The Complexity of Energy Efficiency.

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Preface

This report was made for the Danish Energy Agency, ENS, under a contract "Energispareaktiviteter og deres organisering i EU og USA" as background-material for ENS' work on a new energy conservation plan for Denmark. The request was to make a screening to find tendencies and especially new or restructured measures to implement energy efficiency on the market. The screening should also include a survey of how the National Allocation Plans, NAP, submitted to the European Commission in preparation of the European Trading System, ETS, for greenhouse gases, handled energy efficiency.

Hans Nilsson, FourFact, and Ylva Blume, BorgCo, under contract with FourFact have the pleasure to present the following report on "**The Complexity of Energy Efficiency**".

Analytical overview and summary

Thirty years after the first oilprice-chock the world is still suffering from a high dependency on a few energy supply resources, oil not the least. The European Union focuses on the dependence on imported energy in its "Green Book". Have the energy efficiency improvements failed, or could energy efficiency have a more central role in the economical life than just being a redeemer for wasteful use?

It is often questioned if GDP-growth requires more energy and the answer is: "yes probably , but….!". It may need more energy-service, but not necessarily more energy-use! Present economical welfare is largely achieved because of energy efficiency improvements rather than energy supply. Calculations of the energy efficiency improvements and the structural changes show that they dwarf the traditional energy resources in "fuelling" the growth in worlds GDP. See figure below that is based on the IEA World Energy Outlook 1998.[1]

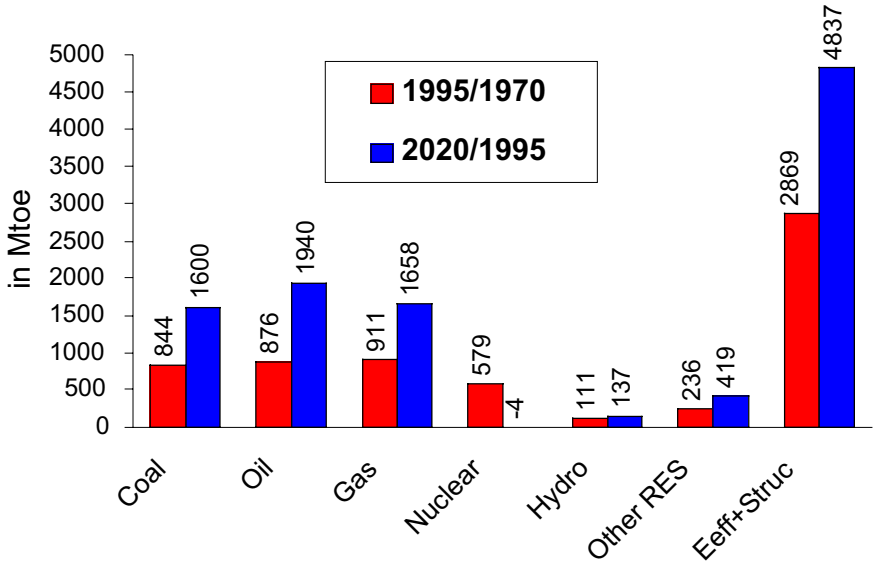

Figure: *"Fuel" for global economic growth; eff.&str. stands for energy efficiency and structural change, i.e. for the effect of the decrease of energy intensity*

Energy efficiency is however a complex issue, primarily because energy efficiency is not a good in its own right, but a characteristic inherent in products bought and used to fulfil other service needs, such as light, comfort and power. To handle this complexity one has to:

- Understand and Address the complexity of energy efficiency (see part 1)
- Manage the complexity of energy efficiency (see part 2)

We have learnt a great deal since the mid-70´s. There is a clear policy learning curve to be observed and used. In the beginning energy efficiency equalled conservation which was motivated to reduce costs and dependency on oil because of the OPEC-control of the oil resources. The market was largely monopolised and quite a bit of result was from direct government activity and interaction. Today the concept of energy efficiency has matured tremendously and contains several more aspects such as, economy, sustainability of resources,

[1] Nuclear Energy and Kyoto Protocol in perspective, M Heindler and G. Benke for Nuclear Advisory Board (FAF) of the Austrian Federal Minister for the Environment. Nov. 2000

environmental impact, security and reliability of energy systems, distribution of welfare and innovations for industrial development. All these aspects could be combined and promoted by energy efficiency achievements. The market in turn has changed and is more fragmented due to liberalisation and globalisation.

