A step into the unknown: feed-in tariff for energy saving

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Abstract

Over the last decades there has been a heated debate about the comparative advantages of quantity versus price policy instruments in the field of sustainable energy (see definitions in the paper). In renewable electricity generation (RES-E) these mechanisms are represented by renewable quota systems coupled with tradable green certificates, and by feed-in tariffs (FITs), respectively. Recently the interest of energy efficiency policy makers has also been drawn by quantity policy instruments. In a few European countries white certificate schemes have been introduced, which combine energy savings obligations with tradable certificates for energy savings from verified projects. Following the promising results delivered by feed-in tariffs for the support of RES-E, it could be interesting to explore the feasibility and possible set up of a feed-in tariff for end-use energy savings.

The paper takes as a point of departure the comparative analysis of quantity systems versus price systems with regard to RES-E. It builds on the theoretical debate of "prices-versus-quantities" and reviews the results achieved by instruments from these two categories in RES-E. The paper reviews other more recent financial support schemes used for end-use efficiency and energy savings such as wire charges and demand response bidding. Taking into account the particularities of end-use energy efficiency projects, the paper subsequently discusses the feasibility and implications of introducing a feed-in type of support for end-use energy efficiency and energy savings. The paper finally discusses the viability for integration of a feed-in tariff for energy savings with a renewable one with the aim of achieving maximum cost effectiveness and improving the coherence of sustainable energy systems. The paper is intended to open a larger debate on a possible FIT for energy savings, and in particular on some theoretical and practical implementation issues, such as measurement.

Introduction

Reducing energy demand is essential to mitigate the inevitable climate change. Reduction in energy demand can be achieved by improving the energy efficiency of the service provided (technological aspect) and/or by realising energy savings without necessarily making technological improvements (behavioural aspect, for instance less overheating or overcooling, less driving). Energy savings (ES) preserve scarce natural resources. Energy efficiency (EE) is an important component to achieve energy saving, as it allows having the same services and goods with less use of energy. Energy efficiency describes how much useful work, activity or service can be generated for each unit of energy consumed. However improved energy efficiency - i.e. replacing a technology with a more energy efficient one - is not per se assuring energy savings, and there are numerous examples where as results of introducing a more efficient technology the actual consumption indeed increases, due to the rebound effect (Lebot 2004) or because of installing larger and more numerous appliances and equipment (larger volume of appliances, more frequent usage) (Moezzi 1998). True energy saving can be achieved by either the introduction of a more efficient technology at the same system conditions (energy efficiency)[1] and/or by its usage in a way that establishes reduction in usage (energy saving without technology)[2]. ES is in most cases resulting in economic savings and other sizeable benefits for end-users (described by many in literature, e.g. Bailie, *et al.* 2006). Many of the advantages of ES for individuals and organisations, are also valid for society as a whole at local, regional, national or global level. In particular climate change is a global issue, and EE and ES are recognised as one of the key areas of action, and certainly the quickest way to start reversing the current rate of growth of harmful emissions.

A number of well-known and well-documented barriers prevent the full uptake of energy efficiency (see, for instance, Sorrell 2000, Golove 1996). To overcome these barriers, governments have introduced policies and programmes over the last 30 years. There is clear evidence that financial incentives are among the most effective polices. Financial incentives can take the form of rebates on most efficient equipment (purchase price reduction, upfront investment subsidies), free give away, tax incentives, etc. Other policies that may have similar impact are energy taxation, demand side bidding, demand side obligations, and tradable white certificates. Some of these polices are described in the next chapter. These polices are in most cases complemented by mandatory efficiency requirements which eliminate the worst performing equipment or new buildings from the market.

Another equally important area of action for sustainable energy systems is the promotion of renewable energy sources (RES) to gradually replace fossil fuel in power generation, heat supply and transport. RES are widely recognised as a desirable and positive energy source to be stimulated and fostered, despite the higher start-up costs for some technologies vis-à-vis some conventional fossil fuel technologies. Many citizens and organisations are already willing to pay more for the use of energy/electricity produced by RES. RES also face various technical, market, regulatory, and financial barriers (well documented in literature), most of them similar to the barriers energy efficiency faces. Similarly recognising the importance of developing and supporting RES, governments across the OECD countries have introduced polices and programmes for the support of RES.

While energy efficiency polices and programmes have taken many different forms ranging from labels and standards, building codes, to information campaigns, voluntary agreements, taxation, investment subsidies and financial incentives, for RES policies have been focussed around creating financial incentives for the investment uptake and for the operation of RES installations. In general with respect to RES the discussion among policy makers and policy analyst has been on which types of incentives are most effective and cost-effective in stimulating the uptake of RES, rather than on the need or justification for incentives. This is because RES are widely recognised as a good energy source to have in a modern society, their primary limitation being the higher investment costs. Only more recently other polices for RES have also been introduced in the form of RES requirements in building codes, for example.

On the other hand financial incentives for energy efficiency have been much more discussed and are not yet accepted by all policy makers and analysts. In addition, the examples of incentives on the demand side have almost all targeted more efficient technologies (appliances and equipment) and have not always supported real and sustainable genuine energy savings. As already indicated, true energy saving can be achieved by either the introduction of a more efficient technology at the same system conditions (energy efficiency) and/or by a change in in energy usage (energy saving without technology, or behaviour change). Traditionally policies and programmes have been designed to improve the ratio between the energy consumed and the service provided, i.e. energy efficiency. However the challenge of mitigating climate change, as well as the need to achieve a sustainable and socially-equitable energy future, demands that absolute, and not just relative, reductions in energy demand are achieved (Lebot *et al.* 2004).

