Counting beans or moving mountains - the predicament of energy efficiency policy

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Abstract

Many studies identify energy efficiency as the most important and least costly option for reducing CO_2-emissions while at the same time contributing to other policy objectives. The main challenge seems to be how to design, implement and evaluate policy to ensure that these opportunities are captured and policy perceived as legitimate. There is often a gap between rhetoric or broadly stated objectives in policy development and the narrow focus on verifying additional savings in evaluation. Ancillary benefits and costs are often overlooked and the primary criteria for impact evaluations are whether policies deliver additional and cost-effective savings. In practice, however, such impact evaluations are fraught with fundamental methodological difficulties and uncertainty. Double counting, spill-over, free rider and rebound effects are real and recognised factors that complicate evaluation. This has been experienced in the development of a harmonised calculation model as stipulated by the Energy Services Directive where a fair amount of attention has been given to such factors. In the mean time the more challenging, yet non-binding, 20 percent target of the EU Energy Efficiency Action Plan is stressing a need for new policy implementation. The question then becomes: how can the legitimate demands for policy to deliver additional savings be realistically addressed in practice and balanced against broad and long-term objectives? To answer this question, we provide an overview and assessment of the issues, opportunities, and correction factors for energy efficiency policy design and evaluation. We challenge the preoccupation with verifying *countable* savings and argue that it can be counterproductive. What *counts* are policy frameworks that can unleash and accelerate energy efficiency across all sectors in order to reach levels that are commensurate with broader energy and climate policy goals.

Introduction

This is a discussion paper. It is written out of concern that current policies and governance approaches are not sufficient to deliver the rates of energy efficiency improvements that are needed to make the transition to sustainable and zero carbon energy systems. Meeting the 2 C target implies a transition of energy and transport systems in the next 40 years which by all estimates must involve high and sustained rates of energy efficiency improvement. It has been estimated that for EU to meet the target of 20 percent primary energy savings by 2020 a tripling of current policy impact is required (Ecofys, 2010). Overall, it is a very different situation from seeking out the least cost options for relatively modest emission reductions or promoting energy efficiency for other purposes. It implies a new framing of energy efficiency policy and corresponding new approaches to policy evaluation. Counting beans (i.e., mainly short term cost-benefit analyses of policy) does not seem sufficient when the task is to move mountains (e.g., reducing average building energy use by 50 percent). Similar concerns have been voiced in the context of Californian energy efficiency policy (Blumstein, 2009; Friedman, 2007). The overall aim here is to explore the ways forward by which policy driven higher rates of energy efficiency improvement can be achieved. For this purpose we revisit some basic issues and concepts in the field of energy efficiency, energy policy, and policy evaluation.

By the predicament of energy efficiency policy we mean the difficulty for energy efficiency to become as centre stage in energy policy as it is in low carbon energy scenarios. Although energy efficiency is often stated as a high priority in the climate policy debate there remains a large gap between rhetoric and practice. For example, the EU Energy2020 strategy has noted that the quality of National Energy Efficiency Action Plans is disappointing, leaving vast potential untapped. In the CDM, end-use energy efficiency accounts for a mere 4 percent of the number of projects and even less in terms of emission credits earned (www.cdmpipeline.org).

One important part of the predicament lies in the basic question why we need energy efficiency policy in the first place. What are the policy goals and objectives? Motivations for energy efficiency policy have shifted over the years. An early motivation was energy security, i.e., to reduce dependence on imported oil after the oil crises. In Sweden, later on, the phase-out of nuclear power became an important argument for electricity end-use efficiency. The idea of least cost energy services for consumers has been a motivation for utility DSM programs in the United States since the 1980s. At present, energy efficiency policy is often motivated by the need to mitigate climate change. This begs the question whether energy efficiency is a goal and an end in itself or just a means to one or several ends?

Another important part of the predicament stems from the difficulty of determining the cost-effectiveness of energy efficiency policy. Energy efficiency policies are often questioned and challenged for not producing additional savings, thus not being cost-effective. Evaluation methodology has developed and improved considerably over the past 20 years but fundamental uncertainties and limitations remain (Blumstein, 2009). Furthermore, evaluating transition strategies for the long term is different from evaluating individual policy instruments and utility DSM programs.

