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Toolkit for Energy Efficiency Obligations

Authors

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The Regulatory Assistance Project. (2012, June). *Best practices in designing and implementing energy efficiency obligation schemes.* Task XXII of the International Energy Agency Demand Side Management Programme. Retrieved from http://www.raponline.org/document/download/id/5003

Staniasnek, D., & Lees, E. (2012, April). *Determining energy savings for energy saving obligation schemes.* The Regulatory Assistance Project and European Council for an Energy Efficient Economy. Retrieved from http://www.eceee.org/RAPeceeeESOreportApril20121.pdf

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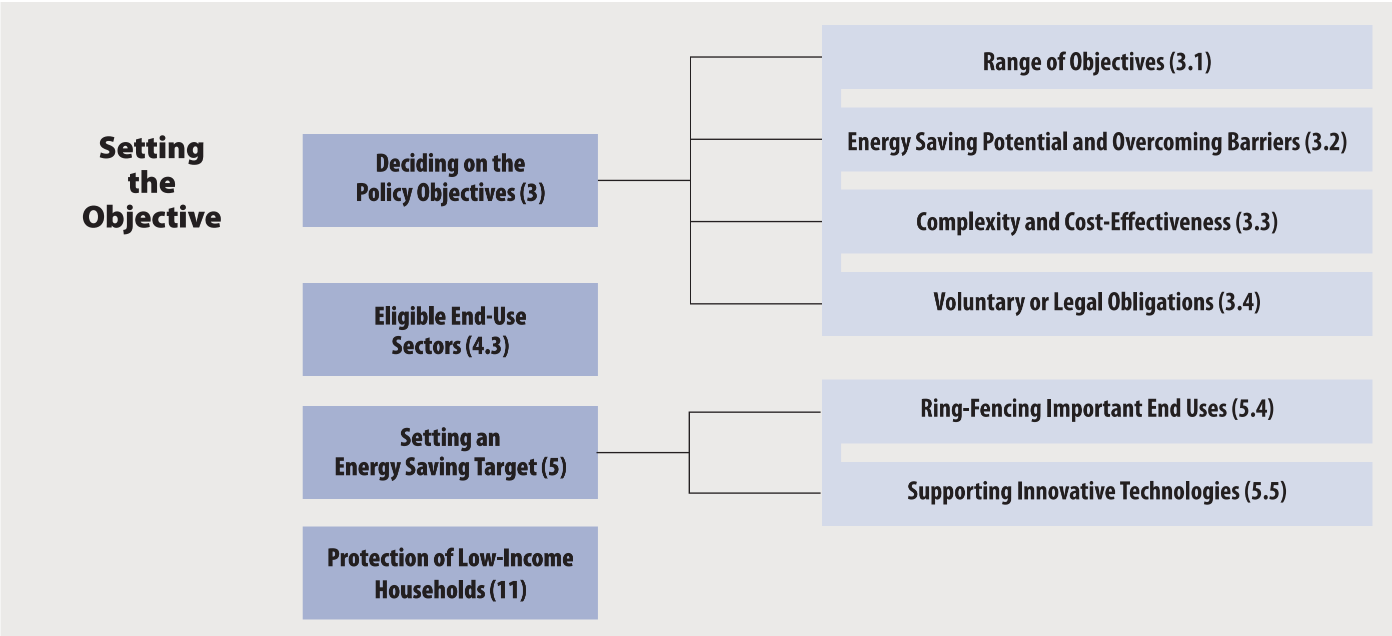
Toolkit for Energy Efficiency Obligations
User's Guide

This guide aims to provide readers with a map of the main considerations involved in setting up and implementing an energy efficiency obligation scheme, and with links to the relevant sections of the toolkit. The text below is clickable; click on the subheading of the section you wish to read to navigate directly to that section in the document. It is organized along four high-level themes: Setting the Objective, Selecting Appropriate Design Features, Compliance Regime, and Review Process. The User's Guide is followed by a traditional Table of Contents.



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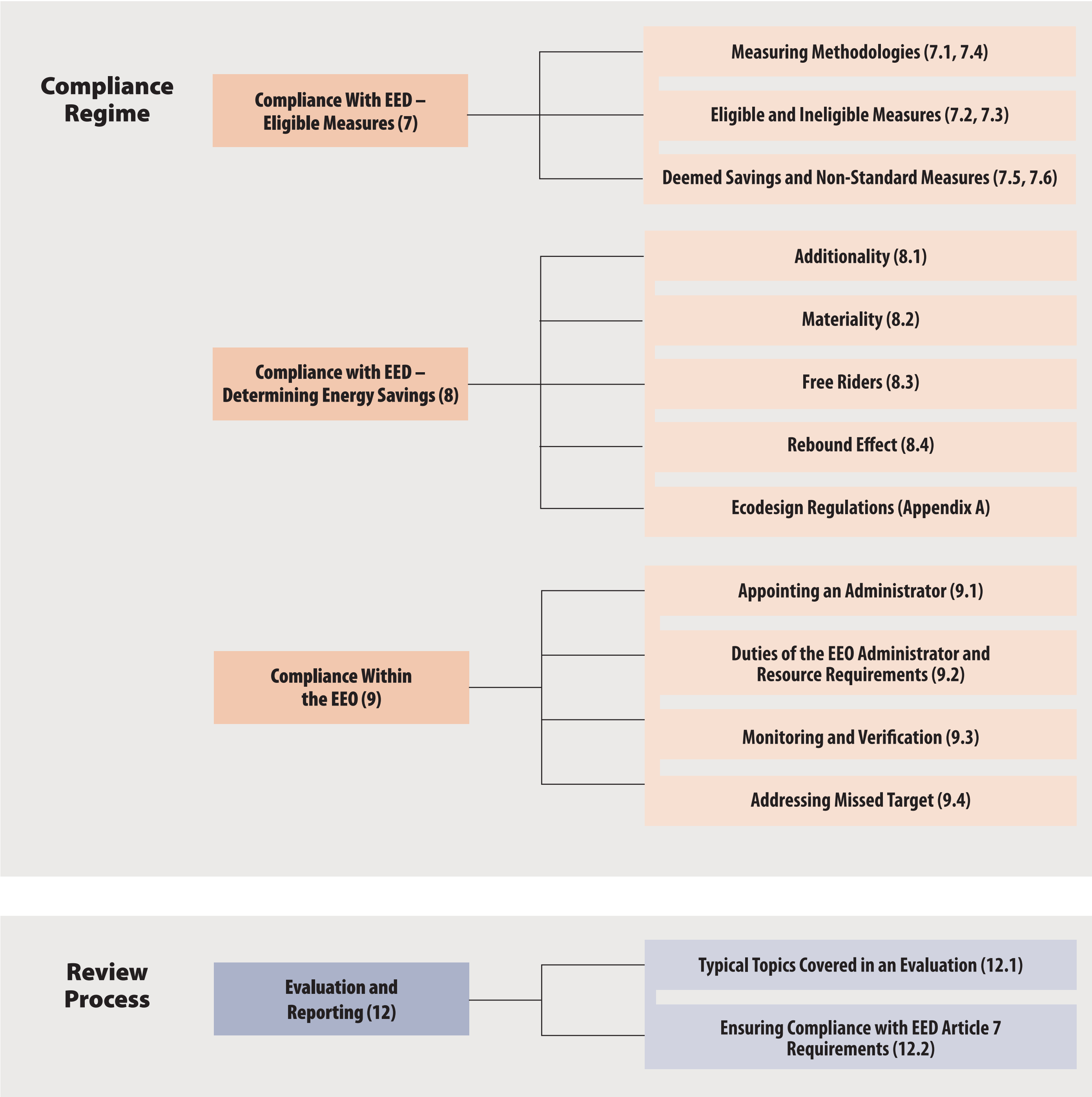
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Acronyms

ATEE	Association Technique Energie Environment (France)
CFL	Compact fluorescent light
CO_2	Carbon dioxide
DIY	Do-it-yourself
ECO	Energy company obligation
EED	Energy efficiency directive
EEI	Energy efficiency index
EEO	Energy efficiency obligation
EERS	Energy efficiency resource standard
EPBD	Energy Performance of Buildings Directive
EPC	Energy performance certificate
ESCO	Energy service company
ETS	Emissions trading scheme
IEA	International Energy Agency
KIS	"Keep it simple"
LPG	Liquid propane gas
M&V	Monitoring and verification
VSD	Variable speed drive
WC	White certificate

1. Introduction

1.1 How to Use This Toolkit

This toolkit serves as a guide for how to introduce and design an effective energy efficiency obligation (EEO). It covers the main design features of EEOs, providing definitions, explanations of the scope and importance of each design feature, and options to consider. The explanations in this toolkit are supported by evidence from EEOs in Europe and elsewhere and case studies are included throughout the text.

The toolkit assumes that the decision to undertake an EEO has already been made, and therefore does not dedicate much time to explaining the benefits of EEOs. Rather, it guides the reader step-by-step through each major component of an effective EEO. The toolkit can be used to support creation of a new EEO or redesign or improvement of an existing EEO.

The toolkit does not cover each design aspect in detail. It is meant to provide the reader with a comprehensive list of each of the areas requiring attention in creating an EEO and the information needed to understand the "what," "how," "who," and "why" of each area. The reader is, therefore, encouraged to use this toolkit as a first step and reference guide for designing an EEO. Wherever possible, the toolkit includes resources where more detailed information can be found.

Lastly, this toolkit can be used to support compliant implementation of Article 7 of the European Union (EU) Energy Efficiency Directive (EED).[1] Although the authors do not guarantee that this guide will fully ensure compliance with Article 7, the information relating to the EED has been developed in good faith and is based on the authors' experience in developing guidance for EED implementation.

1.2 Introduction to EEOs

The use of EEOs or white certificates (WCs) as a policy instrument to deliver energy efficiency has been growing both in Europe and globally. This toolkit will use the widespread EEO name as the generic descriptor, and in this document we will reserve WCs for openly tradable EEOs.

The International Energy Agency (IEA) estimated that in 2012, energy companies spent some $12 billion on EEOs globally.[2] An EEO is a legislative (possibly a voluntary) mechanism that requires the obligated parties to meet quantitative energy savings targets through stimulating cost-effective investment in end-use energy efficiency.[3] It is common for an EEO to set energy savings targets for a few years, typically a three-year period, by the end of which the obligated parties have to achieve certain reductions in energy use by end-users. Although EEOs began on the providers of grid-bound energy such as electricity and gas, they are also being placed on providers of other energy forms, for example, road transport fuel, heating oil, district heating, and so on. Globally, RAP estimates that there are over 50 EEOs operating: 26 in the United States,[4] ten in Europe, two

1 2012/27/EU

2 See Heffner et al. (2013). *Energy Provider-Delivered Energy Efficiency: A Global Stock-Taking Based on Case Studies.* International Energy Agency. Retrieved from https://www.iea.org/publications/insights/insightpublications/EnergyProviderDeliveredEnergyEfficiency.pdf

3 Cost effectiveness is based on consideration of the costs and benefits of energy savings, typically from a societal perspective. The range of costs and benefits of energy savings is discussed in more detail in Section 10.3. Cost effectiveness should refer not to how cheap and/or easy it is to acquire savings at lowest cost, but rather to the extent to which the more diverse range of benefits (energy and otherwise) that flow from investment in a range of energy efficiency policies and measures is greater than the full cost of those policies and measures (to government, energy companies, and consumers).

4 EEOs are called EERSs (energy efficiency resource standards) in the United States. See: http://aceee.org/blog/2014/12/irp-vs-eers-there%E2%80%99s-one-clear-winner-

in South America, four in Australia, and additional obligations in Canada, South Africa, Thailand, and China.

The global experience has been that it is rare for the energy savings target not to be met. This is as a result of the use of financial incentives if the energy savings target is exceeded (common in the United States) or the threat of financial penalties if the energy savings target is not met (common in Europe). Moreover, end-use energy saving measures have generally proven to be cheaper and more attainable than initially envisioned by policymakers and stakeholders.

Depending on how the definition of an EEO is interpreted, the European Union currently has ten existing EEOs with a further eight planned to be implemented as important energy efficiency policies for Member States to meet their EED targets under Article 7.[5]

By 2012, the IEA estimated energy companies in the European Union were spending €2.5 billion per year on EEOs, and RAP estimates that this figure has increased to more than €3 billion in 2014. One of the key distinguishing features of an EEO, as distinct from a National Energy Efficiency Fund, is the "obligation to deliver a certain energy saving target backed by penalties for failure to meet the target." It is this evidence of historical success that encouraged the European Union to adopt the EED in 2012 with clear encouragement for Member States to use EEOs as one of their key policy measures in meeting their energy savings targets under Article 7 of that Directive. In particular, Article 7 and the associated Annex V drew heavily on the past rigorous monitoring and verification (M&V) that had historically underpinned the success of EEOs. The requirements under the EED of ensuring that energy savings are additional and material are discussed in Sections 7, 8, 9, and 12.

When looking at EEOs globally and within Europe, it can be confusing how very differently EEOs operate from one scheme to the next. It is precisely this ability to adapt to local circumstances that gives the EEOs their strength. EEOs can be adapted to reflect the local status of the energy market (regulated or liberalised), the energy efficiency history of the obligated parties, climatic variations, energy savings opportunities in different end-use sectors, local culture, and so on. Examples of this are discussed more fully in later sections, but this power of flexibility means that we have found it difficult in some areas to give specific recommendations; in these cases we lay out the options that can be compared to the local conditions. It is important to note that EEOs have functioned well both where they tackle monopolistic segments and also in liberalised energy markets.

EEOs are not a "silver bullet" to overcoming barriers to energy efficiency and achieving all cost-effective potential. Rather, they are a mechanism with a proven track record of successful delivery of energy savings above what would have been expected under a business-as-usual scenario. EEOs need to be accompanied by complementary policies, particularly building codes and appliance standards, to deliver significant savings, and they need to be paired with appropriate regulatory incentives/requirements for energy companies and end-users.

Finally, energy companies can be a stable source of revenues, avoiding the ups and downs of annual public funding and providing certainty of incentives for energy efficiency installers or energy service companies (ESCOs) to develop sustainable businesses.

In summary, EEOs are a proven and cost-effective policy mechanism for stimulating energy efficiency both globally and within the European Union. The recommendations and options outlined in this toolkit are meant as a guide for designing an EEO that both delivers cost-effective savings and complies with a Member State's Article 7 target under the European Union EED.

5 For example, in Flanders, although there is no energy savings target, the electricity distributors are required to deliver a quantitative target of energy efficiency measures; in Portugal, a levy on electricity distributors is administered by the Energy Regulator and most of the funding is delivered through their associated energy supplier arms. We count Flanders as an EEO, but not Portugal, as only the former has an obligation on the energy distributor to deliver energy savings.

2. Framing the EEO

This section looks at common features of and roles within an EEO, followed by an attempt to classify the wide range of EEOs found globally.

2.1 Common Features and Roles of an EEO

Based on global experience over many years, Table 1 below attempts to outline the common roles that are necessary to design, implement, and verify successful EEOs.[6] Although divergent in their implementation, EEOs on energy companies are based on a number of shared features:

- A binding obligation on energy companies, with clear direction on the scope of the obligation, and penalties (or financial incentives) to motivate compliance;
- The obligation is shared among obligated companies and ultimately the total cost of meeting the obligation is paid by end-use consumers;
- Obligations are met by offering "programmes"; these

Table 1

Roles of Participants in Energy Efficiency Policies	
Government	• Establishes savings targets/goals • Identifies type of entities to be obligated • Identifies expected sources of funding • Defines broad performance parameters, oversight process and consequences • Promulgates complementary regulations
Policy Administrator May be Government or its designee	• Negotiates performance parameters and consequences with obligated entities • Establishes consequences for failing to meet energy savings goals • Verifies achievement of savings goals
Obligated Entities	• Develop and continually refine strategy • Manage implementation of strategy • Supply chain development and relationships • Interact with end use customers • Quality assurance • Track and report (budget/expenses and energy saving results)
Private Sector • Product and Service Providers • Lending Institutions • Local Authorities • Community Organisations • Others	• Leverages strategy to sell efficiency • Provides financing • Installs efficiency measures

6 Wasserman, N., & Neme, C. (2012). *Policies to achieve greater energy efficiency.* The Regulatory Assistance Project with Energy Futures Group and Sleeping Lion Consulting. Retrieved from http://www.raponline.org/document/download/id/6161

include financial incentives, technical assistance, marketing support, and/or other strategies to assist existing retailers and the energy service provider chain in getting end-users to purchase such products and services; and
- Energy savings must be accredited, and a balance struck between accuracy, cost, and administrative efficacy in measurement and verification of savings.

2.2 Broad Classification of Existing EEOs

Box 1 attempts to classify the range of successful approaches.

