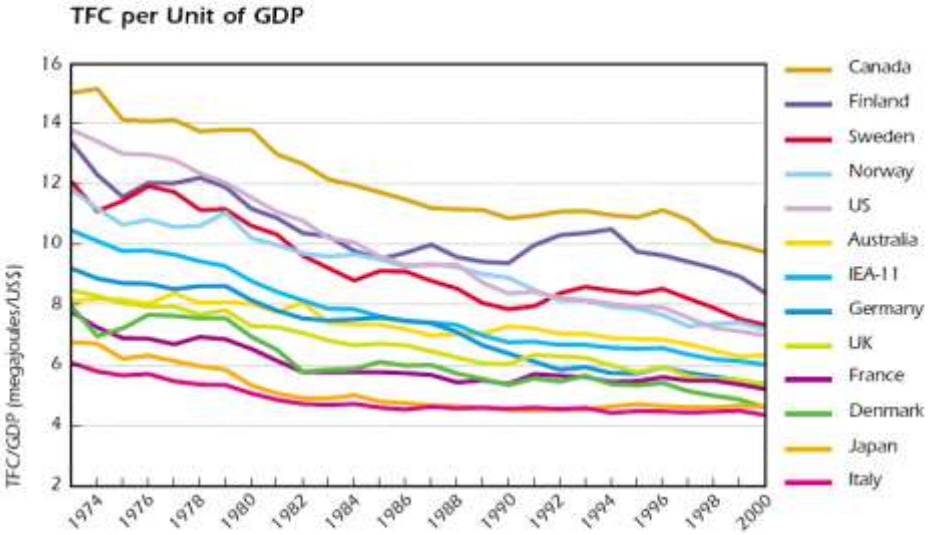


This pace has however been achieved from a comparatively low level of initial consumption and put Denmark in a front position among the OECD-countries, moving from being 4th in the

[5] Source: IEA Indicators
1. **Worldwide Trends in Energy Use and Efficiency**;
http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=2026
2. **Oil Crises & Climate Challenges**- *30 Years of Energy Use in IEA Countries;*
http://www.iea.org/textbase/nppdf/free/2004/30years.pdf

league of "IEA-11" to a head-to-head position among three. A change that seems remarkably good.

Figure 8: Development of Total Final Consumption (TFC) in 11 IEA countries.



Improvement of energy efficiency can occur in two places, either where the fuel is converted (e.g. to electricity or heat in a power station and a boiler) or in the "end-use" technology where the electricity and heat is transformed into the service/comfort that is required.

To create a sustainable and robust energy system the efficiency, in use of fossil fuels as well as in the end-use, has to be maximised, but the actual use of fuels should also be shifted from fossil to renewable, see figure below. Energy systems are traditionally designed to transform high-density fuels in centralised locations into carriers (electricity, steam and hot water) to be transmitted to local users. The use of low-density fuels may require a different systems design with "distributed generation" adapted to local circumstances. Such a reconfiguration would be easier to achieve if end-use efficiency also was improved.

Denmark has more or less exhausted the opportunities to improve efficiency in use of the traditional (high density) fuels by use of e.g. CHP. The only remaining possibilities to move towards sustainability lie either in fuel shifting or in improving end-use efficiency. Fuel shifting has also come quite a way, but what about efficient end-use?

Denmark has moved up in the fore-front among the OECD countries despite already having a good position from the beginning. The reasons seem to be combination of intensity improvements and of structural changes. Intensity changes are mostly induced explicitly by energy policies, but structural changes may also have other reasons.

1.2. Comparing policy "fingerprints"

In a different part of this evaluation policy measures are grouped in three categories: ***Informative, Economical/Financial, and Normative***.

This creates a first view of how the measures a country can use influences actors to change behaviour and to make investments. Not only does it describe the measure individually but also how the measures relate to each other and form packages (portfolios) of measures to create a more favourable condition for actions.

The method can be taken further to look at how different, targeted actors may react. A popular belief is that there are **Barriers** that prevent positive actions. Such a view is mostly based on a perception of actors as being economically rational and profit-maximising in all their actions. Other views put more emphasis on the need for **Research, Development and Demonstration** (RD&D) as a means for new products to be developed by industry and made available to the market. And yet another view stresses that in order to achieve **Market Transformation** large scale programmes (Deployment) are called for to favour certain good products over inferior variations. Making use of these different angles adds aspects to who the agent is and what the driving forces are.

The IEA has developed a method[6] that looks to combinations of measures and puts them into policy packages that work differently depending on what the actors are supposed to do and, more specifically, how different measures function together. For an in-depth explanation see appendix 1.

This report uses the IEA categorisation to develop a method to show how a country's policy-packages are composed, and based on this develops an energy policy "fingerprint". In this "fingerprint" we use three ***policy focuses*** composed from different **operational objectives**:

- Focus on ***Customer relations*** composed from the objectives
  - **Serve** the customer (*provide calculation methods, develop financing methods (ESCO), etc.*)
  - **Incentivise** the customer (*internalise externalities, involve user in investment decisions, etc.*)
  - **Educate** and protect the customer (*develop life-cycle-cost-based purchasing rules, etc.*)
- Focus on ***Business organisation*** composed from the objectives
  - **Manifest** the demand for a change (*aggregate procurement, target niche markets, etc.*)
  - **Vitalise** a conservative business structure (*adapt business-models to boost new technologies, etc.*)
- Focus on ***Market rules*** composed from the objectives
  - **Reconsider** existing regulations and rules (*adapt regulations, e.g. connection of decentralised resources to grid*)

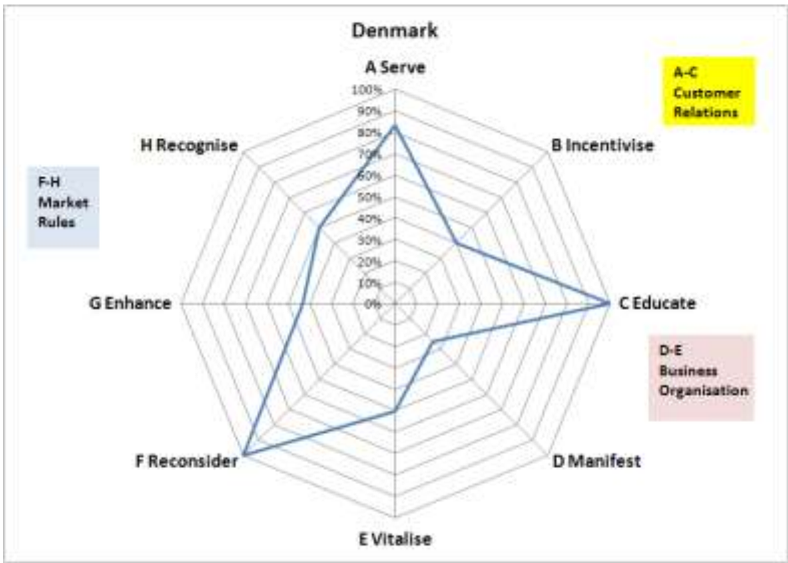
[6] Creating Market for Energy Technologies. OECD/IEA Paris 2003. https://www.iea.org/textbase/nppdf/free/2000/creating_markets2003.pdf

- **Enhance** financial framework and conditions (*enable financing institution to calculate risks from new technologies, etc.*)
- **Recognise** system aspects (*develop methods to handle complex systems changes, e.g. by ISO-standards*)

The IEA-analysis shows that successful policies are mixed and change over time to accommodate changes in circumstances and to enable keeping the pace with market development.

Each of the objectives is in the IEA-model (see appendix 1) constructed from a number of policy measures, such as information, financing, regulation etc. Figure 9 shows the Danish energy policy fingerprint.

Figure 9: The Danish policy "fingerprint"

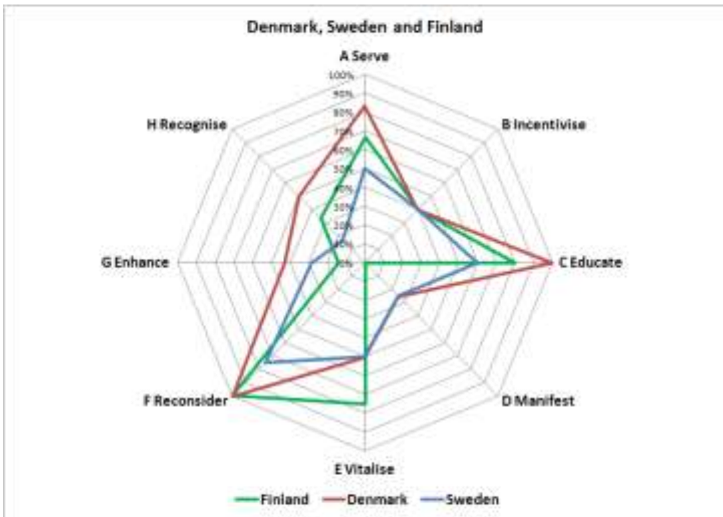


This fingerprint indicates that Denmark when it comes to energy efficiency measures has more emphasis on Customer Relations and Market Rules and less on Business Organisation.

This makes sense since the Danish manufacturing industry for end-use equipment is rather limited and the need to enable the market actors to make best use of the existing products is a better policy strategy. The highest scores are in the objectives "Serving customers", "Educate and protect customers" and in "Reconsider existing regulations and rules".

Denmark clearly has a wider arsenal of measures to deal with the efficiency issues than its neighbours. This creates rather drastic differences in policy characteristics. The only direction in which Denmark is surpassed by its neighbours is in "Vitalising a (conservative) business structure" where Finland has a more distinguished feature

Figure 10 : Policy "fingerprints" of the Denmark, Sweden, and Finland.



In the detailed comparison we find that the following issues are covered by measures that are not used in the same contexts in Denmark (see appendix 1 for explanations of issue categorisation).[7]

Table 2: Measures used in Sweden and Finland that are not used (or used differently) in Denmark

	Measures	Issue (related to the fingerprint)
Sweden	Technology Procurement	*Financing of market adaptation (R2)*
Sweden	Using procurement groups	*Targeting niche markets (M1)*
Finland	Tax deduction for households	*Adapt Incentive Structure (B4)* *Expand market coverage (R1)*
Finland	"Stand-alone" Voluntary Agreement with Branches of Industry	*Adapt Organisation (B7)*
Finland	Energy Performance Contracting and ESCO projects	*Enable Customers (M2)*
Finland	Training campaigns for maintenance staff Audits (as part of voluntary agreements)	*Warn (alert) Customers (M3)*

[7] Source. National Energy Efficiency Plans (NEEP) delivered to the EU

Consider: Would any of these measures be a natural part (complement, substitution) in the Danish palette? There is surprisingly little influence and even less co-operation between the Nordic countries in terms of operational work.

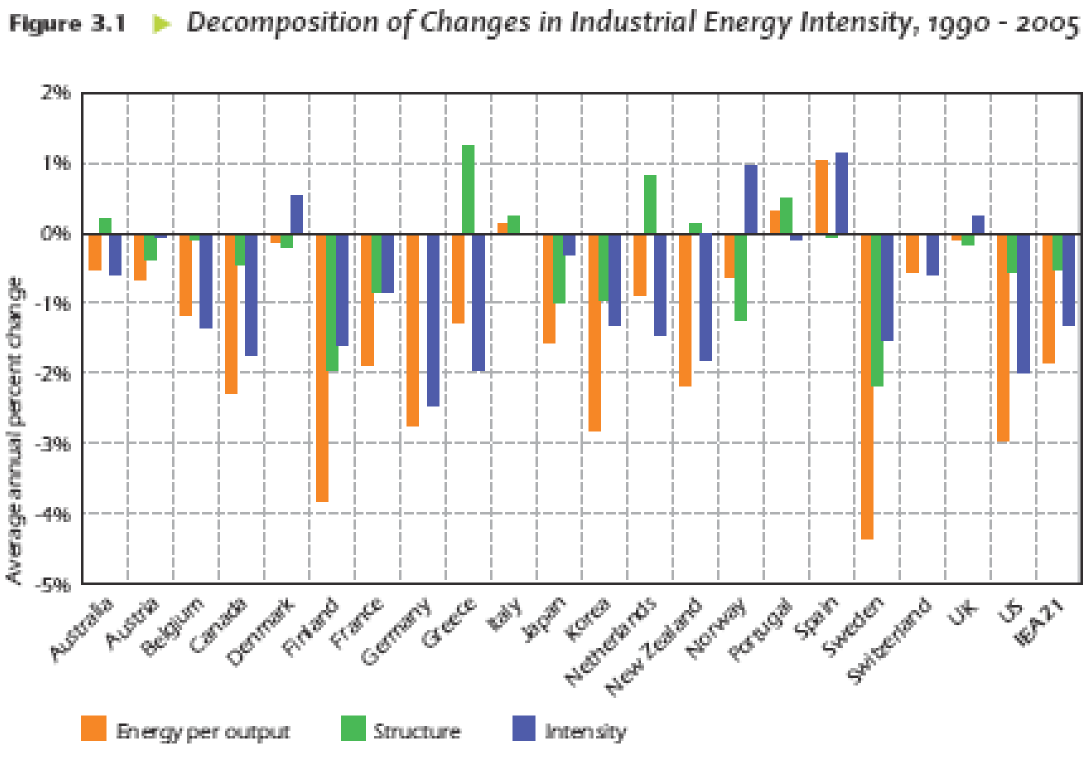
2. Comprehensiveness

The fact that Denmark has a low use of energy in relation to GDP and shows a decline over a long period does not necessarily mean that Denmark is more efficient (in absolute terms), but could be a consequence of a low-intensity industry-structure. In many other areas, service (commercial) sector, transportation, heating, use of appliances there might still be efficiency gains to make. Therefore there is a need to look at efficiency in terms of physical units as is done in the IEA Indicators.

