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Energy efficiency obligations in the Netherlands

A role for white certificates?

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Abstract
The Netherlands have introduced ambitious energy and climate policy, but additional instruments will be necessary to achieve the targets. This paper tries to answer the question whether energy efficiency obligations might be introduced and which lessons can be learned from Denmark, France, Italy and the United Kingdom based on their experiences with utility obligations (also called white certificates). The conclusion is that, potentially, they provide a useful contribution to the Netherlands' toolbox of energy policy instruments.

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Summary

In 2007, the Netherlands formulated ambitious targets with respect to greenhouse gas emission reduction (-30% in 2020 compared with 1990), energy efficiency (a doubling of the annual improvement) and renewable energy (a share of 20% in 2020, compared with 5% in 2005). Although a formal evaluation is yet to be published in 2010, a first estimate reveals that additional instruments are necessary to achieve the targets, especially in the residential and commercial sectors. Next to other options, energy efficiency obligations for electricity and gas companies might be a promising option. This report analyzes experiences in Denmark, France, Italy and the United Kingdom with such obligations (often called white certificates). The main conclusions are:

- Substantial efficiency improvements have been made, often more than expected and currently in the range of 1.4 - 2.8% of energy consumption at the end of a multi-annual period; this has been the result of a gradual increase of targets and realization.
- In the cases in which cost/benefit ratios have been estimated, the results are positive.
- The introduction has to be organized carefully. A specific target has to be defined: a range of 2 - 3% of the relevant energy use at the end of the first three years and 4 - 6% at the end of the next period must be achievable without net costs. The target groups have to be defined: in most countries the buildings and housing sector is most important, but Denmark is satisfied with the inclusion of the industrial sector; extension to distribution grids makes sense, but extension to transport seems less useful. In the Netherlands it is advisable to designate suppliers as ‘obliged’ companies. Administrative costs have to be watched carefully and especially the Danish and UK approaches have distinct advantages. The Italian trading system seems to be a bridge too far to start with.
- If the Netherlands want to introduce the system, legal and practical arrangements have to be made timely and carefully. A strong interaction with stakeholders will facilitate this process.

White certificates are no panacea and will not solve all market failures in the energy system, but they may constitute a useful addition to the policy instruments toolbox in the Netherlands.

1 Introduction

The Netherlands introduced ambitious energy and climate policy in 2007 (Ministry VROM, 2007). Targets have been formulated with respect to greenhouse gas emission reduction (-30% in 2020 compared with 1990), renewable energy (20% share in 2020 compared with 5% in 2005) and energy efficiency (annual improvement increasing to 2%, compared with 1% in 2004-6). In 2010, a formal evaluation will be conducted, which will consider additional instruments in case the targets are expected not to be met. Recently, a first estimate of the possible impact of existing policies was published (Van Dril, 2009). The conclusion is that additional instruments are necessary. The residential and commercial sectors play an important role in this respect. The government is considering several options. This report tries to answer the question whether energy efficiency obligations might be introduced in the Netherlands and which lessons can be learned from other countries that have experience with such obligations (also named white certificates if they are tradable). The report does not answer the question whether efficiency obligations might be more or less effective or efficient than other additional instruments. ECN will also provide the Dutch government with other options to choose from.

2 Ambitions, achievements and opportunities

Table 2.1 sketches the expected situation with regard to renewables and energy efficiency. The estimate of greenhouse gas reductions is more complicated, but the general impression is that the targets can only be met with additional Joint Implementation or Clean Development Mechanism projects (or their successors), as more reductions are necessary based on current policies (92-132 Mton CO_2 eq.) than formulated in the actual policy program (96 Mton).

Table 2.1 *Energy efficiency and renewable energy: targets and recent estimate*

	Target	Estimate 2007	Estimate 2009
Efficiency[1]	2.0%	1.6-2.3%	1.4-1.8%
Renewable energy[2]	20%	11-17%	5-15%

[1] Annual change in %, 2011-20.
[2] Share in overall energy mix, 2020.
Sources: Ministry VROM, 2007; van Dril, 2009

Additional instruments are necessary. The residential and commercial sector plays an important role in this respect. Contrary to the industrial sector, the Netherlands does not have a long tradition of strong and effective policies in the residential sector (comp. IEA, 2009). Furthermore, existing buildings are the only sector in which recent estimates of policy impacts are 'substantially lower' than anticipated in 2007 (Van Dril, 2009). A basic policy instrument in the Netherlands is a covenant between social housing organizations and the energy and construction sectors to renovate and refurbish a considerable part of the housing stock.[1] The implementation of this covenant has proceeded slower and less complete than anticipated. Consideration of a more obligatory system did not deliver an alternative that was suitable for implementation up to now. There is a substantial potential for cost-effective solutions, though. This is not much different from the situation in other countries. Landlord-tenant problems and other market imperfections result in a considerably lower energy efficiency improvement than optimal. For example, in 2007 ECN estimated that 125 PJ could be saved without any net costs from a national perspective and 165 PJ from the perspective of the end consumer (the difference is caused by reduction in taxes due to lower energy consumption). With a five year payback period some 60 per cent of the potential of 87 PJ in existing buildings could be captured by white certificates or other instruments (Daniëls, 2007).

There are different options to increase the energy efficiency efforts in existing buildings: higher or different taxes, other incentives or obligations. This report looks at the option to introduce legal obligations for energy companies to realize more energy efficiency. These obligations have different names in the relevant countries and are implemented in different ways.[2] The aim of this report is to describe and explain recent experiences in relevant countries and look at opportunities to introduce them in the Netherlands. A careful examination will be needed to consider its eventual introduction and interaction with the recent covenant. As the covenant mainly deals with social housing in practice, an option could be to focus an eventual obligatory system on private house owners, commercial and non-commercial buildings (shops, offices, schools etc.). Recently, this was suggested by Member of Parliament Mr Samson.

[1] In the year 2006 the introduction of an energy efficiency obligation was considered carefully in the Netherlands and a decision to move forward was announced by the relevant ministers in a letter to Parliament in December 2006. Energy companies and other stakeholders developed the ideas leading to the covenant as an alternative, which was agreed upon by the new government.
[2] Different terminology is used. In Europe the instrument is called supplier or energy efficiency resp. savings obligations. The latter is preferable as a supplier obligation may also refer to attaining a certain share of renewables. Energy efficiency resource standard is the term used in the US. White tags (US) or white certificates (Europe) are names to refer to trading of certified savings.

The working hypothesis in writing this report is based on four conclusions of a recent IEA paper dealing with how to overcome the financial barriers in boosting energy efficiency that seem to be highly relevant for the Netherlands as well (IEA, 2007):

- Help to overcome this barrier will start from 'fringes' of the market and will be most effective if organized as public-private partnerships. Subsidies only offer short term relief. This start has been made in the Netherlands with the covenant.
- Packages of multiple policies have proven to be much more effective than single measures over the long term. This is well-known in the Netherlands, but maybe the package can be made broader and deeper.
- Lasting changes will only come through the creation of a market for energy efficiency. This, of course, is the essence of white certificates.
- Strong political will is required to pave the way for private investors.

Chapter 3 introduces the background. Chapter 4 explains the experience in relevant countries: the UK, Italy, France and Denmark. Chapter 5 draws some conclusions and gives advice to policy makers in the Netherlands.

3 Background: Recent European policy and Energy Savings Obligations in the US

The introduction of utility end-use energy efficiency schemes is one of the 25 IEA's energy efficiency policy recommendations to the G8 (2008) and IEA's member states (to be adopted at the Ministerial meeting in autumn 2009).