As shown in Box 1, placing the obligation on regulated distribution utilities is the most common method in North America (United States & Canada) and has been used successfully in Italy and Denmark. Placing the obligation on competitive energy retailers/suppliers has also been successful in the United Kingdom, France, Ireland, and four Australian states.

Option 3 uses the obligation as a mechanism to raise money from distribution companies and has a variety of delivery options after the fund has been established. In general, it has been used to great effect by smaller US states or European countries. The delivery mechanism can vary according to local circumstances. It can be placed on a government agency, as in Oregon, put out to tender to a single entity that is neither government-owned nor an energy company, as in Vermont, or simply tendered to all market actors with the relevant experience and skills, as is the case in Portugal.[7] The obligation to deliver can remain on the energy distributor in US states.

Finally, performance contracting with essentially ESCOs is the norm in Texas. It should be noted that this latter mechanism tends to favour either the larger energy users, such as industry, tertiary sector, and larger residential apartment blocks. In Texas, the obligation to deliver remains with the distributors.

The common feature in all of these designs is that the obligation for the delivery of the energy savings target remains on the energy company. In Europe, the experience of EEOs has been that the energy savings targets were set fairly low and were achieved at costs below policymakers' expectations. Targets have been increasing recently and there is evidence that the expanded targets are challenging the obligated energy companies more than in the past. For example, in Great Britain, where EEOs have been in place since 1994 and the energy savings targets have been steadily increased over time, one of the six British energy retailers missed their end of 2012 target by 1.4 percent.[8]

As mentioned earlier, EEOs started in regulated US electricity companies and expanded over time to include natural gas. Within Europe, EEOs have been extended further to include non-regulated energy companies without major problems. Indeed, France and Ireland are pioneering EEOs on the oil importers of road transport fuels. Although an interesting development, to date most of the oil importers in both countries have been meeting their targets through residential end-use energy savings rather than through savings in the transport sector.

Box 1

Range of Successful Approaches Globally

1. Obligation on regulated distribution utility
   E.g., Italy, Denmark, Flanders, most US states, Ontario
2. Obligation on competitive energy retailers
   E.g., Great Britain, France, Ireland, four Australian states
3. Obligation funded by levy on distribution companies but
   a. placed on government agency, e.g., Oregon, or
   b. tendered for a single (non-energy provider) entity, e.g., Vermont (overseen by energy regulator), or
   c. tender to all market actors, e.g., Portuguese regulator
4. Obligation on energy company, but delivered through direct contracting between third parties and end-use consumers, e.g., Texas

2.3 Timescales to Implement an EEO

Determining the timeframe to implement an EEO is, in a sense, similar to asking, "How long is a piece of string?" The answer depends on the scope of the question: Is it referring to the time needed to establish an EEO or the next phase of a current EEO?

7 The Portuguese energy efficiency levy has many similarities to an energy efficiency fund with the fund administered by the Portuguese Energy Regulator and energy retailers as dominant delivery actors.

8 The current Energy Company Obligation (ECO) in the United Kingdom is not delivering to the extent that was anticipated. This is attributable more to the overcomplicated design and the poorly managed transition from previous EEOs than to any fundamental flaw.

Establishing a new EEO often requires new legislation. Unless there is existing legislation that permits the government to set an EEO, parliamentary processes are required and these vary from country to country. Usually this will take at least one year, but political developments can extend this process, for example, splits in the governing coalition (Austria) or upcoming elections.

Continuing an existing EEO can often be accomplished through a simpler and quicker process (e.g., a statutory instrument that sets the new target). Typically this takes three to six months.

For all EEOs, whether new, next phase, or voluntary, perhaps the most time-consuming process is the establishment of the target and procedures for a new EEO and the target plus any procedural changes for an extension to an existing EEO. Setting a new target and procedures generally takes longer than changes and extensions to an existing obligation.

There will need to be negotiations on all the topics covered in the rest of this document with the stakeholders likely to be involved in the EEO. To begin with, it is important to set a realistic target, with a transparent assessment of the impact of the EEO and with an indication of how the target might be met. Simply setting an arbitrary EEO target without evaluating the implications is likely to meet with strong resistance from the energy companies. Governments usually conduct an impact assessment as part of the formal consultation process. Experience has shown that including in this assessment an illustrative mix of how the obligated parties might achieve their targets can help clarify the operation of the EEO for all stakeholders. This illustrative mix is not binding on the energy companies; it is merely an assessment of how the obligated companies might make their EEO targets and the likely cost to these companies and ultimately to the end-use consumers. The obligated companies remain free to deliver their targets in whichever manner suits them and satisfies the EEO administration procedures.

A voluntary approach avoids the need for legislation but still requires consultation/negotiation with the energy companies. As Austria showed when establishing their EEO, the voluntary approach can be implemented more quickly than the legislative approach, although the legal obligation on energy companies to meet their targets may be missing.

Finally, it is important not to make the primary legislation too detailed, as this can make the transition to the next phase difficult. For example, deemed energy savings values are likely to change after three years because of technical progress, new EU Ecodesign minimum energy performance standards, or updated information on actual energy savings or direct rebound effects. If these are defined in the legislation, then this increases the time to make adjustments for the changed circumstances.

3. Deciding on the Policy Objectives

3.1 Range of Policy Objectives

There is a wide range of policy objectives for EEOs both globally and within Europe. Table 2 lists some examples for various Member States that either have EEOs in place or plan to use them as outlined in the Member State's National Energy Efficiency Action Plans submitted to the EU Commission.

There are many reasons for Member States to use EEOs to meet the key opportunities for saving energy. The focus is often driven by which Member States' end-use sectors have the largest cost-effective energy savings potentials and/or which end-use sectors need the most help to overcome the well-known barriers to energy efficiency investment, which are discussed further in the next subsection.

3.2 Energy-Savings Potential and Overcoming Barriers

The two major considerations in determining which end-use sectors will be targeted are:

- What is the potential in that end-use sector?
- Is that sector one that could benefit from the assistance that well-designed and run EEOs provide to overcome the barriers to energy efficiency investment by end-users?

The potential energy savings in each sector are normally known by Member States as a result of their previous work in energy efficiency. The one sector that is universal in European EEOs is the residential sector—not surprising, as across Europe there is significant residential energy savings potential owing to the well-known barriers

Table 2

Examples of EEO Policy Objectives for 11 Member States

Policy Objective	AT	BG	DK	ES	FR	IE	IT	LT	PL	SI	UK
Deliver cost-effective energy savings/reduce energy bills	X	X	X	X	X	X	X		X	X	
Environmental/CO_2 reduction								X			X
Improve energy security by reducing imports							X				
Assist low-income households to install efficiency measures						X					X
Tackle fuel poverty*					X	X**					X
Stimulate energy services market	X						X	X			

* *Fuel poverty refers to that subset of low-income households that struggles the most to heat their homes affordably.*
** *Only five percent of the target is to be met by actions in fuel-poor households.*

to implementing efficiency. In contrast, the agricultural sector is usually small in end-use energy terms, but it can be important for those Member States with significant agricultural exports and where efficiency can help rural communities by lowering the cost of farm production.

Consumers, particularly small businesses and residential customers, need help in the form of audits, advice, financing incentives, and so forth, to overcome the barriers to energy efficiency. Barriers to improved energy efficiency can be and have been overcome through well-designed EEOs. These include:

- Lack of personalised advice on the most effective measures that end-users can undertake
- Limited technical knowledge of the end-user
- Lack of finance on affordable terms
- High transaction costs
- Split incentives, such as between a landlord and tenant or a product manufacturer and end-user
- Lack of confidence in the quality of available options
- Hassle in researching unfamiliar trades and often the need for more than one trade (heating and insulation) to be addressed

Small end-users, such as households and small businesses/organisations that are not energy-intensive and use little energy compared to large industry, face the greatest barriers. For this reason, many countries around the world have included these sectors. There is an additional incentive that EEOs are particularly well suited to mass replication of proven energy efficiency measures using the deemed energy savings approach discussed in Section 8. This is true not just in households, but also in commercial and public buildings for lighting, heating and ventilation improvements, and in industry for motors and drives, compressors, and the like.

More energy-intensive and larger industries tend to have greater knowledge, which reduces barriers to energy efficiency. However, commercial pressures tend to restrict efficiency improvements to those opportunities that have payback periods of less than two years. Also, some of these larger industries will be covered by the EU Emissions Trading Scheme (ETS); therefore, the relative contribution from the EU ETS needs to be taken into account when establishing what fraction of savings can be attributed to the EEO and reported under EED. Finally, for some of the major energy users, there is a further complication linked to complying with European State Aid legislation.

Energy companies can overcome the various barriers to energy efficiency by either working directly with the consumers themselves or supporting those who do. Energy companies also have key roles in other parts of any integrated policy package relating to standards, consumer education, smart metering, and tariff reform, and are thus well placed to promote energy efficiency.

It is also important to address any regulatory barriers to efficiency in the design of end-user tariffs and the regulation of energy-company revenues. End-user tariffs with high fixed charges, or those that reduce unit prices as consumption increases, discourage energy savings. They should be removed to align consumer incentives with efficiency goals. Section 10 addresses incentives in regulation of energy companies.

3.3 Complexity and Cost-Effectiveness

The recent EU funded ENSPOL project looked at EEOs across Europe. It concluded that increasing the complexity of the design and mixed objectives with different metrics, delivery routes, and eligible measures did not align with cost-effective delivery of energy efficiency measures. The current Energy Company Obligation (ECO) programme in Great Britain is a classic example of this problem. The Polish WC scheme also started with an overcomplicated tender approach and in the first call for submissions, only four percent of the expected certificates were approved, some for projects already begun (see Section 8 for why such projects are ineligible on grounds of materiality).

Even for a simple EEO in concept, the actual implementation and administration requires significant process and technical guidelines. Hence the importance of adhering to the KIS principle: Keep It Simple!

3.4 Voluntary or Legal Obligations

An alternative to imposing a legal obligation on entities is to enact a voluntary scheme, at least for the initial stages, which may be supported by the threat of legal enforcement should progress be deemed inadequate. Both Ireland and Austria began with voluntary arrangements before imposing an obligatory arrangement. Conversely, Denmark started with a voluntary arrangement for heating oil providers alongside its obligatory arrangements for networked fuel providers before recently changing the EEO scheme to be entirely voluntary.

The benefits of a voluntary arrangement include:

- reduced regulatory burden (and hence cost);
- better cooperation between authorities and implementing companies; and
- greater flexibility and easier transitions between phases as no statutory instrument required.

The principal disadvantage is the increased risk of noncompliance.

4. Who Should Be Obligated

4.1 Energy Supplier/Retailer or Energy Distributor

As described in Section 2, there is no hard and fast rule for whom to obligate under an EEO, and placing the obligation on either the supplier or the distributor is common. In part, this is down to the local status of the energy market (liberalised or vertically integrated), the energy efficiency history of the utilities, and the local culture of energy efficiency delivery. The key point is that both options have worked. Although EEOs started in jurisdictions with vertically integrated electricity utilities, they have expanded into natural gas and are now working in liberalised markets; furthermore, they have now extended into non-regulated fuels such as heating oil, liquid propane gas (LPG), solid fuels, road transport fuels, and so on. Table 3 outlines the pros and cons of placing the EEO on either the energy distributor or the supplier.

It is also possible to limit the obligation on energy companies to collecting a levy. In this case, the funds would then go to a third-party administrator who would be responsible for implementing the energy efficiency measures. This approach has the benefit that it provides a stable source of revenues (probably by way of a distribution levy) and that the administrator of the funds raised has a single focus on energy efficiency. There could also be a requirement that the administrator

Table 3

Pros and Cons of Placing the Obligation on Energy Suppliers or Distributors

	EEO on Distributor	EEO on Supplier
Pros	Stable source of revenues, as a regulated monopoly is not subject to market competition Energy regulator used to dealing with variations in the size of the obligated distributor	Closer contact with end-use customer Still viewed by customers as the place to ask about energy efficiency In a competitive market, suppliers have more marketing skills than regulated monopolies Could encourage an energy service approach Provides a recognised brand that can help overcome some of the concerns in relation to the installation of building fabric measures in homes
Essential Requirements	Distributor revenue decoupled from the volume of electricity and gas transported Costs recovered through distribution price control Distribution has infrastructure, systems to manage delivery and/or procurement of eligible energy savings	Price transparency to government/energy regulator to assure customers that imposition is modest Not a barrier to market entry for new/smaller energy suppliers Reduce conflict of interest if the supplier has an energy efficiency business within the group
Cons	Little contact with end-users, especially those with small energy demand Unknown brand to small users for some distributors	Can exert control on supply of energy efficiency Prices may not always be as transparent as government would wish

Table 4

EU Countries That Have Set EEOs on Fuels Other Than Electricity and Natural Gas		
Country	**Date**	**Non-Grid Fuels Obligated (Excluding Transport)**
Austria	2009	Heating oil, LPG, district heating
Denmark	2006	Heating oil, LPG, district heating
France	2006	Heating oil, LPG, district heating
Ireland	2012	Heating oil, LPG, peat, solid fuel
Poland	2013	Heating oil
Slovenia	2014	Heating oil, LPG, district heating
Spain	2014	Heating oil, LPG

Note: France and Ireland have also set obligations on the importers of road transport fuels.

ensure minimum energy efficiency activity in each geographic region if this was required. It is essential that the administrator has no conflict of interest, especially in installing energy efficiency measures, and also ensures that there is no barrier to entry for new or smaller energy companies. The disadvantage of this approach is that if the tender is open to many actors, the obligation on successful tenderers to meet energy savings targets can be lost. This results in under-spending of national energy funds and may be part of the reason Spain has decided to move from its previous national energy fund to an EEO.

4.2 The Extent of the Fuel Coverage

Although electricity remains the universal fuel obligated in all EEOs, natural gas is also widely obligated. Other end-use fuels have been obligated in recent times, as shown in Table 4 above.

It is important to note that many of the heating fuel oil suppliers are small—sometimes very small—companies, which can create problems, as the costs of implementing EEOs for energy suppliers decrease significantly with economies of scale. For this reason, it is common to exempt the obligated parties until they have reached a certain percentage of the market in terms of the volume of energy delivered to end-use customers (e.g., France, Italy, Great Britain). An alternative approach used in some states in the United States is for smaller companies to pay into a fund that aggregates all the contributions. The administrator of the fund then delivers the energy savings.

4.3 Eligible End-Use Sectors

There is a wide range of eligible end-use sectors. Eligible end-use sectors are those where energy savings can count toward an obligated party's EEO. The determination of eligible end-use sectors is related to the consideration of the sectors judged to have the greatest energy savings potential and/or that faced the greatest barriers to energy efficiency investment, as discussed in Section 3.2.

Many countries in Europe exclude as eligible customers those companies covered by the EU ETS for greenhouse gases; Denmark, which permits them, has introduced a weighting factor that enhances the value of long-lived savings from non-ETS end-users by 50 percent. In effect, this prevents double incentives for energy savings measures in companies covered by the EU ETS, as they already have incentives to make such energy efficiency investments. Excluding end-users covered by the EU ETS also eliminates any problems of double counting the energy savings from electricity consumption.

Table 5

Examples of Eligible End-Use Sectors in 11 Member States

Eligible End-Use Sector	AT	BG	DK	ES	FR	IE	IT	LT	PL	SI	UK
Residential	X	X	X	X	X	X	X	X	X	X	X
Commercial	X	X	X	X	X	X	X	X	X	X	
Public	X	X	X	X	X	X	X	X	X	X	
Industry	X	X	X	X	X	X	X	X	X	X	
Transport	X	X	X*	X	X	X	X			X	
Agriculture	X	X	X	X	X	X				X	

* *Restricted to four road vehicle measures*

4.4 Should Energy Savings Be Restricted to the Energy Company's Own Customers and Fuel?

This might seem a strange question. Historically, with vertically integrated energy providers, energy savings targets were only achieved through a provider's own customers. However, with liberalisation and the separation of the supply and distribution companies for major electricity and gas providers, some practical issues arose when the obligation was placed on energy suppliers. Suppliers no longer had a natural area monopoly and gained customers outside their historic area; however, they continued to target their customers for energy efficiency measures relating to their properties or premises.

This led to practical problems with promotions of appliances and lighting products through retail outlets used by consumers. Changing a normal purchasing decision to an energy-efficient product through such outlets has proven to be very cost-effective *provided* there is no need to identify at the point of sale whether the purchaser is a customer of a particular energy retailer. For this reason, in the United Kingdom it was decided to allow such energy savings from any householder to count toward the energy target of the energy supplier who stimulated the investment, irrespective of whose customer achieved the savings. This approach was extended to all energy efficiency measures.