The paper reviews briefly the main RES support schemes, and argues that energy efficiency and energy savings need support schemes following similar logic and operational principles. While market-based instruments such as saving quotas coupled with tradable certificates are being successfully introduced for energy efficiency, following their earlier adoption for RES, the introduction of an equivalent FIT for energy savings in electricity does not exist yet and, to the knowledge of the authors, has never been discussed either at theoretical or practical level.

The paper discusses the main theoretical and practical issues involved in establishing a FIT for energy savings, and in particular the measurement of energy savings. The paper places the discussion in the broader context of rewarding energy efficiency only or rewarding genuine energy savings, and strongly advocates for giving incentives to energy savings rather than strictly energy efficiency. The paper also discusses the many additional complexities associated with measuring and rewarding genuine additional energy savings compared to RES-E.

Support schemes for the promotion of electricity from renewable energy sources

Since early 1990s policy makers have recognised the need of introducing financial incentives or equivalent schemes to foster the uptake of renewable electricity generation. Financial incentives were introduced not only to persuade investors to invests in new renewable electricity (RES-E) generation capacity, but also to promote the necessary research and development (R&D) efforts, mainly by equipment manufacturers. Technology innovation and the economies of scale associated with a larger equipment production have lead to improvement of current technologies and brought down production costs. In the EU, all Member States have some type of the RES-E support scheme. The importance of support schemes is also recognised by the Directive 2001/77/EC, which establishes non-mandatory national targets for the portion of electricity consumption to be met by RES by 2010. To achieve these targets, the Directive foresees continuation of national support schemes plus, if necessary, the creation of harmonized market-based support system compatible with the rules of the internal EU electricity

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[1] For instance replacing a 100 liter class C refrigerator with a 100 liter class A+ refrigerator at the same conditions of external temperature or door opening.

[2] For instance using the same clothes washer or a dishwasher at full loads twice as rarely as before.

market. The European Commission is monitoring the progress of individual Member States toward their national objective (European Commission, 2004) and will, if necessary, propose mandatory targets for Member States that do not reach their goals. If all targets are met, renewable sources will cover 22 % of the supply to gross inland electricity consumption by 2010 (the latest RES-E survey predicts a slight under-compliance with the RES-E reaching a share of 19 % in 2010). The Directive also requires a guarantee of the origin for green electricity; guarantee certificates must be reciprocally recognized by all EU Member States. The guaranteed origin of green electricity could be included in mandatory labelling of electricity, which would disclose to the final user the generation mix for electricity supplied.

The major support schemes for RES-E are broadly classified into four groups: feed-in tariffs, green certificates, tendering systems and tax incentives. These are briefly described below.

FEED-IN TARIFFS

Renewable energy feed-in tariffs (FITs), also known as advanced renewable tariffs or standard offer contracts, are used by many countries that successfully support green power. These systems are characterised by a specific price, normally set for several years, which must be paid by electricity companies, usually distributors or suppliers, to producers of RES-E. FITs allow for green power generators to sell power to the grid operator at premium fees set by government for a specified period of time. The fees are usually set at different rates for different technologies (or even differentiated by location, as is the case for wind energy in Germany). For example, Germany has different feed-in tariffs for hydropower, wind, solar, geothermal and biomass projects. The rationale for differentiating by source is that since RES have different rates of return, a generous uniform FIT may generate windfall profits for lower-cost producers and thus involve higher cost to the taxpayers. Conversely, higher cost but still desirable sources of energy may be shut out of the market if a relatively low FIT is applied uniformly (Menanteau, *et al.* 2002). If it becomes apparent that one technology is not being developed at a rate necessary to meet targets, the fees can be adjusted. Usually FITs are decreasing over time as technology development brings down the production cost. The grid operators are legally required to give priority connections to plants generating electricity from low-impact renewable energy sources. The FIT approach can be used to support the development of a well-balanced green power portfolio. If it includes long-term commitments with fair pricing, this approach can provide a stable investment environment and lead to the establishment of local green power manufacturing facilities. It can also result in a diverse ownership structure for green power involving farmers and municipalities, which leads to more rural and economic development. The first successful FIT was introduced in Germany in 1990. Feed-in tariffs exist in most of the Member States of the EU: Germany, Denmark, Spain[3], Finland, France and Portugal, Austria, Greece, Luxemburg, and the Netherlands (from July 2003), Italy (since 2005), Czech Republic, Hungary, Estonia, Slovenia and Latvia.

The additional costs of FIT schemes are paid by suppliers in proportion to their sales volume and are passed through to the power consumers by way of a premium on the kWh end-user price (also known as a wire charge or a public benefit charge). These schemes have the advantages of investment security, the possibility of fine-tuning and the promotion of mid- and long-term technologies. On the other hand, they are difficult to harmonise at EU level (Ringel, 2005), may be challenged under internal market principles[4] and involve a risk of over funding, if the learning-curve for each RES-E technology is not built in as a form of regression over time. A variant of the feed-in tariff scheme is the fixed-premium mechanism currently implemented in Denmark and partially in Spain and the Czech Republic. Under this system, the government sets a fixed premium or an environmental bonus, paid above the normal or spot electricity price to RES-E generators.

RENEWABLE PORTFOLIO STANDARD (RPS) AND TRADABLE GREEN CERTIFICATES

Another successful approach is to allow grid operators to use their own means to meet legal green electricity quotas or a Renewable Portfolio Standard (RPS). The state of Texas in the U.S. has become a leader in using the RPS approach. At the end of 2005, Texas had an installed wind generation capacity of 1,995 MW. As of 2006, a total of 21 U.S. states have RPS regulations. Several members of the European Union have RPS or Renewable Obligations coupled with tradable green certificates including the United Kingdom, Italy, Belgium (Flanders), Sweden, Poland, Romania and Bulgaria (under preparation).