European energy efficiency policy received a big boost from the Energy Service Directive (ESD) in 2006. As a follow-up of ESD, European member states developed National Energy Efficiency Action Plans (NEEAPs). An ambition of the ESD and the NEEAPs is to create targets and frameworks for removing existing market barriers, to improve policies and to create the conditions for development of markets for energy services to final consumers. This 2006 Energy Efficiency Action Plan will be evaluated in 2009. Meanwhile, it has become part of the 2008 EU energy security plan. For the first time, energy efficiency is a main element of EU energy security policy, next to its ambitions with regard to climate change.

The ESD includes considerations for involvement of energy companies and especially the tradability of the results of these activities. In the European jargon they are called white certificates (like the green certificates in renewable energy). White certificates are documents certifying that a certain reduction of energy consumption has been attained. Under such a system, suppliers or distributors of electricity (and often gas and heating oil) are required to undertake energy efficiency measures that are consistent with a pre-defined percentage of their annual energy deliverance or other indicators. White certificates are mostly tradable, except on a formal market place. Although theoretically this instrument may target every final consumption sector (including industry or even transport), in practice it focuses on existing buildings (sometimes residential, otherwise commercial as well), which are considered to hold the greatest potential for cost-efficient energy savings. The European Commission shall put forward a proposal for a directive to further develop the market approach to energy efficiency by means of white certificates and recently asked member states and others to come with ideas in this framework[3]. The procedure is that EU member states will submit their 2nd NEEAP by the end of June 2011 and the Commission will publish a proposal before January 2012. This proposal will contain:

- Requirements to be complied with by energy distributors or retail energy sales companies, such as services, audits and/or measures and funds.
- Proposals to set up voluntary actions and/or market-oriented schemes, such as white certificates.

Therefore, experiences from the Netherlands may influence European policy making, but at the same time interaction with the Commission is necessary to make sure that no steps will be taken that have to be reversed when the Commission introduces its own proposals.[4]

Previously, several US states introduced energy savings obligations for energy suppliers. They have different names; most common is Energy Efficiency Portfolio Standards (EEPS) for utilities. Most of them were introduced in the 1990s or early 2000 to improve security of supply by

[3] The concept had been supported before in the Proposal for a Directive on end-use energy efficiency in 2003: "The Commission considers this to be a possible next step in a few years time and may then come forward with a proposal based on the experiences in some Member states currently developing and implementing such certification schemes".

[4] The case of introducing a European scheme in the near future does not seem very convincing because of equity issues (cross-subsidization between countries), inherent technical difficulties in harmonizing measurement and verification, differences among member states in terms of energy taxation and experience with efficiency policies and because there is no necessary structural difference in marginal costs between member states (this is different from the case of renewable energy). The European Commission is considering introducing a voluntary or regional scheme.

diminishing demand. Independent research shows that they have been quite successful. Horowitz (2007) concluded that states with moderate to strong commitments to utility efficiency programs experienced less electricity growth in industrial and commercial sectors than states with weak or no programs. Berry (2008) had a broader look at the effect of state energy efficiency programs, in which indicators of state efforts were defined as: more spending by utilities; binding standards on utilities; other efficiency policies like CHP, building codes and tax incentives; R&D focused on efficiency and specific state procurement activities. His main conclusion is that "Applying the leading states' energy efficiency programs cuts the growth in a states electricity sales by about 60% as compared to the case with no efficiency programs". Important to note is that this is the *net* effect of these programs. Rebounds, free riders and lack of targeting have been taken into account. At the same time, Buchner and Waide (2008) concluded that "the mandated savings obligation when linked to a suitable non-compliance penalty structure seems to be an especially effective means of ensuring that public policy objectives for energy efficiency are met".

Generally, the targets for utilities start low and increase over time. Most utilities realize 0.5-1% savings per year, but very active ones like Efficiency Vermont realize 1.8% annually; the Vermont scheme is the most ambitious scheme of the US and costs 3% of total utility revenues. A more average example is the Texas approach that started with an obligation for utilities to offset 10% of forecasted electricity growth through energy efficiency, increasing to 20% and for 2009 30 to 50% is under consideration. Indeed, the original targets were modest as electricity growth was 2% annually of which 0.2% had to be saved; real savings were 1% of annual sales. The same approach can be observed in California that first tried to decouple sales and profits for gas and electricity, but more recently adopted a scheme called 'decoupling plus', which aims to make investment in energy efficiency even more profitable for utilities than new power stations would be. As in other US states, fees to finance energy-saving measures are added to each bill and utilities spend the money in pursuit of targets set by the regulator. If a utility achieves between 85 and 100% of the target, it is allowed to get 9% more than it would earn from building new generation; if it exceeds the target, it gets 12% more, between 65 and 85% it does not get a reward and below 65% it has to pay a fine (The Economist, May 10, 2008). California's savings were projected to meet more than half of the state's growth in electricity demand between 2004 and 2013. At this moment US Congress discusses a federal obligation which would combine targets for renewables and energy efficiency. Generally, US utilities are free in deciding how to implement; they simply pay for the resource delivered. However, these schemes are sometimes complicated and not adapted to the European liberalized market. They cannot be copied in Europe, but the basic concept of an obligation is worthwhile to explore further.

In general, utility obligations in the US are not tradable, although gradually different types of flexibility mechanisms are introduced, e.g. connecting obligations to realize more energy efficiency with those aiming at more renewable energy.

Several European countries introduced a comparable approach: the UK (electricity and gas), Italy, France and Denmark (electricity, gas and heat distributors), Ireland (electricity only) and Flanders in Belgium. Especially the UK, Italy, France and Denmark have some years of experience and first evaluation results that might sharpen the focus for the Netherlands.[5]

At the beginning it is important to note that the obligation for energy companies to invest in energy efficiency is the real issue, i.e. more than the tradability of the effects of energy savings (comp IEA-DSM, 2006). There are two reasons for this, which will be explained in this report:

- Evaluations of obligations are more conclusive than evaluations of the tradability, because more research has been done on the issue and more experience has been gained.
- Tradability has advantages - more economic efficiency - but also disadvantages - administrative and regulatory costs - and finding the optimum needs careful analysis and consideration. Therefore, in practice, most countries have opted for 'soft tradability', which opens opportunities to trade with some actors only. Furthermore, white certificates do not intend to replace other policies, but reinforce their effects.

[5] Next to these four countries, schemes exist in Flanders and Ireland, although on a smaller scale. The current Energy Efficiency Obligation in Flanders was put in place in the beginning of 2003. Electricity distributors are required to achieve targets for the promotion of energy efficiency for high voltage end users (since 2008 1.5% of energy used the two previous years) and low voltage end users (in 2004-7 1% of energy used plus 2% linked mainly with the promotion of CFLs to households for electricity distributors which supply more than 10% of their distribution to low voltage end users, since 2008 2% of energy supplied). At the beginning, the annual targets were 1% of energy supplied. Except the CFLs no prescription exists on how to reach the target. No trading is possible. Important measures in the residential sector are low flow shower heads, CFLs, insulation and condensing boilers, in the high-voltage sector they are more diverse. Except one smaller distributor all Flemish distributors met their targets; companies achieved in total 760 GWh in primary savings in 2003 to 990 GWh in 2005; the degree of additionally is uncertain. Annual expenditure in 2004-5 was some € 10 million against a budget of 24 million Euro and is part of the regulated grid tariff. In terms of CO_2 costs the figures indicate 12.3 Euro per ton CO_2 for low voltage customers and 6.3 for high voltage customers. Authors like Lees (2007) complain about the intransparancy of the Flemish system. Ireland has an efficiency obligation system for electricity as well, which is somewhat similar to that of the UK but much smaller (0.24 TWh annual and a yearly cost of 3 million Euro). Poland considered implementing a system, but eventually did not introduce it out of fear of increasing consumer prices.

