Feed-in tariff for energy saving: thinking of the design

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Abstract

Financial incentives are important for the adoption of energy efficient technologies and overcoming certain market barriers to improved energy efficiency. Such incentives are broadly used in various environmental and energy fields and are usually associated with specific technology support, rather than a general sustainable behavioural 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 does not ensure real energy savings due to the rebound effect and remaining barriers.

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, in the form of a fixed financial incentive based on the kWh saved by the end-user. This paper discusses the possible setup of a feed-in tariff for energy savings.

The paper first explores the rationale behind and the possible functionality of a feed-in for energy savings, giving examples of similar policy tools implemented or planned. The paper looks into additionality and persistency of energy savings and explores core interactions between the feed-in and existing tools for energy efficiency. Finally, key advantages and complexities related to a feed-in tariff scheme for energy savings are discussed, intending to open a discussion and foster further research on the topic.

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 reduced energy consumption. 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

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.

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 security of supply gains prominence on the policy agenda. EE and ES are recognised as one of the key areas of action, and certainly the quickest way, as well as 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 prevent the uptake of energy efficiency improvements (see, for instance, Sorrell 2000 and Golove 1996). To overcome these barriers, governments have introduced policies and programmes 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 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. Investment subsidies - e.g. rebates on the purchase of new efficient equipment - are commonly used financial incentives to support energy efficiency. More recently white certificates finally establish a connection between the quantity of savings realised and the additional cash-flow to a project (for details on white certificate schemes see, for example, Bertoldi and Rezessy 2006 and Bertoldi and Rezessy 2008).

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 focussed 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 or also for the operation of the plant over a certain period of time, as in the case of feed-in tariffs. In the context of RES support, the discussion among policy makers and policy analyst has mainly been focussed on which types and what size of incentives are most effective and cost-effective in stimulating the uptake of RES, rather than on the need or justification for incentives.

In contrast, in the case of energy-efficiency, financial incentives have usually supported only the upfront investments of more efficient technologies (appliances and equipment), but not the real and sustainable genuine energy savings over (part of) the lifetime of equipment. There is no clear reason why incentive mechanisms commonly accepted and implemented for the support of renewable electricity are not applied or even considered for the support of energy savings, whereby investment support is disconnected from savings achieved.

The goal of this paper is to analyse the introduction of a feed-in tariff as a policy tool for promoting energy savings in electricity. The paper discusses the concept (based on a general description of Bertoldi and Rezessy 2007) and potential functionality of a FIT for electricity savings, 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 energy savings. The paper strongly advocates incentives to energy savings rather than strictly energy efficiency. The paper looks into the interaction effects between a potential FIT and other policy tools to promote energy efficiency and deploy energy savings, assessing potential complementarities and overlaps. It 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 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 are among the most common and effective 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 (examples are past incentives for A class appliances or CFL lamps). Demand side management policies, programmes and incentives have been used in a more limited manner in Europe, compared to the US. More recently, the attention of policy makers 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.

Despite the fact that most policy instruments target EE and not ES, still some demand response schemes employ particular incentives to trigger temporary power demand reduction rather than relying only on the impact of higher electricity prices. These demand response schemes have been either combined with technological solutions (smart meters) or stand-alone initiatives. Incentives provided to demand response participants to make them shed power usage could be comparable to incentives for energy saving. Nevertheless, demand response hedges participants from very high peak prices and can thus reduce peak load, but does not necessarily generate energy savings.

An end-user acting to conserve energy would benefit from the avoided energy and, as in demand response programmes, could benefit from a possible additional financial incentive. As in demand response programmes *additional* incentives for power saving can be justified based on the additional societal economic benefits of energy savings (e.g. improved reliability of the electricity network, postponement of the grid reinforcement, avoidance of black outs, avoidance of investments in re-

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). In addition the least polluting kWh is the one not consumed.

serve power in the case of electricity savings). Accordingly, the same reasoning and principle could be established for saved energy due to its many societal economic benefits (climate change mitigations, local employment, postponement of investments in power generation, etc.).

FIT for ES: the concept

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 sustained change in behaviour. This can be seen as a core feature of a possible FIT for energy savings. Unlike *energy supplier obligations* – whereby energy suppliers have to deliver energy savings at their consumers' premises, which may lead to additional transaction and administrative costs – a FIT can directly support action by the end-user based on the amount of energy saved. 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[4].

A feed-in for energy savings can be considered a **performance-based subsidy**, whereby action undertaken by end-users – both in terms of investment in energy efficiency technology and in terms of behavioural action – is awarded based on the savings delivered, possibly differentiated by type of action or by end-use sector. In terms of design, the energy savings FIT could be either meter-based or bill-based.

