Rewarding Energy Savings Rather than Energy Efficiency

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ABSTRACT

Financial incentives are important for overcoming certain market barriers to improved energy efficiency and for the adoption of energy efficient technologies. Such incentives are mainly focused on the introduction of specific technologies, rather than behavioral change. While the declared goal of financial support schemes is to save energy or reduce harmful emissions rather than to foster new technologies *per se*, it is very often encountered that such financial support for energy efficient technologies may not ensure real energy savings due to the rebound effect and remaining barriers.

In the area of renewable energies it is common for financial support to be given to power producers for the verified production of renewable electricity, in the form of a guaranteed financial incentive (feed-in tariff). In the energy efficiency policy research little attention has been paid to the possible use of a "feed-in tariff" (FIT), in the form of a financial incentive based on the kWh saved by the end-user. This paper discusses the possible setup of a FIT designed to reward real energy savings (ES FIT).

The paper first explores the rationale behind and the possible functionality of an ES FIT, giving examples of similar policy tools implemented or planned. The paper looks into additionality and persistency of energy savings thus supported. Finally, key advantages and complexities related to a FIT scheme for energy savings are discussed, intending to open a discussion and foster further research on the topic.

Introduction

Reducing energy demand is the cheapest and fastest approach to climate change mitigation. Reduction in energy demand can be achieved by improving the energy efficiency of the service provided (technological aspect) and/or by changing the consumption pattern without necessarily making technological improvements (behavioral aspect, for instance avoiding overheating/overcooling or reducing driving). Energy savings (ES) preserve scarce natural resources. Energy efficiency (EE) describes how much useful work, activity or service can be generated for each unit of energy consumed. EE is an important component to achieve energy savings, as it allows having the same services and goods with reduced energy consumption. However improved energy efficiency - i.e. replacing an installed technology with a more energy efficient one - does not *per se* assure energy savings, and there are numerous examples where introducing a more efficient technology is associated with an increase of the actual consumption, due to the rebound effect: examples are the increase in consumption due to replacing old inefficient appliances with more efficient, though larger (e.g. larger TV or washing machines), or appliances and equipment that may be used more frequently. 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 in most cases results 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 organizations are also valid for society as a whole at local, regional, national or global level. EE and ES are recognized as key areas of action, and certainly the quickest and the cheapest (McKinsey 2009) way, to start reversing the current rate of growth of harmful emissions and reduce energy dependency. Energy savings are a virtual source of energy and in fact among the cheapest ones, at least for a number of end-uses[3].

A number of barriers hinder the uptake of energy efficiency improvements (see for instance, Golove 1996). To overcome these barriers, governments have introduced policies and programs over the last 30 years, with many different forms ranging from labels and standards, building codes, through information campaigns, voluntary agreements, to taxation, investment subsidies, suppliers' obligations and financial incentives. Financial incentives are among the most common policies for promoting energy efficiency, often preferred by policy practitioners for their visibility and perceived effectiveness. Financial incentives can take the form of rebates on most efficient equipment (purchase price reduction, upfront investment subsidies), free give away, tax incentives, etc. More recently tradable energy savings certificates (so called ‘white certificates’), based on suppliers' obligation to save energy, establish a connection between the quantity of savings realized and the additional cash-flow to a project, resulting in financial incentives for the end-user (for details on white certificate schemes see, for example, Bertoldi and Rezessy 2006, 2008 and Bertoldi et al. 2010).

In a similar context – the promotion of renewable energy sources (RES) to supplement and gradually replace fossil fuel in power generation, heat supply and transport – policies have focused on creating financial incentives both for *the investment uptake* and for the *operation* of RES installations. In the RES context financial incentives can be given to project developers for the upfront investment and/or for the operation of the plant over a certain period of time, i.e. in the form of feed-in tariffs. In the case of RES support, the discussion among policymakers and policy analysts has been mainly focused on the types and size of incentives that are most effective and cost-effective in stimulating the uptake of RES, rather than on the need or justification for incentives for the installation of RES systems and their operation.

