Ea Energy Analyses

Best practises in designing and implementing energy efficiency obligation schemes

Taiwan

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Introduction

Why EEO?

It is far from all cost-effective improvements that are realised even if the end-users are aware of the importance and benefits of energy efficiency. Energy efficiency is not the "core business" of businesses nor households. An external force, driving implementation forward energy efficiency opportunities among end-users can therefore be useful to society. An energy efficiency obligation scheme (EEO) can create exactly such a driving force.

The idea is simply that an obligation to pursue energy efficiency is placed on a market actor, typically an energy company, and that the obligated party is allowed to recover their cost of the associated energy efficiency activity. The obligated party may apply energy advice/audits[1] or pay subsidies, or may interact with other executing parties, e.g. suppliers or engineering companies. While the energy savings[2] target and how to recover the cost of the effort are determined by the regulator, it is typically left up to the obligated party to decide where to find the savings.

The EU has in the 'Energy Efficiency Directive' of December 2012 (EU, 2012) pointed to EEO as a central policy instrument for the Member States to meet the common 2020 energy efficiency target. EEOs and the related tradable white certificates have been used for several years in Denmark, France, Italy, United Kingdom (UK), and the USA. As of ultimo 2013, an EEO has also been in place in Poland. Luxembourg and other EU Member States are preparing EEOs for launch in 2015 in accordance with the EU 'Energy Efficiency Directive' of December 2012 and more are expected to follow.

EEO design

Designing an EEO includes identification of which market actors are to be the obligated parties, which energy consumption to include (targeted end-users and energy types), what role the EEO should play among the other energy policies (e.g. a carbon emissions trading system or green certificates), and the savings target of the EEO. This also includes deciding whether to establish a formalised white certificate market and what options for trading will be permitted including the extent of bilateral trade with third parties.

[1] Energy audit – An energy audit is an examination of the energy consumption at a facility or building. The outcome is a formal report that shows the main areas where energy efficiency can be improved, suggests energy efficiency improvement measures, and estimates the likely costs and savings. The audit may be of the entire facility/building or specific systems or processes. The audit is typically carried out by external experts trained in audits.

[2] Throughout the report, no distinction is made between energy efficiency improvements and energy savings.

Other key elements are the financing and cost recovery mechanisms. Typically, EEOs are financed via a surcharge on end-user energy bills, since this reduces the strain on public spending and is a more stable source of financing than public budgets.

Finally, the remaining administrative framework must be defined. This includes among other formulating the rules for documentation ("proof") and verification of compliances, performance incentives and penalties, collection of data, and evaluation of the scheme. In order to maintain a well-functioning and cost-effective EEO repeated control and evaluation is necessary. The size of the administrative burden of an EEO is decisive for the total cost of the EEO.

This report

The purpose of this report is to provide an analytical view on how to best plan and implement a successful EEO in Taiwan based on international experiences. The focus will be on the Danish EEO but examples from France, Italy, Poland, UK, and Vermont are also given.

Further, the purpose is to present a discussion on the relevance and feasibility of an EEO in Taiwan. The preliminary findings will be used as basis for a workshop in October 2014 with key stakeholders in Taipei, Taiwan.

The work was conducted from July to October.

1 The Danish EEO

This chapter presents the Danish EEO, in Danish termed "Energiselskabernes spareforpligtigelse", and its framework. This includes a brief introduction to the context in which the Danish EEO operates; an introduction to the EEO's main structure, stakeholders, and operational organisation together with its historical results and future planning; and an explanation of core philosophy and methodology.

1.1 Context

According to the International Energy Agency (IEA), "*Denmark is a leader among OECD member countries in terms of its well-designed policies for renewable energy, energy efficiency and climate change. The country is a forthright voice in international fora for climate policy and a strong advocate of tougher climate-change mitigation measures. A long history of consensus-based policy making and political stability has been leveraged to develop Denmark's far-reaching and comprehensive energy policies, and also allowed a clear long-term vision to emerge*." (IEA, 2012).

Decoupling from GDP

Denmark has come a long way since the oil crisis in 1973 (and again in 1979). At the same time the Danish economy relied almost entirely on imported fossil fuel. The first national energy action plan was published in 1976 covering a broad set of measures, including energy efficiency in industry and households. A law on heat planning was also formulated in 1979 focusing on the utilisation of surplus heat from industry as district heating. Denmark proceeded to succeed in decoupling economic growth from energy consumption.

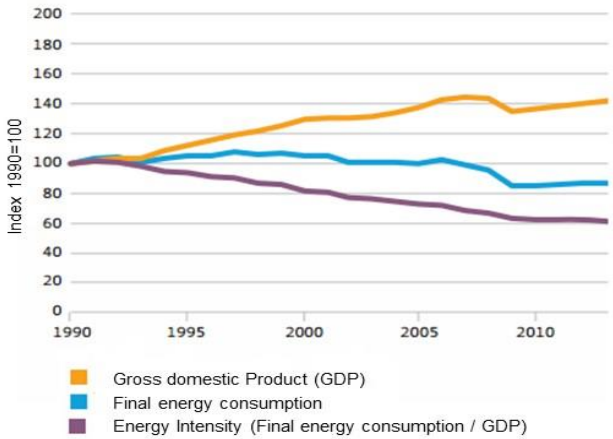


Figure 1: Economic growth, energy consumption, and energy intensity development (DEA, 2012c).

According to the national statistics (DEA, 2012b), the 2012 gross and final energy consumption was 141 and 110 GJ/capita, respectively. In 2012, renewable energy constituted 23.4% of total gross energy consumption and 17 of the percent points were furnished by indigenous renewable energy and the dependency on oil has been reduced to 37%. The 2012 overall intensity of the economy was 0.505 TJ/ million GDP and the energy related CO_2 emission 7.9 tonnes/capita.

The energy consumption by sector and energy type can be found in Figure 2. In the residential sector, space heating and domestic hot water constitutes 83% of final energy consumption (DEA, 2012b).

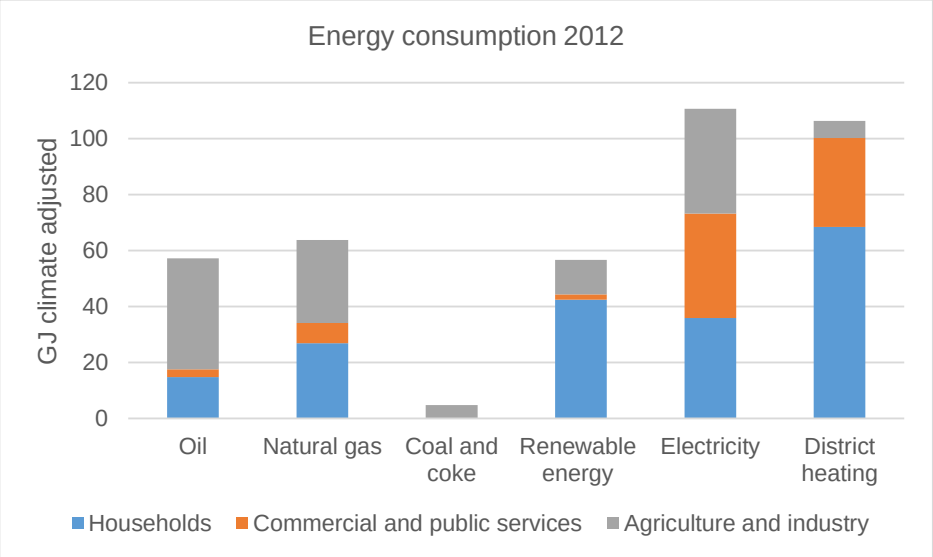


Figure 2: Energy consumption by energy type and sector 2012 – transport sector excluded (GJ climate adjusted) (DEA, 2012b).

Denmark's long-term energy goal is to transform Denmark into a low-carbon society with a stable and affordable energy supply. In 2011, the government published the 'Energy Strategy 2050', a policy document that outlines how Denmark can achieve its goal. Energy efficiency plays an important role in achieving this goal.

EEO oversight

The Danish Energy Agency, under the Danish Ministry of Climate, Energy and Building, is responsible for the entire range of tasks linked to production, supply, transportation and consumption of energy, including energy efficiency as well as the Danish national CO_2 targets and initiatives to limit greenhouse gas emissions. The Danish Energy Agency negotiates and oversees the Danish EEO.

The Danish Energy Regulatory Authority, also under the Danish Ministry of Climate, Energy and Building, regulates the Danish markets for electricity, natural gas, and district heating. In relation to the EEO, the role of the Regulatory Authority is to monitor the associated cost of the obligated parties.

Electricity

Electricity market

The Danish electricity market is an integral part of the Nordic electricity market (see Figure 3). Both Danish and EU authorities have supported liberalisation in order to stimulate free competition in electricity production and trade. Trade on the wholesale market is effected via the power exchange 'Nord Pool'.

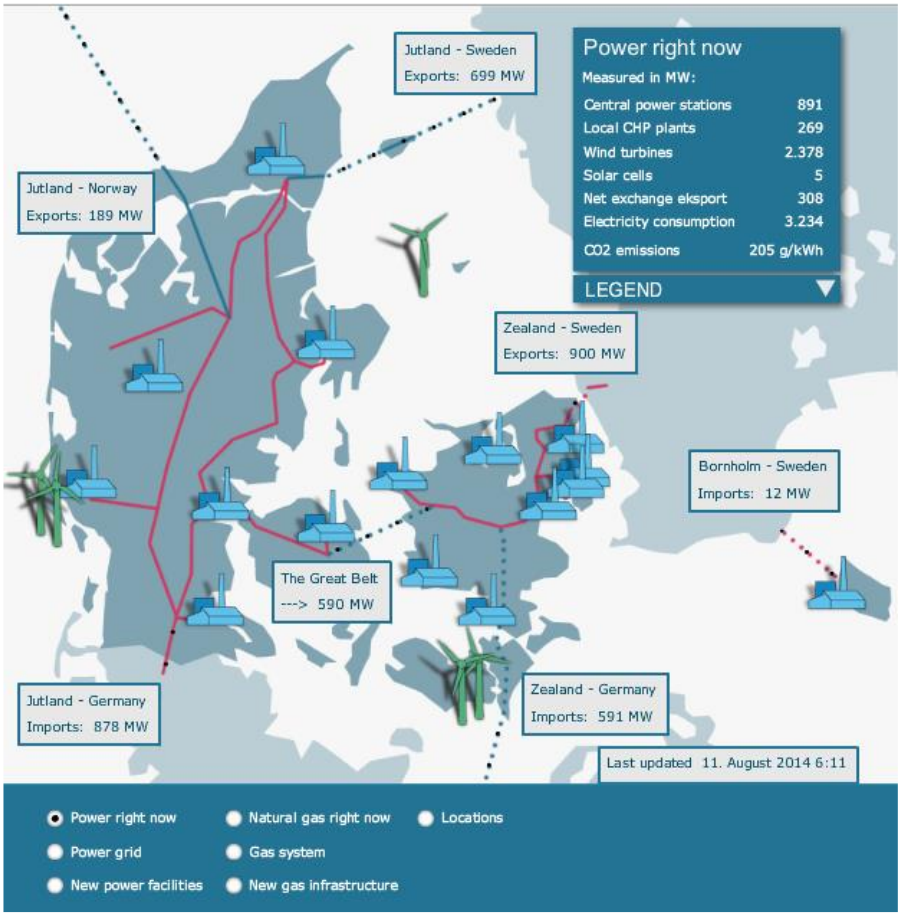


Figure 3: Danish electricity system 06:00 Monday 11 August 2014 (Energinet.dk, 2014).

The Danish electricity distribution companies operate separately from production companies. End-users have free choice of retail companies, which buy electricity from producers and pay distributors to deliver it to the end-

users. The electricity companies have a long history of providing energy efficiency services to their customers.

District heating

The Danish municipalities can through energy planning designate specific areas to district heating or natural gas distribution. This is typically done as new areas are developed and is very seldom practiced for existing developed areas. Electric heating of houses located in these areas is forbidden by law. The municipalities may choose to make accession to collective energy distribution systems (natural gas or district heating) mandatory and may require new end-users within areas with collective distribution system to connect to these.

District heating is de facto a natural monopoly in Denmark since it would not be cost-effective to have a parallel supply network distributing heat to individual consumers. The costs involved are so prohibitive that there is often only one provider in a given area. The establishment and operation of a district heat network and the retail of district heating is usually organised within a single company.

Break-even

The district heating companies are obliged to be a “break-even” venture. Measured as an average over a given period of years, the heat price should be equal to the heat cost. Only expenses that are considered “necessary” may be included in the consumer price. However, a limited return on invested capital is typically accepted. Several regulatory measures are aimed to increase the efficiency in district heating operation, thus reducing the cost of heat to the end-users.

There are today 16 centralised and approximately 415 decentralised plants producing district heating. Their size varies greatly. Most district heating distribution companies are either owned by a municipality or the end-users of the supply area. Typically, the companies are end-user-owned in smaller supply areas while in larger cities, it is usually the local municipality, which owns the local network.

More than 50% of Danish households have district heating. It is used for both space heating and domestic hot water heating.

Natural gas

As a consequence of the oil crises in the 1970s Denmark started explorating indigenous natural gas. As with district heating, certain areas were earmarked

for natural gas supply and 5 regional gas companies were established as monopolies in each their respective regions. The 'EU Gas Directive' of 1998 (98/30/EC) required a gradual opening of the gas markets of the EU Member States and the Danish gas market was completely liberalised as of 1 January, 2004 and all end-users allowed to choose their retailer.

There are today 3 natural gas distribution companies.

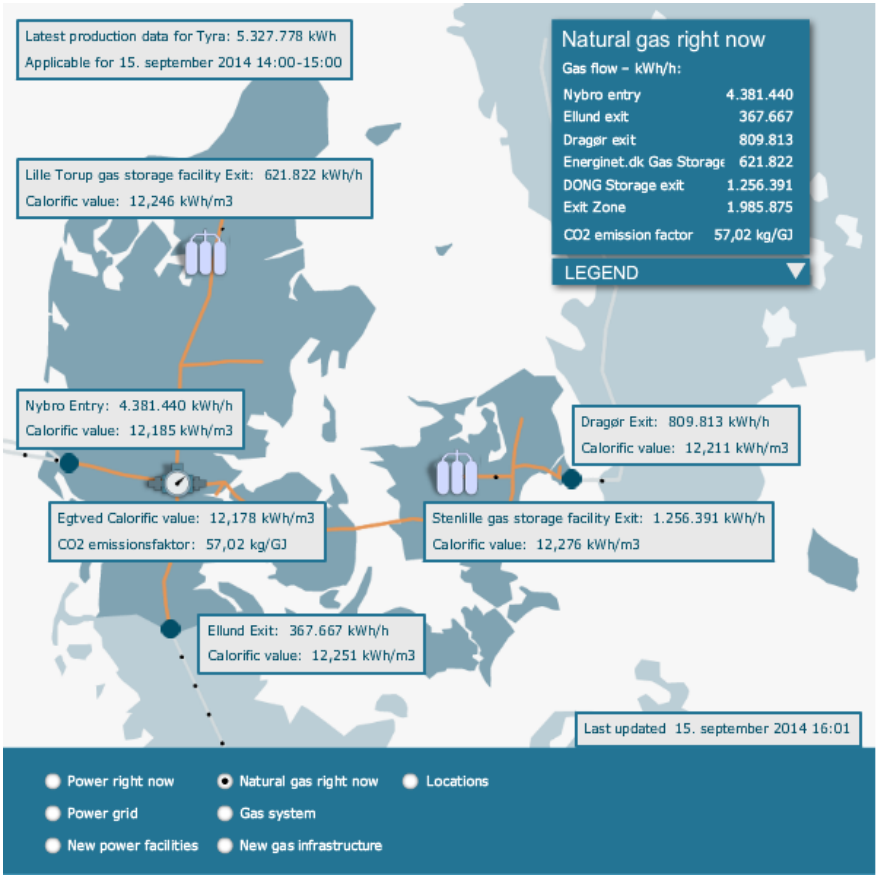


Figure 4: Danish natural gas system 16:01 Monday 15 September 2014 (Energinet.dk, 2014).

Heating oil

Denmark is a net exporter of oil and natural gas but resources are declining and self-sufficency is under threat. At present, oil and gas production makes a significant contribution to Denmark's trade balance.

About 1/3 of the climate adjusted gross energy consumption in Denmark 2012 was based on oil. The transport sector alone accounts for 2/3 of all oil used in Denmark.

All 6 oil distributors operate on commercial terms.

Oil for space heating and domestic hot water is being phased out as part of the 'Energy Strategy 2050'. Thus, new installations of oil boilers are not permitted after 1 January, 2017.

1.2 Organisation

The key actors in the Danish EEO are shown in Figure 5. In the following the roles of the obligated parties, the executing parties, and the regulatory bodies are elaborated.

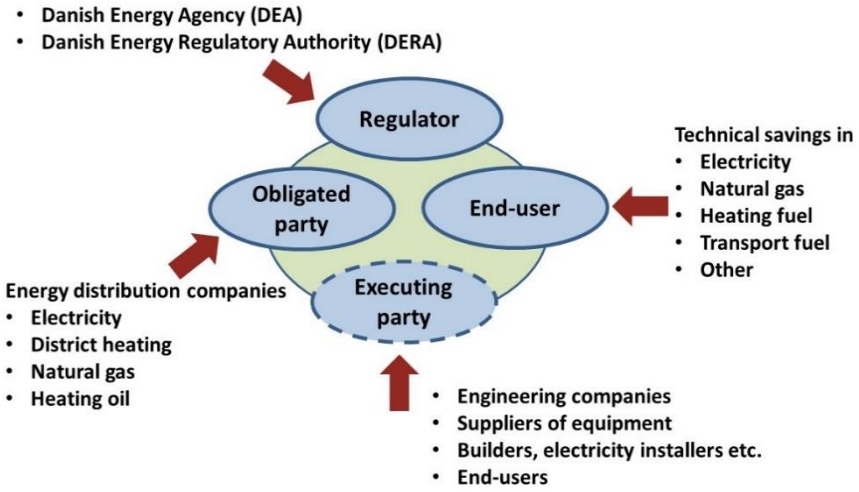


Figure 5: Key actors in the Danish EEO.

Obligated parties

In Denmark, energy distribution companies have been involved in energy savings at the end-user level since the early 1990s. Traditionally, their energy efficiency effort was limited to performing energy audits and giving advice to their customers. Energy audits were given free of charge to the customers and in particular within the industrial sector. This work was formalised with the first EEO that came into operation in 2006. The Danish EEO is based on an agreement within a legislative framework with the distributors of electricity, natural gas, and district heating. The heating oil companies have chosen to commit to the EEO voluntarily. The energy distribution companies covered by the agreement will hereafter be referred to as the obligated parties. There are approximately 500 obligated parties (see Table 1 page 21), mainly due to a large number of district heating companies.

Executing parties

The obligated parties in Denmark are not allowed to implement energy efficiency projects themselves. They must "outsource" the implementation

task to third parties or the end-users. The variation possibilities are shown in Figure 6 further ahead in the text. Third parties can be energy retailers within the same company group as the obligated party, ESCOs[3], or other private companies such as installers, builders, engineering companies, lighting companies, etc.

Only few obligated parties have used tenders, but this is a possibility. Bilateral exchange is possible between obligated parties after the savings have been realised, but the extent to which this is used is limited. Third parties thus play a central role as intermediary between the obligated parties and the end-users (see option 3 and 4 in Figure 6).

Agreements

Different types of agreements can be made between an obligated party and a third party.

One possibility is that the agreement covers a *specific* project. This could be a consultant working for a housing association wanting to energy renovate an apartment building. The consultant enters an agreement with an obligated party, stating that the obligated party buys the right to report the total amount of savings generated by the project. The consultant provides, for example, the housing association with energy advice in return for selling the energy savings realised by the housing association to the obligated party. It should be emphasized that the third party (in this case the consultant) at no time can own the energy savings. The third party is only acting as a link between the end-user and the obligated party.

Another type of agreement is the more *generic* agreement that is not tied to a specific project. An example could be a carpenter that enters into an agreement with an obligated party to realise the energy efficiency improvements in the following year. By way of the payment from the obligated party the carpenter can give a discount to a customer that agrees to e.g. have extra insulation installed. In return, the customer signs over the right to report the energy savings to the obligated party with whom the carpenter has a contract. The obligated party pays the carpenter an amount per realised kWh, and thus all parties of the contractual chain experience added value.

Third parties are allowed to “shop around” for subsidies on behalf of their customers. However, this must be done before the energy efficiency project is

[3] ESCOs (Energy Service Company) – A consultancy group or company engages in a performance-based contract with a client to implement measures, which reduce energy consumption and costs. The payment for their services may be linked to the achieved energy efficiency improvements.

initiated. The level of subsidy is generally known, even though the law does not require disclosure for the indivudal cases.

Subsidies (alone and in combination with advice) are widely used. Figure 6 shows an overview of the different types of intervention and interactions between obligated parties, executing parties, and end-users in the Danish EEO.