The basic problem of demonstrating additionality (for any type of policy driven mitigation measure) can be illustrated by the CDM. Here, a baseline scenario is identified, showing the expected development without a CDM project, a sort of business-as-usual scenario. This is done in order to determine if a project is additional, and an emissions baseline is constructed to calculate the amount of emission credits it should earn. Additionality is difficult to determine, even in renewable energy projects where the production of electricity can be measured, due to the complex nature of investment decisions and the complexity of power system operation and planning. For energy efficiency projects it is even more difficult due a range of factors. Most efficiency measures entail some change in the quality of the service, there are non-energy benefits, rebound effects, etc. Many energy efficiency measures that are profitable on paper are for some reason or other not implemented, leading to enhanced concerns about free-riders and lack of additionality.

The need to legitimise energy efficiency policy through monitoring and verification of (additional) savings is mirrored in the Energy Services Directive (ESD) where top-down and bottom-up evaluation methods are discussed and the need for harmonised methods is stated. Subsequent to the adoption of the ESD, research projects such as EMEEES and expert committees have endeavoured to develop such harmonised evaluation methods. It is not the purpose here to question the importance of evaluating the effectiveness and cost-efficiency of policy. But we ask whether our preoccupation with verifiable savings, needed to legitimise policy, is focusing our attention too much in the direction of "resource acquisition" policy instruments that generate short term verifiable savings. Perhaps it is distracting our attention away from other elements needed for a transition, e.g., efforts to induce lasting market transformation changes for long term and large energy savings, consistent with climate policy goals? Although resource acquisition schemes, such as white certificates, also induce some market changes we argue that greater attention should be given to such market transformation efforts.

Energy efficiency as a means to several ends?

The pillars of energy policy include energy security, environmental sustainability and competitiveness. Other societal goals that are sometimes linked to energy efficiency include job opportunities, protection of consumer interests and increased shares of renewable energy. But energy efficiency is seldom portrayed as an overarching goal in itself. It is primarily a means for reaching these other goals.

One motivation for energy efficiency programs is that it benefits consumers by reducing the overall cost of energy services. This can sometimes lead to higher energy prices, albeit with a lower overall cost of energy services. But lower prices can also follow when costly investments in new supply are avoided. One example is energy efficiency and load management by which security of supply and reliability of service can be maintained without grid investments in capacity constrained distribution networks.

Energy security is often understood, somewhat simplistically, as less national dependence on imported energy, in particular oil and natural gas. I.e., energy security will increase if energy efficiency reduces import dependence. Security may also concern the risks associated with national infrastructure, e.g., interrupted power supplies, nuclear accidents, or ruptured gas pipelines. Energy security is rated as the principal driver of energy efficiency policies, except in IEA countries where climate change ranks higher (IEA 2010). It is rather difficult to think of any examples by which energy efficiency can result in decreased energy security. One exception would be if energy efficiency technologies depend on the supply or import of certain rare earth metals, chemicals or materials. But interruptions here would be less acute than for oil and gas interruptions.

A saved kWh is often hailed as the most environmentally benign kWh, not resulting in emissions from fossil fuel combustion, nuclear risks, or environmental impacts from renewable energy supplies. But energy efficiency can also result in considerable health and environmental impacts. The use of mercury in lamps, or ozone depleting substances in heat pumps are two examples. Other examples, such as glass wool for insulation seem completely harmless. It can be produced mainly from recycled glass using carbon neutral electricity and does not appear to have any health effects. Installed in any building it can reduce the heat demand for hundreds of years, or for the remaining lifetime of the building, without deteriorating.

It is a fallacy to speak of national competitiveness but there is nevertheless the idea in political discourse of a competitive Europe or a competitive country, meaning essentially a thriving and strong economy. But industry may get a competitive advantage from inexpensive production inputs, including low-price electricity. In principle, energy efficiency can also lead to competitive advantage but the effect is likely to be small. Energy is generally a small share of production costs and energy efficiency investments, although profitable, typically means trading-off capital for energy. Energy costs and efficiency is a greater concern in energy intensive industries.