In Denmark a variant of this exists whereby the obligated energy distributors can save any fuel, not just their own. So both electricity and gas distributors have saved significant heating oil consumption. This is also the case in the United Kingdom, although as all obligated energy suppliers are dual fuel suppliers (i.e., electricity and gas) and 90 percent of household fuel is either electricity or gas, the impact on other heating fuels is less marked. Similarly in the French WC scheme, energy suppliers are permitted to save any fuel in an eligible end-use customer.

The decision whether to allow obligated energy companies to save all forms of energy in any household or premise will reflect local issues and the primary objectives of the EEO, but **as a pragmatic solution to simplifying the delivery of energy-efficiency measures, the any-eligible-customer approach has much to recommend it.**

5. Setting an Energy Savings Target

Best practice in meeting the targets for European EEOs is that only energy savings attained in the end-user premises or properties should be counted, that is, energy savings from improved distribution or transmission or generation/production should not be eligible. The latter energy savings can count toward the Member State's EED Article 7 target as part of Article 7.2,[9] but in Europe an EEO would not normally contain such measures. Improvements in transmission and distribution would be covered by the regulated company's duty to keep energy bills low for customers and normal market forces should ensure that generation is efficient.

5.1 Nature of Target

There are two primary considerations related to the nature of the target:

1. In what units is the savings target measured?
2. How is the lifetime of the savings to be handled?

Only the United Kingdom denotes its EEO savings target in terms of carbon dioxide (CO_2) saved at the end-user's property or premises. All other Member States use either an end-use energy savings target or a primary energy savings target. It might seem obvious that an end-use-focussed EED would require energy savings to be denoted in end-use (final) energy, and one advantage of a final energy target is that the savings are denoted in units that are more familiar to end-users and energy providers. However, setting targets in terms of end-use energy is not a requirement under Article 7 of the EED.

Focussing on end-use savings leads to some complications when looking at the extent to which fuel switching should be considered as an eligible energy savings measure under Article 7 (see section 7 later). For example, fuel switching from electric heating to, say, renewable heating will have beneficial results in terms of primary energy savings but not necessarily in end-use energy savings. Moreover, there can be important benefits in reducing CO_2. In the end, the choice between primary or delivered energy comes down to a political decision and requires weighing the pros and cons of each approach.

European experience is also very varied in terms of how long the resulting energy savings should be reflected when setting the target. Variation ranges from either annual energy savings to lifetime energy savings or something in between. However, there is growing recognition that only counting the first-year energy savings toward a target undervalues energy savings from those measures with longer lifetimes. In other words, the correct economic outcome from the Member State perspective is not always achieved by an obligation focussing on first-year savings only, as this favours short-lived measures that do not necessarily bring the greatest long-term economic benefits. This has been recognised in Denmark by the introduction of weighting factors that depend on the lifetime of the energy efficiency measure. Over the years, Italy has also introduced various options to value longer-lived measures, such as insulation and industrial projects. Without recognising the real economic value of the lifetime energy savings, obligated companies with a first-year energy savings target only will naturally focus on the cheaper, short-lived energy efficiency measures, which is not the desired outcome from a national perspective when taking into account the benefits of longer-lived measures. As EED currently sets a cumulative annual energy savings to 2020, this has influenced some of the Member States establishing EEOs for the first time. In the imminent review of the EU EED, it will be important to examine whether the current form of the target with a sharp 2020 cut-off date is impacting the ideal economic solution when viewed over a longer time perspective.

9 Article 7.2 (c) allows energy savings from energy transformation, transmission, and distribution to be counted toward the EED target subject to a maximum of 25-percent cap on EED target reduction from all such Article 7.2 options.

5.2 Deciding Whether to Discount Energy Savings and Counting Toward the EED Target

In cost-benefit analysis, it is standard practice for governments to discount the future benefits of any policy at the societal discount rate. It has become standard practice for EEOs to follow this approach when setting energy savings targets. Of course, this does not affect those EEOs that only count first-year energy savings.

Discounting energy savings is the procedure followed for those EEO targets denoted in lifetime energy savings in France and in the United Kingdom until 2008. In France the energy savings are calculated in end-use energy, cumulated over the lifetime of the project, and discounted with a discount rate set at four percent. The units are known as kWh cumac. In the United Kingdom, a 3.5-percent discount rate was used until significant changes were introduced into the EEO after 2008.[10] As discussed in the previous section, lifetime energy savings (even discounted) reflect better the economic value of the energy savings measure and is considered best practice among EEOs.

As discussed previously, the EED Article 7 target is a curious target as it only counts annual energy savings (undiscounted) in a cumulative fashion for the period 2014 to 2020 inclusive. Translating between lifetime energy savings for individual measures to energy savings that meet the EED target is a simple calculation, as the discounted lifetime for an energy savings measure is derived from the annual energy savings and the lifetime of the measure. So to count energy savings toward the EED target from any energy efficiency measure, the three key pieces of information are: (1) the date of installation of the measure, (2) its annual energy savings, and (3) whether the measure will still be saving energy in 2020, in which case savings from 2014 to 2020 will count – otherwise, only the years for which the measure lasts can be counted.

Finally, encouraging longer-lived measures could be in a Member State's interests if the review of the EED removes the "sunset" clause of 2020 for counting energy savings. **Irrespective of that, discounted lifetime energy savings still better reflect the economic optimum for a Member State and it is recommended that any energy savings beset in such units.**

5.3 Duration of EEO Target and Banking and/or Borrowing of Energy Savings

Although the target under EED Article 7 is calculated on an annual basis, the duration of EEO compliance periods is a matter of scheme design for the Member State. Target setting and review of scheme structure are usually undertaken in line with compliance periods. If a period is too short, it may hinder flexibility in meeting the target and also increase the administrative burden. If it is too long then implementation activity could become highly uneven and technology change (causing a reduction in price of energy savings measures or a new EU minimum performance level is set) during the course of a target period may render the baseline and target calculations invalid. Three-year compliance periods, as used in France and a number of US and Australian schemes, seem to give a balance between these conflicting trends.

It is common for trading schemes to allow banking and/or borrowing to meet their objective. In the EEO context, banking means carrying forward excess energy savings from the current obligation period to help meet an energy savings target in a future obligation period. Borrowing means pulling energy savings that are still to be realised in a future obligation period into the current obligation period. In many European schemes, banking is allowed to a certain extent, but not borrowing.

The practical reason for allowing banking is to avoid stop/start activity in energy efficiency installations. Experience shows that having no banking option limits flexibility for obligated parties (e.g., risk that flow of energy savings does not match with target in period of obligation) and can have "stop-go" impacts for energy efficiency industries if obligated parties meet their targets early.

Borrowing is also meant to introduce flexibility for obligated parties by allowing them to cover any shortfall in the current obligation period with expected savings over the next period. In practice, borrowing enables obligated parties to delay compliance, which in turn slows progress on energy efficiency and can slow momentum to a point that it becomes difficult to continue to increase ambition over time. For these reasons, **borrowing is not an advisable design feature.**

10 With the move to CO_2 targets in 2008, the UK target was set in undiscounted CO_2 savings, which better reflects the fact that it is the absolute concentration of CO_2 in the upper atmosphere that gives rise to climate change and that the average lifetime of a CO_2 molecule in the upper atmosphere is ~80 years. However, the CBA and financial impacts continue to use the 3.5-percent societal discount rate.

Excessive banking can lead to speculative behaviour (realising energy savings only under certain market conditions), the same risk as with excessive borrowing. In addition, borrowing could imply a conflict with a penalty for failing to meet the energy savings target. Therefore, **in most schemes, best practice is to allow banking within a certain range considered sufficient to provide flexibility, but limiting speculative effects.**

5.4 Ring-Fencing Important End-Uses

This is when a particular end-use is considered to be so important to the country in terms of energy savings potential or for social reasons that a minimum level of energy savings must be obtained for that end-use measure. For example, because of the poor insulation levels in the UK housing stock, in 2010 a minimum percentage of the target was required to come from professionally installed insulation.

Clearly this can impact the economic efficiency of the EEO, and careful consideration is required to ensure that the advancement of real energy savings outweighs the loss of energy savings attributable to the ring-fencing before embarking on this route.

5.5 Supporting Innovative Technologies

Historically, the main driver for EEOs has been to deploy the many proven energy efficiency measures that currently are not happening at the rate that would be expected from economically rational behaviour. EEOs were designed to overcome the well-known barriers to energy efficiency. It is possible, however, for EEOs to go a step further and support innovative technologies as part of their design.

Innovation is a wide-ranging process but of relevance to EEOs, potential activities include:

- Technical improvements that result in a significant improvement in performance;
- Lowering the cost of a product, which increases its potential deployment;
- Better design; and
- Innovative services or new routes of getting a product to market.

The last of these is something that has occurred in most European EEOs in that the obligated energy companies have lowered the cost of getting energy efficiency installed via new routes to market, for example, Great Britain, France, and Italy, where the costs of delivery have been less than governments expected. However, other innovation issues have been more difficult to tackle. In the United Kingdom, uplift factors were applied to the energy savings coming from certain highly efficient electrical appliances. The uplift factor results in an enhancement of the energy savings values beyond those which are actually realised. It is intended to help energy efficiency measures at an early stage of market penetration to be more cost competitive with other options on an earlier timescale. Clearly such uplift factors have to be time limited to minimise free riders (see Section 8.3), that is, those that would have bought the more efficient appliance in the absence of the EEO—this becomes more important the longer an uplift factor remains in place.

Finally, if the EEO is being introduced for the first time, then the KIS principle applies and **it is not recommended that uplift factors be used.** Determining technologies and uplift factors requires detailed knowledge of the market for such products, which may not always be available beforehand at a Member State level.

5.6 Exemptions for Smaller Energy Companies

For obligated energy suppliers, there are economies of scale when delivering EEOs, as many of their costs do not scale linearly with the size of the target, and greater activity usually benefits from a more attractive price from energy efficiency contractors. For this reason many European Member States set thresholds in terms of either volume of energy supplied or the number of customers before the smaller energy suppliers are required to undertake the EEOs. However, if trading among suppliers is permitted, then this alleviates to some extent the problem for smaller energy suppliers or new entrants. If the EEO is placed on the energy distributor, then the energy regulator is used to dealing with economies of scale for different-sized energy distributors.

5.7 Realism and Impact on Bills

When starting an EEO for the first time, it is important to start fairly small and grow steadily over time in line with the KIS principle. It is also important to keep the impact on end-user tariffs to a "reasonable level." Globally, this level is between two percent and five percent of a typical end-user bill, with the latter figure for the longer established and most cost-effective EEOs. Further discussion of this issue can be found in Section 10.3.

6. Generation and Trading of Accredited Energy Savings; Role of ESCOs

One of the key roles of an EEO administrator is to validate that the energy savings claim submitted has been achieved and thus can count toward the target of the obligated party. This notification process often relies on issuing and tracking Energy Savings Certificates,[11] which confirm the accreditation of eligible energy savings achieved under an EEO to an obligated energy company. This serves as a compliance mechanism. Section 9 outlines in more detail how the claimed energy savings are validated.

There are two issues to be explored under this heading. First, who is entitled to generate energy savings that can be accredited by the EEO scheme administrator? Globally, the ability to generate WCs is overwhelmingly restricted to the obligated parties. The ability to generate WCs by other than the obligated parties occurs in Italy, France (to a very limited extent), Poland, New South Wales, and Victoria, Australia.

Second, is trading permitted between obligated parties and is there an open market for such trading? Most EEOs that permit trading limit that trading to obligated parties. Open markets exist only for the same five EEOs that permit non-obligated parties to generate WCs.

6.1 Who Can Generate White Certificates?

The most common method is for the obligated companies to choose either to carry out the energy efficiency activities directly or use bilateral contracts with an energy efficiency installer or with a retail outlet for products to deliver the energy efficiency measures to end-users. The obligated party retains the responsibility for ensuring that the measures installed are of sufficient quality and have achieved the claimed energy savings.

The alternative is for appropriately qualified energy efficiency practitioners to be accredited by the EEO Administrator as competent to generate WCs in their own right. In Europe, Italy is the only country that has significant accredited parties who are active in generating energy savings but are not obligated energy companies.[12] Somewhat misleadingly, they are classed as ESCOs, even though many would not satisfy the EU definition of an ESCO.[13] Rather, they provide energy efficiency services more narrowly.[14] Even in Italy, only one-third of WCs were generated by non-obligated parties in 2012, and this has been a similar trend since its inception in 2005. The bilateral contract between an obligated Italian energy distributor and the energy efficiency company remains the preferred route.

In France, during the first phase of the WCs (2006–2009), less than three percent of WCs were traded, and in the second phase the number of organisations (other than obligated parties) that could generate a WC was reduced to just local authorities and social landlords.

6.2 Trading of Accredited Energy Savings

Many EEOs allow trading between obligated parties, including Denmark, United Kingdom, Italy, France, and Ireland. The operation of this form of trading is simple and is carried out by the EEO administrator. For example, under the Great Britain EEO, notification of a transfer

11 All EEO obligated parties are awarded energy savings certificates from the EEO administrator; WCs are usually used for energy savings certificates are more openly traded. WCs are synonymous with energy savings certificates where such certificates are more openly traded.

12 The Polish WC scheme also allows third parties to generate WCs, but the scheme has run into problems with very little WC generation to date and so we cannot comment further.

13 See: http://iet.jrc.ec.europa.eu/energyefficiency/esco

14 In this way, their scope aligns with the definition of "energy service provider" in the Energy Efficiency Directive, 2012/27/EU: "a natural or legal person who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises."

of accredited energy savings from one energy supplier to another is realised through a written request by both parties to the administrator; the price is not disclosed.

Proponents of openly tradable WCs claim that this market-based route has the benefit of lowering costs for consumers in a transparent fashion. This is based on the assumption of a fully functioning market where the main behavioural driver is to generate energy savings certificates at least cost and sell them for the best offer. Such trade can take place on a regulated spot market, administered by either the scheme administrator or another party. For example, in Italy obligated and accredited third parties may assemble energy savings certificates and subsequently trade on an official trading platform run by the electricity market operator.

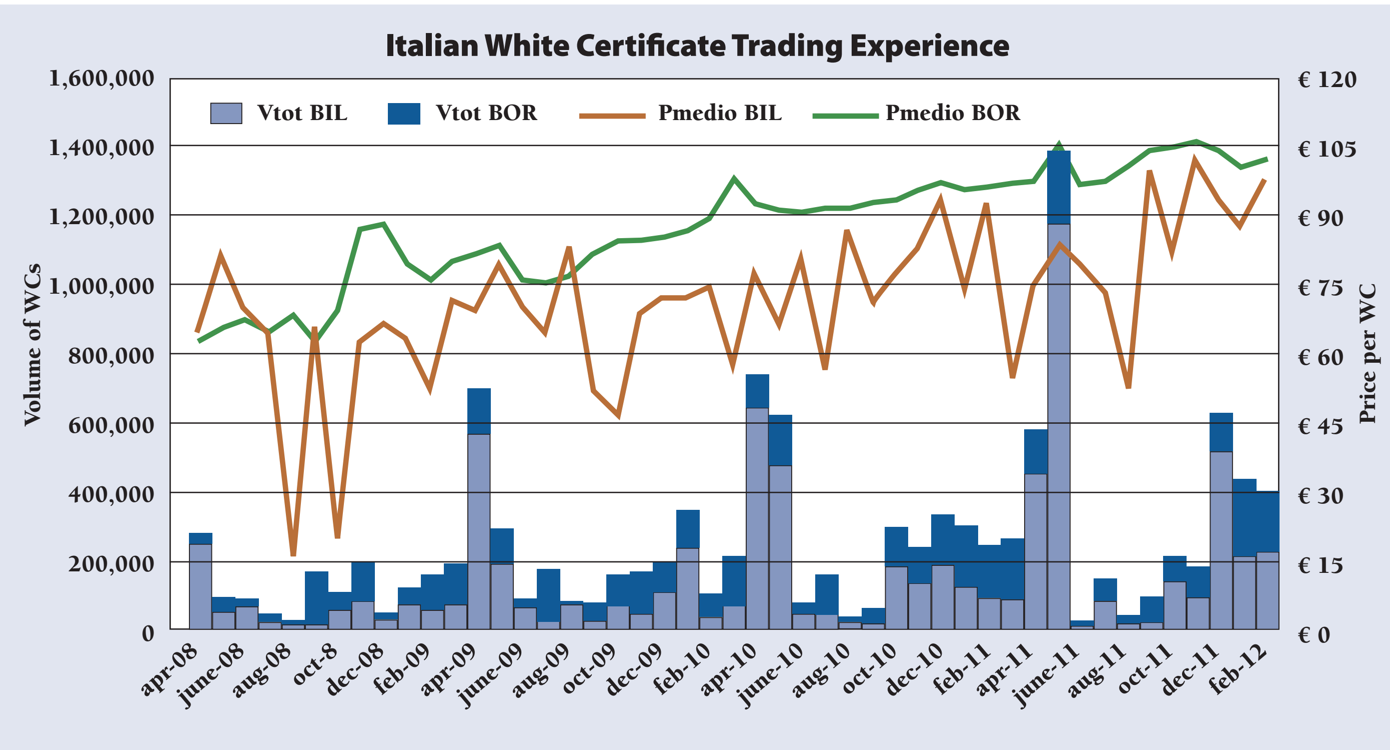
Irrespective of the EEO design, an energy company will try to achieve its target at minimum cost to the energy supplier or distributor; consequently the key metric in EEOs for the obligated company is the euros per MWh of energy savings. EEOs with a market for trading WCs clearly follow this driver and history indicates perhaps more quickly; in Italy in 2008, three-quarters of all the electricity WCs came from the use of compact fluorescent light (CFLs) bulbs. For the period 2012 to 2013, the New South Wales WCs have been dominated by commercial lighting (approximately 80 percent of all WCs) and in the residential sector, by shower-head projects. In Victoria in 2012, more than 80 percent of WCs registered came from standby power controllers.

