Danish energy efficiency policy: revisited and future improvements

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Abstract

Ten groups of policy instruments for promoting energy efficiency are actively used in Denmark. Among these are the EU instruments such as the CO_2 emissions trading scheme and labelling of appliances, labelling of all buildings, combined with national instruments such as high taxes especially on households and the public sector, obligations for energy companies (electricity, natural gas, district heating, and oil) to deliver documented savings, strict building codes, special instructions for the public sector, and an Electricity Saving Trust.

A political agreement from 2005 states that an evaluation of the entire Danish energy efficiency policy portfolio must be carried out before end 2008 and put forward for discussion among governing parties no later than February 2009. A consortium comprising Ea Energy Analyses, Niras, the Department of Society and Globalisation (Roskilde University) and 4-Fact was assigned with this task. The evaluation aimed to answer the crucial questions:

- Is the overall design of the portfolio of instruments appropriate?
- Does the impact of the instruments justify the costs, so that we reach the national goals in a cost efficient way?
- Will the current instrument portfolio be able to meet the required reduction in final energy consumption (goal for 2013) and in primary energy consumption (with goals in 2011 and 2020) as planned by parliament?

Recommendations were made on how to improve and develop the portfolio using cost effectiveness as well as organisational clarity as criteria in developing the recommendations. The evaluation was completed in December 2008, and this paper presents the main findings and proceeds to discuss the issues from an EU perspective.

Introduction

In Denmark energy efficiency has been in focus since the mid-1970s. Many of the existing energy efficiency policies were launched before year 2000 and despite the fact that most have been adjusted on an ongoing basis each of the policies have characteristics reaching back to the year of their launch – characteristics that may no longer be appropriate given the current context.

Energy efficiency can be a cheap way to achieve environmental benefits and reduced dependence on imported fossil fuels. In many cases, energy efficiency projects may be realised at low cost and the increased investment cost is more than offset by the reduced energy expenses. The cost of the policies to promote energy efficiency may however be considerable. If the policies are not designed carefully and revised at regular intervals the cost of the policy portfolio may exceed the socio-economic value of the resulting efficiency improvements.

In Denmark, a total of approximately 86 million Euro is spent every year on measures to promote energy efficiency – in round figures 40 million Euro for the activities of the energy companies (paid by all energy users), 32 million Euro for energy labelling of buildings (paid by those acquiring the label), and 14 million Euro for the Danish Electricity Saving Trust

Table 1. The coverage of the ten policies across end-user sectors.

	Energy efficiency activities	2005 agreement annual targets	Residential sector	Public sector	Private business sector	Energy intensive industry
1	EU CO_2 emissions trading scheme	n.a.	X	X	X	X
2	Energy taxes	n.a.	XX	XX	X	
3	Energy eff. obligations for energy companies	2.95 PJ	XX	XX	XX	XX
4	Energy labelling of buildings	0.5 PJ	XX	X		
5	The Electricity Saving Trust	0.6 PJ	XX	XX		
6	Building codes	1.75 PJ	XX	X		
7	Energy labelling and standards for appliances	0.4 PJ	XX			
8	Directives on energy savings in the public sector	0.5 PJ		XX		
9	Energy efficiency agreements with industry	0.5 PJ.				XX
10	The energy saving program (subsidy to NGO's)	n.a.	XX			

n.a. – not available; xx – the sector is fully covered; x – the sector is partly covered by the activity.

(collected by a special tariff on electricity for households and the public sector).

An evaluation of the entire policy portfolio was carried out as part of the Danish energy policy agreements of June 2005 and February 2008, the intention being to create a basis for updating and strengthening the Danish energy efficiency efforts.

This paper presents this first evaluation of the entire portfolio of the Danish energy efficiency policies. A brief description of the evaluation set-up is followed by an overview of key findings and recommendations made ending with an assessment of whether the current portfolio can meet the agreed energy efficiency targets. Finally, the paper touches upon a couple of general policy issues.

The EA evaluation

Energy efficiency has for the last 35 years been recognised as an important element of Danish energy policy.

On June 10th, 2005 the governing parties of Denmark entered a political agreement whereby targets for energy efficiency were set. According to the agreement, savings in the end-use energy consumption should contribute to growth and industrial development, to maintaining a high security of supply, and alleviating global environmental problems, including not least climate changes. The 2005 agreement also states that the overall goal is that the energy efficiency activities must have a documented impact of 7.5 PJ (1,1 pct. of total final energy consumption – 1,7 pct. of final consumption excluding transport) per year until 2013. The political agreement of February 21st, 2008 increased the target to 10.3 PJ (1,5 pct. of total final consumption) as of 2010 and added a target for the gross energy consumption to emphasise energy savings.

As part of the government strategy for market orientation of the energy efficiency policies the electricity, natural gas, district heat and oil companies were issued with an obligation to save 2.95 PJ per year (first year's saving) and in return given more freedom in choice of activities and the documentation requirements reduced. The target has since then been increased to 5.4 PJ/year as of 2010.

The agreement of 2005 states that an evaluation of the entire energy efficiency policy portfolio must be carried out before end 2008 and put forward for discussion among governing parties no later than February 2009. A consortium comprising Ea Energy Analyses, Niras, the Department of Society and Globalisation (Roskilde University) and 4-Fact was assigned with this task. The task was carried out for the Danish Energy Authority (DEA) in the period May-December 2008. For the sake of clarity the evaluation is in the following referred to as "the EA evaluation".

The aim of the evaluation was to assess whether current energy efficiency policies are sufficient and their organisation effective relative to the agreed targets for the Danish energy policy. The agreement only says that the savings shall be specific and documented, but the evaluation team was asked to focus on the achieved additional energy efficiency and the associated costs to society were to be determined as well as recommendations for improvement. By "additional" we mean the improved energy efficiency than can be directly attributed to a policy instrument, e.g. an energy audit performed by an energy company.

There are currently ten major energy efficiency policies, also referred to as activities, see Table 1. The first five constitutes the bulk of the effort, and the following presentation of the results of the evaluation will therefore focus on these five and in particular the activities of the energy companies since the framework for their activities is the one most recently changed.