So we have on one hand gained a more sophisticated view on what energy efficiency could do and what value it has, but on the other hand the policy environment has changed. One could say that we know better what to do but that we have lost some old tools and are still working on creating new ones. Government actions are still very important but have to be tailored to the new context. There is an opportunity both to make use of the technologies, and to drive them further at the same time. Thus making use of the market learning process. The policy options to do this are twofold and non-exclusive. On one hand, and for some cases, one could work for market acceptance. On the other hand, and other cases, mandate actions.

A very useful and illustrating process for this is the ongoing adaptation to the Kyoto-requirements. The European countries are allocating emission rights to industry. In this process there is a need to judge how much can be achieved by all parties concerned. So far most concern have been on the Trading Sector but any misjudgement in the allocations have to be picked up by the non-trading sector and governments have to monitor the development very vigorously and be prepared to develop the necessary tools to act.

Designing tools for the job

IEA reports that energy efficiency improvements slow down in a time when they are more needed than ever[2]. There is a strong case for initiatives that reinforces positive trends for energy efficiency. From this study we would describe such reinforcement measures in the following three categories:

I. Make the product visible, available and attractive. (Commoditise-Tradify-Incentivise)
   To do so there is a need to:
   - Commoditise energy efficiency to make it accessible for customers/users. They need to see, understand and handle the energy efficiency that is embedded in the products. This requires that suppliers either make a good or show a good, i.e. to refine the product so energy efficiency is an argument or to show the energy efficiency part explicitly.
   - Tradify energy efficiency to make it possible for actors to handle it in a way that engages the stakeholders and releases their innovativeness. This may require rearrangement of the market place or creation of market instruments that forces, visualises or reward trade where energy efficiency is embedded or explicitly targeted.
   - Incentivise energy efficiency to make it more palatable for the stakeholders. This does not necessarily mean new remuneration but rather that the profits and other positive effects are addressed and shown more clearly.

II. Technology development needs to be refuelled
   The IEA study indicates that we have got lax in our attitude towards technological (as well as behavioural) changes. The suppliers and the entire value chain that delivers to the customers need more imperative challenges for their improvement. The globalisation of markets needs to be taken into account in a positive way. Many of the

[2] 30 years of Energy Use in IEA Countries. OECD/IEA Paris 2004

fast-growing economies need totally new concepts to be able to meet their needs without resource depletion. They may want to do it in co-operation with the old industrialised world or without. In either case there is benefit to make use of the change and more benefit if one is able to drive the change.

III. Customer involvement needs to be strengthened in the market places
Customers on the market have the right to buy what is offered to them but little chance to have influence on the offers. Nevertheless customer involvement is often necessary to articulate needs to the producers/suppliers. Aggregation of customer's for procurement is a strong tool for the market to get the message from the concerned parties.

Two IEA studies shows that on one hand the market construction[3] and on the other hand technology development[4] should allow a more dedicated customer involvement also in the electricity market place. Customer capacity to give "Demand Response" should be used to both reduce the price volatility and to enhance system reliability.

Some possible policy conclusions

Design **policy packages** and not only incentives. The packages have the advantage that they respond to multiple goals that the energy efficiency technology in question could have, but also that the packages are more politically robust in times of changes. Such policy-packages should also be based on people way of acting instead of making people act to suit the policy-measures.

Voluntary Agreement should promote the best technologies and maybe even better than today's best, BAT+. In the EU the Lisbon process aims at giving Europe a front position in knowledge based industry. One way to arrive there is to aggregate purchasing power in all sectors and direct it towards innovative products. Denmark has several opportunities to act in this area by the existence of the industry voluntary agreement, the requirement for utilities to act for energy efficiency, the regional efficiency networks, and the electricity saving fund, just to mention the most obvious.

