[DENMARK] Energy Companies' Energy-Saving Efforts

Energiselskabers Energispareindsats

About the measure

Policy instrument	Sector	Starting date and status
Energy Efficiency Obligation scheme	**General (cross-cutting)**	**[2006] – [on-going]**

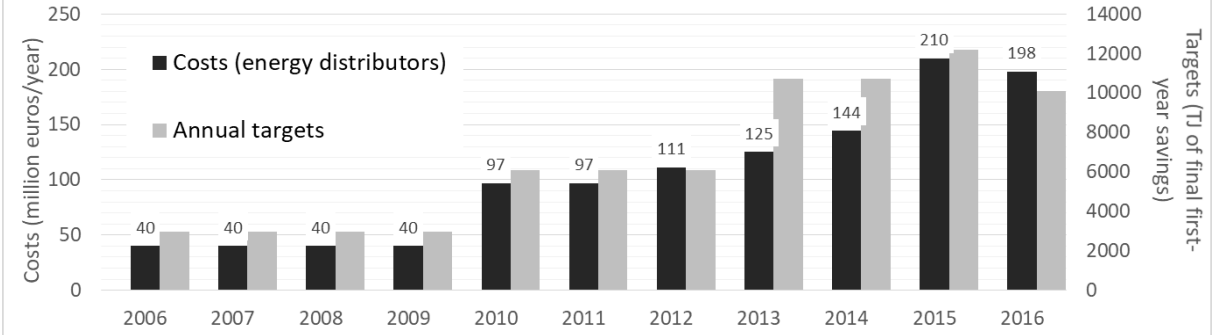
The objective of the scheme is to **promote cost-effective energy savings** that would otherwise not have been realized. It is implemented through an **agreement between the Danish Energy Agency (DEA) and the energy distributors** (electricity, natural gas, district heating and heating oil). Energy distributors are required to achieve **yearly energy savings targets**, and must report each year their achievements to DEA that supervises **random controls**.

Energy distributors may provide advice and information about energy savings, implement energy savings projects on their own grid system, establish agreements with contractors that will implement programmes towards end-users, or provide subsidies to end-users through direct contract.

Actions saving final energy can be done in **all sectors** (+ from 2013, actions on transmission and distribution networks, and solar farms for district heating). Eligibility criteria include **minimum energy performance requirements** and **rules about additionality** (e.g., CFLs and household appliances were excluded from 2010).

Expected energy savings in 2020	Benchmark
83.9 PJ/year (23.3 TWh/year) in 2020 from actions over 2014-2020 (cumulated annual final energy savings) (source: NEEAP 2014)	100% of the target for EED article 7 annual target for 2016 = 2.6% of Danish 2014 final energy consumption (excluding transport)

Means and outputs



Exchange rate used: 1 DKK = 0.135 €; note: costs for all energy distributors, except heating oil distributors
Sources: Togeby et al., 2009 ; Deloitte et Grontmij, 2015 ; Rigsrevisionen, 2017)

Figure 1. Annual targets and reported costs for each year (over 2006-2016).

