

A Danish Case: Portfolio Evaluation and Its Impact on Energy Efficiency Policy

*Mikael Togeby and Kirsten Dyhr-Mikkelsen, Ea Energy Analyses, Denmark
Anders Larsen, Roskilde University and Ea Energy Analyses
Peter Bach, Danish Energy Authority*

Abstract

A political agreement from 2005 states that an assessment of the entire Danish energy efficiency policy portfolio must be carried out before end 2008 with the aim to ensure that the measures and the organisation of the effort is efficient compared to the agreed goals. The evaluation aimed to answer:

- Is the overall design of the portfolio of instruments appropriate?
- Does the impact of the instruments justify the costs, so that the national goals is reached 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 mainly using cost effectiveness as criteria. The evaluation was completed in December 2008, and this paper presents the main findings and the impact on Danish policy.

An important lesson learned is the importance of including all energy efficiency policies in the evaluation. The portfolio perspective gave way to findings that would not otherwise have been captured. With its broad perspective the evaluation could document that the commercial and industrial sectors were prioritised much lower than the household and public sectors. New taxes for the commercial and industrial sectors and a reform changing the Electricity Saving Trust to a Centre for Energy Savings (working with all energy savings within all sectors, except transport) has been important step in a more cost-effective direction.

Introduction

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. It was the first time that an evaluation of the entire portfolio was carried out.

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.

In Denmark, a total of approximately 86 M€ was spent in 2007 on measures to promote energy efficiency – in round figures 40 M€ for the activities of the energy companies (paid by all end-users), 32 M€ for energy labelling of buildings (paid by those acquiring the label), and 14 M€ for the Danish Electricity Saving Trust (collected by a special tariff on electricity for households and the public sector).

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, maintaining a high security of supply, and alleviating global environmental problems, including not least climate changes. The 2005 agreement also states that the energy efficiency activities shall be expanded to secure specific and documented saving of 7.5 PJ (1.7% 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% 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 in 2005 issued with an obligation to save 2.95 PJ per year (first year's saving) and in return given freedom in choice of activities. The level of documentation required for the reported energy savings was reduced compared to the old system. Savings were as of 2006 to be reported every half to the DEA year in a simplified format by energy carrier (5 categories), customer segment (3 segments), method of calculation (3 methods), and annually also by end-use (8 categories). The cost of the activities was no longer to be reported to the DEA. The obligation target has since then been increased to 5.4 PJ/year as of 2010.

Ea evaluation

The agreement of 2005 states that an assessment 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. The steering group for the evaluation was composed of three independent researchers – each of them experts within their own field of expertise (evaluation theory, economics, and energy systems) and two Danish Energy Agency (DEA) representatives. This provided the evaluation team with the possibility of independent professional sparring and ensured a high quality evaluation with robust results. The steering group selected an independent evaluator and commissioned an evaluation design of high level reliability.

A consortium comprising Ea Energy Analyses, Niras, the Department of Society and Globalisation (Roskilde University) and 4-Fact was assigned with the evaluation task. The task was carried out 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 portfolio. The agreement of 2005 requires 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 provided. The term “additional” means the energy efficiency improvement that can be directly attributed to a given policy instrument, e.g. an energy audit performed by an energy company.

There are ten major energy efficiency policies, also referred to as activities, see table 1. The table shows that the Danish policy portfolio focuses on the residential and the public sectors. Thus even this simple table raises the question if there perhaps has been too much focus on these sectors in the Danish portfolio.

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

	Energy efficiency activities	Distribution of the annual target in the 2005 agreement	Residential sector	Public sector	Private business sector	Energy intensive industry
1	EU CO ₂ emissions trading scheme	n.a.	X	X	X	XX
2	Energy taxes	n.a.	XX	XX	X	
3	Energy efficiency 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	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.