The table indicates that the policy in the past has had focus on the residential and the public sector. Thus even this simple table raises the question if there perhaps has been too much focus on the residential sector and the public sector in the energy – saving policy.

APPROACH

In order to overcome the limitations of the time constraint, the EA evaluation was designed to partly rely on desk top research of existing literature, existing databases and earlier evaluations combined with dialogue with stakeholders. Where relevant this information was supplemented with new empirical data of critical importance to the main conclusions and the holistic aspects of the evaluation. The empirical data collection consisted of questionnaires, telephone surveys, and peer reviews.

Furthermore, emphasis was placed on the three largest activities next after the energy taxes and the emissions trading

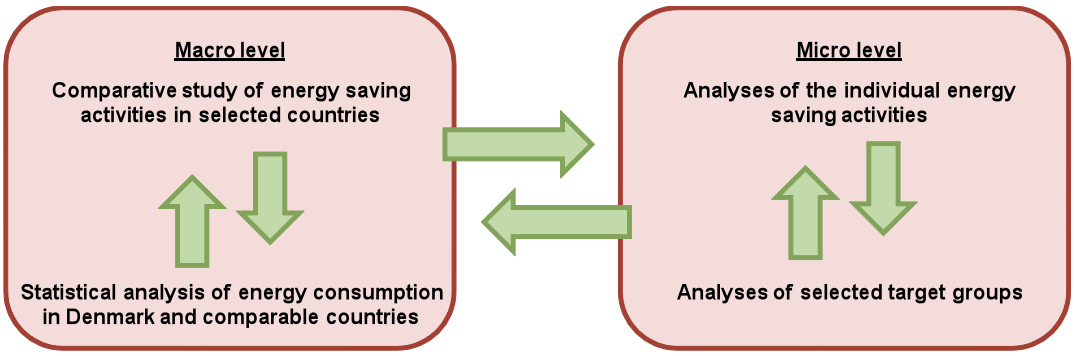

Figure 1. Triangulation applied three times.

scheme, namely the activities of the energy companies, the building labelling scheme, and the Electricity Saving Trust.

Three types of triangulation were applied to achieve greater reliability in the results (see Figure 1). At macro level the Danish achievements were compared to the development in the consumption level in seven selected countries (Sweden, Norway, Finland, Netherlands, Austria, Spain, and Italy) in an attempt to understand whether the Danish achievements can be attributed to Danish energy efficiency initiatives or rather a general international trend. Furthermore, the Danish understanding of how energy policies can be designed and coordinated was challenged in a comparative study of the portfolios of selected countries. At micro level empirical data was collected from two different perspectives, namely the individual energy activity and the perspective of selected activity target groups, the reasoning being that an energy efficiency activity may not be as dominant as expected when taking a broad customer point of view. And finally the findings of the two levels were compared.

Evaluation results

ENERGY TAXES AND CO_2 QUOTAS

Energy taxes have been used for all sectors. In 1977 an energy tax was introduced for households and in 1996 a CO_2 tax was introduced to all sectors. Today households and the public sector pay electricity taxes corresponding to 0.09 Euro/kWh plus 25% VAT. A typical tax for electricity in trade and industry is 0.013 Euro/kWh. Taxes are used for all fossil fuels. Without the energy taxes the Danish energy consumption would be at least 10% higher (Økonomi- og Erhvervsministeriet, 2008). The actual tax paid varies highly from sector to sector and from end use to end use (see Figure 2). The highest tax is paid for electricity used by households and in the public sector. Also energy used for heating have a high tax in all sectors. Energy intensive companies pay the lowest tax. Total revenue from energy taxes is 5 billion Euro, of which half derives from transport.

From 2008 the European Union Greenhouse Gas Emission Trading Scheme (ETS) – has added another cost element. CO_2 quotas are required for most installations with a capacity above 20 MW. These include the energy sector (electricity generation and district heating) as well as industrial installations. For the end-users ETS acts as a European wide energy tax. The current price of CO_2 quotas is 10 Euro/ton CO_2 (6 March 2009, ftp.nordpool.com) and has typically increased electricity price with 0.01 Euro/kWh for all users. The price of CO_2 quotas was 30 Euro/ton in mid 2008 – apparently the economic crisis has eased the demand for quotas.

As part of the EA evaluation a survey of 42 Danish larger industrial companies within the ETS was done. The answers indicate a typical increase of marginal energy costs of 10%. Half of the companies respond that ETS has increased their focus on energy efficiency to some or to a high extent. The companies have reacted to the increase of the marginal price – the grandfathering of quotas to these companies has apparently not disturbed the motivation for energy efficiency.

ENERGY EFFICIENCY OBLIGATION OF THE ENERGY UTILITIES

From 2006 the grid companies for electricity, natural gas, and district heating have been obliged to realise energy efficiency activities. The new obligations constitute a development based on years of utility energy efficiency activities, e.g. electricity utilities have been working actively with energy efficiency since 1990. The commercial oil companies entered the system on voluntary basis.

The obligations are given to the grid companies, but in practice most of the activities are carried out by commercial daughter companies, and often combined with other activities, e.g. selling electricity to industrial companies.

The obligation is expressed as first year's saving (the life time of the saving is not considered). The energy companies have an extended freedom in how they will realise the saving. They can work within their own energy type or any other energy type – only transport is not included. They can work within their own network areas or anywhere in the country. The energy company must be actively involved in a project to record the saving on their list. The activity can take many forms – often energy audits, targeted information, subsidy or a combination of these are used.

Energy savings can be calculated as a *specific calculation*, or based on a *standard value*. Most savings (measured in units of energy) are based on specific calculation which is an engineering calculation based on individual factors about the project, e.g. temperatures, number of hours equipments is used etc. Alternatively a standard value is applied from the catalogue of standard values for approximately 200 savings projects (such as new windows, isolation, new appliances, new boilers, etc.).