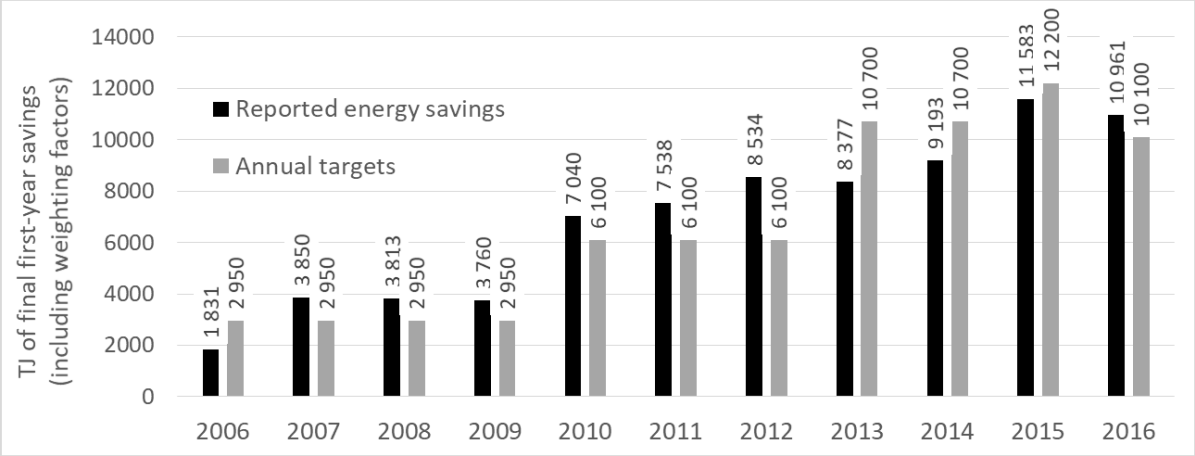
- **Costs reported by the energy distributors** = incentive costs (energy advice, grants to final customers, subcontracting) and administration costs (quality control system, documentation, reporting) for all energy distributors (except heating oil distributors, as they don't recover their costs on the tariffs for energy networks)
- **Administration costs for DEA** (management of the scheme + M&V): **about 540 k€/year** (2015)

The EPATEE project has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement No 746265.

- **Number of actions** (or other participation indicators) **registered by the energy distributors** (in case of controls)**, but not reported to DEA** (to keep reporting simple). No total data available.
- **Investments by participants** are assessed on a sample of projects (in the ex-post evaluations) (total investment done by all participants is unknown)

Data about energy savings

Unit	Main source of data
final first-year energy savings (in TJ/year)	energy savings reported by the energy distributors to DEA



Source: data communicated by DEA

Figure 2. Reported energy savings and annual targets for each year (over 2006-2016).

- **Reported energy savings** = first-year final energy savings including conversion factors, and from 2010 reduction and prioritisation factors (see below). This is the result used to monitor if energy distributors have achieved their targets.

When reporting the results for the EED article 7, the following corrections are made (NEEAP, 2017):

- removal of the prioritisation factors (see explanations below);
- removal of the savings from actions covered by EcoDesign requirements (some are eligible for the scheme, but not for the reporting to EED article 7).

Sources of uncertainties about energy savings

- errors in the calculations and reporting of the energy savings (tackled by random checks);
- uncertainties related to the use of engineering calculations or deemed savings (e.g., differences between estimated and observed energy consumption);
- uncertainties related to the reduction factors (see below + focus on additionality next page).

In the 2015 ex-post evaluations, only 4% of 321 surveyed participants said they observed lower energy savings than estimated (but 55% said it was too early to know or they don't know).

Evaluation of the energy savings

Calculation method(s) and key methodological choices

- **Methods**: pre-defined energy savings ratios according to standardised types of actions (**deemed savings, method 3**), mostly for the residential sector, or specific calculation methods (**scaled savings, method 5**), mostly for actions in industry and services.
- **Baseline** = "before" energy consumption, except for replacement of equipment where repair work cost > 25% of replacement cost (then baseline = market average or legal requirement)

- For **deemed savings**, calculations are made with **normalized conditions** (e.g., weather conditions, heating behaviours).
- For **scaled savings**, **adjustments** (changes in operation hours, production volumes, etc.) may be required to make "before" and "after" energy consumption comparable, and data used for the calculations must be documented so that they can be verified by random controls.

Reported energy savings include weighting factors to take into account the following points:

- **Conversion factors** when substitution between energy sources (favouring district heating);
- **Reduction factors** based on additionality assessments done in previous ex-post evaluations;
- **Prioritisation factors** defined to favour actions with longer lifetime, having impacts on primary energy consumption and in terms of avoided CO2 emissions: savings with short lifetime (< 4 years) are multiplied by 0.5 (and are not reported for EED art.7) and savings with long lifetime (> 15 years) are multiplied by 1.5 (this factor is removed when reporting savings for EED art.7). In 2015, 1% of the reported savings were "short lifetime" and 14% were "long lifetime".

For more details about these factors, see (ENSPOL, 2015).