Evaluation design

The Ea evaluation was to encompass all Danish energy efficiency policies. The evaluation team found the short time frame (7 months) the most challenging part, when designing the evaluation approach. The evaluation was composed of the following work packages:

1. Description of the ten energy efficiency activities, including review of existing reporting, documentations and evaluations.
2. A qualitative comparative study of energy efficiency policies in Denmark, Sweden, Norway, Finland, Austria, Spain and Italy.
3. A quantitative comparative study of trends in energy consumption in Denmark, Sweden, Norway, Finland, Netherlands, Austria, Spain and Italy. The data from EU-data base ODYSEE was used.
4. Evaluation of each activity, with original empirical data collection for selected activities. All ten activities were covered, but special focus was given to the obligation for energy companies and the building labelling scheme.
 - For the energy companies several surveys were conducted to find the energy companies cost used for the activities, to establish a data base about the largest realised projects and a phone survey to describe to end-user perspective for these concrete projects (including total cost and the additionality of the project and over-all satisfaction with the interaction with the energy company).
 - For the labelling of buildings a phone survey was conducted in relation to large buildings and for the single family building a review of new research were done (Kjærbye, 2008).
5. A bottom-up analysis of end-user perspectives on energy efficiency for four selected end-user groups: Owners of old single family houses, owners of houses with electric heating, energy responsible within the public sector and energy responsible at energy intensive industry. Interviews focused on the end-users activities and not on the specific policy instrument in question. This was realised by phone survey with the main idea of describing a realistic picture on energy efficiency – with a starting point independent of the individual policy instruments. The four groups was selected because they could be expected to be more than average interested in energy efficiency.
6. Critical review of the fulfilment of the 2013 goals, primarily based on available documents from DEA and from Danish Economic Councils.
7. Overall analysis and conclusion.

The work packages were designed so that that could be realised in parallel. The strength of the evaluation design was that it was robust and with high probability could be expected to deliver an updated, detailed and realistic description of the energy efficiency activities. Several aspects of triangulation were incorporated in the design:

- The energy efficiency activities were analysed both with the starting point in the activities and with starting point in the end-users. With the first starting point there is a high risk of over-estimating the importance of the activity in focus.
- By including two work packets with an international perspective it was – in the same way – secured a balanced view on the importance of national activities.
- Finally, the design included both bottom-up (WP 4 and 5) and top-down approaches (WP3 and 6).

On the other side, the limits set up for the evaluation did not make it realistic to include time consuming tasks that with a high quality could document issues like additionality combined and across activities and long term impact of the activities. It was also recognised that the phone survey was quick to realise but may not in all cases be highly reliable. However, the surveys were carefully designed with very concrete questions, and questions were only asked in relation to cases (e.g. projects) experienced by the interviewed person.

During the evaluation process, stakeholders were at regular intervals informed about evaluation progress through meetings and a short newsletter. This was used both to collect new information and to pave the way for a broad acceptance of the conclusions of the evaluation.

Evaluation results

Energy taxes and CO₂ quotas. Energy taxes have been used for all sectors. In 1977 an energy tax was introduced for households and in 1996 a CO₂ tax was introduced to all sectors. Today households and the public sector pay electricity taxes corresponding to 0.09 €/kWh plus 25% VAT. A typical tax for electricity in trade and industry is 0.013 €/kWh. Taxes are used for all fossil fuels. Without the energy taxes the Danish energy consumption would be at least 10% higher (Økonomi- og Erhvervsministeriets model EMMA, 2008). The actual tax paid varies highly from sector to sector and from end-use to end-use (see figure 1). The highest tax is paid for electricity used by households and in the public sector. Also energy used for heating has a high tax in all sectors. Energy intensive companies pay the lowest tax. Total revenue from energy taxes is 5 billion €, of which half derives from the transport sector.

As of 2008 the European Union Greenhouse Gas Emission Trading Scheme (ETS) – has added another cost element. CO₂ quotas are required for most installations with a capacity above 20 MW. These include the energy sector (generation of electricity and district heating) as well as industrial installations. For the end-users ETS acts as a European wide energy tax. The current price of CO₂ quotas is 13 €/ton CO₂ (March 2010, ftp.nordpool.com) and has typically increased electricity price with 0.01€/kWh for all users. The price of CO₂ quotas was 30 €/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.

