Investments in energy saving measures in Italy and UK: the impact of national support schemes on the business strategies of an ESCO

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Abstract

Energy efficiency measures can be tailored to suit different customer segments, with a comparatively wide range of returns on investment. ESCOs are thought to be a key player facilitating the practical implementation of energy-efficient measures. However, limited awareness of end-users about the available technologies, as well as concerns on the availability and ease of obtaining funds to finance energy-efficient measures are limiting the diffusion of such technologies. Policymakers in Great Britain (EEC scheme) and Italy (TWC scheme) have addressed energy efficiency issues through the implementation of national policies based on market-based instruments, where energy efficiency measures are linked to tradeable assets. When comparing the two schemes, however, there are significant differences which affect the information and financial incentives available to developers of energy efficiency projects. This paper carries out an empirical analysis of such differences, as seen from the point of view of an ESCO potentially interested in investments in energy efficiency projects. Its first part outlines the regulatory and market framework for energy efficiency measures in Italy and UK, including energy efficiency targets and achieved outcomes to date under the analysed schemes. The key factors affecting business choices for an ESCO aiming to operate in the energy efficiency sector in either country are outlined in a strategic overview. In the second part, further to a survey on relevant costs and prices, we carry out a financial appraisal of investments in selected energy saving measures to be implemented by an ESCO. The financial analysis is carried out in three national scenarios: two are reflective of the existing regulation in Italy and Great Britain, while the third aims to portray the hypothetical situation resulting from the implementation of the Italian TWC scheme in Great Britain. Under all scenarios, the aim is to evaluate the effect of such TWC scheme on the net present value of the investment, calculated before interests and tax. The empirical analysis carried out for selected case studies shows that the financial incentive provided by WhCs may well be sizeable, and is even more important for those projects where the Net Present Value without WhC contribution is a small number.

Introduction

Energy efficiency issues have been addressed by the implementation of various national and international policies (Oikonomou and Patel, 2004). In particular, the EU Directive on promotion of energy efficiency and energy services sets specific energy efficiency targets for the EU member states (EC, 2003) and the Green Paper on Energy Efficiency has been issued as general framework of policy action (EU, 2005). Several market-based instruments have been proposed and implemented in EU and national countries. Among them a relatively new instrument is the Tradeable White Certificates (TWC) scheme, which is considered a cost-effective way to complement existing policies aiming at increasing energy efficiency, and reducing CO_2 emissions (it also builds upon experiences of other similar schemes, such as the EU Emission Trading Scheme and national Tradeable Green Certificates, see Bertoldi et al. 2005).

The recent years have seen a fresh interest towards the provision of energy services, including energy audits, maintenance and operation advice, property management, and the supply of specialized equipment. The energy system has seen innovative utilities (Bertoldi et al., 2003) moving towards offering added value through energy services, horizontally integrated and complementary to the traditional supply of energy. Other stakeholders in the energy system, such as equipment and system suppliers, and installation and engineering companies, decided to enter the same market. Companies providing energy services to final energy users, including the supply and installations of energy-efficient equipment, and/or the building refurbishment, maintenance and operation, facility management, and the supply of energy (including heat), are known as Energy Service Provider Companies (ESPCs). Energy Service Companies (ESCOs) also offer these same services; however, ESCOs differ from ESPCs in the following ways: (1) they can finance, or arrange financing for, the operation of an energy system, (2) they guarantee the energy savings (as reflected in the contract), and (3) their remuneration is directly tied to the energy savings achieved.

ESCOs are thought to be a key player facilitating the practical implementation of energy-efficient measures. However, limited awareness of end-users about the available technologies, as well as concerns on the availability and ease of obtaining funds to finance energy-efficient measures are limiting the diffusion of such technologies. The strategies put forward to foster the development of an ESCO industry (Bertoldi, 2003.) include standardization of contracts, and the provision of more information for financial institutions and new financial incentives. In the presence of information asymmetries, both national TWC schemes in Great Britain and Italy should open business opportunities to ESCOs.

When comparing the two schemes, however, there are significant differences which affect the information and financial incentives available to developers of energy efficiency projects. Both schemes allow the trading of energy efficiency credits (EEC credits in Great Britain, and 'White Certificates' in Italy), but, in contrast with British EEC provisions, in Italy the accrual and trading of the white certificates is not limited to the obliged parties, and the certificates are traded on an exchange. Separating the energy efficiency measures from the relating credits should help decentralize the investment decision to the parties that have most information about its cost-effectiveness. Also, this should ensure competition between project developers bidding to supply certificates, favouring the implementation of the most cost-effective measures.

This paper aims to carry out an empirical analysis of such differences, as seen from the point of view of an ESCO potentially interested in investments in energy efficiency projects. Its first part outlines the regulatory and market framework for energy efficiency measures in Italy and UK, including energy efficiency targets and achieved outcomes to date under the analysed schemes. The key factors affecting business choices for an ESCO aiming to operate in the energy efficiency sector in either country are outlined in a strategic overview. In the second part, further to a survey on relevant costs and prices, we carry out a financial appraisal of investments in selected energy saving measures to be implemented by an ESCO. The financial analysis is carried out in three national scenarios: two are reflective of the existing regulation in Italy and Great Britain, while the third aims to portray the hypothetical situation resulting from the implementation of the Italian TWC scheme in Great Britain. Under all scenarios, the aim is to evaluate the effect of such TWC scheme on the net present value of the investment, calculated before interests and tax.

The Tradeable White Certificate scheme

The Tradeable White Certificate (TWC) scheme is an energy efficiency trading scheme, which aims to the reduction of energy demand at the end-user level, and the decrease of the relating greenhouse gases emissions through market based mechanisms. Within the European Union, Italy has implemented the first fully-fledged TWC scheme in Europe, and the Italian model has informed debate on the topic throughout the EU (Pavan, 2002). Another notable energy efficiency trading scheme is the British Energy Efficiency Commitment (EEC) scheme. In common with the Italian scheme, which allows trading of white certificates, the British scheme allows trading of 'energy efficiency credits'.

It is worth to clarify the terminology. The term 'energy efficiency credit'[1] means any certified record of savings which is acknowledged by the regulator as valid for scheme compliance purposes. By contrast, the Italian 'white certificates' are formally separated by the underlying measures that led to their issuance, and are a freely traded commodity whose market demand relies on their validity to demonstrate compliance with the targets under the scheme. Hence, they can either be used by the obliged actors to comply with their targets, or can be sold to other (obliged, or otherwise interested) parties. In this way, obliged actors, depending on their marginal costs, can decide whether to implement energy efficiency measures or purchase certificates. Those that over-fulfilled their targets can sell their excess of TWC to those that have implemented less energy saving measures.

Generally, trading activities involving energy efficiency credits and/or white certificates can be grouped according to the difference in provisions of the implementation scheme (NERA, 2006):

- *Horizontal trading*: it is the trading between the obliged parties (plus external parties, where allowed) who can trade certified energy saving credits;
- *Banking*: it refers to the possibility to carry over energy savings from one compliance period to the following one – it is also known as 'inter-temporal trading', 'internal trading[2]', or 'borrowing[3]';

1. In the context of this paper, unless otherwise specified, the term 'energy efficiency credit' will refer to the tradeable credits embedded within the British EEC scheme.