Ex-post verifications and evaluations

Energy distributors report annually a summary of the energy savings they achieved, but keep a detailed documentation of the actions they supported in case of controls by DEA. **Annual random checks** are supervised by DEA and can lead to reductions in reported energy savings. For more details about how M&V is implemented for the scheme, see (ENSPOL, 2015).

In addition, **external ex-post evaluations** were performed in 2008, 2012 and 2015. In 2012, **changes in energy consumption of a control and participants group** (about 160 households each) were **compared over 24 months**, showing that the net effect for the participants group would be about 56% of the energy savings achieved (caution: small samples, not meant to be representative). In 2015, **econometric analyses** (panel data regression and co-integration) were used to assess net effects **at sector level**. However results were **conclusive only for industry** (74% of additional actions). The data available in other sectors were not disaggregated enough to make possible to distinguish the effects of the scheme from effects of other factors (e.g., energy prices).

Other indicators monitored and/or evaluated

Indicator	Explanations
Cost-effectiveness of the obligated parties	Costs incurred by the obligated parties per reported kWh saved, with > Costs reported by obligated parties include: administration costs, programmes or sub-contracting costs, grants to final customers, and possibly purchasing energy savings from other obligated parties. > Reported kWh saved = first-year final energy savings with weighting factors Indicator used to benchmark individual companies' total costs of meeting their target, and to monitor the cost-effectiveness of their strategies. **About 5.2 c€/reported kWh saved in 2013** (Deloitte et Grontmij, 2015)
Socio-economic cost-effectiveness	Socio-economic net value of additional energy savings projects over the lifetime of the actions: comparison of the costs to achieve energy savings with costs and externalities that would occur if the same amount of energy would have needed to be produced (taking into account the price, emissions of CO2 and other pollutants of marginal energy production). Calculations made per project type over the lifetime of the project. In 2013: **net benefit of about 0.9 c€ per kWh saved for businesses, net cost of about 0.8 c€ per kWh saved for households** (results based on a sample of 56 projects (Deloitte et Grontmij, 2015).
Costs per type of actions	Should be reported by the energy distributors (but scope of costs not explicit + ex-post evaluations mentioned high uncertainties about these data)

Distribution of the energy savings according to various indicators	The reported energy savings are monitored per type of obligated parties, per end-use sector, per energy carrier and per action type. These distributions are compared to the energy consumption per end-use sector and per energy carrier to see if there are trends in how the obligated parties target their programmes. See for example (Danish Energy Agency, 2017).

Other aspects evaluated

Qualitative assessment of the **impact of the scheme on the energy efficiency markets**, through a **survey of contractors**. The evaluation done in 2015 reported that among the 153 surveyed contractors, 30% said that they experienced a "large increase" in demand from end users for energy savings projects since 2006, 38% said they experienced a "moderate increase" and 32% said they experienced "no increase". However, it is not clear to what extent these changes are due to the obligation scheme or to other factors. The evaluators indeed concluded that this approach does not provide an accurate estimation of spill-over effects, but brought only some insights.

Likewise, the **econometric analyses** of long time series per end-use sector was also meant to take into account possible **spill-over effects**. However, the result of these analyses is an overall assessment of the impact of the scheme on energy consumption per end-use sector. It does not provide explanations about what market transformation effects would have occurred.

The **impact of the obligation scheme on energy prices** is estimated for each energy source, by dividing the total costs reported by the obligated parties by the total final consumption. Overall the increase was between 0.12 and 0.2 c€/kWh in the years 2010 to 2013. More specifically, the **surcharge on energy prices** has been estimated by the DEA for 2013-2015 as 0.23 c€/kWh for electricity, 0.17 c€/kWh for gas, 0.2 c€/kWh for district heating and 0.04 c€/kWh for oil (ENSPOL, 2015). For comparison, Eurostat data provides an estimate of electricity prices for "average" household customer in Denmark and its decomposition: 30.4 c€/kWh, whereof 21 c€ for taxes and levies, 3.8 c€ for supply costs and 5.6 c€ for network costs. Assuming that the surcharge on electricity prices would be the same for all end-use sectors, this surcharge would represent about 0.8% of the "average" electricity price for households in 2015, or 4% of the network costs. Based on the surveys done in 2015, the evaluators mentioned that few end-users (especially households) were aware of how much they pay on their energy bills for the scheme (Deloitte et Grontmij, 2015). This is in line with the fact that the increase rate due to the surcharge is very small (0.8% vs. taxation level of 69%).