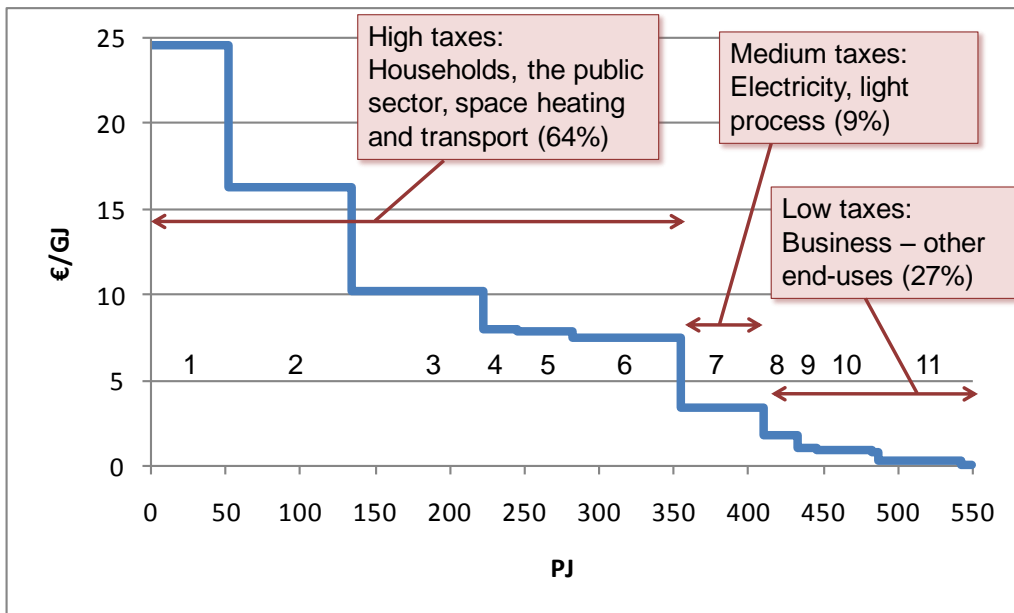


Figure 1. Energy taxes paid in Denmark. The x-axis is defined as the tax-basis, which is fuel, except for electricity, where the tax basis is electricity. Detailed rules are applied to combined heat and power generation, so taxes are paid for the part of the energy consumption used for heat generation. 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-quotas 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).

Energy efficiency obligation of the energy utilities. Since 2006 the grid companies for electricity, natural gas, and district heating have been obliged to realise energy savings. The new obligation constitutes a development based on years of utility driven energy efficiency activities. The Danish electricity utilities have been working actively with energy efficiency since 1990. The commercial oil companies entered the system on voluntary basis.

The actual activities may take many forms. Often energy audits, targeted information, subsidy or a combination of these are used.

The overall distribution of the realised saving among sectors is similar to the energy consumption. 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.

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 is compared with the obligation.

Utility	Savings by energy type				Total (% of obligation)
	Electricity	Natural gas	District heating	Oil	
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	1,090 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%

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 Agency. The survey resulted in a database

with 270 realised energy efficiency projects. The calculated saving based on these ex-ante engineering estimates corresponds to 401 GWh, or 49% of the yearly obligations for all energy companies.

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

Table 3 shows how the utilities were involved in the projects. Economic analysis included documentation of the expected saving for a project.

Table 3. 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%

The rules requiring active involvement by the utility do not require that the energy saving must be additional. In order to assess the additionality the Ea evaluation team asked a number of consumers 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 the resulting answers should be considered with care. However, more accurate evaluation design could not fit the time and the budget of the evaluation. An earlier evaluation of the additional impact of electricity audits based on statistical methods (Larsen et al, 2006) did not establish any effect of the audits, but problems with data quality hindered a clear result.

Although the method chosen in the Ea evaluation is associated with some uncertainty, the results seem to indicate that about half of the recorded saving would not have been realised without the intervention of the energy utility.

Results also indicate that the projects are economically attractive from both the customer perspective and the energy company perspective.

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

The Danish 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) and 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 € 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 m² must be labelled every 5 years (as of 2009 – lowered to 1,000 m²). 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 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 Ea evaluation also found that the impact is at best limited.

The labelling is obligatory but the law is not enforced and without specification of possible sanctions. As of 2009 all the labels including the recommendations are gradually being made public

available. This 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 an (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 hampers 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. They list energy efficient products, current retailers, and the cheapest product prices so that the individual consumer can find a suitable and low priced product with a few clicks of the mouse. The EST has, as an independent institution, been actively influencing both the demand and the manufacturing and retail side of the appliance markets and uses the public media very actively to pursue 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 €/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 convert to district heating or natural gas heating, would have stayed with electric heating for the next 20 years. If 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%.