2.1. A look at the sectors

In ***industry*** energy intensity has increased in Denmark over the last 15 years, but this is also the case in Norway. Both Sweden and Finland have clearly reduced energy intensity. In the wider European context the improvements in Austria and Italy are small and Spain has, just as Denmark, an increasing intensity. The Netherlands is the only one in the group of comparison countries that has been really successful in reducing industrial energy intensity.

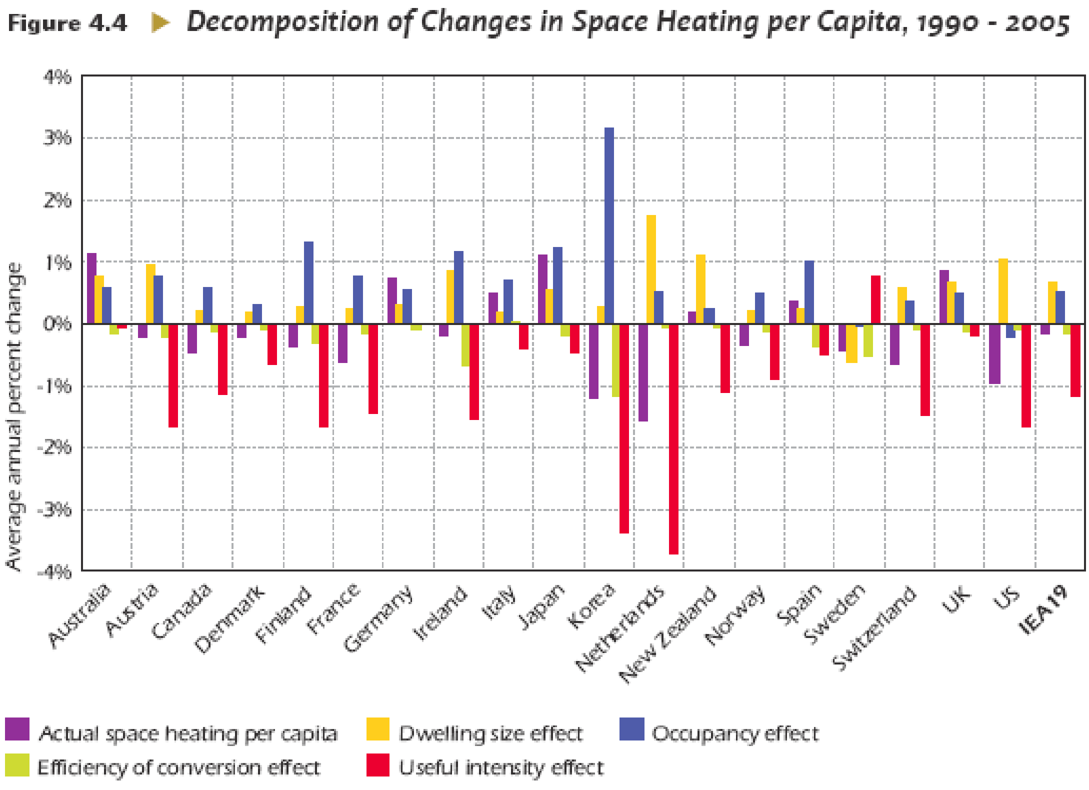
Figure 11: Decomposition of changes in use of energy in the industry



Consider: Does this indicate that the Danish energy efficiency programmes have not been sufficient in the Industry?

Space Heating decompositions show that there is a trend towards increased floor space per occupant in dwellings in all of the selected countries (the dwelling size and the occupancy effect). Most countries show improvements in energy intensity in dwellings with the exception of Sweden. All countries nevertheless have a decreasing use of energy. The high occurrence of heat pumps in Sweden and their efficiency of conversion compensates partially for increasing intensity. The Netherlands is the country that has the most impressive increase in efficiency.

Figure 12: Decomposition of changes in use of energy in space heating

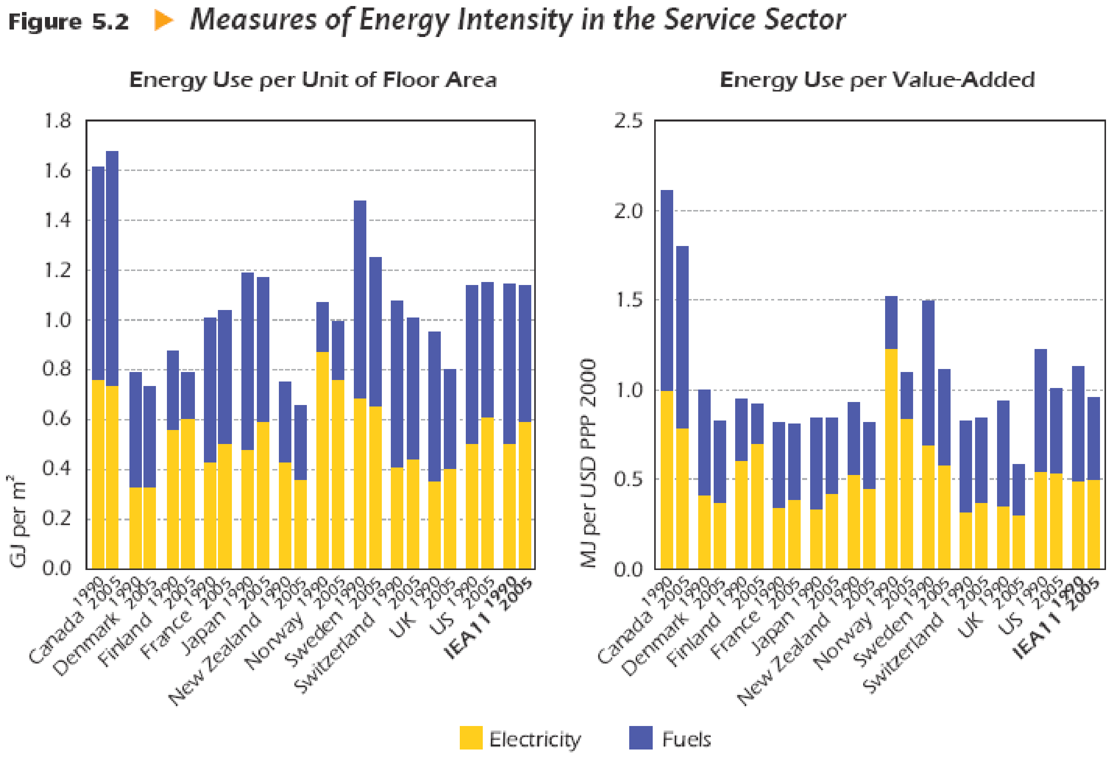


Consider: The Danish improvements are not exceptional among the group of compared countries. The Netherlands, Austria, Norway and Finland have done better.

The ***service sector*** shows a general trend of growing energy use due to lighting, air-conditioning and use of more IT-appliances, but mostly in growth of the activity in the sector.

In terms of intensity there is rather a general trend of improvement. In this sector Denmark together with Finland stands out as exceptionally good in contrast to Norway and Sweden.

Figure 13: Decomposition of changes in use of energy in the commercial sector



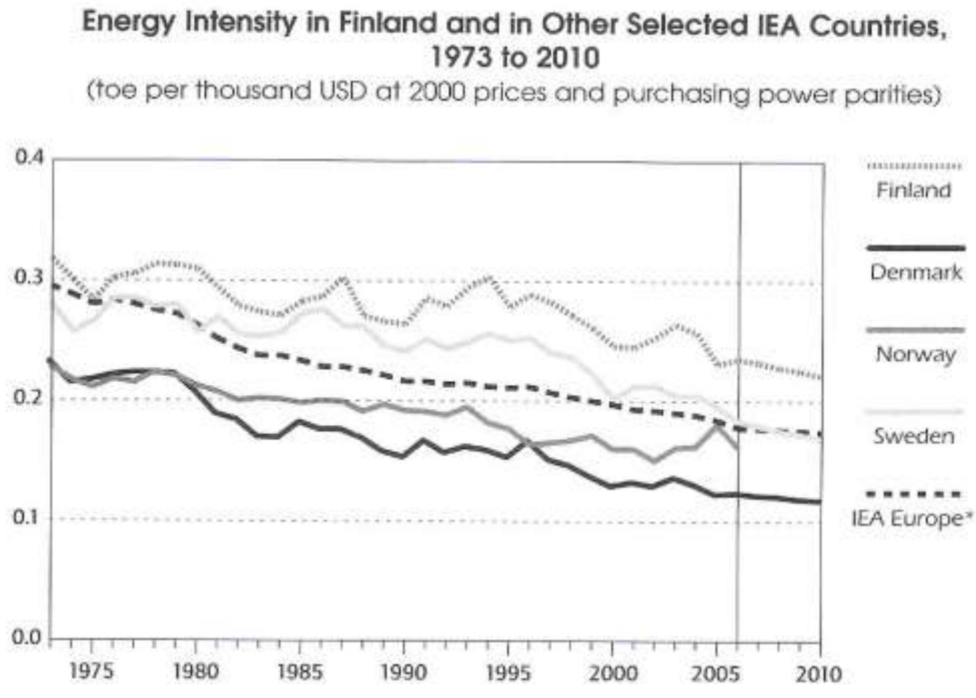
Consider: The difference between the Nordic countries might have an explanation in use of measures rather than in differences in climate.

2.2. The Nordic Countries

Having checked the sectors we will go closer into each of the comparison countries and see how they have composed their measures and with what result.

One would assume that the Nordic countries had a strong resemblance in use of measures to handle energy efficiency since the electricity system is strongly interconnected, the countries have a long tradition of Nordic co-operation, and since there is a close cultural and political relation.

Figure 14: Energy Intensity in the Nordic countries and in the IEA Average.8



* excludes Luxembourg and Norway throughout the series, as forecast data are not available for these countries.

Sources: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2007; *National Accounts of OECD Countries*, OECD Paris, 2007; and country submissions.

Surprisingly there is very little resemblance in applications of measures among the Nordic countries. Just a look at the requirements for insulation (U-values) in building codes reveals more differences than similarities and differences that are not necessarily justified by variations in climate (outdoor temperatures).

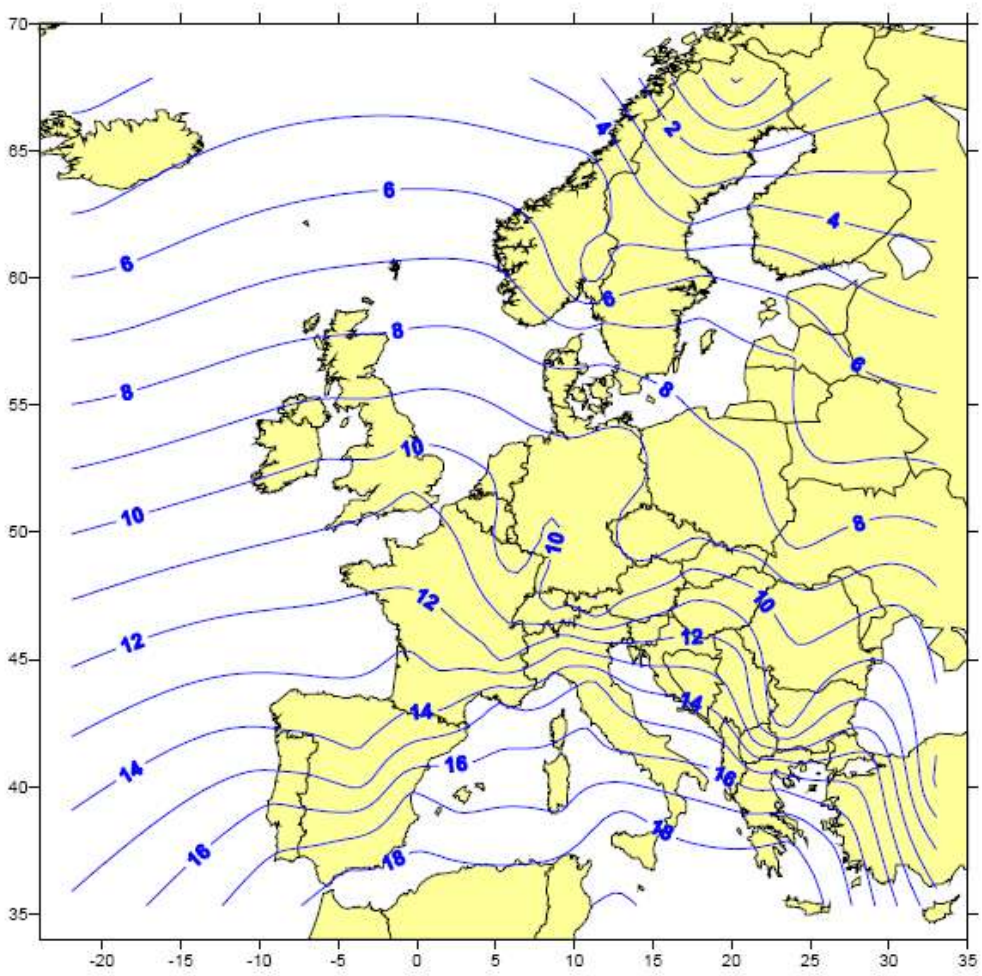
Table 3: Energy Efficiency Building Standards in the Nordic Countries, 2007.9

	Component U-values (W/K,m2)				Overall U-values	
	Ceiling	Wall	Floor	Windows	Overall	Average
Sweden	0.13	0.18	0.15	1.3	0.72	0.72
Denmark	0.15	0.20	0.12	1.5	0.77	0.77
Norway	0.13-0.18	0.18-0.22	0.15-0.18	1.2-1.6	0.70-0.90	0.80
Finland	0.15-0.18	0.24-0.29	0.15-0.29	1.4-1.7	0.91-1.10	1.01

[8] Source: IEA Country Studies, Finland 2007 Review.