As the costs reported by the energy distributors increased significantly (by about 25%) between 2010 and 2016, the National Audit Office was also asked to review the scheme (Rigsrevisionen, 2017), including a review of the written materials about the scheme, interviews with key stakeholders and an audit of a sample of energy distributors. The statutory auditors concluded that the efforts made by the public authority to ensure that the scheme promotes cost-effective energy savings have been satisfactory, but that the efforts to ensure that the energy distributors comply with the scheme's rules were not sufficient. The statutory auditors pointed that the annual sample checks done by the public authority covered a small proportion of the energy distributors' reports, whereas high error rates were identified from 2013 (27%) and increasing to 43% in 2015. They also highlighted that the public authority had not verified if the energy distributors had corrected the energy savings where errors were identified. The auditors also considered that the public authority did not control enough the risk that energy distributors bought energy savings to their affiliated companies at an overcharged price, and more generally that the costs reported by the energy distributors were not enough monitored.

These problems were identified based on the regular monitoring of the scheme and the results of the evaluation done in 2015 (Deloitte et Grontmij, 2015). The observations from the monitoring and evaluation of the scheme were thus already taken into account in the new agreement entered into force in December 2016. This agreement includes a greater focus on the control and documentation

of the energy savings by the energy distributors. It was complemented by a decision of the government in April 2017 to allocate additional resources (€15 million) to the Danish Energy Agency and the Danish Energy Authority (until 2021) in order to strengthen the control on reported energy savings. This includes expanded random checks, special controls and enhanced control of the costs incurred by the energy distributors, thanks to the recruitment of about 20 new employees (Danish Energy Agency, 2017).

Focus on additionality

The **main objectives of the ex-post evaluations** were to investigate whether the rules of the scheme were appropriate, the level of satisfaction of the stakeholders (obligated parties, end-users, etc.), the costs induced by the scheme and its overall cost-effectiveness (see indicators in previous page). Energy distributors can indeed recover on the energy distribution tariffs the costs incurred to achieve their targets, under approval by the regulatory agency (DERA). Assessing additionality is the key to ensure that the scheme delivers a net benefit to all end users.

Additionality was defined in these evaluations as follows: "*energy savings are additional if the energy savings actions had not been implemented (today or within the next few years) in the absence of the obligation scheme*".

In the evaluations done in 2008 and 2012, additionality was assessed by a **survey of a sample of participants** (companies and households) asking them:

- *"to what extent were you, before you were in contact with the obligated party, thinking about realising the energy saving project?"*
- *"with what probability the project would have been realised within the next year (or within three years) – without the help from the utility?"*

In 2012, these questions were complemented to check the consistency of the answers:

- *"How critical to the implementation of the project was the subsidy you received?"*

This approach was debated by the stakeholders, pointing out its high uncertainties and therefore questioning to which extent results with high uncertainty can be used to guide decision on improvements. The debates became indeed stronger after the 2012 evaluation, as this led to applying reduction factors for some of the deemed savings (e.g., replacement of oil boilers, windows and cavity wall insulation). The criticism raised in particular the issue of **possible bias in the answers** to this type of hypothetical question and the **small size of the samples** (88 interviewees in 2008, 209 in 2012).

The evaluators acknowledged that using a few questions may be a cost-effective approach, but may be questioned for validity reasons. They recommended for the next evaluations to add qualitative questions and triangulation with less subjective methods to assess the baseline such as market data.