In the case of job creation it is probably true that many energy efficiency technologies and services are more labour intensive than traditional energy supply. Examples include building refurbishments and jobs in energy management, but the argument is dubious. Increased labour productivity is important for economic development. In principle, it is not a goal in itself that it should take more man-power to build a passive house than a conventional house, although it probably does. It may also need more professional maintenance than a conventional house. In some cases, such as LED traffic lights, new technology means less labour is needed to replace lamps, because of longer lamp lifetime. This is a key benefit of making the switch to LED.

An often used argument for energy efficiency has also been the ability to extend the life of depletable resources such as fossil fuels. With renewable energy supply this becomes a lesser argument but instead energy efficiency becomes the mechanism by which more energy services can be produced from a limited renewable resource and thereby the stress on the natural environment and biodiversity is reduced. Although renewable energy resources are thousands of times greater than human use there are geographical limitations and costs associated with their utilisation. Materials scarcity may pose a limitation for some specific renewable energy technologies but is not likely to limit the overall potential (IPCC, 2011).

The hierarchy and trade-off between goals when there are goal conflicts, e.g., the use of domestic coal for energy security versus environmental protection, is mainly a political decision. Energy efficiency is unusual in that it appears to be good for just about everything, and not fraught with any serious goal conflicts. The main argument against it seems to be that energy efficiency policy may create distortions in the market and lead to economic losses.

Market failures and barriers

In addition to the goals discussed above, a common argument for energy efficiency policy has been the existence of market failures and market barriers, and that removing those would improve overall economic efficiency. Market failures are often understood to include external costs not being priced, lack of information and sometimes underinvestment in RD&D by the market. Without delving on economic theory, these are factors for which there is wide agreement that government intervention is warranted. But in the case of external environmental costs, energy efficiency policy is not the “first best” policy to address the problem. Instead, emissions should be priced, thus reflected in higher energy prices that provide incentive for energy efficiency investments. Information and RD&D efforts on the other hand can be targeted at energy efficiency (e.g., through labelling and government financing).

There is also a range of other barriers against perfect uptake of energy efficiency in the market. Energy being a low priority, lack of access to capital, and misplaced incentives are examples of such barriers. It is generally not seen as a market failure that we as consumers have priorities other than making seemingly economically rational decisions on energy efficiency related investments. These and other barriers can be categorised as factors that impose transaction costs. The question then is, should the government intervene to reduce such transaction costs, e.g., by regulating minimum efficiency standards or requiring certain levels of energy efficiency in public procurement?

Some would argue no since doing so would distort the market. Any such forced investments has an opportunity cost, i.e., the same money could have been used for something else and better.

In this line of reasoning, what might motivate energy efficiency policy is the absence of universal "first best" policy, such as a carbon tax. A regulation or financial incentive to stimulate energy efficiency investment would then be acceptable as a second best policy. Situations where second best policies are preferred for political reasons are not unusual. For example, imposing high prices on carbon emissions may lead to carbon leakage effects in energy intensive industries competing in global markets. In this case, an energy efficiency policy can be used as "second best" but also as a support mechanism to reduce costs and improve competitiveness (Ericsson et al, 2011).

But turning away from theory there are also obvious examples where the price mechanism does not work and where government intervention can save money. It is difficult to envision, even in a perfect world of "first best" policy where all costs of electricity are internalised, that higher prices to end-users would make electronics manufacturers reduce stand-by losses in response to customer demand. The amount of stand-by losses is simply not an issue for most consumers when buying a new appliance. Complementing the "first best" policy with regulation and procurement guidelines to reduce these losses is easy to motivate.

There are considerable savings potentials even in situations where you would not really expect them. For the energy intensive industry, energy costs certainly matter and in Europe the environmental costs are largely internalised, e.g., through ETS and higher electricity prices (although allocation principles and the level of permit prices may be debated). But then, how should we understand the fact that Swedish energy intensive industry could save about 5 percent or 1.45 TWh of its electricity use with pay-back times of less than 1.5 years as a result of a government-led energy efficiency program called PFE (Stenqvist and Nilsson, 2011)? Programme participants include large process industries that would be expected to have a focus on reducing production costs, including energy input costs.