4 Experiences in the UK, Italy, France and Denmark

Table 4.1 presents the ambitions of the schemes in four countries; Table 4.2 provides some other characteristics.

Table 4.1 *Ambitions of recent market-based efficiency programs*

	France	UK	Italy	Denmark
Stated goal	54 TWh (2006-9)	62 TWh in 2002-5 130 TWh in 2005-8 4.3 MtCO2 in 2008-11 (1) 5.4 MT CO_2 in 2008-11 (2)[a]	5.8 Mton in 2005-9, from 1.1 Mtoe (2005) to 1.9 Mtoe (2009)	2.95 PJ per year (2006-10) 5.4 PJ (from 2010)
Stated goal recomputed in TWh per recent year	18	43 (2005-8)	12.5	10.5 to 19.4
In % of consumption or emission in first year	0.46% (expected result)	0.33% (2005-8) 1% (2008-11)	0.5 - 0.6%	0.34% (2006-10) 0.61% (2010)
In % of consumption or emission at end year[b]	1.4% (2008-9)	2.21% (2008)	1.8% (2009)	2.8% (2010)

[a] The 2008-11 ambitions were increased in September 2008.

[b] Computed by the Danish consultancy Ea taking into effect the accumulation of effects of activities with a long life-time; it gives lower percentages for France

Sources: Togeby et al., 2009; Bodineau; ECN research

These ambitions are lower than the 'More with Less' covenant in the Netherlands, but that target is covering a longer period. The Dutch target is 100 PJ, i.e. 10% of household consumption, which means 2% of total TPES but only related to gas use. One might say that this ambition for a much longer period (2009-2020) is twice that of the existing schemes in the four countries, but comparable with the UK ambition for 2008-2011.

A market-based efficiency program or tradable white certificate scheme has to look at several issues:

- Setting a target.
- Defining obliged parties.
- Calculating how to reach the target and which technologies are eligible.
- Defining trade rules.
- Creating relevant institutions for verification, registration and enforcement.

As the scheme will always be part of a broader package, the links to other instruments are also relevant.

Below we will present the outlines of the national schemes and look at these issues, focusing on those aspects that might be important for consideration in the Netherlands.

Table 4.2 *Other aspects of market-based efficiency programs*

		France	UK	Italy	Denmark
Realization		36 TWh per 1/1/09	187 TWh in 2005-8	2 Mtoe in 2005-7	5.74 PJ (2006+7)
Related to target		67% in 84% of time	144%	182%	98%
Relevant company		retail	retail	grid	grid
Market approach		bilateral	between suppliers only	electronic market	between suppliers only
Target groups	Residential	88%	89%	63%	41%
	Industry	6%	4%[a]	4%	51%[a]
	Commercial	4%	-	26%	-
	Transport	1%	-	-	-
	Public	-	7%	7%	8%
Activities	Insulation	13%	68%	-	3%
	Heating	54%	9%	26%	59%
	Lighting	?	14%	70%	3%
	Industrial pr.	?	-	4%	25%
	Appliances	?	6%	[b]	4%
Threshold		400 GWh/yr but all heating oil companies	50,000 customers	50,000 customers	no
Innovation bonus		no	yes	no	no

[a] Combined with the commercial sector.
[b] Combined with lighting.

The United Kingdom

First, we describe the background and design of the energy obligations in the UK. Second, the results in actions and measures, savings, investments and transaction costs are described. Finally, the ideas in the UK to develop the system further are described.

The UK introduced the supplier obligation in its actual form in 2002, but renewed it in 2008. The idea behind it is that it is in the interest of households to improve the energy efficiency of their homes as payback periods of e.g. insulation are only two years, but barriers to investing in efficiency measures are difficult to overcome. The supplier obligation is designed to help overcome these barriers as far as possible (UK Government, DECC 2009). It looks at eight gas and electricity retailers that have to comply and the obligation is only relevant for delivery to households; the target is based on their number of customers. It has been suggested to extend the obligation to small businesses and organizations, but this was not carried out. The obligation works with three-year targets: the Energy Efficiency Commitment 1 (EEC, 2002-5) and 2 (2005-8), followed by the Carbon Emission Reduction Target (CERT, 2008-11). CERT commenced in April 2008, but its ambitions were strengthened with 20% in September 2008 as a direct response to energy price increases. CERT is now seen as 'the principal driver of energy efficiency improvements in existing homes in Great Britain' (IEA, Energy Efficiency Policies and Measures database). Although the obligation addresses suppliers of gas and electricity, the savings can be accredited for initiatives applied to the use of any energy carrier for residential purposes. To avoid creating barriers to entry for small suppliers, a threshold of 50,000 customers has been introduced. A specific feature of the UK system is that it also has a specific social goa;, it supports the British 'Fuel Poverty Strategy'. Fuel poverty is considered to occur when a household spends more than 10% of its income to satisfy energy needs. In EEC, at least 50% of the energy savings had to occur in the so-called priority group, defined as households that receive certain income-related benefits or tax credits. In CERT 40% of each supplier's target has to be delivered in the priority group, which is now more broadly defined as those receiving benefits or be-

ing over 70 years of age. CERT probably is the most ambitious obligatory system in Europe these days.

All measures in the UK have a deemed score, which means that computations and estimates have been made before for 'standardized' activities. The main steps to determine the savings are:

- Annual energy savings (in kWh per year) were estimated on an ex ante basis.
- These savings were discounted (in EEC1 using a rate of 6% and assumed lifetimes, in EEC2 3.5%).
- Fuel standardization of energy savings was based on kW input of different fuels and carbon content.

Innovative measures may count additionally. An innovative action is one that has not been used in the preceding period, unless it is in a new form (e.g. a new type of insulation material) which significantly increases the energy efficiency (more than 20%). In EEC2 the maximum share of innovative measures for each obliged company was 6%, but in the September version of CERT this was increased to 10% (therefore the actual delivery may be less than the targeted 5.4 Mton CO_2). This uplift is mostly 50% and in some cases 100%. Innovation occurs mainly in appliances (like integrated digital TV's or standby savers) and according to Ofgem it played a visible role in market transformation. However, the impact was small in delivering energy services (Ofgem 2008).

The estimates try to make corrections for deadweight (additionality) based upon market statistics, but the level of accuracy has been called questionable (Togeby 2007). Suppliers have a number of routes to the market, including direct marketing such as mail out or phone calls, door knocking by suppliers and installers, work with retailers to get to the do-it-yourself market and cooperation with manufacturers to attain the 10% innovative technologies uplift. The expected results are a combination of number of measures, standardized efficiency improvement, estimated additionality and (standardized) technical lifetime.[6] No monitoring requirement for actual savings exists. Most activities are undertaken in insulation. The share of insulation in EEC2 was even higher than in EEC1 (68% against 56%), whereas that of lighting decreased from 24% to 14% and of appliances from 11 to 6%. Most frequently implemented measures in EEC2 have been: cavity wall insulation (76 GWh savings), loft insulation (50 GWh), compact fluorescent lamps (CFLs), (22 GWh), do it yourself loft insulation (9 GWh) and several types of efficient boilers (8 GWh). These five measures generated 89% of all savings. Some two-third of the savings was achieved in gas, 27% in electricity and 5% in coal; in EEC1 the shares of gas and electricity had been 44% resp. 49%. This implies that the occurrence of double counting with the EU Emission Trading Scheme is decreasing, but it is still substantial.

As stated earlier, in EEC2 a discount rate of 3.5% has been used (impact: a technical lifetime of 40 years with 3.5% is one of 20 years with 0%), but as the target changed into $MtCO_2$ in CERT, a discount rate of 0% is now being used. This has certainly been strongly influenced by the Stern Report (Stern, 2007).