Energy saving are recorded as final energy, so all energy types count as the same. 1 kWh saved can be 1 kWh electric-

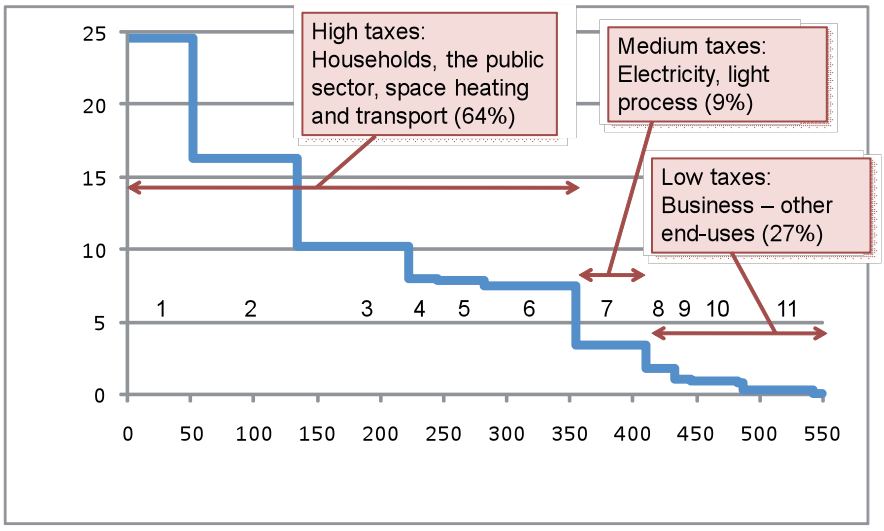

Figure 2. Energy taxes paid in Denmark. The x-axis is defined as the tax-basis, which is fuel, except for electricity, where the tax basis is electricity. Detailed rules are applied to combined heat and power generation, so taxes are paid for the part of the energy consumption used to heat generation. Major types of taxation: 1: All electricity used in households and public sector, and used for comfort heating in other sectors. 2: Gasoline. 3: Diesel, 4: Coal for heating (CHP). 5: Gasoil for heating. 6: Natural gas for heating. 7: Electricity for processes. 8: Waste. 9: Electricity heavy processes. 10: Fuel for processes. 11: Fuel for heavy processes. Note that CO2-quatas are required for electricity (1, 7 and 9), for district heating (4 and part of 6) and for some energy intensive processes (part of 11).

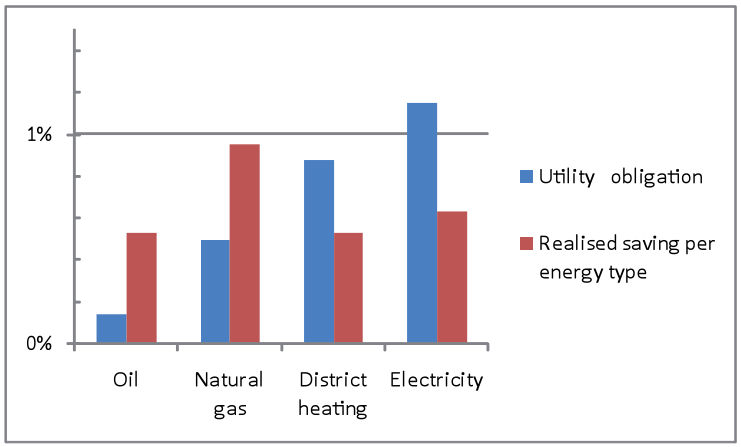

Figure 3. Yearly energy efficiency obligation and realised energy efficiency for Danish energy companies (first year's saving). The column with realised energy efficiency show the average yearly saving per energy type based on the period 2006 to end of first half of 2008. The total obligation is 2.95 PJ per year. Values are compared with the yearly consumption per energy type. For oil the basis is total oil sale minus oil used for transport.

ity or district heating. This has been chosen although cost and CO_2 emission can vary a lot across energy type: District heating can be CHP based on natural gas, while electricity can be coal based. Only in relation to conversion projects, e.g. when converting electric heated houses to district heating, electricity is weighted with a factor 2.5.

These features distinguish the Danish system from similar schemes in UK, France and Italy (Togeby et al., 2007). The obligations and the extended freedom in execution signify that the Danish system bears many features of a white certificate system.

The utilities must meet their obligations by the end of 2008. All energy types will meet the obligation; however a few individual district heating companies have not fulfilled their goal.

The energy type of the realised saving is different from the obligations. It is seen from Figure 3 and Table 2 that more energy saving are attracted to natural gas and oil. Less is recorded in electricity and district heating. Investment in efficient industrial boilers may attract projects for natural gas. The costs of district heating are often relatively low and combined with the fact that improvement in building isolation can be costly, it may direct projects to other energy types.

While the oil companies and the district heating and natural gas utilities mainly deliver saving within its own energy type,

Contents Keywords Authors

Table 2. Recorded energy saving from 2006 to end of first half year of 2008 per energy utility and per energy type. In the row "Total" the recorded saving are compared with the obligation.

Utility	Savings by energy type				
	Electricity	Natural gas	District heating	Oil	Total (% of obligation)
Electricity	1,541 TJ	1,273 TJ	243 TJ	351 TJ	3,422 TJ (98%)
Natural gas	253 TJ	898 TJ	23 TJ	441 TJ	1,614 TJ (129%)
District heating	122 TJ	241 TJ	1090 TJ	241 TJ	1,685 TJ (75%)
Oil	-	-	-	398 TJ	398 TJ (106%)
Total	1,917 TJ	2,412 TJ	1,355 TJ	1,414 TJ	7,119 TJ (97%)
Total (% of demand)	1.6%	3.4%	1.3%	2.2%	2.0%

Table 3. Recorded energy saving from 2006 to end of first half year of 2008 per sector.

Utility	Savings by sector			
	Residential sector	Public sector	Trade and industries	Total
Electricity	694 TJ	283 TJ	2,444 TJ	3,421 TJ
Natural gas	1,011 TJ	73 TJ	530 TJ	1,614 TJ
District heating	952 TJ	192 TJ	541 TJ	1,685 TJ
Oil	347 TJ	0 TJ	50 TJ	397 TJ
Total	3,004 TJ	548 TJ	3,565 TJ	7,117 TJ
	42%	*8%*	*50%*	*100%*

Table 4. Largest energy saving project recorded by energy utilities.