In contrast, in the case of energy-efficiency, financial incentives have been adopted only for the support of upfront investment, but not for the real and sustainable genuine energy savings over (part of) the lifetime of energy efficient equipment. Incentive mechanisms commonly accepted and implemented for the support of renewable electricity in the form of a FIT (or tradable green certificates) are based on metered electricity production. Energy savings - i.e. avoided consumption - cannot be metered. Energy savings are the difference between the real metered consumption and a "what would have happened situation" counterfactual situation,

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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.

[3] Many energy saving measures can be implemented at low or no cost: a review of 64 studies assessing the costs of CO_2 mitigation in the domestic buildings and 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 (Urge-Vorsatz and Novikova 2006). From 18% to 89% of the CO_2 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 (Urge-Vorsatz and Novikova 2006).

which needs to be established (Blumstein 2009). This is one of the main reasons why a FIT for energy savings has not been applied or even considered for the support of energy savings, whereby investment support is somehow disconnected from savings achieved[4].

The goal of this paper is to analyze the implications of the introduction of a FIT as a policy tool for promoting energy savings in the end use sectors (beyond the consumer meter). The structure of the paper is as follows. In the next section, it discusses the concept (based on a general description of Bertoldi and Rezessy 2007) and potential functionality of an ES FIT, bringing examples with similar schemes already in place or planned. It places the discussion in the broader context of rewarding energy efficiency only or rewarding genuine and verified energy savings, including a discussion on the complexity and challenges of establishing the counter-factual situation, which is generally easier for energy efficiency (a ratio) than for energy consumption (an absolute amount)[5]. Next, the paper explores the case for supporting energy savings in the framework of the classical debate of prices versus quantities. Finally, it raises some issues related to the additionality and persistency, as well as the equity and the transaction costs of energy savings.

Feed-In Tariff for Energy Saving: Thinking of the Design

Standards and labels (including building codes and certification), financial incentives traditionally in the form of investment subsidies (grants), information and training, energy audits and energy management systems, and more recently suppliers' obligations are among the most common tools to promote EE. Standards and building codes are introduced to remove the worst equipment from the market, while financial incentives can expand the market share of the most efficient equipment. More recently, the attention of policymakers has been drawn by the possibility to use market-based instruments to promote EE, most notably energy supplier obligations and white certificates, whereby suppliers are obliged to meet savings targets and allowed to trade with certified energy savings in the derived market.

ES FIT: The Concept and Beneficiaries

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, and/or as a result of <u>sustained</u> change in behavior. This can be seen as a core feature of a possible ES FIT. Unlike investment *grants*, which are rewarding consumers based on the size of their investment, a FIT rewards end-users based on the *operational performance of their investment* in terms of energy savings[6].

An end-user acting to conserve energy benefits from the monetary savings from avoided energy consumption. With an ES FIT – as in demand response programs – the consumers could

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[4] In many investment support scheme such as utilities incentives and white certificates energy savings are estimated ex-ante (deemed savings) or ex-post with more complex program evaluation.

[5] We are indebted to the anonymous reviewer for this comments

[6] Normalizing energy savings to account for autonomous savings, which occurred without any action on the side of the consumer (e.g. reduced occupancy levels of times) are discussed later in the paper.

benefit from an additional financial incentive. As in demand response programs *additional* incentives for power saving can be justified based on the additional societal economic benefits of reduced peak power (e.g. improved reliability of the electricity network, postponement of the grid reinforcement, avoidance of black outs, avoidance of investments in reserve power).

This is why an ES FIT for energy savings can be seen as a **performance-based subsidy**, whereby action undertaken by end-users – both in terms of investment in energy efficiency technology and in terms of behavioral action – is awarded based on the savings delivered[7]. In terms of design, the ES FIT could be either based on the actual number of saved kWh of electricity or m^3 of gas (referred hereinafter as quantity-based FIT, e.g. based on the actual quantity of savings) or based on a fixed discount on the bill (target-based FIT).