[9] Source: Energy Policies of IEA Countries. Finland 2007 Review and Sweden 2008 Review.

Figure 15: Annual average outdoor temperature 1981-2000.[10]



One reason for the differences is, no doubt, the differences in industry structure and resources. There could, however, be another element referred to as "the perception of responsibilities". This element refers to differences in perceptions about how societies and markets should be organised to serve its citizens and clients best. The perception of responsibilities basically have to do with politics but not necessarily on a left to right scale but rather on how stakeholders in the society co-operate and how measures interact.

Denmark seems to have a well developed social contract that is best manifested in the very broad political agreement on energy efficiency that was noted by the IEA in its country review and that has been further reiterated in the agreements between the political parties in 2005 and 2008. There is no other Nordic Country that has made an equal manifestation of the will to give priority to energy efficiency.

[10] Source: Ecoheatcool http://www.euroheat.org/ecoheatcool/documents/Ecoheatcool%20WP1%20Web.pdf

2.2.1. Sweden

Sweden has followed the European pace of intensity improvements since the first oil-crisis but has since the beginning of the 90's begun to close in, i.e. improve faster.

The Swedish building codes for new buildings are the most demanding in the Nordic countries.

For the residential sector there have been grants primarily to reduce the use of electricity and oil for heating. Grants have also been used to exchange windows in existing buildings and to attain the U-value level of 1.2.

For industry there is exemption from electricity tax if efficiency measures are undertaken. The system is based on auditing and use of energy management systems and requires that measures with pay-back times lower than 3 years have to be implemented. Management should measure and judge investments based on Life Cycle Cost calculations (LCC).

Municipalities traditionally have a high level of activity and all municipalities have energy advisors, which are backed up by regional agencies for energy efficiency. Advisors are voluntary but subsidised by the government. Their mandate has been restricted by law for fear that they should compete with consultant services. A legislation that has recently been relaxed since it was observed that the advice is rather a trigger to use consultants for the detailed design of actual undertakings. The advisor's mandate has also been widened to cover "climate and energy" and include transportation.

An area where Sweden has been outstanding is technology procurement where both a method has been developed and used extensively.[11]

2.2.2 Finland

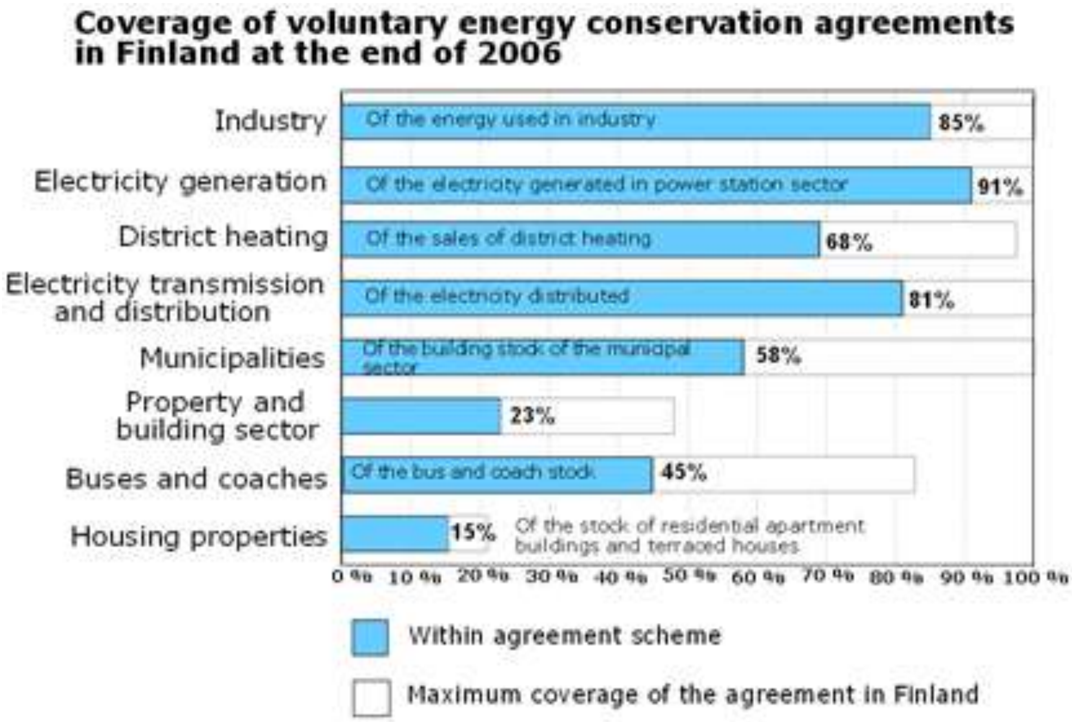
The gap in energy intensity between Finland and IEA-Europe has widened since the 1970s. This also means that Finland has developed worse, in terms of energy intensity per GDP, than the IEA average and even its Nordic neighbours.

Finnish policy on energy efficiency is largely based on voluntary agreements between the government and sector associations. There are currently eight areas for voluntary agreements that cover approximately 60 % of Finland's total energy consumption.

The energy efficiency agreements are based on a systematic procedure of energy audits that evaluates existing consumption and identifies cost effective energy efficiency initiatives in the audited entity.

[11] http://www.swedishenergyagency.se/web/biblshop.nsf/FilAtkomst/ET2006_08w.pdf/$FILE/ET2006_08w.pdf?OpenElement

Figure 16: Coverage in percentage of energy consumption per sector of voluntary agreements in Finland12



The Ministry of Trade and Industry provides a subsidy covering 40 % of the costs of carrying out energy audits. Subsidies are also available for investments in new energy efficient technologies covering a maximum of 20 % of total costs. Projects must have a payback time over two years to qualify for a technology subsidy and priority is given to projects that reduce electricity consumption. Subsidies are available for both EU ETS and non-EU ETS sectors.

Assuming that the average technical lifetime of an energy saving activity is 7 years[13] the results is a CO_2 abatement cost of €7/tonne CO_2 for the voluntary agreements in Finland. The accumulated savings in energy costs is estimated at €136 million annually[14] over the same period based on an average cost for heat and fuel of €15/MWh and for electricity of €35/MWh.

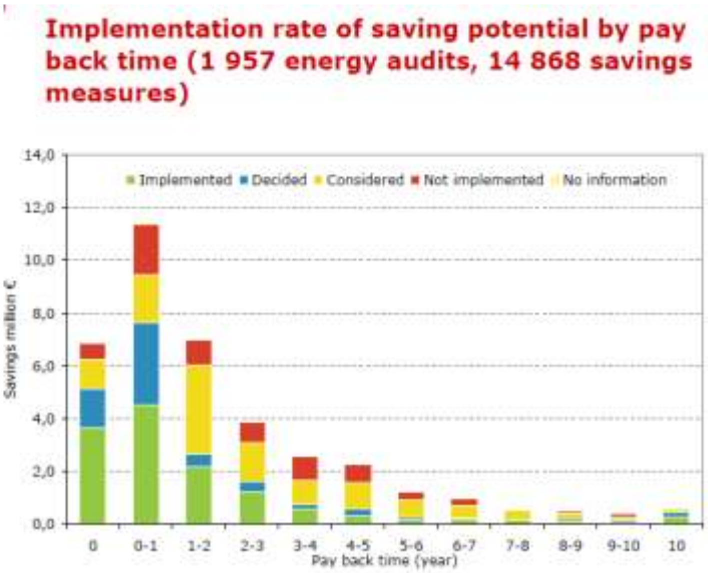
There are no punitive measures for participants not implementing cost effective energy efficiency initiatives identified through energy audits. This could explain why there are 7 TWh of potential savings identified in the energy audits carried out in industry that have not been implemented by 2006 despite the fact that they are considered cost effective.

Despite the large amount of cost effective savings that have not been implemented the voluntary agreements have achieved far more savings than the original target of 5.5 TWh by

[12] Motiva, www.motiva.fi
[13] This is based on the fact that 82 % of investments were in the industrial sector. Generally industry requires a short payback time of approximately 3 years for investments.
[14] www.motiva.fi

2010. The number of cost effective energy savings not yet implemented in industry may partially explain why Finland's energy intensity is increasing compared with IEA Europe.

Figure 17: Implementation as a result of auditing in Finland



It is also noteworthy that Finland, in spite of having the coldest climate of the Nordic countries, has the weakest building codes. There are, however, voluntary agreements with window manufacturers and construction firms that attempt to implement more energy effective building design than required in the building code. These are started in 2007 and it is uncertain what effect they have had. In the residential sector there is tax deduction for labour costs incurred for upgrading heating systems in households has been in place since 2000. 60 % of labour costs are tax deductable with an upper limit of €1,150 (DKK 8,600). The tax rebate can be applied simultaneously for both spouses in a household. In 2006 an energy subsidy was included in the programme in addition to the tax rebate. Subsidies are given for connection charges to district heating systems and investment in equipment that upgrades residential heating systems to being emission free.

The Finnish seem to have bet most on one horse only, the voluntary agreements, which have an impressive coverage. Such agreements however have to have a strong possibility to be tightened and even punitive if they do not deliver.

2.2.3 Norway

Norway has kept pace with the IEA-Europe in terms of energy intensity improvements since the first oil-crisis. Energy intensity has improved on average by 1.9 % between 1990 and 2005. ODYSSEE have calculated that energy policies in Norway have resulted in additional annual reductions in energy intensity of 0.7 % between 1990 and 2005. The country has acknowledged that the need for energy efficiency is not only general housekeeping but is also related to energy security. A fact that can be traced also in the establishment and development of ENOVA as an agency for efficiency and renewable fuels, especially following a drought period which hit Norway hard being almost 100 % reliant on hydropower for electricity. ENOVA manages an energy fund that is funded through a levy on electricity. The fund has a ten year financial framework of NOK 5 billion (4.5 BDKK.)

A grant scheme for electricity savings in households was introduced in 2006. Grants are available for investments in heat pumps (excluding air to air heat pumps), biomass boilers and electric heating control devices. The grant covers 20 % of investment costs up to a maximum of NOK 4,000 for boilers and control devices and NOK 10,000 for heat pumps. There is also an energy information helpline that is accessible and free of charge.

Subsidies of 0.2-0.5 NOK/yearly kWh to cover surplus costs, for energy efficiency improvements are available for the housing, buildings and sites if energy reductions is at least 10 % in projects with savings bigger than 500 MWh yearly. The grant also covers smaller demonstration projects if buildings are renovated and energy consumption is a maximum of 50 % of legislative requirements.

In industry there has been developed a system for internal benchmarking between networking industries in the same branch and that is said to have been positively received by business and spurred activities to improve. Further to this there is a system with voluntary agreements leading to exemption of tax when certain efficiency levels are reached. A system resembling those implemented in Denmark and Sweden. Energy audits and standardised energy management systems are used to define which specific measures should be undertaken and a grant of 20 % of investment costs in energy efficient technologies is provided by ENOVA. Consumption data of investments funded by ENOVA have to be reported annually for five years. This is used to create an anonymous database that forms ENOVA’s benchmarking for industry.

Policy patterns for residential and industrial sectors in Norway indicate a general reliance on financial incentives.

Figure 18: Policy measures used in Norway (Source: ODYSEE-MURE, Energy efficiency policies and measures in Norway 2006, 2006)

Residential policy pattern

Industrial policy pattern

The knowledge that energy efficiency also has bearing on energy security might be the underlying explanation to that Norway has been fairly successful in their undertakings.

2.3. Continental Europe[15]

2.3.1. The Netherlands

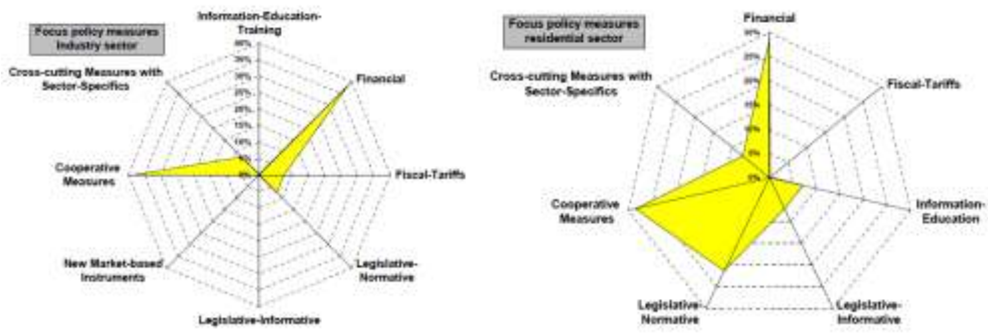
The Dutch policy on energy efficiency is based on achieving increases in efficiency of 1.3 % annually from 2008 increasing to 1.5 % from 2012.