An RPS sets a set of green electricity quantitative targets and places responsibility for meeting those goals on the electricity producers or suppliers (retailers), with significant penalties for non-compliance. An RPS is often supported by a tradable renewable energy certificate (also known as tradable green certificate, TGC). RES-E generators receive green certificates for the amount of electricity they generate. Generators with legal commitments can invest in own RES production, purchase green power or purchase only the certificate from third parties if it is cheaper to do so. Because of the focus on low-cost green electricity, the TGC approach has been most successful in stimulating wind power development. To support other green electricity resources, an RPS can assign distinct targets for each green power source.

Under a TGC system RES-E is sold at conventional power-market prices. In order to finance the additional cost of producing green electricity, and to ensure that the desired green electricity is generated, all suppliers (or in some countries producers or consumers) are obliged to purchase a certain number of green certificates from RES-E producers according to a fixed percentage, or quota, of their total electricity consumption/production. Penalty payments for non-compliance

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[3] As Lauber (2004) notes, in 2001 Germany, Denmark and Spain referred to as the three classic FIT countries accounted for 84 % of the installed wind capacity in EU-15. Germany is also leading in PV installations.

[4] To avoid competitive distortions and to be in line with market liberalization (at least at national level), the compensation scheme needs to distribute financial burdens equally between operators: for instance in the case of Germany where the northern and coastal TSO has to feed in a large share of wind power whereas southern TSO have little RES-E generation, the compensation centres on an annually recalculated national average of renewable energy infeeds. Since the year 2000 a national feed-in law determines that operators whose feed-ins fall below this average have to buy 'green' electricity from those TSO above this average at the fixed prices (Ringel 2005).

are transferred either to a renewable research, development and demonstration (RD&D) fund or to the general government budget. Since producers/consumers wish to buy green certificates as cheaply as possible, a secondary market of certificates independent from the physical flow of electricity develops where RES-E producers compete with on another to sell green certificates. Therefore, green certificates are market-based instruments, which have the theoretical potential, if functioning well, of ensuring best value for investment (Bertoldi, 2003). These systems could work well in a single European market (Ringel, 2005) and have in theory a lower risk of over-funding. However, green certificates may pose a higher risk for investors and long-term, currently high cost technologies are not easily developed under such schemes (Ringel, 2005). These systems may also present higher administrative costs.

TENDERING

Pure tendering procedures existed in two Member States (Ireland and France). However, France has recently changed its system to a feed-in tariff combined with tendering system in some cases; in 2005 Ireland announced in 2005 a similar move. Under a tendering procedure, the state places a series of tenders for the supply of a given amount of RES-E, which is then supplied on a contractual basis at the price resulting from the tender. The additional costs generated by the purchase of RES-E are passed on to the end-consumers of electricity through a specific levy. While tendering systems theoretically make optimum use of market forces, they have a stop-and-go nature not conductive to stable conditions. This type of scheme also involves the risk that too low bids may result in projects not being implemented.

FINANCIAL OR TAX INCENTIVES

Several countries in the EU, as well as Canada and the United States, provide tax incentives for wind generated green electricity. Green electricity generating equipment and systems often qualify for accelerated depreciation under tax laws making investment in green electricity more financially attractive. In the EU systems based only on tax incentives are applied in Malta and Finland. In most cases (e.g. Cyprus, UK and the Czech Republic in the EU), however, this instrument is used as an additional policy tool.

The above categorisation into four groups of policy tools is a fairly simplified presentation of the situation. There are several systems that have mixed elements, especially in combination with tax incentives. In some Member States more than one support scheme has been introduced to get the maximum benefits. For example in Italy there are tradable green certificates for power producers (mainly wind, biomass and small hydro) and a feed-in tariff for the support of PV.

Prices versus quantities: summary of the classical debate in RES support

The FIT and the renewable quota/TGC systems represent the classical debate known as "prices versus quantities", or price-driven versus capacity-driven approaches. The former, *i.e.* FIT, indicate the exact price, or cost of compliance, without giving any clear indication as to the exact quantity to be produced at this price. Conversely, the quantity model (RPS) stipulates in advance the exact outcome to be achieved, without giving indications on the cost of compliance, except that marginal cost of compliance is normally equalized across sources (Menanteau *et al.* (2002)[5].

There are pros and cons for both of these instruments. An RPS aims to develop a set percentage of RES-E at least cost, and does not provide any incentives to develop renewable energies exceeding the quota. Prioritisation of cost minimization (static economic efficiency) has a number of impacts. It may lead to restricted geographical distribution, limited technological development and technological variety, reliance on foreign equipment producers and low or no R&D investments on the part of equipment producers (Lauber 2004). On the other hand if quotas are set for a long-term period and are independent from governmental policy, then a stable planning horizon is set and risk is minimized for producers. These factors also make investments more attractive for financing institutions. In addition, since there is no bottom price, generators are likely to exercise pressure on equipment producers for lower prices and on developers for best available locations (Lauber 2004).

In contrast, FITs encourage technological development (dynamic efficiency) and if properly designed ensure security for producers for the long term. However, FITs allow producers to keep the surplus created by technical development and generate excessive profits, unless there is a way to adjust the tariff accordingly (Lauber 2004, Menanteau, *et al.* 2002). A stepped FIT approach may allow for decreasing the tariffs over time according to the expected learning curve and economies of scale. Another way to avoid windfall profits is by differentiating FIT according to technology performance indicators and according to whether they are given to existing, possibly fully depreciated, or new capacity (Haas *et al.* 2002). However, such precise design involves significant information requirements, that is, the marginal generation costs of each generator.