The flexible mechanisms of the Kyoto-agreement could work in the same direction as above, both JI and CDM. According to the Danish NAP it is the intention to use both these instruments. It would then be an advantage to promote such JI/CDM projects that may also produce spin-off for Danish Industry and Danish needs. One such area that seems possible to exploit is small-scale, decentralised CHP.

Development of instruments could be needed to strengthen the "distribution of energy efficiency" by, e.g. developing ESCOs within a context of **commitments and certificates**.

[3] Power to choose. Enhancing Demand Side Participation in Competitive Electricity Markets. OECD/IEA Paris 2003.
[4] Distributed Generation in Liberalised Electricity Markets. OECD/IEA Paris 2003.

These should then also take notice of the need to mobilise the non-trading sector and/or to make up for the non-incentives for utilities to act for energy efficiency.

In this context it could be worth considering forms for banking, and also to develop bonus-fines within both the commitments (see above) and in the trading sector. Early action could merit a top-up from public funds.

Part 1: Understanding and Addressing the Complexity of Energy Efficiency. Policy Framework

Introduction

Energy is needed to provide essential services in any society, services that can be expressed as light, comfort, power and mobility. It is this demand for services that drives the need for supply in the energy system. The services can however be provided by energy-using technologies that uses little or much energy and uses different types of energy for the same output of services.

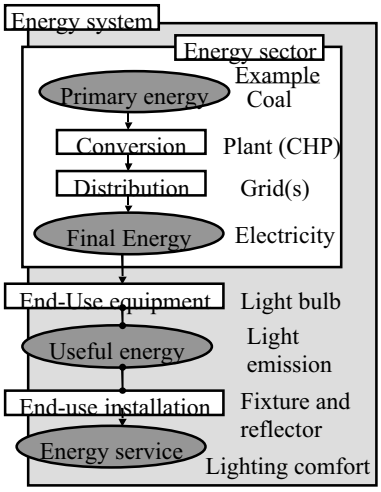

Figure 1: The Energy system

Focus for energy policy is mostly on the supply side because that is where the consequences become visible. Energy supply has emissions, creates waste, requires logistics, is scarce, can fail abruptly, etc. Lots of effort is therefore put in to securing of supply and to tackle the problems it have. Logically the first line of action however ought to be to focus on:

- Needs for services and
- End-use technologies for delivering of the services

Improvement of end-use technologies also has the effect that it is possible to provide more services with the same amount of energy supply as before. Thus these improvements drive increases in welfare, comfort and in spreading energy services to people whom earlier did not have access to such. The technology improvement hence has two sides; economising and rising/spreading of welfare.

One of the problems in dealing with energy efficiency is that it is not an easily trade-able good, but merely a performance characteristic, embedded in products that are demanded and traded for other purposes.

The logic that energy can be economised became obvious and apparent with the sharp oil crisis in the 70´s and then primarily as a tool to ease the impact of the price-chock. Since then the societal perspective has widened and in the following the development is described in more detail.

- Firstly, the tendencies and trends over 30 years,
- Secondly, how the pieces in the present paradigm have formed today's menu of opportunities
- Thirdly, how the institutional framework has absorbed the new paradigm and support (or hinders) energy efficiency

From Conservation to Sustainability. (General tendencies and trends).

The general trends can be captured in studies of the IEA material from three decades of work devoted to the issue of oil-dependency including energy efficiency as a means to reduce it. Other sources could then be used as corroborating "snap-shots" that gives evidence to the state at a given time.

Evolving of the concept
Energy efficiency has been in focus for administrations since the first oil-crisis in the early 1970´s. Primarily addressed as energy conservation, and part of emergency actions, to reduce the threat to the economy from high oil-prices determined by the producers' cartel, OPEC. Creation of the IEA in 1974 widened the perspective on energy efficiency from a short-term emergency issue to an issue to reduce oil-dependency in a longer term.[5] R&D resources had to be pooled between the IEA countries. Thus the organisation should develop (common) policies, measures and technologies to reduce dependency on oil.