Project	First year's saving
Six step evaporator	56 GWh
Use of by-product hydrogen to produce steam	26 GWh
Converting of new type of town gas	23 GWh
Campaign for using clothesline instead of tumble drier	20 GWh
Partnership with chemical company	12 GWh
New natural gas steam boilers	11 GWh
Converting oil and electricity for heating to natural gas	10 GWh
Retrofitting boiler with flue gas cooler	9 GWh
Retrofitting kiln to optimize air flow	8 GWh

the electricity companies have recorded more than half of their savings outside electricity. This major change relates to the 2006 change of rules.

The overall distribution of saving among sectors is similar to the energy consumption (see Table 3). The electricity utilities, however, have focused on industrial companies. They emphasise that utility costs can be minimised in relation to the large energy users. District heating organisations are generally smaller than the other utilities, and have often decided to work with their own customers and own energy carrier.

As part of the EA evaluation 26 energy companies were asked to deliver information about their largest energy efficiency projects. This information is collected by the companies as part of the internal documentation of reported savings towards the Danish Energy Authority. This resulted in a database with 270 realised energy efficiency projects. The calculated saving based on ex-ante engineering estimates corresponds to 401 GWh, or 49% of the yearly obligations for all energy companies. Table 4 shows the largest projects.

177 of the projects were realised in trade and industry (342 GWh). Among these telephone interviews were made with 105. Each interview focused on the specific project realised in the company.

Table 5 shows how the utilities were involved in the projects. Economic analysis included documentation of the expected saving for a project. The rules requiring active involvement by the utility, does not require that the energy saving must be additional. To make the basis for an evaluation of the balance between costs and benefit the contact person was asked to state "with what probability the project would have been realised within the next year – without the help from the utility?"

It is recognised that this is a hypothetical question, and that answers should be considered with care. However, more accurate evaluation design could not fit the time and the budget of the evaluation. In an earlier evaluation of the additional impact of electricity audits was carried out based on statistical methods (Larsen et al, 2004 and Larsen et al, 2006). The evaluation did not establish any effect of the audits, but problems with data quality hindered a clear result.

Based on 88 cases in our interviews the weighted average of the additionality factor is indicated to be 45%. The same question, but with a three years horizon, indicated 33% additionality.

Out of the 88 cases, 42 have indicated a low additionality factor (between 0 and 10%) and 13 indicated a high additionality (between 90 and 100%). A review of the statements that each

Table 5. Form of activity in relation to trade and industries. N= 94, several answers possible.

In which way was [the energy company] involved	Share of total answers
Economic analysis	56%
Idea	41%
Technical analysis	31%
Subsidy	23%
Implementation	11%
Other	24%

person gave after answering the probability question supports the result: For some the utility help was essential and for others it did not change anything.

Although the method is not accurate, it is concluded that about half of the recorded saving would not have been realised without the intervention from the energy utility.

The evaluation results are associated with some uncertainty but seem to indicate that the projects are economically attractive from both the customer perspective and the energy company perspective.

BUILDING LABELLING

Labelling of buildings has existed since 1979 and the system has been modified several times, most recently in 2006.

The Danish implementation of the energy labelling scheme for buildings requires that all buildings are labelled before they are sold. The labelling report consists of a label (A to G) with individual recommendation on how to reduce the energy consumption. The energy label is calculated based on information about building physics. The cost of the labelling is 650 Euro per label. Also new buildings must be labelled before they are taken into use. This can act as a control of the building code. Buildings larger than 1,000 m^2 must be labelled every 5 years. Preparations have been made for making the issued labels public so that energy companies and other stakeholders may use the information to target their activities.

The Danish labelling system exceeds current EU minimum requirements in terms of ambition and extent.

Kjærbye (2008) has evaluated the labelling scheme by studying the natural gas consumption for 4,000 small buildings with and without an energy label. Data are from 2002 – before the latest revision of the scheme. The conclusion is clearly that no significant difference can be found between houses with and without a label. Apparently the owners without an energy label can manage to implement as many energy efficiency projects as owners with a label. Or in evaluation terms: The additional impact of the labelling is close to zero.

As part of the EA evaluation a small survey was done to describe results from the labelling scheme for large buildings. The evaluation found that the impact is at best limited.

The labelling is obligatory but is not enforced and without specification of possible sanctions. The planned publication of the issued labels is expected to increase the interest for the labelling and its recommendations, but according to the EA evaluation this is not likely to alter the cost-benefit balance significantly. One of the problems inherent in the system is that a (expensive) consultant is sent out to a building whose owner may not at all be interested in the label or ready to receive the information contained in the labelling report. The cost of labour of the consultant does not match the benefits of the realised savings and reduces the cost-efficiency of this policy.

THE ELECTRICITY SAVINGS TRUST

The Electricity Savings Trust (EST) was created in 1997 with the aim to promote cost-effective electricity savings in households and public institutions. One of the main tasks was to reduce the use of direct electric heating through switch to district heating or natural gas boilers. Since then energy efficient appliances and efficient use of appliances have become the main focus area.

The activities are primarily information activities, voluntary agreements and technology procurement. The EST has thus successfully created a number of web based price lists that list energy efficient products, current retailers, and the cheapest product prices so that the individual consumer can find a suitable low priced product with a few clicks of the mouse. The EST has as an independent institution been actively influencing both the demand and manufacturing and retail side of the appliance markets and uses the public media very actively to reach its goals.

Contrary to the activities of the energy companies, the cost of the EST is easily established but the energy efficiency impact not clearly identified. The activities of the EST are financed through a 0.01 Euro/kWh levy on the electricity consumption of households and public institutions.