One way of looking at the issue of market failures is to say that energy efficiency policies that are cost-effective from a societal point of view (e.g., standards to reduce stand-by losses or the PFE program) per definition also address a market failure. Whether we call it a barrier, lack of information or something else, there is per definition a market failure behind the 5 percent savings made in Swedish industry according to this line of reasoning.

For a singular goal such as reducing carbon dioxide emissions, it is relatively easy to argue the case for carbon pricing as the first best policy (although it is difficult to determine the right price, i.e., the external cost). Policies to improve access to information, as well as to support RD&D, innovation and market introduction, can be important complements. Overall, targeting market failures with cost-effective policy is a good guiding principle in policy making.

But, as discussed in the previous section, energy efficiency is often a means to simultaneously address several goals. In the case of energy security it is difficult to quantify the monetary value of energy efficiency. Another case is when energy efficiency becomes part of an economic stimulus package. Although it is right to balance the cost of energy efficiency against the benefits it is difficult to put a value on the combined benefits. Thus in practice, policy makers must make decisions under considerable uncertainty with consideration of multiple goals.

On a final note we may also ask whether it is right that government forces us to build energy efficient but slightly more expensive houses, or that efficiency standards preclude the use of incandescent light bulbs in the future (here we assume that these measures are cost-effective either from a societal point of view or under an assumed energy efficiency target). But this is basically a political and ideological issue about giving up some degree of individual freedom in the interest of reaching common societal goals.

The cost of energy efficiency

Energy efficiency is often portrayed in abatement cost curves as the negative- or least-cost, and thus no-regrets option to reduce GHG emissions. It is an old and well documented fact that there is a large potential for profitable investments in energy efficiency and thus reduced emissions. Although cost curves have been published since long in the academic literature, one of the better known and recent examples of such analyses is the global abatement cost curves published by the consulting firm McKinsey&Co. At the low end with negative costs are typically energy efficiency measures and at the high end we find carbon capture and storage (CCS) and solar cells. (On a separate note, it is interesting that such curves do not display expensive energy efficiency measures at the right end of the curve although no doubt such expensive options do exist).

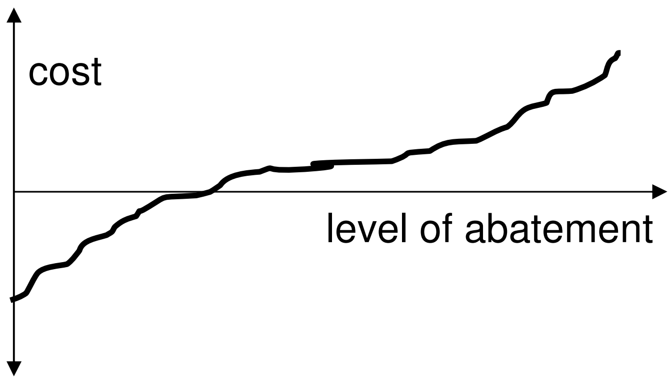

Figure 1. Schematic abatement cost curve

The fact that such analyses and curves show negative cost options can be explained by some of the market failures and barriers discussed above. An overlapping or complementing explanation is that the abatement cost estimates do not include all the costs associated with various options. For example, replacing incandescent lamps with LED lamps may seem profitable. But to the individual consumer it may entail various transaction costs (as noted above) as well as costs represented by the changed quality of the light or other aspects of visual appearance in existing fixtures. Another example is that going from top-loaded to front-loaded washers may challenge existing norms concerning what a washer should look like, thus representing a cost.

However, energy efficiency in that sense is no different from the other abatement options that also are subject to such hidden costs, generally not included in cost estimates. For solar energy, adding panels to your house and changing its appearance may be considered a cost. Nuclear concerns such as weapons, accidents and waste represent costs that are generally not reflected in abatement cost estimates. The various abatement options have in common that such cost exist but they are generally hard to quantify and monetize.

It also follows from this observation that introducing a carbon price at the level of a specific abatement cost will not be enough to get full implementation of the corresponding abatement options, or the already profitable energy efficiency measures for that matter. Such a "first best" policy can therefore to be complemented with other policies aimed at reducing transaction costs, other hidden costs, or poorly motivated standards and regulation that prevent deployment.