The Netherlands have one thing in common with Denmark and that is the tendency to work with and develop strong social contracts with stakeholders. The ”covenants”, of which there are several, is a manifestation of this way of making agreements. Since the end of the 90's there is an energy efficiency benchmarking covenant with the industry, including utility businesses. A similar programme (LTA2) has been developed for smaller industries

The benchmark (target) is the top 10 % of installations worldwide and the benchmark is redefined regularly (every 4 years). There is striking resemblance with the Danish A-club and the U.S. Federal Energy Management (FEMP) Programme in this respect of developing niche-markets.

There are tax reductions for industrial enterprises making investments in energy efficient technology if they are a part of a voluntary agreement. Technologies qualifying for tax exemptions are listed by SenterNovem. This is in accordance with the benchmarking agreements and assists industry to keep in touch with technological developments. Support is also given to energy audits.

Figure 19: Policy measures used in The Netherlands (Source: ODYSEE-MURE, Energy efficiency policies and measures in the Netherlands 2006, 2006)



[15] Based on the IEA Country Studies for the countries concerned.

In the Dutch treatment of the residential sector there is also a strong resemblance to the Danish approach. New Buildings are subject to a Buildings Regulation (EPN Energy Performance Norm). This norm is supported by an Optimal Energy Infrastructure Programme (OEI) that aims at integration energy savings and sustainable energy issues at the local level by providing instruments for calculation and benchmarking and also some economic support. Finally there is a voluntary instrument, Energy performance on Location (EPL) which allows a report mark on a scale 1-10 to score the buildings.

Similar systems (EPR and EPA) are using regulation (R) and advice (A) for existing buildings and uses also subsidies to promote A-class equipment. The systems have been revised with the introduction of the EU Buildings directive.

The Netherlands seem to have found ways to enable also complicated combinations of actors to work towards a common goal of high energy performance standards, both in buildings and in industry.

2.3.2 Austria

The Austrian energy efficiency activities are undertaken mainly on a local (regional and/or municipality) level and shows wide variations between the different regions. Some federal initiatives exist among them and most important the "Klima:Aktiv" campaign. This campaign addresses both renewable fuels and energy efficiency and gives explicit advice on e.g. "passive energy buildings". The requirements of the Klima:Aktiv programme also governs the access to financial support for buildings.

The federal and state governments in Austria provide €2.5 billion in financial support for building and renovating dwellings annually. This is 1 % of GDP and nearly 3 % of the national budget. Support is provided through direct subsidies and low interest loans. The size of subsidies available is, amongst other requirements, determined by the thermal energy performance of the relevant buildings. The table below shows the subsidies available for renovations leading to reductions in thermal energy requirements in existing buildings.

It should however be noted that these subsidies do not only relate to the energy performance of the buildings and <u>should therefore not be attributed to energy alone but also to general improvements of the building standard</u>. It is rather an example on how energy can be made part of a package deal.

Table 4: Subsidy provided for renovations in buildings in the Vienna Region

Reduction in thermal energy requirements	50 kWh/m^2	70 kWh/m^2	90 kWh/m^2	110 kWh/m^2
Subsidy per m^2	€30	€45	€60	€75

For the construction of new buildings the subsidy provided is also related to the thermal performance of the building envelope. Subsidies are provided according to the thermal energy performance of the new construction in relation to the energy performance of a low energy house. In Austria a low energy house is defined as having a thermal energy consumption of no more than 40 kWh/m^2 per year. The building code in Austria allows for a maximum thermal energy consumption of 100 kWh/m^2 per year. The rates for subsidies available are shown in the table below.

Table 5: Subsidies available for new buildings in the Vienna Region

Heat demand compared to a low energy house	2 x	1,6 x	1,3 x	1 x
subsidy/m^2	€30	€45	€60	€75

The subsidy programme for new residential buildings and the renovation of existing buildings has been very successful with over 80 % of all new dwellings receiving some form of subsidy through the scheme and 50 % of renovation projects receiving subsidies. The government intends to shift the focus of the programme in the future to renovation instead of new constructions. Currently 80 % of the programme's budget is used on subsidies to new buildings.

The programme's aim is not only to improve energy efficiency in dwellings. It is intended to increase the standard of existing residential properties built after World War II and to maintain and protect jobs in the Austrian construction sector. It has resulted in a substantial fall in thermal energy consumption in Austrian households.

The programme has resulted in some important local activities that show a high success-rate. An example of this is the "Thermoprofit" project in Graz, which was originally developed as a municipal ESCO-activity. It has since matured to a method that is more widely used, also in other regions.

A number of initiatives have been launched under Klima:Aktiv to promote renovations through various channels in the residential sector. One of these involves chimney sweeps promoting energy efficiency measures when visiting households and supplying easy-to-implement energy-saving advice. If the household is interested an energy consultant from the relevant federal province visits the household.

The Topprodukte online guide to energy efficiency products was launched in 2006 in support of the national Klima:Activ climate strategy.[16] On the Topprodukte website[17], consumers can sort appliances by efficiency, price, energy rating and size, among other criteria. There is also a quick check energy efficiency calculator available on the internet for household products. This is intended to provide consumers with an easy method of comparing energy consumption of products.

[16] http://www.klimaaktiv.at/
[17] http://www.topprodukte.at/

In industry the approach is mainly to make use of voluntary programmes which focuses on creation of energy management systems. The National Climate Strategy includes a programme for industry that is based on developing a system of benchmarking for industry based on energy indicators, a series of sector specific best practice examples of energy efficiency and a programme of energy auditing.

Austria participates in the Expert System for the Supply of Thermal Energy in Industry (EINSTEIN)[18] financed by Intelligent Energy Europe. The project focuses on the potential for reducing thermal energy demand through the combination of existing affordable technologies. It aims to contribute to the widespread implementation of integrated energy-efficient solutions in industries with low and medium temperature heat demands. This is achieved through disseminating an energy auditing tool kit, training of energy auditors and implementing auditing campaigns. Industrial branch associations are involved in the programme along with regional governments. Subsidies for carrying out energy audits are provided for small and medium sized industries.

For CHP there is established a minimum performance standard for applications to receive subsidies and an obligation on grid companies to purchase electricity from CHPs supplying public district heating systems in order to promote the use of CHP.

It is explicitly stated that there is no intention to activate utilities as vehicles for energy efficiency even if some companies do have such programmes.

The overall annual intensity improvement in Austria, over time period since the first oil-crisis in the 70s, is below that of the IEA average. It seems as if the best performance is in space-heating which might be attributed to that some regions have been more active and successful than others.

2.3.3 Spain

The track record for Spain in terms of energy intensity is very different from that of all other IEA countries. Intensity has risen since the oil-crisis in the 70s. Since 1985 energy intensity has increased by 3.3 %. From 1991 to 2000 Spain had the Energy Efficiency and Conservation Plan. This was aimed at industry and building sectors. Due to the lack of evaluations of programmes under this plan it is not possible to say with any accuracy what effect the EECP has had. A study on the impact of energy efficiency on employment concluded that financial aid from EECP may have sped up the decision to implement initiatives that would have been implemented anyway.

[18] http://www.iee-einstein.org/

The Spanish government has developed an *Energy Saving and Energy Efficiency Strategy for Spain 2004-2012*. This is also referred to as the E4 plan and is based largely on regional initiatives that are coordinated with federal government. Public spending on the plan is set at €729 million between 2004 and 2012, which is expected to cover 10 % of the overall costs of achieving the target of savings in primary energy consumption of 12 Mtoe. Public funding is provided from the federal and regional budgets as well as from a levy on electricity. The strategy is especially focussed on energy efficiency in buildings and electrical equipment in households and offices as well as transport.

A new building code was approved in 2006 that is expected to reduce consumption in new buildings. A minimum requirement for solar contribution to total energy consumption in new buildings is one of the most important points of the code. There are programmes designed to reduce consumption in existing buildings through new regulations on heating installations and the introduction of energy labelling for buildings.

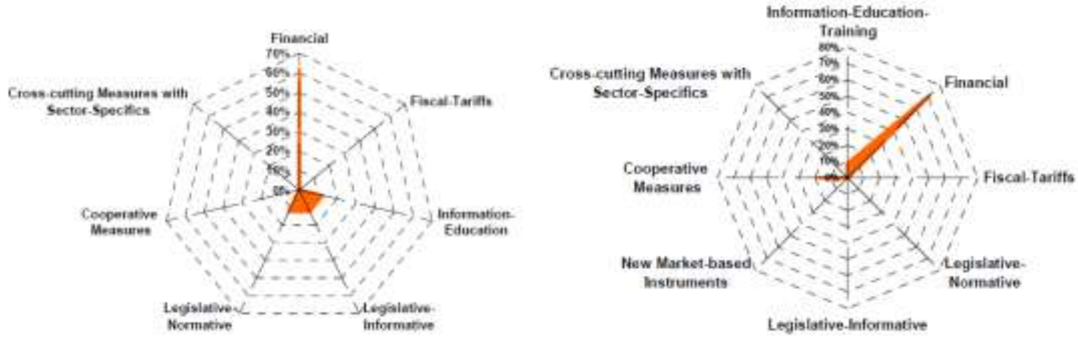
Funds have been made available to provide incentives for replacing 2 million electrical appliances with more energy efficient models. It has not yet been determined exactly how this will be implemented. Awareness campaigns and training of traders and salesmen in promoting energy efficient equipment form part of the strategy for increasing the use of energy efficient appliances.

There are limited initiatives for energy efficiency in the industrial sector. A programme for subsidising energy audits is to be initiated and the government will establish voluntary agreements with both public and private enterprises and branch organisations. Subsidies will be available for purchasing energy efficient technologies for industrial purposes.

The government intends to introduce energy efficiency requirements for water treatment and desalination plants as well as issue guidelines on energy efficiency in street lighting.

The policy patterns for the residential and industrial under the E4 plan are shown below.

Figure 20: Policy measures used in Spain (Source: ODYSEE-MURE, Energy efficiency policies and measures in Spain 2006, 2006)



Policy pattern for residential sector

Policy pattern for industrial sector

Spain has 17 regions that are governed with great autonomy. Some have rather strong aspirations to improve the energy situation both by making use of renewable fuels and energy efficiency.

2.3.4 Italy

Up till the introduction of White Certificates in 2005 the Italian policies for energy efficiency have been very modest. This is apparent in the below IEA-average performance in intensity-improvements. The slow improvement could to some extent be explained by the low overall-intensity in energy use, but that low level is mostly due to beneficial climatic conditions than to earlier economisation. It is only the residential sector that has shown improvements whereas intensity has risen in both the industry and the commercial sectors! The IEA country report states that the remaining potential for improvements is high.

The policies and measures undertaken are low-key and mainly adhere to EC-directives using rather lax minimum performance standards for appliances and equipment and requiring energy management systems in industry. Improvements in energy efficiency can generally be attributed to a high price-level for energy rather than to energy efficiency policy.

Italy introduced a white certificates mechanism in 2005 to support energy efficiency measures. The white certificate mechanism is based on an obligation for electricity and gas distributors to achieve annual energy savings targets. The target increases annually. Projects have a crediting lifetime of five years with the exception of heating and air-conditioning projects, which have an 8 year crediting lifetime. The target is therefore accumulative over time. In 2008 new, more ambitious targets were set and energy savings obligations were extended to 2012. The new targets are compared with the original targets for the white certificate scheme in the table below.

Table 6: (Table derived from Relazione Annuale 2007, Gestore Mercato Electtrico, 2008)

Year	Original target (Mtoe)			New target (Mtoe)		
	Electricity	Gas	Total	Electricity	Gas	Total
2008	0.8	0.7	1.5	1.2	1.0	2.2
2009	1.6	1.3	2.9	1.8	1.4	3.2
2010	-	-	-	2.4	1.9	4.3
2011	-	-	-	3.1	2.2	5.3
2012		-	-	3.5	2.5	6.0

Energy savings have to be additional in order to receive white certificates from the regulator. Additionality is determined as savings over and above the market average or legislative requirements, whichever is greater in terms of energy efficiency. A technical baseline must prove additionality. White certificates are issued ex-post, after the savings have been realised. A white certificate is equivalent to 1 toe energy saved. There are three types of certificates, type I are electricity savings, type II gas savings and type III other energy savings.

White certificates can be traded on an exchange or bought bilaterally. There are approximately 90 active trading companies on the exchange over and above the 30 distribution companies. In 2007 the volume of trade on the exchange was almost half of the total trade in white certificates.

Figure 21: Volume of certificates traded on white certificate exchange in 2007. (Table derived from Relazione Annuale 2007, Gestore Mercato Electtrico, 2008)

Prices for white certificates in the first half of 2008 are shown in the table below.

Table 7: (Table derived from Mercato dei Titoli di Efficienza Energetica, 1 semestre 2008, Gestore Mercato Electtrico, 2008)

	Type I (Electricity)	Type II (Natural Gas)
Volume	132.675 Mtoe	33.373 Mtoe
Average price	€56	€62

The Italian case indicates that even when intensity looks to be favourable, there is often room for further improvements and that just following suite with the main-stream does not pay off.

In light of such observations the development of the White Certificates could be seen as a last ditch attempt to implement energy efficiency that might turn out to be good but will hardly make up for lost years.