2. Any credit that is carried over by an interested party must be accounted for in the balance sheet, and profit & loss statements, and its nominal value is normally marked-to-market. Hence, from an accounting point of view, any such credits are formally surrendered by the previous year's administration to the next year's one. Consequently, the notion of 'trading' – albeit an 'internal' one – holds true.

3. 'Banking' happens when an obliged party is over-compliant, and carries over the excess efficiency credits/certificates accrued to date to the following year. Conversely, 'borrowing' happens when the obliged party is under-compliant, and is forced to become over-compliant in the following year. In practice, there are limits to the amount of credits or certificates that can be banked or borrowed by any given obliged party.

- *Vertical trading*: this is when parties involved are allowed to purchase credit from energy saving activities implemented by other parties.

The trading mechanism ensures that the system has a higher flexibility than in the case of reliance upon command-and-control measures, and it allows the implementation of the energy efficiency measures in the more cost-effective way. It also results in a separation between 'energy efficiency measure' and saving credits, which should help towards assigning the decision about which measure to implement to the parties that have more information to properly select the most cost-effective measures among those available. Moreover, this would increase competition among project developers bidding to supply certificates, which in turn should increase the likelihood of choosing the most cost-effective measure (NERA, 2006). Trading can potentially benefit all obliged and eligible parties; its main benefits are:

- Cost reduction: trading provides incentives to implement energy efficiency measures where is most cost-effective to do so;
- Risk reduction: the efficient spreading of activity across actors and time helps in reducing uncertainty for each individual actor, as risk is split and efficiently allocated to the party that is best placed to manage it.

British EEC credits, and Italian white certificates are both tradeable within the national frameworks supervised by the respective national regulators. In both cases, the schemes draw upon a project-based approach[4], where credits or certificates are generated for selected approved activities. The tradeable credits/certificates are used in combination with an obligation scheme, where energy market actors (the 'target group[5]') are obliged to reach given targets of energy savings. Those mandatory targets are generally set by the government after negotiation with the actors involved, and in accordance with the objectives[6] of the scheme. In practice, the targets often refer to the total energy savings to be achieved via investments in energy efficient projects. The fulfilment of the obligation is acknowledged by the issuance of tradeable certificates, which are issued to the party undertaking energy efficiency activities, and are proportional to the amount of energy saved.

Within the Italian scheme, white certificates can also results from energy saving measures implemented by actors external to the obligation scheme itself, such as ESCOs (which are considered 'eligible' parties). Such TWC scheme allows any eligible party to make their own assessment of the financial attractiveness of any energy efficiency project also on the basis of the expected proceeds from the sale of the relating certificates. More specifically, ESCOs do not have any saving obligation, but they might well participate in the scheme by implementing energy-efficient measures, obtaining the resulting certificates, and then trading them.

Other than in Italy, In Europe, few countries have implemented a TWC scheme, or are considering to do so. Italy was the first to introduce it in 2005, followed by France in 2006[7]. As we have seen, the British EEC scheme combines its obligation system for energy savings with the possibility of trading both obligations (efficiency 'targets') and savings (efficiency 'credits' - see below), but stops short of actually implementing trading of efficiency-related 'certificates' (TWCs), formally separated from the underlying measures that led to their issuance. There is interest in the concept of tradeable certificates in Norway and Sweden (NERA, 2006), and Denmark and Netherlands are seriously considering their introduction in the near future (Oikonomou et al, 2006).

The following sections outline details relating to the Italian TWC scheme and the British EEC tradeable credits scheme.

Italy

In Italy, the system was introduced in 2002 and started in 2005. The obligated parties (target group) are electricity and gas distributors serving more than 100,000 clients (as at 31 December 2001); this includes 22 gas distributors (covering about 60 % of the customers) and 8 electricity distributors (covering almost 98 % of all customers) (Oikonomou et al, 2006). The obligation plan has a target of 243 PJ (5.8 MTOE) of primary energy saved over the 2005-2009 period, which would imply an average 0.5 % annual reduction of energy demand. This obligation is adapted every year on the basis of the achievements of the previous year. The year-by-year national target for electricity and gas is shown in Table 1.

Table 1. National targets for energy efficiency in Italy (MTOE).

Year	*Electricity*	*Gas*
2005	0.1	0.1
2006	0.2	0.2
2007	0.4	0.4
2008	0.8	0.7
2009	1.6	1.3
Cumulative	3.1	2.7

Source: AEEG (2006)

Every WhC lasts for five years for all implemented measures, with the exception of building insulation and other measures in bioclimatic architecture, lasting eight years. One WhC is equivalent to one saved TOE/year of primary energy. The energy savings are calculated according to the typology of energy efficiency measure to be implemented (AEEG2004); the calculations are either *ex-ante* on the basis of technical standards or predefined analytical procedures, or *ex-post* by putting in place the appropriate measurement procedures. Where the energy-efficiency measures to be implemented draw upon technical standards, the value of primary energy to be saved is calculated using coefficients based on the average efficiency of the Italian energy system (electrical and thermal energy production); such coefficients are regularly updated so as to take into account technology improvements. There are 3 types of WhCs:

4. This approach is in contrast with the alternative 'cap-and-trade' approach, which places restriction directly on the quantity the policy seeks to limit.

5. The target group in Italy (gas and electricity distributors) differs from that in Great Britain (gas and electricity suppliers).

6. Generally, the energy efficiency targets may reflect policy objectives which need not be only specific environmental ones (eg. curtailing green-house gas emissions), but may well include social objectives (this is the case in Great Britain, where the target group has an obligation to obtain 50 % of EEC credits from projects involving the priority group), geographically restricted ones, temporal ones, political ones (eg. the Italian policy theme of security of supply) or other behavioural and technological ones.

7. For further details, see Moisan, 2005.

Table 2. Summary of issued WhCs (Jan 2005-May2006) in Italy.

	Number emitted	*% of the total*
Type I (electricity)	214.244	75%
Type II (gas)	62.826	22%
Type III (other fossil fuel)	9.767	3%
TOTAL	**286.837**	**100%**

Source: AEEG (2006)

Table 3. Summary data for the first 13 market sessions in Italy.

	Type I	*Type II*	*Type III*
Traded	15.024	10.086	76
Total value	€1.157.412,29	€948.060,73	€2.572
Min. price	€69	€90	€32
Max. price	€84	€98	€36
Average price	€77,04	€94	€33,84

Source: AEEG (2006)

Table 4. Summary of energy efficiency measures implemented in Italy, first year results.

Sector of implementation	*Percentage of the total*
Domestic sector, electricity (such as bulbs and white appliance substitution, etc.)	33%
Public lighting (such as high efficiency lamps, lighting systems, etc.)	27%
Residential electricity production and distribution (co-generation, solar-thermal, etc.)	21% (of which 8% from solar thermal)
Domestic sector, heating (such as boiler substitution, insulation, etc.)	14%
Measures in the industrial sector (inverters, highe efficiency electric motors, etc.)	5%

Source: AEEG (2006)

type I WhCs for electricity, *type II* WhCs for gas, and *type III* WhCs for other fossil fuels. The certificates can be traded both between the obliged parties, and among external parties such as ESCOs.