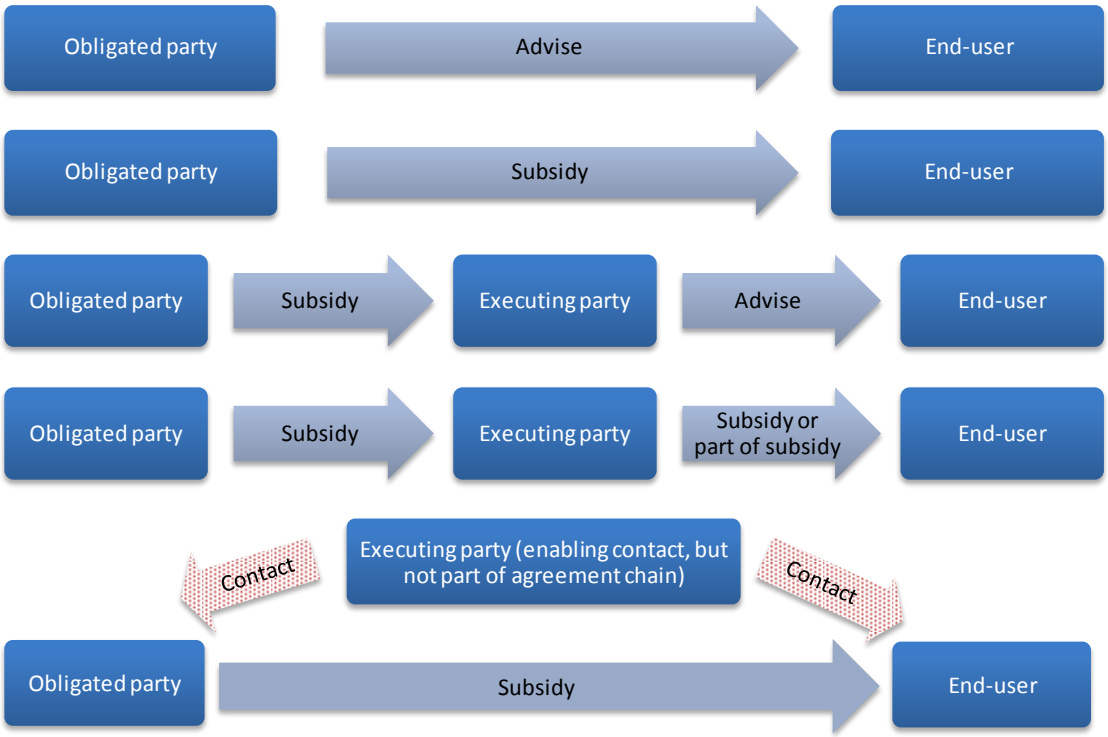


Figure 6: Overview of types of interventions used in the Danish EEO. Option 3 and 4 are the type mentioned in the two examples described in the text above on agreement types.

Administration

As mentioned earlier, the Danish Energy Agency is the key administrator of the Danish EEO. As such, the Danish Energy Agency prepares the framework and rules for the EEO based on negotiations with the obligated parties.

The Danish Energy Agency is responsible for assessing the net impact and appropriateness of the EEO at least once within the three-year period of an obligation period so that political decisions on adjustments can be based on evidence. The evaluation is carried out by an independent entity. The Danish

Energy Agency also initiates independent sample checks annually of the documentation[4] of registered savings.

The obligated parties of the electricity, district heating and oil sectors report their achieved registered savings to their branch organisations who compile the information into aggregated figures and forward these to the Danish Energy Agency once each year. The four natural gas network companies report directly to the Danish Energy Agency. Each obligated party is responsible for annual audits of their records. Every second year these audits must be carried out by an external entity.

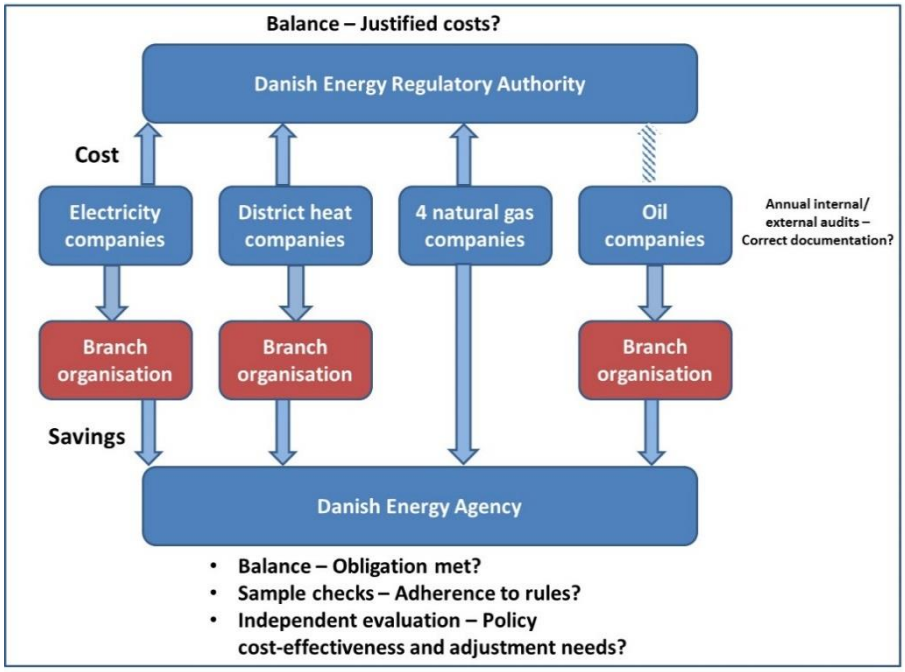


Figure 7: Overview of the reporting to the authorities in the Danish EEO.

The combined cost for administration and intervention, incurred by the obligated parties within the electricity, district heating, and natural gas sectors is reported annually to the Danish Energy Regulatory Authority, as they are grid companies (monopolies). The oil companies have so far voluntarily provided estimates of their cost. The Danish Energy Regulatory Authority

[4] The documentation includes the obligated parties' demonstration ("proof") of the savings realised and allow for inspection by random sampling, to verify that this is the case. The documentation of the individual energy saving actions should in addition to general information about the customer and stakeholders, include information on how savings are calculated and the obligated parties' involvement. Documentation also directly or through referrals to contracts with third parties contain information on the obligated parties' costs of acquiring the right to report energy savings. See template examples in Annex II and III.

produces an annual benchmarking of energy companies' recognition eligible costs. The benchmarking of realised savings and costs is publically available[5].

Technical workgroup

In order to simplify procedures certain energy efficiency measures do not require specific calculation of savings but may rely on standardised saving (see more in section 1.5). A technical work group decides once a year whether there is a need for updating the standardised savings values, compiled in the so-called 'Standard value catalogue'. The technical work group is composed of representatives from the obligated sectors. The Danish Technological Institute assists the technical work group in the actual updating of the values and the values are subject to approval by the Danish Energy Agency. Furthermore, separate market investigations may be initiated at any time anyone deems it relevant.

1.3 Core philosophy

The foundation of the Danish EEO is a strong focus on cost-effectiveness, freedom of method, a competitive energy efficiency market, simple rules and lean administration, dynamic regulation, and self-regulation amongst the obligated parties.

Cost-effectiveness

The framework for the Danish EEO is designed to provide a "cost-effective agreement with the energy distribution companies, which strengthens the competition exposure of the [energy savings] effort" (DEA, 2012a). A competitive energy efficiency market is sought created via third party access and a high degree of methodological freedom in how to realise the savings. Another way that cost-effectiveness is encouraged in the Danish EEO is through simple and dynamic administration of rules and reporting.

Freedom of method

With the introduction of the EEO, the saving effort was significantly restructured. The obligated parties were permitted to realise energy savings across the entire country, within all forms of energy, and within all sectors; only transport was excluded. In 2013, four measures within transport were introduced but uptake is yet close to none.

[5] Realised savings: http://www.ens.dk/forbrug-besparelser/energiselskabernes-spareindsats/lovgrundlag-kontrol-resultater/opnaaede
Benchmark of costs: http://www.ens.dk/forbrug-besparelser/energiselskabernes-spareindsats/af-talegrundlag-kontrol-resultater/benchmark-0

Freedom of method was introduced in 2010 with respect to the types of instruments that the obligated parties may use (advice and/or subsidies) as well as trading savings. The changes increased the dynamics and flexibility of the EEO market among other through increased competition in providing competent advice to industrial customers since these are considered very attractive (Ea Energy Analyses, NIRAS and Viegand & Maagøe, 2012). Freedom of method is thus an important design feature in realising the most cost-effective savings under the Danish EEO.

Competitive energy efficiency market

A competitive energy efficiency market with a focus on transparency and involvement of third parties has been the object of close attention in Denmark. Third party access is designed to ensure that not only the obligated parties' daughter companies get a share of the energy savings market. Trading between obligated parties and third parties is another way to encourage competition and thereby cost-effectiveness. Trading savings requires an agreement on the ownership of the savings between the end-user, the obligated parties, and a possible third party before the project is commenced.

After the savings have been realised obligated parties who exceed their annual obligation target, can sell the excess to other obligated parties or the savings can be transferred to the following years within the 3-year agreement period. At the end of a calendar year, the deficit may, however, not exceed 35% of the average annual target. The flexibility of the EEO market realises efficiency gains, which would not be available in the absence of trading.

Simple rules and lean administration

In order to achieve smooth regulation and low administration cost (for the regulator as well as the obligated parties and third parties), the rules that define whether a given project can count towards the target must be simple and easy to use. The administration of an EEO needs to be simple and leanin order to achieve an acceptable balance between simplicity and high additionality[6] of the savings realised. The Danish experience is that a higher level of detail in documentation is not necessarily equal to higher accuracy and certainty. The overall target is distributed between the sectors — oil, electricity, natural gas and district heating — and the regulator (Danish Energy Agency) is indifferent to whether an individual company fails to reach its target for a given year, so long as the sector as a whole meets its energy

[6] A saving is deemed *additional* if it would not have been implemented or accelerated without the obligated party's involvement. *Additionality* expresses the likelihood that the energy savings would not have been realised without the obligated party's involvement.

savings obligation. Another example of simplification is the extensive use of standard values for realised savings, see section 1.5.

Dynamic regulation

An EEO is a sensitive instrument, which cannot be left unattended for several years. Technologies and markets develop, and loopholes may develop. A central idea behind the Danish EEO is that it should leave room for creativity. The most efficient way to interact with end-users to promote energy efficiency is not defined by the regulator. For the obligated parties the task is to fulfil the obligation at as low cost as possible. This may result in high attention to loopholes. A "loophole" can be a legal way of recording savings that, however, renders very little net impact. Giving low cost compact fluorescent light bulbs away free is such an example. Thus, it is important that the EEO is dynamic and the regulators are ready and willing to close the loopholes as they arise. Consequently, certain end-uses are no longer permitted to be counted towards the obligation; e.g. energy efficiency white goods since the additionality is judged too low in Denmark today.

To be successful in the long run it is thus important that the EEO from the start is equipped with a mechanism of evaluation and progressive development. In the danish EEO, independent random sampling tests are conducted each year as part of the quality control,and independent evaluations of the EEO are carried out routinely. Proof of additionality is required in the form of documentation of the fact that interaction with the end-user took place *before* the project was initiated. Further, the overall additionality is estimated as part of the EEO evaluation that takes place once within each obligation period.

Self-regulation amongst the obligated parties

Compliance

Within the Danish EEO, there is a certain amount of self-regulation and potential shaming effect if caught bending the rules. Concerning penalties applicable in case of non-compliance, the Danish EEO design is lenient. The only consequence of deliberate or involuntary faults or omissions discovered in the annual random sampling control is that the overall energy sector must provide extra savings the following year equivalent of the savings that were deemed faulty.

Cost check

The Agreement of 13 November 2012 reads as follows regarding the costs of the EEO activities: "the Danish Energy Agency may request that grid and distribution companies with costs among the 5% highest per kWh reported (however, always up to 25 companies) account for how they have ensured

cost-effectiveness, including their focus areas, methods, costs, and use of market terms. The Danish Energy Agency may also request the companies with the lowest costs to account for their focus areas, methods and calculation of costs."

As the supervisory authority, the Danish Energy Agency may subsequently establish specific agreements with individual enterprises that demonstrate too high costs to ensure they adjust future efforts. Agreements will be realised through a decision before the end of May in the year following the benchmarking. This decision must be complied with by no later than 1st January in the subsequent year. The same procedures applies for companies with low cost – but not only to ensure that they have complied with the rules but also in order to see if they are particularly innovative and whether their methods could be promoted to other companies to increase the overall performance of the entire EEO effort.

It may be argued that the risk of being caught is relatively small and that the system provides some incentives for over-reporting of savings and does perhaps not sufficiently encourage cost-minimisation. To some extent, the credibility currently rests on the generally low corruption level in the country; that the obligated parties have experience in providing energy savings for end-users and therefore have highly skilled employees; and that the obligated parties support and agree with the target (social responsibility).

1.4 Target

The Danish EEO target is set in first year savings and only final energy savings count towards the target. The Danish EEO in 2006-2009 was 2-3 times higher than the savings realised under the previous system. The energy saving target in this period, was 2.95 PJ per year which corresponded to 0.7% of total final consumption in the sectors included (transport is not included).

Target development

The overall target has been raised with each new obligation period, and the obligated parties are still overachieving.

The energy political agreement of 21 February 2008 dictated an average annual saving target for Denmark as a whole to 1.5% of the final energy consumption in 2006 equivalent to 10.3 PJ per year. At the same time the target of the EEO was with the agreement of 20 November 2009 increased to 5.4 PJ per year as of 2010 i.e. more than half the total Danish energy efficiency effort. However, not all savings reported under the obligation scheme can be expected to be additional and therefore the target was increased by

approximately 15% to 6.1 PJ per year for the period 2010-2012. The average annual final energy consumption in the period 2010-2012 was 411.7 PJ excluding transport and non-energy use and thus the annual target approximately equivalent to 1.5% of the obligated parties' annual sales.

With the most recent agreement, the political agreement of March 2012 (DEA, 2012a) the obligation was raised with 75% – compared to the target for 2010-2012 – to 10.7 PJ per year for 2013 and 2014 and will be doubled in to 12.2 PJ per year for the period 2015-2020. The target development of the Danish EEO can be seen Figure 8.

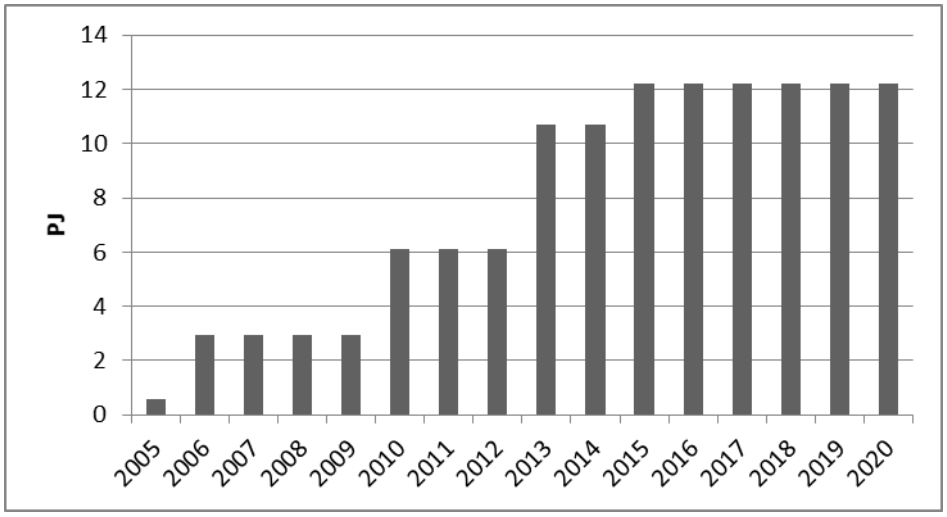


Figure 8: Development in the Danish EEO target. First years saving. The value for 2005 (0.6 PJ) indciates savings from the previous policy and has been estimated based on reporting from utilities.

Target distribution

Each of the four sector negotiate a specific share of the total target, roughly proportional to their market share. It is up to each sector dvide the share among the companies in the sector. Typically it is based roughly on market shares. The distribution of the target between the obligated parties for 2013-2014 and 2015-2020 is shown in Table 1 below.

	Number of obligated parties	Target 2013-2014 (PJ)	Target 2015-2020 (PJ)
Electricity distribution companies	70	4.5	5.0
Natural gas distribution companies	3	2.0	2.3
District heating distribution companies	412	3.7	4.3
Oil companies	1 (6*)	0.5	0.6
Total	**496**	**10.7**	**12,7**

*Table 1: Energy savings target (PJ) and number of obligated parties with in the different sectors. *The 6 oil companies report as one obligated party represented by an association formed to handle the EEO (DEA, 2012a).*

First year savings

Eligible energy savings are counted for the first year after an energy efficiency measure has been implemented (as opposed to the estimated lifetime of the measure).

Counting only first-year energy savings is the simpler method compared to counting lifetime savings. However, this may favour low-cost, short-lived measures over more costly measures that save more energy over their lifetime and thus may be more cost-effective in a long-term perspective. Focussing on low-cost measures may also encourage projects that install only one measure in a facility rather than carrying out comprehensive energy efficiency improvements that capture all available cost-effective energy savings, thus risking lost opportunities (Regulatory Assistance Project, 2012).

Priority factors

To encourage specific energy savings measures in non-EU ETS[7] fuels (oil, natural gas, coal) with a lifetime beyond 15 years, an uplift of 50% is provided. Likewise, to discourage energy savings with a lifetime of less than 4 years these saving are downgraded to half the value. This also supports the compliance with the Danish non-ETS target and other general energy policy objectives in Denmark.

1.5 Impact

Measurement and documentation

An *ex-ante* approach is used in the measurement and documentation of savings in the Danish EEO. The energy savings are calculated with reference to the results of previous independently monitored energy improvements in similar installations.

[7] EU ETS – EU carbon emissions trading system

Engineering estimates

One version of the ex-ante approach is e*ngineering estimates*, where calculation estimates for specific project are used. This approach is used where establishing robust measured data for a specific installation is difficult or disproportionately expensive (e.g. be replacing a compressor or electric motor with a different kWh rating than that for which independent information on savings has been measured). Engineering estimates dominate the total savings in Denmark. This approach is typically used outside the residential sector.

Standard values

The remaining part of the savings are measured and documented by use of 'Standard value catalogue' (a catalogue of more than 100 measures – typically within residential sector – are updated yearly[8]) with baselines equal to market average or EU standards. Using a list of pre-approved measures reduces the administrative burden of both the obligated parties and the verification process (Annex IV: Standard value catalogue).

It should be noted, that defining standard pre-approved measures and verification processes that reduce the transaction costs for obligated parties and project developers may also unintentionally direct the market towards types of projects or sectors where such standard are possible.

Market survey

A third calculation method exists, namely market surveys, related to specific activities such as campaigns or voluntary agreements, in so far as these activities influence "market development in a given area towards more energy efficient products and solutions (such as energy management, smart meters, etc.). Calculation of an independent effect of market influence may only be used if calculation using standard values is not possible. For example, if in connection with a subsidy scheme, information on the actual end-user is available, then the main rule is that the saving should be calculated using standard values." (DEA, 2012a).

In fact, independent information campaigns, or independent campaigns to change consumer behaviour, are discouraged and therefore the market survey method is rarely used as documentation of savings.

Documentation

Obligated parties must keep the documentation of measurements ready for the annual random sample check. For the savings based on engineering estimates this includes documentation of a fair computation of the realised

[8] A machine translation can give some insight in the nature of the catalogue: http://translate.google.dk/translate?sl=da&tl=en&prev=_t&hl=da&ie=UTF-8&u=http://svk.teknologisk.dk/PDF/standardv%25C3%25A6rdikatalog%25202.6.pdf&act=url Note that many measures count as zero savings. These have had a kWh value in earlier versions. E.g. buying of A-labelled freezers and washing machines do not count as savings anymore, because the market already is dominated by these efficient models.

savings. To enhance additionality, the obligated party must document proof of involvement (interaction with end-user) before the energy saving project is implemented. The documentation consists of the contract between obligated party, end-user, and third party (where applicable). This is known as the "documentation exchange chain". Examples of standard documentation contracts can be found in Annex II and III.

Achieved impact

The amount of savings realised in the residential and public sectors has been fairly stable since the EEO was first introduced, whereas savings realised in industry rapidly increased as a result of the increased obligation from 2010 onwards. About 65% of all registered saving in 2011 were found in the industry and commercial sectors (see Figure 9).

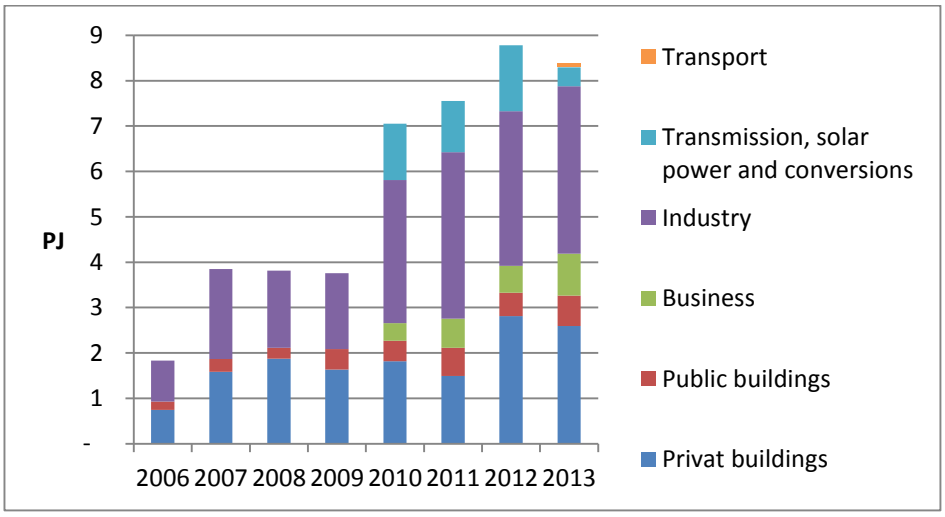


Figure 9: Reported savings in the Danish EEO 2006-2011 distributed on consumption sectors. The reported savings are measured in first year savings. Note that the commercial sector was not reported separately from industry until 2010 and savings in transmission grid, installation of solar power, and switching energy type were not included in the agreement until 2010 (Ea Energy Analyses, NIRAS and Viegand & Maagøe, 2012; DEA, 2014; DEA, 2013).