Due to data issues, it was not possible to include an econometric analysis of market data (for energy efficiency technologies) in the 2015 evaluation. But this evaluation did include the following new approaches (compared to previous evaluations):

- **survey with a control group** (households and "non-households") + assumption that a web survey provides more reliable answers compared to the previous evaluations (phone survey), as respondents get opportunity to thoroughly consider the answers they submit;
- **econometric analysis of variables related to end-users and energy savings projects**, to investigate what variables (within each end-user group) may influence the additionality rates;

- **top-down regression analysis per end-use sector**, based on long time series of main macro variables affecting energy consumption and costs incurred by the energy distributors for the scheme, to assess the overall net effects (assuming that this method enables to capture directly or indirectly the additionality of energy savings projects, rebound effect and spill-over effect);
- **survey of contractors** (installers and engineering consultancies) to assess whether there have been spill-over effects in the supply chain (the evaluation concluded that this approach does not provide an accurate estimation of spill-over effects, but brought some insights).

Experience feedback from stakeholders

Interview with Peter Bach (Danish Energy Agency, evaluation customer)

1. **What is the role of evaluation in the management of the scheme?**

The ex-post evaluations are used to complement the monitoring of the scheme when preparing a revision of the agreement for the scheme. Therefore these evaluations aim to investigate the satisfaction of the stakeholders (energy distributors, contractors, end-users), the impacts in terms of energy savings and the cost-effectiveness of the scheme (from a society point of view). The first point is important to know how the scheme can be improved in practice. The second point is important to know if the scheme meets its objectives. And the last point is to know if the energy distributors are using cost-effective approaches to deliver the energy savings, which is an essential criteria for the cost recovery mechanism.

It is important to distinguish M&V and evaluation. M&V provides data and feedback as a regular basis for managing the scheme. Evaluation provides an independent and in-depth analysis of the scheme and its impacts, in order to draw recommendations.

2. **What were the main lessons learnt from the evaluations (about the impacts of the scheme and what could be improved)?**

All the recommendations of the ex-post evaluations have not necessarily been implemented. But they have been discussed with the obligated parties, and many of them have been used, either directly and with some further adaptations.

For example, simple prioritisation factors have been adopted after the first evaluation (2008), in order to take into account the differences in lifetime per action type, and to favour actions with longer lifetimes. Another example is the introduction after the second evaluation (2012) of a rule that actions with a payback time of less than 1 year could not receive a grant, as this was raised as an additionality issue.

3. **What were the lessons learnt in terms of evaluation practices?**

In the early 2000's, there was an evaluation of the previous scheme (obligation of energy advice). It tried to compare a control group of companies with a group of companies that received energy advice due to the scheme. This turned to be very difficult, because it required to collect data at the plant level (while many data are more easily available at the company level) and because long time series were required whereas the way the data are monitored (information systems) changed over time. At the end, the result was that the annual random variations (statistical noise) were too large. So it was not possible with this method to distinguish the possible effects of the scheme compared to the effects of other factors. It would be now even more difficult to use this method, as the scheme has now been in place for many years. So it would be very difficult to define a control group with companies that would not have been involved in the scheme and without selection bias.

That's why other methods have been used in the later evaluations.

Our experience is that when preparing a tender for an evaluation, the specifications for the evaluation should be focused on defining clear evaluation questions. The choice of the evaluation methods to answer these questions should be up to the bidders. This makes possible to compare offers with different methodologies.

Another well know lesson is that evaluation is easier when data are collected on a regular basis along the implementation of the scheme. This may be seen as a burden, in particular by the obligated parties. But this is essential to make monitoring and evaluation possible. When the scheme started in 2006, it appeared too cumbersome to develop a centralised database to collect data from the obligated parties. The situation has changed now with the new possibilities offered by the development of Information and Communication Technologies. This could be a way to improve the data collection in the coming years.

4. **What would you like to highlight about your experience related to the evaluations of the scheme?**

The legitimacy of the evaluation is an important issue, so that the evaluation results can be used to take decisions for improving the scheme. When preparing the evaluations, there have been preliminary discussions with the energy distributors to discuss about the evaluation objectives and methodologies. We also created an international advisory group where evaluation experts provided comments and suggestions as external reviewers.