The achieved impact has been harder to quantify. The EST routinely evaluates its activities; however, the focus is foremost on various communication aspects and consumer recognition. The impacts estimated by the EST evaluations are according to the findings of the EA evaluation most likely overestimated. As an example EST assumes that the 30,000 houses with electrical heating that they have helped to be converted to district heating or natural gas heating would have stayed with electric heating for the next 20 years. This assumption is not backed up by surveys or other information describing the reference case and is quite unlikely to be realistic with the high Danish taxes on electricity used for heating. When renovating the houses investment in energy efficiency or new heating system would likely take place. If the all the converted houses in the reference case would have converted linearly over 20 years – the additional effect of EST activities would have been 50%.

EST evaluation practises could easily be modified to render a more reliable and robust estimate of likely impacts.

Information activities as the ones supplied by the EST are valuable and the EA evaluation is critical to the current limit for EST. Electricity used in households and the public sector is highly taxed, and furthermore electricity is included in the ETS and covered by a number of other policy instruments.

OTHER POLICIES

The **building code** has been important in reducing the energy consumption of new buildings. Tying the requirements to the overall energy use of the building instead of using individual requirements for each building element creates good flexibility in design. However, the current building codes and the planned tightening of the code in 2010 will promote onsite energy supply (e.g. solar heating) independently of what the alternatives may be. This could prove costly if for example the alternative is district heating based on combined heat and power production or surplus heat. At present 63% of all new Danish houses are supplied with district heating (Aggerholm, 2008).

Labelling of appliances is well known among the consumers and the EU estimates that at a European level the labelling will lead to more than 700 TWh savings until 2020 (consultation document, 2008). As part of the EA evaluation a survey was carried out among buyers of tumble driers. The survey found that although energy consumption and the environment are important to the buyers and they look at the label of the appliance other factors such as the price and convenience is much more important. At present the appliances on the market are almost solely B or C labelled. Only a very few A labelled (and D labelled) appliances are sold.

The evaluation found that buyers of tumble driers overestimate their choice of drier – for example 36% of the survey respondents that bought a B-labelled drier believe that they bought an A-labelled product. This could together with the narrow range of labels available possibly be interpreted as follows: The consumers are interested in energy efficiency but the fact that no E, F or G labelled products exist on the market may lead the consumers to thinking that all available products are acceptable from an energy point of view.

Directives on **public sector savings** encompass demands that the possibilities for energy savings are made public and that these are realised within certain conditions. The EA evaluation confirmed what was already known – namely that the public sector has not been able to "lead the way" for other consumers. A statistical analysis of the energy consumption in 100 public buildings, with a total area of 1 million m^2, indicated an increase in energy consumption per area during the period 2000 to 2007 of 4% for heat and 10% for electricity.

This is disappointing since this sector together with the household sector is the consumer segment that is being targeted by the greatest number of the existing policies (see Table 1). However, there appears to be a movement in the public sector towards a more active attitude towards energy savings and opportunities in connection with already planned renovation projects are being exploited.

Energy efficiency agreements with industry provide energy intensive industries with an opportunity for refund in their CO_2 tax in return for energy management etc. The policy is currently being revised and it is decided that in the future it will only apply to electricity consumption. The revision is linked to the overall revision of the CO_2 taxes, mentioned earlier in this paper.

The electricity companies are according to the agreement with the Climate and Energy Ministry of March 29th, 2004 obliged to set aside 3.3 million Euro/year for broad information activities that can supplement the electricity companies' own activities. This **energy saving program** was evaluated just shortly before the EA evaluation (Catinét Research, 2008) and therefore not investigated further. In short the conclusion was that although some of the launched projects might have an impact too little data was accessible to judge the kWh impact and cost-effectiveness – the exception being the support provided to three large NGOs.

Overall the EA evaluation found that some of the current policies have been surpassed by developments in their national and international context and that the coordination of the different policies is lacking, for example coordinating between EST campaign and energy company activities. The introduction of the CO_2 emissions trading scheme has for example increased the electricity price and thus the incentive to save electricity but at the same time electricity savings will not lead to CO_2 reductions within the current quota period since the total European quota is fixed. The Electricity Savings Trust was created before the ETS.

Will energy policy targets be reached?

The political agreements from 2005 and 2008 have future targets for final and gross energy consumption. Final consumption (excluding transport and non-energy purposes) is to be decreased to less than 430 PJ per year by 2013. Gross energy consumption is to be decreased to 846 PJ by 2011 and 828 PJ by 2020 (corresponding to respectively 2% and 4% of consumption in 2006)

Different projections made by DEA and Danish Economic Councils (EC) since 2007 show that together with the actual policies having an effect, energy prices and rate of economic growth also have a large impact on energy consumption.

Most projections of the gross energy consumption are close to the political targets. With the lower economic growth compared to the last 15 years being incorporated in the latest projection by EC, the outcome indicates a lower increase in demand for energy in the coming years even though oil prices included in the projection are also lowered (increasing by 3% from 85 USD/barrel in 2010). Higher efficiency in the production of heat and electricity also contributes to the lower growth in gross energy consumption. Hence the political target for gross energy consumption in 2011 and 2020 seems to be within reach if the effectiveness of the policies applied to continues.

The EA evaluation concludes however that the target for final energy consumption for 2013 not will be reached with the current portfolio except in case of economic recession and high energy prices.

Also several assumptions in the DEA projections from 2008 seem to be too optimistic. This includes the long life times of savings as well as a high degree of market transformation (permanent impact of activities). The additional effects of the individual policies, especially the energy labelling of buildings and the activities of the energy companies, are lower than the targets in 2005 agreements. In Table 6, a comparison of the targets of savings of 7.5 PJ a year, as defined as part of the 2005 agreement, and the estimated additional achievements according to the EA evaluation is presented. The figures show the gap between targets and additional achievements is more than 2.2 PJ.