In the case of meter-based FIT the subsidy can be awarded 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). Even though submetering and data acquisition technologies to meter individual equipment or systems are now becoming available at reasonable cost, the authors believe that a meter-based FIT could be operational only with the spread of advanced metering and feedback infrastructure. A number of EU Member States are spreading the use of smart meters: full roll-out is expected due to obligation for instance by 2011 in Italy, by 2009 in Sweden, by 2015 in Portugal, by 2018 in Spain (Vasconcelos 2008), and by 2014 in Norway (Grande et al. 2008). At the same time, 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 case of bill-based FIT the subsidy can be awarded on reducing the amount of energy consumed, as indicated on the energy bill with possible normalisation for exogenous factors such as occupancy levels (see later). A bill-based FIT uses data that is compiled and regularly communicated to the end user. Hence, it can be expected to have relatively modest administrative costs. In the European Union 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 are beneficial also in terms of enabling and encouraging the end-user to identify and follow energy use change.

Beneficiaries and types of project supported

A FIT for ES targets directly the end-user. A practical way forward proposed by the authors would be to initially focus on electricity savings in the residential sector and base the FIT on the consumption of a household over a certain period, compared to a previous period and adjusted for external factors (see later). A more technology-oriented scheme may focus on a limited number of well understood eligible technologies or saving options, such as lighting, appliances, etc. A FIT can be differentiated by type of project and/or by end-use sector. A FIT can be awarded for different duration to reflect the different lifespan of various projects.

Functionality

When a party indicates its intention to take part in the FIT scheme, it will present a project for energy savings describing the technologies or behaviour changes that will be implemented and the other conditions affecting the saving. Intermediaries, or any market agents, can act as project aggregators. To ensure clarity, a list of technological and behavioural solutions should be supplied by the FIT system operator. 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). This is a way to avoid speculation with the system, but may be complex to administer.

In the case of a bill-based FIT, 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 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. 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 is 3000 kWh, then to be eligible for a FIT, a household would need to reduce to, say, 2700 kWh in year t. The FIT would be limited in time – to, say, 2-3 years – but to be eligible for it, a household would need to sustain the consumption reduction. In this example, the reduction of 10% in annual consumption may be rewarded with a lump sum equal to 10% of the bill, or the total amount of kWh saved can be awarded in terms of Eurocent/kWh. In addition, if in year t+2 the household realises further 10% savings – reducing its annual consumption to 2400 kWh – then it 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. It needs to be emphasised that it is challenging to sustain reductions of annual electricity consumption, due to the in-

4. Normalising 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.

creasing penetration of appliances in the residential sector and the changed patterns of use.

Normalisation 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. In the case of meter-based FIT, it will be necessary to have a metering period before and after the implementation to monitor the savings (possibly of the same time length).

A FIT can be financed by a small public benefit charge (as is financed the white certificate scheme in Italy or the Electricity Saving Trust in Denmark, for example). Public benefit charges, also known as system benefits charges or public goods charges, are wire charges placed on per kWh sales to fund energy efficiency. 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 bill-based FIT the processing of the data and payments can be done via the electricity suppliers (see examples of Portugal and Toronto below). A meter-based FIT may call for the involvement of a central authority to process the data and administer the payments.

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 totalling 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 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 last summer collectively earning rebates totalling CAD 2.3 million (approx. 1.4 million Euro). The average residential rebate is CAD 16 (approx. 10 Euro). The average commercial rebate is about CAD 285 (approx. 175 Euro) (TCH 2007)[5].

In its National Energy Efficiency Action Plan, submitted under Directive 2006/32/EC, Portugal states its intention to introduce the so-called efficiency cheque, 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 cheque to spend on energy efficiency measures (investment) will only be received in the second year if consumption levels reached in the previous year are maintained. As of early 2009, the efficiency cheque is not yet in place.

5. 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%.

In China the Ministry of Finance and the National Development and Reform Commission are awarding enterprises in East China with the equivalent of 22 Euro per ton of coal saved per year and the enterprises in Mid or West China with the equiv of approx. 27 Euro per ton of coal saved per year. Enterprises are eligible that 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. These are part of the Top-1000 Energy Consuming Enterprises Program in China - a kind of VA with the largest consumers (Price et al, in print).

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 fix 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 programme is a strong motivation for consumers to save, or at least to not overpass the agreed consumption of their profile (Grande et al. 2008).

Further options: FIT as a form of target setting

The potential of behavioural change on the side of the consumer can be harnessed with the help of informative or improved electricity bills and advanced electricity meters (Stern 1986, Novikova et al. forthcoming). If properly designed these tools (or their combination) can offer detailed, customised and consumer friendly information and trigger electricity savings. It has been shown that a more frequent bill with customised 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)).

As in some of the examples reviewed above consumers joining a FIT programme may be given a target to save electricity compared to, say, the last 2 years, and can attain the tariff in case of success. The studies presented suggest that such a 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 meter or bill based FIT already incorporates the possibility to combine these and easily inform the consumer frequently.