3. Compared measure by measure (the mirror-approach)

This chapter aims at finding similar measures in the other countries and compare how they have been designed and applied and to see how they have succeeded. In this comparison we also select some examples from the United States where e.g. several states apply locally developed mechanisms that may be of interest.

Table 8: Overview of comparisons

Danish policy measure	Mirror	SELECTED OBJECTS TO COMPARE
Energiselskaberne	**3.1** The role of the Energy Companies	• Italy: White Certificates • UK: EE Commitments • US: EE Resource Standards • US: Incentive Penalty mechanism
DE net sparepulje	**3.2** Utility funding of activities	• US: Public Benefit charges
Elsparefonden	**3.3 Top-runner benchmarking**	• Netherlands. Benchmarking • Norway: Bransche-nettverk • EU: Top-ten
Bygningsreglementet	**3.4 Building Codes**	• EURIMA study of building performances • UK the 40 % building
Energimærkning af bygninger samt eftersyn	**3.5 Improving existing buildings**	• EPBD Buildings platform • Finland: Voluntary agreement
Energibesparelser i det offentlige	**3.6 The public sector**	• US Federal Energy Management Programme (FEMP)
Apparatmærkning og -normer	**3.7 Labelling of appliances (supportive actions)**	• Netherlands: COEN and HIER campaigns
Aftaleordning	**3.8 Voluntary Agreements**	• Finland Voluntary agreements • Netherlands. LTA2
Afgifter og CO_2-kvoter	**3.9 Taxes, levies and quotas**	• Sweden PFA (Tax deduction) programme • France: Bonus-Malus (Feebates)

3.1 The role of the energy companies

The role of the energy companies (utilities) is debated and will probably continue to be. Will they have a role at all in their customer actions by focusing on the services or should they stick to their original market actor role as profit-maximising sellers of a commodity?

The changing regulation of markets has further complicated the matter since the original vertically integrated company has been divided into different functions, not all of them necessarily logically since countries have used different approaches for their market design.

With the fragmented structure of deregulated markets the responsibilities and thereby the interest to act for the system as a whole has been diluted. This has broken the possible "chain of command" to utilities act for Demand Side Management (DSM), but has on the other hand opened for other actors to "break ranks" and incorporate energy efficiency in their business. This is, however, a process that is not yet fully developed and that will develop differently in each country depending on how the governments chose to design the markets and the regulation.

The vertical function, the chain, to deliver energy from the source to the use is generally fragmented into generation/production, transmission, supply/trade, and distribution companies with a regulator overseeing the system. While the generation and supply companies have a natural incentive to maximise production and sales, respectively, the network companies have some incentives to limit bottle necks in the network system (e.g. at time of peak load). These business interests do not always align with the general societal wish to reduce energy consumption.

Their attitude to energy efficiency as a business opportunity could be pictured as follows.

Table 9: Different utility functions and how Energy Efficiency apply as a business opportunity to them on a liberalised market

	Business interest in Energy Efficiency	
Actor	**Peak Load**	**Load Level**
Generation company	**No** (prices are set on the margin)	**No** (loss of sales)
Systems responsible (regulator)	**Yes** (to avoid systems break-down)	**Possibly regional and in special situations** (to avoid bottlenecks and to allow systems to develop as planned)
Transmission and Distribution	**Yes** (to maintain systems and avoid bottlenecks)	See above
Energy supplier	**Yes** (as a business opportunity to shift loads and operate in pools)	**Yes** (but primarily as a marketing instrument)

a) Natural actors

Arguments have been made that the majority of the potential for energy efficiency can be accomplished if implementation responsibilities are given to proper actors and the framework is arranged accordingly.[19] With this view utilities basically belong to an **"artificial framework"** without or with little business interest in energy efficiency. There are however other **"natural frameworks"** of winners in energy efficiency. Didden and D'haeseleer also acknowledge a need for "additional mechanisms" (training, branding) and "programmes" (labelling, rebates, loans) as instruments to support the frameworks.

- The *artificial framework* is characterised by the need to compensate losers and thereby incentivizing their participation, typically energy utilities that are losing profit from selling less. Such a framework will have great difficulties to be sustained. In California, USA, the state regulator has taken it a step further by creating an incentivising bonus mechanism for the utilities and a penalty for underperforming.

[19] [Didden and D'haeseleer] Demand Side Management in a competitive European market: Who should be responsible for its implementation?. Energy Policy 31 (2003) 1307-1314.

- The *natural framework* uses the winners, such as manufacturers of efficient equipment and Energy Performance Contractors, as actors, but acknowledges the use of funding organisations as catalysts for the process. Such funds can be established via the use of a "Public Benefit Charges" on energy tariffs. Within such systems utilities can also be turned into winners if their own activities can improve their economic result. A suitable design of the market with e.g. white certificates and energy efficiency commitments is then critical for success.

b) Refocused actors

Development of the instrument known as "White Certificates" is an attempt to make use of the utilities' well developed infrastructure with direct customer relations in order to get a wider deployment of efficient end-use technologies. It is also an attempt to shift their focus from profit-maximising by volume of sales alone.

The most dominant cases in Europe are the Italian system with tradable certificates and the British with "Efficiency Commitments". These two have also targeted different market actors, i.e. the Italian white certificates gives the responsibility to the distribution companies and the UK commitments to the energy suppliers, c.f. table above.[20] In both cases these actors may find their task to curb peak loads natural but when it comes to reducing the load level less interesting unless they can turn the action into a marketing favour.

The Italian system aims at mobilising the "natural actors" such as ESCO's for the job and therefore tends to make the utilities responsible for the financing rather than the result.

In the U.S. there are also systems to the same end in the Energy Efficiency Resource Standards which is rapidly spreading across the country.[21] [22]

c) Incentivising actors

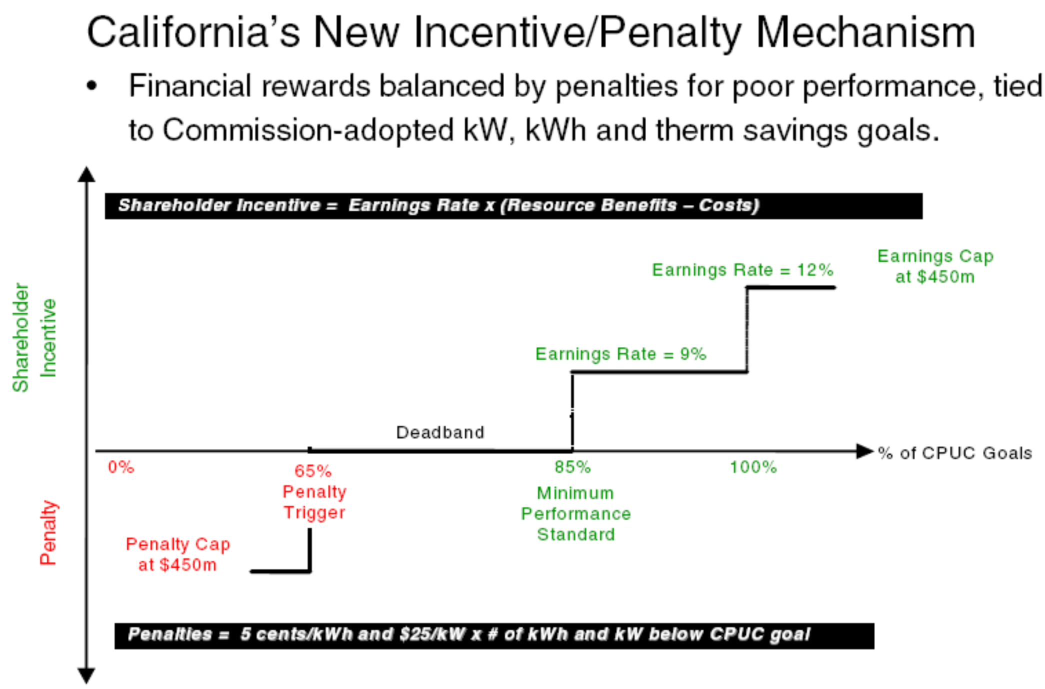
The state regulators in California and Ohio have taken further steps by incentivising deliveries of energy efficiency to the customers.

Common for these attempts to mobilise the utilities in the delivery of energy efficiency is that they require regulatory involvement to create benchmarks and baselines and/or to establish acceptable performance of eligible equipment. California has sugared the deal further with an incentivising bonus mechanism for the utilities and in consequence a penalty for underperforming.

In the presidential debate in the U.S. this sort of change is also known as "flipping incentives" to utilities and reward delivery of efficiency instead of volume of sales.

[20] Design of White Certificates, http://ea-energianalyse.dk/reports/710_White_certificates_report_19_Nov_07.pdf
[21] http://www.aceee.org/pubs/e063.pdf
[22] http://www.ferc.gov/market-oversight/mkt-electric/overview/elec-ovr-eeps.pdf

Figure 22: The Californian mechanism to decouple sales volume from company profit.



The reregulation of utilities is not settled by far. There is a wish to allow the market to develop new ways to deliver service including efficient use of energy. There is also a need to ensure that system functions in terms of e.g. correct pricing and energy security, are maintained. It remains to be seen if all the functions can be reconciled with new market design, but while this development goes on there will be room for new combinations of both market entrepreneurship and market regulation.

All the above mentioned aspects indicate a need for a regulation that carries both a carrot and a stick. Encourages good performance and efficient use of energy and rewards those who deliver but also penalises those who don't.

3.2 Extra tariff charges

Several countries have tried systems to make the utility-business fund either regular operations such as deployment of equipment (see above) or information-campaigns or research that also covers energy efficiency. In the U.S. several states uses "public benefit charges", which is a certain amount put on the tariffs.[23] These charges are then funnelled via state bodies or special agencies for the activities. One of the older and more established is

[23] http://www.aceee.org/pubs/u002.htm

NYSERDA, the New York State Energy Research and Development Agency, which is financed with 175 million USD per year by use of a surcharge of 0.173 UScents/kWh (1.73 mills/kWh). A sum that is financing R&D, Energy Efficiency and Low-Income Programmes (LI), see table below.

Table 10: Example (New York) to show size and use of the US Public Benefit Charges for different purposes.24

	Details of Public Benefit Program Funding					Renewables
	R&D	EE	LI	RE	Total	Portfolio Standard
million $	40.0	93.0	42.0	43.1	218.1	2004 PSC order in Case
mills/kWh	0.32	0.74	0.33	0.34	1.73	03-E-0188 sets target
% rev.	0.25	0.59	0.27	0.27	1.39	of 25% RE in 2013. RE
admin.	NYSERDA	NYSERDA	NYSERDA	Utility		surcharge supports RPS

This funding mechanism has been used also in Norway in the 1990s to finance Regional Energy Efficiency Centres, but has since then been abandoned.[25] In UK a similar mechanism was used to set up the Energy Saving Trust (EST), “a pound per customer”.

Using utilities to fund activities seems to be closely related to the citizens’ perception of a society’s role in general. In the U.S. taxing is generally a difficult way to raise funds. In the U.K. and Norway it rather seems to have been used to top-up funding for a period.

3.3. Top-runner benchmarking

a) Sectorwide and targeted

The Netherlands has long applied a system of long-term agreements with industry and the building sector in which a high performance level has been set as a target for improvements. A level that further is successively ramped upwards over time.[26] For the bigger companies there is a benchmarking function in which each plant has to compare itself with the best region in the world or with the best 10% of installations outside the Netherlands. The companies have to provide a plan on how they themselves should reach the top-level.

For the residential sector the Netherlands has a system to push performance of new buildings upwards. The Energy performance Coefficient (EPC) is gradually tightened from 1.4 in 1995 to reach 0.4 in 2015. The target level 0.4 is comparable to passive house standard with an energy need of 15 kWh/m^2.

[24] http://www.aceee.org/briefs/tbl5.pdf

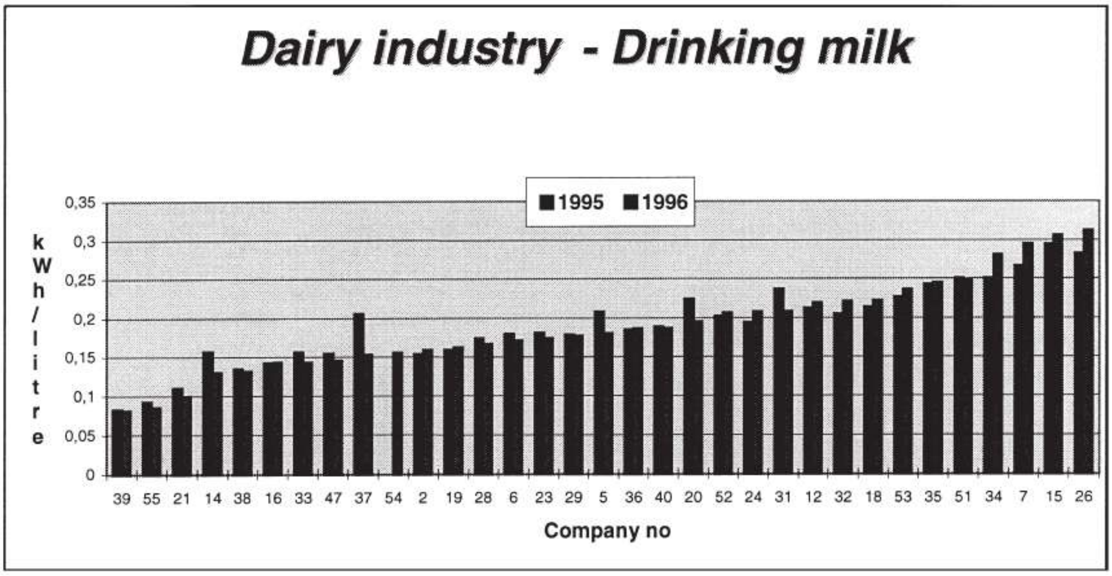
[25] Public Purpose Energy Efficiency Programs and Utilities in Restructured Markets. The Electricity Journal, Volume 9, Issue 6, July 1996.