Outcomes in Italy

So far, 30 obligated electricity and gas distributors and other 577 not obliged parties (smaller distributors and ESCOs) have joined the scheme (AEEG 2006). The WhC market was officially launched on March 7th 2006. The national targets for 2005 were set to 151,911 TOEs, of which 97,854 for the electricity sector and 58,057 for the gas sector, and allocated to the obliged parties. Almost all the obliged distributors have met the targets (just three distributors, two from the electricity and one from the gas sector, missed theirs), in compliance with the 50 % special provision (AEEG, 2006). The total energy saving between January 2005 and May 2006 has been of 286,837 TOEs. Data relating to WhCs issued so far are outlined in table 2.

The overall energy savings (and relating WhCs) account for savings 184 % higher than the set national targets. The results also show a bias toward electricity market where energy savings seems to be easier to achieve. This pattern is evident also in the trading prices of the WhCs, see table 3 summarizing results for the first 13 market sessions (up to 31st May 2006, the WhCs market system kick off being the 7th March 2006).

Energy efficiency projects eligible towards the issuance of white certificates (WhCs) may involve domestic customers, as well as industrial and commercial customers and public administrations[8].

As outlined in table 4, most of the measures have been implemented in the lighting (private and public) and in the domestic electricity sector. However, it must be noted that about 60 % of the certificates issued derives from measures implemented before 2005 (the scheme is retroactive up to 2001) (AEEG, 2006).

The number of certificates exchanged through bilateral agreements has been considerably higher (83 %) than those exchanged on the trading market. The total number of bilateral exchanges was in fact of 120,381 TOE (May 2006), of which 104,498 of Type I (about 87 % of the total).

8. This is in contrast with the British EEC scheme, where targets and credits involve only domestic customers.

Great Britain

In Great Britain, the main vehicle for achieving energy savings in the household sector is the Energy Efficiency Commitment (EEC) scheme, introduced in two phases: 2002-2005 -EEC1- and 2005-2008 -EEC2. Consultation is on-going for a third phase EEC, covering the period 2008-2011 (DEFRA 2006).

For the EEC1 phase, the energy reduction target was set to 62 TWh of fuel standardised carbon equivalents (which equal to around 16 PJ, almost 1 % of energy consumption)[9]. The energy saving target for the EEC 2005-2008 has been set at 130 TWh by DEFRA in the end of 2004. This is roughly twice[10] the amount of target savings set for EEC1 (2002-2005) (Ofgem, 2006b). The savings can be achieved in residential dwellings heated by gas, electricity, coal, oil or LPG, and for each fuel a coefficient is set for the conversion in carbon equivalents.

The obliged parties are all the gas and electricity suppliers; during EEC1 the minimum threshold for participation was 15,000 customers, this includes 11 suppliers in 2002 (covering 99 % of the market), plus other three entrants up to 2004 (DEFRA, 2005). During EEC2 the threshold was raised to 50,000 domestic customers. Those suppliers that exceeded their Energy Efficiency targets are able to carry over these energy savings into the EEC (with a limit of 10 % for each supplier's target) – *banking* (DEFRA, 2005). Energy suppliers are also allowed to meet their required saving targets by buying 'savings' from other parties in the scheme (*vertical trading*).

The only sector covered by the obligation scheme is the domestic one, which is divided in two groups. The first, called *priority group*, accounts for 33 % of total households (Pablo et al, 2004) and comprises low income households such as pensioners, social housing households, households receiving benefits, and, more generally, 'fuel poor'[11] customers. The second group covers all other consumers. The obligated parties must deliver at least 50 % of the energy saving measures to the priority group. Moreover, the suppliers are required to finance a

9. There is consensus around the notion that this target was not a very ambitious one, and that it would have been achieved anyway in the business as usual scenario, thanks to technical improvement and necessary substitution of obsolete equipments (Bonneville & Rialhe, 2005).

10. The two targets are not fully comparable due to a number of new assumptions (e.g., discount rate) in the methodology used by DEFRA.

11. 'fuel poor',customers are those that spend more than 10 % of their income on energy needs.

Table 5. Proportion of overall achieved savings per measure (EEC1 – 2002-2005) in UK (DEFRA, 2005)

Measure	*EEC1 – year 1*	*EEC1 – Year 2*	*EEC1 – year 3*
Appliances	3%	4%	4%
Heating	1%	3%	5%
Insulation	12%	20%	24%
Lighting	4%	8%	12%
TOTAL	**20%**	**35%**	**45%**

share of the total implementation cost of the measure, called *inducement cost*. The inducement cost is on average higher for the Priority group than for the other group. In fact, for the former it is about 80 % of the implementation cost for structural measure (mainly insulation and heating) and 100 % for non-structural measures (such as bulbs substitution, appliances replacements) whereas for the latter those percentage lower to 50 % and 40 % (Oikonomou et al, 2006). In both phases of EEC, the suppliers are not financed for introducing energy saving measures. In contrast with the case of Italy, in UK suppliers are not restricted by regulated tariffs; hence, they are almost free to charge as they see fit towards the implementation of energy efficiency measures.

A the start of EEC1 there were twelve obligated suppliers, however two of them ceased trading before the end of EEC1 and did not meet their EEC obligations, resulting in a shortfall of nearly 1 TWh[12]. The remaining suppliers overachieved their targets by just under 26 TWh[13], the efficiency credits over-accrued until then could be carried over[14] to the EEC2 phase. About 56 % of the savings were achieved by insulation, 24 % from lighting schemes and 20 % both from heating and white appliances, as outlined in table 5 (DEFRA, 2005). 42 TWh (48.5 % of the total energy savings) resulted from measures provided to priority group households.

During EEC1 the Government announced that the target post 2005 would have been much higher than EEC1. This has increased suppliers' activity in the last year of EEC1. By the end of EEC1 suppliers had already achieved more than 25 % of their EEC2 combined target. Those energy savings have been carried forward from EEC1 to EEC2 and most of them were coming from insulation measures (Ofgem, 2006a). At the end of the first year of EEC2, suppliers achieved energy savings for 76 TWh, worth 60 % of the overall target (Ofgem, 2006a). Of that, about 46 % was delivered to the priority group. The main measure delivered to this group is insulation, whereas the range of measures delivered to the other group is more diverse (but still predominantly insulation). Overall, about 85 % of the energy savings achieved to date has come from insulation measures, 4 % from lighting measures, 2 % from appliances and 3 % from heating (Ofgem, 2006a & 2006b).

Italy vs. Great Britain

The key features of the Italian and the British energy efficiency schemes and market conditions are outlined below.