The presence of a market without any ring-fencing of end-use or of customer segment thus seems to accelerate the trend to one or two highly cost-effective measures when viewed from an energy company's perspective. This kind of approach risks missing the greater overall benefits such as the increased comfort and health associated with home insulation programmes. The broader benefits of energy efficiency are discussed in Section 10.3.

Price transparency is not necessarily guaranteed by open markets because most trades are still conducted bilaterally and so there may not be reliable information on market prices. There can be an imbalance between buyers and sellers; for example, in New South Wales, the three large electricity retailers dominate the demand side, while there are 111 accredited sellers. Consequently the market is subject to imperfect competition by market dominance and information asymmetry between buyers and sellers.

A further complication occurred in New South Wales as the retail electricity prices are regulated for residential customers and that price included an EEO cost based on the full penalty price if an obligated supplier misses its target. The limited spot market data available indicate that the spot price has never exceeded the penalty price and at times has been as low as 16 Australian dollars below the penalty price (2009) and 23 Australian dollars below (2013). In other words, although trading itself led to lower prices in the market place and thus lower costs to the energy suppliers, customers still paid the full penalty price and this price was passed through to

Figure 1



obligated energy companies.

This also occurred in Italy when the Italian electricity WC market in 2007 was dominated by CFLs. These were costing the distributors approximately €30 to €35/WC and the distributors were getting €100/WC from the distribution price control. This implies a significant benefit to the energy companies paid for by the end-use customers. It was after this that the energy regulator required disclosure of actual prices paid by energy distributors in their bilateral contracts as the regulator (correctly) thought that the bilateral prices were below the market price. This continued even after the changes to CFLs, as shown in Figure 1.

Figure 1 shows the difference between the marginal price of the WC in the marketplace and the price paid in bilateral contracts. The solid navy line (Pmedio BOR) is the spot market price and the light blue line (Pmedio BIL) is the bilateral price as disclosed to the Italian Energy Regulator. The bar columns also show dominance of the bilateral contract approach in terms of volumes of WCs (source AEEG).

The Italian WC market is run by the electricity market operator GME. At the end of 2011, 377 operators were able to participate in the organised market; on the demand side, 57 operators had done at least one trade, and on the supply side, 205 operators had done at least one trade. The Italian WC system has a fairly unusual approach in that payments to the energy distributors by the administrators are made annually over five years; most WC trading schemes tend to pay a single financial amount after the energy savings have been approved by the administrator for placement on the market place.

The global experience available shows that markets are not essential to cost-effective delivery of energy savings; most WCs are generated through bilateral contracts and these prices tend to be lower than the (marginal) WC market price. In turn, this may reflect that meeting EEO targets turns out to be cheaper than governments think when setting those targets.

6.3 Are There Additional Costs in Open Trading of WCs?

It is difficult to get information on the additional costs of having a WC trading scheme compared to an EEO without tradable certificates. The experience of New South Wales indicates that the costs of administrating the scheme are five percent or more as a proportion of energy retailer costs. This is much higher than was the case for Great Britain in 2008 to 2012, when the administrative costs were less than one percent of the energy retailer expenditure. The administrative cost is ultimately passed on to energy consumers.

In Australia, there are two other states with EEOs but which do not undertake trading on an open market place—South Australia and Australian Capital Territory. An independent review of the South Australia scheme also examined the option of introducing a trading mechanism into their EEO called REES, and concluded, "In the specific context of REES, it seems clear that enabling certificate-based trading would raise the total costs of the scheme" and there would not appear to be a sound case of introducing tradability within REES in the short term."

The Italian WC market has more parties than just the obligated distributors and these energy service providers have to undergo accreditation to satisfy the administrator and the market operator.

Finally, in keeping with the KIS principle, **where an EEO is being introduced for the first time, introducing trading creates an added level of complexity that can hamper implementation. For this reason, it is advisable to weigh the pros and cons of trading only after an EEO has had time to launch.**

6.4 Role of ESCOs

In international discussions, ESCOs are often referred to as key players in successful implementation of many energy efficiency measures. However, when comparing the global debates in different countries, it becomes obvious that there is no exact definition yet for the scope of ESCO activities. There are many definitions, but two main concepts can be distinguished, namely a broad definition, comprising all businesses and crafts dealing in any way with energy saving, and a narrower definition, focussing on specialised companies offering energy performance contracting. The definition in the 2012 EU Energy Efficiency Directive considers energy performance contracting a key element in energy service and defines it as follows:

> *Energy performance contracting means a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings.*

For ESCOs satisfying this narrower definition, most activity has been in the non-process energy areas. Offices and public buildings offer significant opportunities for replication, and methods have been developed to accommodate increasing information and communication technology (ICT) equipment and usage. In contrast, in process industries, measuring energy efficiency improvements is more difficult because of the variations in product mix, input materials, age of the plant, production, and so forth.

In Europe, most existing ESCO activity[15] is focused on the public, commercial, and large condominium sectors where similar improvements in the required energy services are possible and the need for aggregation is less compared to single-family homes. The most common services delivered by ESCOs are heating/cooling, building automation and control equipment (including cogeneration), and street lighting. Complex building projects in the public sector such as HVAC and controls in hospitals and schools are also common. Box 2 gives details of the current ESCO market in the European Union.

Also in the United States, most ESCO activity is focussed on the public sector, schools, universities, and hospitals.

In summary, global experience demonstrates the preference of ESCOs for standard and replicable measures over more complicated improvements required in industry. EEOs do not eliminate these industrial process barriers, and the experience is that within EEOs, the main ESCO market lies in the public, commercial, and large condominium sectors—that is, it mirrors the existing ESCO market outside EEOs. EEOs offer an opportunity for ESCO involvement similar to the existing main ESCO markets. ESCOs in a market where accreditation of energy savings is restricted to obligated energy companies will have to operate by securing business from those energy companies through bilateral contracts.

Box 2

Current Status of the ESCO Market in Europe for Some Member States

The largest ESCO market exists in Germany, where between 250 and 500 ESCOs are active. The exact number depends on the definition used. The size of the ESCO market in 2010 was estimated to be approximately €2 billion per year. The main projects were concerned with public and private non-residential building projects and cogeneration, district heating, and renewables through contract energy management.

In terms of industrial ESCOs, Finland and Denmark are the two countries with significant ESCO activity. Finland has many energy-intensive industries, such as paper and pulp production, chemical industry, and metallurgic facilities. In Finland in 2010, the eight ESCOs had an industry and public sector market of approximately €4 million/year. Industry sector projects typically involve process or horizontal technologies such as motor systems. The Finnish government subsidised (depending on the specific project) 15 to 30 percent of the investments carried out by ESCOs.

In Denmark, in 2010 the ten ESCOs had an annual turnover of between €8 and €25 million. The main activities were modernisation and refurbishment of public buildings and some industrial projects undertaken under the Danish EEOs.

In Italy, the ESCO market did not grow between 2010 and 2013 according to the 2014 review by JRC—it was static at approximately €500 million per year. Using an Italian definition of an ESCO, which is narrower than the Italian WC definition, there are between 50 and 100 players. The ESCO market is dominated by a few large companies, mostly subsidiaries of large international corporations. Most projects have been implemented in the public sector, especially health care. The private sector is much less developed, especially in the residential case. Although over 2,000 companies were notified with the administrator for the WC scheme, only 377 had actually attained a WC administrator approval.

15 JRC Ispra. (2010). Retrieved from http://bookshop.europa.eu/en/energy-service-companies-market-in-europe-pbLBNA24516/

7. Energy Savings Measures and Eligibility for Meeting EED Target

This section is intended as a guide to assist in identifying which energy efficiency measures are to be considered eligible and which may not be eligible to count toward the EED energy savings target. The reader is referred to the original Commission guidelines for the full requirements.[16] Finally, this information is given in good faith, but cannot be guaranteed to mirror the Commission's thinking in all cases.

7.1 Measuring Methodologies

Any measure that will be counted toward the EED Article 7 target must demonstrate that the energy savings claimed have either been directly attained or have been estimated with a fair degree of reliability. Annex V of the EED defines in the opening paragraph the three principle methodologies permitted, and these closely mirror the standard practice in global EEOs. They provide a high degree of confidence that, if followed, these methods will provide reliable energy savings estimates. They are:

- **Deemed energy savings**, which refers to the results of previously independently monitored energy improvements in similar installations (often called ex ante);
- **Metered savings**, in which the savings from the installation of a measure or package of measures is determined by recording the actual reduction in energy use taking into account factors such as additionality, occupancy, production levels, and the weather, which may affect consumption (often called ex post); and
- **Scaled savings**, in which engineering estimates of savings are used; this approach may only be used where establishing robust measured data for a specific installation is difficult or disproportionately expensive, for example, replacing a compressor or electric motor with a different kWh rating than that for which the information on savings has been independently measured and verified or where the scaled savings are carried out on the basis of nationally established methodologies and benchmarks by qualified or accredited experts that are independent of the obligated parties.

There is also an option under EED to look at surveyed savings following advice, information campaigns, labelling or certification schemes or smart metering to measure changes in consumer behaviour. This method may not be used for energy savings resulting from the installation of physical measures. The use of this option has not been widely taken up because the energy savings values are difficult to establish, especially with respect to the duration of the behaviour change. In the United States, assigning a one-year lifetime for such measures is common in the residential sector; this may underestimate the lifetime energy savings.

7.2 Likely Eligible Energy Efficiency Measures

Energy savings being proposed must be a direct result of individual actions undertaken as a result of an energy efficiency policy measure of a Member State. Article 2 defines "policy measure" as:

Policy measure means a regulatory, financial, fiscal, voluntary or information provision instrument formally established and implemented in a Member State to create a supportive framework, requirement or incentive for market actors to provide and purchase energy services and to undertake other energy efficiency improvement measures.

Individual action means an action that leads to verifiable and measureable or estimable, energy efficiency improvements and is undertaken as a result of a policy measure.

So an EEO clearly meets these requirements. It is more difficult to demonstrate the eligibility of measures

16 See: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0451&from=EN

undertaken pursuant to policies in which the main objective is not to achieve energy savings, but which may result in a reduction in energy consumption. One of the most common questions is whether measures undertaken pursuant to renewable energy subsidy support schemes (e.g., either feed-in tariffs or financial incentives for renewable heat usage) can qualify as energy savings measures.

Renewable energy support schemes are primarily policies to promote the use of renewable energy sources, not energy efficiency. Many of these may not actually result in any reduction in the end-use energy being required, as they simply substitute the source of supply (e.g., photovoltaics replacing grid-based electricity) or are a form of fuel switching (e.g., biomass purchased for combustion substituting for fossil fuels).

However, some renewable energy sources will contribute to a reduction of delivered energy. For example, solar water heating replaces either fossil fuel or electricity in providing hot water. There is clearly a reduction in the energy delivered to the premises for hot water.

Whether using the deemed or scaled engineering estimates or directly measured energy savings approach, the eligible energy savings are deduced in the same way (i.e., by comparing the new installation with the appropriate baseline). Sometimes that is a simple before-and-after comparison; sometimes it is relative to any EU minimum requirement; other times it is relative to the typical alternative. One of the most important baselines is the Ecodesign regulations. Appendix A collates all the dates of application and dates of further strengthening in terms of minimum energy efficiency performance under the Ecodesign Directive for those measures most likely o be supported by EEOs.[17]

There are many energy efficiency measures that clearly save end-use energy, provided they are installed correctly using quality products. They are summarised in Table 6. (See text for more details, especially regarding how energy savings are determined from the measure.)

Some measures are likely to be only eligible to

17 Directive 2009/125/EC

Table 6

Eligible Measures—Equipment-Based Summary

Measure	Points for Consideration
Retrofit insulation	Only count energy savings if at the time of installation in the EED period the installation is above Energy Performance of Buildings (EPBD) requirements for cost optimal refurbishment
Efficient heating and controls (small scale)	Savings reduced after Ecodesign transposition date to only those that exceed minimum requirements
Solar water heating	Check source of any subsidy to establish the primary policy objective
Heat pumps in buildings	Greater end-use energy savings from fossil fuel heating systems
Efficient HVAC equipment	Any Ecodesign minimum performance standards?
Regular maintenance of boiler systems	Primarily for smaller sized boilers (EPBD Article 14)
Efficient products and appliances	Savings reduced after Ecodesign transposition date to only those that exceed minimum requirements
National minimum standards	Savings reduced after Ecodesign transposition date to only those that exceed minimum requirements
Lighting	Energy savings only for the part superior to EU Ecodesign values
Replacement of motor, drives, compressors, and pumps	Energy savings only for the part superior to any EU Ecodesign values
Industrial combustion and cooling	Consider any EU Ecodesign minimum performance standards
Hybrid vehicles	Compare energy consumption of hybrid vehicle with the petrol or diesel version
Pure electric vehicles	Ensure energy savings determinations are for similar sized vehicles
Ecodriving	What is the lifetime of the energy savings?
Nitrogen-filled tyres	What infrastructure is in place to service such tyres?
Modernising existing diesel trains	Need figures on annual distance travelled by refurbished vehicle

Table 7

Measures Only Eligible For Exemption Under Article 7.2	
Measure	**Points for Consideration**
Cogeneration	No end-use energy savings as replacing source of electricity and heat supply
District heating schemes	No end-use energy savings as replacing source of heat supply

count toward the EED target as part of the Article 7.2 exemptions and thus form one of the options collectively capped at 25 percent of the overall target. These are shown in Table 7.

7.3 Potentially Ineligible Energy Measures

Some of the actions that may not be eligible to count toward the EED target have been mentioned previously—where an energy efficiency improvement did not result in an increase over the EU minimum requirement, or where the policy was not primarily aimed at energy efficiency. Table 8 includes the potentially ineligible measures identified earlier for completeness and some further examples. In all cases if judged eligible, there must be verifiable energy savings delivered from the energy efficiency action.

It is perhaps worth a few words of explanation regarding awareness-raising campaigns. European Member States have been running information campaigns and awareness-raising on energy efficiency since the 1970s. It has always been difficult to disentangle the actual impact of such campaigns, and therefore Member States will need to justify any claimed savings from such activities.

Personalised energy efficiency advice on a residential or small organisation property can be equivalent to the energy audits more common in the industrial and tertiary sectors. The key to success, however, as with the energy audits, is the extent to which the recommendations of the personalised advice are actually followed up. Moreover, proper baselines are essential. For example, as Energy Performance Certificates (EPCs) are mandated by EU law for the sale of buildings and new tenancy, it will be important to ensure that the change of occupant advice is not included in the claimed energy savings. However, if that EPC results in the installation of an energy efficiency measure then subject to the various EED requirements, this energy savings could be counted toward their EED Article 7 target.

7.4 Baseline Issues

For directly measured energy savings, it is important to monitor the energy consumption before and after installation of the energy efficiency measure. Other factors that can influence energy consumption have to be considered, for example, in industrial processes, changes in the feedstock or finished product can affect energy consumption.

Such an approach is not practical or possible for small organisations and householders, and so deemed energy savings and scaled engineering estimates are commonly used and have proved extremely popular within EEOs. Deemed energy savings are based on independently verified energy savings values from previous installations of a given measure. In households, these would typically

Table 8

Potentially Ineligible Measures for Meeting EED Target	
Measure	**Points for Consideration**
Electricity generation from renewable energy	No end-use energy savings as replacing source of electricity supply
Heat production from combustion of renewable energy sources (e.g., wood, biomass)	No end-use energy savings as replacing source of heat supply
Electrification of rail transport, new metro system, etc	Generally not an energy efficiency policy
Training of energy auditors	Required by Article 16 of EED
Awareness raising campaign	Difficult to determine energy savings explicitly; personalised energy efficiency advice for small energy users likely to be easier to quantify but need to avoid overlap with EPCs

be broken down by house type, age of property, and floor area. Because of the wide differences between temperature requirements and occupancy patterns for households, energy savings are averaged over all households rather than requiring a baseline and independent measurement for each individual household. That is, as hundreds or thousands of such measures are installed (e.g., wall and loft insulation), it is accurate to say that the average value will be representative of the deemed energy savings value.[18]

Scaled engineering estimates take an intermediate approach between deemed and actual measured energy savings. For example, replacing a compressor or electric motor for which proven energy savings have been determined for a different kWh rating can be scaled for a similar application. This measure is commonly used in office HVAC equipment.