Discussion

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

- Additionality and persistency of energy savings achieved;
- Supporting energy savings: prices versus quantities;
- Interactions between FIT for ES and already existing tools supporting energy efficiency and energy savings such as voluntary agreements, energy taxes, energy saving subsidies, white certificates, and minimum energy performance standards.

PERSISTENCY AND ADDITIONALITY OF SAVINGS

A major issue in the implementation of a feed-in tariff for energy savings 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 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).

Energy savings are evaluated against a reference situation (baseline), which shows what the consumption would have been in the absence of the action. A household bill in the previous period – adjusted for external factors, see next – can be a baseline. There are a number of situations where energy or electricity consumption decreases because of an external change, which distorts the comparison of the post-retrofit situation with the baseline. An example could be children moving out of their parents' 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). An often debated issue is the correctness to award this type of 'unintended' autonomous energy savings (independent of any intended action by the end-user) and penalise other situation (e.g. house occupied for longer periods).

In estimating energy efficiency improvements 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 in energy policy evaluations or literature. However, since energy savings are considered as a target of climate policy, it is worth noting that in emission trading, the emission cap refers to absolute emission reductions regardless of the conditions under which emission reduction or increases 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 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. 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 is 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 the point of whether to reward also autonomous savings under a FIT further research is warranted.

Furthermore, behavioural change is rarely eligible for direct financial support. Examples of behavioural savings are: the user deciding to switch off equipment when not in use, decrease/increase the set temperature point (heating/cooling) or decrease the size of (new) equipment (e.g. refrigerator or car), and finally dispose of or reduce usage 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 with 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 shrink in demand for the product) will results in energy savings, while companies that are in business expansion (growth in demand for the final product) 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.

A key issue is the availability of the infrastructural or organizational set up for measurement of the actual electricity consumption to verify the savings in a 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 (trustful) for identifying the energy savings. As already discussed above smart meters can serve as the means to follow and record actual consumption at the spot of the 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.

Two major conclusions can be derived from the discussion above. First, the measurement of the energy saving is one of the most critical issues in a possible FIT for saved energy. Second, an initial learning phase of FIT should be limited to electricity savings or focussed on some well-analysed and simple equipment/systems.

PRICES VERSUS QUANTITIES: THE CLASSICAL DEBATE

The FIT and energy saving obligations (targets) combined with white certificates represent the classical debate known as "prices versus quantities", or price-driven versus capacity-driven approaches. The former, *i.e.* 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). 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 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, FITs encourage technological development (dynamic efficiency). However, FITs may be too generous for some (low-cost) technologies (such as CFLs), while insufficient for other. One way to avoid this situation is by differentiating FIT according to technology and end-use sector. A stepped FIT approach may allow for decreasing the tariffs 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, there are views that due to the above detailed advantages and shortcomings, a possible solution is to establish a FIT in the market, and gradually replace it with the quota-driven approach only when markets and technologies are more mature. It needs to be acknowledged that a preference for quantity schemes is related to policy making traditions and styles: neo-liberal supporters are more prone to quotas and tradable certificates[6]. While a comparison of the track record of these two instruments is an interesting issue, this is outside the scope of this paper.

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 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).

INTERACTIONS BETWEEN A FIT FOR ENERGY SAVINGS AND OTHER POLICY TOOLS TO SUPPORT ENERGY EFFICIENCY AND ENERGY SAVINGS

Given the complex policy environment in most countries, various objectives are pursued in terms of energy savings and energy efficiency, alongside with economic efficiency. It is often the case that these objectives overlap and it may happen that one reduces the effectiveness of the other. As these policies are designed and implemented in an already "congested" policy environment, interactions take place. This raises the issue of compatibility of the different policy instruments, which is of crucial importance for further policy design.

To this end, an introduction of a new instrument (e. g. feed-in tariff) can be criticised as redundant, if the latter does not generate added value to the existing policies. In a brief ex-ante analysis, we show that – with some exceptions – FIT can potentially act complementary and enforce targets of the remaining policy instruments. It needs to be emphasised that interactions depend on the specific design and concrete implementation details in each national context.

We briefly analyse three kinds of interactions , building on a framework by Oikonomou and Jepma (Oikonomou and Jepma 2008):

1. Level of interaction (e.g. sectors involved, technologies, enforcement in the presence of penalty or not);
2. Kind of interaction: complementary, overlapping, mutually exclusive;
3. Additionality (i.e. does a FIT create additional value or incentives).

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 in the context of RES support to Volkmar Lauber from the University of Salzburg.