In CERT the uplift has been extended to real time displays and micro-generation (with a separate uplift share of 2%).

Utilities achieved their EEC targets easily. The EEC1 target was 62 TWh for three years (this refers to the cumulated savings and was discounted over the lifetime of the equipment funded). This goal was exceeded by 40% (86 TWh) and the suppliers who exceeded their target were allowed to bank the measures for the second period (EEC2), with a target of 130 TWh. In EEC2 187 TWh of energy savings were achieved, i.e. 44% above the target. This leads to a carry over

[6] Some precautions were taken to take into account the rebound effect. A so-called 'comfort taking' effect (turning the central heating higher in an insulated home) of 15 to 45% was introduced.

to CERT of 30% of the initial CERT target (Ofgem 2008), which equals 25% of the increased September version. The carry over or banking has helped energy suppliers plan their activity and has avoided stop-go situations. Different energy suppliers took quite different measures (e.g. the share of appliances in EEC1 was between 1 and 32%), which is a healthy sign of specialization and branding. The UK model has triggered competition among suppliers as they compete for customers (implementing measures for other customers is common practise in the UK). Ofgem has powers to fine companies up to 10% of turnover for non-compliance. The level of deadweight (free riders - customers who would have taken up the measure in any event) is estimated around 20% (Lees, 2008).

But also after correction for deadweight the increase of the obligation is impressive. Something around 0.4% of emissions will have been saved each year.

Table 4.3 *The UK obligatory system: realization (2001-8) and target (2008-11)*

	EEC1 (2001-5)	EEC2 (2005-8)	CERT (2008-11)
Annual CO_2 savings [Mton]	1.1	1.8	5.2
CO_2 emission by households[a]	145	140	130
Saving in % of emission [%]	0.8	1.2	4.0

[a] Direct and indirect (from power generation).
Source: IEA, Energy Review UK (2006b); Purchar, 2009.

Spending by utilities increased rapidly: from 300 million Pounds per year in 2005-8 to 1,100 million in 2008-11. The latter amounts to some 3% of the energy bill to customers. The increase is somewhat faster than that of expected carbon savings: 1.8 Mton in 2005-8 to 5.2 Mton in 2008-11. This shows that it is expected that marginal costs of efficiency efforts will slowly rise. However, up to now the effort has been very cost effective and it is expected that this will remain the case. An evaluation of EEC1 showed that an investment of 533 million GBP by suppliers and 371 GBP by households and other parties resulted in a net present value benefit of 4,524 million: a cost/benefit ratio to society of 1:5. The costs were 20% lower than anticipated. The independent evaluation of EEC2 estimated a 1.1 billion GBP investment by suppliers and households delivered net present value benefits of 8.3 billion. The estimated costs of savings paid by households were around 20% of their 2006 consumer prices. For every GBP raised from households, EEC2 was expected to produce GBP 9 in long-term benefits (UK Government 2009). This is a net present value to Great Britain of 53 GBP per ton of CO_2 saved (Lees 2008). For 2008-11 the expected costs to UK society are 3.2 billion GBP, but expected benefits are 15.8 billion (UK Government). As the UK is entering into a higher marginal cost area, this seems somewhat optimistic. The very positive cost/benefit ratio is mainly due to the long lifetime of most savings. Especially without a discount rate this raises the question if this isn't an overestimation. Without the policy measure some other activity would have taken place in the building and within 10 years new approaches may have had even more impact than the current one.

Bilateral trading between obligatory parties and banking from one period to another is allowed; only banking takes place. Energy savings and individual obligations may be traded if approved by the regulator. Anonymous trade or spot trade is not possible, but bilateral - over-the counter - trade is allowed. Therefore the UK system is not a 'real' white certificate system.

Some research has been done on the nature and level of transaction costs of the UK system. Five types of transaction costs have been distinguished (Mandaca, 2007).

1. Costs related to preparation; finding customers willing to implement measures is cumbersome. Energy suppliers relied on third parties to address this issue, mostly local authorities and social housing partners. Further, the customers had to be persuaded to implement measures. It was mentioned that even if households were aware of the benefits of energy effi-

ciency and could get highly subsidized insulation (up to 70% for priority groups), monetary savings did not persuade people to implement measures. Gradually these costs decreased as may be seen in the increase of insulation activities. A third source of costs, approval of measures by Ofgem, was not a big issue due to the standardized approach.

2. Costs related to implementation. In most cases energy suppliers did not implement measures themselves but relied on partners: consulting services, managing agents or 'middlemen' that charged fees up to 10 GBP per insulation measure, and insulation contractors. In case of appliances energy suppliers worked with retail companies or equipment manufacturers (which offered more attractive discounts).
3. Costs related to measurement and verification. Once measures were implemented, monitoring requirements included their actual use and consumer satisfaction.
4. Costs related to trading. In the UK almost no trading took place between suppliers, but energy suppliers did purchase energy savings generated under other government programmes and in some cases bilateral trading of obligations occurred. It turned out that a major impediment of trading was the perception of transaction costs. Furthermore, trading was hampered by the absence of clear procedures for determining liability.
5. Costs related to declaration (redemption) were considered to be low.

All in all, transaction costs have been estimated to represent some 10% of investment costs for lighting (mainly negotiation with local partners and retail companies) and some 30% for insulation (mainly search for customers and negotiation with managing agents and contractors). But even with these transaction costs, the cost-effectiveness of lighting and insulation measures is very positive (Mundaca 2007). For lighting, the estimated net financial benefit to society was between 2 and 6 p/kWh and including estimated external costs between 3.4 and 8,5 p/kWh. However, transaction costs are an important issue to take into account and more complicated arrangements have to be watched, whereas general information efforts necessarily have to be a part of the system.

The administrative costs of the supervisory body, Ofgem, are low: some 600,000 to 1 million GBP yearly.[7] This is due to the standardized features of the system, and the lack of trading which would need a separate market mechanism. It is not considered that the lack of trading leads to inefficiencies and higher costs, as the UK energy retail market is transparent and competitive and the suppliers costs are not separately regulated but part of their 'energy package'. Therefore this system might be as cost effective as or even better than a separate white certificates trading system.

In the UK many activities are subcontracted by the energy suppliers to installation or construction companies.[8] In case of partnerships with a combination of financial flows (e.g. local community and energy supplier) an unresolved issue is how to attribute the actual delivery (at this moment everything is attributed to the obliged party, but that seems to be somewhat biased).

The UK is considering how to further develop the system. A call for evidence published in the summer of 2007 showed most support for a continuation of the existing-based response. A major issue is that a majority of the delivering mechanisms involved only 'market push' or involved partnering with project partners where measures were delivered for free, but no 'consumer pull' yet (change of behaviour). CERT already tried to include more behavioural measures and hopes to address consumers' apathy towards energy demand (Ofgem 2008). It is clear that the UK is struggling with the behaviour of customers. To increase the level of interaction with customers the government proposed to include qualified home energy advice and attribute a fixed score to it under CERT. CERT also introduced 'demonstration actions', which allow

[7] These costs are recovered through licensing fees for suppliers.

[8] The UK tried to incentive the take-off of specialized energy saving companies (ESCOs) by giving them an additional bonus, but this did not prove to be successful. More generally, a problem is to apply for a precise definition of ESCOs.

suppliers to test or trial new technologies with the certainty that they will get some CERT credit based on the level op investment by the supplier.

A general conclusion in the UK is that the energy efficiency obligations have been successful in delivering low cost measures. But from now on more expensive measures must be taken. That's why a more strategic approach is needed to reduce costs. The UK Government recently increased its ambition considerably (Miliband, 2009) by announcing:

- A universal, street by street, house by house approach with everyone offered comprehensive and low-cost advice.
- A plan for finance accessible to all.