The most recent evaluation of the EEO found that the overall additionality[9] of the scheme was 46%. Additionality is relatively higher for the biggest energy saving projects, which were reflected in the additionality of industry projects being 52-60% (Bundgaard, 2013). In contrast, the additionality of the residential sector was estimated to be much lower. A cautious estimate put it at 20%, but the evaluation did not have enough data to produce a statistically significant estimate (Ea Energy Analyses, NIRAS and Viegand & Maagøe, 2012). The results from 2012 correspond with the findings of the 2008 evaluation where

[9] Additional savings are savings that can be attributed solely to the activity.

the additionality for large energy savings projects was found to be around 50% (Togeby, Dyhr-Mikkelsen, Larsen, & Bach, 2012).

1.6 Costs

The average costs for implementing the energy efficiency obligation on energy distributors in Denmark for 2006-2009 was 33,8 øre/kWh first year savings (6.07 $cents/kWh first year saving). This figure includes the costs of the end-users, the administrative costs of the Danish Energy Agency, and the activity, administration, and quality assurance costs of the obligated parties (Danish Energy Association, 2013).

In December 2011, the Danish Energy Regulatory Authority published, the first benchmark assessment of the cost of the obligated parties on implementing the EEO in Denmark (DERA, 2011). The benchmark covered savings realised in 2010. Since then benchmarks for 2011 and 2012 have been published.

	2010	2011	2012
Electricity grid companies	7.5	7.6	8.0
Natural gas distribution companies	7.5	7.6	6.9
District heating distribution companies	5.1	4.4	5.1
Oil companies	6.0	Not published	6.5
Average costs	**6.6**	**6.4***	**6.8**

*Table 2: Benchmark average costs in $cent/kWh first year savings for 2010, 2011 and 2012.*Excluding the savings realised by the oil companies (DERA, 2011; DERA, 2012; DERA, 2013)*

The latest benchmark shows a slight increase in the average cost per kWh in 2012 compared to previous years. Further, the benchmark shows that there are variations in the level of cost for implementing the target between the obligated parties (DERA, 2013). The latest evaluation of the EEO estimated that approximately 15% of the cost of the obligated parties was spent on administration (Ea Energy Analyses, NIRAS and Viegand & Maagøe, 2012).

For 2013 and onwards more detailed cost data will be available as the obligated parties must now specify how much of the cost is used on administration as well as a distinction of cost with regards to whether third parties or the obligated parties' daughter companies were involved in realising the savings.

Relative cost

An evaluation of the entire Danish energy efficiency policy portfolio was carried out in 2008, the intention being to create a basis for updating and

strengthening the Danish energy efficiency efforts. The policy portfolio is shown in Table 3.

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

Table 3: Danish energy efficiency policies in 2008 (Togeby, Dyhr-Mikkelsen, Larsen, & Bach, 2012). n.a. = not available, xx = the sector is fully covered, x = the sector is partially covered by the activity.

One of the results of the evaluation was a comparison of the socio-economic costs of the key policies. The comparison showed (see Figure 10) that the EEO was far more cost-effective than building codes and one of the reasons is that the Danish EEO targets all consumers including industry.

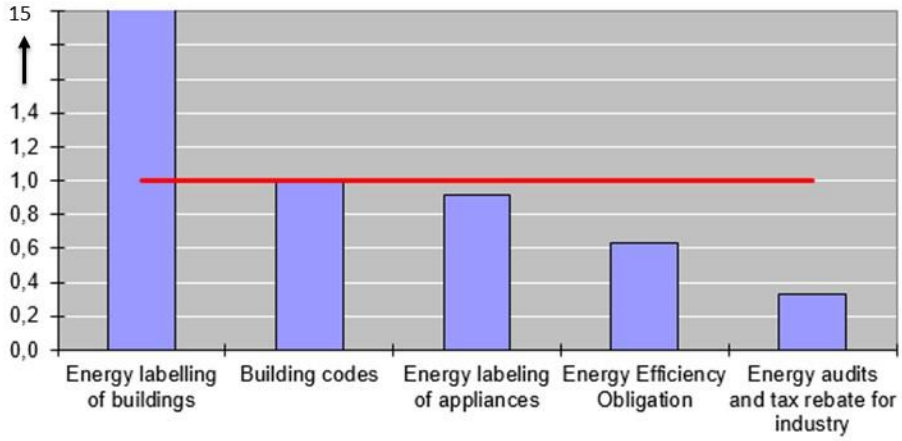


Figure 10: Estimated socio-economic cost of the key policies. A value of less than 1 indicates that the total cost of energy efficiency is lower than the cost of supplying energy (Togeby, Dyhr-Mikkelsen, Larsen, & Bach, 2012)

The difference in the socio-economic cost between the labelling programs, the EEO, and the energy audits and tax rebate for industry can be explained intuitively.

Firstly, the challenge with energy labelling of appliances is to get from the stage where customers are exposed to the label regarding the energy qualities of the appliance to actually acting on the information (i.e. that the customer actually chooses the energy efficient model over a less efficient model). The sensitivity to the energy consumption of appliances (and thus the energy bill) is not very high compared to other qualities (upfront investment costs, design, brand, colour etc.). The energy impact of the labelling is therefore moderate if no additional activities to motivate the customers to act energy efficiently take place.

Similarly with energy labelling of buildings. Furthermore, the energy labelling of buildings is relatively expensive since the associated review of each building is very time consuming.

Energy audits combined with a tax rebate program for energy intensive industry was introduced to protect energy intensive industries against the high CO_2 taxes that exists in Denmark (since energy intensive industries compete on international markets which are not subject to the same high level of CO_2 taxes). Energy intensive industry was offered the opportunity to enter a voluntary agreement. The agreement was that the energy intensive industries introduce certified energy management and carry out energy efficiency improvements that have a payback period of less than 4 years. In return, the industries were refunded part of their CO_2 tax payment. The energy efficiency improvement projects were profitable from a business perspective (as well as a societal perspective). Although this would in theory mean that the industries would realise these savings without the program, would frequently be other barriers that prevented these from being realised without the program.

The EEO lands in between the appliance labelling and the voluntary agreement. The EEO targets both small and large end-users. The main cost of the EEO is the cost of the contact with the end-users. The time it takes to find x kWh savings with a large end-users is in most cases less than the time it takes to find x kWh savings with a small end-users. Furthermore, many of the energy efficiency improvements that can found in the residential sector (i.e. small end-users) AND counted towards the EEO have a payback time of 10-15 years. The EEO therefore has a higher socio-economic cost than the voluntary agreements with energy intensive industries.

1.7 Financing

Except for the oil distribution companies, the obligated parties have monopoly status and the cost incurred as a result of their EEO activity is financed over the end-user energy bill. Energy bills are typically issued every quarter based on historic consumption and once a year adjusted to fit actual consumption of the most recent year.

The amount to be recovered for EEO activity is determined in advance as a temporary increase of the revenue caps on the basis of the average actual costs incurred by the relevant *sector* in the preceding year. On the basis of the financial information about the individual company's costs of meeting the EEO, there will be a retrospective adjustment at individual company level, so that the companies' actual costs are covered.

If a company in a given financial year has incurred greater costs than anticipated when determining the raised revenue cap for the relevant year, there will be a retrospective adjustment in the following financial year through a supplementary raise of revenue cap for that year. If a company in a given financial year has incurred fewer costs than anticipated when determining the raised revenue cap, the amount will be brought back to the consumers through a temporary reduction in consumer prices in the following financial year.

According to the Agreement of 13 November 2012, the individual companies' costs must be broken down by costs of administation of the agreement and other costs of acquiring the right to report energy savings. The administration costs of the agreement only includes costs incurred for documentation, quality assurance and reporting of energy savings, as well as the adminsitration cost of the branch organisations.

Furthermore, each of the energy sectors are obliged to report the costs at an sector aggregated level revealing the degree of trade and use of subsidies, as shown in Table 4 below.

	Item	%
1	The total costs of the grid or distribution companies	100%
2	Percentage costs of administration	
3	Percentage cost of external players through direct agreements between a grid and distribution company and/or its group company	
4	Percentage costs of subsidies to the end customer from a grid and distribution company and/or its group company	
5	Percentage costs of purchases of realised energy savings from antoher grid and distribution company	
6	Percentage costs of realisations in a grid and distribution company and of agreements with group companies (item 1 less items 2-5)	

Table 4: Breakdown of sector costs required by the Agreement of 13 November 2012 (DEA, 2012a). The first set of detailed values were to be developed for the activities in 2013 but unclarities in the reported data means that trustworthy results are not yet publically available.

The costs are reported annually to the Danish Energy Regulatory Authority without additional detail. The EEO system is designed in this way in order to minimise administration cost. The end-users are not informed about exactly how much they contribute to energy savings financed over their energy bill since also other items are included[10]. The level of cross-subsidisation between end-users is therefore unclear.

Benchmarking of cost is as mentioned earlier carried out annually to assess the cost-effectivenes of the activities of each obligated party. The danish Energy Agency may request those with costs among the 5% highest per kWh reported (however, always up to 25 companies) and the lowest per kWh reported to provide more detailed information that will allow an assessment of the individual company's efforts. Depending on the findings and whether the company is cooperative, the Danish Energy Agency may establish specific agreements with the relevant companies about adjusting their efforts and about their calculation of costs and impose special future terms for the company's implementation of energy saving efforts. No specific penalty has been outlined in the agreement.

[10] There are basically two cost items from energy saving initiatives that can be financed via the energy bill. Fixed costs associated with customer relations, such as meter rental in the electricity sector, and variable costs related to energy consumption. These financing options can be used alone or combined. Furthermore, there may be price differentiation within customer groups based on the voltage level. Price differentiation may be made in both the fixed and variable costs. In principle, it is also possible to exclude some groups of customers to pay energy saving contribution. There is currently no comprehensive inventory of how the obligated parties finance their energy efficiency efforts. The associations of electricity and district heating have produced guidelines for their members but there is considerable variation in the companies' practices.

1.8 Future planning

In order to ensure sound value for money while achieving the national energy efficiency targets in time, the Danish EEO is perceived as a dynamic instrument that requires continuous adjustment at regular intervals.

Questions that are repeatedly debated and assessed are among other:

- What should the **scope** of the EEO be – what is best addressed by an EEO scheme opposed to other policy measures?
- How can **a progressive and innovative market** for energy efficiency be ensured – what solutions should be allowed, what solutions can be standardised, and how to verify the impact of solutions?
- How can a **competitive market for energy efficiency** be ensured – which entities should be obligated (retailers or network companies) and how can third party involvement contribute to avoiding market monopoly?
- How can **cost-effectiveness** be ensured – What mechanisms are used to create motivation to improve cost-effectiveness created?
- How can the **administrative burden** (and thus administration costs) of all involved be minimised without jeopardising impact?

1.9 Summary of design features

An overview of the key design features in the current Danish EEO is provided in in Table 5.

Design feature	Denmark
Policy Objectives	To decrease total primary energy consumption by 7.6 % in 2020 compared to 2010.
Legal Authority	Voluntary agreements by obligated parties and the Danish Energy Agency within a legislative framework.
Fuel Coverage	Electricity, natural gas, district heating, and heating oil. The transport is not included.
Sector and Facility Coverage	Residential, public & private business and industry end-users.
Energy Saving Target	10.7 PJ/year for 2013-2014 and 12.2 PJ/year for 2015-2020. The target is in first year savings.
Sub-targets and Portfolio Requirements	None.
Obligated Parties	Distributors of electricity, natural gas, district heating (regulated monopolies), and heating oil.
Measurement, Verification, and Reporting	Distributors verify and report savings; can be calculated or deemed savings. Yearly random sample control.
Compliance Regime	Energy savings must be well documented and they must be verifiable by an independent party if chosen for control. Deficits in target realisation must be obtained in the course of the following year.
Penalty	None.
Performance Incentives	Yearly benchmark of savings and costs for obligated parties
Eligible Energy Savings	Distributors must engage third parties to achieve energy savings outside own distribution area or energy type except for transport
Eligible Energy Efficiency Measures	Many types, including energy audits, subsidies for efficient appliances, equipment and retrofitting; also small scale renewables
Trading of Energy Savings	Energy savings, when realised, may only be traded among obligated energy distributors
Funding	Cost recovery through tariffs

Table 5: Design features of the Danish EEO scheme.

2 International comparative analysis

In this chapter, the Danish EEO will be compared with similar schemes in other countries in the world. The examples are primarily from EU Member States where an EEO scheme has been in place for several years and where evaluations have been carried out i.e. France, Italy, and UK. Examples from Poland and Vermont (USA) are also included where relevant. The EEO schemes are:

- Energiselskabernes spareforpligtigelse, Denmark
- Certificats d'économies d'énergie, France
- Carbon emissions reduction target (CERT), UK;
- Il meccanismo dei Titoli de Efficienza Energetica (TEE), Italy;
- White certificate system, Poland.
- Energy Efficiency Vermont, Vermont, USA;

The comparison will address the topics: organisation (including the role third parties), targets, impact, costs, and financing. The comparison is based on a desk study and is not intended to be a comprehensive record of system design and experiences but rather to show the variety in possible implementation choices and illustrate the key elements for the success of the Danish EEO. A brief overview can be found in Annex V: Summary of reviewed EEOs.

2.1 Organisation

A distinction is made between obligated parties and executing parties. Obligated parties are those that have been saddled with the responsibility to provide energy efficiency improvements. Executing parties are those that are allowed to realise the savings. The obligation and the execution can be placed on the same parties but often the wish for competition makes it attractive to differentiate between these – the underlying assumption being that a larger number of actors will create a downward push on the cost per kWh realised energy efficiency improvement.

Obligated parties

In an EEO, the obligation can be placed on energy distributors, energy retail companies, or a combination of both. In many cases, the obligated party will not be the executing party. Therefore, the obligated party could be a distribution company, even if this company does not interact with the end-users. In addition to the network-bound energy providers, the obligation can be placed on fuel companies – either retail companies or wholesale/import companies.

The choice of obligated parties in the EEO schemes is often closely related to the scheme's energy coverage and the market structure of the dominant energy types (see Table 6).

Energy type	Distribution company	Retail company
Electricity	X	X
Natural gas	X	X
District heating	X	
Heating oil		X*
Transport fuels		X*
Other fuels		X*

*Table 6: Market structure by energy type. *Obligation could also be placed on wholesale/import companies.*

Table 7 and Table 8 list the pros and cons of placing the obligation on either the distribution or the retail companies.

Distribution companies	
Pro	Con
• Distribution companies are local monopolies, under regulated tariffs, thus easy to expand the existing regulatory regime to accommodate EEO. • Neutral in regards to customers contact and loyalty due to monopoly situation. • Stable regulated organisations that will not go out of business (as may happen with retailers) and low probability for newcomers and bankruptcy, minimising the related challenges in distribution of targets. • Recuperate their costs in the tariffs. • With proper tariff regulation, they do not have the strong push to sell 'more kWh', as is in the case of retailers.	• Do not have direct contact to end-user and thus may lack motivation to involve end-use energy efficiency. • It is a challenge to ensure effective regulation of tariffs. • The role of the distribution companies is primarily to measure consumption and operate the network.

*Table 7: Pros and cons of placing the obligation on energy **distribution** companies.*

Retail companies	
Pro	Con
• Can transfer costs to their clients – no need for regulation of tariffs, albeit cost still may be monitored. • Strong links to the final consumer. • Retail companies compete on price and agreement types as well as the ability to offer services. Obligations may encourage them to transform their business model away from pure commodity sales and towards energy service sale or at least to implement energy efficiency projects among their clients as an additional service*. • Uniquely placed to provide information about consumption through billing processes and to inform consumers about measures on offer*.	• May increase customer loyalty and thus limit the market movements further. • Larger retailers may be better equipped to offer energy efficiency service. • May be wary of reducing energy sales through promoting energy efficiency.

*Table 8: Pros and cons of placing the obligation on energy **retail** companies. *These aspects may also be beneficial if the retail companies act as third parties for the distribution companies.*

It is important to note that an obligated party may be permitted to operate outside its own energy type. Figure 11 illustrates a theoretical case where only electricity companies are obligated, but where savings can be counted in all energy types.

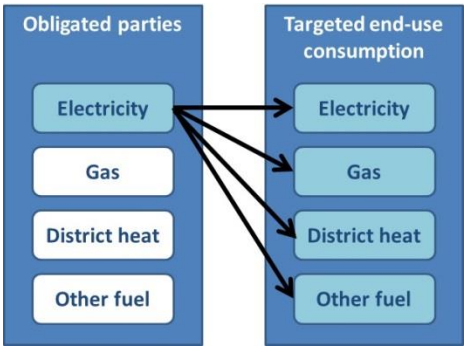


Figure 11: Illustration of a theoretical case where only electricity companies are obligated, but where savings can be counted in all energy types.

Executing parties

A distinction is made between the obligated parties and those entities that carry out the actual energy efficiency projects – the so-called “executing parties”.

The EEO may allow the obligated parties to acquire the energy savings in various ways:

- Energy efficiency projects that the obligated parties have executed directly themselves.
- Energy efficiency projects that end-users have implemented.
- Energy efficiency projects realised by third party either via
    - Bilateral trade,
    - Tendering the implementation of projects or engagement of a third party to implement energy efficiency projects on their behalf (e.g. technology supplier, ESCOs, installers, contractors etc.), or
    - Purchase certificates on a spot exchange market.

The general understanding is that if you allow any third party to produce eligible energy savings and fill the role of 'executing party' instead of the obligated party themselves, then the market for energy efficiency will be more competitive and the cost of energy efficiency lower.

Energy efficiency services can be provided by existing entities such as providers of technical equipment (lighting, motors, cooling, compressed air, etc.) and even the end-users. Most often industrial companies have agreements with equipment providers that also include repairs, maintenance, or even optimisation. It would be simple for these providers to add an extra service in the form of energy efficiency considerations. The execution could also be left to the end-user. In practise, however, the end-users may need help to deliver the needed documentation.

Tendering the obligation or part hereof to third parties can be imposed on the obligated parties. It is, however, not recommended to require obligated parties to tender out the bulk of energy savings, as this can result in high cost per energy saving – especially in an immature energy service market.

Important is to consider risks that the executing parties are expected to take. Experience from e.g. Denmark and Poland indicates that prices tend to increase if submitting a bid is associated with risks. In Poland, the first tender came to a standstill in 2013 because fewer bids than needed were submitted due to the risk of projects being rejected. The alternatives, e.g. to initiate individual projects or to enter framework agreements, may result in much lower prices and risk for the executive partner. If tenders are used the size of these and the formal requirements must be carefully designed.

The following table sums up the organisation of the EEO in the chosen case countries. More detail is provided in the text after the table.

Country	Who is obligated (number of obligated parties)	Who is the executing parties
Denmark	Distributors of electricity, natural gas, district heating, and heating oil (Approx. 500).	Anyone including the obligated parties and end-users
France	Electricity and natural gas retail companies, Large district heating and cooling distribution, heating oil retailers and transport fuel distributors that sell to end-consumers (Approx. 2,500).	Only, obligated parties local authorities, the National Housing Agency, and social housing landlords can produce eligible energy savings.
Italy	Electricity and natural gas distributors with over 50,000 final customers (Approx.72).	All electricity and gas distributors, companies operating in the sector of energy services (approved by the EEO regulator); and companies or organisations having an energy manager or an ISO 50001-certified energy management system in place.
Poland	Retail companies within electricity, natural gas, and 5MW+ district heating; large end-users operating on the Energy Exchange; and brokerage firms operating on the Energy Exchange (Estimated to 2,041).	Anyone including the obligated parties.
UK	Electricity and gas retail companies with more than 250,000 residential customers (6).	No limits
Vermont	Electricity distribution companies but the obligation is handled by a single entity 'Efficiency Vermont' (17 plus Burlington electric Department)	Efficiency Vermont created especially for the purpose to deliver state-wide energy efficiency programs.

Table 9: Overview of the organisation of EEOs in Denmark, France, Italy, Poland, UK, and Vermont.

Denmark

As described in section 1.2, the obligated parties under the Danish EEO is the distributors of electricity, natural gas, district heating, and heating oil. Heating oil distributors participate on a voluntary basis. For electricity, natural gas, and heating oil, the obligation is negotiated with the sector branch association. There is approximately 500 obligated parties, mainly due to a large number of district heating companies. Involvement of third parties are as described in the previous chapter an important component of the Danish EEO framework.

France

The policy objective for the white certificate scheme in France is to realise the diffuse but immediately available potential for energy efficiency in France, particularly in the residential and tertiary sectors. The obligated parties are electricity and natural gas retail companies, district heating and cooling distribution companies where the annual sales exceed a threshold (i.e. 100 GWh/year for LPG and 400 GWh/year for others), as well as heating oil retailers and transport fuel distributors that sell to end consumers. Although around 2,500 companies are obligated under the programme (mainly heating oil suppliers), but 80% of the obligation target falls to the two largest obligated companies (EDF and GDF).

In France, the obligated parties and some non-obligated parties can produce eligible energy savings, which are then used to create certificates. Obligated parties have a variety of options for meeting their commitments. They may:

- Implement energy saving programmes (within their customer base);
- Buy energy efficiency certificates; or
- Pay a penalty of 2 €cent/missing kWh (equivalent to 2.68 $cent/missing kWh).