The Ea evaluation found that the EST information activities are valuable, but there no longer exists a reason for limiting the efforts to the electricity use in household and public sectors, 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.

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 m2, 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 a refund in their CO₂ 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 CO₂ 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 M€/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 had an impact, too little data was accessible to judge the kWh impact and cost-effectiveness – the exception being the support provided by three large NGOs.

Will energy policy targets be reached?

The political agreements from 2005 and 2008 have future targets for final and gross energy consumption. Final consumption (excl. 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 2% and 4%, respectively, of the consumption in 2006)

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

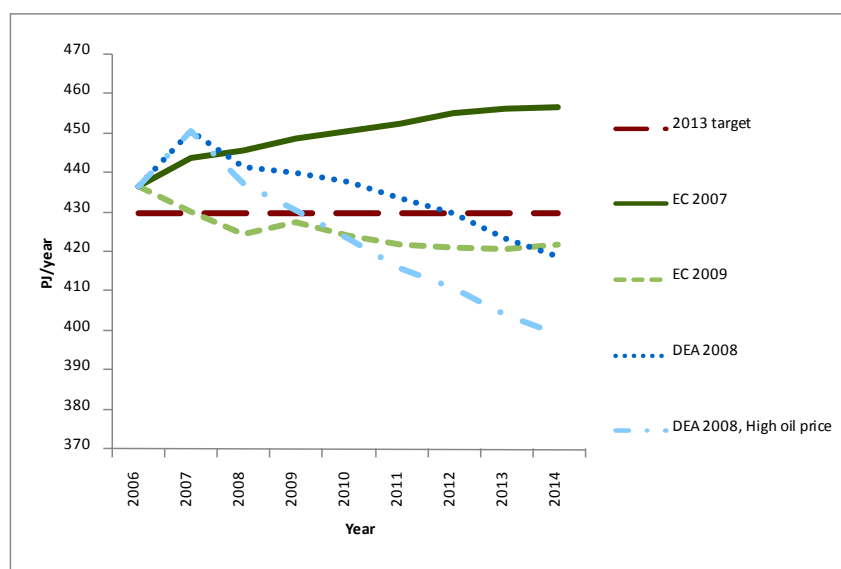


Figure 2. Five prognoses for the development of the end-use energy consumption. Projections begin in year of publication. Due to slight differences in calculations and data included, e.g. DEA includes energy products for non-energy purposes, the calculations made by EC have been inflated by 1% (difference in 2005) for better comparison. Please, also note, that new prognoses are made continuously and that those presented here are not the most recent.

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 policy portfolio except in case of economic recession and high energy prices.

Although projections of energy consumption involve a degree of uncertainty in the underlying data as well as their mutual 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 was 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 CO₂ emission society transport considerations will be increasingly integrated with the other aspects of energy supply optimisation and operation.

At the time of the Ea evaluation it was only the activities of the energy companies (besides taxes and ETS) that addressed 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 3.

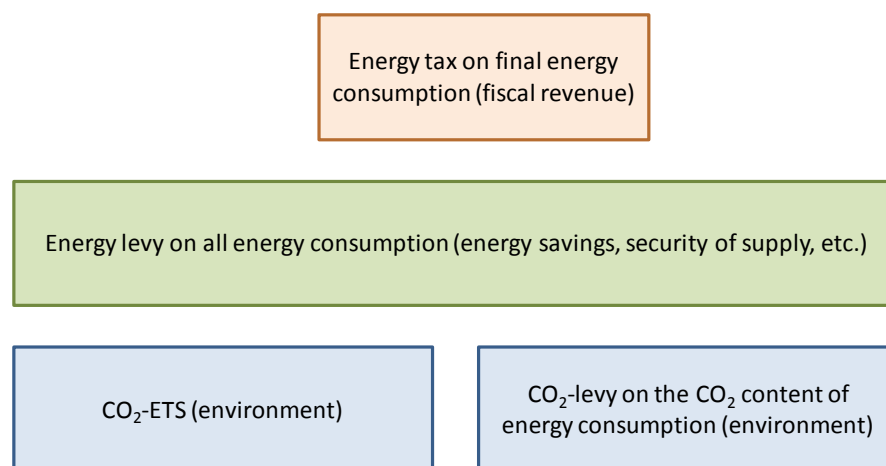


Figure 3. Suggested structure of an energy tax reform. The energy tax could be paid by households, while the other two layers of taxes should be paid by all energy users.