[26] See the Energy Efficiency Plan http://ec.europa.eu/energy/demand/legislation/doc/neeap/netherlands_en.pdf Annex II, pages 23-28

b) Selfcontrolled networks

The Norwegian network in branches has for a long time used a system in which companies anonymously keep track of their own industry by delivering their energy statistics to the authorities for processing and publication. The publication however is made without revealing the identity of the companies who thereby can see their own position without having to reveal and expose themselves.[27]

Figure 23: Publication of anonymous data from the Norwegian branch network for dairies.



c) Appliances

Announcing the best performance characteristics of appliances is done more or less in all countries. There is one attempt to make it for the consolidated European arena but still only as a project called Top-ten.[28] Presently this network includes material from Switzerland, France, Austria, Netherlands, Belgium and Poland, but is expected to soon include also Finland, Hungary and Italy.

The format looks interesting for a merger with the Danish sites of similar type.

> Standards are normally associated to minimum performance levels, but is obviously quite frequently used also to signal outstanding performance to users or benchmarking among competitors. There might be room for much creative development in the area and for the purpose of "branding" of energy efficiency.

[27] Networking among companies represents a potential for CO2 reduction. Journal of Cleaner Production, Volume 8, Issue 6, December 2000.

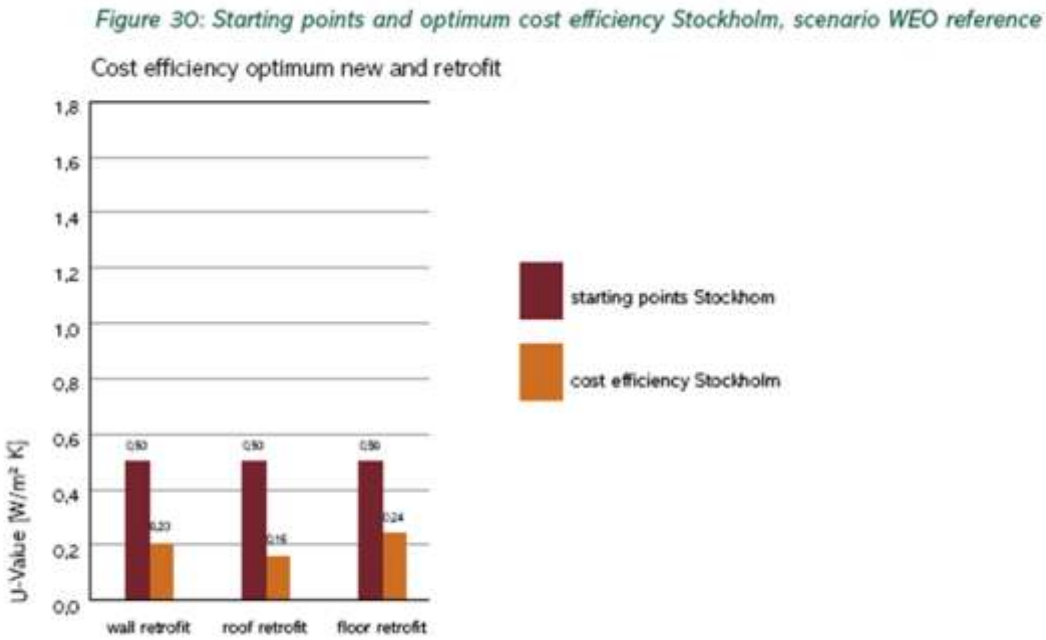
[28] http://www.topten.info/index.php?page=about_topten_info

3.4 Building codes

The requirement in the Nordic building codes as regards U-value differ quite a bit and the Danish code is good in parity with the others. A study by EURIMA shows that the requirements for new buildings are roughly right according to calculations of cost efficiency, but also that the optimum is shallow and that a tightening pays off well through lower energy costs.[29]

The more crucial issue is the requirements (or rather the lack thereof) for existing buildings.

Figure 24: Existing insulation compared to cost-efficient for retrofit in Stockholm.30



The Eurima report has also calculated the requirements necessary in existing buildings to reach a high level of CO_2 savings (85%) in the Northern part of Europe. Similar concerns of the state in existing buildings are voiced in a study from Oxford University called "the 40 % house" in which it was argued that the better option for many low performing buildings would be demolition.[31]

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[29] Eurima "U-values for better performance of buildings" http://www.eurima.org/uploads/ModuleXtender/Documents/88/documents/EURIMA-ECOFYS_VII_report_p1-65.pdf

[30] Source: EURIMA "U-values for better performance of buildings". (NOTE the figure is altered to concentrate on existing buildings)

[31] http://www.eci.ox.ac.uk/research/energy/downloads/40house/40house.pdf

Table 11: Requirements to reach high CO2-reduction ambitions by insulation of existing buildings in Europe.32

U-values of different components	Single family house built before 1975	Required level to reach a CO_2 emission target of 85% savings
Floor	0.5	0.25
Wall	0.5	0.2
Roof	0.5	0.15
Window	3.0	1.1
Ventilation Heat Recovery (VHR)	-	80 %
Resulting heating demand (kWh/m2)	160	28

3.5 Improving existing buildings

The underlying idea with the declaration of buildings is that existing buildings should gradually be improved. This seems to have been overshadowed by discussions on details in the directive.

With the energy Performance of Buildings Directive (EPBD) labelling has been made mandatory throughout Europe.[33] The process of implementation is still ongoing and subject to the subsidiarity principle which allows countries to make their own choice of e.g. labelling. Most seem to have chosen a system that associates with the appliance labelling either by use of classes (A-G) or by use of a sliding scale that has the traffic-light-colours from red to green to signal the quality. There are however noteworthy examples where countries have deliberately chosen a different label that does not have any resemblance with the established one.[34]

Looking at the reports from the implementation process it is obvious that most of the work is concentrated on

- the technological aspects such as, auditing and calculation given the differences in building standard, tradition and climate
- the formal aspects such as certification of auditors, establishing of registries and time periods between audits.

a) Communication, awareness and shopping

The critique against the buildings declaration and labelling can be summarized in the sentence: "Labels do not save energy". This is true but misleading. The role of the label is to communicate the status of the building and to provoke actions. Therefore the more important part of the system is the suggestions for improvement that should be a part of the

[32] EURIMA
[33] Continuously reported on the EPBD platform http://www.buildingsplatform.eu/epbd_publication/doc/EPBD_BuPLa_Country%20reports_20080624_2_p3126.pdf
[34] http://www.boverket.se/upload/Bygga%20och%20förvalta/bifogade%20filer/energideklaration/Pappersversionen.pdf

declaration. This should be an aid (a shopping list) for the stakeholders when considering necessary actions at a time that is suitable.

b) Forcing stakeholders

The Finnish voluntary agreements have especially targeted 300,000 buildings still using oil for heating.[35]
The means are basically boiler-inspections that should inspire not only to efficiency improvements in the boiler but also shift to renewable fuels and to improvements of the building itself. The target is an improvement 5% better than Business as Usual (BAU).

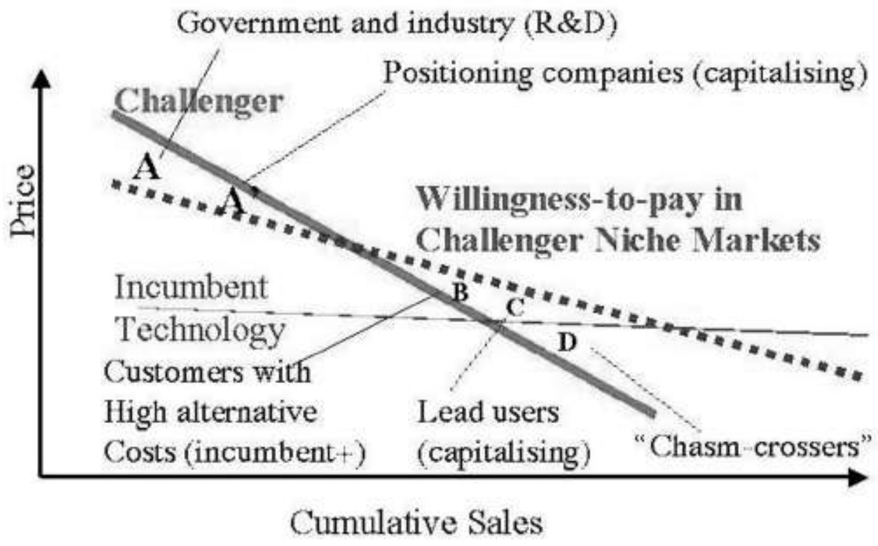
> Improvement of existing buildings is the most crucial issue there is. Numerous studies show the potentials but the policy measures are few. The newly advertised strengthening of the EU Buildings directive seems to be the best vehicle and Denmark might have a better position with experience to enforce it.

3.6 The public sector

The public sector is often challenged to be a frontrunner in improving energy efficiency. This makes sense for two reasons. One is that the public sector has many publically available facilities that can be used for testing and demonstration and that good housekeeping with common resources, taxpayer money, is basically assumed to be common practice. The other is that the purchasing power of the public sector is sizeable and therefore could be the horse pulling the wagon in a market transformation attempt. A market transformation that both have the possibility to form a volume that enables new technology to enter the market and to be further developed in terms of cost and performance, i.e. “to ride down the learning curve”[36]. The public sector can thus be an important “niche market”. [37]

[35] http://www.motiva.fi/midcom-serveattachmentguid-34ee98647afaf13a4b5a7d2582362a50/hoylaiii_en.pdf
[36] The learning curve shows how the costs are reduced by a growth in accumulated volume of a technology. I rule of thumb says that every doubling of the market reduces the cost by 20 %.
[37] Cretaing Markets for Energy Technologies http://www.iea.org/textbase/nppdf/free/2000/creating_markets2003.pdf and Experience Curves for Energy Technology Policy. http://www.iea.org/textbase/nppdf/free/2000/curve2000.pdf

Figure 25: New technology makes use of different niche markets to reach break-even with incumbent technology.38



The US Federal Energy Management Programme (FEMP) is the most well-known example of how the public sector acts as the motor for the desired market transformation.[39] Chartered in 1973, FEMP helps government agencies find innovative solutions to their most difficult energy challenges and address their full range of energy management responsibilities, including:

- New construction
- Building retrofits
- Equipment procurements
- Operations and maintenance (O&M)
- Utility management.

FEMP is sometimes characterised as the organisation that serves the US government by managing the presidential order to buy from the best quartile of the market: "... agencies shall select products that are in the upper 25 percent of energy efficiency as designated by FEMP".[40] The Programme has as a goal to improve energy efficiency by 35 % till 2010 compared to 1985 level.

They work with a great variety of instruments but basically they are all to serve the local managers for government installations to fulfil this goal.[41] FEMP provides unbiased, expert technical assistance in areas such as energy and water audits for buildings and industrial facilities, peak load management, whole-building design and sustainability, renewable energy technologies, distributed energy resources, and CHP technologies. They also provide analytic

[38] Creating markets for efficient technologies by establishment of strategic niche markets. ECEEE 2003
[39] http://www1.eere.energy.gov/femp/index.html
[40] EXECUTIVE ORDER 13123. GREENING THE GOVERNMENT THROUGH EFFICIENT ENERGY MANAGEMENT. http://ceq.hss.doe.gov/nepa/regs/eos/eo13123.html
[41] Evaluations Demonstrate Federal Technical Assistance Programs Move the Market. ECEEE 2000

software tools for project screening to help agencies choose the most effective energy and water project investments.[42]

3.7 Labelling of appliances (supportive actions)

Labelling of appliances is uniform over Europe and the EU-label has even been the model for more types of equipment than that which is covered by the EU-directives. It can be assumed that the label is an icon itself and communicates performance level to people in a way that is understood. The only drawback is that it is not designed for technology development and has had to be modified by adding A+ and A++ to the series when class A performance level was surpassed.

The national applications sometimes need amplifying the message by supportive actions. This mostly happens because governments want a faster market uptake of equipment with outstanding performance.

The Netherlands have two programmes COEN (Consumer and Energy) that addresses intermediary organisations and HIER that address consumers. COEN financed by the government and HIER financed by the government and NGOs.

The Netherlands have earlier had subsidies connected to choice of the best performing (class A) products but those programmes were abandoned due to budget restrictions. Evaluations show that subsidies can be justified at least for some time and mostly in connection with introduction of labelling or new classes in the system in order to attract awareness to these.[43]

3.8 Voluntary agreements

"Voluntary agreements" is an often quoted solution to get a wide participation to improve energy efficiency and use of renewable fuel. There is however a risk, that such agreements become self-deceptions rather than effective instruments.[44] The crucial issues are:

- to set a baseline together with a target that is non-trivial or even canonising business-as-usual and
- to have means for enforcement in case of non-compliance.