- *White certificates*: in Great Britain, the tradeable EEC credits are not formalized into a standardized and quantified 'certificate' of energy efficient activity, and are not traded on a specialized exchange. In Italy such a tradeable certificate exist (White Certificate), and is a commodity separate from the measure from which originated.
- *Trading scheme*: in Great Britain only obliged parties can trade, through bilateral contracts. In Italy certificates can be traded between obliged parties and also eligible parties such ESCOs, both by bilateral agreement and multilaterally on the regulated trading market.
- *Sector and technology coverage*: the British EEC scheme focuses on measures at the household level and has specific requirements to achieve at least half of the savings in the low income 'priority group'. The Italian scheme, instead, includes all energy end-use sectors, as well as intermediate uses in the gas sector.
- *Measures covered by the scheme*: in both countries the regulators provide a list of pre-approved measures[15], and set eligibility and monitoring & verification criteria for innovative measures which are off the list. The British regulator rewards 'innovative' measures with a credit bonus, while in Italy there are no such provisions. In contrast to the Italian case, The British regulator explicitly excludes improvements in energy efficiency resulting from use of renewables such as wind power, solar photovolatics or biomass either for the generation of heat or electricity.
- *Parties under saving obligation*: in Great Britain the obliged parties are electricity and gas suppliers[16] whereas in Italy they are the gas and electricity distribution companies[17].
- *Market overview*[18]: In Great Britain there are six main electricity suppliers active in the household market with additional companies active in the large user sector. The UK electricity supply market is moderately concentrated and has consolidated to closely match the structure of the generation market; the degree of competition is considered acceptable even though the number of fully independent suppliers is limited to three companies. Prices have been generally below European averages for both electricity and gas, although they have increased significantly recently and in some cases now exceed the EU average. In Italy, functional unbundling of distribution system operators and of the gas transmission system operator has not yet been fully addressed. The Italian retail market is split into two segments, roughly of the same size: the free market and the regulated market consisting of

12. The shortfall is about 1.6 % of the total energy saving target in households for EEC1, set at 62 TWh.

13. This is about 42 % of the total EEC1 target.

14. Due to adjustments in the energy saving calculations, the savings for 26 TWh during EEC1 are worth 35 TWh, or nearly 27 % of the total EEC2 target.

15. In both countries savings are certifiable under the schemes if the energy savings result from measures undertaken over and above the 'business-as-usual' scenario (additionality criteria).

16. Energy suppliers can use their direct contact with energy consumers to facilitate energy efficiency programmes; however, they face conflicts of interest as energy efficiency measures among their own customers result in smaller sales of their product.

17. Distribution companies may not be the best choice of target group, since locating the obligation on these requires changes to to regulatory price control mechanisms to ensure that the costs of the scheme could be recovered. In Italy, the choice probably reflects the still low degree of functional unbundling at the distribution level.

18. Source: European Commission, 2007a, b & c.

non-eligible customers (i.e. households[19]) and eligible customers who still choose to buy electricity at regulated tariffs. There is a single wholesale buyer for the electricity supplied to the regulated market. In 2006, there were 168 distributors in Italy, the largest of which (Enel Distribuzione) supplies most of the regulated market (85.5 %). Electricity prices in Italy are among the highest in Europe, while gas prices are generally in line with European averages.

- *Role of third parties*: In both countries the obliged parties can outsource the implementation of energy efficiency project[20], In Italy, in addition to the above, third parties which implement energy efficient projects may accrue TWCs and subsequently trade them, while in Great Britain EEC credits (and their financial value) essentially accrue only to obliged parties which underwrite efficiency projects.

Readers interested in a more detailed characterization of similarities and differences between the two national schemes promoting energy efficiency are referred to the table 1 in (Oikonomou et al., in press).

ESCOs and energy efficiency

The implementation of energy-efficiency projects falls squarely in the typical business mission of ESCOs. In such case, ESCOs would provide performance and savings guarantees, and their remuneration would be directly tied to the energy savings achieved. Therefore, the ESCO risks its payments on the performance of equipment and services implemented. Where there is relative certainty over the exact values of investment costs and future savings, the ESCO might be in the position to arrange the financing needed for capital expenses by securing future cash flows from the resulting savings. Typically, such financing is ensured by either a *shared savings or a guaranteed savings* contract. In the former the ESCO assumes the performance and credit risk; in the latter the client assumes the credit risk, while the ESCO assumes the risk for the savings.

In Europe, several barriers prevent the full development of the ESCO industry (Bertoldi 2003):

> "The IEA DSM Implementing Agreement Task X identified the following as some of the major barriers: lack of information and understanding of the opportunities that energy efficiency offer; lack of culture for project financing; public procurement rules that prevent the use of ESCOs; "low" price of electricity; safety and reliability concerns that hinder the introduction of new technologies; burdensome administrative procedures that allow only very large projects to be carried out; and limited understanding of energy-efficiency and performance contracting by financial institutions."

We have already outlined similarities and differences between the British EEC scheme and the Italian TWC scheme. It is worth looking at the differences between the two national scenarios from the point of view of an ESCO.

Under the British EEC scheme, energy efficiency measures that are eligible for credits are only those affecting the domestic sector. The liable organisations pay project developers to undertake energy efficiency activities, and currently this is done through contracting, with a requirement that the supplier specifies the details of the project to the scheme regulator. Most of the savings undertaken under the EEC are carried out by third-party contractors, which bid for the provision of EEC-compliant energy efficiency services to the suppliers (NERA, 2006). As far as energy services are concerned, suppliers are incentivised to deliver efficiency measures as a part of an energy service scheme. In order to qualify for a 50 % credit bonus[21], the scheme must offer an audit of the customer's property, provide advice, offer the consumer a deferred payment for the cost of the measures, and the action must result in the customer saving at least 13 % of his/her previous energy needs. The implementation of any new energy service scheme is subject to suppliers' approval; while, on one hand, investments in energy services could benefit from the financing available to energy suppliers, practically an energy service approach is not yet common[22].

Conversely, the Italian TWC scheme allows more degrees of freedom to ESCOs. Energy efficiency measures are not restricted to a specific sector, and ESCOs need not be necessarily tied to energy suppliers or distributors, and may liaise directly with the regulator. The arrangement between a supplier and its TWC provider could be limited to the exchange of certificates, independently of any monitoring, reporting, and verification of the underlying energy efficiency activities. Under the TWC scheme, ESCOs seeking to invest in energy efficient measures (and engaging in a *guaranteed savings* contract with their customer) would have to assume the risk for the future savings accrued by their implementation. Essentially, the risks are correlated to the volatility in energy (electricity) prices and in the future behaviour of the end-users affected by the measures. Any ESCO participating as a third party within a TWC scheme would be exposed to an additional financial risk, correlated to the volatility in WhC market values; the relative weight of such risk increases as the relative weight of the financial contribution from WhCs increases. The key factors influencing WhC market prices include both elements of market design (scheme provisions addressing WhCs bankability; balance of WhCs supply and demand; statutory penalties for parties who under-comply with their targets), and exogenous factors affected by uncertainty (marginal cost of energy efficient technologies; market value of electricity and primary fuels; industry structure, liquidity of WhC market). Generally, small project developers (due to constraints in the availability of finance and their typical need of frequent payments) are exposed to the risk of cash-flow problems caused by poor liquidity of the WhC market[23]. This might stop them from undertaking projects where the financial contribution expected from the sale of WhCs has a large relative weight on the overall revenues. Clearly, alterna-

19. This part of the market is becoming eligible as of July 2007.

20. In Britain, most of the energy savings undertaken under the EEC are carried out by third parties.

21. As in the case of 'innovative actions', the bonus credits are capped at 10% of the supplier's overall target.

22. Based on information from stakeholders NERA 2006, states that, rather than a direct consequence of the current regulatory provisions, this is primarily due to lack of interest from customers.