In the case of quantity-based FIT the subsidy can be awarded based on saved amount of energy compared to a predefined and agreed energy consumption (ex-post and based on meter reading) with or without adjustment for climate and other 'external' conditions (see later). In case of a target-based FIT, the FIT subsidy is awarded contingent upon the reduction of the amount of consumed energy by a certain amount (target) or on reaching a certain threshold. It is based on the energy consumption as indicated the energy bill with possible normalization for exogenous factors such as occupancy levels (see later). A target-based FIT uses data that are compiled and regularly communicated to the end user via the bill. EU Directive 2006/32/EC on energy end-use efficiency and energy services requires that, where appropriate, billing performed by energy distributors, distribution system operators and retail energy sales companies is based on actual energy consumption, and is presented in clear and understandable terms. Billing on the basis of actual consumption shall be performed frequently enough to enable customers to regulate their own energy consumption. Both of these solutions – quantity-based and target-based FIT – are beneficial also in terms of enabling and encouraging the end-user to identify and follow energy use change. In addition, with the roll-out of advanced metering and feedback infrastructure the consumption could be monitored in real time, making easier for end-user to meet energy conservation targets[8].

Types of Projects Supported and Functionality

An ES FIT targets directly the end-users, stimulating them to save energy. A practical way forward proposed by the authors would be to initially focus on electricity and gas savings in the residential sector, given the more limited variations in consumption among households compared to variations among end-users in other sectors and base the FIT on the consumption of a household over a certain period, compared to a previous period and adjusted for external conditions. This adjustment – or normalization of the consumption numbers – may be required e.g. for occupancy levels (reduction in per capita consumption), changes in opening hours, changes in production, weather variations, etc.

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[7] In principle the FIT could be differentiated by type of action or by end-use sector, but this would add a lot of complexity and program cost for sub-metering and analysis

[8] For smart electricity meters full roll-out is underway in Sweden (about 10-15% of these meters are only capable of remote-reading, these are also expected to be changed in the coming years), almost full penetration is seen in Italy and is expected to saturate in 2011, and further mass roll-out plans for electricity meters are available in Portugal by 2015 and in Spain (by 2018) and in Norway by 2014 (Grande et al. 2008). Smart gas meter plans are made in only Italy as of yet. Many countries have or are seeing a fast and wide scale voluntary deployment of intelligent meters (such as New Zealand, Australia, Turkey, Finland, Norway, Denmark).

In the case of a target-based FIT – whereby a fixed discount on the energy bill is awarded – data from the bills of consumers can be used to ascertain reduction in consumption as compared to a previous billing period: for example reduction in consumption in year *t* as compared to consumption in year *t-1* or reduction compared to the average of consumption over the last two or three years. A way of ensuring that savings are sustained can be to only grant the FIT for one year and require that in order to be eligible for a new FIT reward (or discount) in the subsequent year, the end-user shall keep its consumption at the reduced level as compared to the average of the previous two years. For example, if in year *t-1* (or an average of years *t-3*, *t-2* and *t-1*) the annual consumption of a household was 3000 kWh, then to be eligible for a FIT, a household would need to reduce by say, 10%, i.e. to 2700 kWh in year *t*. The FIT would be limited in time – to, say, 3 to 5 years – but to be eligible for it, the household would need to sustain the consumption reduction each of the subsequent years (e.g. to not exceed annual consumption of 2700 kWh). In this example, the reduction of 10% in annual consumption[9] may be rewarded with a lump sum equal to 10% of the bill. In addition, if in year *t+2* the household realizes further 10% savings – reducing its annual consumption to 2400 kWh – then the household can be eligible for reward equal to 20% of its annual bill, or the total amount of kWh saved can be awarded in terms of Eurocent/kWh (see later the example of efficiency cheque in Portugal). It needs to be emphasized that it is challenging to sustain reductions of annual electricity consumption, due to the increasing penetration of appliances in the residential sector and the changed patterns of use.