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 was recommended 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 the key to success. The Ea

evaluation suggested that 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, according to the recommendation, 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 Ea evaluation recommended that building codes 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 Danish 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 according to the Ea evaluation. 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 were not enforced by the authorities. This is not consistent with sound public management and leads to frustration among those who adhere to the regulations.

In conclusion, in spite of continuous data collection – the data concerning impact and costs was 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.

Impact of the evaluation recommendations

The recommendations from the evaluation and the status is summarised in table 4. The overall impression is that the Ea evaluation has had a considerable impact on the further development of the energy efficiency policy. However, although it seems fair to say that the evaluation has played its part in creating the possibilities for the listed changes, a critical factor was that the political environment was ready for changes and therefore more receptive to suggestions.

It can be interesting to reflect on the link between choice of evaluation design and results. Evaluations may be well designed and of high statistical quality, but may oversee the most important issues. One of the observations made in the Ea evaluation was that the Danish energy efficiency portfolio as a whole at the time of the evaluation was overly focused on households and the public sector and in particular their electricity consumption. Another observation was that there was an overlap of responsibilities for information campaigns. These observations were only possible due to the fact that Ea evaluation reviewed the entire policy portfolio. Many other evaluations of the EST, the energy labelling for houses and other single activity evaluations have failed to see this. Only the holistic approach of the Ea evaluation revealed these issues. One of the resulting recommendations was to establish a ten-year programme of energy efficiency covering all sectors and end-uses and to exclude campaigns from the activities that utilities may count towards meeting their savings obligations.

It can be highly recommended that portfolio type evaluations are included in a country's evaluation activities. Such portfolio evaluations may be designed as expert reviews, like the IEA country review. In the Ea evaluation the evaluation team added taxes and CO₂ quota system to the evaluation. The initial tender did not include these elements. This extension is considered as very important, because the economic signals from these two elements probably is among the most important Danish energy

efficiency policy instruments – and because the portfolio became complete by including them in the scope of the evaluation.

The Ea evaluation proved that a large portfolio of policies can be evaluated using a focused evaluation design and still provide valuable feedback to policy makers.

The quality of this evaluation mainly lies in the use of the evaluation as presented in table 4. Furthermore, that the entire energy efficiency portfolio was the object of the evaluation. But these qualities come at a cost, especially given the tight time and resource constraint, and topics such as economic assessment and impact relative to the counterfactual development were treated only to a limited extent. The evaluation instead made the most of existing earlier evaluations.

Table 4. Summary of recommendation and the status.

Recommendation (December 2008)	Status (February 2010)
Establish a ten-year programme for energy efficiency covering all sectors and all energy types. Increase energy efficiency activities targeted the business sector.	Law 1516 of December 27, 2009: A new Centre for Energy Efficiency is created to promote energy efficiency through information, campaigns, and marked support for all sectors and all energy types. Transport is not covered. The Danish Electricity Saving Trust is replaced by the centre. Budget for the new centre will be the same as for the Trust, disregarding that the target is much wider.
Increase taxes for business. The tax level should reflect the policy targets concerning security of supply, renewable energy, and other environmental concerns than CO ₂ . The recommendation is also reflected in tax commission from February 2009.	Law 527 of June 06, 2009: Energy taxes are increased with 5-15% and a new tax is introduced for business (from 2013). Total revenue is 2 M€/year and this is recycled in terms of reduced tax on income. Taxes were also increased in households and public sector.
Introduce a simple priority factor in relation to energy companies' obligation.	November 20, 2009 an agreement is entered between the Ministry of Climate and Energy and the energy companies. The agreement includes a simple priority factor with the values 0.5, 1, and 1.5. The low value is for projects with a life time below 4 years, and the high value is for projects with life time over 15 years, outside the CO ₂ quota sector.
Reduce the costs in relation to labelling of building. Prioritise buildings with high specific consumption.	Several changes has focused on improving the utilisation of the label, e.g. by making the information public and requiring that the label must be a part of the advertisement of properties. However, no changes that will reduce the cost of labelling or to prioritise building have been decided yet, but work is ongoing to make the labelling more efficient. The government has suggested a change of the law to make it mandatory to display the label in all advertising of buildings for sale.
Develop activities targeted existing buildings. This could include subsidy, standard solutions and other elements that can reduce the cost of renovating buildings.	A new centre to support installers with knowledge concerning energy saving can be seen as a step in this direction. The centre was decided before the evaluation. No further steps have been taken.
Campaigns should not be part of the energy companies obligations	Campaigns are excluded the from the energy companies activities (agreement, November 20, 2009)
Change the rules in relation the building codes that motivate use of solar heating or photovoltaic independent of the cost of the alternative supply	The government has decided to set special requirements for new buildings connected to district heating from 2015
If requirements in relation to energy labelling of buildings are maintained, these should be enforced. The combination of legal requirements and no sanctions should not be part of public administration. Only half of the required labels in connection with the sale of single family houses have been delivered.	No change.
Improve practise in relation to documentation and evaluation for all activities	It is included in the new law of December 27, 2009 that the government shall have more focus documentation og evaluation. They shall once a year present a report with calculations of effect, etc.
Make labelling and minimum efficiencies more dynamic	EU is working with new definition of the appliance labels.
Improve coordination between activities.	Two existing coordination forums are ended (Coordination committee for energy efficiency and Local energy saving committee) and coordination is handed to the new Centre for Energy Efficiency and a new Advising committee for Energy Efficiency. (Law of December 27, 2009)