23. During the trading sessions since its opening, the Italian WhC seem to have become less and less liquid, particularly for type 3 WhCs.

Table 6. ESCOs' business barriers and opportunities in Italy and UK

	Barriers	***Opportunities***
Italy	customers are not familiar with energy performance contracting lack of qualified consultants Lack of trust in ESCOs' capability to deliver solutions Uncertainty in the market value of WhCs Poor WhC market liquidity	Transparent price signals provided by WhC market High electricity price High solar radiation levels (for solar thermal/PV) High business potentials in the air conditioning sector Innovative energy services actions are not subject to distributor/supplier approval
UK	Low electricity price Lack of customers' interest in purchasing energy services Innovative energy services approaches require suppliers' approval	High business potential in improving building insulation
Common to both countries	lack of standardized contract conditions Poor availability of finance Companies are reluctant to sign on energy-efficiency projects when the implementation might jeopardize key production processes Few qualified energy managers - emphasis on purchasing rather than demand-side measures	Perceived government thrust on climate change policy and on fostering energy efficiency

tive contractual arrangements (such as the use of forward sale agreements) could be suitably put in place in order to manage suck risk, though arguably they would not address the structural causes of poor WhC market liquidity.

Table 6 outlines the key business barriers and opportunities for ESCOs in Italy and UK.

In conclusion, in both Italy and Great Britain, the business outlook for ESCOs is cautiously positive. Many of their business opportunities are directly related to the most common barriers faced by end-users aiming to implement energy-efficiency projects, such as lack of access to financing, lack of the necessary technical and financial expertise, limited time in organisation for considering energy efficiency, and competing responsibilities (maintenance, production, equipment purchasing, etc.).

Methodology

The aim of the analysis is to quantify the impact of tradeable WhCs on the financial viability of selected energy efficiency measures (seven case studies). As we have seen, under EEC provisions ESCOs and other third parties are not eligible to the accrual of energy savings credits. This analysis takes the point of view of an ESCO which does not belong to the target group, and yet (as under Italian regulatory provisions) is eligible for accrual of tradeable energy saving certificates, hence is potentially interested in investing in energy efficiency projects also on the basis of the additional revenues from the sale of WhCs. The financial appraisal consists in a Net Present Value (NPV) calculation, in line with widely adopted practices[24] in the financial industry. In all cases, the ESCO is assumed to engage in a *guaranteed savings* contract with the end-users, and NPV values for the selected case studies are calculated in relation to three different national scenarios. The analysis estimated the relative weight of revenues from sale of WhCs, compared to total revenues, towards investment profitability. The investment opportunities were appraised according to their net present values.

The first scenario (Italy) reflects the existing regulatory and market outlook in Italy; the ESCO, in addition to the revenues from the energy savings, can capitalize from the proceeds of the sale of WhCs on the traded market. The second scenario (UK current) is representative of the current circumstances in Great Britain: the ESCO benefits from the energy savings, but is not eligible to accrual of energy savings certificates[25]. The third scenario (UK with WhCs) is hypothetical, and assumes that Great Britain had implemented a TWC scheme along the same lines as Italy; under such assumption, the ESCO, while not member of the target group, is eligible to accruing WhCs, and can indeed sell them as a commodity on the traded market. The aim is to evaluate the effect of such TWC scheme on the net present value of the investment, calculated before interests and tax.

Across all scenarios, the case studies for energy efficiency project are not restricted to the domestic sector[26]; consequently, in the third scenario (UK with WhCs) all energy efficiency

24. NPV calculations offer a way to appraise investments, as the higher the NPV, and the more attractive the investment. Other widely used appraisal techniques involve screenings on the basis of 'pay-back time' (PBT) and 'internal rate of return'. Generally, each approach has attractions and drawbacks when compared to others, but all of the above approaches fail to address the issue of future volatility in the prices and values of the underlying costs and assets. Nevertheless, their relative simplicity is without doubts one of the reasons why they are widely adopted. Addressing volatility requires an approach which is mathematically more sophisticated (such as real options theory), and is beyond the scope of this paper.

25. Under EEC provisions, the only parties eligible for tradeable energy saving credits are gas and electricity suppliers. Consequently, the relating financial value of EEC credits is fully internalized by the suppliers, and is beyond the reach of third parties like ESCOs.

26. This is in contrast with the British EEC scheme, which is restricted to domestic end-users. NERA, 2006, outlines the tradeoffs between restricting activities to one sector or allowing all sectors within the credit scheme:
"Generally speaking, a larger set of eligible measures and participants helps identify the most cost-effective energy savings. On the other hand, smaller consumers (both households and SMEs) are often thought to face the biggest barriers to improving energy efficiency, while large consumers are often targeted by other policy measures. With no restriction on sectors, an energy efficiency scheme may lead to low-income consumers subsidising energy efficiency improvements in large industrial and commercial organisations."

Table 7. Key similarities and differences within the chosen national scenarios

	Italy	*UK current*	*UK with WhCs*
Cost of energy (EUR/MWh)	120	100	100
Ratio kWh/TOE	4,545.45	4,545.45	4,545.45
Cost of energy (EUR/TOE)	545	454	454
No. of years eligible for WhCs issuance	5	0	5
Average market value of WhCs (EUR)	80	n/a	80
Discount rate	6.00%	6.00%	6.00%

projects are assumed eligible to accrual of WhCs, regardless of the sector of application. The case studies were chosen under the assumption that the energy efficiency measures to be implemented would reduce electricity consumption (rather than natural gas), and with a view to covering the range of end-users in all sectors; each case study was referenced from the technical sheets issued by the Italian AEEG. In all of the case studies, the total amount of energy saving measures to be implemented are normalized so as to achieve 25 TOEs of energy saving, which is the minimum amount to trade the WhCs in the Italian market, using the standard procedure for the measurement of savings (AEEG 2004).

The NPV figures were calculated subject to a set of assumptions, and the reader should approach the NPV figures with caution. The financial models compared estimates of fixed costs with estimates of revenues calculated on the basis of average values of electricity price and WhCs. Since both energy prices and WhCs market values are subject to fluctuations, the NPV figures represent a snapshot of what would happen if the system assumptions held constant for the duration of the asset lifetime. Additionally, in order to allow fair comparisons, the analysis stopped short of considering the effect of different national tax regimes, as well as any other support scheme, for they both might differ significantly, and are often specific not only to the national setting, but also to the nature of the energy saving measure.

A price survey was carried out among appliance providers and qualified installers, so as to gather current relevant market prices and costs. Where possible, the authors aimed at using conservative estimates, so as to under-estimate the financial benefits arising by the energy savings, and over-estimate the cost of investments, operations and maintenance. In the case studies where the energy saving measure is based on the substitution of a less efficient technology (as in the case of light bulbs), then investment, operations and maintenance cost are calculated as difference between the generally cheaper conventional technology and the more expensive energy-efficient one.