There are views that due to the above detailed advantages and shortcomings, a preferable set-up kick-starts the market with a feed-in system, and introduces the quota-driven approach only when markets and technologies are more mature. While a comparison of the track record of these two instruments is an interesting issue, due to space limitations this is outside the scope of this paper. However, a point to be made here is that often the preference to one of the schemes is related to ideological beliefs, e.g. neo-liberal approach to RES promotion forms the basis of RPS [6].

In order to compare instruments, economic theory usually draws on the criteria of ecological effectiveness (in this case the key question 'is a certain pre-defined share of renewable energy reached at a given point in time?') and economic efficiency (the

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5. The New Jersey RPS that was adopted in March 2004 may be considered an exception to this: it provides for separate targets for different technologies with different buyout prices.

6. This has been the case e.g. in Great Britain, where the economic efficiency resulting from market instruments is believed to be more important than rapid action to mitigate climate change. A discussion about the overarching operative challenges that each of the two instruments may face is outside the scope of this paper. However, a useful comparison involves looking at the time horizon needed for creating a stable RPS: RPS is considered to work well in Texas because RES-E generators receive long-term contracts under the legislation. In Britain they do not, and it is the distributors that draw most of the benefit from the Renewable Obligation (RO) rather than the generators, who function in an environment of great insecurity. We are greatly indebted for these remarks to Volkmar Lauber from the University of Salzburg.

question: 'is this target reached at least cost?'). Turning to empirical evidence, however, the picture is more complex. There has been much greater development of wind power (in comparison to the EU-15 average during the last years in countries using FITs (Germany, Denmark, Spain) than in countries using quota models (the Netherlands) (Ringel 2005).

Support Schemes for Energy Efficiency: beyond the subsidy tradition

Traditionally polices used to promote energy efficiency have differed in logic from the ones described above aiming at RES-E promotion. The most common and effective policies to promote EE include standards and labels (including building codes and certification), financial incentives traditionally in the form of investment subsidies, information and training, energy audits and energy management systems. Some of these are mandatory, other are voluntary. In particular standards and building codes are introduced to eliminate the worst equipment from the market, while incentive is given to expand the market share of the most efficient equipment (examples are past incentives for A class appliances or CFL lamps). Demand side management policies and incentives have been used in a more limited manner in Europe, compared to the US. Most of policy instruments target EE and not ES. More recently the attention of policy makers has been drawn by the possibility to use market-based instruments to promote EE. In the section below some energy efficiency support schemes, which are also present in RES-E or whose operational logic is similar to the RES-E policy support toolkit are briefly described. Experiences from both Europe and the US are described. Since this paper is intended to open a broader discussion on quantity-based mechanisms for the support of EE and ES, it is outside its scope to provide an in-depth evaluation of these policies and mechanisms).

DEMAND-SIDE UTILITY PROGRAMS, INTEGRATED RESOURCE PLANNING

Following the first oil crisis in the 1970s, in the US federal regulators and state public service commissions began implementing utility policies that led to the creation of utility DSM programs (Gillingham 2004). The first utility programs in the 1970s were often information and loan programs, designed to educate consumers and businesses about the cost-effectiveness of energy efficiency measures and to provide low-cost subsidized financing for investments in those measures (soft loans) (Gillingham 2004). Utilities gradually learned that education alone produced limited energy savings. In addition, most consumers were not interested in subsidized loans (Stern et al. 1985). Thus utilities were led to consider programs that contained stronger financial incentives to convince consumers to make energy saving choices (Nadel and Geller 1996). The first financial incentive programs to be used extensively were rebate programs, with cash rebates given out by utilities to consumers who purchased designated energy efficient equipment. Rebate programs, as well as other financial incentive programs, received a considerable boost in the 1980s with the advent of integrated resource planning (IRP), also known as least-cost planning. IRP is a process in which utilities consider a broad range of supply and demand resource options to meet the future energy needs of their customers. The role of IRP has greatly diminished with energy sector restructuring and liberalisation, because the generation and supply of electricity are unbundled in separate companies. In Europe DSM programmes started in the late 1980s and continued through the 1990s in many countries including Germany, Denmark, Sweden, the Netherlands, and Spain (Vreuls 2004).

PUBLIC BENEFIT CHARGE

In the United States DSM spending dropped in the mid to late 1990s due to the effects of deregulation. The most common approach that regulators have taken to stem the decline has been to establish a public benefit fund (PBF) to fund DSM and other programmes (Gillingham 2004). PBFs are designed to fund energy efficiency programs, renewable energy programs, programs to assist low-income families to pay their energy bills, and a few other designated public benefit activities (Nadel and Kushler 2000). While PBFs can be designed in different ways, they are all typically funded by a per-kWh "wires charge" on the regulated electricity distribution system (Khawaja, Koss, and Hedman 2001). These wires charges are often referred to as "systems benefit charges" or "public benefit charges." The systems benefit charge rate is usually set based on historic spending for public benefit programs, such as utility DSM energy efficiency spending. The level of the charges is typically between 0.05 and 0.3 EUR cents/kWh (Nadel and Kushler 2000). A frequently cited advantage of systems benefit charges is that they are considered competitively neutral because they are added to all electricity generation (Khawaja, Koss, and Hedman 2001). In Europe PBFs have been introduced in the UK and Denmark. In the UK the three phases of the Energy Efficiency Standards of Performance (EESoP) scheme operated from April 1994 through to March 2002. Projects designed to achieve these targets were funded by a levy on customers of 1 GBP per year for the first two schemes and a nominal expenditure of 1.20 GBP per year for the third scheme. By 2000, when EESoP 3 was set, the energy supply market was fully competitive and hence there was no ability to set a levy. In Denmark the Electricity Saving Trust started in 1997, and in 1998 it started to be funded through a volume-based levy of 0.08 EUR cents/kWh, collected by distribution companies on households and public sector consumers. The total amount collected was around 12 million Euro per year. Private companies or electricity companies were invited to tender to design and implement projects (Lopes 2000).