And the risk of wasting money

An important concern in the context of energy efficiency policy is whether it will result in the waste of money that could have been put to better use elsewhere. There is, of course, the risk that policy is forcing investments in thicker wall insulation, super-windows, etc., that are not profitable. The value of future savings may never match the extra investment. Given that there is such a risk the question is whether this is a big problem.

In most cases, energy efficiency involves a higher first cost, an investment, that pays off in lower energy bills. It is a matter of trading capital for energy. The optimal thickness of wall insulation in a house, or pipe diameters and heat exchanger areas in a process industry is determined by investment costs, expected future savings and the discount rate for calculating the present value of those savings. For example, with a low discount rate the optimal pipe diameter is larger since we value future energy savings from lower friction and pressure drop higher than if we use a high discount rate.

There is some evidence that the penalty for overinvesting in energy efficiency is very small. The life cycle cost for keeping a house warm, pumping water, or ventilate does not change much as a function of insulation thickness, pipe diameter or air-handling unit size. Although a minimum in the life cycle cost can be calculated, the penalty for straying from that minimum when making an investment is very small. Thus, being too energy efficient is not very costly. The other side of this coin is that wasting energy may not be very costly either, if the waste results from avoided capital investments.

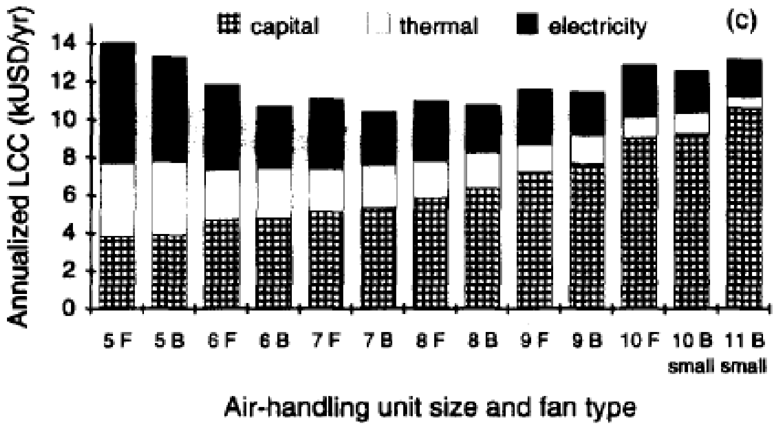

Figure 2. Example showing a flat minimum in the LCC curve (Nilsson, 1995).

In figure 2, the capital cost increases as we move to larger air-handling units where lower pressure-drops and higher rates of heat recovery decreases the electricity and heat costs. We have found very few analyses of this phenomenon in the literature but one example is Steinmeyer (1994) who concluded that "the world is flat" based on his analysis of energy efficiency options in the process industry. But he also noted that: "In the long run, technological change is a more important topic than the trade of energy for capital." Similar evidence of flat minima is found also in analyses of appliance standards (Turiel et al, 1993) and central air-conditioners (Adnot, 2003).

Baselines, additionality and correction factors

Surprisingly, the ESD does not state that savings should be additional, i.e., over and above autonomous rates of improvement, or that free-rider effects should be accounted for. Perhaps this is a constructive ambiguity that was needed for getting the ESD adopted in 2006. But getting real savings from policy is, of course, important. In the context of CDM, additionality is critical since countries with commitments to reduce emissions can off-set these against the emission credits earned from CDM projects.

We do not question that the additionality of energy efficiency measures that are implemented as a result of policy can be determined with reasonable certainty. We also think that it is important to assess the extent to which policy instruments and programmes are effective (i.e., deliver what they are intended to) and cost-effective (i.e., deliver without wasting money). Our concern is that an overly strong focus on "counting the beans" in terms of energy savings is misguided in the context of making the transition to low-carbon energy and transport systems.

Energy related investment and consumption decisions are made in a complex reality under a range of different factors and expectations about the future. Figure 3 suggests a number of factors and policies that shape energy use in the built environment. For example, an electricity market or tariff reform may have a large impact on electricity prices and thus energy efficiency but it is generally not considered an energy efficiency policy. The primary objective of economic stimulus would be to create jobs but energy efficiency may well be an additional objective. Educational efforts may be more or less geared towards energy efficiency. These are generally considered very important, but the effect in terms of energy savings may be impossible to quantify. A lighting campaign is a more clear-cut case of an energy efficiency policy instrument, the effects of which can be singled out and evaluated against the background of everything else.