Net present values for all scenarios were calculated using a 6 % discount rate. The values used for the price of electricity in Italy and Great Britain reflect average market values[27] (measured during year 2006). In general, every certified saving of one TOE and allows the accrual of one WhC. Under the assumptions of the analysis, one WhC is equivalent to 4,545.45 kWh; in Italy and Great Britain this corresponds respectively to EUR 545 and 454 worth of energy savings calculated at average retail electricity prices. All case studies are normalized to savings of 25 TOEs, which is the minimum size of yearly savings that the Italian regulator allows for registration under the TWC scheme. Where applicable, the value and time period of eligibility of tradeable WhCs is assumed equal respectively to EUR 80[28] and five years, in line with current circumstances in Italy. In all the financial models, the above values are kept constant in nominal value throughout the expected lifetime of the assets.

Table 7 outlines the key similarities and differences among the chosen national scenarios.

Application

Each of the following case studies was referenced from the technical sheets issued by the Italian AEEG.

Provision of indoor lighting with energy efficient light bulbs

The case examines the provision of light in residential and commercial dwellings, (after AEEG technical sheet No. 1). Potential clients include domestic customers, as well as commercial firms and local authorities. The investment involves changing filament wire bulbs with compact neon lights with internal power supply, having a conservatively estimated lifetime of five years. Table 8 outlines the key features of such investment.

One can see that the investment needed to fit 1,712 energy efficient bulbs (equivalent to a saving of 25 TOEs per year) is EUR 13,699. The net present value of such investment is positive for each scenario.

Provision of outdoor (public) lighting with high pressure sodium vapour bulbs

The case examines the provision of public outdoor light, see AEEG technical sheet No. 18. Potential clients include mainly local authorities. The investment involves changing mercury vapour bulbs with high pressure sodium vapour bulbs, having a lifetime of five years. Table 9 outlines the key features of such investment.

One can see that the investment needed to fit 556 energy efficient bulbs (equivalent to a saving of 25 TOEs per year) is EUR 28,889. While the net present value is positive for each scenario, the Italian figure results significantly from the comparatively high energy prices in Italy.

27. Notably, electricity prices in UK are lower than in Italy, consequently the value of energy savings (measured in kWh) in UK is correspondingly lower.

28. This figure reflects the traded WhC average market value within the Italian traded market during the first trading 15 sessions, and in this study it is taken as estimate of the long-term market value of WhCs. Since the first sessions, the market value of WhCs in Italy has dropped to below EUR 57.

Table 8. Provision of indoor lighting with energy-efficient light bulbs

*2*36 W energy saving bulbs with internal power supply*	*Italy*	*UK current*	*UK with WhCs*
Lifetime of Energy-Saving Device (years)	5	5	5
Per-unit cost of Energy-Saving Device (EUR/Unit)	€ 33.00	€ 33.00	€ 33.00
Per-unit cost of installation (EUR/Unit)	12	12	12
Per-unit TOE savings (TOE/(Unit*year))	1.460E-02	1.460E-02	1.460E-02
No. of ESD units required to save 25 TOEs	1,712	1,712	1,712
Per-unit Energy savings (EUR/(Unit*year))	7.96	6.63	6.63
Annualized values			
Difference Total Inv. Costs ESD-Conv. (EUR)	€ 13,699	€ 13,699	€ 13,699
Difference Total maintenance costs ESD-Conv (EUR)	€ 8,656	€ 8,656	€ 8,656
Difference Total Inv.& Maintenance ESD-Conv. (EUR)	**€ 22,354**	**€ 22,354**	**€ 22,354**
Total Energy savings (EUR)	**€ 57,441**	**€ 47,799**	**€ 47,799**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**€ 43,512**	**€ 25,445**	**€ 33,870**
Payback time (years)	1.07	1.56	1.29
% contribution of WhCs to NPV	19%	0%	25%

Table 9. Provision of outdoor (public) lighting with high pressure sodium vapour bulbs

70W High Pressure Sodium Vapour bulbs for provision of public light	*Italy*	*UK current*	*UK with WhCs*
Lifetime of Energy-Saving Device (years)	5	5	5
Per-unit cost of Energy-Saving Device (EUR/Unit)	€ 50.00	€ 50.00	€ 50.00
Per-unit cost of installation (EUR/Unit)	12	12	12
Per-unit TOE savings (TOE/(Unit*year))	4.500E-02	4.500E-02	4.500E-02
No. of ESD units required to save 25 TOEs	556	556	556
Per-unit Energy savings (EUR/(Unit*year))	24.55	20.43	20.43
Annualized values			
Difference Total Inv. Costs ESD-Conv. (EUR)	€ 28,889	€ 28,889	€ 28,889
Difference Total maintenance costs ESD-Conv (EUR)	€ 18,722	€ 18,722	€ 18,722
Difference Total Inv.& Maintenance ESD-Conv. (EUR)	**€ 47,611**	**€ 47,611**	**€ 47,611**
Total Energy savings (EUR)	**€ 57,441**	**€ 47,799**	**€ 47,799**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**€ 18,256**	**€ 189**	**€ 8,614**
Payback time (years)	2.74	4.44	3.44
% contribution of WhCs to NPV	46%	0%	98%

Table 10. Purchase of energy-efficient fridge-freezer

Class A+ fridge-freezer with 220L volume	*Italy*	*UK current*	*UK with WhCs*
Lifetime of Energy-Saving Device (years)	12	12	12
Per-unit additional cost of Energy-Saving Device (EUR/Unit)	€ 33.00	€ 33.00	€ 33.00
Per-unit cost of installation (EUR/Unit)	0	0	0
Per-unit TOE savings (TOE/(Unit*year))	2.600E-03	2.600E-03	2.600E-03
No. of ESD units required to save 25 TOEs	9,615	9,615	9,615
Per-unit Energy savings (EUR/(Unit*year))	1.42	1.18	1.18
Annualized values			
Difference Total Inv. Costs ESD-Conv. (EUR)	€ 317,308	€ 317,308	€ 317,308
Difference Total maintenance costs ESD-Conv (EUR)	€ 0	€ 0	€ 0
Difference Total Inv.& Maintenance ESD-Conv. (EUR)	**€ 317,308**	**€ 317,308**	**€ 317,308**
Total Energy savings (EUR)	**€ 114,325**	**€ 47,799**	**€ 47,799**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**-€ 194,558**	**-€ 269,508**	**-€ 261,084**
Payback time (years)	21.51	29.64	25.2
% contribution of WhCs to NPV	-4%	0%	-3%

Purchase of energy-efficient (class A+) 220 litres fridge-freezer instead of a less efficient unit (less than A class)

The case for purchasing an energy efficient (A+) fridge-freezer of 220 litres volume instead of a less efficient unit is examined, see AEEG technical sheet No. 12. Potential end-users are mainly domestic customers. The investment includes the additional cost of the energy-efficient unit, as opposed to the less efficient one. The lifetime of the asset is assumed equal to 12 years, during which the relevant energy savings accrue. Table 10 outlines the key features of such investment.