DEMAND RESPONSE

Electricity load management programmes aim at limiting peak electricity loads, shift peak loads from peak to off-peak hours, or encourage consumers to change demand in response to changes in suppliers' cost of providing power. Electricity load management programmes serve the original intention of demand-side management to change the shape of the load curve for suppliers for better reliability and peak-load reduction to avoid new power plant construction or reinforcement of the distribution network. Some examples include direct load control programmes, interruptible load programmes, voluntary demand response programmes, real-time pricing tariffs, and demand bidding programmes (Gillingham 2004). The main types of demand response programmes are market-based/economic and reliability programs. The sub-categories under the market-based/economic umbrella include dynamic pricing/tariffs and price-responsive demand bidding. Sub-categories under the reliability umbrella include contractual curtailment, voluntary curtailment, and direct load control/cycling. In demand bidding it is the end-users who could offer to modify their normal energy consumption patters in exchange for a financial compensation, which may be a discount of supply price, or a compensation for the energy not used. The change in energy consumption pattern may be temporary (in this case is very similar to Demand Response) or more continuous nature, freeing up some consumption or power for specific periods (e.g. peak time during summer or winters). Demand bidding programmes allow consumers to specify their own reservation bid for a certain amount of load reduction. If the market-clearing price of electricity at a given time is at or above the reservation bid price, the consumer is required to reduce electricity demand by the specified amount in exchange for a payment for the reductions

DEMAND SIDE BIDDING (TENDERING)

Demand Side Bidding, which is based on a national or regional energy saving *target* and has a regulatory nature, is different from Demand bidding. The state or the regulatory authority calls for 'bids' from projects (among certain sectors or in general) that will deliver energy savings to reach the target (logic similar to the tendering system for RES). Demand Bidding and Demand Side Management could allow implementing more tailor-made measures and actions taking into account unwanted interactions with other energy policy instruments.

WHITE CERTIFICATE SCHEMES

A tradable certificate for energy savings (TCES) portfolio involves four key elements (Bertoldi and Rezessy 2006, Bertoldi, Rezessy and Voogt. 2005, Langniss and Praetorius 2003, Pavan 2002,2003): (a) defining an energy saving target and rules for its achievement (b) introducing a tradable instrument (certificate that embodies verified energy savings) and trading rules; (c) institutional infrastructure to support the scheme and the market (measurement and verification, evaluation methods and rules for issuing certificates, a data management and certificate tracking system and a registry); (d) cost recovery mechanism in some cases. Variations of this policy mix have been introduced in Italy, Great Britain, and in France. In the Flemish region of Belgium there are savings obligations imposed on electricity distributors without certificate trading option. The first scheme in the world with a white certificate trading element has been introduced in New South Wales (Australia); it is however a GHG trading system that has an end-use energy efficiency element.

In Italy energy savings targets are combined with tradable certificates for energy savings issued to distributors and energy service companies, as well as with a cost recovery mechanism via electricity and gas tariffs or dedicated funds in some circumstances. In Great Britain, following the EESoP program, the Energy Efficiency Commitment (EEC) runs in 3-year cycles from 2002 to 2011 requiring that all gas and electricity suppliers above a certain threshold of domestic customers deliver a certain quantity of 'fuel standardized energy benefits' by assisting customers to take energy-efficiency measures in their homes. In the French system obligations are set for energy suppliers above certain size delivering electricity, gas, domestic fuel (not for transport), cooling and heating for stationary applications; a threshold for the imposition of a savings target is also set and the obliged actors have received targets in proportion to their market sales in the residential and tertiary sectors.

TAXATION

While for promotion of RES taxation is used in the form of tax incentives or exemptions for RE technologies, for end-use energy efficiency one of the most discussed polices to reduce consumption has been the introduction of a tax on energy consumption in order to increase the energy/electricity prices and thus stimulate energy saving measures undertaken by the end-user. However in most end-use sectors energy demand is rather inelastic[7]: estimates show that the (short-term) elasticity of demand for electricity is 0.1-0.4; for natural gas elasticity of demand is higher at around 0.2-0.6 due to availability of substitutes in some applications: both these values are below 1, which means that demand is inelastic towards price increases and therefore there will be a small demand response to a price increase (Varró 2004). Low price elasticity of demand, coupled with the lack of information on ways and possibilities to reduce energy consumption, can seriously undermine the effect of energy taxes. In addition, energy taxes are not generally popular with consumers/voters, which tend to demand lower prices (this was also a driver for the market liberalisation in the EU). The following example can be given illustrating the likely impact of an energy tax: when the oil price was in the range of 10 USD to 20 USD (e.g. 1997-1998), it was claimed that an energy tax doubling the oil price would achieve most of the technical saving potential. However nowadays with the oil price in the range between 50 USD to 70 USD, still efficiency and savings are not to be implemented as the economic theory would expect (the effect of the well know barriers).