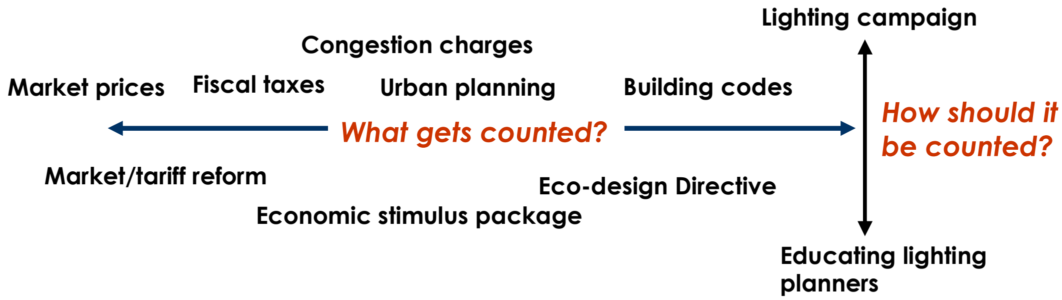

Figure 3. Factors influencing investment and consumption decisions

A number of issues must be considered when estimating the savings that result from policy (Wuppertal Institute, 2009). One is that several policy instruments may interact and care should be taken not to double-count the savings by attributing them to policy more than once. There can be positive spill-over or multiplier effects, leading to indirect or secondary savings from a policy. There can also be negative spill-over effects if a policy is creating an increased product demand leading to higher product prices, or that products get diverted from other markets (at least in the short term). There can also be free-rider effects.[1] A particular issue is rebound effects (although they are generally small) in terms of increased consumption of an energy service, re-spending of income from savings, or lower energy prices, resulting from energy efficiency. It is this complex web of effects from market interventions that makes many analysts and policy makers wary about the benefits of energy policy.

Without getting into detail about rebound effects it might be useful to reflect on this issue in the broader context of a transition to low-carbon energy and transport systems. Carbon pricing through taxes or cap-and trade is a critical element in such a transition. An increased carbon price or other taxes can make energy supply even more expensive in order to cancel out much of the rebound effects. Second, if the world actually reduces the use of fossil fuels (perhaps keeping some with CCS), these fuels will become very inexpensive, but their use will not increase in response to that (except with CCS) assuming a corresponding increase in carbon prices. The argument that reduced fossil fuel use somewhere in the system simply leads to increased use somewhere else is no longer valid in this situation. Third, rebound effects are very welcome in many cases. For example, the low wattage of LED lamps facilitates solar-battery lanterns - a productivity improvement leading to a brighter future with more light for many people in developing countries. The existence of rebound effects is simply not a good argument for society to stop striving for productivity improvements through better technology.

As we move 10-20 years into the future, we also need to question what the meaning of a baseline is. Let us assume that an evolving web of energy efficiency policies and technology development means that LED lamps have become the norm in 2020 and that incandescent light bulbs are not manufactured anymore. Should LED installations still be considered additional? Do we need to update the baseline and when? The counterfactual situation, i.e., one without energy efficiency policy, becomes increasingly hard to determine as we move further into the future.

Reframing energy efficiency policy and evaluation

Energy efficiency policies and programs have been motivated by goals such as energy security, energy poverty, reduced emissions, consumer interests, employment, economic efficiency, etc., and quite often combinations of such goals. This means that goals for energy efficiency should not be pursued in isolation but they are linked to a broader set of goals for sustainable energy which in turn are linked to a broader set of social and economic development goals. Yet, in order to assess and legitimize energy efficiency policy our evaluation efforts tend to focus on calculating the short term cost-effectiveness of individual policy instruments and programs.