Table 1. Interactions of FIT with other policy instruments

Policy instrument	Sectors	Technologies	Interaction status (complementary, overlapping or mutually exclusive based on the common sectors and technologies)	Added value of functioning (+,-,?) and comments
Voluntary agreements	SME's, ESCOs, Industry	All demand technologies	**Complementary**: Technologies and behavioural change, **Overlapping**: Double crediting for energy savings	+, with a risk of free-riding if baseline of electricity use is not defined clearly per player
Energy taxes	SMEs, households	All demand technologies	**Mutually exclusive**: Technologies and behavioural change	-, simultaneous and opposite market signals rewarding savings and punishing consumption.
Energy saving subsidies	SMEs, households	All demand technologies	**Overlapping**: Rewarding savings and technologies simultaneously	-, unless specific technologies in subsidies are addressed
Energy supplier obligations and white certificates	Energy suppliers	Specific eligible technologies	**Mutually exclusive**: all sectors involved (supply to demand) **unless** coverage of FIT and white certificates delineated by sector	-, effectively the same target, different implementation path
Minimum energy performance standards	Industry	Specific technologies	**Complementary**: Technologies and behavioural change	+, clear market signal for technologies above baseline, as long as MEPS are in the baseline

Table 1 presents our main findings but we acknowledge that interactions can differ substantially depending on the design characteristics of each policy instrument (Oikonomou and Jepma 2008).

Introducing FIT along with Voluntary Agreements (VAs) may generate an added value to the scheme by increasing its scope. A possible drawback of such policy combination could be the stimulation of free-riding behaviour and double crediting, especially in the case of very cost-efficient actions ('low hanging fruits'). While this can serve as an incentive for achieving minimum targets, it could lead to misallocation of resources and lock out more expensive investments in the market. Nevertheless, if FIT is assigned to technologies for specific sectors participating in VAs, which fall above the normal business behaviour, then FIT could indeed serve to stimulate more expensive and effective technologies.

Energy taxes and FIT appear to be mutually exclusive. Energy consumption taxation 'punishes' consumption by passing a price signal for reducing energy use. An extra financial incentive in the form of FIT can lead to an increase in savings, but rewarding end users double – once through the avoided taxation and another time through the FIT payment. An elaborate design of these mechanisms financing savings above a minimum threshold per household group could reduce this risk.

Investment subsidies (e.g. grants) linked to investment in energy efficiency technology overlap with FIT. In other words, SMEs and households can receive financing for purchasing energy saving technologies, and at the same time an extra incentive for the operational reduction of their energy use. This combined scheme could lead to free-riding behaviour, since it will trigger more players towards energy saving at rather increased costs, while on the other hand it could act as an incentive for adopting more expensive technologies (above the 'low hanging fruits') due to double crediting. It needs to be pointed out that in the RES support, investment subsidies are often present along with FIT.

Energy supplier obligations are the 'flip side' of FIT (see the section on prices versus quantities): effectively they only differ in terms of delivery path, e.g. whether the demand reduction is made directly by the end-user in response to a FIT (or other factors) or facilitated by the supplier in order to meet its target. On the other hand, a possible interaction of these two may result in the following: obligations of suppliers guarantee a minimum energy savings target reached, and end-users via FIT can trigger towards more energy saving actions, on top of suppliers' obligations. Furthermore, FIT can finance the 'self-contribution' of end-users to projects financed by suppliers. However, double counting appears to be a serious threat.

Finally, minimum energy performance standards as an information tool can be complementary to FIT, in the sense that they provide clear market signals towards which technologies are deemed energy efficient. From an end-user's point of view, these standards lessen their information barrier, and hence transaction costs.

Final remarks

Financial incentive mechanisms introduced in the field of energy efficiency and energy savings are usually linked to upfront investment costs and thus disconnected from savings achieved. This paper discussed the possibility of implementing a FIT for energy savings to 'reward' and give incentives to energy saved, in particular covering electricity consumption in the household sector. A feed-in for energy savings can be considered an operational performance-based subsidy, whereby action – including technical improvements and behavioural 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 consumption reduction as attested by the electricity bill compared to a previous period and possibly adjusted for external factors appears to be a practical framework for setting a 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 be awarded in terms of Eurocent/kWh. This 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.

Such a scheme has 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 performance-based scheme. A FIT can also reward energy saving behaviour and not technology only. Such a system can foster the market for energy efficiency technologies. 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. 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.

On the other hand, there is a trade-off between design simplicity (bill-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. Since in the field of energy efficiency the policy space is getting 'crowded', interaction effects should be carefully examined in each specific context.

The present paper is intended to foster a discussion among policy makers and analysts. Thus 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, and well as more research and discussion on support mechanism for true energy savings, beside the well-known efficiency support schemes. Careful monitoring and evaluation of similar schemes already in place will point at design and implementation lessons. In this respect the bill-based scheme introduced in Ontario is a good starting point for any further analysis.

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