A step into the unknown: feed-in tariff for energy saving

Rather than trying to 'punish' consumption (and inefficiency) with an energy tax and get through the complexities of trying to define an optimum level of taxation, public money (or money raised through a small wire charge - see later discussion) can be used to 'reward' and give incentives to energy saved, as a result of technology implementation, or as a result of change in behaviour. This can be seen as a core feature of a possible FIT for energy savings. Among the many advantages, incentives for genuine energy savings achieved would help to recognise and highlight energy savings as a *virtual source of energy* available in our society due to the many losses and poor efficiency in energy consuming equipment industrial production plants and buildings (a.k.a the end-use sectors). Energy savings are a virtual source of energy and in fact among the cheapest ones, at least for a number of end-uses[8]. As operational incentives are intro-

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[7] Price elasticity of demand /supply refers to the percentage change generated by 1 % price change. Elasticity depends on the existence of close substitutes (for electricity, none), on the sensitivity of demand to income (for electricity, moderate) and on the share in the total expenditure (for electricity, moderate).

[8] Many energy saving measures can be implemented at low or no cost: a review of 8 studies assessing the costs of CO2 mitigation in the domestic buildings and

duced in all Member States for RES-E, and many of them use feed-in tariff as a very effective way to support RES-E, it would make sense to investigate whether operational incentives for the virtual energy source 'energy saving' - in the form of a kind of FIT - could be introduced and how this would work.

As described in this section, the main challenge is how to design the right incentive for saved energy, and in particular on the electricity consumption how to create an 'automatic' FIT based on a unit of energy saved, similar to the FIT for RES-E. It is also important to note that in some demand response schemes particular incentives are used to trigger temporary power demand reduction, rather than rely only on the impact of higher electricity prices. The incentive provided to demand response participants to make them shed power usage could be comparable to an incentives for energy saving. Demand response hedges participants from very high peak prices. In the same manner an end-user saving energy would benefit from the avoided energy cost due to the saved energy and the possible additional financial incentive. As in demand response programmes *additional* incentives for power saving are still needed and offered, because of the additional societal economic benefits of demand response (improved reliability of the electricity network, postponement of the grid reinforcement, avoidance of black outs, avoidance of investments in reserve power). Accordingly the same reasoning and principle could be established for saved energy, because also saved energy offers many societal economic benefits (climate change mitigations, local employment, postponement of investments in power generation, etc.).

FEED-IN TARIFF FOR ENERGY SAVING: THINKING OF THE DESIGN

The analogy with the demand response incentives stops here, as instantaneous power can be measured at any time. In operational terms a feed-in for energy saving resembles demand-side bidding, whereby an authority calls for 'bids' from energy saving projects (among certain sectors or in general) that will deliver energy savings to reach a national or regional energy saving target. The differences come from that fact that a feed-in is not necessarily linked to a quantified energy saving target (though, depending on the preferences of the policy maker, it might be) and also because a feed-in would establish a pre-defined amount of money to be attributed to each unit of energy saved (even if differentiated by technology), rather than rely on a tendering process. In this respect a feed-in for energy savings can be considered a **performance-based subsidy**, whereby projects are awarded based on their performance (savings delivered, possibly differentiated by technology). In addition a feed-in will always be based on an ex-post assessment of the savings, as explained below.

The authors would like to limit the initial discussion to the case of electricity savings for a possible FIT for energy savings.

To keep a close analogy with the RES-E FIT, the energy savings FIT should be based on **measured and metered values (ex-post and based on meter reading)** with or without adjustment for climatic and other 'external' conditions (see later). A practical way forward proposed by the authors would be to have only a number of well understood eligible technologies or saving options in an energy saving FIT scheme (e.g. lighting, appliances, etc.), at least in the initial phase. When a party indicates its intention to take part in the FIT scheme, he/she will present a project for energy savings describing the technologies or behaviour changes that will be implemented and the other conditions affecting the saving (some can be only established ex-post, such as temperature patterns). Thus only these technologies or behavioural changes will be **monitored and rewarded with a FIT expressed in Euro/unit energy saved** (if necessary corrected for external conditions or differentiated by technology). In most cases it will be necessary to have a metering period before and after the implementation to monitor the savings (possibly of the same time length). Sub-metering and data acquisition technologies are now available to meter individual equipment or systems at reasonable cost. In this practical option also **differentiated saving feed-in tariff** (e.g. low for CFLs, high for building insulation) can be established, and also savings can be awarded for different duration to reflect the different lifespan of various projects.

However the authors would emphasise the fact that even when energy saving are evaluated against a reference situation - which could be consumption of the house, building or plant for the previous period, (e.g. the previous year or averaged over the three previous years) - there are a number of situations where energy or electricity consumption is decreased because of an external change that distorts the comparison of the post-retrofit situation with the reference scenario. An example could be children leaving their parent house, or all occupants getting a job outside the house and thus leaving the house empty for long time (or the opposite situation where someone starts working from home, using electricity and heat all day). A key question the authors would like to raise is whether it is correct to award this type of 'unintended' energy savings and penalise other situation (e.g. house occupied for longer periods).

One of the main problems (and in the author views the most crucial) with the design of a feed-in tariff for energy savings is how *to measure energy savings* and how to attribute energy saving to different factors. In contrast renewable electricity generation does not face the problem of evaluation: additional kWh generated are metered, and no adjustment is needed for climatic condition (e.g. wind or solar radiation), which could also have a big impact on the energy produced. The following elements can all be part of an energy saving action, or in some cases can constitute an energy saving action or bring an unintended saving effect of their own:

- technology improvements (usually defined as energy efficiency),
- behavioural changes (reducing overheating or overcooling, switching of the lights, using dishwashers or clothes washers at full loads), or
- external factors (warm weather, changes in production output).