Finland is the country that uses voluntary agreements most extensively. In their application there is a strong connection to a system of audits that can prevent use of trivial baselines and also account for results in a proper manner. There is also, as a part of an EU-programme, extensive auditing handbooks produced and that shows a very structured approach.[45]

[42] http://www1.eere.energy.gov/femp/about/index.html
[43] http://www.aid-ee.org/documents/001Labelling-Netherlands.PDF
[44] http://www.sei.ie/uploadedfiles/InfoCentre/voluntaryagreementsfinalreport.pdf
[45] http://www.motiva.fi/en/projects/saveiiprogramme/auditiproject/

Figure 26: The Structure of Energy Audits.[46]

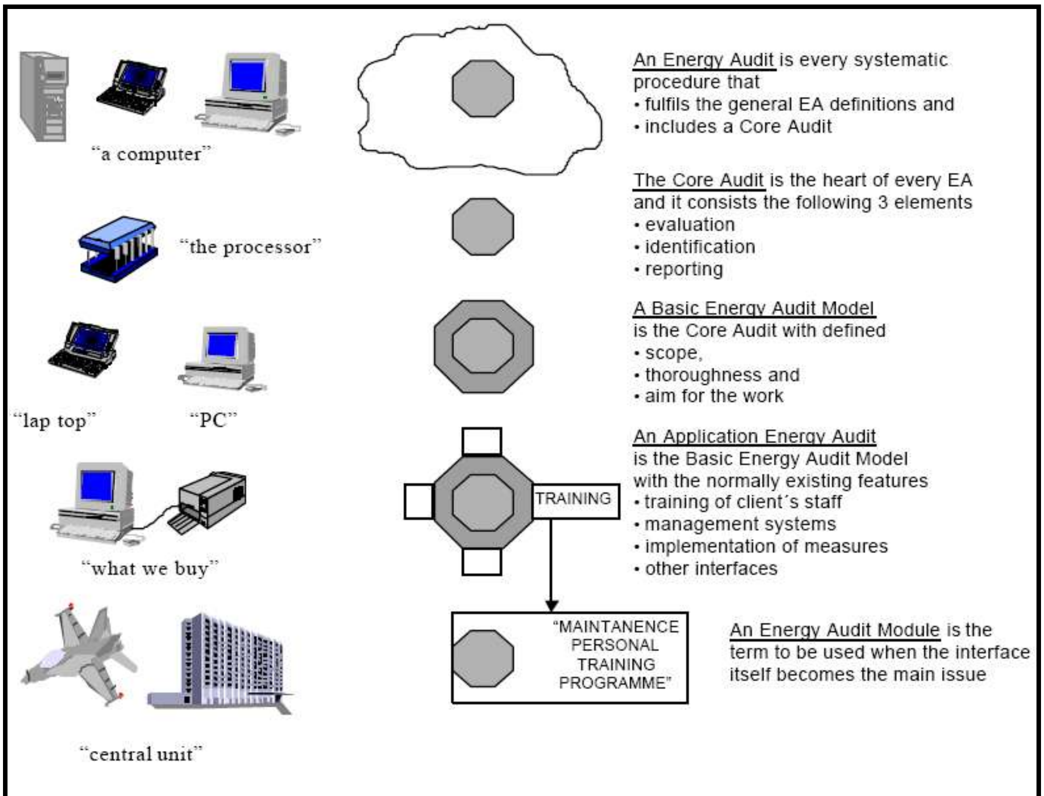


Figure 1: The structure of Energy Audits

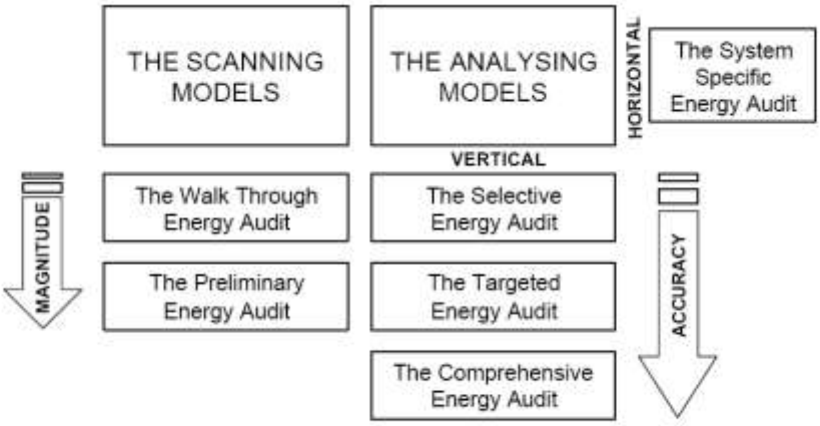


Figure 9: The Basic Energy Audit Models

The use of benchmarking in the Long-Term Agreements in the Netherlands is another way to avoid the pitfalls of corrupt baselines since the comparisons are always selected from other countries.

[46] http://www.motiva.fi/attachment/f16d4d543f99d7a59f54560a69063a0e/435cc93f15c4dd7272d126f40f2b006e/Audit-final-report.pdf*

3.9 Taxes, levies and quotas

The most preferred measure to have an impact on the market is making use of financial means, either by subsidising or by taxation, in order to "correct" the calculation and arrive at a different decision. This obviously presumes that those who make the decisions are primarily doing so from the point of view of economic rationality. Industry is also assumed to be more inclined to make such rational decisions than individuals.

a) Industrial application

The Swedish PFE-programme offers energy intensive companies to deduct the tax on electricity (0.5 öre/kWh) if they join the programme, introduce an energy management system and undertake measures that have a pay-back time shorter than 3 years.

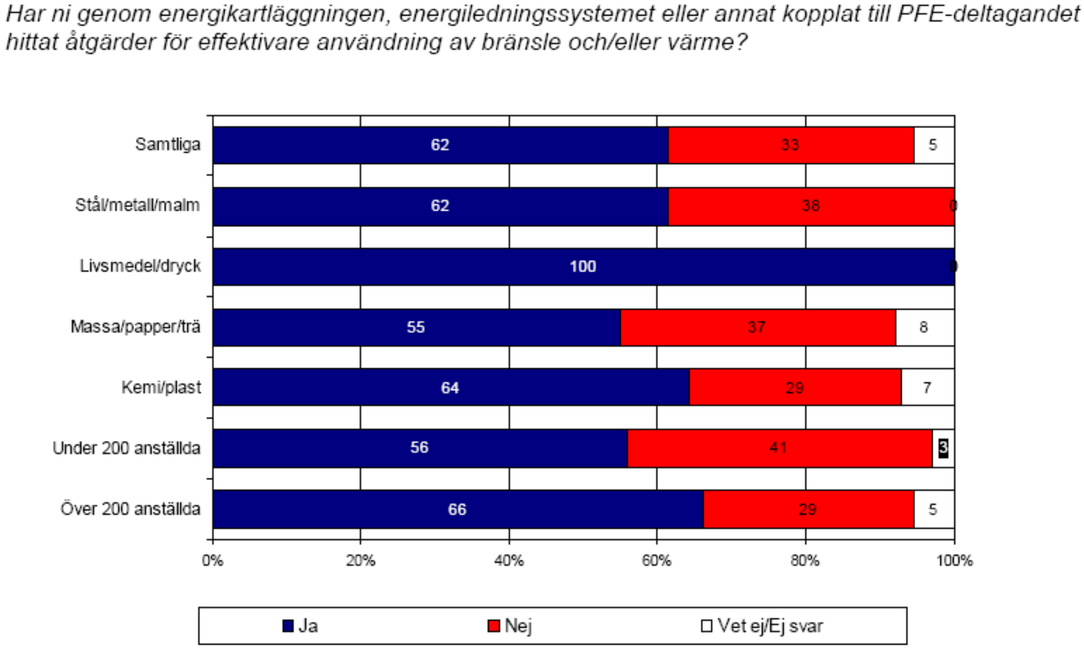
After 2 years 98 companies have joined the programme and represent 29 TWh of the Swedish use of electricity i.e. 20 %. In these companies 900 measures have been identified that requires investments of one billion SEK and that saves 500 millon SEK/year. [47] An interesting result is that the companies in the work have identified further profitable measures to save fuel (excluding electricity).

The interest and results seem to indicate two issues that have often been postulated but also firmly rejected by those who defend the view of pure economic rational behaviour:

- Tax deduction has a value in itself and attracts interest beyond what is purely economically rational
- Companies have not (contrary to their statements) full knowledge of their opportunities to save energy and improve the economic result.

[47] http://www.swedishenergyagency.se/web/biblshop.nsf/FilAtkomst/ET2007_10.pdf/$FILE/ET2007_10.pdf?OpenElement

Figure 27: Interview result from PFE: "Has the company found other energy measures of interest except those that save electricity?"[48]



b) Individual application (Fee-bates)

France introduced in December 2007 a system of fee-bates (bonus-malus) for cars where buyers get a bonus if the car emits less CO_2 and has to pay a fee if it emits more. The basic idea is that the system should be revenue neutral by collecting as much fees as it pays in rebates. It however seems as if this car application has had too great a success and paid more rebates than fees collected.

[48] http://www.energimyndigheten.se/Global/Filer%20RoT%20-%20F%C3%B6retag/Utv%C3%A4rdering%20PFE%202007%20-%20slutversion.pdf

Table 12: The French Bonus-Malus system for cars introduced in 2007. [49]

Classe	Emissions CO2 (g/km)	Prix moyen TTC (en €)	Bonus (-) / Malus (+) à l'achat sans mise à la casse	Bonus (-) / Malus (+) en % du prix de vente moyen	Exemples de modèles (dans certaines versions)	Part dans les ventes de véhicules neufs en 2006
A+	<=60	Nc	- 5000	Nc	Véhicule électrique	0 %
A	<=100	12 306	- 1000	8,13 %	Smart, Fiat 500	0 %
B	de 101 à 120	15 374	- 700	4,55 %	Citroën C1, C2 et C3, Renault Clio, Peugeot 107 et 207, Fiat Punto	18,1 %
C+	de 121 à 130	18 244	- 200	1,10 %	Citroën C4, Renault Mégane, VW Polo, Dacia Logan	12,8 %
C-	de 131 à 140	18 244	0	0,00 %	Citroën Xsara Picasso, Peugeot 307 et 407, Seat Ibiza	15,8 %
D	de 141 à 160	21 925	0	0,00 %	Citroën C5, Mercedes Classe A, Ford Focus	28 %
E+	de 161 à 165	27 530	+ 200	0,73 %	Peugeot 607, Opel Zafira	4 %
E-	de 166 à 200	27 530	+ 750	2,72 %	Mégane II break, BMW série 3, Toyota Rav-4	14,5 %
F	de 201 à 250	35 606	+ 1600	4,49 %	Mercedes Classe E, Nissan X-Trail, Renault Vel Satis	5,4 %
G	>250	53 240	+ 2600	4,88 %	VW Touareg, Citroën C6	1,4 %

The French system is heavily debated and there are suggestions to expand it to more products, but this is still not decided.

4. Conclusions and observations

The Danish measures have an impressive coverage and have generally been effective both in terms of amount of efficiency delivered to the Danish society and in terms of costs for the operations. They nevertheless give an impression of being designed for their purpose in a different time and need to be reconsidered and redesigned to suit the huge task that is ahead. A task that requires deployment of good technologies and development of even better in an unprecedented scale to establish a sustainable energy system.

This may require:

- A tuning of the policy measures that takes into account technology maturity and niche market ability (see figure 29 below).
- Development of "policy packages" that are designed for current stakeholder capacities and needs (see appendix 1).
- Reconsideration and redesign of existing policy measures also with the aim of "commoditizing" energy efficiency on a European scale based on Danish experiences.

[49] http://www.ecologie.gouv.fr/IMG/pdf/bonus-malus-2.pdf

4.1 Comprehensiveness

Most of the countries reviewed in the studies have no doubt entered into serious attempts to reduce energy intensity, but clearly have had very different degrees of success. Denmark has a very good track-record in the overall delivery of energy efficiency improvements. Compared to IEA-Europe Denmark has developed better. The only country that can compare is The Netherlands.

There are two dominant features in Denmark. One is the tradition of consensus that allows use of voluntary agreements between relevant parties (as opposed to command and control. The other feature is the wide-ranging palette of measures with explicit requirements for different situations, applications and actors. No other country has these features to the extent that Denmark has.

One clear difference and explanation of the successes (and lack of such) in the countries compared seems to lie in the ideological approach to how government and actors in the society/market should co-operate. The least success appears in the societies where there is an underlying conviction (hope) that market actors are always economically rational.[50] The highest success seems to be where actors can set up challenging goals together (benchmarks) and find forms to compete towards these goals, such as in the Netherlands.

Another divider is the way that subsidies are used. The more advanced models take into account technology maturity, customer abilities/preferences and niche markets, c.f. figure below.

[50] Price is often quoted as important, but it is seldom distinguished between pure price (energy related to other goods) effects and those economic effects that follows of a budget constraints due to higher total costs.