Although projections of energy consumption involve a degree of uncertainty in the underlying data as well as their mu-

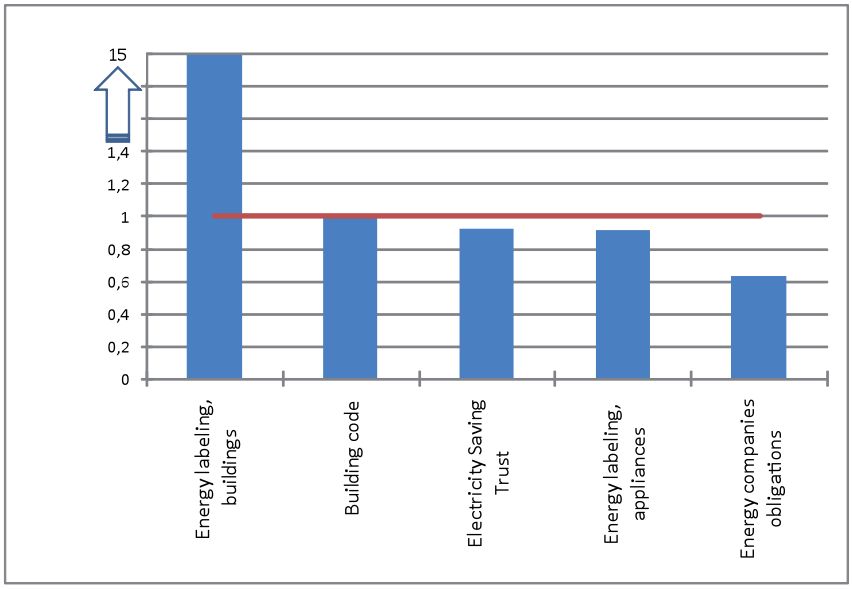

Figure 4. Estimated socio-economic cost of the key policies. A value of less than 1 indicates that the total cost of energy efficiency is lower than the cost of supplying energy.

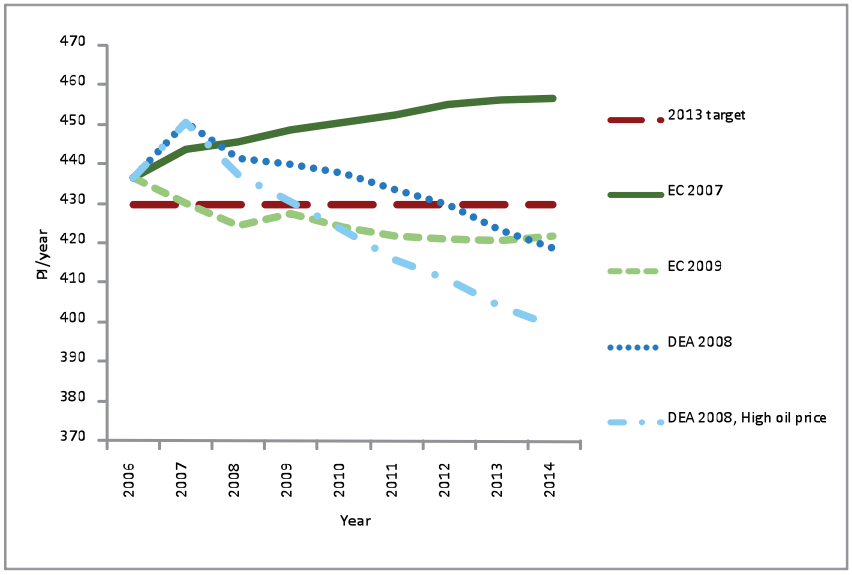

Figure 5. Five prognoses for the development of the end-use energy consumption. Projections begin in year of publication. Due to slight differences in calculations and data included, e.g. DEA includes energy products for non-energy purposes, the calculations made by EC have been inflated by 1% (difference in 2005) for better comparison.

tual influences, the EA evaluation indicates that the political targets might not be reached with the current policies in a long-term growth economy with concurrent demand for energy and subsequent higher energy prices. This is especially the case with final energy consumption.

Recommendations of the EA evaluation

The overall recommendation of the EA evaluation is to increase the total activity level to promote energy efficiency. This can be done by creating a 10 years program for energy efficiency activities with extra funding. This would allow better impact and coordination of the policy portfolio. More resources would together with a program signal a political commitment to greater achievements. The program should encompass all end-use segments including the transport sector since in a low CO_2 emission society transport considerations will be increasingly integrated with the other aspects of energy supply optimisation and operation.

At present it is only the activities of the energy companies (besides taxes and ETS) that address the consumption in the business segment. Achieving energy efficiency in this segment should be given higher priority and their energy tax increased for the sake of energy supply security. The energy tax structure proposed by the EA evaluation can be seen in Figure 6.

Contents Keywords Authors

Table 6. Comparison of annual targets and achievements for the period 2006-2008.

First years savings (PJ)	2005 agreement targets	Additional achievements	Comment
Energy companies	2.95	1.50	With 50% additionality
Electricity savings trust	0.60	0.30	Estimate assuming 50% additionality
Labelling of buildings	0.50	0.02	With low realisation of recommendations and 50% additionality
Other activities	3.45	<3.45	-
Total	**7.50**	**<5.27**	**-**

In order to steer the activities in the desired direction, the current obligation of the energy companies to provide offers to all consumer segments and prioritise heating savings should be removed and replaced by a so-called **priority factor**. Such a priority factor could be used to steer the activities in the socio-economically optimal direction and would probably be easier to alter at regular intervals as opposed to detailed regulations. The idea is that the priority factor could increase the efficiency of the activities, while maintaining the simple administration of the system.

The impact of the building labelling scheme might be increased by use of supporting measures such as financial support and package solutions / standard offers. Here it is important to remember that the EA evaluation showed that the craftsmen and product suppliers are key to success. The total costs of the building labelling scheme could be reduced, e.g. by a mixture of prioritising certain building types, introducing different degrees of labelling, and accepting that an independent consultant does not have to be present in all cases.

All information activities targeted at behaviour and market changes should be managed by the 10 year program in order to create synergy and simplicity and to separate business PR activities from energy saving activities. At present information activities can count towards the savings obligation targets of the energy companies and a grey zone exists between such information activities and pure PR activities.

The building codes should be revised concerning the provisions regarding onsite energy production. A solution could be to limit the requirement to demanding that all new building should be *prepared* for onsite production. Solar heating may not be the best supply if e.g. biomass based district heating is available close by.