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the whole buildings stock worldwide attests that for most countries a large amount of potential can be tapped at negative cost i.e. with a net benefit for the society (Novikova and Ürge-Vorsatz 2006). From 18 % to 89 % of the CO2 emissions in the residential buildings of developing countries and economies in transition studied, and from 11 % to 25 % of those in developed countries, can be captured at negative cost (Novikova and Ürge-Vorsatz 2006).In addition the least polluting kWh is the one not consumed.

Most of the energy efficiency policies and incentives (for example incentives for CFLs, appliances, motors, building insulation, etc.) are based on the implementation of technologies and/or techniques that improve systems' efficiency. On the basis of assumption about the likely conditions (or keeping the same condition as before the efficiency implementation) the resulting energy savings are calculated. Monitoring and Verification (M&V) protocols are based on the assessment of the energy saving due to the technology or technique implementation. To this end, normally a Business as Usual (BaU) scenario is established, and savings are evaluated against the BaU scenario. Savings are evaluated either *ex-ante* by substituting an existing technology with a more efficient one and keeping all the other system conditions the same (size, usage, external conditions such as weather, etc.); ex ante estimates are based on a lump saving value attributed to different types of measures can be made where energy saving actions are well-understood and replicable. Savings can be also evaluated *ex-post*, by doing some metering or energy analysis and again adjusting the results in order to compare consumption at the same system conditions. As examples of the ex-ante saving evaluations are the savings calculations for CFLs or white goods in the white certificates schemes in Italy, France and in the Energy Efficiency Commitment in Great Britain. The major problems with ex-ante evaluation are the threat of partial realisation of savings and poor additionality. For instance, an ex-ante assessment may fail to assess real energy savings, as one consumer may replace an existing appliance with a larger one (even though more efficient appliance) thus the result could be a higher energy consumption despite the higher efficiency of the new appliance vis-à-vis the replaced one . Another example is when a subsidised or free given-away CFLs never get installed, resulting in reality in zero energy saving. Some ex-ante evaluation methods are adjusted ex-post to reflect such situations, always estimated on the base of statistical samples. Another important issue well discussed in literature is the *rebound effect* (see, for instance, Lebot et al 2004), where the economic benefits resulting in more energy efficiency are triggering additional energy consumption (as example are CFLs burning for more hours as people perceive these cost little, driving more kilometres with more efficient cars, as it cost the same as the lower mileage with the less efficient car, heating or cooling to higher/lower temperatures). However a specific case that should be excluded from the rebound effect discussion is whereby an efficiency improvement does not result in energy savings because savings are offset by improved comfort to meet quality levels – for example in some countries it is difficult to construct baselines in public institutions because prior to the project rooms have been underheated or under-lighted.

Furthermore, behavioural changes are rarely eligible for direct financial support. Example of behavioural savings are: the user deciding to switch off equipment, decrease/increase the set temperature point (heating/cooling) or decrease the size of equipment (e.g. refrigerator or car), and finally dispose of some equipment (e.g. the car when switching to public transport for daily commuting). Energy savings also depend on structural or temporal changes imposed on the participants by other circumstances beyond their control or having higher priority for them. Contraction in business (for example an empty hotel or production line moved to another site) or smaller production output (due to less demand for the product) will results in energy savings, while companies that are in business expansion (more demand for the final product) will face a higher consumption. In particular many schemes and M&V methods adjust ex-post the energy savings for climatic condition, e.g. a very hot summer or a cold winter, building occupancy, production levels, etc (Bertoldi 2003, IPMVP).

It is also important to highlight that in measuring energy efficiency there has been "traditionally" the practice to adjust the actual consumption to 'normalise' the conditions (e.g. for heating it is common to use the same degree days in calculating energy saving), and this point has not been challenged very much in energy policy evaluations or literature. However since energy savings are considered as an instrument in climate policy, it is worth noting that in emission trading schemes, the emission cap refers to absolute emission reductions no matter in which conditions emission reduction or increase are achieved. Even in the case of an advanced and well-thought allowances allocation methods (e.g. a method based on benchmarking and on effective available techniques for emission reductions), it may happen that a large district heating plant under a cap-and-trade regime (the EU ETS for instance), gets its allowance allocation for future emissions with a benchmarking scheme and these represent a CO_2 emission reduction vis-à-vis the BaU scenario. However, if the country where this specific plant is located experiences three or four very warm winters and thus there is a reduced need for heat and therefore less heat generation, this plant will emit less CO_2 and thus achieve its target with less or no effort. In other words, this heat generation plant may achieve its CO_2 emission target without any action (the opposite may also happen, and in this case the plant has to do additional efforts). At present no ex-post adjustment are allowed in the ETS! One should also keep in mind that the EU ETS is a cap-and-trade system and not a financial support tool as a feed-in tariff. On this point the authors do not have a definitive position, and they want to start a discussion about it.

Two major conclusions can be derived from the discussion above. First, the measurement of the energy saving is one of the most critical issue in a possible FIT for saved energy. Second, in the case energy saving FIT would be tested it will be wise to limit it to electricity savings, and perhaps in the initial phase to some well analysed and simple equipment/systems. An energy saving FIT could in principle be established not only for electricity savings but also for gas or other heating fuels. However these are not discussed in the present paper.