The topics of additionality and free riders are important for ensuring that the energy savings of the energy company are eligible to count toward the Member State's EED target; they are discussed in Section 8. These issues also depend on baselines such as the historic trend in installation of energy efficiency measures.

7.5 Creation of a Deemed Energy Savings List of Measures

As mentioned earlier, deemed energy savings have proven to be a very popular way of delivering energy savings when used with EEOs. Deemed savings offer certainty of the energy savings that the energy company will receive provided the measure is correctly installed. The approach also offers easier administration for both the energy company and the administrator. Finally, all these benefits translate into lower costs for end-users than would otherwise have been the case.

There are different approaches to establishing deemed energy savings in Europe. Underpinning all of them is that the deemed savings are only awarded to an efficiency measure that is both proven and independently verified to save a certain amount of energy and also is capable of multiple replications. Such deemed energy savings measures are defined in a list of standardised measures, published by the EEO administrator and usually accompanied by a list of any relevant technical standards and sampling procedures for M&V. Two approaches are illustrated here: France and the United Kingdom.

France publishes a list of eligible measures that now comprise approximately 300 such measures along with their deemed energy savings formulae. These values are established by the Association Technique Energie Environment (ATEE). A stakeholder process is conducted by ATEE in conjunction with ADEME (the French Environment and Energy Management Agency) and all the key WC stakeholders or their trade bodies. ATEE produces books (now on a website) of the eligible end-use energy efficiency measures and for each one gives the energy savings values per year and over the lifetime of the measure. In France, three climate regions are required owing to the spread in weather and annual temperatures between them; the energy savings values for each of these regions differ for measures reducing heating requirements.

In practice, even in France, despite the fact that there are approximately 300 eligible measures, the overwhelming majority of the energy savings come from the top ten measures. The ten standard operations indicated in Table 9 make up two-thirds of the energy savings certificates attributed to standard operations under the scheme. In Table 9 the reference column links to the energy savings calculation of the fiche in ATEE's catalogue of energy saving measures.

The **British** energy regulator, Ofgem, publishes on its website a list of eligible measures and the energy/CO_2 savings expected from them.[21] The residential deemed lifetime CO_2 savings are deduced from the annual energy savings and lifetimes of the energy efficiency measure. For many residential measures, these CO_2 lifetime savings are shown by house type and number of bedrooms (as a proxy for area).[22] Additionally Ofgem publishes two guidance documents for energy suppliers and energy efficiency installers to ensure that their eligible measures and eligible savings satisfy Ofgem's requirements (see Section 9 for more details and web links). As in France,

18 It is good practice to periodically verify that the deemed energy savings values are still relevant.

19 See: http://www.atee.fr/c2e

20 Bertoldi, P., et al. (2010, March). Energy supplier obligations and white certificate schemes: Comparative analysis of experiences in the European Union [Original research article]. *Energy Policy,* 38(3), 1455–1469.

21 See Ofgem's list at: https://www.ofgem.gov.uk/publications-and-updates/carbon-emissions-reduction-target-supplier-guidance-version-3

22 For properties much larger than the average size, there is an option for energy suppliers to specify energy savings in terms of the square meterage insulated.

Table 9

Top Ten Energy Efficiency Measures in the French WC Scheme

Sector	Reference	Standard Operation	% of Total Savings
Residential	BAR-TH-06	Individual-unit condensing boiler	15.29
Residential	BAR-EN-01	Attic or roof insulation	9.63
Residential	BAR-EN-02	Wall insulation	7.21
Residential	BAR-TH-07	Collective-unit condensing boiler	6.28
Residential	BAR-TH-12	Independent wood-burning heating devices	5.87
Tertiary	BAT-EN-01	Attic or roof insulation	4.88
Residential	BAR-TH-08	Individual low temperature boiler	4.57
Residential	BAR-EN-04	Window with insulating glass	4.33
Residential	BAR-TH-07-SE	Collective-unit condensing boiler with a contract guaranteeing the energy efficiency	3.84
Industry	IND-UT-02	Asynchronous motor	3.81

the documents are periodically updated in line with any changes owing to external factors, such as the banning of CFLs under EU regulations.

For the period 2008 to 2012, more than 95 percent of the energy savings in Great Britain came from the top ten measures and only 29 measures were used in that period. A list of the top ten measures is shown in Table 9.

7.6 Handling Non-Standard Energy Measures

Although deemed energy savings are popular, they do not meet all situations. For example, often there is a new technology with high replication potential but for which the energy company does not have an independent

Table 10

Total Number of Measures Installed in CERT (April 2008 to December 2012)

Energy Efficiency Measure	Total Number of Measures Installed	Reduction in CO_2 (t)	% of Total CO_2
Cavity wall insulation	2,568,870	65,793,377	27.7
Professional loft insulation	3,897,324	61,114,833	25.8
CFLs	303,952,610	43,706,936	18.4
DIY (self-installed) loft insulation	2,821,275	26,092,330	11.0
Shower regulators	9,653,441	9,894,974	4.2
Fuel switching	108,516	6,066,026	2.6
Window glazing over building regulations (square metres)	34,590,263	4,441,122	1.9
TVs	30,482,662	3,830,164	1.6
Standby savers	4,926,715	3,382,104	1.4
Real-time displays	2,999,981	2,901,249	1.2
Subtotal	**396,001,657**	**227,223,116**	**95.8**
All other measures	117,754,057	10,027,177	4.2
Total	**513,755,714**	**237,250,292**	**100.0**

Source: Ofgem

estimate of the energy savings. In general, there are two options available to the energy company.

First, the energy company (sometimes in conjunction with the product manufacturer) will pay for deemed energy savings to be independently verified. This may involve field trials if the technology is dependent on end-user behaviour; for example, in 2007, UK field trials were undertaken to establish average energy savings from using a new specially designed washing machine and associated low temperature detergent that operated at room temperature, as washing machine energy use is dependent on the number of people in the household, starting dirtiness of the wash load, and so forth.

Second, the energy company can install the new technologies as part of their EEO activity and get the energy savings independently verified. Of course, no energy savings are awarded to the energy company until after the deemed energy savings have been independently established.

It is important to note that process energy in industry usually requires measurements before and after savings measures have been implemented. It faces the additional challenge that the energy savings have to address the various factors that may occur through change of feedstock or range of products produced. These usually have to be directly measured and result in more expensive M&V costs.

8. Determining Energy Savings in the Context of the EED

Determining energy savings is a complex area. Two resources provide valuable information on determining energy savings, particularly in the context of the EED:

Report on Determining Energy Savings for EEO Schemes. This report strongly influenced the EU Commission in drawing up the rules under Article 7 and Annex V of the EU EED 2012.[23] It also goes into more detail on how the energy savings in Denmark, France, and the United Kingdom are carried out, and Chapter 8 details how to determine energy savings on a measure-by-measure basis for the most common installations.

JRC Ispra's webpage on "Applying common methods and principles for calculating the impact of energy efficiency obligations schemes or other policy measures under Article 7 of the Energy Efficiency Directive." JRC Ispra held a workshop in Brussels on June 10, 2015 on this topic.[24] The interpretation of determining actual new energy savings values from installed measures was discussed with particular respect to:

- Additionality
- Materiality
- Free Riders
- Rebound Effect

The JRC webpage provides access to the presentations and discussions from the workshop.

8.1 Additionality

Under EU EED and guidance notes from the Commission, energy savings are required to be additional. In other words, the energy savings from an energy efficiency measure installed can only be claimed for that part of the performance that is above legally binding European Union- or Member State-level requirements. This means that, among other things, savings must exceed the EU minimum performance requirements in the EU Ecodesign Directive or any requirement under EPBD. Similarly, for taxation policies designed to improve energy efficiency, only the energy savings attributable to the taxation amount above any minimum levels required by EU legislation (e.g., fuel transport taxation) can be used with real price elasticities of demand to determine the energy savings.

To give some examples, for measures supported by an obligated party and installed in a newly built property, only those savings over and above those required by the prevailing building regulations governing that property can be counted. Similarly, major renovations in buildings are covered by Member State building regulations (as required by the EPBD), so only energy savings above the minimum requirement may count.

The Ecodesign Directive also has an impact on additional savings, as the EU minimum baseline for estimating energy savings from energy-using products will increase over time. The dates of the EU minimum baseline changes are in line with the transposition of the Ecodesign legislation into Member State law. Appendix A gives a list of some of the important ones that might affect EEO energy savings.

8.2 Materiality

Annex V.2(c) of EU EED states that "the activities of the obligated, participating or entrusted party must be demonstrably material to the achievement of the claimed savings"; This remains a difficult concept to define precisely. The term "material" means that the party in question must have contributed to the realisation of

23 Crossley, D., et al. (2012). *Best practices in designing and implementing energy efficiency obligation schemes.* Montpelier, VT: Regulatory Assistance Project. Task XXII of the International Energy Agency Demand Side Management Programme. Retrieved from http://www.raponline.org/document/download/id/5003

24 Joint Research Centre, Institute for Energy and Transport. (2015, June). Applying common methods and principles for calculating the impact of energy efficiency obligations schemes or other policy measures under Article 7 of the Energy Efficiency Directive [Workshop]. Retrieved from http://iet.jrc.ec.europa.eu/energyefficiency/node/9080

the specific individual action in question, and that the subsidy or involvement of the obligated, participating, or entrusted party must not have had what is clearly only a minimal effect on the end-user's decision to undertake the energy efficiency investment. The term "demonstrably" means that Member States must be able to show that this is so. The activities of the obligated parties that are implementing the policy measure must be "material" to the carrying out of the action.

The example given by the Commission in their guidance notes describes a subsidy of €1 toward an efficient appliance costing €400 remains as an obvious example of non-materiality. At what point the subsidy level becomes "material" remains more difficult to define. The only unambiguous example of non-materiality is one in which projects **have started before the involvement of the obligated energy company.** Restricting government grants to projects that have not already started is normal practice for government funding within the EU-28.

In Denmark, simple rules have been established by the administrator of the EEO:[25]

- The savings may not be implemented before the contract is issued and vice versa
- A contract between the distributor and third party shall be issued before implementation of the energy savings
- Energy companies can only count savings where they are directly or indirectly involved, which may be advice, energy audit, subsidies, and so forth

Switzerland has established the following criteria for its grant programme known as ProKilowatt,[26] which is a competitive tender programme for energy savings in all end-use sectors outside of transport:

- Criteria fulfilled if no legal obligation to carry out measure, if project not yet realised, and if pay back period >5 years
- Subsidy maximum of 20 percent for projects with payback of >5 years
- For companies with voluntary/negotiated target agreements or energy audits: energy efficiency measure not part of agreement or already in energy audit, that is, only additional activities can receive subsidies from ProKilowatt such as if the energy efficiency measure was recognised in agreement or audit as not being economic

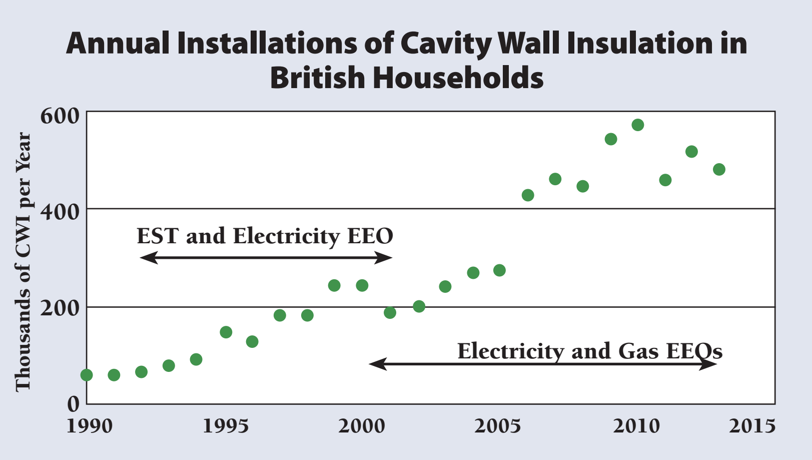
8.3 Free Riders

Free riders are those end-users who would have installed the measure anyway in the absence of EEO.[27] It is recognised that all energy efficiency policies aimed at the retrofit/replacement market will contain free riders. Although steps should be taken to minimise free riders in the design of the EEO, it is only really possible to determine the extent of the free riders afterward. This is one of the reasons the evaluation of any EEO is important.

There have been various attempts to estimate the significance of free riders. These include using baselines of activity for the energy efficiency measures before the start of the EEO, surveying participant end-users as to whether they would have done the measure without the EEO, and using the innovation theory of market penetration for new products to see if the classic S-shaped curve has changed for rapidly moving consumer products since the start of the EEO. Each has its own advantages and disadvantages.

Carrying out a survey of a sample of participant end-users as to whether they would have done the measure without the EEO is low cost, but properly framing the question is crucial, as the perception by the end-user of what the survey is trying to establish can influence the result. The clearest signal of the extent of free riders is obtained from using baselines of activity for energy efficiency measures before the start of the EEO and to

Figure 2



25 See: http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/files/documents/events/03_eichhammer.pdf. Also includes some information on German criteria for materiality.

26 Ibid.

27 This definition of free riders applies to all energy efficiency measures irrespective of whether it is carried out under an EEO or an alternative measure.

see whether a significant gain in activity occurs after the start of the EEO. Figure 2 shows one such example, representing the volume of cavity wall insulation measures under the Great Britain EEOs.

Note that only approximately 8 percent of British homes were heated by electricity in this period, and so the big expansion occurred once an EEO was introduced to the gas suppliers who supplied 80 percent, growing to 85 percent, of heating fuel for Great Britain's households in the period.

This prompts the question of how do you establish baselines, as government or energy agencies do not always know the baselines for the key energy efficiency measures? Trade associations of the particular energy efficiency measures will know the annual sales of their members and are usually happy to provide the total activity of their members on an unattributed basis, particularly if the point of the enquiry is to try and stimulate activities for their members. Once again, it should be noted that this applies to all energy efficiency measures installed by Member States to meet their EED target, not just EEOs.

The final method of addressing free riders is quite sophisticated and depends heavily on the availability of data on the market penetration of the more efficient appliance and lighting products, both before and after the EEO is introduced. Such data are available from commercial market tracking data sources such as GFK, but are expensive to buy. More data on this approach can be found in the link in the footnote.

For smaller Member States, buying such market data on appliances and lighting on an annual basis would impose significant cost. A one-off purchase at the start might be warranted to identify the products most in need of support and thus most likely to minimise free riders. Alternatively, a collective approach to the EU Commission to provide such historical data for the smallest or newest members of the EU-28 may be worth pursuing.

Another way of minimising free riders is to focus the promotions on a class of eligible customers who are less likely to afford the energy efficiency product (e.g., low-income customers).

In conclusion, free riders are inevitable in EEOs; they can and should be minimised by design of the EEO; they can only be precisely determined at the time of evaluation of a certain phase of the EEO.

8.4 Rebound Effect

The general definition is that the rebound effect occurs where improved energy efficiency is used to access more energy services rather than energy reductions. It is commonly split into two components: the direct rebound effect (e.g., increased amenity or comfort being taken by the end-user rather than the expected energy savings) and the indirect and macroeconomic effects.

The direct rebound effect is when some of the benefits are taken by the end-user in increased amenity or comfort. A classic example is that higher indoor temperatures are subsequently observed after insulating homes or in higher production rates in industry. It should be noted that some of the direct rebound effects have positive impacts, for example, improved health, reduced energy poverty, or improved productivity. Unfortunately such multiple benefits of energy efficiency are not included in EED, although they can be significant (see section 10.3).

The direct rebound effects are measureable and lie in the range of 10 to 30 percent for households and 20 to 60 percent for industry. In EED, Annex V.1 covers the direct rebound effect in the way that energy savings values are determined, that is, when calculating the actual reductions in energy consumption for the individual measures, any direct rebound effects need to be estimated and the reduced value used in the deemed or scaled energy savings used by obligated parties.

The indirect and macroeconomic effects are when some of the financial savings resulting from the energy efficiency measures being installed are spent on other things that have an energy consumption associated with them. The magnitude of the rebound effect is typically expressed as the percentage of the potential savings taken back from the maximum efficiency improvements expected. There is much literature on this subject, but no clear agreement on the size of this type of rebound effect, as it is difficult to measure. However, Article 7 of the EU EED does not discuss the indirect or macroeconomic rebound effect and therefore it does not need to be taken into account for energy savings counting toward the EED target.