Another issue that appeared difficult to handle is the verification of the situation before the implementation of the action. Most of the M&V rules are used to verify the actions ex-post. However, it is often not possible to check the "before" situation once the action is implemented. For example, it is difficult to verify what boiler (type and age) was replaced or what level of insulation was already in place. One way can be to ask for a picture of the building or equipment before the implementation of the action. However, it is still possible for installers to "cheat", for example by photographing another boiler. So this remains a concrete tricky issue.

Interview with Kirsten Dyhr-Mikkelsen (EA Energy Analyses, evaluator)

1. **What is your experience from the two first evaluations of the EEO scheme?**

It is always very motivating for us to know that the evaluation customer is genuinely interested in our results and that the results are used as basis for decisions regarding the policies that were evaluated. This also means that the stakeholders show a keen interest in the results. Our approach is when possible to engage the relevant stakeholders in the evaluation and to be open about the progress of the evaluation work so that the end result does not come as a shock. In my opinion, this approach benefits the overall decision-making process.

In cases where, for example, the stakeholders have strong opposing interests, it can be useful to give presentations for each group separately so that there is room for free discussion. This also provides us as evaluators with important insights regarding the policies and how they actually operate, which in turn benefits the quality of the evaluation results. Our experience is that the stakeholders are very positive towards such an approach.

An additional advantage is that when we have had regular contact and discussion with the individual stakeholder groups, then all parties – us included – are better prepared for the media attention and can minimise the

distortion of the evaluation results by the media. This is something which frequently happens.

A point worth mentioning is that policy administrators should not rely on third party evaluations alone to tell them what is going on. Evaluations can never replace the trust and insights gained from a regular and frequent contact between the policy administrator and the affected parties.

2. What were the main lessons learnt from the evaluations (about the impacts of the scheme and what could be improved)?

We were involved in the evaluation of the entire Danish energy efficiency portfolio in 2008 and the evaluation of the Danish energy efficiency obligation scheme in 2012.

An example of the findings from the 2008 evaluation is that there, as expected, was an ineffective overlap between some of the policies.

A comparison of the cost-benefits of the different policies very clearly showed that some were a lot more cost-effective than others. For example, the building labelling scheme in the form at the time of the evaluation was approximately 12 times less cost-effective than the energy efficiency activities of the energy network companies. And the most cost-effective measure was the energy tax system.

In the 2012 evaluation of the energy efficiency obligation scheme, we found that information campaigns carried out by the obligated parties were difficult to distinguish from ordinary company PR campaigns. Information campaigns without strong documentation of net impact were subsequently removed from the eligible list of energy efficiency actions.

In the 2012 evaluation, we among others took a closer look at the largest energy efficiency projects. We selected about 100 projects representing about 20% of the total savings reported for the scheme for the year under scrutiny. A key conclusion was that several of these projects had a payback time of less than 1 year. A new rule was consequently adopted for the next obligation period requiring that in order to be eligible a project must have a payback time of more than 1 year. We also recommended to define a maximum cap of for example 33% for economic incentives given. This recommendation was, however, not adopted.

Another lesson learnt is that additionality is a difficult topic for most to grasp. It is not necessarily cost-effective to strive for 100% additionality – on the contrary. And this fact is difficult to communicate.

Overall, the plan for administrating the Danish energy efficiency obligation scheme is well thought out, since it recognises that any policy will have flaws and that the flaws will change with the market developments. Policies are thus living creatures and need to be adjusted periodically to take into account changes in context, markets, policy priorities, etc. And a timely evaluation can provide the necessary basis for this.

3. What were the lessons learnt in terms of evaluation practices?

The main constraints were as often is the case related to time and budget limits. The main challenge in the 2008 and 2012 evaluations was to deliver sound results fast enough, with a very tight schedule. This implies finding ways to prioritize and select what work to do – in particular, in relation to the data collection.