More concrete, the ambition is that by 2015 all houses eligible for cavity wall and loft insulation will have done so and that by 2020 7 million homes will have had a whole-house refurbishment: not just basic energy efficiency measures, but solid wall insulation or new technology to generate heat and power for the home. This is an impressive change as up to now observers remark that only 'low-hanging fruit' of cheaper measures have so far been installed at scale (Egerton, 2008). Furthermore, although gas consumption has started to decrease, the measure has yet to make much impact on electricity consumption. It may be expected that CERT will increasingly become UK's main policy instrument to attain this ambition. This is the reason it has already been announced that after the existing CERT a measures-based obligation will continue until December 2012 with a guaranteed carry-over - even when the exact post-2011 arrangements haven't been decided upon yet (UK Government, 2008). Investigation of whether the obligation could be changed from a measures-based approach to one based on outcomes, such as an overall reduction in carbon or delivered energy from the household sector, is being considered.

Italy

In April 2001, two Ministerial Decrees set targets of reducing consumption of electricity and gas of 33 TWh per year in the period 2002-6 against a business-as-usual scenario and therefore Italy may rightly claim to have introduced the "first operational tradable certificates scheme specifically focused on end-use energy efficiency world-wide" (Pavan, 2008). The target amounted to some 5-15% of the Italian Kyoto target and one-third of the needed carbon savings in the residential and commercial sector. The command and control component of the scheme, i.e. the energy efficiency obligation, was introduced with the implementation of the first European directive on the liberalization of the electricity and natural gas market in the form of a public service obligation for energy distribution companies. The market-based component, the trading of certificates, was introduced in mid 2001, together with the definition of the obligation. In the next three years, 2002-2004, the regulatory authority for electricity and gas (AEEG) developed further technical and economic regulation via consultation of all parties involved and the system is fully operational since January 2005.

The national target is divided over suppliers with more than 50,000 customers[9] according to their individual market shares: 22 gas grid companies and 8 electricity grid companies have an obligation to invest in energy efficiency. In the early days the system was dominated by electricity that accounted for some three quarters of the certificates. At least 50% of the individual obligations needed to be covered by energy efficiency measures within the companies' sector (gas or electricity), whereas the remaining share may be fulfilled elsewhere. A comprehensive list of 20 standardized eligible measures exists.[10] The regulator issues certificates to obliged energy suppliers or to energy savings companies (ESCOs) for their activities. Trade of certificates does not need official approval and can take on any form, from bilateral contracts to transactions on an anonymous market. Obliged grid companies are able to recover costs through an additional

[9] Originally 100,000, but the new threshold was considered an improvement to increase the liquidity of the system.

[10] The list is updated regularly, triggered by the modification of reference conditions under which the savings are evaluated. For example, in the case of white appliances the target line has been increased as 'A' equipment has become the norm.

element in the tariffs. The difference between this guaranteed costs recovery and the cost of the efficiency measures is the obliged suppliers' profit or loss. Each year the obligation is a combination of new activities and the results of activities in the past with an assumed lifetime of 5-8 years (in the other countries all effects of a measure are attributed to the year of investment). The target is based on annual savings in the period 2005-2009 It is set such that by the end of the fifth year, 2009, a specific combination of annual savings plus the cumulated savings in the past must have been achieved.[11] This is different from the practice in the UK and France where all savings are attributed to the year of investment. The grid companies may conclude bilateral contracts with specialized energy savings companies (ESCOs), but they may also trade the certificates at a specialized market. A new sector of enterprises came into being; specialized ESCOs service providers deliver 75% of the savings. Two organizations have to supervise the system: the supervisory body AEEG (equivalent to the British Ofgem) is responsible for project evaluation, certification, checking of the obligation and penalties. The AEEG has developed a rigorous monitoring and verification system. The electricity market operator GME registers the white certificates and (since recently) over the counter bilateral contracts. In 2008, for example, almost 40% and in 2007 one third of the volume of obligations was traded (up from 17% in 2006), of which 70% bilateral. Trading may therefore be called significant.

The level of compliance was more than satisfactory: in 2007 2 Mtoe of certified savings has been reached against a target of 1.1 Mtoe. This was partly due to the acknowledgement of 'early actions', measures that had been implemented before the official start of the scheme. Up to 2007, however, Italy had separate markets for gas, electricity and other certificates, which was considered to be unsatisfactory. In general, the market price for gas activities was much higher than for electricity. The electricity certificates market was highly dominated by one incumbent supplier (ENEL). Therefore, at the end of 2007, the three submarkets were merged into one and registration of bilateral contracts became compulsory. The obligation to implement 50% of the measures in the sector itself was abandoned and a new rule was introduced stating that, if supply exceeds demand with more than 5%, the difference is automatically turned into an additional target for obliged parties in the next year. Prices are now considered to reflect somewhat more accurately the actual supply and demand conditions.[12] Italy is the only country with a meaningful market price; targets for the years 2010-12 have been introduced: 6 Mtoe for electricity and 2.2 for gas.[13] This new target is higher than the target of 2009, but the increase is less impressive than might seem at first sight, as the efficiency effect of measures taken in the past are added to the recent ones with a maximum of 5-8 years.

Similar to the UK, the majority (85%) of activities are deemed savings with standardized accounting. Still, engineered actual estimates for complex projects and specific energy monitoring plans that have to be pre-approved by the regulator are possible as well. If they are associated with 'hard' measures a 5% premium may be given for information campaigns and training programs. The number of such 'soft' measures is growing.

The Italian supervisory body estimates that an overall investment by supplier and household of € 100 leads to a reduction in the energy bill of € 1400 (gas oil) to € 850 (gas and electricity) (Pavan, 2009). The latter figure is comparable with the UK figure. Actual savings delivery is dominated by lighting, as ENEL distributed CFLs for free. In practice, the maximum of 8 years of lifetime makes investment in lighting much more attractive than in double glazing or insula-

[11] For example, the 2009 target for electricity is Mtoe 1.6 savings, which is a combination of 0.8 Mtoe new savings and 0.8 Mtoe cumulated savings from measures taken in the past. For gas the amounts are 0.6 (new) plus 0.7 (cumulated from past) = 1.3 Mtoe. In total the 2009 target is 2.9 Mtoe, of which 2.6 Mtoe is distributed to the obliged companies and the rest is not implemented as it is due to companies below the threshold.

[12] Up to the revision all utilities could make use of a possibility to receive 100 Euro/toe as cost compensation. As the gas certificate price in Summer 2007 was some 80 Euro and the electricity price some 30 Euro/toe, this was an easy way to earn money. After the evaluation in 2007 this compensation has been abandoned. In 2008 the average certificate price was 65 Euro, which is much closer to the assumed average costs of efficiency measures (some 50 Euro) than pre-2008 prices.

[13] Italy is considering extending the system to the transport sector.

tion and is even considered to 'steal' other savings (Togeby et al, 2007). But different from the UK system, investments in the improvement of the distribution grid or increase in the efficiency of power generation is also possible.

In general, the Italian system is considered to be a success (comp. Lees 2007). However, observers have made three remarks about the system:

- It is suboptimal to award benefits in later years in a context in which future targets are unknown.
- The system is not oriented to the future; no real long-term investments are made.
- This is the case although the formal obligation is with the grid companies . As it is impossible to switch to another grid company no inherent impediment exists for grid companies to have a long-term orientation.