28 See: http://iet.jrc.ec.europa.eu/energyefficiency/sites/energyefficiency/files/files/documents/events/05_lees.pdf

29 A rule of thumb is that once market penetration for any product has reached 30 percent, the likelihood is that there is a greater risk of free riders dominating.

30 See Bio Intelligence Service. (2010, November). *Preparatory Study for the Review of the Thematic Strategy on the Sustainable Use of Natural Resources*. Report for European Commission (DG ENV). Retrieved from http://ec.europa.eu/environment/natres/pdf/BIO_TSR_FinalReport.pdf

9. Compliance Regime

9.1 Appointing an Administrator of the Scheme

In the United States, it is usually the energy regulator that is responsible for administering the EEO. In Europe, only the United Kingdom, Portugal, and to some extent Poland have given this duty to energy regulators; the administration is usually undertaken by either the national government or an energy agency. Whoever is chosen as the administrator must have the appropriate legal powers to carry out this function, and this is usually given in the national legislation linked to the law establishing the EEO.

In tradable WC schemes there is a potential role for the administrator in accrediting non-obligated parties to generate energy savings certificates. In reality, in Europe, Italy is the only country that has gone down this route to date.[31]

9.2 Essential Duties of an Administrator and Resource Requirements

The government will normally set the target for the EEO in legislation, while the administrator's responsibilities include:

- Allocating the government-set energy savings target between obligated energy companies;
- Determining accreditation process for energy savings;
- Issuing technical guidance on eligible measures;
- Accrediting energy savings;
- Putting in place mechanisms to track any transfer or trade of savings; and
- M&V (covered in the next section)

The first task for the administrator is to allocate the individual targets to the energy companies based on their share of the energy type in the end-use market. This means that those companies that provide dual fuel (say, gas and electricity) will have separate targets for each fuel.

The next challenge for the administrator is to define all the administrative requirements necessary to conduct the proper functioning of the EEO. These cover the process to ensure that energy savings are accredited, any technical guidance on the measures that are qualifying, and any guidance on installation.

For the **process guidance**, this document would cover:

- how the administrator has set each energy company's energy savings obligations;
- any arrangements for prior approval of the energy company's actions or schemes that it plans to undertake; it is common for the administrator to do this, because, although this does not guarantee the energy company any energy savings, it hopefully picks up any projects that would not be subsequently approved;
- how the administrator will determine the actual energy savings that have resulted from the energy company actions or schemes;
- where necessary, how the administrator will enforce compliance with the requirements of the statutory EEO legislation; and
- the specification of the information that the administrator will require to produce the annual report to the government on the progress of the scheme to date; this report will also discuss any issues that should be drawn to the government's attention.

The technical guidance sets out the technical standards or specific requirements that need to be met when delivering or installing the energy efficiency measures to ensure that the energy savings attributed to each measure are in fact realised. It can also include specific best practice guidelines to follow when installing measures, as without these being adhered to, the energy savings may not materialise.

31 Poland, when fully running, will have the energy regulator as the administrator, although the government does give input to the tender exercise.

As one can imagine, these guidance documents can be quite lengthy (80 to 100 pages each for process and technical documents); it is recommended that the Ofgem guidance cited here be consulted, as it is in English.[32] It is also good practice for the administrator to issue spreadsheets for the common energy savings measures, along with their deemed energy savings values, to avoid excessive paperwork and to make life simpler for both the administrator and the energy company.[33]

Once the energy savings have been accredited by the administrator as valid, then they may be subsequently traded either between the obligated energy companies or on an open market such as exists in Italy and to a small extent in France. Again, the administrator will need to establish mechanisms to trace those accredited savings.

It is rare that the administrator will contain all the technical expertise that is required to carry out its role, and it is common for them to call on independent experts or the Member State's energy agencies (e.g., ADEME in France and ENEA in Italy).

All of this implies a cost to the administrator, which has to be paid either by the government or the obligated parties. This is why deemed or scaled energy savings have proven to be effective ways of minimising the administrative burden. Historically in Europe, the administration requirement has been low. In Italy, the energy regulator initially had three people working on the WC scheme, and later five. The regulator also used three to ten part-time expert consultants to supplement the in-house team.

The figures for the British EEO administered by the energy regulator Ofgem are shown in Table 11 from 2002 to 2015. The figures for spending by the energy suppliers are in cash of the day and have not been converted to euros because of fluctuating exchange rates.

Note the dramatic increase in Ofgem staff numbers from 2013. This is a clear example of what happens when the first principle of EEOs is forgotten: keep it simple. The overcomplicated structure of ECO, with many subtargets, different metrics for the sub targets, different eligible measures, prescribed delivery routes that are different for the subtargets, the abandonment of deemed energy savings, and so on, has resulted in an overly bureaucratic system.

As mentioned earlier, there are also the resource costs of the external experts that the administrator uses. During CERT the costs of Ofgem staff plus external spend was approximately £1.2 million and was paid by the energy companies. Putting this cost into perspective, it was less than 0.2 percent of the expenditure by the energy suppliers on ECO.

Table 11

Administration Resources Required for Different Phases of the British EEO From 2002 to Present

EEO Name and Period	Ofgem Staff Numbers	Energy Supplier Spending £ Million/Yr (Historic Cash Terms)
EEC1 2002-2005	4 start; 7 at end	£136
EEC2 2005-2008	7	£305
CERT 2008-2012	7 start; 9 at end	£770
ECO 2013-present	38	~ £900

Sources: Ofgem for staff and DECC evaluations for supplier spending up to 2012; RAP estimate for ECO

9.3 Monitoring and Verification

This function is carried out by the administrator but is given a separate heading because of the complexity and importance of M&V in ensuring that energy savings claimed have indeed materialised. The first check is to ensure there is no outright fraud (i.e., the energy efficiency measures have actually been installed). For the larger projects that have independent monitoring, this is a fairly straightforward process. For those projects that have used deemed energy savings, and as these tend to be more numerous, the administrator should resort to a sampling process. In such instances the administrator or their agent will telephone the property or premises where the deemed energy savings measure was installed to confirm that it was indeed done and that it was done by the energy company who is claiming the accreditation. It can be useful at the same time to also ask about customer satisfaction, as this can pick up problems in the approaches by either energy companies or energy efficiency industries that need to be addressed.

It is also important to ensure that the energy efficiency measure has been properly installed, and again the

32 See Ofgem's supplier guidance: https://www.ofgem.gov.uk/publications-and-updates/carbon-emissions-reduction-target-supplier-guidance-version-3

33 See Ofgem's example of such a spreadsheet: https://www.ofgem.gov.uk/publications-and-updates/carbon-emission-reduction-target-cert-scheme-spreadsheet-v1.3-suppliers

technique will depend on whether savings are being measured through deemed energy savings, scaled engineering estimates, or measured savings. Technical quality monitoring for deemed energy savings is best done on a sample basis using independent skilled agents; the agent will visit the property or premise to check the actual installation. Scaled engineering estimates are done by an independent party in the first place, and all that may be required is periodic checking that the approved independent party is "still up to the job." The same applies for directly measured energy savings.

Again, this is an area where it is clear that technical expertise is often required for the administrator to check that the savings claimed are indeed valid.

An example of the sampling technique adopted by Ofgem for 2008 to 2012[34] is shown in Box 3.

9.4 What Happens If the Energy Savings Target Is Missed?

Within Europe, no Member State has adopted the positive incentives for obligated companies who achieve or exceed energy savings targets that are common in the United States. Therefore this section focusses on the penalty framework that has been used in the European Union. It is important to begin by saying that to date there have been very few instances in which an energy company has missed its total energy savings target.[35] Nevertheless, well-designed penalties that are rigorously applied are often essential to ensure compliance.

Box 3

CERT Sample Monitoring Requirements

1% customer utilisation monitoring for electrical items, DIY loft insulation, and DIY radiator panels provided to householders for free.

5% technical monitoring for professionally installed insulation and heating measures. NB technical monitoring is not required for microgeneration measures installed under the government's Microgeneration Certification Scheme.

1% customer satisfaction monitoring for professionally installed insulation, heating measures, and microgeneration measures

5%—or a statistically significant sample, whichever is smaller—utilisation and evaluation monitoring of behavioural measures (e.g., advice and smart metering)

Source: Ofgem Supplier Guidance Manual

As always, the approach to penalties varies widely across Europe. The approaches can be classified as:

- Fixed penalty set in advance (e.g., France and Ireland)
- Penalty to be proportionate to the shortfall in energy savings but not defined in advance (e.g., Italy and the United Kingdom)

France established a clear penalty for each kWh that was missed from its energy savings target. The level was twice the expected cost estimated by the French government, but in the first two phases of the French WCs, that penalty level has in fact been five times the estimated cost to the energy suppliers of the WC. Although this method has the advantage of being clear, according to Irish energy suppliers it has created problems for some suppliers who are under pressure from energy efficiency providers to pay more than they normally would because they are aware of the higher level of the penalty; RAP is not aware of similar problems in other Member States. Perhaps this reflects the tightness or otherwise of meeting the EEO target.

The undefined penalty approach was recently put into effect in 2013 in the United Kingdom where for the first time the total energy savings target was missed along with some ring-fenced targets in the Great Britain 2008 to 2012 EEO. In principle, a British energy supplier could have been fined up to ten percent of the group turnover, but this magnitude of fine was not enacted. The first step was that the energy suppliers that missed their targets had to make good the shortfall in their targets as quickly as possible. There then followed a long delay in determining the level of appropriate fine, partly because this was the first time that such an instance had occurred since 1994. Eventually in late 2014/early 2015, various fines were imposed on those energy companies that had missed either their total energy savings target or one of the ring-fenced targets—for insulation or low-income households. The largest fine was £28 million, but most were ~£10 million or less and the magnitude of the fines was nowhere near ten percent of group turnover. The nature of the fines varied and sometimes was simply either to make a donation to a charity clearly linked to low-income

34 For more details on sampling requirements, see: http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/ CERT%202008-2011%20Supplier%20guidance.pdf

35 There are a few more examples in which a ring-fenced sub target has been missed (e.g., an insulation obligation in Great Britain CERT ending December 31, 2012).

customers or to deliver benefits to this customer segment alongside a nominal £1 cash penalty payment to the energy regulator.

RAP would strongly recommend that if penalties were part of any EEO framework, they should be "intelligent fines." In other words, the energy companies should make up the shortfall on their energy savings target and any monetary fine should be proportionate to the shortfall and should be used to directly help those in fuel poverty and/or to aid in the installation of additional energy efficiency measures.

10. Framework for Cost Recovery

Under EEO schemes in the European Union, all costs are ultimately borne by the consumer and recovered through energy bills rather than from the state budget via taxation. What varies is the way that this cost recovery is undertaken, and this in turn is linked to whom the obligation is placed on and whether the retail tariff is still regulated or not. Each of these instances is discussed in what follows.

10.1 Cost Recovery Structures

Obligation on energy supplier in a liberalised market

As there is no regulation of retail tariffs, costs will simply be considered as a cost of business, which retail providers will incorporate into the energy tariff. Although this has simplicity, the cost of the EEO may not be transparent. It relies on competition in the retail market to provide an incentive for the energy suppliers to deliver their target as cheaply as possible.

Obligation on energy supplier but retail tariffs still regulated

For the residential sector in France, as in many Member States, the retail tariffs for electricity and gas supply are still regulated. This has led to some argument by French obligated energy suppliers as to the extent to which the costs of the EEO are included in the regulated tariff.

It should be noted that because the other residential heating fuels are all covered by the same obligation, there is no distortion of interfuel competition occurring. Ultimately, the regulation of the retail prices should disappear under the electricity directives; however, in the interim, how to ensure fair cost recovery for energy suppliers with regulated tariffs will remain an important issue.

Obligation on distributor subject to regulation

Across Europe, all distribution companies are regulated and the regulation typically follows either a rate of return regulation (also known as cost plus regulation) or some form of revenue or price cap legislation.

For a **rate of return** regulation approach, the costs can be included as an additional cost item with approval or auditing procedures to ensure accuracy and that the estimates are reasonable. Denmark is a good example of such an approach, where an increase in allowed revenues is made each year on an ex ante basis, based on the average costs incurred in the previous years. This is then adjusted ex post on an individual energy distributor basis so that actual costs incurred are recovered through an upward or downward adjustment to the following year's distribution tariff. The Danish Energy Regulatory Authority since 2011 has undertaken benchmarking of the cost effectiveness of the EEO between distributors, and the EEO administrator requests that a number of the highest and lowest cost firms on a per-kWh basis provide additional detailed information for assessment. The administrator then has the option to adjust a given distributor's future energy savings efforts; additionally, information from the lower cost entities can be used for knowledge sharing purposes to encourage cost reduction.

Under a **revenue cap regulation** approach, the costs of the EEO scheme may either be estimated ex ante and included in the allowed revenues with a direct incentive on the distributor to achieve efficient output or treated as a cost pass-through item within the broader cap regulation framework. Italy is an example of this approach, where an assumed tariff contribution has been applied to estimate a fixed contribution per kWh for cost recovery based on trends in energy prices. This should incentivise obligated parties to seek out more efficient measures and thus increase their potential profit. However, as discussed in Section 6, this framework was vulnerable to sudden market shifts such as those seen in the rapidly falling costs of CFLs and the resultant windfall returns to electricity distributors at the expense of the end customer. The Italian regulator then required full price disclosure, which improved transparency.

It should be noted that in keeping with EED Article 15.4, the distribution price legislation should ensure that there is no disincentive for energy distributors to promote energy efficiency; in practice this means decoupling the revenues of the distributor from the volume of energy they distribute.

10.2 Illustrative Mix to Meet the Target

Irrespective of on whom the obligation is placed or whether the tariff is regulated or not, Member State governments need a good estimate of the likely cost that will be incurred by customers in meeting a specific energy savings target. For that reason, it has become good practice for the government to create and to cost how the target will be met by using an illustrative mix of energy savings measures. Note, this is not a prescriptive way for the energy companies to meet their target; it is merely an illustration of one way to do so. Such an illustrative mix is commonly used in the impact assessment accompanying the legislative setting of the target to explore the financial impact on end-users' tariffs.

10.3 Typical Impacts on End-Use Customers' Bills and Broader Societal Benefits

The illustrative mix discussed in the previous section provides an indicative cost of the EEO and hence an indication of the likely impact on end-users' energy unit tariffs (that is, the impact on the cost per kWh). This is not the same as the impact on energy bills of participating end-users. Even when the cost per kWh increases, bills will decrease as a result of using fewer energy units.

As mentioned, globally EEOs typically range from two to five percent of end-user consumer bills. In Europe the highest percentage is in the United Kingdom, at approximately four percent of household energy bills; elsewhere it is from one to three percent. Table 12 shows the costs for some of the longer-established EEOs in the European Union.

Table 12

Comparison of Evaluated Annual Energy Expenditure by the Energy Companies in Four Well-Established EEOs

Country	Energy Company Spending per Year (€M)	Energy Company Spending per Head per Year (€)	Period
Denmark	100	18	2011
France	300	5	2011 to 2013
Italy	750	12	2014
United Kingdom	1,700	26	2008 to 2012

The benefits of EEOs accrue not just to participants, but also to non-participants who also benefit from lower bills. As the IEA report on "Capturing the Multiple Benefits of Energy Efficiency" shows, there are significant benefits to the non-participating end-users as well, particularly for electricity in the form of deferred transmission and distribution upgrades, reduced costs of CO_2 emissions and line losses, reduced prices in capacity and wholesale markets, lowering the cost to Member States of meeting their renewable energy obligation, and so on.[36] Several of the multiple benefits from the IEA report are reproduced in Figure 3, illustrating the multiple benefits for the US state of Vermont in 2010. This graph reflects benefits solely arising from the effect of energy savings (i.e., reduced overall energy consumption) on the energy system. (For comparison, the levelised cost of the EEO to end-use consumers [regulated prices in Vermont] was equivalent to $39/MWh). Table 13 also shows these benefits and whether they apply to just those customers participating in the EEO or to all customers. In the Vermont example, the benefits to all customers exceed their annual contributions to the EEO, and that is without any benefits from renewable energy obligations or health benefits being taken into account.