Frequently, evaluations aim to determine the net impact of a policy. Finding a relevant control group to use quasi-experimental approaches (statistical comparisons of a participants and a control group) is often not possible and can be expensive. So, in many cases, the only option left is to use surveys. Therefore, evaluators at times have to rely on surveys where the respondents are self-reporting. Typically, the evaluation takes place

some time after the activity and the end-users may not remember exactly what took place, why they chose to participate or not, what the cost was, and more importantly would they have acted differently if they had not participated. And finding the relevant person to talk to can be difficult, especially when it comes to non-residential consumers.

One thing that we experienced, for example in the 2012 evaluation, was poor quality of the data reported by the obligated parties to the Danish Energy Agency. Each obligated party had its own information system to gather and report data. Some of the data was not accessible electronically. This means that data are available in different formats, making it difficult to put them altogether in a consistent way and also to verify them.

The Danish Energy Agency was in favour of a common platform to centralize and report data from the start of the scheme in 2006. But the stakeholders were strongly opposed to that. These positions have since changed and it may in future evaluations be possible to access data from a common database.

Getting reliable cost data is a big challenge in the scheme evaluation. We would like to be able to pinpoint whether observed changes in the overall costs of the scheme are due to changes in costs per action type or changes in the company strategies, like targeting selected customer segments. Moreover, the various sizes of the obligated parties subject to the Danish scheme imply different structures of costs. The added complication is the errors that arise from the fact that the kWh is reported by calendar year while the costs are registered according to the calendar of normal accounting principles. So for example in the 2012 evaluation, there was a need to carefully check these data to ensure a reasonable consistency.

With regard to the role of evaluators, one "guideline" that can be illustrated by the 2008 evaluation is that evaluators should remember to take a critical look at the evaluation scope defined in the tender. In 2008, we suggested that the scope should be expanded to also include the energy taxation scheme. Doing so enabled us to clearly compare the impact and cost-effectiveness of each of all the energy efficiency policies.

In terms of evaluation methods, it is essential for us to use triangulation, i.e. to compare results obtained with different methods and/or from successive evaluations. This provides a stronger basis for our conclusions.

We chose on one evaluation of the obligation scheme to use both a top-down and a bottom-up approach. We used quite a lot of effort to do the top-down assessment. But data were too flawed and the relative impact too small to be discernible. Therefore, the bottom-up approach was preferred by the tenderer for the successive evaluations. However, the roll-out of smart meters creates new opportunities for future evaluations and potentially better access to disaggregated data.

4. **In parallel of the ex-post evaluations, are there other evaluations or studies that provided insights about the impacts of the scheme and/or possible interactions with other policies or drivers (or barriers) for energy efficiency?**

We of course look for sources of information of any kind when conducting an evaluation. If for example, a smaller study has been made of the use of economic subsidies as a leverage for energy efficiency, then we consider the study in our work but not uncritically. In the 2008 evaluation, we actually included a thorough review and assessment of previous evaluations of one of the policies being evaluated.

We also routinely look to other evaluations of the same topic to compare results and ask the question whether the evaluations point to the same result or not and why. Especially when sample sizes are small.

5. **What would you do differently if this would be to do again?**

We would very likely use the same overall evaluation approach. However, if we had more money, then we could use larger samples!

The introduction of smart meters will provide better access to certain data opening up for alternative evaluation approaches.

6. **What else would you like to highlight about your experience related to the evaluations of the scheme?**

The call for tenders for an evaluation has a major influence on what can be done in the evaluation. A good call for tenders can pave the way for a good evaluation and vice versa.

It could perhaps be very useful if the EPATEE project could provide guidance about the preparation of calls for tenders for evaluations.

To go further

About the measure

- Web page of the Danish agency for energy on the scheme (in Danish) :

http://www.ens.dk/forbrug-besparelser/energiselskabernes-spareindsats

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http://enspol.eu/results

- Description of the measure in the MURE database:

http://www.measures-odyssee-mure.eu/public/mure_pdf/general/DK6.PDF

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How to cite this case study

Broc, J.S., 2017. Energy Companies' Energy-Saving Efforts in Denmark. Case study prepared by IEECP for the EPATEE project, funded by the European Union's Horizon 2020 programme.