In the first period of the French EEO (2006-2009), eligible actors included all the economic actors (legal entities) provided that the energy savings were additional to the main economic activity.

In the second period, the eligible actors were restricted to local authorities, social housing landlords, and the national association dedicated to building refurbishment (ANAH) (Baudry & Osso, 2011). Industrial and commercial enterprises whose main business is not energy efficiency and for whom the energy savings action produces no direct income to produce eligible energy savings, were thus excluded. It can be argued that the main reason for this exclusion was that the public administration in charge of processing the files for delivering the certificates wished to limit the number of actors that could submit files.

Thus, the involvement of third parties in France is much more restricted than in other EEOs (Baudry & Osso, 2011).

The non-obligated parties namely represented less than 10% of the certificates delivered but a larger part of the files to process, meaning more work for the regulator.

The ANAH was kept in the scheme, because they manage a specific program targeting fuel poverty ("Habiter mieux"), thus needing to be eligible for the contracts they pass with the obligated parties to get funding for this program. The associations of local authorities were very active in contacting members of the parliament so that they remain eligible actors (the same for social housing bodies) while it seems that the professional associations of companies did not really react to the proposition of restricting the eligible actors.

Another point of negotiations between the local authorities and the public administration was the minimum threshold of energy savings to submit a file. The administration wanted it high enough to limit the number of files to process, while the local authorities wanted it low enough to be able to submit a file. The compromise was to define a rather high threshold (compared to the first period), but with the possibility for an eligible actor to submit one file a year without any threshold[11].

Italy

Under the Italian EEO, approximately 72 electricity and natural gas distributors are obligated. The target is expressed in tonnes oil equivalent (toe) primary energy saved. The target is reached by the presenting a corresponding number of white certificates (each equal to one toe). Electricity and gas distributors may fulfil their obligation by implementing energy efficiency projects or by buying white certificates from other parties in the energy efficiency certificates market.

Each obligated party typically has an executing party inside the company group but most of the executing parties are private independent entities, and most of the certificates are delivered by independent entities. Parties eligible to submit projects for accruing white certificates includes all electricity and gas distributors, energy service companies (approved by the EEO regulator); and companies or organisations having an energy manager or an ISO 50001-certified energy management system in place. In order to produce eligible energy savings third parties must be accredited by the Italian Authority for Electricity and Gas (AEEG) as an energy service company (ESCO)[12].

More than 80% of the savings have been delivered by third parties, such as ESCOs. Obliged parties generally buy certificates on a market managed by GME or through bilateral negotiation with executing parties. The exception is

[11] Informal interview 8 August 2014 with researcher from Écoles des Mines, France.
[12] Please note that a large majority of the accredited ESCOs are not ESCOs as defined by the EU but instead installers of energy efficiency measures.

the massive hand-outs of compact fluorescent lamps (CFLs), which have been directly mailed or sold by retailers under the brand of the distributor that subsidizes them (Rezessy & Bertoldi, 2010)..

Bilateral contracts make up almost twice the amount traded in the spot market. The preference for bilateral contracts can probably be explained by the need for large obligated parties to obtain a considerable number of certificates with the smallest number of transactions possible. In the spot market, the supply is quite fragmented and mostly consists of ESCOs holding a limited number of TEEs. This is why the large obligated parties seek to enter into bilateral contracts, including multi-year contracts, with actors who can sell a sufficiently large number of TEEs. The residual quantities then found in the spot market. With the increase of yearly obligations, this pattern has become more common (GME, 2012).

Poland

In Poland, the EEO is placed on electricity and natural gas retail companies, district heating retail companies with a capacity above 5 MW, large end-users operating on the Energy Exchange, and uniquely for Poland brokerage firms operating on the Energy Exchange. The total number of obligated parties is estimated to 2,041. The EEO was placed on the retailers since they already operate in a competitive market and therefore have an incentive to minimise costs and they have contact to the end-users.

There is no particular focus on third party involvement in Poland but there is a wide access to third parties for project execution and sub-tasks. The aim is to encourage a wide range of executing parties and anyone including the obligated parties may function as executing parties. The actual number of parties bidding projects into an auction may, however, not exceed 200. The Polish Energy Regulatory Office (ERO) manages the auctions and approves projects for auction. Both planned and completed projects can be submitted for approval but first when a project is completed may it enter the auction. Executing parties (bidders) must have an account on the Energy Exchange for their achieved white certificates.

Prior to the EEO, energy auditors were required to have third-party liability insurance as well as to receive special training, pass an exam, and listed in a central registry. However, these requirements have been repealed, the latter in an attempt to create more job opportunities. In order to be sure that the energy efficiency audit is made by a competent person, it is recommended for the executing parties to ask for the information from an auditor about their

previous experience with concluding the energy efficiency audit. A penalty of up to 5 years exclusion from auctions can be given for lack of due diligence in audits by those submitting projects for approval by ERO.

UK

Between 2008 and 2012, the Carbon Emissions Reduction Target (CERT) was the main legislative driver for improving energy efficiency in homes within United Kingdom (not including Northern Ireland). As of January 2013 CERT was been replaced with two supplementary instruments, namely 'Green Deal' and the 'Energy Company Obligation' (ECO) (DECC, 2012). The change from CERT to Green Deal and ECO can be characterised as a "transition from a supplier obligation to a financing mechanism" (Rosenow, Eyre, & Croft, 2013). There is limited material available of the effects of Green Deal and ECO and the focus in this comparison is therefore CERT.

The obligated parties in CERT were the electricity and gas retail companies with more than 250,000 residential customers. Six retail companies were obligated throughout the whole CERT period.

Compared to the situation in Denmark, involvement of third parties and potential preferential treatment of obligated parties own installers etc. has been less of an issue in the UK during CERT.

In principle, there were very few limits in regards to executing parties and delivery routes and mechanisms under CERT. Obligated parties could deliver the savings by working directly with end-users or by working with third parties as executing parties. Obligated parties could combine the various delivery routes, choose to focus their efforts on one particular route, or spread their activities. This approach was primarily chosen in order to provide full flexibility for the obligated parties to achieve the CERT target with lowest costs, but also to support a transition of the retail companies to become more market orientated as energy service companies.

The obligated parties used a range of mechanisms to deliver their obligations. Principal delivery routes included offering measures direct to consumers and partnering with social housing providers. Other delivery routes included collaborating with retailers, manufacturers, and third sector organisations in conjunction with government programmes such as 'Warm Front'. In terms of how offers were most effectively communicated, visible and proactive promotion (e.g. door knocking) was considered key by both installers and householders

in driving uptake, by actively increasing awareness and engagement with CERT measures.

There are no available data as to how many and to what extent executing parties were involved in CERT.

Vermont

Vermont State in USA has had extensive energy efficiency programs since 1990. Originally, programs were run by the state's electric utilities under jurisdiction of the Vermont Public Service Board (PSB), but in 1999, the Public Service Board transferred operations to a new entity – 'Efficiency Vermont', a state wide "energy efficiency utility". The obligation to provide energy efficiency still formally remains with the 17 electricity distribution companies (not counting Burlington) but the separate institution 'Efficiency Vermont' is appointed to actually deliver the energy savings and demand reductions. This change made regulatory oversight easier.

Given the choice of set-up, the involvement of third parties is built in. The initiated energy efficiency programs have so far primarily consisted of rebates that could be combined with technical assistance and information. Rebates may constitute 10-40% of the end-user investment cost. Efficiency Vermont enters agreements with manufacturers, distributors, and retailers and these then offer rebates to their customers and return information on the sales and other key data to Efficiency Vermont. The benefits of the energy efficiency programs are thus open to those interested. Since efficiency Vermont handles the obligation on behalf of all utilities (except Burlington Electric Department), there is no issue of uneven competition among the utilities.

In summary, the choice of organisational set-up depends on the political objectives of the EEO and other energy policies as well as the level of ambition.

2.2 Targets and realised savings

When introducing an EEO, the level of the target can be lower in the first years. Later the obligation can be increased. It is thus important to prepare the legislation for increasing the target, in order to keep this option open and prepare the obligated parties for a potentially more ambitious target. Experience from other countries shows, that this approach has been widely and successfully used.

Yearly target help distribute the savings over the obligation period, thus avoiding delaying the realisation of energy efficiency improvements until the

end of the obligation period. The target can be distributed amongst the obligated parties according to their volume of final energy (sold or distributed).

Most EEOs permit banking and borrowing of energy savings from one year to the next within an obligation period or from one obligation period to the next. In case of an acceptable short-fall, the short-fall is allowed recovered within the next year but typically short-falls are not allowed from one period to the next. Similarly, surplus can be transferred from one year to the next. Surplus is more likely to be allowed transferred from one period to next than short-falls. Since failure to achieve net impact during the first years can be difficult to "catch up" before the end of an obligation period a limit of deficit between years can be imposed. In contrast, no limits to over-performance (banking) should be set, as this might discourage the obligated parties' involvement in e.g. larger energy efficiency projects.

Based in the international experience it can be recommended to be cautious about setting sub-targets that address particular policy objectives. Restrictions would potentially hinder that the market identifies and realises the most cost-effective savings thus countering the key policy objective of the EEO. Furthermore, it would complicate the reporting and verification procedures thus adding to the administration costs.

The table below shows a breakdown of the savings target for each of the studied EEOs, together with fulfilment of the target. This is further elaborated for each country in the following text. The table shows that in Denmark the obligated parties have achieved significantly more than the agreed targets, while they in Italy are lagging significantly behind. France has had two obligation periods, each followed by a transition phase due to delays in alterations of the legislative framework among other related to the 'Grenelle Act' (agreement on the sustainable development) (Court of Auditors, 2013). The obligated succeeded the target of the first period significantly. The Polish system has just been established and achievements are yet uncertain. The included target for the UK is the overall objective for the period 2008-2012, as there were no annual targets. Not all of the six British obligated parties met their goals, but overall, the target for the period was met. Vermont did not reach its objectives for the period 2009-2011 but this should be seen in light of the fact that Vermont exceeded the previous targets by 19%.

Country	Year	Target (GWh)	Reported savings (GWh)*	Target achievement (%)
Denmark (final energy)	2012	1,694	2,368	140%
	2011	1,694	2,094	124%
	2010	1,694	1,958	116%
	2009	778	1,044	134%
France (final savings cumac[13])	2015-2017	Minimum 600,000	TBD	TBD
	2014	115,000	TBD	TBD
	2011-2013	345,000 of which 90,000 is in transport fuels	TBD	(100% per 31 August 2013)
	Mid 2009-2010	None	99,100	-
	2006-mid 2009	54,000	65,200	121%
Italy (primary energy)	2011	61,639	39,542	64%
	2010	50,009	32,564	66%
	2009	37,216	26,749	73%
Poland (primary energy)	Jan 2013 - Mar 2016 (2013**)	25,586 (6,397)	TBD (25.3)	TBD (0%)
UK (lifetime CO_2-eqvivalent)	2008-2012	293 Mt CO_2	296,9 Mt CO_2	101%
Vermont* ** (final energy)	2011	120	101.5	85%
	2010	120	110.8	92%
	2009	120	84.9	71%

*Table 10: Percentage of goal attainment for Denmark, France, Italy, Poland, United Kingdom, and Vermont. *Note that the reported savings are not necessarily the same as comparable savings realised. ** Figures in parenthesis are for the first auction. *** In addition to the energy saving target Vermont also has targets for the reduction in summer and winter peak load (54.0 MW and 51.2 MW over 3-year period).*

A comparison of the set targets with the consumption level of the targeted sectors can be found in Figure 12 below. Please note that annual target is estimated based on a number assumptions that may deviate from reality. Furthermore the numbers for the final energy consumption and gross energy consumption include the transport sector, although only very little to no energy efficiency activity is taking place in this sector.

[13] Cumac – Cumulative and discounted (in French, cumulés actualisés). This term is used to refer to the annual delivered energy savings from an energy efficiency measure, summed over the lifetime of the measure and discounted at a standard rate.

	Target	Assumptions	Estimated annual target	2012 consumption	Share
DK	2012 target = 1,694 GWh final energy = 6,098 TJ	6,098 TJ	6,098 TJ	591,275 TJ final energy*	1.0%
				398,253 TJ final energy excluding transport sector*	1.5%
FR	2014 target = 115,000 GWh cumac final energy = 414,000 TJ	5 years, 4% discount	89,694 TJ	6,312,490 TJ final energy*	1.4%
				4,207,599 TJ final energy excluding transport sector*	2.1%
IT	2011 target = 61,639 GWh lifetime primary energy = 221,900 TJ	12.5 years (= 5 years and tau 2.5)	17,752 TJ	4,982,623 TJ final energy*	0.4%
				3,330,957 TJ final energy excluding transport sector*	0.5%
				6,833,503 TJ gross inland*	0.3%
PL	2013-2016 target (approx. 3 years) = 25,586 GWh lifetime primary energy = 92,110 TJ	5 years	6,141 TJ	2,664,287 TJ final energy*	0.2%
				1,940,068 TJ final energy excluding transport sector*	0.3%
				4,101,994TJ gross inland*	0.1%
UK	2008-2012 target (approx. 5 years) = 293 lifetime Mt CO_2e	30 years	10 Mt CO_2e	145.3 Mt CO_2e residential sector**	6.7%
VT	2011 target = 120 GWh final electricity	10 years	12 GWh	5,499*** GWh retail electricity sales	0.22%

Figure 12: Savings targets compared to the targeted consumption – estimates. Source: Eurostat (2014). **Source: DECC (2014). *** Source: US EIA (2013).*

Denmark

In Denmark, the target has been raised with each obligation period. The target for 2013 and 2014 is 10.7 PJ per year and is raised to 12.2 PJ per year for the period 2015-2020. The target development is shown in section 1.4. There are no sub-targets in the Danish EEO, however, it is indicated that projects in existing buildings and businesses should be prioritised. This is not quantified, but mentioned in the agreement text. Furthermore, extra weight is placed on measures with extra-long lifetime.

Annual savings targets for sectors represent an average over the 3-year obligation period and over- and under-coverage can be transferred between individual years. The deficit at the end of a calendar year may not exceed 35% of the year's average annual target.

France

In France, the first EEO phase (2006-2009) started with a target of 18 TWh_{cumac} for each year over 3-year period, in total 54 TWh_{cumac}. In the transition phase awaiting the outcome of Grenelle II discussions no obligation was formulated

but 99.1 TWh were achieved during the 1.5 years. The target for the second period (2011-2013) was more ambitious, namely 345 TWh_{cumac} over 3 years with a subtarget of 90 TWh_{cumac} for transport fuels. Currently, the French EEO is again in a transition phase and the target for 2014 is set to 115 TWh_{cumac}. This is likely to be followed by a target of minimum 600 TWh_{cumac} over 3 years (2015-2017) (Court of Auditors, 2013).

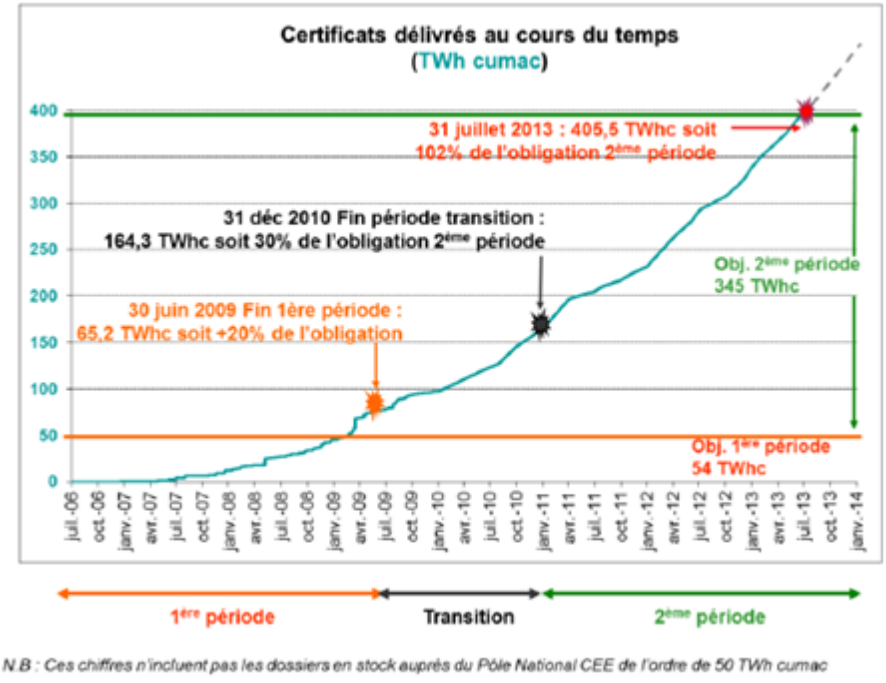


Figure 13: Issued certificates since 2006 (Court of Auditors, 2013).

In France, standardised measures dominate the market. Of the total volume issued from 2006 to ultimo August 2013 (405.5 TWh_{cumac}) more than 95% were standardised measures (see **Fejl! Henvisningskilde ikke fundet.**).

Banking is allowed in France within the obligation period. All major suppliers have fulfilled their energy saving obligations during the first periods and have adapted their commercial policy to include energy efficiency issues (Vieillefosse, 2013).

At the end of the first period, the energy retailers collectively achieved 120.7% of their first phase target at a cost equal to one-fifth of the penalty set by the French Government.

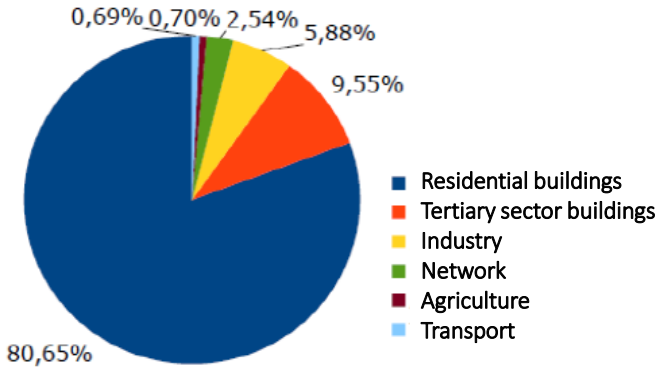


Figure 14: Realised standardised savings by end-user sector per end June 2013. (Court of Auditors, 2013)

83.8% of the savings were a result of activities in residential buildings, with over 72% of energy efficiency improvements being heating equipment improvements, particularly boilers and heat pumps. The reason behind the domination of heating efficiency improvements is a direct result of the tax breaks that were available for households for installing either more efficient boilers or heat pumps. ADEME estimates that in the first period the tax breaks were worth €1.3 billion (equivalent to $1.74 million) to consumers. This meant that the energy retailers had to put very little subsidy in at all, their work being more an exercise in bringing a little known tax break to the attention of households (Lees, 2014).

Italy

There have been three obligation periods in Italy: 2005-2009, 2008-2012 and 2013-2016 in Italy. The cumulative targets for obligated parties, set at a yearly increase of 200 Mtoe/year in 2005, were amended and raised in 2007 so that the target was 2.2 Mtoe in 2008 to 6.0 Mtoe in 2012. The 2016 obligation will be 9.51 Mtoe. Originally, the obligated parties were obliged to fulfil at least 50% of their target within their own energy type but banded targets are no longer used.

Figure 15 below shows the TEE targets and results 2005-2012. In the first period (2005-2007), there were an excess of white certificates on the market. This was followed by changes that have taken the market to the opposite situation. Especially in 2010, there was a lack of white certificates – not enough energy savings projects eligible for white certificates were implemented. This under-supply is carried on to the next years, as no opt-out fee is available for the obligated parties.

The main drivers of the changes over the years have been the raised target, the completion of the 5 years cycle for the first projects, CFL and certain other

measure are no longer permitted. Another point was that after years of small and fractioned energy efficiency measures, the value of the TEEs was not enough to further for example large projects for energy intensive industry.

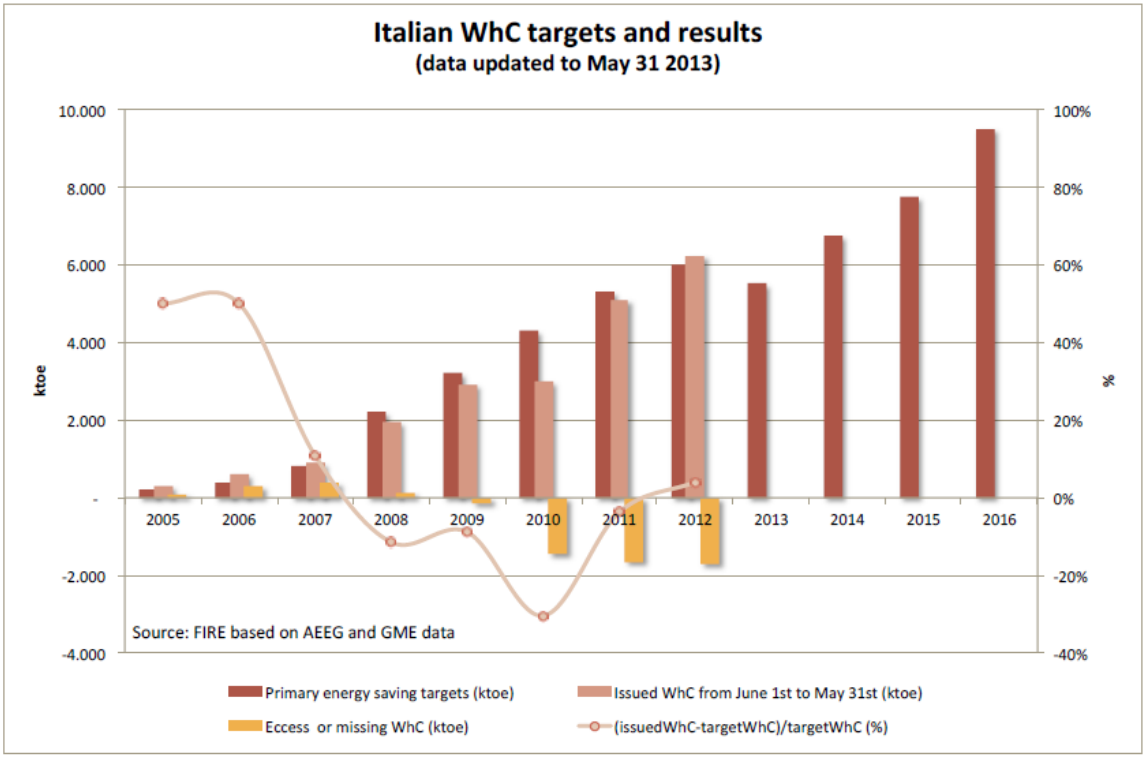


Figure 15: Targets and results for the Italian white certificates (Di Santo, 2013).