Although the example of Vermont is one of benefits in a vertically integrated power sector, the benefits to the electricity provision and to all customers still apply in Europe even though the electricity provision chain is no longer integrated.[37]

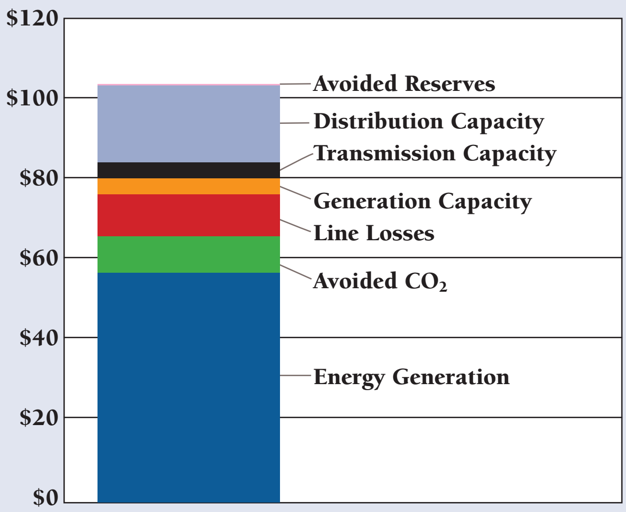
Thus, well-designed electricity EEOs can provide benefits to all consumers in excess of the costs of the EEO; this EEO cost on the bills

36 International Energy Agency. (2014). *Capturing the multiple benefits of energy efficiency.* Retrieved from https://www.iea.org/bookshop/475-Capturing_the_Multiple_Benefits_of_Energy_Efficiency

37 The IEA report also contains the results of the system level direct benefits resulting from deep investment in energy efficiency, which shows potential savings in the range €10 to €21 billion per year by 2035 in German power generation and grid infrastructure costs.

Figure 3

Multiple Benefits of EEOs Accrued to Vermont Energy Provision Chain in 2010, Expressed as Levelised USD/MWh



is less than 40 percent of the energy provider benefits and less than the USD 47/MWh benefits that accrue to all non-participating customers.

As the IEA points out, there are also important societal, environmental quality, and health benefits, and the current estimates of these are also given in their publication. Some of these additional benefits are included in the UK impact assessment of the extension of the existing EEO (CERT) in 2010 and shown in Table 14.

Table 14 shows the total costs (i.e., including energy supplier and household or landlord contributions) were £5,504 million, including "hidden costs" to households or landlords of £1,581 million, in 2010 money. The

38 UK Department of Energy and Climate Change. (2010, June). *Extending the carbon emissions reduction target to December 2012 – Impact assessment.* Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48491/121-iacertextension.pdf

Table 13

Breakdown of All Consumer Benefits in the Vermont Electricity EEO in 2010

Benefit to Energy Provider	Results USD/MWh*	Benefit to All Customers?
Avoided generation energy costs	57.5	No
Avoided existing environmental regulations costs (not CO_2)	Small	Yes
Avoided CO_2 emissions costs at $20 per ton	9.4	Yes
Avoided line losses	10.2	Yes
Avoided generation capacity costs	3.8	Yes
Avoided transmission capacity costs	3.2	Yes
Avoided distribution capacity costs	20.0	Yes
Minimising reserve requirements	0.7	Yes
Reduced cost of renewable resource obligation	0†	Yes
Reduced credit and collection costs	Not studied	Yes
Subtotal of all energy provider multiple benefits	>104.8	Yes
Additional multiple benefits to end-users		
Reduced maintenance costs	17.4	No
Saving of other fuels	14.4	No
Reduced water use	10.8	No
Subtotal of additional end-user multiple benefits	>42.6	
Total energy provider and end-use consumer benefits	**>147.4**	

* *The annual average retail price for electricity in Vermont in 2010 was $132/ MWh. Source: US EIA, 2012.*
† *Vermont has a binding renewable obligation target expressed in absolute energy terms; in Europe, the target is expressed in terms of percentage of electricity provided, but the value for other northeastern states that have similar percentage targets has been estimated at between $1.80 and $6.30/MWh.*

hidden costs cover household costs such as redecoration costs and time spent organising and coordinating installations by homeowners, which are not included in the cost of installation.

The direct impact of an EEO on the end-user tariffs is an important metric, particularly for political acceptability, but this figure should not be the only consideration, as the extensive work of the IEA has shown. A full analysis of costs and benefits should be undertaken to demonstrate a level playing field.

Table 14

Department of Energy & Climate Change Impact Assessment of the Costs and Benefits of the Proposed Extension From 2010 of the Existing EEO

Benefits	**Millions of Pounds, 2010 (Present Value)**
Reduction in energy use	
Total	***6,916***
Reduction in required purchase of EU ETS Emissions rights	202
Reduction in non-traded CO_2 emissions	2,869
Subtotal	***3,071***
Increased comfort	3,175
Air quality impact	989
Total	**14,150**

Costs millions of Pounds P(PV)(2010)	**Energy Supplier**	**Household or Landlord**	**Total**
Installation cost	2,308	1,614	3,922
Hidden cost	0	1,581	1,581
Total	**2,308**	**3,195**	**5,504**

11. Protection of Low-Income Households

Some Member States (including the United Kingdom, France, and Flanders in Belgium) have introduced a "ring-fencing" requirement on the obligated parties to meet a percentage of their targets through energy efficiency measures installed in low-income households.

The reason for ring-fencing low-income households is linked to considerations of social equity. If there was no such requirement, energy suppliers or distributors would have an incentive to install energy efficiency measures in the homes of those customers most able to contribute to the cost of that measure. Such a socially perverse incentive would mean that those low-income householders unable to pay for the cost of the measure would miss out on the benefits of the EEO despite paying through their bills for the costs of the EEO scheme. Ring-fencing a part of the residential energy savings target that has to be achieved in the households of low-income families is one way to ensure that all customer segments benefit from the EEO.

11.1 How to Define Low-Income Households

There is no official European definition of low-income households. The challenge for policymakers, therefore, is to enable the obligated energy companies and their agents to easily identify eligible houses without either excessive cost or being intrusive about the finances of the household, while at the same time having consistent and defensible rules for eligibility. For these reasons, the simplest way to identify households as low income is by using receipt of a certain government benefit that is linked to the income of that household – for example, belonging to a programme that offers fuel assistance in winter. Colloquially known as "passport benefits" in the United Kingdom, these provide simplicity and defensibility for the energy companies or their agents in identifying appropriate households as eligible. Indeed, the householder will have some evidence that they are currently in receipt of the eligible government benefits.

The drawback to this approach is that it does not take into account the energy efficiency of the property, and many social housing providers actually have very good standards of energy efficiency.

Other alternatives considered have been linked to the social tariffs that are present in some countries, (e.g., Flanders, France, and the United Kingdom). These lower-cost tariffs are offered by energy suppliers to vulnerable households, but they are restricted to grid-based energy provision. In reality, the number of households that such tariffs cover is a minority. Suggestions have been made to look at the heating bill, but this is not necessarily a good indicator, as in the case of the lowest income homes, which tend to under-heat to a level they can afford or to only heat one or two rooms.

There is likely not going to be a perfect solution to defining eligibility for energy efficiency measures in low-income homes, but experience shows that it is not wise to create a new definition of low-income households other than that which the government has established, as this leads to considerable disputes on eligibility. **In the early stages of introducing an EEO, the interpretative difficulties and appeals would likely overwhelm an emerging system if anything other than the government criteria were used for evidence of low-income households.** If later it is felt that a particularly vulnerable set of households (e.g., elderly and infirm) should be focussed on, this should again be easily identifiable from national passport benefit eligibility criteria.

12. Evaluation and Reporting Energy Savings to the European Union Under the EED

Energy savings actually delivered are only precisely quantified during the periodic evaluations that take place at the end of an EEO phase. Evaluations involve making estimates of the free riders (i.e., those end-users who would have implemented the energy efficiency measure in the absence of the EEO) and additionality in terms of being greater than baseline requirements set by the European Union (e.g., ECO Design minimum energy performance standards, EPPD new build and renovation requirements).

For this reason, it is important that the **evaluation is carried out by a competent person who is independent from either the obligated parties or the EEO administrator.** The evaluation should also try to identify lessons that have been learned and feedback ways to improve the next phase of the EEOs.

As all the Member States with or having plans for an EEO intend to use the EEO to satisfy part of their EED Article 7 requirements for energy savings, it makes sense for the EEO to use the same criteria as will be required by the European Union in determining the relevant energy savings for EED. This is not to say that the EEO evaluation must be identical, simply that it will minimise the workload for government.

12.1 Typical Topics Covered in an Evaluation

This is not meant to be a definitive nor indeed a complete list of the topics that might be covered, rather merely illustrative. Topics could cover:

- **Target-related issues.** The EU administrator will have dealt with meeting the target, but an evaluation might compare the expectations of how the target would be met with reality; any variation between the energy companies in meeting their target; estimation of the free riders; and the extent to which any allowed banking carried forward from the previous EEO affected energy efficiency activities in the phase being evaluated
- **Energy and environmental related issues.** CO_2 savings, other environmental emissions; any improvements in air quality, and so forth
- **Financial.** The financial benefits accruing to those participants in the EEO; impact on end-users' energy bills; indicative cost of saving a delivered unit of energy; cost effectiveness from a national perspective; impact on EEC2 on lower income households and, if targeted, fuel poverty; geographic split of benefits within the Member State
- **Market transformation impacts.** The impact of the EEO on the market for energy efficiency products or prices; development of ESCOs; impact of the EEO on small businesses; innovation brought about by the EEO—technical improvements, reduction in costs of energy efficiency measures, or more efficient delivery mechanisms
- **Other issues.** Lessons learned, comparison with other EEOs in the European Union, recommendations for further improvements

12.2 Ensuring Compliance With EED Article 7 Requirements

Rather than gather all the information again, a list of the individual requirements is presented here with links to the appropriate sections in this report.

- Section 7: Eligible Energy Savings Measures
- Section 8: Determining Energy Savings
- Section 9: Compliance Regime

13. The Benefits That EEOs Can Bring: UK Real-Life Examples

This section looks at the longest running EEO in Europe to see if it is making an impact in turning down energy demand, and explores why an EEO can be seven times more effective in saving energy in the residential sector than an energy or a carbon tax.

13.1 Can EEOs Really Turn Down Energy Demand? Top-Down Evidence

This analysis uses British government data on total final residential gas consumption, as Great Britain has the longest running and largest EEO in the European Union. Furthermore, because it is now only targeted at the residential sector, any impact would be most visible in this EEO.

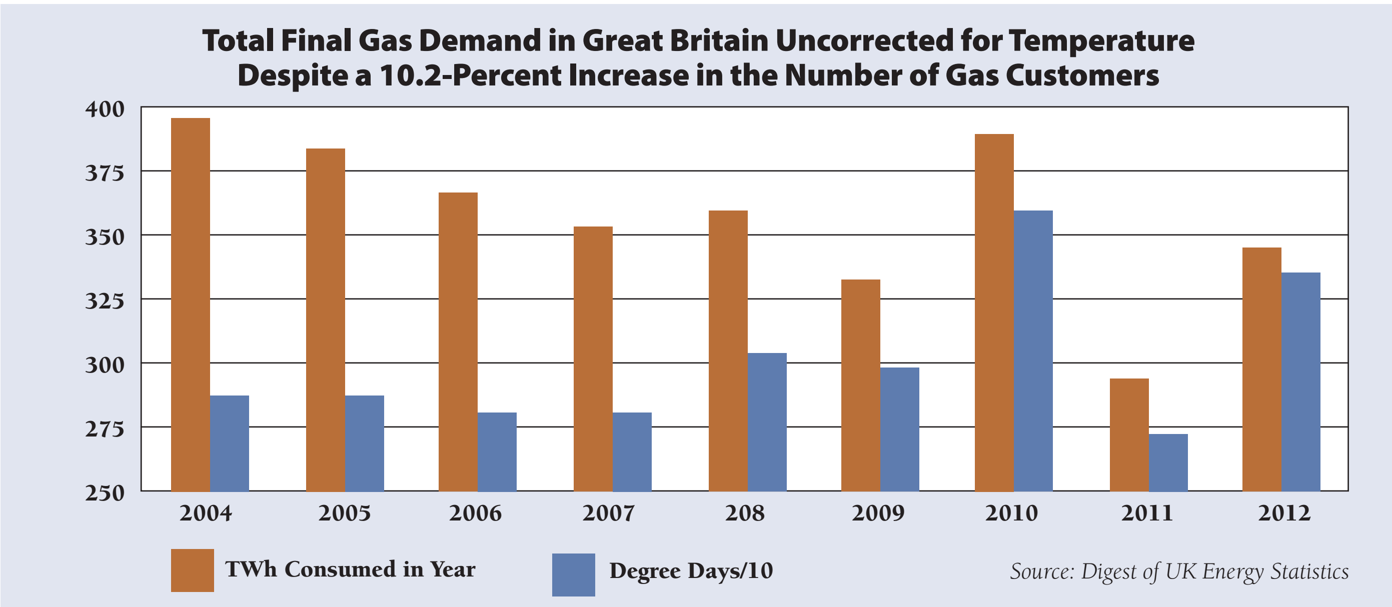
Prior to 2005, total residential gas demand was increasing typically in the range of one to two percent per year, the extent depending on the severity of the winter. In Great Britain, natural gas is the main (non transport) fuel in the residential sector, accounting for more than 70 percent of household final energy demand, as gas provides more than 80 percent of all Great Britain heating and hot water demand.

But in 2005, three important developments occurred that would reduce demand. First, the EEO doubled (72 percent of delivered energy savings in EEOs come from insulation measures in gas-heated households). Second, new energy efficiency regulations on boiler replacement meant condensing boilers quickly moved from 36 percent of the replacement market to more than 97 percent. Third, gas price increases for residential customers reduced demand; for every ten percent increase in gas prices, demand is reduced by two percent.

Going forward from 2005, there was an important factor that increased demand. Between 2004 and 2012, gas customers increased by 2.23 million (10.1 percent) owing to the expansion of the gas network.

As is well known, residential gas demand correlates strongly with winter temperatures. The traditional way in Europe to measure the impact of the coldness of any particular year is to look at the degree days, that is, heating degree days are a measure of how much (in degrees) and for how long (in days) the outside air temperature is below 15C. They are commonly used in calculations relating to the energy consumption required

Figure 4



to heat buildings. The starting year, however (2004), was a relatively warm winter, as shown in Figure 4.

The reduction in total residential gas demand is obvious, despite the 10.2-percent increase in gas customers and fluctuating winter temperatures. It is also important to remember that the decline in total Great Britain residential gas consumption started before the recession.

13.2 Can EEOs Really Turn Down Energy Demand? Bottom-Up Evidence

The best evidence from a bottom-up approach comes from the largest energy supplier in Great Britain, British Gas. They undertook a major examination of the individual annual gas consumption data for four million customers (approximately 40 percent of their customer base) for the period 2006 to 2010. They looked at factors affecting demand, including:

- Households, income, and tenure of property;
- External and internal temperatures;
- Energy efficiency measures installed; and
- Changes in behaviour, lifestyles, increased climate change awareness, energy efficiency advice, and the like.

For this four-year period, conclusions were that average household consumption fell by 22 percent over the period. The annual decrease was 4.9 percent per year compound. The biggest factors affecting this reduction (shown in Figure 5) were:

- Behaviour and lifestyle changes reduced demand by approximately 2.7 percent per year compound; and
- Energy efficiency measures (mainly insulation and heating) reduced demand by 3.3 percent per year compound.