The alternative method for calculating the amount of FIT would be to fix a target for annual consumption for the year *t* for the household - e.g. 3000 kWh - and reward each kWh saved compared to the target with an amount of Eurocent/kWh. This amount could reflect the average cost of conserved energy or the marginal kWh generation cost), in the case of a consumption of 2700 kWh this would be in the value of 300 kWh. The award for each kWh saved could be fixed or could be dependant on the Time of Use (ToU) to reflect the cost of kWh production and distribution at different times. A ToU FIT would require smart meters. Attention should also be paid to interaction with for reward for power shedding in demand response programs if a household simultaneously benefits from a FIT and participates in a DR program.

The ES FIT can be financed by a public benefit charge (as financed in the case of the white certificate scheme in Italy or the programs of the Electricity Saving Trust in Denmark, for example). Public benefit charges, also known as system benefits charges or public goods charges, are charges placed on energy sales to fund energy efficiency (both on electricity and gas). The creation and implementation of such charges was widely practiced during electricity industry restructuring as a means of preserving a minimum level of funding for energy efficiency and other public goods. Public benefit charge funds are generally placed in the custody of the efficiency program administrator. In terms of administration, in the case of a target-based FIT the processing of the data and payments can be done via the energy suppliers (see examples of Portugal and Toronto below). A quantity-based FIT may call for the involvement of a central authority to process the data and administer the payments.

As with some RES FIT schemes, there may be a limit on the amount of savings rewarded to match the raised public benefit funds: in this case either end-users are paid on a first-come

[9] The authors are in favor of an annual accounting for a FIT rather than a monthly one The latter gives much quicker and thus more potent consumption feedback, but also introduces short-term fluctuations that may over-compensate the homeowner for savings in a particular month that are later made up with more consumption.

first-served basis until the public benefit charge funds are allocated or a bidding systems is introduced[10] and only the lower offer for the remuneration of the kWh saved are accepted (e.g. below XY cent/kWh saved). For all energy consumers there will be small tariff increase to pay for the ES FIT.

Can an ES FIT be Effective?

The potential of behavioral change on the side of the consumer can be harnessed with the help of informative or improved electricity bills and advanced electricity meters (Urge-Vorsatz et al. 2009). If properly designed, these tools (or their combination) can offer detailed, customized and consumer friendly information and trigger electricity savings. It has been shown that a more frequent bill with customized feedback about households' consumption combined with tips to address possible inefficiencies has enabled the owners to reduce their electricity consumption by 10% on the long term (Wilhite and Ling 1995). Stromback (2009) has confirmed an average consumption reduction between 5-10% on a worldwide review depending on the design of the feedback.

Abrahamse et al. (2005) reviewed around 40 peer-reviewed studies and compared the savings potential from feedback of various design. In cases when ex-ante goal setting and/or success reward was integrated with feedback in the field experiment or the policy design, the reduction potentials grew to 15-22% (McCalley and Midden 2002, Becker 1978, Midden et al. 1983), significantly increasing the awareness and willingness of the electricity users independently whether the target was set by themselves or assigned. The level of savings depended on the size of the goal set: for instance in an experiment with groups assigned to save 2% electricity consumption and 20%, the former achieved an average of 5.7% reduction, while the other 15.1% (Becker 1978), and in another study a 10% savings target resulted in 7.7%-12.3% decrease of gas demand depending on the feedback received (Van Houwelingen and Van Raaij 1989). Savings were proven to be attained by target setting but without feedback, however significantly lower than in a combined design (20% goal leading to a 5% reduction result (Becker 1978).

The above suggest that an ES FIT scheme will be effective and the level of energy saving will depend on the set goal or the size of the reward, and can be augmented significantly by proper tailored feedback to the consumer. The suggested ES FIT designs already incorporate the possibility to combine these and easily inform the consumer frequently.