Policies and programs have often focused on what has been called resource acquisition, i.e., realising near term savings potentials through creating incentives for retrofits or for buyers of new equipment to make wiser choices. In many cases, energy companies (especially in monopoly markets and with a social obligation) have been seen as the natural agents for implementing such policies and programs (Blumstein, 2009). In this context, the traditional approach to evaluation has made sense. We evaluate one policy instrument at the time, calculate the resulting energy savings (corrected for free-riders etc.), and weigh the savings against the cost in order to value the degree of success.

In the early 1990s there was a growing interest in programs that would lead to market transformation, i.e., lasting changes in the market for energy using equipment. The Swedish technology procurement program was a forerunner in this area, aimed at bringing higher efficiency appliances, windows, heat pumps, etc. to the market through bulk purchases. A market transformation strategy can involve R&D, demonstrations and field tests, commercialisation

[1] For a more detailed account of effects visit the EMEEES project website at www.evaluate-energy-savings.eu

incentives, stimulating market diffusion in various ways, adopting standards to remove the least efficient products and practices, etc. (Geller and Nadel, 1994).

In a situation where society needs to increase the rate of energy efficiency improvement from 1-1.5 percent to perhaps 3 percent or more per year, a stronger emphasis on market transformation appears necessary. Previous analysis indicates that this is possible (Blok, 2004; Ecofys, 2010). Despite its merits, the idea of market transformation does not seem to have gained sufficient ground as a strategic objective in the development of energy efficiency policy. There are some examples, such as energy labelling, that have had a clear effect on some markets. In addition, it should be noted that resource acquisition approaches, such as white certificate schemes, also generate market transformation effects, such as the development of an energy services market. But although important elements may already be there in many cases, they are not coordinated in concerted market transformation efforts. One explanation may be that the authority or jurisdiction over the different elements of a market transformation strategy rests with different government departments, agencies and other actors. Another explanation may be political cycles where energy efficiency and approaches to policy goes in and out of fashion.

Achieving high rates of energy efficiency improvement implies the use of policy packages that target different sectors, end-uses and technologies. Sustaining such high rates over many decades means that policy packages should be designed with a long term view, e.g., thinking about the state of the building stock 10 or 20 years from now and what the future steps may be considering also uncertainty about factors such as technology development and consumption patterns. It implies a different mindset and framing concerning the objectives of energy efficiency policy, how it should be designed, and how it should be evaluated. This, in turn, has implications for how energy efficiency is governed.

Governing the energy efficiency transition

Energy efficiency is not as centre stage in the broader energy and climate policy debate as one would expect based on the important role assigned to energy efficiency in numerous low-carbon scenarios and other studies. One important explanation is that energy efficiency cuts across all sectors in society. Thus, integration of policy across different political domains for greater coherence is important. Although important stakeholders can be identified (e.g., manufacturers of insulation material or ESCO companies) they are, in the overall picture, relatively diffuse and fragmented and with limited lobby power. Similarly, responsibility, jurisdiction, resources and accountability for energy efficiency in government are commonly also diffuse and fragmented.

Making the transition to a low-carbon society implies that the rates of energy efficiency improvement double, or even triple, and that those rates of improvement are sustained over several decades, i.e., an energy efficiency transition. Previous analysis shows that such high annual rates of improvement in new equipment, installations and buildings are possible at least for the next 10-20 years and that consistent deployment of new technology at the rate of capital turn-over would result in substantial decreases in absolute energy use in industrialised countries (Blok, 2004). Realising this will require a huge effort in technology innovation, diffusion and deployment. This, in turn, requires policy and governance.

The concept of governance is used throughout the social sciences to describe how societies, organisations and networks are collectively steered and governed. Governance is often used in opposition to government, which refers more narrowly to predominant steering by state institutions. In the context of an energy efficiency transition, governance includes all purposeful mechanisms and measures aimed at steering social systems towards making such a transition. Governance can comprise everything from strict state regulation to voluntary measures by private and civil actors. It includes approaches to policy and policy processes as well as organisational and institutional aspects.

The recent IEA project on energy efficiency governance defines it as (IEA, 2010): "…the combination of legislative frameworks and funding mechanisms, institutional arrangements, and co-ordination mechanisms, which work together to support the implementation of energy efficiency strategies, policies and programmes." Based on extensive surveys and interviews the IEA study suggests a framework based on three aspects with underlying specific "activities" that contribute to an overall system of good energy efficiency governance, see Fig. 4. Although the relative importance of different activities is highly contextual, the framework provides a useful checklist for policy makers.