It should be noted that the results in 2011 and 2012 are affected by the introduction of the "tau" coefficient and that therefore the figures for the target and issued TEEs in these two years are not directly comparable[14].

By comparing the cumulative number of TEEs issued as against the cumulative level of targets for each year, it becomes clear that since 2008 the total number of issued certificates has been lower than the cumulative target. However, the obligation for any given year expires on 31 May of the subsequent year. Hence, participants may acquire a proportion of certificates issued in the first half of the subsequent year to comply with the obligation.

The general perception is that the targets have always been achieved – however, this is not necessarily so; the achieved savings have been sufficient to

[14] In 2011, a multiplier ("tau") was introduced that calculates energy savings by taking into account the technical life of the action, discounting them with a coefficient to consider wear and other causes of performance reduction over the years. The average tau is expected to be 2.5.

avoid penalties and penalties are only issued if the shortfall is more than half the targeted savings.

Poland

The target for the Polish EEO is 25,586 GWh (2.2 Mtoe) by 2016 – almost half the national energy efficiency target specified in the second 'National Energy Efficiency Action Plan'. The obligated parties are obligated to purchase white certificates equal to a certain share of their annual energy sales revenue in a given year namely 1.0% in 2013, 1.5% in 2014, and 1.5% in 2015. Alternatively, they have to pay an opt-out fee.

The intention is that at least once every year an invitation to tender is published and an auction held on the received tender bids. The first tender was published 31st December 2013 with a deadline for tenders 30th January 2014. The aim was to select the winning tenders in March but the process was delayed and the winning tenders were first selected 29th August 2014. The target for the first auction was 550,000 toe but only projects of combined 20,700 toe passed the first auction. Per 7 August 2014 only 2,179 toe have been traded (Client Earth, September 2013). It is therefore likely that a large amount of the obligation will not be met but instead the obligated parties will pay the opt-out fee.

UK

The UK EEO counts lifetime carbon savings. The target for CERT was 293 Mt lifetime CO_2e for the period 1 April 2008 to 31 December 2012. With an average of 30 years lifetime, this is equivalent to 3% yearly savings of total residential consumption in 2012. The target includes a sub-target for social equity reasons. 40% of the target must be met with savings in low-income households and/or elderly people (priority groups since 2008). In the extended target, 15% of the target must be realised amongst the most disadvantaged in society (super priority group since 2011) and 68% must be professionally installed insulation measures (Insulation Obligation, since 2011).

By 31st December 2012, 296.9 Mt CO_2 of carbon savings had been achieved, equivalent to 101.3% of the overall CERT target of 293 Mt CO_2 (Ofgem, 2013b). Figure 16 shows the carbon savings by measure type and year as a percentage of total carbon savings achieved while figure 17 shows the cumulative carbon savings by type of measure.

Measure	EEC2 Carryover	CERT Year 1	CERT Year 2	CERT Year 3	CERT Year 4	CERT Year 5	Total
Insulation (inc. Insulation obligation)	8.7%	10.4%	12.2%	9.1%	11.7%	14.2%	66.2%
Heating	1.4%	0.4%	1.1%	1.8%	2.2%	1.3%	8.2%
Lighting	2.5%	7.1%	4.4%	2.9%	0.4%	-0.2%	17.3%
Appliances	0.0%	0.6%	1.2%	1.3%	0.6%	2.2%	5.9%
Microgeneration & CHP	0.0%	0.1%	0.2%	0.3%	0.0%	0.2%	0.8%
Behavioural	0.0%	0.0%	0.0%	0.7%	0.1%	0.6%	1.5%
Demonstration actions	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Total	12.7%	18.6%	19.0%	16.1%	15.0%	18.5%	100.0%

Figure 16: Lifetime carbon savings by measure type and year as a percentage of total lifetime carbon savings achieved (Ofgem, 2013b).

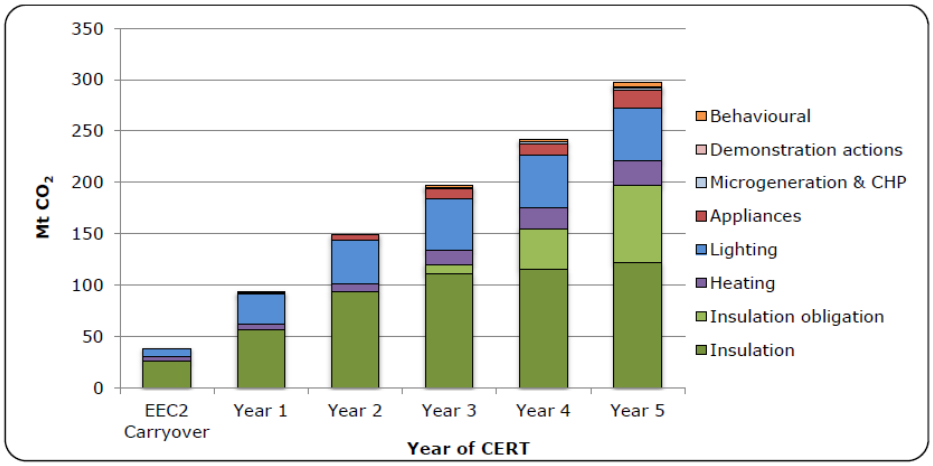


Figure 17: Cumulative lifetime carbon savings by measure type (Ofgem, 2013b).

Two obligated parties under CERT did not comply with their sub-target, one obligated party also missed its overall target. However, only one case of penalties has so far been enforced – an obligated party was judged to have provided incorrect information and sanctioned to make up for the savings plus pay a fine.

Vermont

For the 3 year period 2009-2011 the target of Energy Efficiency Vermont was 360 GWh for the 3 years combined (about 2% of 2008 electricity sales) and winter and summer peak demand reduction targets 51.2 MW and 54.0 MW respectively (about 5% of peak load). Certain geographical areas and certain end-user groups are considered more vulnerable than others are. Thus, there are special demand reduction targets for certain geographical areas.

Furthermore, of the $92 million 3-year budget for 2009-2011 'Efficiency Vermont' had to spend a minimum of $19.7 million on residential programs and $6.3 million on programs targeting low-income customers.

Overall targets were met but performance fluctuates somewhat from year to year. For the 3-year period 2009-2011, the result was 298 GWh – an average of 99.3 GWh/year – and winter and summer peak demand reduction results 42.7 MW and 53.5 MW, respectively.

Figure 18 shows the achieved annualised electricity savings 2000-2010. Efficiency Vermont saved 311 GWh in the contract period 2006-2008, exceeding its 3-year savings target of 261.7 GWh. In 2007 and 2008, savings from energy efficiency measures more than offset the average underlying rate of electricity load growth.

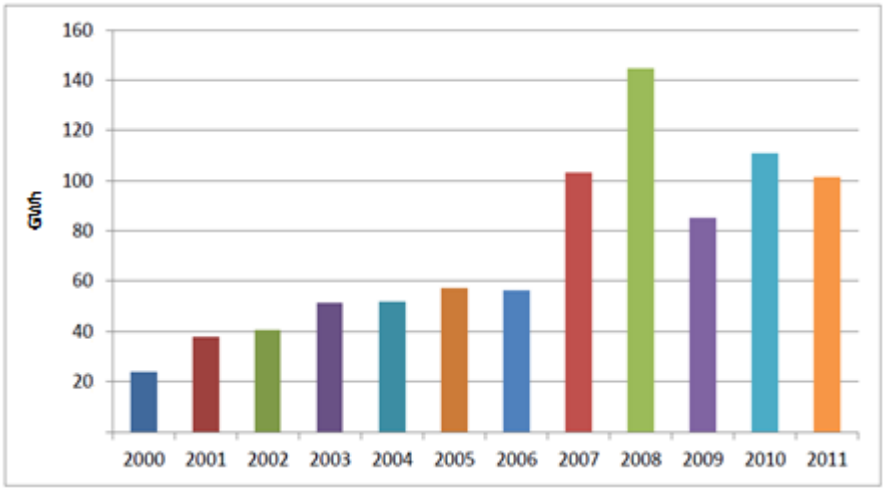


Figure 18: Annualised electricity savings (GWh) in Vermont 2000-2011 (Efficiency Vermont, 2012).

The key results for the most recent contract period (2009-2011) are presented in Figure 19.

	2009	2010	2011	2009- 2011 Total
Energy savings in megawatt-hours (MWh)	84,900	110,800	101,500	297,200
Total Resource Benefits (millions of dollars)[1]	$101.4	$112.0	$95.7	$309.1
Tons of CO_2 emissions avoided through efficiency	540,000	805,000	695,000	2,040,000

Figure 19: Key results 2009-2011 (Efficiency Vermont, 2012).

Sub targets

Freedom of method helps to ensure cost-effectiveness. When sub targets are set up for certain technologies, sectors or other specified areas, the market

conditions of the EEO changes. Consequently, this can result in higher costs for the total EEO. Annual targets for the realisation of savings, on the other hand, ensure stable costs over time and improve cost efficiency, as there is less risk of a sharp upward price pressure towards the end of the obligation period.

Lesson learned: Sub targets under CERT

Compared to Denmark, the efforts under UK's CERT were significantly more controlled. The EEO was not only limited to households but a share of the savings also had to be realized in designated segments of the market: From the beginning of CERT there was an obligation to realise 40% of the savings in a priority customer segment consisting of households of certain social benefits or with elderly residents. During the program added two new binding targets:

- 'Super priority group' – 15% of the total effort would be implemented in a subset of low-income families who were already included in the priority segment, but were considered to be at high risk of energy poverty and
- 'Insulation Obligation' – 68% of the total effort should be insulation of homes, installed by professionals.

Specific sub targets for selected customer segments was introduced in UK to ensure that the EEO was spread across all household types. Without a prioritisation of socially vulnerable groups, it was expected that these would be under-represented in the saving efforts. The further prioritization of vulnerable low-income groups were introduced at the same time as other energy poverty initiatives were repealed, and thus compensating the target consumers for some of this effect.

The 'Insulation Obligation' was introduced by the government to shift its focus from savings with the least cost for the obligated parties - the replacement of incandescent light bulbs in particular - to savings in the building stock. In the UK, the sub targets were largely realized at the expense of the cost-effectiveness of the effort.

Savings realised in socially disadvantaged groups are implicitly more expensive than the average, taking a major outreach in order to convince the customer to complete a project. In addition, this customer group only have limited capital or access to credit, which can cover the costs of the energy savings project and therefore can be difficult to engage in a project. The same type of savings project thus have higher costs simply because of customer segment. In addition, it proved difficult for the obligated parties to demonstrate that the savings were realised in the priority groups. The customers themselves were not motivated to provide information on their social conditions, and obligated parties chose in several cases, to over-fulfil the sub targets to be on the safe side.

The costs of achieving the target is not reported in the UK, and it is therefore not possible to quantify the total additional costs incurred as a result of the sub targets.

The 'Insulation Obligation' had a similar impact, albeit for other reasons. Insulation was already the most widely energy savings technology of the obligation, but the sub target nevertheless meant that efforts intensified in the area. Towards the deadline for the obligation, the demand for professional installers were so high that it pushed the price of the work up.

The situation in UK was further aggravated by the fact that the obligated parties were facing significant financial penalty (potentially up to 10% of global turnover), if they did not meet their individual obligations and sub targets by the end of the three-year commitment period. A slow start therefore created a large hump towards the end of the three-year period and a large increase in the price per savings. Requirements for annual progress could have distributed the effort more evenly, thereby somewhat reducing the price spike.

In the period leading up to the deadline, the instrument costs (subsidies) for many projects exceeded the investment and installation costs. The prospect of significant financial penalty if not both main target and sub targets were met, meant that there insulation projects was completed without co-payment by customers and many customers did even get a supplementary financial subsidy.

The clear conclusion from CERT is that when EEOs are used other political agendas than just energy efficiency improvement, this has consequences for the cost-effectiveness of the savings realised.

In Denmark, 44% of the savings was realised in industry in 2013, while 31% was realised in households. This is a direct consequence of the fact that larger and cheaper cost savings can be realised in industry. Freedom for the obligated to choose which end-users to target is in line with the core philosophy of cost-effectiveness in the Danish effort. If Denmark introduced sub-targets of for example buildings, the cost of the effort could be expected to increase. Partially because savings in buildings themselves are in the high end of the cost spectra and the saving per household customer is relatively small and partially because the administrative cost of directing the activities towards a specific sector generates extra costs.

In summary, the review of the various EEOs shows that targets are gradually increased or modified as the market actors gain experience and the market matures. Timely target achievement is important in order to realise the development goals of society.

2.3 Net impact

The net impact attributable to a given policy instrument used is often the object of scrutiny when policy instruments to promote energy efficiency are evaluated. The term “net impact” is easy to define but generally difficult to measure (Vine, Hall, Keating, Kushler, & Prahl, 2012).

Additionality

The net impact is defined as the additional energy efficiency impact resulting solely from the policy instrument in question. Thus, savings that would have been realised without the EEO do not contribute to the net impact. A saving is

deemed *additional* if it would not have been implemented or accelerated without the obligated party's involvement.

In Denmark, there is a strong focus in the public debate on whether the energy savings reported by the obligated parties, are additional. This topic does not give rise to the same degree of public debate in all EU Member States.

Value for money is the goal. The more additional savings the EEO can achieve per invested dollars the better. However, this does not mean that the regulator should strive to make sure *all* realised savings under the EEO are additional. A requirement for 100% additionality is not necessarily optimal since the costs associated with ensuring 100% additionality can be high.

The rules that define whether a specific energy efficiency project can be included must be simple and easy to use. In practise, this limits the possibilities of setting detailed requirements about additionality. In the strict sense a project is only additional if it would not be realised without the intervention from the obligated party (or a third party). However, it is not possible "to measure" what would have happened without a certain intervention since it is a hypothetical situation (also referred to as 'contra factual'). The additionality of an EEO is best analysed at macro level and with statistical methods, e.g. comparing the development in a large sample of end-users that has received support from the EEO and a large control sample that has not received support.

Furthermore, additionality cannot be determined once and for all but must be regularly assessed since in particular the free-rider ratio can vary greatly depending on end-user type, activity design, and external circumstances and does not remain constant over time.

With regard to achieving a certain amount of additional savings, the obligation target can be inflated to take into account a lack of additionality.

Denmark

The Danish regulator seeks to ensure a certain degree of additionality in the EEO without making the burden of proof (i.e. the documentation requirements) unnecessarily complicated. This means that the DEA has sought to minimize the requirement for proof of additionality of each project. Instead, the issue of additionality is investigated in the evaluation of the total EEO that takes place every 3 years.

One of the basic requirements in the Danish EEO is that the obligated parties must be involved in the energy efficiency improvement project prior to the realisation of a given energy saving. The involvement requirement aims to exclude at least some of the end-users who would have completed the project without the EEO (so-called “free riders” or “deadweight”).

In addition, certain types of energy efficiency measure are no longer permitted to be counted towards that obligation target. This includes for example white goods where the current market maturity, energy labelling, and minimum energy performance standards result in very low additionality.

Moreover, the methods used to determine the amount of savings realised, typically use the current average market situation or EU minimum energy performance standards as baseline rather than the situation at the end-user before the project is initiated (e.g. the existing equipment).

As a new feature of the latest revision of the EEO framework (DEA, 2012a) also requires that projects must have a payback period of more than 1 year if the obligated parties provides subsidies to the end-users.

Finally, the Danish energy Agency engages and independent evaluator every 3 years to evaluate the overall EEO including the overall additionality and cost-effectiveness of the EEO and providing the basis for an adjustment of the savings target and the framework of the scheme. The most recent evaluation found the overall additionality to be approximately 50% of the reported savings (Ea Energy Analyses, NIRAS and Viegand & Maagøe, 2012).

France

Per 31st December 2010, 95% of energy saving certificates issued were for standardised energy efficiency measures. The baseline of the majority of the standardised measures is the existing situation before initiation of the energy efficiency improvement. Energy savings achieved through implementing non-standard energy efficiency measures require approval of both the methodology and the level of savings achieved.

A review by Court of Auditors in 2013 found that the analyses made of the EEO impact are only partial and do not use ex-post data to assess impact. (Court of Auditors, 2013). The same review calls for a more frequent update of the standardised savings so that the latest market developments are taken into account earlier. The issues of additionality is in other words apparently not adequately dealt with.

Italy	In Italy, the baseline for calculating the savings is defined as the current market standard. In practice, an average of the traded products is used for lighting, electrical appliances, and boilers, while minimum energy performance standards for building serve as the baseline for savings in buildings. Apart from this, the potential free-rider effects are not considered. In Italy, personal tax credits have an important role to play when it comes to energy savings projects in privately owned buildings, and it is not clear whether the tax credit or the EEO is the driving force for the achieved energy savings. This is in itself not a problem, but the actual cost of the will be higher than it seems since the savings are lower.
Poland	In the Polish EEO, there are no plans to determine the additionality i.e. what extent the projects would have occurred on their own accord or a slightly later time. The savings are estimated as the difference between the before-state and the after-state. No particular consideration is given to the risk of lock-in effect – i.e. that sometimes it is more expensive if the whole project is not done at once, but only the cheapest measures, thus making the residual measures more expensive to realise afterwards. While there are no specific requirements for additionality, there are requirements for an energy inspection prior to approval of the project to be trading on the stock exchange and major projects also require verification of savings after the realisation of the project.
UK	In the UK, technical additionality based on market surveys of the energy performance of the products sold in the market place prior to the start of CERT and market saturation for the different products. A “statement of additionality of the project” was mandatory for actions involving third parties. In previous household energy efficiency programmes, Department of energy and Climate Change (DECC) has assumed that a certain level of measures that would have been installed in absence of policy is subsidised by the programme. However, in the CERT extension (2011) DECC assumed that the occurrence of this was negligible in CERT.
Vermont	In Vermont, as well as the rest of the United States, evaluation of the net impact is systematically assessed using several formal benefit-cost tests. Vermont uses 3 of the 5 classic benefit-cost tests identified in the ‘California Standard Practice Manual’, namely the utility/program administrator test, participant test, and social cost test. The social cost test is the primary test for

decision-making. An independent audit of the savings claims made by Efficiency Vermont takes place after each period i.e. every 3 years.

The calculation of net savings takes into account free-riders, free-driver/spill-over, persistence, and line loss factors. The lifetime of the measures varies depending on the measure in question. As a rule the baseline of the customised projects is the actual condition before the energy efficiency activity while the baselines for standard measures follows the federal baselines suggested by the US Department of Energy. However, for commercial and residential buildings building codes and characteristics specific to the state of Vermont are applied.

Evaluations are mainly administrated by Vermont Department of Public Service. Evaluations can be divided into impact evaluation and performance benchmarking. State-wide impact evaluations are conducted using a deemed savings database, the so-called 'Technical Reference Manual'. Changes to the 'Technical Resource Manual' are applied prospectively – just as in Denmark.

In summary, neither achieved savings or unit costs should be taken at face value without consideration of the degree of additionality of the EEO. A comparison of savings and unit costs across the different EEOs is not straightforward and perhaps a comparison across different policies within a country is more useful to provide insights that can lead to improvements in design and execution of the EEO.

2.4 Costs

The challenge for any EEO or energy efficiency policy is to ensure a downwards pull on the costs per net energy efficiency improvement. It is difficult to compare EEO costs across countries due to differences in the composition of the energy supply and demand, differences in end-uses, and differences in political agendas. Even within the individual EEO there can be justified differences in costs e.g. from one obligated party to another or from one year to another.

This section is therefore not intended to illustrate that one country is performing better than another. The intention is only to show the historical development in costs, how costs are handled, and how transparent the different regimes are.

Denmark

A benchmark of average costs in $cent/kWh first year savings showed slight increase in the average cost per kWh in the lates years. The cost for the

obligated parties were 6.6, 6.4 (excluding the savings realised by the oil companies), and 6.8 $cent/kWh for 2010, 2011, and 2012. The most recent evaluation of the EEO estimated that approximately 15% of the cost of the obligated parties was spent on administration (Ea Energy Analyses, NIRAS and Viegand & Maagøe, 2012). More information on the costs of the Danish EEO can be found in section 1.6.