Possible Integration of Energy Saving with the RES-E Feed-in Scheme

The present section discusses another important issue: the possible integration of the saved energy FIT with the already existing RES-E FIT, which may also offer a practical solution to introduce a support for energy savings. As already indicated the FIT scheme is a very successful model for RES-E support adopted in many Member States and OECD countries. Usually a FIT scheme covers the whole RES-E production at a specific site (e.g. PV, installed in a house), which is metered and rewarded. It may happen that some end-users install some relatively expensive PV panels (compared to energy saving costs resulting from energy efficiency technologies) and in order to get the 'attractive' FIT price premium feed the whole production of the PV into the grid (with a meter dedicated to measure the RES-E electricity produced), while at the same time continuing to purchase electricity from their suppliers to supply their homes. In these homes cheaper options (in Euro/kWh) to save energy may exist than the cost of generating electricity in the PV installation, such as reduction in standby losses, efficient lighting through CFLs, efficient appliances, etc.

A possible way to foster energy savings in systems and buildings which install a PV system, is to **reward with a 'combined' FIT only the net metering**, i.e. electricity minus own electricity consumption over a certain period (example over a full year). If this would not be possible due to a much higher electricity consumption (even after the efficiency measures) than the feasible electricity generation from the PV system, the household could be requested to achieve electricity savings at least equal to the RES-E production (unless that the end-user proves that the feasible options to save energy where already implemented before the installation of the PV system). In this case **an existing RES-E feed-in tariff would also cover energy saving**, and with the same amount of support for the achieved RES-E generation and an equivalent energy savings. An interesting option would be to **increase** (e.g. double) the feed-in tariff to reward also the additional energy saving, but still reward the RES-E production *only if* equivalent savings are implemented.

Final remarks

There is no clear reason why incentive mechanisms commonly accepted and implemented for the support of RES-E are not applied or even considered for the support of energy savings, whereby financial support is normally linked to investment and is thus disconnected from savings achieved. In addition, as described in the paper, policy tools have traditionally been used to support efficiency rather than savings (energy efficiency not always results in energy savings). A common financial incentive to support energy efficiency is the investment subsidy (e.g. a rebate on the purchase of new efficient equipment). More recently white certificates finally establish a connection between the quantity of savings realised and the additional cash-flow to a project. White certificates at the moment are based on efficiency improvement (or saving over a hypothetical baseline) and do not discriminate between technologies (among the eligible sectors). In addition, white certificates in a similar manner to green certificates are rewarding the cheapest projects (in term of implementation and transaction costs and energy saved per Euro spent), and thus more long term and expensive saving project may not be implemented with a white certificate scheme.

Taking as a point of departure price and quantity based support instruments for RES-E (feed-in tariff and RPS and TGC, respectively), the authors have discussed the possibility of implementing a FIT for energy savings, in particular for the electricity sector. However a simple transposition of the traditional RES-E FIT to energy saving cannot be done, due to the complexity of evaluation of the saving. From a theoretical point of view a feed-in tariff presents many advantages, however its practical implementation with regard to energy saving opens a set of design issues and difficulties (in particular regarding the correct assessment and measurement of the energy savings), which may results in somewhat high transaction costs. However other instruments used for the support of energy efficiency also have their administrative and transaction costs; there has been no comprehensive comparative study of the transaction costs of different policy tools to date.

The paper has presented various conceptual issues involved in the measurement of energy saving, i.e. what constitute a savings action (e.g. compared to what) and when to reward savings (technology, behaviour, external conditions). It is also highlighted as for RES-E and EU ETS external factors such as weather patterns due not results in ex-post adjustments.

According to the authors, a FIT could be an interesting support scheme for energy savings. It may have several benefits: it could offer long-term support (e.g. up to 20 or more years for energy saving measures with long payback periods, such as building insulation) and certainty on the market for energy efficiency technologies. In contrast current financial incentives for efficient equipment mostly tend to have a very short lifespan, often linked to annual budgets[9], and often suffer from lack of policy continuity. Other advantages of a FIT for energy savings include the possibility to tailor it to reflect the technical and economic saving potentials available in the various end-use sectors and technologies (e.g. incentives higher for project associated with longer PBP or with high social value) and the possibility to gradually phase it out or even pre-define its duration by type of measure. A FIT would establish a strong correlation between the amount of support granted and the result of the action (savings), departing from the current inefficient logic of investment-based subsidies and establishing a performance-based scheme. A FIT seems a very good approach to ensure that energy efficiency measures *really take place* and produce genuine additional savings (too often the rebound effect eats up a large part of the saving) and that the implemented measure stay in place for a reasonable number of years.

A possible FIT for energy savings could be both technology oriented, and could also include behavioural changes (which is the weak point of other policy instruments such as White Certificates). The authors argue in favour of rewarding savings resulting both from energy efficiency improvement against a hypothetical baseline to keep the same service or conditions (or increasing to acceptable levels if the starting conditions are below comfort levels), and also in favour of rewarding voluntary behavioural changes resulting in saving related to a documented reduction of the service level (e.g. lower house temperature, less kilometres travelled).

In the authors' views a FIT supporting only electricity savings may be an initial step, and could be introduced as part of the feed-in tariff for RES-E, and with the same amount of financial incentive reward both RES-E and energy savings. Alternatively the RES-E feed-in tariff could be increased to give additional benefit to the end-user when implementing energy saving measures (under the condition that the saving equal the RES-E).

The present paper is intended to raise the issue and start a discussion among energy saving policy makers and analysts.

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[9] There are notable exceptions, such as white certificate schemes, if established for a multi-annual period.

The authors believe that it is worth investigating the energy savings FIT further, as it could offer some interesting benefits, such as providing a performance-based support. The paper is intended to raise questions and open a wider debate rather than to offer definitive answers. To this end the authors recommend to complement the theoretical discussions with a pilot project to explore the possible energy saving FIT different implementation options (including the integration with the RES-E FIT), and well as more research and discussion on support mechanism for true energy savings, beside the well known efficiency support schemes.

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