France

The French energy efficiency certificate system was announced in the Livre blanc of 2003 as the major policy tool to stabilize final energy consumption by 2015 at the 2003 level with an assumed GDP growth of 2% per year. Its overall objective is a reduction of French energy intensity of 2% by 2015 and 2.5% by 2030 in the relevant sectors. In the Business as Usual scenario final energy consumption would increase with 0.9% per year, so the implicit target is a yearly efficiency improvement in the household and commercial sectors with annually 0.9% (IEA, 2004).

The French white certificate system has been introduced gradually - first as an obligation only and subsequently including the possibility of bilateral trading, but very explicitly without an electronic market place - as a successor of obligatory energy efficiency activities of the two dominant utilities EdF and GdF. It formally started in July 2006 as an experimental measure and arose out of the French energy law passed in July 2005. Still, 80% of the volume of efficiency activities is implemented by these two companies. Only larger electricity and gas companies feel the obligation as a threshold has been introduced. The 54 TWh target for three years (July 2006 - 2009) has been divided based upon market share by energy volume in the residential and commercial markets and the price of energies, into 57% electricity, 26% gas (together 25 companies) and 13% heating oil and - very specific for France - LPG and heating and cooling (2350 mainly small enterprises who may act as one group). Comparable with the UK the accounting unit is the cumulative efficiency improvement of an activity, computed for the lifetime of the product with a 4% discount rate. The savings can be achieved using predefined standardized actions (some 170 in 2009), but may be customized as well.[14] The lifetime of the certificates is three periods of three years; banking is allowed. The target can be reached either by implementing end use energy saving or by buying energy saving certificates. As said earlier, formal certificate trading is not allowed and there is no market price.. Nevertheless, other 'eligible parties' (large industrial enterprises or local communities) that have invested in energy efficiency may sell their certificates bilaterally to 'obliged parties'. At 1 January 2009 4% of the number of certificates had been traded (Bodineau 2009). Administrative costs are modest. At the government side some 24 persons operate the system (registration, certificate applications and policy implementation incl. regional offices) plus some 5 for monitoring and evaluation (Togeby et al. 2007). Specialized energy saving companies (ESCOs) are not allowed to participate in the trading system but may be subcontracted by energy suppliers. Therefore, a certificate price does not exists. A price cap of the certificate price of 0.02 ct/kWh has been introduced but has not been used up to now.

Indeed, for a utility like EdF the organization of local partnerships with fitters or electricians is a determined activity in boosting the local community. In practice a combination of advice and organization by utilities, and tax credits for house refurbishment takes place: the certificate system helps to develop and structure the supply of services, and enhances the promotion of the tax

[14] France is the only country having developed standardized transport measures.

credit. Improving the 'energy efficiency supply chain' is the core of the French system. The normal retail route for CFLs and appliances has not been used as efficiently as in the UK (Lees, 2007). Utilities offered new services and created new partnerships. The tax credit and white certificates are complementary and haven't been introduced as additional or conflicting measures. The major focus in the French system has been on the residential sector, in particular on heating measures. Energy suppliers developed new services for energy efficiency projects in the residential sector, such as energy audits and low-interest loans for equipment or building renovations, and have initiated training programs on energy savings and communication of best practices.

Interestingly, the French system apparently offered business opportunities for French incumbents Edf and GdF/SUEZ. The two largest companies specialized in energy efficiency in Europe are French: Dalkia (owned by EdF and Veolia) and Cofely, the new GdF/SUEZ entity with 35,000 employees developing energy efficiency in buildings and local production of energy (CHP, renewables) (Le Figaro, 4/3/09).

The targets are considered to be relatively low. After 2.5 years, at the beginning of 2009, two-third of the target had been reached, of which 88% in residential building; 40% by means of better boilers, 14% by heat pumps, 13% by better insulation and 3.5% by solar water heaters. A reduction of 3.8 TWh/year of the energy consumption is expected to be achieved, which is equal to 0.46% of the total residential and commercial buildings consumption. It was assumed that electricity prices could increase with 0.5%, but up to now energy suppliers did not ask for passing through the costs in the official regulated consumer tariffs (France still has a system in which regulated tariffs are the benchmark for consumer prices). The French government is considering a substantial increase for the next three year period January 2010-2013 (Bodineau, 2009).

Denmark

In June 2005 political parties in Denmark agreed on future energy-saving initiatives in which energy companies play a central role. Since 1994 already electricity and gas grid companies have been receiving small payments through a component put into the tariffs and they use these funds to reduce the energy consumption of their customers. In 2004 electricity companies received 180 million DKK, district heating 40 million and gas distribution 25 million; most recently it was slightly increased to € 40 million (7 DKK is about € 1). They mainly offered information, audits and demonstration of new efficient technology. Evaluation indicated that after 10 years of existence electricity consumption was some 3% less than it would have been without the measures. A snapshot in 2003 indicated a neutral net present value with a CO_2 price of 40 DKK/ton CO_2 and in 2004 a positive NPV of 178 million DKK with a CO_2 price of 50 DKK/ton (IEA, 2006a).

This system was the backbone of the new approach that had more focus on market-oriented policies that were introduced in 2006. The new system was much more ambitious, but at the same time also more flexible. Before 2006 trading was not allowed and costs/revenues had to be equal for each group of customers. E.g. a utility obtaining money from residential customers would have to spend that amount on these customers. The new system bears several features of a real white certificate system. As more efficiency was expected, payment to utilities stayed at previous levels. Originally the annual target of the energy efficiency obligation was 1.02 PJ (out of a total energy improvement goal of 2.71 PJ), in the draft action plan of December 2004 it was increased to 1.27 PJ (of a 5.33 PJ total), and in the final agreement of early 2006 to 2.95 PJ (of a 7.5 PJ total). This is an annual efficiency improvement, formulated for the years 2006-2013 - compared with the Baseline of final energy consumption excl. transport of 1.7% - of which 0.75% efficiency improvement annually by means of the utility obligation. This was part of the overall ambition of the Danish government to stabilize total energy consumption excl. transport (IEA, 2006a). In February 2008 the overall ambition was again being ramped up. The new agreement commits Denmark to cutting its energy consumption by 2% by 2012, compared with

2006, and by 4% in 2020. As a part of this overall target, the ambition for utilities was again sharpened from 2.95 PJ per year to 5.4 PJ from 2010, all by 'first year's saving'. This leads to an underestimation of the eventual impact. For example, 1.1% first year's saving in electricity with a life time of 9 years and an additionality factor of 50% has an impact after 9 years of 5% saving (Togeby, 2009b).

Denmark has some 240 'obliged companies': 75 in electricity and gas and 160 in district heating. The obligation lies with grid companies, but in practice most activities are carried out by commercial daughter companies (the stricter legal 'unbundling' of energy distribution companies would complicate this solution in the Netherlands). Different from the UK model, from 2006 onward companies are allowed to search for energy savings in all energy types and all over Denmark. They are not restricted to their own (type of) customers and savings in all types of energy are possible (except transport). This stimulates specialization and a higher cost effectiveness of enterprise measures, especially by the smaller district heating companies. Most of the realized savings take place in the sector in which the company operates, but this is not always the case. Almost 50% of the obligation has to be achieved by electricity grid companies, 30% by district heating companies, 20% by natural gas companies and a very small share by heating oil companies.

Typical activities under the Danish obligation scheme are energy audits, subsidies, information and combinations of these. Unlike in other European schemes, in Denmark the energy company must be actively involved in the project before the investment. The largest part of savings occurs in industry and is realized in oil and natural gas consumption.

Administrative simplicity is an important aspect of the Danish system (Togeby, 2007). This led to some important features. First, only the first year's savings are taken into account. This prevents the declaration of lifetimes of measures and a discount rate, but leads to an underestimation of the effect of e.g. insulation or improved boilers. Secondly, all savings have the same weight: electricity savings weigh as heavy as heating efficiency improvement. In reality the effect on primary energy consumption differs as the average efficiency of power generation is some 40%. Danish authorities do not consider this a big problem, as the lifetime of efficiency improvement in electricity (lighting or appliances) on average is much shorter than in heating. Therefore, these two aspects balance each other.