France

During the first phase, there was little WC trading in the market place. The trading option was not heavily used, partly because of the restrictive rules governing who might be an eligible party to earn WCs in their own right, but also because of the reluctance of the two major energy retailers to purchase WCs on the open market. Consequently, less than 3% of the total certificates were traded in the first period, and the price was usually between 0.3 and 0.35 €cents/kWh$_{cumac}$ (equivalent to 0.40 and 0.47 $cents/kWh$_{cumac}$) (Lees, 2014).

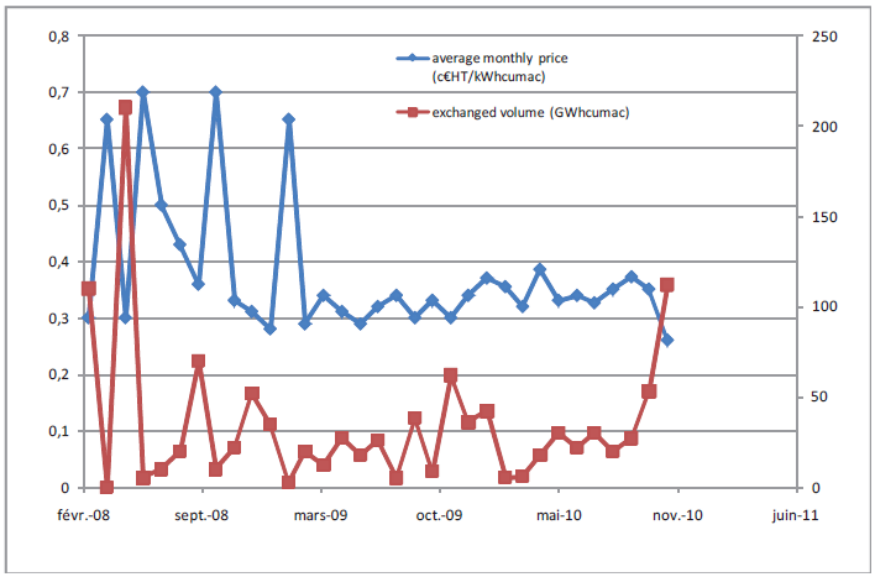


Figure 20: Volume (GWh$_{cumac}$) and price (c€ exclusive of VAT/kWh$_{cumac}$) of FESC traded in the national registry (Baudry & Osso, 2011).

The average price development of the traded certificates can be seen in Figure 21. Again, it should be noted that the majority of the certificates are not traded. A review by Court of Auditors in October 2013, explains that there is a great variation in the cost incurred by the obligated parties. The certificates created by the three largest obligated parties represent about 70% of the total certificates delivered since 2006 – EDF 41%, GDF 19%, and Total 11%. The cost of the certificates realised by the electricity retailer EDF is significantly higher than the average and even increased between 2011 and 2012, while

the obligated fuel retailers are able to create certificates at a much lower cost. It seems that the newest entrants to a larger extent provide subsidies directly to the end-users instead of intermediary third parties. The latter is the preferred approach of EDF and GDF and appears to be less cost-effective.

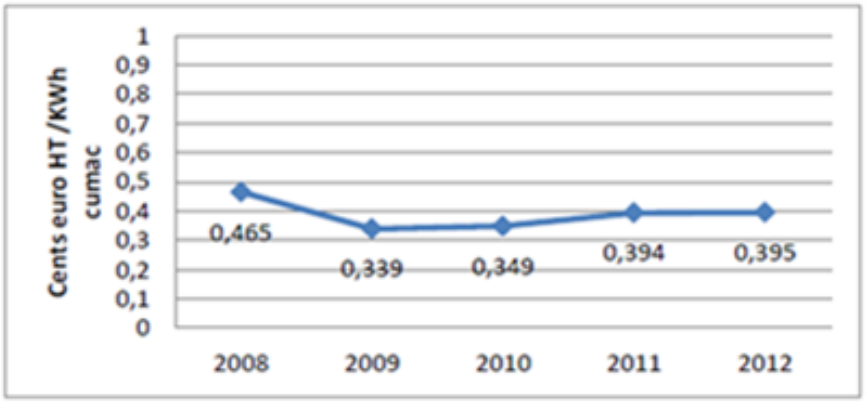


Figure 21: Development of the certificate price on the certificate registry EMMY (Court of Auditors, 2013). HT = excluding taxes (in French "hors taxes").

Furthermore, the administration cost of the obligated parties is estimated to about 20% of their certificate costs. The Court of Auditors conclude that the regulatory procedures related to the issuing of certificates are unnecessarily complicated and could be simplified resulting in a reduction of administration costs. In general, the Court of Auditors found that the lack a cost transparency does not permit adequate assessment.

In France, the administrative cost of the regulatory entities were in 2009 estimated to 700,000 €/year (equivalent to 937,345 $/year[15]) with 13 full-time equivalent positions (Bertoldi & Rezessy 2009). Today, this it is estimated to 17-18 full-time positions plus a few hundred thousand € for studies.

Italy

Trading of white certificate is a key feature of the Italian EEO, where distribution companies to a wide extend rely on other market actors to implement projects, and these are allowed to sell the certificates on the market. The certificates are traded in one session per week and the price of the certificates is determined based on bids from sellers and buyers. Both bilateral trade of certificates and trade via the formal certificate exchange market are allowed. Volume and prices from bilateral transactions are also made public.

[15] Applied conversion rate: 0.74679 €/$.

Having a white certificate scheme where all transactions and prices – both over-the-counter (bilateral) and spot market prices – are disclosed is inherently transparent. Furthermore, access to produce savings is open for a wide range of third parties.

The average weighted cost of compliance under the Italian EEO has varied a lot over the years as shown in Figure 22. However, the cost for the obliged parties depends on the policies and strategies of buying certificates. For market and bilateral negotiation, the cost for obliged parties depends on the availability of certificates. The lower the supply of certificates, the higher the market prices compared to the cost recovery value granted to the obligated parties.

Most certificates traded over the last years (both bilaterally and spot market) have been traded for 90-110 €/toe (equivalent to 121-147 $/toe and 1.04-1.27 $cent/kWh). The highest price on the spot market so far was 116 €/toe (equivalent to 155 $/toe and 1.34 $cent/kWh). The administrative cost (implementing authority) is financed via a "pass-through" tariff on the energy bill. The estimated administrative cost is 1 million €/year (equivalent to 1,339,065 $/year).

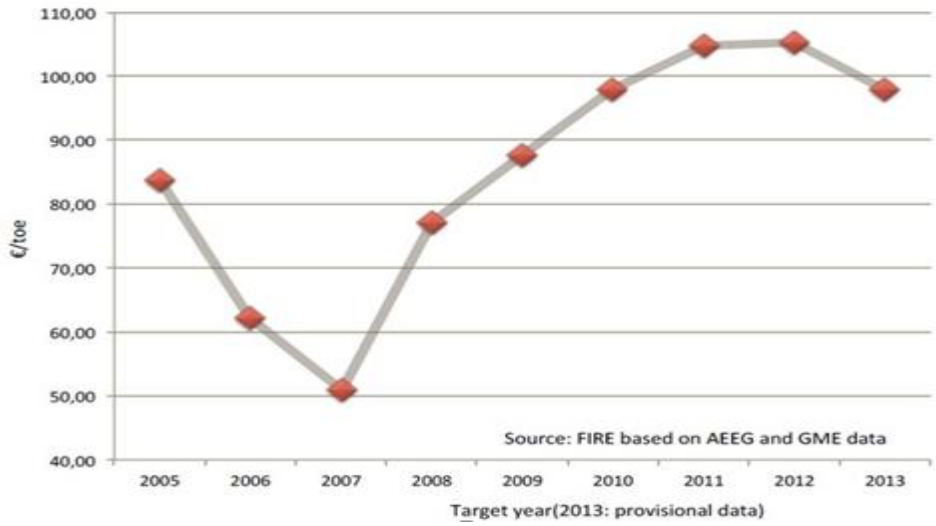


Figure 22: Weighted average white certificate price on the GME market (Di Santo, 2013).

Poland

The Polish white certificates are publically traded at the Energy Exchange and the price of the certificates is therefore known. Bilateral trade is also possible and the volume of the transactions and the minimum and maximum prices offered in a given day will be known.

The auction price in Poland will depend on the number of projects that are bid in and the demand from obligated parties. The 1,000 PLN/toe (equivalent to 319 $/toe[16]) opt-out fee is an alternative to buying savings on the auction, and thus functions as a maximum price.

The actual cost of the white certificate scheme is not yet known but the administration cost is estimated to 0.5% of the average white certificate price and the Exchange costs to also 0.5% of average white certificate price. The average white certificate price of the 2,179 toe traded per 7th August 2014 is 960 PLN/toe (equivalent to 306 $/toe). Thus, in total 969 PLN/toe or 83 PLN/MWh (equivalent to 309 $/toe or 2.6 $cent/kWh) average annual savings so far. (http://www.polpx.pl/)

UK

Only bottom-up estimates based on delivered measures is available for CERT in the UK, including the impact assessment provided by DECC which estimated the overall expenditure the scheme (2008-2012) to be around 5.5 billion £ (equivalent to 9.2 billion $[17]). Assuming 500 TWh realised saving, a deduction of 20% of costs based on historic experiences and the average lifetime of savings assumed to be 30 years the total cost is equivalent to an average of 0.26 £/kWh first year savings (equivalent to 44 $cent/kWh first year savings). This is however, an estimate with many uncertainties. Relatively, cost of compliance with the CERT target was much higher at the end of the period, *inter alia* due to that fact that incentives needed to realise savings in some cases were more that 100%, particularly for the super priority group where some companies offered cash as well as free insulation.

The cost to Ofgem for administration of the programme (including monitoring, verification, and auditing) was app. 1.03 million £/year (equivalent to 1.73 million $/year). The level of subsidies to end-users is unknown.

Vermont

According the annual report 2011 of Efficiency Vermont, the levelized cost of energy efficiency investments made by Efficiency Vermont in 2011 was approximately 1.6 $cents/kWh. To supply the same energy and capacity over the average 10-year life of the efficiency measures installed in 2011, Vermont electric utilities would have had to spend approximately 11.2 $cents/kWh, based on 2011 values of avoided costs.

[16] Applied conversion rate: 3.13466 PLN/$.
[17] Applied conversion rate: 0.59589 £/$.

A benchmarking assessment compared Vermont's 2008 energy efficiency programs (including Burlington Electric Department) against 9 other organisations identified as having above median savings at below median costs or as key peers (being in the Northeast, a state agency, or a publically owned utility). Furthermore, only comparative programs were used in the benchmark. The results showed that Efficiency Vermont's residential programs are relatively cheap measured per first year savings (0.11 $/kWh and 847 $/kW) and the commercial and industrial programs relatively expensive savings (0.34 $/kWh and 2,067 $/kW). Both is because lighting programs constitute a relatively high share of efficiency Vermont's activities. Lighting accounted for 94% of the residential energy savings of Efficiency Vermont. About 54% of the savings in the commercial and industrial sector derive from a direct installation program that focuses on lighting retrofits. Looking to the future, a shift from lighting towards a higher focus on efficiency improvements in buildings and heating is planned.

Stimulating cost-effective energy efficiency improvements

Trading

Trading can contribute to an increase in the cost-effectiveness of an EEO. This however, requires that the energy saving target established is sufficiently high with respect to the existing saving potential in the sectors covered by the EEO. "The more challenging the obligation is, the greater the benefit of trading as it brings diversity in the marginal costs of compliance among trading parties" (Bertoldi & Rezessy 2009).

France, Italy, and Poland have chosen to establish a system of formalised energy savings certificates, which are traded on an exchange but also allows for bilateral agreements. The bilateral agreements represent a large share of the savings. For some countries, however, the additional administration cost of establishing and operating a certificate exchange market may not justify the cost-efficiency gains of trading for obligated parties and society. Combined with (public) benchmarking of prices, bilateral exchange could achieve the same results as a certificate exchange market with regard to prioritising realisation of the most cost-effective measures first.

Performance incentive

In general, the obligated parties have incentives to minimise costs, however, specific motivation may be needed to ensure that the money is spent cost-effectively if the obligated parties are allowed to also be executing parties. One way to overcome this issue could be to require a certain minimum involvement of third party as executing parties. A first step would be to track whether there actually is an issue of lack of cost-effectiveness.

If the obligated parties are the distributors, it may be important with performance incentives. This can be part of regulated tariffs and may include a maximum cost per realised saving. If the obligated parties are retailers it may not be important to add special rules because they have strong incentives for keeping the price low. Either way, publication of costs will encourage obligated parties to improve performance.

Care should be taken when designing performance incentives so that it does not solely encourage pursuit of a high number of projects/savings (including free-riders) irrespective of the cost per additional savings.

2.5 Financing

A central feature of the EEO is how the activities are financed. Regulation and control of the cost are typically different for distribution and retail companies. Distribution companies are natural monopolies and spending is regulated. Determining the right level of cost-recovery can be a challenge. Retail companies, however, operate on market terms and no additional regulation is therefore needed. In both cases, transparency is key to cost-effectiveness.

It is important that the obligated parties not only have an incentive to deliver savings but also an incentive to limit costs per kWh saved. In a market situation significantly dominated by one player price pressure must be created in a different manner, for example by a requirement for public solicitation for bids and a maximum market share for each bidder.

In competitive energy markets, there are two possible cost recovery paths for an EEO. The costs of meeting energy savings targets are either:

- Treated as a cost of doing business and energy providers adjust their prices to recover these costs; or
- Funded by the government through direct budgetary appropriations, or additional charges are imposed on regulated network companies.

The first cost-recovery mechanism provides for a more stable instrument as financing of the EEO will not be part of the yearly budget negotiation of the government in competition with other policy priorities.

The costs of energy efficiency measures undertaken under an EEO will most often be passed through in energy prices, whether explicitly in regulated distribution charges or implicitly in retailer costs. In EEOs where regulated energy providers are the obligated parties, regulatory mechanisms to enable energy

providers to recover their costs are needed. Sometimes regulators also provide compensation for reduced energy sales.

Typically, all end-users will carry the cost of the EEO but not all will benefit directly from the EEO. Cross-subsidisation between end-users and sectors can occur when cost recovery is not coupled with sub-targets set for e.g. residential vs. industrial sector.

What level of cross-subsidisation can be accepted is a political decision. End-users sensitive to price increases are best compensated outside the EEO scheme.

Common to the EEO in Denmark, France, Italy, Poland, UK, and Vermont is that, is that the costs of the schemes are not covered through government budgets but charges on customers' bills. Vermont stands out as the only country amongst these that channels the financing through a fund rather than through the obligated energy companies.

Denmark

As described in section 1.7, cost recovery in the Danish EEO takes place through electricity, district heating, and natural gas network charges. The level of charges depends on local conditions, and is based on historical cost of recovery for each obligated party. Heating oil companies fund their effort through a private fund established by the branch organisation. The charges for the EEO cannot be distinguished on the end-user energy bill.

France

In France, there is no formal cost recovery system. Although the French gas and electricity sectors have been fully open to competition since 2007, gas and electricity prices for most customer classes remain regulated. The cost of compliance with the EEO target is taken into account when general tariffs are set by the regulator. The cost of achieving energy saving targets has been subsidised for gas retailers in part through funds raised by France’s natural gas consumption tax (Regulatory Assistance Project, 2012).

Italy

The Italian TEE is financed through the gas and electricity energy bill. Cost recovery for obligated parties is determined centrally by AEEG as fixed cost recovery through a tariff contribution, depending on the type of saving achieved. The cost recovery is a flat fee, which is not related to the actual cost incurred by the obligated parties. The administrative cost of the implementing authority (AEEG) is financed via a “pass-through” tariff on the energy bill. The

estimated administrative cost is 1 million €/year (equivalent to 1,345,329 $/year).

Poland

In Poland, the obligated parties can recover their costs from the end-user energy bills. The executing parties bid in projects to the exchange and therefore carry the risk of any fluctuations in auction price (or lack of performance in terms of energy savings). They also carry a renewed risk every year since they have to submit the same project again next year to be rewarded for savings in the next year. The cost covered by the state budget concerns the administration costs of the system – mainly the cost of the operation of the Energy Regulatory Office that is the implementing body of the white certificates system.

UK

In UK, cost is placed on the obligated parties who can recover their costs from the customers. The cost of CERT was considered "cost of doing business" as an energy retailer in the UK, and neither the total cost of compliance for obligated parties nor the level of subsidies to end-users was regulated or publicly known. The financing mechanism was not changed during the obligation period.

Vermont

Efficiency Vermont is funded via an "energy efficiency charge" on the electricity tariff of all end-users. Further, funding for heating and process fuel efficiency programs is provided via the nine state carbon trading scheme "Regional Greenhouse Gas Initiative" and the income from payments for capacity by ISO-New England[18].

The energy efficiency charge is set annually by Vermont Public Service Board. End-users pay based on the number of kWh and, for end-users served under a demand rate, the number of kW that they are billed for each month. There are six rate classes, and rates are the same for all members of each customer class. The 2013 energy efficiency charge ranges from 0.404 $cents/kWh to 1.011 $cents/kWh and from 89.54 $cents/kW to 99.65 $cents/kW, depending on customer class and demand charges.

The administrator's cost-recovery is partially dependent on target achievement in terms of real savings and partially on the associated economic costs: the more and cheaper savings are realized the greater the remuneration, and the fewer and more expensive savings, the lesser remuneration. In this way, Vermont seeks to stimulate a bulk of energy savings at a cost-effective price.

[18] ISO-New England is a regional non-profit transmission organisation that oversees the operation of the bulk of electric power system and transmission lines of member utilities.

3 Feasibility of EEO in Taiwan

In this chapter, we present a discussion on the relevance and feasibility of an EEO in Taiwan. The preliminary findings will be used as basis for a workshop in October 2014 with key stakeholders in Taiwan.

The chapter starts with a summary of the characteristics of an EEO and then moves on to sketch the energy efficiency situation in Taiwan. This is followed by preliminary conclusions regarding whether an EEO is a suited policy instrument suited for Taiwan today.

3.1 What characterises a successful EEO?

EEO strengths

Summing up the reviews presented in the previous chapters, the strengths of an EEO as an energy efficiency policy instrument are:

- Annual obligation targets create a push in the market for implementation of energy efficiency solutions that is not achieved by economic logic alone. The underlying assumption is that the current uptake of energy efficiency is deemed too slow and that that the EEO is designed so that under-achievement is sufficiently discouraging. Furthermore, it is assumed that the focus is on technical solutions and less on behaviour modification.
- The financing of the energy efficiency activities can be administrated by the obligated parties thus limiting the strain on public administration or another entity. Further, the financing regime creates a stable framework for the policy in the longer term, compared to programme funding subject to changes in public budget negotiations. Thus allowing time for an energy efficiency market to develop.
- The necessary funds can be collected through an existing system i.e. energy bills and does thus need a new separate collection system. (This can also be the situation in the case of levies on the tax bills.)
- An EEO permitting third party access to the execution of energy efficiency projects and with cost transparency can even in a situation where the obligated party is a monopoly create a certain amount of market competition and thus a downward push on the cost. The underlying assumption is that sufficient competition can be achieved.
- An EEO can increase the impact of policies such as labelling and minimum energy performance standards. Furthermore, energy audits and energy management systems can identify opportunities for energy efficiency activities permitted under the EEO.

- Provided that a relatively high degree of freedom of choice is permitted with regard to energy efficiency activities, targeted end-users, and energy carriers then the market will seek out the most cost-effective energy efficiency projects. The underlying assumption her is that there is alignment between the societal benefits of the energy efficiency projects and the benefits to the obligated parties and the executing parties.

Note that a certain amount of cross-subsidisation between end-use sectors (residential, industrial, tertiary/other) can be expected since experience shows that industrial energy efficiency projects are very cost-effective (large savings per contacted end-user and short payback time). And naturally there will be cross-subsidisation between participants and non-participants. This is, however, not different from many other policies.

Critical elements

An EEO is a success if the EEO:

- Delivers the energy efficiency impact indicated in the obligation targets,
- Is cost-effective,
- Permits market driven innovation of new energy efficiency solutions and approaches, and
- Is in alignment with other energy efficiency, energy, and societal development goals and policies.

The appropriate choice of EEO design is not universal; the EEO must be composed to fit the unique cultural context and history of the country in question. However, four elements are critical for a well-functioning EEO:

- Presence of sufficient and strong/competent market agents – regulator, obligated parties, and executing parties,
- Transparency of costs,
- Adequate compliance/performance incentives, and
- Repeated adjustments and updates based on monitoring and evaluation.

Rules of thumb

However, some generic rules of thumb can be derived from the review of existing EEOs. These “recommendations” are listed below.

Overall EEO:

- Keep the set-up simple.

- Give the obligated parties as much freedom of method as possible regarding how to realise the potential.
- Keep the EEO design dynamic and updated in order to address e.g. loopholes.
- Recognise that compromises will be necessary.

Obligation targets:

- Start at a modest level and plan periodic increases. Formulating targets in final energy savings can be easier to communicate to end-users than e.g. gross energy savings or carbon savings.

Obligated parties:

- The obligation can be placed on grid (monopoly) or retail (market exposed) companies. Including all types of energy can help avoid distortions among energy carriers but a first step could be to include a selection only.

Executing parties:

- There is no reason to restrict who can be executing as long as rules for documentation etc. are complied with. The energy efficiency projects could be realised by the obligated parties, end-users, or third parties (e.g. technology supplier, ESCOs, installers, contractors, etc.). Projects realised by third party can be obtained via bilateral trade, tendering, or a spot market exchange (as in Italy and Poland).
- Tenders should be used carefully since tendering can result in high cost per energy saving – especially in an immature energy service market where strict documentation conditions and perceived risks may increase the costs the underlying assumption being that the risk of failure or high cost is carried by the bidder.