Examples from the Real World

A number of countries have implemented or plan to introduce similar schemes. In the frame of its Summer Challenge program to reduce summer power demand on the grid, Toronto Hydro offered a 10% rebate to residential and business customers in several cities in Ontario who managed to reduce 10% on their summer electricity usage compared to their previous year's summer consumption usage. Approximately 24% of Toronto businesses cut electricity demand earning rebates totaling CAD 3.7 million (approx. 2.26 million Euro). The average electricity savings per business customer who reached the 10% target over the program period was

[10] Bidding may be too complex for the residential sector, and it could be an option for the commercial or industrial sector. We are indebted to the anonymous reviewer for this comment.

approximately 6,820 kWh. For residential customers, the average savings was 402 kWh and more than 30% of eligible residential customers reduced consumption by at least 10% compared to the previous summer collectively earning rebates totaling CAD 2.3 million (approx. 1.4 million Euro). The average residential rebate per household was CAD 16 (approx. 10 Euro). The average commercial rebate was about CAD 285 (approx. 175 Euro) (TCH 2007)[11].

In its National Energy Efficiency Action Plan, submitted under Directive 2006/32/EC, Portugal states its intention to introduce the so-called efficiency check, whereby a bonus is granted to electricity consumers in the residential and service sector. This bonus is equivalent to 10% or 20% of electricity costs for 2 years in case of observed 10% or 20% reduction in electricity consumption, as compared to the consumption in the previous year. The efficiency check to be spend only on energy efficiency measures (investment)[12], will only be received in the second year if consumption levels reached in the previous year are maintained.

In China the Ministry of Finance and the National Development and Reform Commission are awarding enterprises with the equivalent of approx. 22-27 Euro per ton of coal saved per year, depending on their location. To be eligible enterprises need to have energy metering and measuring systems to document proven savings of at least 10,000 tce (0.29 PJ) from energy saving tech transformation projects, which makes the program resemble a performance contract, whereby the payment is related to specific technical measures installed and monitored. The awards are part of the Top-1000 Energy Consuming Enterprises Program in China - a kind of voluntary agreement with the largest consumers (Price et al 2009).

In 2005 Trondheim Energy in Norway introduced a pilot program for 2500 households, whereby the households and the company agreed on a fixed volume of energy usually to be distributed for a year at fixed price and in an agreed profile. In case the household deviates from the profile in negative terms (a household uses less electricity than agreed upon), the supplier "buys back the extra energy" at a *spot price*. The spot price is usually higher than the fixed price per kWh, and depends on the household location plus a mark-up. In case of a deviation upwards (a household uses more electricity than agreed upon), the additional consumption must be paid for by the consumer at the same higher *spot price*. The program gives a strong motivation for consumers to not overpass the agreed consumption of their profile (Grande et al. 2008).

Another informal arrangement is introduced by voluntary carbon reduction groups, booming in the UK, but also appearing in other countries. The members of such groups pledge to a saving target: if they exceed the energy consumption originally aimed at, they have to pay a fine. Details of schemes differ, however in all of them additional costs are incurred if the pledged energy saving targets are not met. The main conclusion is that individuals and businesses are willing to participate in such a scheme.

These arrangements can provide further lessons for the design of ES FIT, especially as to whether in the absence of a quantified target the level of savings and thus the cost of an ES FIT go beyond cost effective levels, i.e. the cost of conserved energy goes beyond the cost of generated kWh.

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[11] More than 74,000 business and residential customers saved 20% or more and more than 80,000 business and residential customers saved 10 to 20%.

[12] This could be a required feature of an ES FIT policy, to avoid spending the bonus on other energy-using appliances and home electronics, or on energy-intensive activities like a plane flight for holidays. We are indebted to an anonymous reviewer for this comment

Discussion

This section points at some major design issues that should be taken into consideration when evaluating ex-ante the benefits of introducing an ES FIT.

1. Additionality and persistency of energy savings achieved should be ensured;
2. Supporting energy savings: prices versus quantities.

Persistency and Additionality of Savings

A major issue in the implementation of an ES FIT is how to attribute the results of energy saving actions to different factors. The following elements can all be part of an energy saving action, or can constitute an energy saving action or bring an unintended saving effect:

- Technology improvements (usually defined as energy efficiency);
- Behavioral 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).

Energy savings are evaluated against a reference situation (known as baseline or counterfactual situation), which shows what the consumption would have been in the absence of the action. A household energy bill in the previous period – adjusted for external factors, see next – can be a baseline. There are a number of situations where energy consumption decreases because of an external change, which distorts the comparison of the post-retrofit or behavior change situation with the baseline[13].