References

Aggerholm, S. (2008): *Energy frames for the buildings of the future – Theme day on reduction of the energy consumption in buildings* (Energirammer for fremtidens bygninger. Temadag om reduktion af energiforbruget i bygninger) Statens Byggeforskningsinstitut (SBI).

CATINÉT Research (2008): *Evaluation of the projects of the energy saving fund 2005-2007* (Energisparepuljens projekter fra 2005-2007. Samlet evaluering).

Consultation document (2008): *Consultation document on the revision of the Energy Labelling Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances*. Working Document presented by the Directorate General for Energy and Transport, European Commission.

Ea Energianalyse, Niras, RUC and 4-Fact (2008): *A way to higher energy efficiency. Evaluation of all Danish energy efficiency activities* (En vej til flere og billigere energibesparelser. Evaluering af samtlige danske energispareaktiviteter)

ESD (2006): *Directive 2006/32/EC of the European Parliament and the Council of 5 April 2006 on energy end-use efficiency and energy services*.

Kjærbye, V. H. (2008): *Does Energy Labelling on Residential Housing Result in Energy Savings?* Anvendt Kommunal Forskning (AKF).

Larsen, A., S. Leth-Petersen, V. H. Kjærbye and O. Rieper (2006): *The Effect of Energy Audits in Danish Industry - Evaluation of a DSM Programme*, Energy Studies Review Vol. 14, No. 2.

Ministry of Climate and Energy (2009): *Agreement about the future energy efficiency activities*. (Aftale af 20. november 2009 mellem klima- og energiministeren og net- og distributionsselskaberne inden for el, naturgas, fjernvarme og olie repræsenteret ved Dansk Energi, Dansk Fjernvarme, Foreningen Danske Kraftvarmeværker, HNG/Naturgas Midt-Nord, DONG Energy, Naturgas Fyn samt Energi- og Olieforum om selskabernes fremtidige energispareindsats.)

Ministry of Transport and Energy (2006): *Agreement of August 22, 2006 between the Transport and Energy Minister and the network and distribution companies within electricity, natural gas, and oil*. (Aftale af 22. august 2006 mellem transport- og energiministeren og net- og distributionsselskaberne inden for el, naturgas og olie repræsenteret ved Dansk Energi Net, HNG og Naturgas Midt-Nord, DONG, Naturgas Fyn og Oliebranchens Fællesrepræsentation om selskabernes fremtidige energispareindsats).

[Nord Pool] Nord Pool carbon market, www.nordpool.com

SRC International, AKF and Elkraft System (2002): *Handbook in evaluation of energy savings activities* (Håndbog i evaluering af energispareaktiviteter).

Togebjerg, M., K. Dyhr-Mikkelsen and E. James-Smith (2007): *Design of White Certificates. Comparing UK, Italy, France, and Denmark*. Ea Energy Analyses.

Økonomi- og Erhvervsministeriet (2008): *Growth, climate, and competitiveness* (Vækst, klima og konkurrenceevne).