Consumption sector coverage

- The choice of end-user sector coverage and energy carrier coverage should be aligned with the national energy efficiency ambitions and the political context – For example, a focus solely on energy intensive industries and other large industries may result in a higher impact on national energy intensity than a focus on all sectors including the residential sector, but it might be difficult to justify a levy on the tariffs of all end-users if not all segments have the opportunity to benefit. Another example: If lowering carbon emissions is a priority then important fossil fuel end-uses could be the focus of attention.

- Accept overlap with carbon trading and taxation schemes since carbon trading shcemes are “just” an economic signal and the EEO can provide additional push.

Permitted energy efficiency measures:

- Focus on technical measures with an expected lifetime of more than 4-5 years.

Types of intervention that the involved parties may use:

- Give freedom to obligated parties and executing parties to find productive ways to interact with the end-user. A decision should be made whether to permit technical advice only or also subsidies.

Measurement and documentation to be provided by the obligated parties and executing parties:

- Ex-ante computation and approval of savings reduce company risks and administration.
- Prepare standard values for the most common types of measures in the mass market (e.g. white goods).

Reporting to the regulator and verification of the reported information:

- Yearly reporting of realised savings.
- Yearly control of a sample of reported savings.
- Simple documentation of additionality.

Trading of energy efficiency savings once realised:

- Encourage bilateral trading between obligated parties and with third parties.

Performance incentives:

- Must be adjusted to the chosen type of obligated parties.
- Sample quality checks of for example the top ten and bottom ten performers (as in the Danish EEO).

Non-compliance regime:

- The most appropriate method for ensuring compliance depends on the cultural context – with “name & shame” at the one end of the scale (used in the Danish EEO) and heavy financial penalty at the other end (used in the UK EEO).

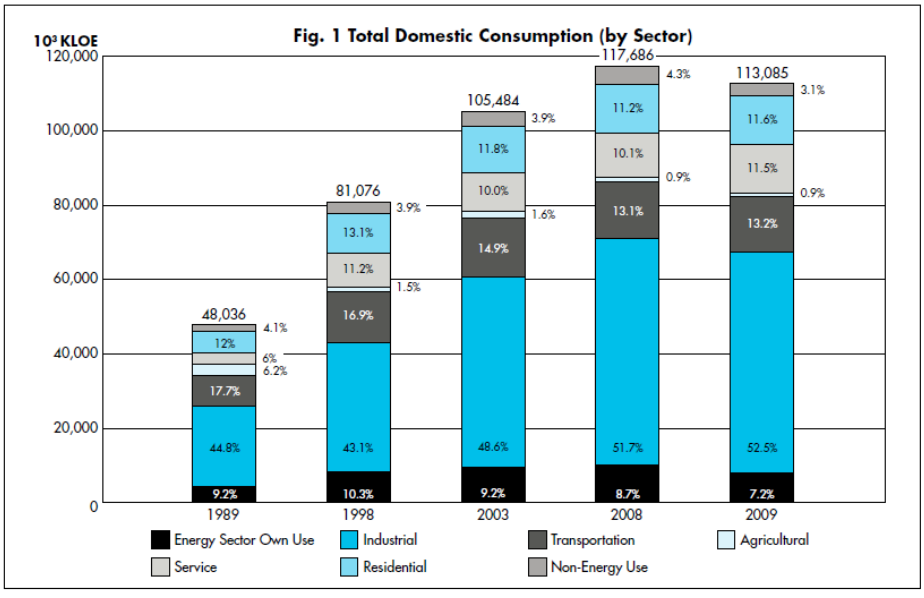
- An option to pay a penalty instead of fulfilling the target is detriment to the EEO concept which is to push for more speedy uptake of energy efficiency and therefore socalled “opt-out” payment should not be permitted.
- A financial penalty may act as a maximum (a “cap”) for the costs of achieving the target and can risk becoming the guiding price level for the energy efficiency market. The size of the cap is therefore important and updates should be possible.

Assessment of EEO impact and cost-effectiveness:

- Periodic evaluation with a broad in-depth perspective that allows assessment of the additionality of the activities and improves the understanding of the operation of the EEO.

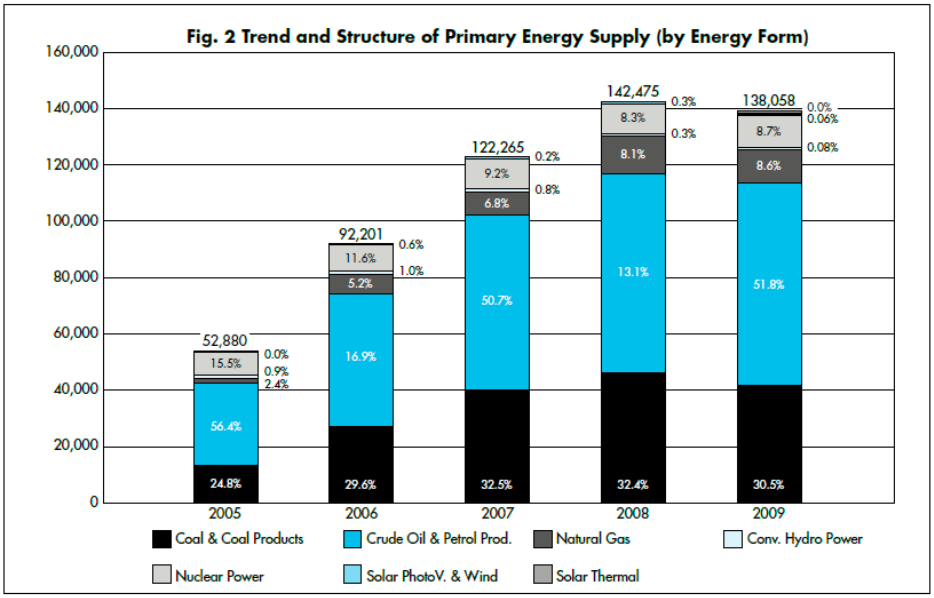
3.2 Is an EEO a policy instrument suited for Taiwan today?

In 2009, less than 1% of the energy consumption was supplied by indigenous resources and fossil fuels constituted more than 90% of energy consumption (see Figure 23 and Figure 24). The picture remains the same today (see Figure 25). It is clear that Taiwan is highly vulnerable to interruptions of energy imports and global fluctuations in energy prices. The industrial sector is by far the largest energy consuming sector.



Source: Bureau of Energy, Ministry of Economic Affairs, *Energy Statistics Handbook, 2009*, (Taipei: Ministry of Economic Affairs, 2010).

Figure 23: Total final energy consumption (million kilolitres of oil equivalent) of Taiwan by sector 2005-2009 (Chang, 2012).



Source: Bureau of Energy, Ministry of Economic Affairs, *Energy Statistics Handbook, 2009*, (Taipei: Ministry of Economic Affairs, 2010). Available from http://www.moeaboe.gov.tw/opengovinfo/Plan/all/WorkStatisticsAll.aspx

Figure 24: Total primary energy supply (million kilolitres of oil equivalent) of Taiwan by energy carrier 2005-2009 (Chang, 2012).

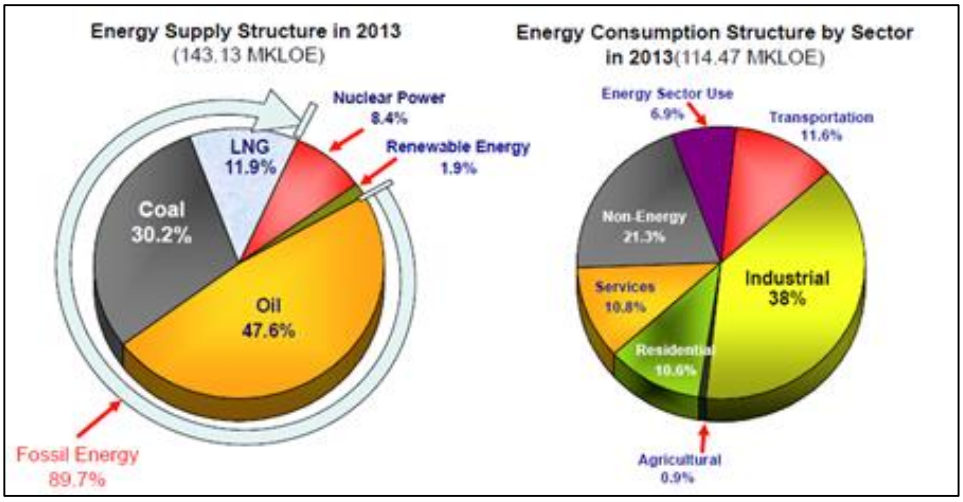


Figure 25: Taiwan total 2013 primary energy supply by energy carrier and energy consumption by sector (million kilolitres of oil equivalent) (Taiwan Industrial Technology Research Institute, 2014).

Relevance of an EEO in Taiwan

The relevance of an EEO for Taiwan depends on the level of political ambition for energy efficiency and energy in general relative to what is being achieved with existing policy instruments.

Overall energy policy

As a consequence of Taiwan's limited indigenous fossil energy resources and extreme dependence on energy imports the priorities of the Taiwan energy policy concern:

- Security of supply,
- Protection against price volatility, and
- Carbon emission reduction.

Political energy efficiency commitment

The Taiwan government regards energy efficiency as an important means to achieve these goals.

An EEO is a significant policy instrument that has a long-term character since it aims to build and strengthen a market for energy efficiency and involves many stakeholders. A strong political commitment to energy efficiency and longterm strategic development goals for energy efficiency are therefore necessary to obtain maximum benefit from introducing an EEO.

Taiwan has set itself very ambitious energy and energy efficiency development goals. In the 'Strategy Framework of Sustainable Energy Policy', announced by Taiwan's government in June 2008, the declared ambition is to improve the overall energy efficiency by more than 2% per annum, and it is expected that the energy intensity will decrease 20% by 2015 compared with 2005 level. This includes changes in intensity due to changes in the composition of the economy towards a higher share of non-energy-intensive industries. Supplemented by further technological breakthroughs and proper administrative measures, energy intensity is aimed to decrease 50% by 2025.

The development in energy intensity in the period 2008-2012 has been a 2.92% average decrease per year (see Figure 26). If 2013 is included then the annual decrease achieved has been 2.45%.

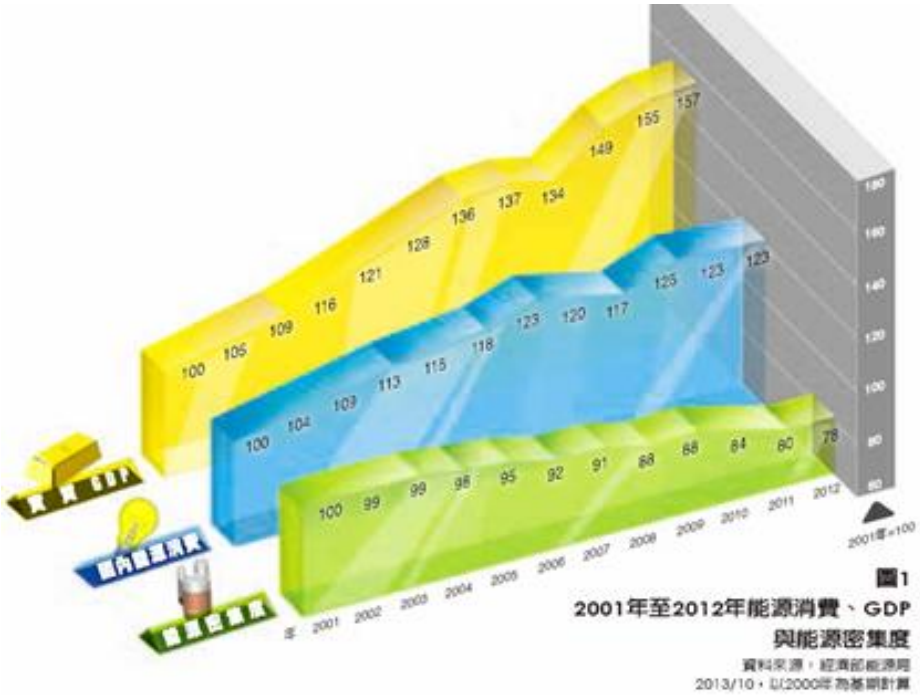


Figure 26: Development in GDP, energy consumption, and energy intensity 2001-2012 (Bureau of Energy, Taiwan Ministry of Economic Affairs, 2013).

Other legislation pertinent to energy efficiency includes:

- Nuclear-free homeland policy, 2002
- Renewable energy development act, 2009 – 16% RE capacity by 2025, feed-in tariff (has currently only 530 MW onshore, aim is 1.2 GW onshore and 3 GW offshore by 2030)
- Energy Management Act, July 2009
- Industrial Innovation Act, April 2010
- National master plan on energy conservation and emission reduction, May 2010
- Income Tax Act, May 2010
- New energy policy, November 2011
- Energy Development Guideline, October 2012
- Greenhose Gas Reduction Act, not yet passed

Key drivers for energy efficiency are true costs of energy and internalisation (e.g. in monetary terms) of political concerns regarding security of supply, robustness against global energy price fluctuations, and environmental impact of energy exploitation. Efforts have been taken to increase energy/electricity prices to represent true costs. In return, energy efficiency can help lessen the strain on end-users deriving from energy price increases.

It is, however, well recognised that not all barriers to energy efficiency can be translated into price signals and be overcome by applying economic logic. Given the ambitious energy efficiency goals of Taiwan and the progress achieved so far, an additional push is needed to meet these goals and an EEO could consitute such a driver.

Existing policy instruments include the following ((Taiwan Industrial Technology Research Institute, 2011) and (Taiwan Industrial Technology Research Institute, 2014)):

- Mandatory programs
  - Minimum energy performance standard for manufacturers and importers, introduced in the 1980's starting with non-ductive airconditioners (1981), refrigerators (1984), cars and motorcycles (1987), fluorescent lamps (2001), 1-phase and 3-phase induction motors (2002), self-ballasted fluorescent lamps (2007), ballasts (2009, compact fluorescent lamps (2010), dehumidifiers (2011), incandescent bulbs (2012), and LED (2014);
  - Energy labelling of end-use equipment (http://www.energylabel.org.tw/index_en.asp);
  - Energy audits for industrial customers, energy management for the top 6 energy intensive industries, and 3 mandatory energy efficiency improvement measures (reduce leakages in aiconditioning, ban of incandescent light bulbs, and lower indoor airconditioning temperature) for certain service sector businesses (11);
  - Procurement requirements, started 1999, concerning airconditioners, refrigerators, self-ballasted fluorescent lamps, compact fluorescent lamps, dehumidifiers, clothes washers, and water fountain machines; Furthermore the public sector's "Four-saving program" has as target to reduce electricity, oil, water, and paper consumption by 10%, 14%, 12% and 40%, respectively, by 2015 relative to 2007.
- Voluntary programs
  - Energy conservation label, started in 2001, per October 2011 it included 34 categories and contracts with 308 manufacturers covering 4,878 products;
  - Public awareness raising, education and promotiona ctivities;
  - Incentive programs, for example the incentive program 1st October 2008 – 31st March 2009 for airconditioners,

refrigerators, and clothes washers with an energy cnservation label.

Figure 27: The Taiwan energy conservation label (left) and energy label (right).

An EEO can constitute a valuable addition to such instruments enhancing the impact and cost-effectiveness of the total portfolio of energy efficiency policies. Lessons learned from existing energy efficiency policies on what works and what works less well are important input to designing an EEO that is suited for Taiwan and to formulating a suitable policy mix including an EEO.

Feasibility of an EEO in Taiwan

The following initial assessment of the energy situation in Taiwan is based on a review of only a few reports and articles. It is therefore only to be considered as *preliminary* and a starting point for a more detailed assessment of the relevance of an EEO to Taiwan given the current and historical context of Taiwan and the political ambitions for the future development of Taiwan.

The assessment is a comparison of the requirements for a succesfull EEO compared to the existing “building blocks” available today.

Price signal

End-user energy prices are not fully true cost energy prices. This has among other as consequence that state-owned power company, Taipower, is substanitally in debt.

At the same time, a program has run for several years that rewards residential end-users for reducing their consumption. All residential end-users – irrespective of the absolute level of consumtion and economic capacity – that can show a decrease in their annual electricity consumption from one year to the next receive an economic reward. The total amount of subsidy provided by this scheme peaked at 8.0 billion TDW and reached 3.6 billion TWD last year.

Agents

Taiwan has focused on energy efficiency for several years and the necessary capacity among key agents is therefore likely to exist.

At the state level the overall regulatory oversight for an EEO could reside with the Taiwan Ministry of Economic Affairs (MOEA), perhaps represented by the Bureau of Energy. A strong regulator is key to good oversight.

The state-owned power company, Taipower, holds a national monopoly on electricity production, transmission, distribution, and retail and would therefore be a likely candidate as obligated party. Retailers of other types of energy carriers (oil, LNG, LPG, coal) exist and, if above a certain size, could also become obligated parties if the intention is to realise energy efficiency improvements within all energy carriers. An alternative could be to permit that Taipower pursues energy savings among all energy carriers and not only electricity.

The monopoly situation of Taipower is in principle no hindrance to an EEO if cost transparency in order to assess value-for-money can be ensured and for example competition among executing parties can be ensured. Benchmarking of the costs can be made relative to other energy efficiency policies or to EEOs of other countries. Special attention should, however, due to the state-ownership be given to ensure clear sepeartion of regulatory oversight and the activities of Taipower.

It is critical that evaluation – and – perhaps also the monitoring – is carried out by an independent party due to the state-ownership and the monopoly situation. Such an open approach would limit the risk of unjust criticism and promote a “healthy” operation.

Financing

Collecting funds via tariffs is not a novel concept to Taiwan and the issue of concern is therefore more whether a (new) levy on the energy tariff can be tolerated by the end-users.

EE market

A market for energy efficiency solutions already exists in Taiwan, supported by labelling schemes. Energy efficiency service providers include among other

- Taiwan Energy Service Association (TESA), established August 2008, and
- Taiwan Association of Energy Service Companies (TAESCO), established June 2005.

Other stakeholders including (but not nessesary limited to) large end-users could also be given access as executing parties.

The TESA and TAESCO entities could be useful vehicles for sharing know-how, lessons learned, and ideas in relation to an EEO.

Furthermore, experiences and information from the energy audit scheme can provide a valuable input for the EEO and point to areas of significant energy efficiency potentials within the audited sectors.

Coverage

Given the energy development priorities of Taiwan (security of supply, etc.) there is no reason to limit the EEO coverage to the electricity sector. There may, however, be other justifications for a limited coverage.

An option could be to limit the EEO to certain end-use sectors. A gradual phase-in could start with the industrial sector since it is likely that large savings can be found here at a relatively low cost. Another option could be to start with those segments most vulnarable to increases in energy prices. But as mentioned earlier, given the high energy efficiency ambition and the significant challenge it is to realise the ambition, a larger coverage will provide a larger basis for finding cost-effective energy efficiency oppertunities.

Similarly, it is not necessary to limit the coverage to certain end-uses.

3.3 Where to start?

If a decision is made to proceed with the development of an EEO for Taiwan, a first step could be to establish the total **quantity** of energy savings that has to be achieved by the EEO and the unit of measurement (e.g. kWh final energy) and spread over the obligation period. It should also be established which end-use sectors and energy carriers are to be **targeted** so that the required amount of energy savings can be achieved.

Next would be to select the key features of the EEO design, namely

- Choice of obligated parties and executing parties,
- Method for distribution of the obligation target among obligated parties,
- Financing and cost-recovery methods,
- Trading possibilities,
- Performance and compliance regime, and

- Permitted intervention methods.

It might be relevant with a gradual phase-in and a plan for the phase-in must be determined already well ahead to give the involved parties sufficient time to adapt.

Then follows the more detailed design of the EEO. This includes choices regarding permitted energy efficiency solutions, methods for calculation of savings, procedures for reporting and verification, and procedures for monitoring and evaluation.

4 References

Baudry, R., & Osso, D. (2011). Energy certificates in France: A new frame for the second period (2011-2013) and afterwards. *ECEEE 2011 Summer Study*, 447-454.

Bertoldi, P., & Rezessy, S. (2009). *Energy saving obligations and tradable white certificates.* Report prepared by the Joint Research Centre of the European Commission.

Bundgaard, S. (2013). Evaluation of the Energy Efficiency Obligation in Denmark. *ECEEE Summer study Proceedings*.

Bureau of Energy, Taiwan Ministry of Economic Affairs. (2013). *Energy conservation - Efficient and effective.*

Chang, S.-l. (2012). *Taiwan's energy conundrum – special report,.* Asia Program, Woodrow Wilson International Center for scholars.

Client Earth. (September 2013). *Black paper: Implementation of EU Climate and Energy Law in Poland.*

Court of Auditors. (2013). *Raport d'Evaluation de la Cour des Comptes sur Les Certificats d'Economies d'Energie.* Paris. Retrieved from http://www.ccomptes.fr/content/download/61712/1513684/version/3/file/rapport_certificats_economie_energie.pdf

Danish Energy Association. (2013). *Why obligations schmes are the solution for European Member States during the financial crisis.* Danish Energy Association. Retrieved from http://www.danishenergyassociation.com/~/media/EU/Why_obligations_schems.ashx.

DEA. (2012a). *Agreement of 13 November 2012 on the energy saving efforts of energy companies entered into between the Minister for Climate, Energy and Building and the distribution companies for electricity, natural gas, district heating and oil.* Danish Energy agency.