An interesting aspect of the Danish system is the large share of activities in the industrial sector. This is related to the long tradition of energy audits by utilities in industry and the relatively low transaction costs of larger industrial projects. Most savings are based on specific engineered calculations and recorded as final energy. The share of 'standardized activities' is smaller than in the other countries, which might be related to the larger share of efficiency improvements in industry.

At the end of 2008 and early 2009 the system was evaluated with the aim of further increasing the energy efficiency activities. It was expected that the overall annual goal of 2.95 PJ would almost be met, but not for all district heating companies. It turned out that especially electricity distribution companies had realized savings in other areas: 48% of the obligation was related to electricity, but only 27% of the realized efficiency improvement[15]. For example, electricity companies voluntarily invested in efficient natural gas boilers.

The evaluation also tried to get an impression of the degree of additionality of the energy efficiency obligation. To which extent would the activity have been implemented without the help of the energy company? The general impression is that additionality amounts to some 45%; this is the share of industrial projects that would have been realized within one year without the help of the utility; within three years this is only 33% (Togeby, 2009a). The most important activity

[15] Figures for 2006, 2007 and the first half of 2008.

had been economic analysis of the specific project in industry: 56% of the interviewed customers had appreciated this activity, next to 41% to which the utility had suggested new ideas; 31% had used technical analysis; 23% had been offered a subsidy and in 11% of the projects the utility had been involved in implementation. Even with this small share of additionality, the cost/benefit ratio is considered to be very positive. Assuming that saving activities deliver for five years (say the average of insulation and lighting) and that additionality is 50% for all projects (not only in industry), costs of savings are considerably lower than the energy price being saved (Table 4.4).

Table 4.4 *Cost and benefits of utility obligation in Denmark*

[$/kWh]	Electricity	Gas
Utility costs	0.08	0.02
Company investment	0.22	0.10
Cost of saving[16]	0.08	0.03
Energy price	0.10 - 0.20	0.06 - 0.12

Source: Togeby (2009a).

The evaluation suggests that realized additional energy efficiency (based upon one year computation of results, which implies a substantial underestimation) is some 0.5% yearly (Togeby et al., 2009).[17] Additionally, it is suggested that of all applicable energy efficiency policy measures in the residential and commercial sectors, besides energy taxes (labeling of appliances, building codes, labeling of buildings and the Savings Trusts that offer advice), the energy companies obligation is the most cost effective one. One has to remark that, although this indicates that obligations are cost-effective from a national perspective, this does not imply that all measures are perceived as being profitable for the end-users. This is the reason why subsidies and other financial incentives are used.

The evaluators offered some advice for further improvements in the next phase of the obligation system (Togeby, 2009a), which is now under consideration in the Danish parliament and has to be implemented by the end of 2010:

- More attention has to be given to enforcement, which is considered as weak.
- The interaction with the European Emission trading System (ETS) has to be considered more carefully. Indeed, savings in power generation do not lead to additional CO_2 reduction as the caps for the period up to 2012 (in the officially approved Danish allocation of CO_2 permits) and 2012-2020 (in the European allocation of permits) have already been formulated. The interaction could be improved by the introduction of a so-called 'priority factor' (somewhat comparable with the UK innovation bonus, or 'banding' in the UK renewable energy obligation) that could increase motivation for savings outside of ETS or with a long lifetime effect.
- Only real savings have to be taken into account; not enabling activities such as information campaigns, which would imply a different direction than is looked at in the UK.
- Improve cooperation with other actors, such as social housing institutions, with respect to renovation activities.
- Include even more end use sectors, such as transport, and further increase the focus on business sectors as they offer the best opportunities for cost effective savings.

[16] According to the formula $\frac{\text{utility cost + company investment x additionality}}{\text{lifetime x additionality}}$

[17] Because of the additionality factor of 50%, 2.95 PJ will not deliver additional savings to the full extent and therefore the *overall* energy efficiency target will not be met. This is something a country like the Netherlands has to take into account as well.

5 Lessons for the Netherlands

It is useful for the Netherlands to carefully consider the introduction of energy efficiency obligations and have a look at its possible tradability. This is useful because of three reasons:

- Current policy instruments are not sufficient to realize government ambitions to increase energy efficiency up to 2%annually.
- These obligations have proven to be a cost effective policy instrument in relevant other countries. In the UK, France and Denmark the suppliers play an active part in energy audits, subsidies or soft loans, information campaigns and training programmes. The Netherlands need such actions to reach their targets.
- If implemented in cooperation with the European Commission, it precedes new European measures.

Table 5.1 does not prove that the Netherlands do much worse than countries with energy efficiency obligation systems, but illustrates the actual challenge.

We did not investigate what causes these differences. The general impression is that the quality of the building stock in the Netherlands is higher than in the United Kingdom, so maybe the surface area per person is higher as well. But the message is that scope for further improvement exists.

Table 5.1 *Emission in households and services*

	[ton CO_2/capita]
Netherlands	2.5
United Kingdom	2.0
Italy	1.5
France	1.8
Denmark	1.4

Note: Direct and indirect (electricity).
Source: Ecofys

One has to make a distinction between the presence of a potential of cost-effective energy efficiency measures, and the indication that white certificates are the best way to achieve them. This potential is undoubtedly present. Both theoretical and empirical arguments in favour of more energy efficiency in Europe and the Netherlands are overwhelming. Cost-effective potentials of 27 to 30% for the household and commercial sectors have been illustrated in different ways - even without taking external effects into account (European Commission, 2005). The potential in existing buildings in the Netherlands not captured by existing policies is at least 5 – 10%, equivalent to the original ambition and the recent estimate of actual policy activities (van Dril, 2009).The next question would be whether white certificates are a good or the best way to capture this potential. The following arguments *against* white certificates could be mentioned:

- They cannot give absolute certainty that a specific CO_2 or energy consumption target can be met. This is especially relevant in a situation in which significant rebound effects may be expected: due to more efficient heating one may be tempted to increase the temperature, or due to a lower energy bill one may spend additional money in travelling. It might be that the rebound effect is larger for white certificates than for energy taxes. However, the rebound effect seems to be low or non-existent for white appliances and lighting, but large for transport by cars, cooling and heating (Giraudet and Quirion, 2008).
- Transaction costs. It has been estimated that search for information, persuasion of customers, negotiation with business partners, measures and verification activities represented some 10% of investment costs for lighting measures and some 30% for insulation measures (Mundaca, 2007). This might be the case for other instruments as well, but it has to be taken into account carefully.

- Other instruments might be more effective, esp. energy taxes. This argument is not very convincing. Of course, energy taxes or CO_2 prices that equal external effects are a precondition of any efficient policy approach towards energy sustainability. But still important market failures exist and higher prices do not automatically overcome them. Market failures have to be tackled by changes in institutional arrangements and a more active role of energy companies could be a part of that.

Therefore, a cleverly implemented white certificate system is no alternative for 'letting prices speak the truth' (in other words, energy taxes or other ways to increase the CO_2 price) but they may complement each other. Therefore it is reassuring that Oikonomou (2007) calculated that even with a discount rate of 30% and a small package of measures in a white certificates system 32 Mt CO_2 could be reduced in the household sector in the Netherlands, which might be compared with the total cumulative CO_2 reduction in the built environment of 2.4 Mt CO_2 in 1995-2002. With a discount rate of 5% the cumulative net financial savings amounted to more than three times as much (from € 1,000 to € 3,240 million in 1995-2020). After careful modeling, he concluded that white certificates "are a policy instrument that could be useful for the design of future energy policy in parallel with the existing instruments and policies already applied in the Netherlands".[18]

The following lessons were learned by Oikonomou and Mundaca (2008) during their comparison between green and white certificates:
- A binding long-term target must be expressed.
- A proper market must be ensured to avoid oligopolistic market conditions and market conditions have to ensure tradability.
- Standardized common procedures should be employed for savings calculations, for monitoring and verification to reduce transaction costs.
- The target should not only address 'low hanging fruit', but has to stimulate innovative technologies as well.
- A concrete penalty should be set.