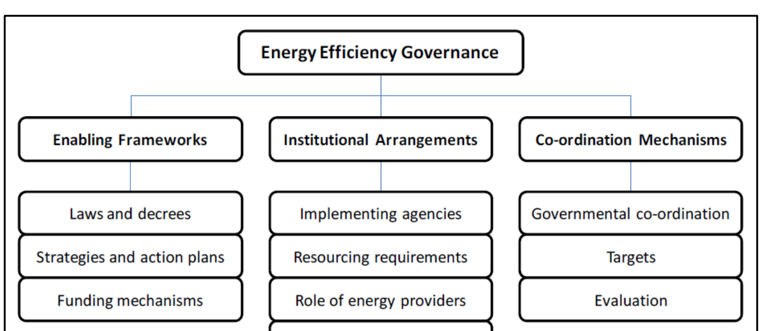

Figure 4. Three key aspects and associated activities for energy efficiency governance (IEA, 2010)

The technology characteristics, actor networks, and markets involved in energy efficiency vary widely across sectors and technologies. For example, in the case of building energy performance, coordination and steering across a complex web of actors is required (including building material and equipment suppliers, original equipment manufacturers (i.e., sub-suppliers), architects and engineers, builders, building owners, tenants and users). For practical purposes, it may be easier for actors in this sector to relate to predictable building codes than to future carbon prices. Thus an overarching issue is what approaches to governance, at different levels from local to supranational, are most effective in various technology and sector contexts. Addressing stand-by losses in appliances requires different approaches than energy efficiency in industrial processes.

The variation and complexity noted above, and differences between countries concerning present energy efficiency levels and market structures, as well as policy traditions and styles makes it impossible to devise an optimal policy mix or recipe for governance. But governments have an important role to lead the way through setting goals and make decisions concerning resource allocation and responsibility, as well as build trust in the stability of new market and investment frameworks for energy efficiency. Top-down governance approaches such as building codes and minimum efficiency standards that are predictable can be complemented with bottom-up approaches such as transition management to stimulate innovation and niche market development for new technology.

For policy to be accepted and policy processes to be perceived as legitimate it is generally considered important to engage various stakeholders in policy development, and not only powerful energy companies. To build trust, it is also important to safeguard implementation. A possible approach is the set-up of independent commissions or expert panels engaged in monitoring and ex-post evaluation, assisting and watching that policies evolve with dynamic consistency to reach the long-term goals. Such safeguard mechanisms can facilitate policy learning and evidence based policy development, in addition to ensuring that actors stand by commitments. Stronger documentation of policy effects as a result of this may also legitimise policy.

Conclusions

The climate policy debate has focused on least marginal-cost mitigation strategies that lead to modest emission reductions in the short term. This mindset is now giving way to a new narrative of pathways to a low-carbon future that is consistent with the 2 C target, involving 80-90 percent emission reductions by 2050 in developed countries. Energy end-use efficiency accounts for the largest share of the mitigation potential according to most studies. Against this background this paper has provided an overview and assessment of issues for energy efficiency, policy design and evaluation. Overall, it shows that energy efficiency is characterised by some complexity and uncertainty concerning policy and evaluation. But we also conclude that pursuing energy efficiency is a low-risk strategy in terms of economic risk and that it has positive, or at least not negative, effects on several societal goals.

Governing the energy efficiency transition implied by a low-carbon future, involving high and sustained rates of energy efficiency improvement for decades, is a different governance challenge than ensuring that moderate emission reductions are achieved at the lowest possible marginal-cost in the near term. The transition requires a reframing of energy efficiency, policy and evaluation where the current focus on verifiable additional savings in the short term gives way to a greater emphasis on concerted and sustained market transformation efforts for the medium and long term. Government has an important role in establishing the enabling frameworks, institutional arrangements and co-ordination mechanisms associated with such a transition. Suitable approaches will vary between different technology, sector and national contexts. A common denominator is the importance of legitimate policy processes and mechanisms for safeguarding implementation to build greater trust and acceptance among actors.

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