DEA. (2012b). *Energy in Denmark.* Danish Energy Agency. Retrieved from http://www.ens.dk/sites/ens.dk/files/about-danish-energy-agency/142557_energy_in_denmark_2012_uk-.pdf

DEA. (2012c). *Energy Policy in Denmark.* Danish Energy Agency. Retrieved from http://www.ens.dk/sites/ens.dk/files/dokumenter/publikationer/downloads/energy_policy_in_denmark_-_web.pdf

DEA. (2013). *Status for energiselskabernes energispareindsats 2012.* Danish Energy Agency. Retrieved from http://www.ens.dk/sites/ens.dk/files/forbrug-besparelser/energiselskabernes-

spareindsats/Lovgrundlagkontrologresultater/Opnaaederesultater/status_for_energiselskabernes_energispareindsats_2012.pdf

DEA. (2014). *Status for energiselskabernes energispareindsats 2013.* Danish Energy Agency. Retrieved from http://www.ens.dk/sites/ens.dk/files/forbrug-besparelser/energiselskabernes-spareindsats/Lovgrundlagkontrologresultater/Opnaaederesultater/status_for_energiselskabernes_energispareindsats_2013.pdf

DECC. (2012). *Final Stage Impact Assessment for the Green Deal and Energy Company Obligation.*

DECC. (2014). *2013 UK Greenhouse Gas Emissions, Provisional Figures and 2012 UK Greenhouse Gas Emissions – Final Figures by Fuel Type and End-User.* UK Department of Energy and Climate Change. Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/295968/20140327_2013_UK_Greenhouse_Gas_Emissions_Provisional_Figures.pdf

DERA. (2011). *Orientering om benchmarking af omkostningerne i 2010 til energispareindsatsen hos net- og distributionsvirksomhederne indenfor el, naturgas og fjernvarme.* Valby: Danish Energy Regulatory Authority.

DERA. (2012). *Orientering om benchmarking af omkostningerne i 2011 til energispareindsatsen hos net- og distributionsvirksomhederne indenfor el, naturgas og fjernvarme.* Valby: Danish Energy Regulatory authority.

DERA. (2013). *Orientering om benchmarking af omkostningerne i 2012 til energispareindsatsen hos net- og distributionsvirksomhederne indenfor el, naturgas og fjernvarme.* Valby: Danish Energy Regulatory Authority. Retrieved from http://energitilsynet.hawking.mocsystems.com/fileadmin/Filer/0_-_Nyt_site/VARME/Materiale_til_varmenyheder/Energisparebenchmark_2012-tal_endeligt_notat.pdf

Di Santo, D. (2013). *White certificates and other incentives for energy efficiency and renewables and cogeneration.* Milano: FIRE. Retrieved from http://www.slideshare.net/dardario/2013-07-wh-c-incentives-and-chp-eerm

Ea Energy Analyses, NIRAS and Viegand & Maagøe. (2012). *Evaluation of the Danish Energy Efficiency Obligation.* Copenhagen, Denmark: Ea Energy Analyses, NIRAS and Viegand & Maagøe for Danish Energy Agency.

Efficiency Vermont. (2012). *Annual report 2011.* Efficiency Vermont.

Energinet.dk. (2014, August 11). *energinet.dk*. Retrieved from Gasnettet lige nu: http://www.energinet.dk/Flash/Forside/index.html?target=gas_now

Energinet.dk. (2014, August 11). *Energinet.dk*. Retrieved from Elsystemet lige nu: http://www.energinet.dk/Flash/Forside/index.html

EU. (2012). *EU Energy efficiency directive. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.* Brussels: European Union.

European Commission. (2013). Guidance note on Directive 2012/27/EU on energy efficiency, amending Direc-tives 2009/125/EC and 2010/30/EC, and repealing Directives 2004/8/EC and 2006/32/EC – Article 7: Energy efficiency obligation schemes. *SWD(2013) 451 final of 6 November, 2013*. EU.

Eurostat. (2014). *Supply, transformation, consumption - all products - annual data [nrg_100a].* Eurostat.

GME. (2012). *Annual report 2011.* Gestore dei Mercati Energetici.

IEA. (2012). *Energy Policies of IEA Countries - Denmark 2011 Review.* International Energy Agency. Retrieved from http://www.iea.org/publications/freepublications/publication/name-34631-en.html

Lees, E. (2014). *French White Certificates and Energy Savings in the Transport Sector.* RAP.

Ofgem. (2013b). *The final report of the Carbon Emissions Reduction Target (CERT) 2008-2012.* London, United Kingdom: Ofgem. Retrieved from http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/CERT_FinalReport2013_300413.pdf

Regulatory Assistance Project. (2012). *Best Practices in Designing and Implementing Energy Efficiency Obligation Schemes.* IEA DSM Programme Annex XXII.

Rezessy, S., & Bertoldi, P. (2010). Energy Supplier Obligations and White Certificate Schemes: Comparative Analysis of Results in the European Union. *2010 ACEEE Summer Study on Energy Efficiency in Buildings.* European Commission, Institute for Energy Joint Research Centre.

Rosenow, J., Eyre, N., & Croft, D. (2013). Energy policy in transition: evidence from energy supply and demand in the UK. *ECEEE SUMMER STUDY PROCEEDINGS*.

Taiwan Industrial Technology Research Institute. (2011, October). Current status of energy efficiency policies and measures in Taiwan. *Presentation from US-TAiwan Clean Energy Forum*.

Taiwan Industrial Technology Research Institute. (2014, May). Energy situation and business opportunity in Taiwan. *Presentation at the 16th Joint Meeting of Taiwan-Britain Business Council*.

Togeby, M., Dyhr-Mikkelsen, K., Larsen, A. E., & Bach, P. (2012). A Danish case: portfolio evaluation and its impact on energy efficiency policy. *Energy Efficiency, 5*.

US EIA. (2013). *Electric Power Monthly with Data for December 2012 (table 5.4.B).* US Energy Information Administration. Retrieved from http://www.eia.gov/electricity/monthly/current_year/february2013.pdf

Vieillefosse, A. (2013). *The French white certificates scheme and the EED.* Ministry of environment, sustainable development and energy. Retrieved from http://atee.fr/sites/default/files/4-alice_vieillefosse_dgec.pdf

Vine, E., Hall, N., Keating, K., Kushler, M., & Prahl, R. (2012). Emerging issues in the evaluation of energy-efficiency programs: the US experience. *Energy Efficiency, 5*(1), 5-17.

Annex I: Abbreviations and exchange rates

Abbreviations

AEEG – Italian Authority for Electricity and Gas
CERT – Carbon Emissions Reduction Target (UK)
CFL – Compact fluorescent light bulb
CHP – Combined heat and power
CO_2e – CO_2 equivalents
DEA – Danish Energy Agency
DECC – Department of energy and Climate Change (UK)
DERA – Danish Regulatory Authority
EEO – Energy efficiency obligation
EU – European Union
IEA – International Energy Agency
LPG – Liquid propane gas
Mtoe – Million ton oil equivalents
TEE – "Titoli di Efficienza Energetica" (Italy)
toe – Ton oil equivalents
UK – United Kingdom

Energy conversion

1 toe = 41,868 MJ = 11.63 MWh
1 kWh = 3.6 MJ

Symbol	Name	Value
k	Kilo	10^3
M	Mega	10^6
G	Giga	10^9
T	Tera	10^{12}
P	Peta	10^{15}

Applied exchanges rates (October 2014)

1 USD ($) = 0.74679 EUR (€)
1 USD ($) = 0.59589 GBP (£)
1 USD ($) = 5.56741 DKK (1 krone = 100 øre)
1 USD ($) = 3.13466 PLN (zloty)

Annex II: Documentation template – Standardised saving

Standardised saving						
General customer information						
Customer name **Address** **Zip code and city** **Tel. no. (if applicable)**						
Consultant/operator, who has the contact with the customer						
Stamp **Signature**						
Type of involvement						
Tick off (there may be more than one)	Subsidy	Advice	Other			
Initiatives						
Subject (e.g. window replacement)	**Deemed saving no.**	**Type of energy**	**Number**	**Value**	**Factor**	**Total saving****
	(No. from catalogue)	(code*)	units	[kWh]	(0.5/ 1.0/ 1.5)	[kWh]
1.						
2.						
3.						
4.						
5						
6.						
I alt						
Type of energy	District heating	Natural gas	Oil	Electricity	Biomass	Other
Code*	D	N	O	E	B	O
**** Total savings = Number of units * Value * Factor**						
Agreement on the transfer of savings						
Conclusion of the agreement	It has been agreed that the right to report the energy savings to the Danish Energy Agency is transferred to the company below. The customer cannot subsequently sell the energy savings to other side (another external operator or net- and distributions company). This agreement is made before the customer has entered a binding agreement with supplier of this/these energy savings, which is covered by this agreement. **Date** _____ **The customer's signature** At energy savings larger than 20 MWh the customer must sign that there is an agreement on the transfer of the right to report.					

The right to report	Specify the name of the net- and distribution company (-ies), the savings is transferred to	
Realisation completed	This part is filled in when the realisation is completed	
	Documentation	Attach documentation that shows that the energy reduction initiative has taken place. For example a copy of the invoice for work done, measurement or confirmations from the end-user
	Date	_____
	The customer's signature	_____

Annex III: Documentation template – Engineering estimate

Engineering estimate				
Project title:	Enter short title			
General customer-/Owner Information (complete owner information only if different from customer information)				
Customer name **Installations address** **CVR no.** **Contact tel. no.**				
Owner name **Owner address** **CVR no.**				
Consultant/operator, who has the contact with the customer				
Name **Address** **CVR no.**	Possibly stamp			
Type of involvement				
Tick off (there may be more than one)	Subsidy	Advice	Other	
Project description (Attach extra material)				
Current situation	Description of the current situation incl. the technical and behavioural elements.			
Future situation	Description of the future situation, i.e. description of the installation / initiative and its technical and behavioural elements, as well as the activities to be undertaken to achieve actual savings. The elements in the description must be identifiable. It is therefore important to describe where installations / components are physically located.			

Calculations (Additional material / documentation must be attached)	
Preconditions	Description and documentation of the preconditions underlying the calculations (lifetime, prioritisation and conversion factors, operating hours, production changes, brands effects etc.)
Calculations	Execution of the relevant calculations / measurements. It is important that the conditions for savings are described and documented, including for example hours of operation, air and fluid volumes, temperatures, etc., to enable third party to verify the calculation of savings.

Results

Initiatives For example, optimization of process plants	Energy type	Annual consumption		Annual energy savings without factors	Prioritisation / conversion factors	Savings reported
		Current	Future			
	(code*)	[kWh]	[kWh]	[kWh]	[-]	[kWh]
Total						
Energy type	District heating	Natural gas	Oil	Electricity	Biomass	Other
Code*	D	N	O	E	B	O

Simple payback	State the projects expected investments in relation to the economical savings, expressed as a simple payback including subsidies.

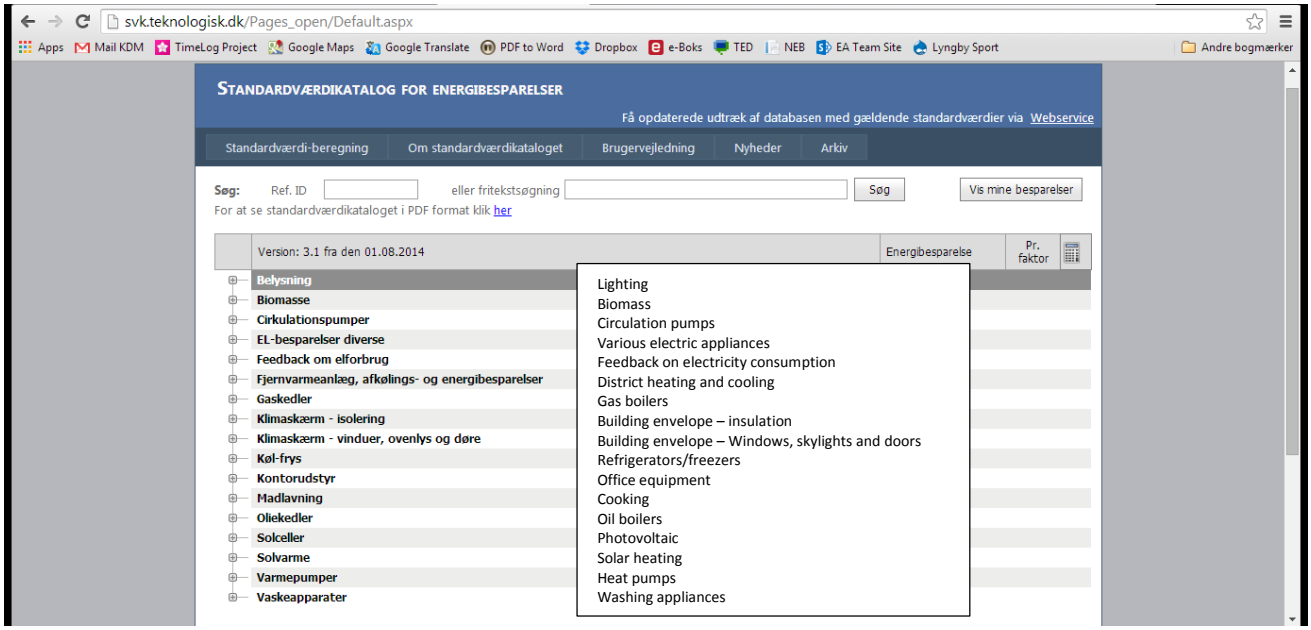
Agreement on the transfer of savings

Conclusion of the agreement	By signing the customer acknowledges that the right to report the energy savings to the Danish Energy Agency is transferred to the company below. The customer cannot subsequently sell the energy savings to other side (another external operator or net- and distributions company). At the same time, the customer confirms that the energy saving project is not already ordered or initiated and that they have not already applied for subsidies for the energy savings at the same problem with other actors or companies. **Date** _____ **The customer's signature** _____
The right of reporting	Specify the name of the net- and distribution company (-ies), the savings is transferred to

Realisation completed	This part is filled in when the realisation is finished	
	Date	
	The customer's signature	
	Documentation	Attach documentation that shows that the energy reduction initiative has taken place. For example a copy of the invoice for work done, measurement or confirmations from the end-user.

Annex IV: Standard value catalogue

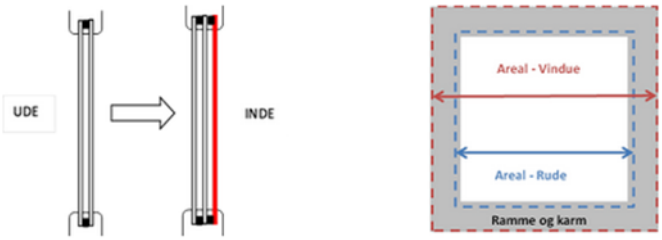
The Danish standard catalogue is available as pdf file but also online at http://svk.teknologisk.dk/Pages_open/Default.aspx.



Note that many measures count as zero savings. These have had a kWh value in earlier versions. E.g. buying of A-labelled freezers and washing machines do not count as savings anymore, because the market already is dominated by these efficient models.

A few examples of the current standard values are given below:

Lighting option 8	
Before situation	50 W halogen light or 60 W incandescent light bulb
After situation	7.1-9 W LED light
Energy saving	37 kWh/year/unit
Priority factor	1.0
Limits in application	Can be applied for households or similar with approximately 1,000 hours of use per year.

Window 12	
Before situation	Windows with 2 layer thermal glass with cold edge
After situation	All glass in existing windows has been replaced by 3 layer energy glass
Energy saving	147 kWh/year per m^2 glass area 
Priority factor	1.0
Limits in application	Can only be applied in buildings used as homes

Gas 13	
Before situation	Traditional open gas boiler connected to a hot water container
After situation	Condensing gas boiler (connected to a hot water container) that meets the minimum requirements of the 2010 building regulation including an A-labelled circulation pump. Boiler efficiency must be at least 96% at full load and 105% at 30% load.
Energy saving	9,006 kWh/year/unit
Priority factor	1.5
Limits in application	Can only be applied for 80-200 m^2 single family dwellings

Refrigerator	
Before situation	Existing refrigerator
After situation	Refrigerator with A++
Energy saving	As of 1 January 2011 the value is set to 0 kWh/year/unit
Priority factor	1.0
Limits in application	None

Pump 2	
Before situation	Circulation pump for domestic hot water without controls
After situation	Automatic timer control on the circulation pump for domestic hot water
Energy saving	58 kWh/year/unit. Can be used in combination with other standard values for example for boilers and heat pumps
Priority factor	1.0
Limits in application	Can only be applied for 80-200 m^2 single family dwellings

Annex V: Summary of reviewed EEOs

* - Cost of compliance are not straightforward comparable as details regarding additionality and lifetimes vary.

Design parameter	Denmark
Unit	Final energy (first year Joule)
Obligated parties	Distributors of electricity, natural gas, district heating, and heating oil (approx. 500).
Executive parties	Anyone including the obligated parties and end-users
Estimated annual target	6,098 TJ (in 2012)
Target achievement (share of 2012 consumption)	1.0% of final energy
Cost of compliance*	6.8 $cent/kWh first year savings
Trading	Energy savings, when realised, may only be traded among obligated energy distributors
Financing	Cost recovery through tariffs
Sector coverage	Residential, tertiary (public & private), industrial. Limited transport options. Small scale supply options. Limited network options.
Compliance regime	Deficit in realising savings target must be achieved the following year. Opt-out fee not available, no financial penalty.

Design parameter	FRANCE
Unit	Final energy (kWh_{cumac})
Obligated parties	Electricity and natural gas retail companies, Large district heating and cooling distribution, heating oil retailers and transport fuel distributors that sell to end-consumers (approx. 2,500).
Executive parties	Only, obligated parties local authorities, the National Housing Agency, and social housing landlords can produce eligible energy savings.
Estimated annual target	89,694 TJ (in 2014)
Target achievement (share of 2012 consumption)	1.4% of final energy
Cost of compliance*	Traded certificates 2008-12: 0.339-0.465 €cent/kWh_{cumac} (0.45-0.62 $cent/$kWh_{cumac}$)
Trading	Formalised energy savings certificates, traded on an exchange or bilaterally
Financing	Cost recovery through tariffs
Compliance regime	A 2 €cent (2.68 $cent) penalty per kWh_{cumac} shortfall. When the penalty is paid, the deficit is cancelled. If an unjustified shortfall occurs again in the next period, the penalty will double.

Design parameter	ITALY
Unit	Primary energy (toe)
Obligated parties	Electricity and natural gas distributors with over 50,000 final customers (approx.72).
Executive parties	All electricity and gas distributors, companies operating in the sector of energy services (approved by the EEO regulator); and companies or organisations having an energy manager or an ISO 50001-certified energy management system in place.
Estimated annual target	17,752 TJ (in 2011)
Target achievement (share of 2012 consumption)	0.4% of final energy
Cost of compliance*	1.04-1.27 $cent/kWh (90-110 €/toe) first year savings (traded values)
Trading	Formalised energy savings certificates, traded on an exchange or bilaterally
Financing	Flat fee (i.e. independent of actual costs) recovered through tariffs
Compliance regime	General provision of non-compliance penalties (minimum 25,000 € (33,477 $) and maximum 155 million €208 million $) set on a case-by-case basis.

Design parameter	POLAND
Unit	Primary energy (toe)
Obligated parties	Retail companies within electricity, natural gas, and 5MW+ district heating; large end-users operating on the Energy Exchange; and brokerage firms operating on the Energy Exchange (Estimated to 2,041).
Executive parties	Anyone including the obligated parties.
Estimated annual target	6,141 TJ (in 2014)
Target achievement (share of 2012 consumption)	0.2% of final energy
Cost of compliance*	Not yet known
Trading	Formalised energy savings certificates, traded on an exchange or bilaterally
Financing	Cost recovery through tariffs
Compliance regime	Obligated parties can pay an opt-out fee, which is expected to be more expensive than white certificates. Non-compliance may result in a penalty, of which the maximum level is 10% of the party's annual revenues.

Design parameter	UNITED KINGDOM
Unit	Lifetime carbon equivalents (ton CO_2e)
Obligated parties	Electricity and gas retail companies with more than 250,000 residential customers (6).
Executive parties	No limits.
Estimated annual target	10 Mt CO_2e (in 2012)
Target achievement (share of 2012 consumption)	6.7% of Mt CO_2e residential sector
Cost of compliance*	0.26 £/kWh (44 $cent/kWh) first year savings
Trading	The 6 obligated parties decide what measure, when and how. Some work with preferred installers, while others work with a wide range of installers and managing agents, and yet other have set up their own energy efficiency business
Financing	Cost recovery through tariffs
Compliance regime	Ofgem had the power to fine the obligated parties up to 10% of global turnover.

Design parameter	VERMONT
Unit	Final energy (kWh) and load (kW, winter and summer peaks)
Obligated parties	Electricity distribution companies but the obligation is handled by a single entity 'Efficiency Vermont' (17 plus Burlington electric Department)
Executive parties	Efficiency Vermont created especially for the purpose to deliver state-wide energy efficiency programs.
Estimated annual target	12 GWh (in 2011)
Target achievement (share of 2012 sales)	0.22% of retail electricity sales
Cost of compliance*	11-34 $cent/kWh first year savings
Trading	Not relevant
Financing	Cost recovery through tariffs but via a joint fund (Heat and process fuel energy efficiency programs are funded via carbon trading scheme and capacity payments)
Compliance regime	Financial incentive – For the period 1st January, 2009 to 31st December, 2011, VEIC could earn up to $2.18 million for meeting the agreed targets, calculated by a weighted formula and net of free-riders.