The NPV of the investment is negative for each scenario, in spite of a relatively small price difference (EUR 33) between

Table 11. Fitting frequency regulators on electric pumping systems rated less than 22kW

Frequency regulator (inverter) on pumping systems rated less than 22kW	*Italy*	*UK current*	*UK with WhCs*
Cost of Energy (EUR/MWh)	100	€ 83	€ 83
Ratio kWh/TEP	4,545.45	4,545.45	4,545.45
Cost of Energy (EUR/TOE)	€ 455	€ 378	€ 378
Lifetime of Energy-Saving Device (years)	5	5	5
Per-unit cost of Energy-Saving Device (EUR/Unit)	€ 114.55	€ 114.55	€ 114.55
Per-unit cost of installation (EUR/Unit)	0	0	0
Per-unit TOE savings (TOE/(Unit*year))	1.500E-01	1.500E-01	1.500E-01
No. of ESD units required to save 25 TOEs	167	167	167
Per-unit Energy savings (EUR/(Unit*year))	68.18	56.74	56.74
Annualized values			
Total Inv. Costs ESD (EUR)	€ 19,091	€ 19,091	€ 19,091
Total maintenance costs ESD (EUR)	€ 15,318	€ 15,318	€ 15,318
Total Inv.& Maintenance ESD (EUR)	**€ 34,409**	**€ 34,409**	**€ 34,409**
Total Energy savings (EUR)	**€ 47,868**	**€ 39,833**	**€ 39,833**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**€ 21,884**	**€ 5,424**	**€ 13,849**
Payback time (years)	2.08	3.48	2.59
% contribution of WhCs to NPV	38%	0%	61%

Table 12. Fitting reduced-flow shower heads within sport centres

Reduced flow shower heads in sport centres changing rooms	*Italy*	*UK current*	*UK with WhCs*
Lifetime of Energy-Saving Device (years)	5	5	5
Per-unit cost of Energy-Saving Device (EUR/Unit)	€ 3.24	€ 3.24	€ 3.24
Per-unit cost of installation (EUR/Unit)	1.76	1.76	1.76
Per-unit TOE savings (TOE/(Unit*year))	1.050E-01	1.050E-01	1.050E-01
No. of ESD units required to save 25 TOEs	238	238	238
Per-unit Energy savings (EUR/(Unit*year))	57.27	47.66	47.66
Annualized values			
Difference Total Inv. Costs ESD-Conv. (EUR)	€ 1,190	€ 1,190	€ 1,190
Difference Total maintenance costs ESD-Conv (EUR)	€ 501	€ 501	€ 501
Difference Total Inv.& Maintenance ESD-Conv. (EUR)	**€ 1,692**	**€ 1,692**	**€ 1,692**
Total Energy savings (EUR)	**€ 57,441**	**€ 47,799**	**€ 47,799**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**€ 64,174**	**€ 46,107**	**€ 54,532**
Payback time (years)	0.08	0.11	0.1
% contribution of WhCs to NPV	13%	0%	15%

the the energy-efficient unit and the less efficient one. It must be noted that increasing the price difference will worsen the financial case. The number of units needed to accrue annual savings worth 25 TOEs is 9,615 – this figure is about 0.6 % of the total number of fridge-freezers sold in UK during 2004 (BNC14, 2006).

Fitting a frequency regulator (inverter) on electric pumping systems rated less than 22 kW

The case for fitting a frequency regulator (inverter) on electric pumping systems rated less than 22 kW is examined, see AEEG technical sheet No. 9. Energy saving coefficients were chosen on a conservative basis (i.e. assuming two work shifts per day, and 20 % static head). Potential end-users are industrial customers. The investment involves the purchase, fitting and maintenance of suitable frequency regulators coupled with electric motors powering pumping systems. The lifetime of the asset is assumed equal to five years. Table 11 outlines the key features of such investment.

The electricity price chosen for this case study (100 EUR/MWh in Italy, 83 EUR/MWh in UK) is lower than the price used in the other case studies; this reflects the fact that industrial customers benefit from lower costs of energy. The investment needed to fit 167 units is EUR 19,091. The NPV of the investment is positive, with a pay back time below four years for each scenario. If the White Certificates were available in UK, the NPV of the investment would increase more than twofold (from EUR 5,424 to EUR 13,849).

Fitting reduced-flow shower heads in the changing areas of sport centres

The case for fitting reduced-flow shower heads in the changing areas of sport centres follows from the AEEG technical sheet No. 13c. Potential end-users are owner/managers of sport centre facilities. The model assumes that hot water is produced with an electric boiler, hence the energy savings result in lower consumption of electricity. Table 12 outlines the key features of the investment.

The investment needed to fit 238 units is EUR 1,190. The NPV of the investment is positive and worth a large multiple of the initial investment, with a pay back time of about one month for each scenario. The accrued energy savings are substantial, and allow for correspondingly high returns. The White Certificates provide only a small fraction of the total investment income.

Table 13. Solar thermal panels for domestic use

thermal solar panel for domestic water heating	***Italy***	***UK current***	***UK with WhCs***
Lifetime of Energy-Saving Device (years)	20	20	20
Per-unit cost of Energy-Saving Device (EUR/m^2)	€ 700.00	€ 700.00	€ 700.00
Per-unit cost of installation (EUR/Unit)	0	0	0
Per-unit TEP savings (TOE/(Unit*year))	1.810E-01	1.177E-01	1.177E-01
No. of ESD units required to save 25 TOEs	138	138	138
Per-unit Energy savings (EUR/(Unit*year))	98.73	53.4	53.4
Annualized values			
Difference Total Inv. Costs ESD-Conv. (EUR)	€ 96,685	€ 96,685	€ 96,685
Difference Total maintenance costs ESD-Conv (EUR)	€ 47,527	€ 47,527	€ 47,527
Difference Total Inv.& Maintenance ESD-Conv. (EUR)	**€ 144,212**	**€ 144,212**	**€ 144,212**
Total Energy savings (EUR)	**€ 156,408**	**€ 84,600**	**€ 84,600**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**€ 20,620**	**-€ 59,612**	**-€ 51,188**
Payback time (years)	8.92	31.71	19.59
% contribution of WhCs to NPV	41%	0%	-16%

Table 14. Photovoltaic panels for electricity production

1kWp photovoltaic panel for residential electricity generation	***Italy***	***UK current***	***UK with WhCs***
Lifetime of Energy-Saving Device (years)	20	20	20
Per-unit cost of Energy-Saving Device (EUR/Unit)	€ 6,500.00	€ 6,500.00	€ 6,500.00
Per-unit cost of installation (EUR/Unit)	0	0	0
Per-unit TOE savings (TOE/(Unit*year))	3.447E-01	2.241E-01	2.241E-01
No. of ESD units required to save 25 TOEs	73	73	73
Per-unit Energy savings (EUR/(Unit*year))	188.04	101.71	101.71
Annualized values			
Difference Total Inv. Costs ESD-Conv. (EUR)	€ 471,370	€ 471,370	€ 471,370
Difference Total maintenance costs ESD-Conv (EUR)	€ 24,953	€ 24,953	€ 24,953
Difference Total Inv.& Maintenance ESD-Conv. (EUR)	**€ 496,323**	**€ 496,323**	**€ 496,323**
Total Energy savings (EUR)	**€ 156,408**	**€ 84,600**	**€ 84,600**
Total income from WhCs (EUR)	**€ 8,425**	**€ 0**	**€ 8,425**
NPV	**-€ 331,490**	**-€ 411,723**	**-€ 403,298**
Payback time (years)	37.12	96.08	69.39
% contribution of WhCs to NPV	-3%	0%	-2%