The concept of A-G labelling of appliances has been successfully communicated to the consumers. Energy labelling and minimum standard schemes must be dynamic in order to continue to reflect the market changes and at the same time avoid confusion among the consumers. A clearer distinction between energy efficient and non-energy efficient products (combined with using the full scale A-G) could help push the markets further. Failure to introduce sound dynamic labelling scales at EU level will most likely result in competing labelling schemes being introduced by stakeholders who wish to truly promote energy efficiency.

Many of the obligatory measures are not enforced by the authorities. This is not consistent with sound public management and leads to frustration among those who adhere to the regulations.

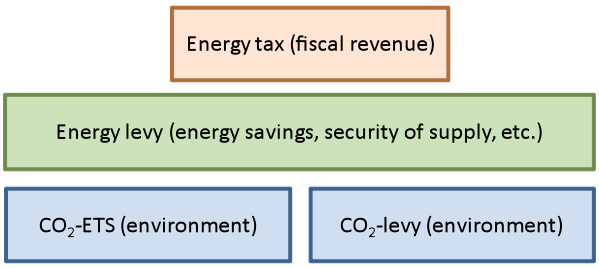

Figure 6. Suggested structure of an energy tax reform. The energy tax could be paid by households, while the other two layers of taxes should be paid by all energy users.

All in all – in spite of continuous data collection – the data concerning impact and costs is very limited or of limited quality and must be improved. The ongoing data collection could be improved through sampling and annual mini evaluations. A central unit could be charged with this task or the task to ensure a suitable quality.

Current policy practice – issues and possibilities

APPLICATION OF EVALUATION RESULTS AND RECOMMENDATIONS

The governing parties initiated energy efficiency policy discussions mid January 2009 based on the results and recommendations of the EA evaluation and the issues raised in the evaluation are thus currently being debated.

The overall timing of the evaluation may prove very good indeed. Various circumstances such as the high oil prices in 2008, the recent natural gas supply dispute between Russia and Ukraine, the economic crisis, and the fact that Denmark will be hosting the UN Climate Change Conference in December 2009 may contribute to creating sufficient political momentum to allow significant changes to the current Danish energy efficiency policy portfolio.

The EA evaluation recommends higher taxes on energy used in industry, but did not recommend to increase taxes for e.g. households. The EA evaluation was published in December 2008, and followed by a report from a tax commission in February 2009. The tax commission refers to the EA evaluation and recommends increasing energy taxes to reflect the political concerns for the security of energy supply. In March 2009 a tax reform was decided. This included reduction of income taxes and a broad increase of energy taxes for all energy users. Taxes for industry will increase in the order of 15%, and also taxes for households will increase. A compensation system will secure the social profile of the new taxes.

There has been an intensive debate about the evaluation and how to develop the Danish energy efficiency activities. The political debate is ongoing (March 2009) and decisions are expected before summer 2009.

POLICY EVALUATION AS INTEGRAL PART OF POLICY-MAKING

Evaluation of policies is in itself part of policy-making. Not only the evaluation results but also the evaluation process itself influences the acceptability of the ensuing policy changes and the adherence to these. The DEA chose an independent evaluator and commissioned an evaluation design of high level reliability. The steering group for the evaluation was composed of two DEA representatives but also three independent researchers – each of them experts within their own field of expertise (evaluation theory, economics, and energy systems). This provided the evaluation team the possibility of independent professional sparring and ensured a high quality evaluation with robust results.

During the evaluation process, stakeholders were at regular intervals informed about evaluation progress through meetings and a newsletter. The evaluation period was very short (net 6 months) but the brevity had the positive side-effect that the evaluator had to focus on essence rather than detail. It was only possible to carry out the EA evaluation within such a short period due to stakeholder willingness to cooperate and through careful evaluation design. Parallel to the EA evaluation other evaluations were also being carried out as preparation for the 2009 policy negotiations including more detailed investigations of individual policies (e.g. the building regulations) which provided valuable input for the EA evaluation and vice versa.

The open dialogue about the EA evaluation while in progress and the intended use of the results is considered important to a successful outcome.

QUALITY OF CURRENT EVALUATION PRACTISE

The various Danish stakeholders have accepted the idea of evaluation as a tool for learning and improvement and widely conduct own evaluations in order to assess progress, impact and design of their energy efficiency activities. An evaluation guidebook was developed (SRC International et al., 2002) in order to develop a common language and understanding for evaluations so as to improve not only the evaluations but also the commissioning of evaluations. The handbook is for example used as reference for all the energy efficiency evaluations commissioned by the DEA. As part of the EA evaluation work earlier evaluations were assessed to see whether earlier findings and data could be useful to the EA evaluation.

The EA evaluation found that although evaluations are widely used among the Danish stakeholders, there is room for improvement in the quality of the evaluations. In some cases only a slight extra effort could make the results more robust concerning energy saving impact and costs. The EA evaluation therefore recommended that this should be dealt with. A possibility could be to create a facility whereby the impact evaluations of publically financed energy efficiency activities are offered an independent expert review of the design before they are carried out.

STAKEHOLDER INVOLVEMENT – ROLES AND TASKS IN POLICY FORMULATION AND IMPLEMENTATION

The Danish energy efficiency policy is shaped through a continuous dialogue between the government and various stakeholders. In addition to ad hoc consultation and public hearing processes, the government has also sought to create organisational fora that facilitate a more structured involvement of the stakeholders.

Organised stakeholder involvement in policy formulation and implementation requires a clear definition of roles and tasks in order to realise the intended benefits but also requires preparedness from the stakeholders to engage actively. Two recent attempts from the government to engage stakeholders in coordination of energy efficiency activities had a poor outcome.

In 2000, local energy saving committees were created and given as task to discuss initiatives to further energy savings in the local areas and to coordinate the local activities between the local energy companies and between these and the local authorities and Agenda 21 work. However, while the energy companies were obliged to participate in the running of the committees, the other parties were only obliged to keep themselves informed about the work. The uneven role distribution combined with only a modest interest from the local authorities and an increased competition between the energy companies resulted in poor attendance and no significant achievements except for a few exceptional cases.