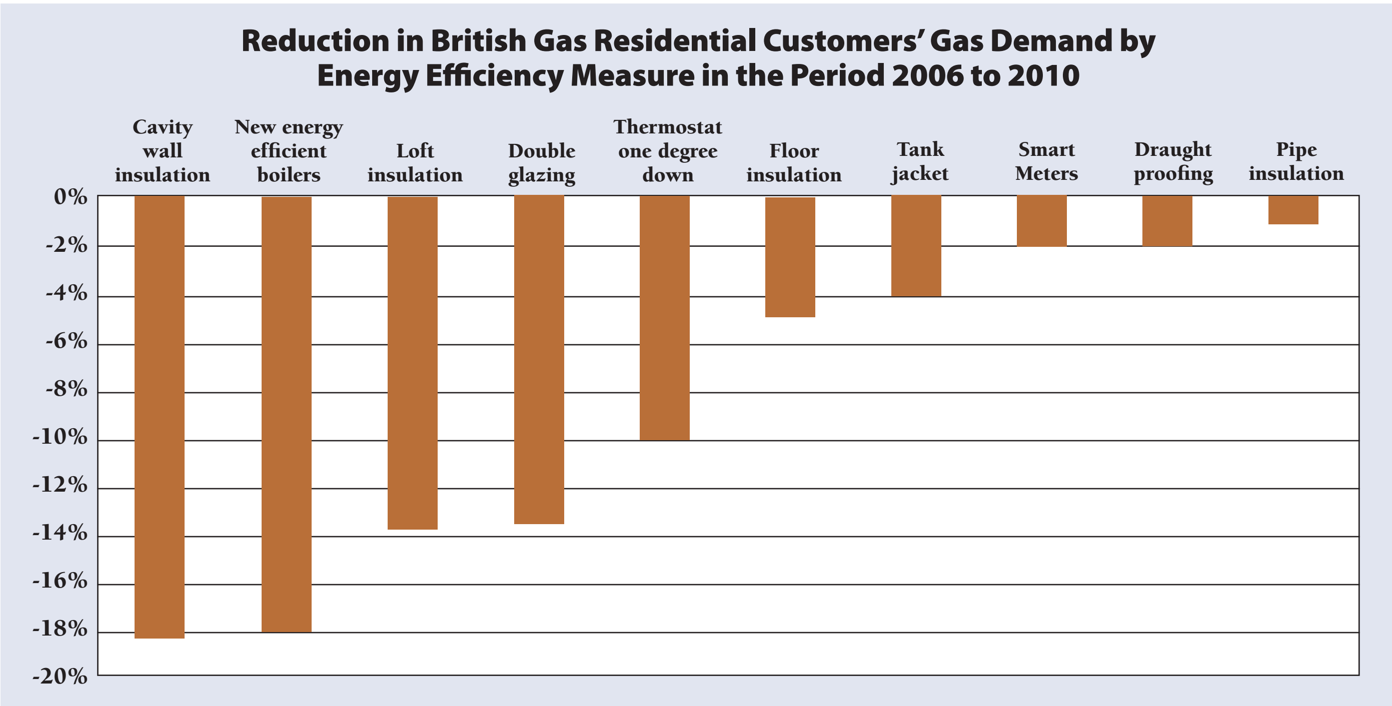
Other factors smaller in magnitude increased demand, which is why the above factors reduced demand greater than the observed 4.9 percent per year compound reduction (see report for full details).

13.3 Decarbonising Electricity Provision and Affordability in the Residential Sector

As we decarbonise, energy supply costs are predicted to rise, and energy affordability in a low-carbon world is a concern. Energy affordability is already an issue and is likely to grow in importance politically. For example, the French EEO from January 2011 has ring-fenced energy savings from low-income households.

Historically in the European Union, the EU ETS has been the main driver in reducing CO_2 emissions. The ETS increases the cost of energy and sends strong price signals to the supply side and larger energy users, but the signals to the demand side outside of those directly captured by ETS are much weaker. For example, in Great Britain, for a ten-percent increase in electricity prices, demand reduction in the residential sector is minus 2 percent; thus, a one-off electricity price increase of three percent will reduce electricity demand by 0.6 percent in the following year.

Figure 5



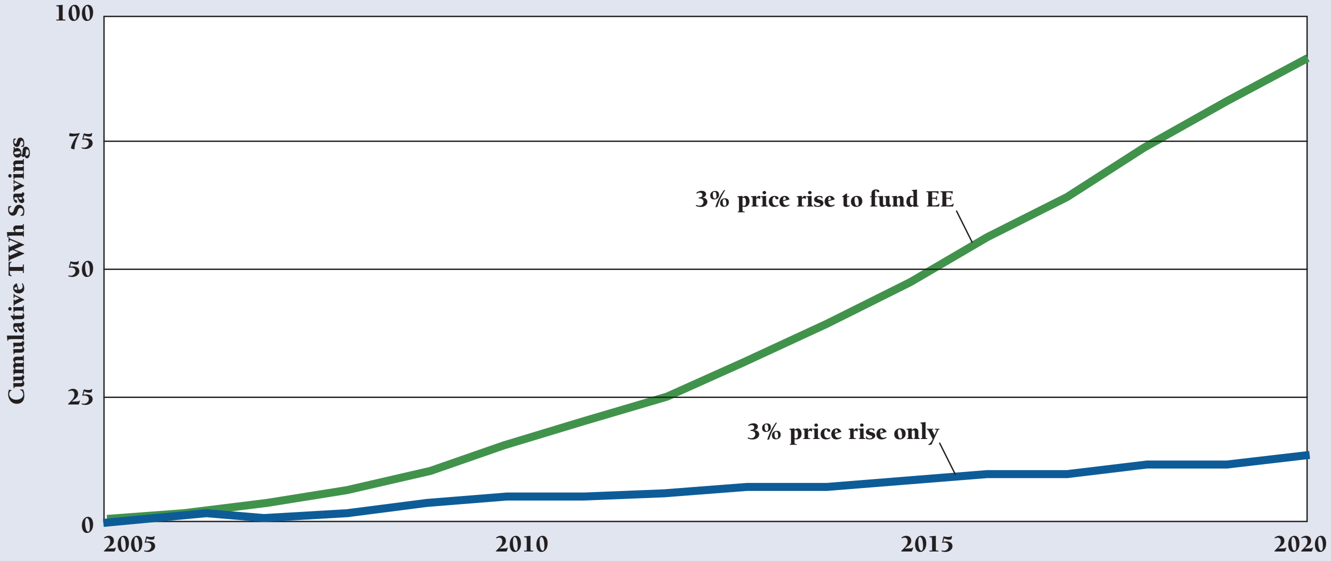
But what if that one-off three-percent price increase was to be reinvested each year in energy efficiency measures in households by way of an EEO? An analysis was undertaken using data on the levelised cost (€2 cents/kWh) to electricity suppliers in the British EEO for the period 2005 to 2008. The analysis used the actual electricity savings obtained by energy suppliers in the period 2005 to 2008, which are primarily insulation (36 percent), lighting (34 percent), and appliances and information and communication technology (29 percent). The calculation allows for the fall-off over time of electricity savings from the shorter-lived measures; it also corrects for comfort (increased amenity) – important for insulation measures; and for the heat replacement effect of more efficient lighting and appliances.[40]

The calculation assumes that the levelised cost of saving a unit of electricity remains the same in real terms after the end of 2008 until 2020, and that the real price of electricity remains constant in the same period. Using data derived from the British EEO for the period 2005 to 2008, Figure 6 illustrates clearly that by 2020, an EEO is seven times more effective in saving energy than a one-off price increase.

The result is not surprising. Investing that one-off price increase each year in something that is already cost-effective is bound to lead to greater longer-term energy savings.

Figure 6

Data From Great Britain EEO 2005 to 2008 Shows That Investing In a Price Increase in Energy Efficiency Saves Seven Times More Electricity Than That From a One-Off Price Increase of an Energy Tax



40 The heat replacement effect occurs when the inefficient electricity-using appliance and lighting are replaced by more efficient versions. The waste heat of the old, inefficient versions need to be replaced by the heating system in the heating season and reduces the apparent annual energy savings. For example, for cold appliances and efficient lighting, the heat replacement effect reduces energy savings by approximately 30 percent in Great Britain applications. Equally, in situations in which there is a summer peak demand owing to air conditioning, replacing inefficient lighting and appliances has a clear benefit.

Appendix A

Ecodesign Regulations and the Dates of Entry Into Force for the Main Requirements Covering Different Energy Efficiency Measures

The list contains only the main requirements, and in some cases the requirements might vary according to the size of the product or other parameters (Global Warming Potential of the refrigerant for air conditioners, for instance). The only way to get the complete information is to copy the relevant Annex in the Regulation (usually Annex I or II).

In some cases (fans and water heaters), there is a reference to the relevant Regulation because requirements depend on so many factors that it is very complicated to generalise.

The relative level of stringency might vary between different Regulations. For instance, for circulators, many products will already be available on the market when the second requirements come into force, whereas the first requirements for motors are not stringent and many products will already be in the market place.

Regulation 640/2009. Electric motors

- From 16 June 2011. Motors between 750 W and 375 kW shall be IE2 efficient
- From 1 January 2015. Motors between 7.5 kW and 375 kW shall be IE3 efficient or IE2 and incorporate a Variable Speed Drive (VSD)
- From 1 January 2017. Motors between 750 W and 375 kW shall be IE3 efficient or IE2 and incorporate a VSD

Regulation 641/2009. Circulators

- From 1 January 2013. Circulators shall have an energy efficiency index (EEI) of not more than 0.27
- From 1 August 2015. Circulators shall have an EEI of not more than 0.23

Regulation 643/2009. Refrigerators

- From 1 July 2010. EEI <55
- From 1 July 2012. EEI <44
- From 1 July 2014. EEI <42

Regulation 1015/2010. Washing machines

- From 1 December 2011. EEI <68
- From 1 December 2013. EEI <59

Regulation 1016/2010. Dishwashers

- From 1 December 2011. EEI <71
- From 1 December 2013. EEI <63

Regulation 327/2011. Fans

- The Regulation provides a table with minimum requirements in Annex I. Requirements come into force on 1 January 2013 and 1 January 2015.

Regulation 206/2012. Air conditioners

- From 1 January 2013. SEER >3.60, SCOP >3.40
- From 1 January 2014. SEER >4.60, SCOP >3.80

Regulation 547/2012. Water pumps

- From 1 January 2013. MEI at best efficiency point 0.1
- From 1 January 2015. MEI at best efficiency point 0.4

Regulation 932/2012. Tumble driers

- From 1 November 2013. EEI <85
- From 1 November 2015. EEI <76

Regulation 813/2013. Space heaters

- From 26 September 2015. Boilers, space heating energy efficiency above 86 percent. Electric boiler space heating energy efficiency above 30 percent. Heat pump minimum space heating energy efficiency 100 percent.
- From 26 September 2017. Electric boiler space heating energy efficiency above 36 percent. Heat pump minimum space heating energy efficiency 110 percent.

Regulation 814/2013. Water heaters

- Requirements come into force on 26 September 2015, 26 September 2017, and 26 September 2018. Please see tables in Annex II on the Regulation.

Regulation 66/2014. Ovens, hobs and range hoods

- From 3 February 2015. Ovens EEIcavity <146, hobs ECelectric hob <210, EEgas hob >53, hoods EEIhood <120
- From 3 February 2017. Ovens EEIcavity <121, hobs ECelectric hob <200, EEgas hob >54, hoods EEIhood <110
- From 3 February 2019. Ovens EEIcavity <96, hobs ECelectric hob <195, EEgas hob >55, hoods EEIhood <100

Regulations 244/2009, 245/2009, and 1194/2012 (excluding the amendments of these). Lighting

- Regulation 245/2009 covers technologies predominantly used in tertiary lighting, including street lighting such as metal halide lamps. LEDs are also covered under Regulation 244/2009 (efficacy requirements for non-directional LEDs) and 1194/2012 (efficacy requirements for directional LEDs and information requirements for all LEDs).
- The Commission plan was to revise all three regulations in 2015 to have one single regulation covering everything.
- Incandescent light bulbs were phased out in Europe over time starting in September 2009 until virtually all traditional incandescent bulbs were banned in September 2012.
- As lighting has many end-uses (e.g., directional/spotlighting, general illumination, ambience), the EU legislation is complex, and specific lamp replacement may require a careful understanding of the relevant Ecodesign regulations.

Appendix B
Sample Case Studies: Italy and France

Italy

Policy Objectives
To serve as primary driver for end-use energy efficiency

Obligated Parties
Distributors of electricity and natural gas

Fuel Coverage
Electricity and natural gas

Sectors Covered
All sectors including transport, and all end-uses; the primary energy target permits small-scale co-generation and photovoltaics

Trading
Trade of energy efficiency certificates through bilateral contracts or spot market

Who can generate energy savings certificates?
Obligated parties, energy service providers, companies and government bodies with an energy manager, electricity or gas distributors not subject to obligation

Energy Savings Target
7.6 Mtoe primary energy, cumulative, 2013–2016

Eligible Measures
Preapproved list of measures with deemed saving values, plus other measures qualify on a case-by-case basis

Ring Fencing
No

Measurement and Verification
Deemed savings; scaled engineering estimates

Scheme Administration
AEEG (Regulator) until January 2013; GSE (state-owned company responsible for renewable energy development) since January 2013. ENEA (technical assistance); Gestore dei Mercati Energetici SpA is the WC market operator.

Cost Recovery
Built into the distribution price control

France

Policy Objectives
To realise the diffuse but immediately available potential for energy efficiency, particularly in the residential and tertiary sectors, which are responsible for 40 percent of final energy consumption and one-quarter of greenhouse gas emissions in France.

Obligated Parties
Retailers of electricity, natural gas, heating oil, and importers of road transport fuel

Fuel Coverage
Electricity, natural gas, heating oil, LPG, district heating, road transport fuels

Sectors Covered
All sectors including transport, except for sectors covered by the EU ETS

Trading
Trade of energy efficiency certificates via over-the-counter market allowed but not widespread (less than four percent)

Who can generate energy savings certificates?
Obligated energy companies, local authorities, and social housing

Energy Savings Target
700 TWh cumac, cumulative, 2015 to 2017

Eligible Measures
Preapproved list of measures with deemed savings values, plus other measures qualify on a case-by-case basis

Ring Fencing
Not until the end of 2015; low-income households from January 2016

Measurement and Verification
Deemed savings; scaled engineering estimates

Scheme Administration
Ministry of Ecology, Sustainable Development, Transport and Housing (rules and level of obligation); ADEME (technical support); ATEE (deemed savings values)

Cost Recovery
None for unregulated energy providers; as price of electricity and gas is still controlled in France, the regulator is authorised by law to take into account retailers' costs of complying with EEO in setting tariffs.

Glossary

Additionality: In the European context, this means that only savings that go beyond the minimum requirements originating from EU legislation can count toward the Member State EED target.

Banking: Carrying forward excess energy savings from the current obligation period to help meet an energy savings target in a future obligation period.

Borrowing: Pulling energy savings that are still to be realised in a future obligation period into the current obligation period.

Deemed savings: A simplified approach to determining energy savings for common energy efficiency measures; the values are an average energy saving for that measure and are determined from independently monitored trials on historical experience with the measures. Also referred to as "ex ante" measures.

Energy audit: A systematic procedure with the purpose of obtaining adequate knowledge of the existing energy consumption profile of a building or group of buildings, an industrial or commercial operation or installation, or a private or public service, identifying and quantifying cost-effective energy savings opportunities, and reporting the findings.

Energy distributor: A natural or legal person, including a distribution system operator, responsible for transporting energy with a view to its delivery to final customers or to distribution stations that sell energy to final customers.

Energy efficiency: The ratio of output of performance, service, goods or energy, to input of energy.

Energy performance contracting: A contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure, verified and monitored during the whole term of the contract, where investments (work, supply, or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings.

Energy savings: An amount of saved energy determined by measuring and/or estimating consumption before and after implementation of an energy efficiency improvement measure, while ensuring normalisation for external conditions that affect energy consumption.

Energy savings certificate: A certificate representing a defined unit of energy savings, for example, a kWh. Savings levels are often defined based on lifetime savings discounted to the present. Certificates are granted by the implementing authority under an EEO. Obligated parties and, under certain EEOs, third parties, earn energy savings certificates for qualifying, verified energy savings achieved in a compliance period. Each certificate represents the same value. Energy savings certificates are first and foremost a compliance mechanism—obligated entities retire energy savings certificates in an amount equivalent to their obligation at the end of each obligation period. In certain EEO schemes, certificates can be traded among obligated entities or in a broader market.

Energy service provider: A natural or legal person who delivers energy services or other energy efficiency improvement measures in a final customer's facility or premises but who does not enter into an energy service agreement in which payment is linked to subsequent performance.

ESCO: A natural or legal person who enters into an energy service contractual arrangement with a beneficial end-user; in doing so, the provider of energy efficiency improvement measures, verified and monitored during the whole term of the contract and where investments (work, supply, or service) in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement or other agreed energy performance criterion, such as financial savings.

Final customer: A natural or legal person who purchases energy for his or her own end use.

Final energy consumption: All energy supplied to industry, transport, households, services, and agriculture. It excludes deliveries to the energy transformation sector and the energy industries themselves.

Free riders: Those who would have installed the energy efficiency measures anyway in the absence of the EEO.

Materiality: The party in question must have contributed to the realisation of the specific individual action in question, and the subsidy or involvement of the obligated, participating, or entrusted party must not have had what is clearly only a minimal effect on the end user's decision to undertake the energy efficiency investment.

Metered savings: Where the savings from the installation of a measure or package of measures is determined by recording the actual reduction in energy use, taking due account of factors such as occupancy, production levels, and weather, which may affect consumption. Often referred to as "ex post" savings.

Obligated party: An energy distributor or retail energy sales company that is bound by the national EEO schemes referred to in Article 7 of the Energy Efficiency Directive.

Rebound effect: Where improved energy efficiency is used to access more energy services rather than to achieve energy reduction.

Retail energy sales company: A natural or legal person who sells energy to final customers.

Scaled savings: Engineering estimates of savings in cases where establishing robust measured data for a specific installation is difficult of prohibitively expensive (e.g., replacing a compressor or electric motor with a different kWh rating than that for which independent information on savings has been measured).

White certificate: See "energy savings certificate."

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