In estimating energy efficiency improvements the actual consumption is often 'normalized' (e.g. for heating it is common to use the degree days in calculating energy savings), and this point has not been challenged in energy policy evaluations or literature. However, since energy savings are considered as a target of climate policy, it is worth noting that in many cap and trade programs such as the EU emission trading scheme, the emission cap refers to absolute emission reductions regardless of the conditions under which emission reduction or increases are achieved[14]. On the point of whether to reward also autonomous savings under a FIT further research is warranted.

Energy savings also depend on structural or temporal changes imposed on the participants by other circumstances beyond their control or with higher priority for them. Contraction in business or smaller production output will results in energy savings, while

[13] E.g. children moving out of their parents' house, or all occupants getting a job outside the house and thus leaving the house empty for long hours every day. An often debated issue is the correctness to award this type of 'unintended' autonomous energy savings and penalize other situation (e.g. house occupied for longer periods)

[14] 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 baseline. However, if the country where this specific plant is located experiences very warm winters with a reduced need for heat and therefore less heat generation, this plant will emit less CO_2 and achieve its target with minimum effort. At present no ex-post adjustment is allowed in the ETS.

companies that are in business expansion will have higher consumption. In particular many schemes and monitoring and verification methods adjust ex-post energy savings to climatic conditions, e.g. a very hot summer or a cold winter, building occupancy, production levels, etc.

Furthermore, behavioral change is rarely eligible for direct financial support or is eligible under energy supplier obligations and white certificate schemes[15].

A key issue is the availability of the infrastructural or organizational set up for measurement of the actual energy consumption to verify the savings in an ES FIT scheme. The metering practices vary widely among countries, ranging from the lack of individual metering to sophisticated on-line complete home metering systems that can display and record the electricity consumption of individual appliances. There are meter reading systems, where the actual consumption is verified by the supplier only once a year, and payment is done in equal fractions based on an estimate, or the bills are produced based on the consumer reading and reporting. Neither solution is suitable (trustworthy) for identifying the energy savings. As already discussed above smart meters can serve as the means to follow and record actual consumption at the point of consumption or in the central data record so that the precise values of consumption and savings are known. A possible intermediary solution may be frequent personal meter reading, in which case correct bills can be produced and used for the determination of the FIT.

Prices versus Quantities: The Classical Debate

The ES FIT on one hand and the energy saving obligations (targets) combined with white certificates on the other represent the classical debate known as “prices versus quantities”, or price-driven versus capacity-driven approaches. ES FIT, indicates the *exact price* for awarding a kWh of electricity saved without giving any clear indication as to the exact quantity to be saved at this price. Conversely, the quantity model – energy saving targets – stipulates in advance the *exact outcome* to be achieved in terms of energy savings (assuming full compliance), without giving indications on the cost of compliance, except that marginal cost of compliance is normally equalized across sources.

There are pros and cons for both of these instruments. Energy saving targets and white certificates aim to ensure a certain amount of energy savings at least cost, but do not provide any incentives to exceed the target (unless banking into future periods is allowed). Support systems that establish cost minimization – delivering a given outcome at the least cost – as the top priority may cause limited technological development and technological variety, reliance on foreign equipment producers, low or no R&D investments on the part of equipment producers and (in the case of renewables) deployment of projects to restricted geographical region (Lauber 2004). On the other hand if targets 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 obliged parties and energy efficiency businesses. These factors also make investments more attractive for financing institutions. In addition, since there is no bottom price, obliged parties are likely to exercise pressure on equipment producers for lower prices and harvest first 'low hanging fruits'.

In contrast, ES FITs can encourage technological development, but may be too generous for some low-cost technologies (such as CFLs), while insufficient for other. One way to avoid

[15] In the UK the supplier obligation will recognise energy savings induced by smart meters and in house displays as this will have an impact on the behaviour. Unlike energy supplier obligations a FIT can directly support action by the end-user based on the amount of energy saved.

this situation is by a **stepped FIT** approach allowing for decreasing the ES FIT (cent per saved kWh or discount level) over time according to the expected learning curve and economies of scale. However, such precise design involves significant information requirements, that is, the costs of conserved energy for each technology and end-use sector.