Thermal solar panel for domestic water heating

This case study draws from the AEEG technical sheet No. 8. It analyses the investment needed to fit thermal solar panels (2 square metres flat collectors, 20 years lifetime) for the production of hot water; potential end-users include domestic customers and owner/managers of residential/commercial building facilities. The model assumes that hot water is produced with an electric boiler, hence the energy savings result in lower consumption of electricity. Table 13 outlines the key features of the investment.

The investment needed to fit 138 units is EUR 96,685. The NPV of the investment is positive in Italy, but negative in UK, where the lower electricity price do not justify such investments on strictly financial terms. Even the contribution of White Certificates in UK would not be enough to completely offset the large negative NPV of the investment.

PV panel for domestic electricity production

This case study draws from the AEEG technical sheet No. 7. It analyses the investment needed to fit photovoltaic panels (rated 1 kW peak electric power, 20 years lifetime) for the production of electricity; potential end-users include domestic customers and owner/managers of residential/commercial building facilities. In Italy, for such measures to be eligible to WhCs, the AEEG requires each installation to be rated below 20 kWp; an owner/investor is allowed to add several installations in order to cumulate annual savings equivalent to the minimum threshold of 25 TOEs. Table 14 outlines the key features of the investment.

The investment needed to fit 73 units (of 1 kWpe each) is EUR 471,370. The NPV of the investment is largely negative both in Italy and in UK, and the income contribution from the White Certificates offsets only a small fraction of the initial investment costs. It appears that the electricity price is too low to justify such investments on strictly financial terms.

Results and comments

Tables 15-17 summarize the results of the financial appraisals carried out under the assumptions held for each scenario. Each investment is normalized so as to achieve annual energy savings of 25 TOEs, and consequently become eligible to the issue of the relating WhC (also known as Energy Efficiency Title, TEE: 1 TEE = 1 TOE/year of accrued energy savings).

The investment with the highest return involves fitting reduced-flow shower heads, and this is followed by the provision of energy-efficient indoor lighting. Conversely, fitting PV panels, and investing in energy-efficient fridge-freezers leads to the worst returns, in both cases negative and large.

In the 'UK current' scenario, the highest return investment still involves fitting reduced-flow shower heads, and this is followed by the provision of energy-efficient indoor lighting. Conversely, fitting solar-thermal panels, investing in energy-efficient fridge-freezers, and fitting PV panels all generate increasingly negative returns. In contrast to the previous case, the NPV released by the provision of energy-efficient outdoor lighting drop from EUR 18,256 (in Italy, with WhCs) to EUR 189 (in UK, without WhCs).

Table 15. Summary of the financial appraisal results for Italy

Investment in Italy	*No. of units/25 TEE*	*EUR/25 TEE*	*EUR/(kWhe*year) saved*	*NPV (EUR)*	*Pay back time (years)*
Indoor lighting	1,712	13,699	0.12	43,512	1.07
Outdoor lighting	556	28,889	0.25	18,256	2.74
Fridge-freezer	9,615	317,308	2.79	-194,558	21.51
Inverter	167	19,091	0.17	21,884	2.08
Reduced-Flow Shower heads	238	1,190	0.01	64,174	0.08
Solar thermal panels	276 (m^2)	96,685	0.85	20,620	8.92
PV panels	73 (kWep)	471,370	4.15	-331,490	37.12

Table 16. Summary of the financial appraisal results for UK current

Investment in UK current	*No. of units/25 TEE*	*EUR/25 TEE*	*EUR/(kWhe*year) saved*	*NPV (EUR)*	*Pay back time (years)*
Indoor lighting	1,712	13,699	0.12	25,445	1.56
Outdoor lighting	556	28,889	0.25	189	4.44
Fridge-freezer	9,615	317,308	2.79	-269,508	29.64
Inverter	167	19,091	0.17	5,424	3.48
Reduced-Flow Shower heads	238	1,190	0.01	46,107	0.11
Solar thermal panels	276 (m^2)	96,685	0.85	-59,612	31.7
PV panels	73 (kWep)	471,370	4.15	-411,723	96

Table 17. Summary of the financial appraisal results for UK with WhCs

Investment in UK with WhCs	*No. of units/25 TEE*	*EUR/25 TEE*	*EUR/(kWhe*year) saved*	*NPV (EUR)*	*Pay back time (years)*
Indoor lighting	1,712	13,699	0.12	33,870	1.29
Outdoor lighting	556	28,889	0.25	8,614	3.44
Fridge-freezer	9,615	317,308	2.79	-261,084	25.2
Inverter	167	19,091	0.17	13,849	2.59
Reduced-Flow Shower heads	238	1,190	0.01	54,532	0.10
Solar thermal panels	276 (m^2)	96,685	0.85	-51,188	19.6
PV panels	73 (kWep)	471,370	4.15	-403,298	69

In the 'UK with WhCs' scenario, the highest return investment again involves fitting reduced-flow shower heads, and this is followed by the provision of energy-efficient indoor lighting. Conversely, fitting solar-thermal panels, investing in energy-efficient fridge-freezers, and fitting PV panels all generate increasingly negative returns. Due to the positive value contribution resulting from the WhCs, all NPVs are higher than in the previous case. Hence, the contribution of WhCs might help tipping the balance towards the implementation of all those energy-saving measures whose NPV (in UK, without WhCs) is a small positive or negative number. Notably, this is the case of the provision of outdoor lighting, as well as fitting energy-efficient inverters on electric pumping systems.

In all of the above scenarios investing in energy-efficient fridge-freezers and fitting PV panels result in negative NPVs, and require investments which are about one order of magnitude higher than in the other examined cases. Hence, it appears that improving the diffusion of such technologies requires additional support measures.

Conclusions

The implementation of a White Certificates trading scheme has the potential to accelerate the adoption of energy-efficient technologies, since the tradeable certificates may well provide investors with financial incentives which are complementary to those offered by the accrued energy savings. This paper takes the point of view of an ESCO seeking to invest in energy efficient measures, and compares and contrasts the British EEC scheme with the Italian TWC scheme, outlining the main opportunities and barriers for business.

On the basis of a review of market prices and conservative assumptions, the financial appraisals presented in this paper offer some practical examples of provisional NPVs generated by investments in selected energy efficiency measures. The empirical analysis carried out for selected case studies shows that the financial incentive provided by WhCs may well be sizeable, and is even more important for those projects where the Net Present Value without WhC contribution is a small number.

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