Our overview does not contradict these findings but underlines them. Some doubt do arise as to whether the tradability issue is urgent enough in general to be a part of starting the system in the Netherlands.

Experiences in and evaluations of white certificates in other countries contain some important lessons and considerations for the Netherlands.
1. Define a target. Some countries defined their target in energy values, the UK changed it into CO_2. The latter is somewhat curious, as a utility obligation system will not lead to CO_2 reduction in electricity and only in heat outside the sectors directly covered by the ETS. However, energy efficiency might be expected to increase and therefore it seems more appropriate to define the target according to energy values such as TWh or PJ. Most countries started with a target that could be attained without much difficulty, and then gradually increased it. In the light of the actual climate challenge a somewhat more ambitious approach could be considered. However, the effect is that the obligation is changing the business model in the energy industry towards a model of selling less energy and more energy services. This is an ongoing process that takes time. Taking the necessity of learning to cope with the system into account, a saving of approximately 2-3% of the relevant energy use at the end of the first three years and 4-6% at the end of the next three years must be achiev-

[18] An alternative might exist: Green4sure. This is an idea developed by a consortium of trade unions and NGOs to introduce individual CO_2 caps for buildings and transport. Each group is assigned a carbon budget, administered by energy companies. This ambitious plan aims at substantial CO_2 reduction: minus 50% by 2030. White certificates could be a first step towards such a more aggressive approach, if needed. The consortium itself suggested that temporary policies could be implemented if the new approach could not be developed quickly enough. Comp. CE Delft, 2007.

able without net costs. If such a target has to be met by building improvements only and does not include the introduction of efficient appliances, a more ambitious approach such as the actual UK CERT and its ambition to attain improvements in millions of houses is also needed in the Netherlands. Such an approach is possible, but will cost considerably more and needs an overall national strategy of which the savings obligation could only be a part.

2. Define which target groups have to be reached. In most cases the buildings sector (households and commercial enterprises) is in focus, but Denmark did include the industrial sector and is quite satisfied with this approach. Even broader applications such as distribution grids and the transport sector have been mentioned. There are pros and cons for different types of extension.. Especially the industrial sector has many cost-effective opportunities to improve energy efficiency. The Netherlands have a long and successful tradition of boosting energy efficiency in industry and commercial sectors by multi-annual sectoral agreements, but in principle an energy efficiency obligation could be an interesting additional option. For larger industrial enterprises the added value will be much lower, as they are already covered by the European Emission Trading System (ETS) and have a fixed emission cap. Of course, it would probably lead to more energy efficiency but not to additional CO_2 reduction in large industries. Extension to distribution grids could be useful, because there is a substantial saving potential. Transport is a different story. Marginal costs of efficiency improvement in transport are relatively high, so the actual use of this additional opportunity could be limited. Energy utilities are not familiar with transport, so transaction costs could be relatively high. It is advised to start more modestly with areas that are not fully covered by other instruments and are familiar to energy utilities: housing, commercial business and small industries and distribution networks. This way a fruitful interaction with the introduction of smart meters could also be organized. Furthermore, it is necessary to involve these parties in the set up of the scheme.
3. Define which companies will be 'obliged'. In theory grid companies seem to have an advantage, as they have a long-term focus and are unbreakably connected with their customers. As the Netherlands have introduced a so-called ' market model' in which only suppliers have contact with their clients, and as in practice in the observed countries the energy supply companies are responsible for most of the actual activities, an obligation to suppliers seems to be the only feasible and defendable option. Eventually, the obligation could support the development of energy suppliers to become providers of genuine energy services.
4. Monitor administrative costs. In this respect the Danish and UK approaches have advantages, whereas the Italian system might be relatively expensive. A full-fledged electronic trading system might not be the best system to start with. Administrative costs are relatively high and the rewards are probably low, as the Netherlands have a satisfactory competitive retail market in which utilities cannot pass through high costs very easily. Furthermore, most trading elsewhere is bilateral. It is useful to introduce this possibility of bilateral trading which enables utilities to specialize.[19] Introducing the possibility of standardized accounting seems extremely useful.[20] To make that happen the Netherlands has to start developing this system on time. The additional possibility of using real savings in complex projects seems to make sense as well and is frequently used elsewhere. A more difficult question is whether lifetime energy efficiency improvement or one-year improvement only has to be taken into account. Some compromise between simplicity and a reflection of real savings probably could be found. Maybe a combination of the Danish approach (that counts savings in gas use and heating 2 ½ times as heavy as electricity by looking at savings in fi-

[19] Lees (2007) expects that 'the market is in its early stages and will undoubtedly grow in time". We think this will depend on the ambition of the targets and the differences in marginal costs of suppliers. As long as many opportunities exist to reap opportunities with negative marginal costs, no real need exists to invest in a real market system. This is completely different from the case of renewable energy and the ETS. Another important issue is whether an oligopoly has to be feared, which was the case when the Dutch government considered the issue of a possible national green certificate scheme.

[20] An interesting idea that has not been explored is to combine product standardization in which CEN is involved and the standardization of measuring the energy performance of buildings due to European and national regulation with the standardization of energy efficiency performance (white certificates).

nal energy use) and the UK ‘banding’ (giving bonus points to some innovative approaches - which could be extended to savings with a long lifetime) merits consideration. In this way arbitrary decisions with regard to the discount rate and dubious rewards for decades of savings are prevented.

5. The long-term orientation could be further strengthened by stating in the law that the system will be introduced for a period long enough to make real investments worthwhile (say 2020, the target period of government policy). Introduction of for example three times a three-year period with periodical evaluation and the opportunity to bank certificates might be considered. This could also solve the problem that, without a real market system, over performance will only be rewarded partially. Bilateral trading and banking is a first step to overcome this. A trade-off between administrative costs and rewarding of overacting the targets might exist. By defining on time how the long-time ambitions might develop, this tension could be smaller.
6. It seems to be useful to introduce a threshold for small energy suppliers, such as the 50,000 client threshold used elsewhere.
7. Look at enforcement right from the beginning. A penalty as in the French approach could be useful, but in that case the height of the penalty has to be such that utilities are not tempted to pay only without acting.
8. Realize that legal and practical arrangements have to be made. Drafting a law and getting it passed in Parliament easily takes two years, so a speedy process is needed if the actual government wants to realize this. Practical arrangements like standardization of efficiency measures, verification procedures and supervision arrangements have to be developed in parallel. Strong interaction with stakeholders will facilitate this process.

An energy efficiency obligation alone will never solve market failures, though. Interesting is the British idea to move from an ‘input’ to an ‘output’ oriented system at some time. The rebound problem will remain difficult to solve. After enough experience has been gained, the issue of an absolute cap for the household and commercial sector, as suggested by Green4sure, might come back on the table. As no country in the world has any experience with such an instrument, it might be extremely challenging to start with that approach already. In any case, no silver bullet exists in energy efficiency policy. Eventual introduction of an obligation has to remain a part of a solid, integrated package. A start of that package has already been made with the introduction of the covenant ‘More with Less’ between the social housing sector, the relevant ministries, the construction sector and the federation of energy companies.

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