In terms of integrating such quantity and price schemes, renewable energy support debate suggests to establish a FIT in the market, and gradually replace it with the quota-driven approach only when markets and technologies are more mature.

Final Remarks

Financial incentive mechanisms introduced in the field of EE and ES are usually linked to upfront investment costs, and in the case of EE to predicted (deemed) savings (Blumstein 2009, Bertoldi 2006) and thus disconnected from actual energy savings performance[16]. This paper discussed the possibility of implementing an ES FIT to reward energy saved, in particular covering energy consumption in the household sector. An ES FIT can be considered an operational performance-based subsidy, whereby action – including technical improvements and behavioral change – undertaken by end-users is awarded based on the savings delivered.

The paper has presented various conceptual issues related to design, operation and infrastructure, and potential difficulties of such a scheme. A system based on a targeted consumption reduction as attested by the energy bill compared to a previous period and possibly adjusted for external factors appears to be a practical framework for setting a FIT (target-based FIT). A way of ensuring that savings are sustained can be to only grant the FIT once per year and require that in order to be eligible for a new FIT payment in the subsequent year, one needs to keep consumption at a certain level as compared to the average of the previous two years. The sustained reduction of consumption can also be awarded in terms of Eurocent/kWh. It is important to note that the size of the award (e.g. the value of the kWh saved, or the fixed discount offered for those customers who reach the threshold), the cost of energy (in this case electricity and gas), and finally the price elasticity are all important elements that shall determine the success of an ES FIT. Proper communication to end users would be needed to seek their participation.

The ES FIT system can be financed by a small wire charge, just as supplier obligations are financed in Italy. Persistency of savings can be ensured with appropriate design. To keep the analogy with the renewable FIT - where there are no obligations to install RES capacity - there will be neither an obligation nor a penalty for suppliers or for end-users, only rewards.

Such a scheme can have a number of potential benefits. First of all, support is based on the performance of the end-user in terms of savings achieved and support goes directly to the end-user. 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 truly performance-based scheme. While fostering the market for EE, an ES FIT can also reward energy saving behavior. Other advantages of an ES FIT include the possibility to tailor it to reflect the technical and economic saving potentials available in the various end-use sectors. An ES FIT seems a very good approach to ensure that EE measures *really take place* and produce genuine additional savings. If the ES FIT is properly designed it

[16] One example of real saving measurement is foreseen in the Italian White Certificate scheme, which – for large projects – is based on the before and after measurement of energy adjusted to reflect equal condition.

could assure that the implemented measures stay in place for a reasonable number of years, e.g. by renewing the discount on the bill for a minimum number of years provided the consumption is maintained below the established threshold.

On the other hand, there is a trade-off between design simplicity (e.g. a simple target-based scheme) and additionality of savings. It can be complex to assure that only action-induced (as opposed to autonomous) savings are awarded. Rewarding savings against a hypothetical baseline to keep the same service or conditions (or increasing to acceptable levels if the starting conditions are below comfort levels) can bring complexity and increased reporting provisions, thus discouraging participants, and increasing transaction costs. Since the policy space in the field of energy efficiency is getting crowded, interaction effects should be carefully examined in each specific context.

Rather than to offering definitive answers, the present paper is intended to foster a discussion among policymakers and analysts, raising questions, proposing options and opening a wider debate. To this end the authors recommend to complement the theoretical discussions with a pilot project to explore the possible ES FIT different implementation options. Careful monitoring and evaluation of similar schemes already in place will point at design and implementation lessons. In this respect the target-based scheme introduced in Ontario is a good starting point for any further analysis.

Further issues that merit consideration include the setting a unit price for ES FIT and the impact of the underlying cost-structures (fixed system costs that apply even with reduced consumption), as well as equity aspect of an ES FIT. Finally for electricity savings the interaction with the renewable FITs shall be further analysed to avoid double benefits.

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