Figure 28: Aligning of: a) Market penetration towards saturation as function of time (and technology maturity), b) Technology cost (learning curve) as function of accumulated volume. [51]

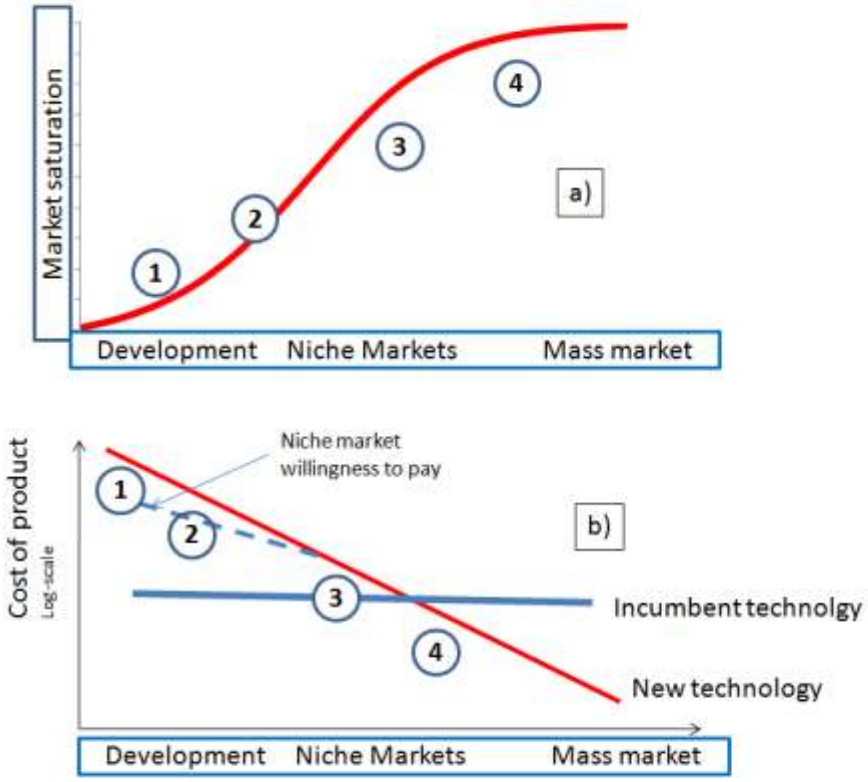


Table 13: Examples of support and ways of incentivising stakeholders. Related to figure 29 above.

Stage	Technology characteristic	Measure to support (examples)	Incentive function
1	Prototype, Demonstration	R&D, Soft loans[52], guarantees, risk-sharing	Focus on possibilities and attract interest of stakeholders-innovators
2	High Cost, Performance over time unclear	Technology procurement, Subsidies for limited (test) series	Attract niche market actors that want to be first movers
3	Controlled cost, development of services	Information, advisory service	Market pull
4	Known and available	Labels, Campaigns, Training	Ascertain properties and verification of function

Some further observations about Denmark in comparison with other countries:

- The business/companies that deliver energy efficiency to the market (SMEs for installation, building refurbishments, operations and maintenance etc.) have not received much attention in the policy making. There might be considerable learning

[51] Based on figure in "Deploying Renewables. Principles for Effective Policies" https://www.iea.org/w/bookshop/add.aspx?id=337 and on presentations in IEA Deployment seminars http://www.iea.org/Textbase/work/2007/learning/Nilsson.pdf

[52] Loans with favourable conditions in terms of rate and/or possible grace periods

effects in the distribution chain that could reduce both the transaction costs as well as the costs for the measures per se.

- Energy intensity in industry has not developed as fast as in other sectors or in comparable countries. Are the challenges not tough enough?
- Energy consumption for space heating has diminished more in some of the comparable countries. Could it be that the high saturation of district heating and extensive use of CHP has diverted interest away from the need to improve end-use intensity?
- The administrative sector (in the commercial segment) has developed well in comparison to other countries. Are there lessons to be learnt for other sectors and in this particular industry?
- An more pronounced operational Nordic co-operation would make sense e.g. in Technology Procurement, use of Voluntary Agreements, Auditing, Buildings control, use of smart meters and development of smart grids etc. Especially in light of the special activities and the interest that the EU has shown in these areas.

From a policy package perspective, and as indicated in the fingerprints, what is missing among the Danish policies is engaging industry as suppliers of energy efficient technologies in a more focused manner. The explanation could simply be that there are few Danish companies manufacturing such. If so, it would be worthwhile to consider that the entire distribution chain down to the customer/user also has other important actors (consultants, installation companies, service companies, etc) and that international co-operation could have a strong impact on the international manufacturing business that would also benefit Danish users.

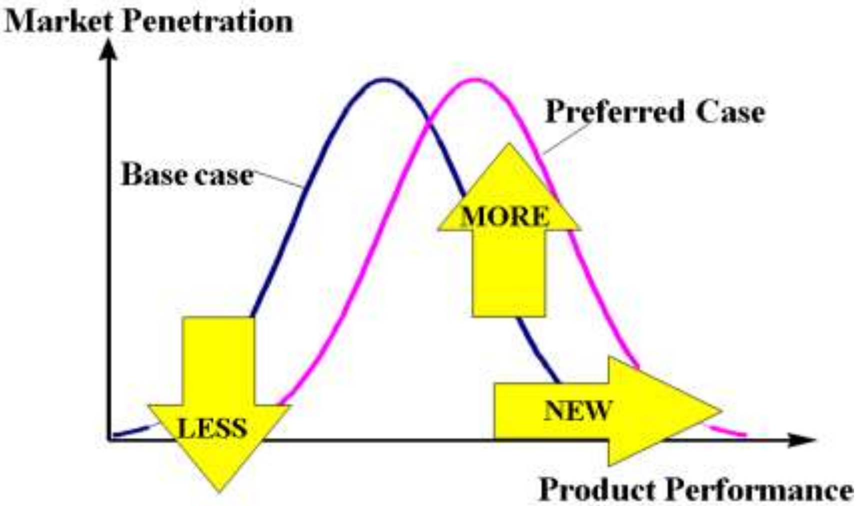
4.2 Mirroring single policy measures

For a total change of the market for energy efficiency there is a need for a multitude of actions to:

- Cut off the tail of the market and have less of the badly performing equipment sold to the market.
- promote the best part and have more of the good performance. The issue is to make the end-users interested in the better performing equipment at the time when they are deciding to buy and then to repeat this choice in the future
- stretch the front further with new innovative equipment with super-good performance (pulling the rest of the market along). Mainly an issue for parties who have an interest in technology development but also in profiling themselves as market leaders.

Denmark seems to have made extensive use the actions to cut off the tail and to promote the good, but less to stretch the front.

Figure 29: Market Transformation from base case to preferred case



Denmark has an extensive catalogue of policy measures that could be inspired and altered based on experiences from other countries and vice versa!

Table 14: Examples of alterations of existing Danish policy measures inspired by policies of other countries.

Mirror	Reflexes in the mirror
3.1 The energy companies 3.2 Utility funding of activities (DE Net sparepulje)	The incentive system and the division of roles between stakeholders should be considered taking international developments into account
3.4 Building codes 3.5 Improving existing buildings (energy labelling in particular)	The building codes for existing buildings could be improved
3.3 Top-runner benchmarking (Elsparefonden) 3.6 Savings in the public sector 3.7 Minimum standards and labelling of appliances (supportive actions)	a) The Danish supportive system with information for individuals could be used to improve and create a pan-European system b) A more focused use of the public purchasing power for technology improvement should be considered (on a Nordic base)
3.8 Voluntary agreements	a) Benchmarking for industry performance should be reconsidered b) Auditing systems may be improved
3.9 Taxes, levies and CO_2-quotas	a) There seem to be a tendency to act on carrots even if they not always are big. Tax exemption spurs to deeds even beyond the economically rational b) Fee-bates could be introduced

Appendix 1: Typology for measure and packages of measure[53]

Table 15: Policy Packages and their operational objectives

Operational Objective	Characteristic Application and Examples of Measures	
Serve the customer	*The customer/user is assumed to need assistance in making better choices from among available technologies. Some relevant measures: the provision of customer-oriented information and calculation tools; and occasionally some interventions to enhance market functions, e.g., third-party financing, development of energy service companies (ESCOs), etc.*	CUSTOMER RELATIONS
Incentives for the customer	*Good technologies known to customers are not widely adopted because of market imperfections and externalities. Some relevant measures: internalise external costs through tax measures, adjust market structure so that those who benefit from energy efficiency can influence technology choice.*	
Educate and protect the customer	*Inferior technologies are overly used because of inertia on the part of both suppliers and consumers, which weakens competition from new alternatives. E.g., purchasing rules may favour low initial investments and under-estimate high operating costs.*	
Manifest the demand for a change	*Find niche and develop niche markets in which to launch and adapt technologies; their development could start a process of more widespread market uptake. Some relevant measures: work with stakeholders to aggregate product demand; help to finance learning investment.*	BUSINESS ORGANISATION
Vitalise conservative business structure	*The market has got stuck with traditional products delivered in forms that are not always favourable for customers and users. Activities to improve competition (e.g., deregulation) can vitalise market actors.*	
Reconsider existing regulations and rules	*Wider application of good technologies can be hampered by legislation and regulations primarily adapted to conventional technologies. E.g., liberalise regulations affecting electricity feeds from small scale combined production of heat and power (CHP) and independent power producers.*	MARKET RULES AND INSTITUTIONS
Enhance financial framework & conditions	*Financial arrangements available to buyers may not be well adjusted to the needs of new energy technology markets and this may impede capital stock turnover and slow the adoption of new technologies. Enhancement of financial conditions may open new opportunities.*	
Recognise system aspects	*A technological solution designed for a specific problem can affect the output of a larger system. Recognition of the totality of the system (energy, comfort, productivity, environment, etc.) is sometimes necessary to understand and handle the technology shift. A typical instrument is the ISO 9000 and 14000 standards.*	

[53] Source: Creating Market for Energy Technologies. OECD/IEA Paris 2003.

Table 16: Policy Packages and their components in terms of measures and their related perspective in terms of perception of issues.

	Barrier type described in case study												Technology R&D+D				MT Purpose		
	Information	Transaction Costs	Risk	Finance	Price Distortion	Market Org. – Split Incentives	Market Org. - Bias	Market Org. - Cost	Market Org. - Tradition	Regulation	Capital Stock Turnover	Technology Specific Barrier	Existing Technology	Few Known Solutions	Not Known Solutions	Niche Market Addressed	New Product	More of Good Products	Less of Bad Products
Types of Measures	Clarifying technical performance		Active verification		Correct prices	Adapt incentive structure	Adapt market routines	Adapt Production	Adapt Organisation	Adapt rules	Timing measures	Focus technology to market	Expand market coverage	Finance market adaptation	Finance tech. development	Identify niche, negotiate	Target niches	Enable customers	Warn customers
Operational Objective																			
A Serve	X	X	X	X									X					X	
B Incentivise					X	X								X		X	X		
C Educate	X						X			X			X						X
D Manifest								X						X		X	X		
E Vitalise									X				X	X				X	
F Reconsider										X			X					X	X
G Enhance			X	X	X						X			X		X	X		
H Recognise												X	X		X	X	X	X	

Table 17: Positioning Denmark

	Barrier type described in case study												Technology R&D+D				MT Purpose		
	Information	Transaction Costs	Risk	Finance	Price Distortion	Market Org. – Split Incentives	Market Org. - Bias	Market Org. - Cost	Market Org. - Tradition	Regulation	Capital Stock Turnover	Technology Specific Barrier	Existing Technology	Few Known Solutions	Not Known Solutions	Niche Market Addressed	New Product	More of Good Products	Less of Bad Products
	B1		B2		B3	B4	B5	B6	B7	B8	B9	B10	R1	R2	R3	R4	M1	M2	M3
Types of Measures	Clarifying technical performance		Active verification		Correct prices	Adapt incentive structure	Adapt market routines	Adapt Production	Adapt Organisation	Adapt rules	Timing measures	Focus technology to market	Expand market coverage	Finance market adaptation	Finance tech. development	Identify niche, negotiate	Target niches	Enable customers	Warn customers
The Danish applications	Byggmärkning,	Apparatmärkning,	(Selskaben)				Selskaben			Byggningsreglöementet			Offentlige			Aftalen, Sparepuljenuljen		Elspareffonden	Byggningsreglementet, Apparatnormer, Avgifter och kvoter

Appendix 2: Sources for the Danish Evaluation

Country	Main resources		Reason for selection	Source				
	Production (electricity)	Production (heat)		IEA country study[54]	IEA efficiency database[55]	General IEA information	Energy Charter[56]	EU National Action Plans[57]
Denmark	-	-	-	2006 pdf	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=DK	2004	X
Sweden	Nuclear and hydro	Biofuel	**Nordic Country**	2008 available at cost	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=SE	2006	X
Norway	Hydro	electricity	**Nordic Country**	2005 pdf	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=NO	-	NA
Finland	Nuclear and coal (CHP)	NG and coal	**Nordic Country**	2007 available at cost	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=FI	-	X
The Netherlands	NG, coal, wind	NG	**Similarity in use of CHP**	2004 pdf	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=NL	-	X
Spain	Coal, NG, nuclear, wind	NA	**Similarity in Big prop. of wind and biofuel**	2005 pdf	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=ES	-	X
Austria	NG and hydro	NG and biofuel	**Similarity in Renewable energy for heating**	2007 available at cost	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=AT	-	X
Italy	NG	NG	**Contrast by Low activity in policy**	2003 pdf	X	http://www.iea.org/Textbase/country/m_country.asp?COUNTRY_CODE=IT	-	X

54 http://www.iea.org/Textbase/publications/free_new_type_result.asp?type=Country+Review+%28Book%29&Submit=Submit

55 http://www.iea.org/textbase/pm/?mode=pm

56 http://www.encharter.org/index.php?id=42

57 http://ec.europa.eu/energy/demand/legislation/end_use_en.htm