A coordination committee was formed as part of the most recent changes in the energy efficiency policies in 2005. The task of the committee is to ensure a better common prioritisation and increased cooperation between all stakeholders and to ensure a greater focus on savings within heating. The committee includes representatives of the activity implementing organisations, a number of consumer groups, the engineering society, and associations within building construction and heating systems. The committee has provided advice to the Climate and Energy Ministry in a number of cases but has not actually coordinated any activities yet; in spite of a great need for coordination of for example the information activities of the energy companies and the Danish Electricity Saving Trust.

When talking about stakeholder involvement it is often implied that the initiative is taken by for example the national energy authorities, however, we are seeing a trend towards stakeholders themselves setting the agenda. In Denmark, island communities, local authorities, and larger cities are increasingly setting their own ambitious targets for energy system development (often related to sustainability issues combined with a wish for local socio-economic development and visibility) and thus setting the agenda for the public debate and national policy making. This push for action can be a plus if the national government can harness this drive to the benefit of the entire country but also puts pressure on the government to react to these initiatives and assess the impact on the combined national achievements and development.

A wider perspective

Given the declared intention of the Danish government to further a market based energy system, it is our view that one of the main challenges for Denmark (as well as for all of Europe) is to

Contents Keywords Authors

create a so-called **intelligent price driven energy system** – an energy system with clear price signals on both demand- and supply-side that reflects the current short-term and long-term political priorities and at the same time exploits the technological possibilities for reacting to these price signals.

Another key challenge is **true integration of the transport sector** in the energy system without which cost-effective opportunities for optimisation and large scale renewable energy exploitation can be lost. Bio fuels will probably not be able to cost-effectively transform the transport sector to extent necessary to ensure sustainability – nor quickly enough.

The transport sector is finally after many years of exclusion now an integral part of the energy efficiency debate, partly due to its high reliance on fossil fuels and partly due to the fact that integration with the electricity system now is a real possibility. A strong argument for increased efforts within the transport sector is that the necessary price signalling system is already in place and what is needed is "merely" an adjustment of the levels.

Integration and coordination are the crucial features for achieving cost-effective future energy systems.

And just a brief comment about what is currently counted as energy efficiency improvement measures: In the ESD directive as well as the Danish legislation individual "**domestic generation of renewable energy sources**, whereby the amount of purchased energy is reduced (e.g. solar thermal applications, domestic hot water, solar-assisted space heating and cooling)" (quote from Annex III, ESD 114/77) are considered energy efficiency improvement measures that can be counted towards the Member State energy saving targets. However, there is a real danger that such measures may be damaging in a system perspective (holistic socio-economic perspective). For example, while individual generation might make socio-economic sense in a sparsely populated area with individual oil based heating systems, it might be much too costly in an area with low cost district heating e.g. in a densely populated area.

The **broad overall programme** proposed in the EA evaluation report for coordination of the Danish end-use energy efficiency policies/activities will provide the framework for synergies and consideration of long-term perspectives independent of which stakeholders are currently the actual implementers of the policies. Within such a programme the efforts can be organised in a manner to bring market forces and mutual competition best in to play.

International cooperation will continue to be an important aspect of the Danish energy policy. Firstly, we must respond to occurring changes in the international markets whether energy prices or technologies; international goods markets require international policy cooperation. International agreements on for example increased energy savings targets will require adaptation of the Danish policies and their implementation. Secondly, we can as a nation choose to take on a frontrunner role and pro-actively work to influence and shape the development of the markets. An example could be to make an EU-wide technology procurement call – possibly together with a couple of other interested nations – cost-effective standard packages for energy renovation package of single family houses.

On February 17th, 2009 Members of the European Parliament backed European Commission proposals to extend the scope of the EU's Eco-design Directive to include all products with an impact on energy use, such as windows, insulation materials, and water-using devices. Currently, only devices that directly use energy are part of the scheme. It was consequently requested that the Commission come up with a proposal by 2012, extending the scope to "non-energy-related products" with "significant potential for reducing their environmental impacts throughout their whole life-cycle" (EurActiv article 179566).

Although several Member States (such as Denmark, Finland, Netherlands, Sweden, and the United Kingdom) have attempted to establish energy labelling systems for windows (not just window glass) still no consumer friendly clear energy labelling of the total energy characteristics of windows exists.

Several Member States have established significant subsidy schemes for energy efficient renovation of the existing building stock. Some have an extra incentive to do so given that the quality of the building stock is poor not only from an energy perspective e.g. Austria and United Kingdom.

Early March, 2009, the Danish parliament/government presented a tax reform. One element of the reform is that a subsidy fund consisting of a total of approximately 200 million Euro will be established for renovation of the existing housing stock. The details concerning the subsidisation criteria are still to be determined but subsidies will be given only in 2009. Initially, it was the intention that the subsidy be earmarked for *energy* renovations but the final decision was to leave out this requirement. This could in our opinion result in a grave loss of opportunities for energy efficiency improvements.

One of the findings in the EA evaluation was that in Denmark the impact as well as the cost-effectiveness of the energy labelling of buildings have so far been very poor. This could prove to be the case for other EU Member States as well. Prioritised targeting and "light" versions of the energy labelling could possibly improve the situation somewhat. Priority could for example be given to public buildings or certain types of buildings that allow a standardised renovation approach. The new subsidy will possibly help to increase the impact of energy labelling but not necessarily the cost-effectiveness.

Important agents in the renovation process are the companies providing the various renovation services. The EA evaluation showed that they are key influencers in the decision making process. It is therefore critical for success that these companies become better equipped to advocate energy efficient solutions.

Energy efficiency and energy savings concerns are not a passing/temporary political trend but more and more so a question of security of supply as well as economic stability and development – nationally and EU wide. Solutions such as carbon capture and storage will not address the issue of security of supply. Furthermore, the need for expedience calls for vigorous action and cannot be solved alone by exploitation of renewable resources and market adaptation of new technologies currently being researched but must to a high extent rely on the ability our apply a holistic approach to the energy situation and as such reductions in the demand for energy.

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