The reasons for energy conservation were mainly based on economic arguments[6]:

- Depletable resources should be available longer
- Tightening of the energy market should be postponed
- Investments in energy efficiency had higher returns than in supply
- Investments in energy efficiency could be made in smaller increments and thus be more flexible when outlook is uncertain
- Widespread public concern (!) about environmental effects of energy production[7]

At that time any shift away from oil was preferred, even from oil to coal. Since then the environment – and notably the climate-issues – have entered into the perspective and the need for improved energy efficiency further underlined. The strive for sustainability, i.e. to not further deplete the resources of the earth, also means that both renewable fuel and energy efficiency is preferred and necessary. With this view it is more advantageous if the two needs are developed together. Reduce energy use to allow for the (remaining) energy need to be supplied by the renewable fuels.

Lately the concern for reliability and security of energy systems has added to the arguments for improvement in energy efficiency since too high demand and unfavourable load characteristics create a strain in the supply that makes the transmission and distribution

[5] The IEA was at that time also known as "the oil-club".
[6] Energy Conservation in IEA Countries, OECD/IEA Paris 1987, p 26.
[7] Note that environment was addressed as a public concern but not necessarily an objective issue to deal with

vulnerable. This concern has been inherent in the concept also earlier but not articulated in the terms of market function (Demand Response) till later.[8]

Further the economic development in the fast growing economies in Asia, notably China, has made it clear that energy services provided even with present best available technologies (BAT) is not sustainable. The only possibility to make the present western standard of living available for the huge populations in these countries is by a step change in energy efficiency of the products.[9]

Along the same line of thinking it is clear that electrification for two billion people in the less developed countries (LDC) preferably should be based on renewable fuels. Such a development would benefit greatly if the end-use technology, such as lighting, refrigeration, pumping etc., could be made more efficient since a balance between demand and supply by use of renewable fuels is easier to obtain when less is required.[10]

The growing list of arguments for energy efficiency and sustainability should also be valued in light of the Lisbon strategy:

> ***"The Union has [today] set itself a new strategic goal for the next decade to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion."*** [11]

The implementation of this strategy has come in new light when the European Commission has decided that efforts should be made to raise R&D expenditures for innovations and among the means to find ways to direct public procurement towards innovations. Energy efficiency is an obvious candidate.[12]

The need for improvements in the use of energy has thus rather been made more and more obvious for parties concerned with the infrastructure for energy supply in the society. Governance of some sort seem to be necessary to both convey the view of concern to the actors in the society and to support their choice for energy efficient solutions. Governments would like to both make use of the technology development and to drive it further.

In parallel most of the IEA countries have made profound changes in their market organisation. Handling of the energy issues has been more fragmented. Markets have been "liberalised" and in some cases also privatised. The actors both on the supply side and on the demand side see and control less of the system as a whole. They communicate only with the closest levels in the value-chain and are given very limited responsibilities. Government interventions has thereby to some extent been made either impossible or been more restricted not to disturb the market and its actors.[13]

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[8] There is still a need for fast emergency actions more based on a societal sense of urgency. The IEA secretariat has in its programme of work such an activity called "Saving electricity in a hurry". In reality this is however more "Quick load curtailment for some time" than saving.

[9] This is the obvious result of the global views on consequences in terms of energy supply and need for investments in supply capacity made in the IEA biennial publications "World Energy Outlook".

[10] See "G8 Renewable Energy Task Force", Final report, July 2001.

[11] The Lisbon strategy, March 2000

[12] Investing in Research: An action plan for Europe. COM(2003)226 final. See especially paragraph 5.4. Public Procurement.

[13] Notable is the Swedish case of Vattenfall (The state owned supply Company) who in their "Uppdrag 2000" had the task to develop services for the market in terms of energy efficiency and that has been disbanded in total.

Rebound or welfare?
It is sometimes said that improvement of energy efficiency is partly self-destructive due to so called "rebound". When technology for a given service uses less energy this will instead be used in so much greater volume or used more extensively which will even lead to a greater use of energy than before.

It is highly likely that energy-efficient technologies will have budget effects, i.e. that the user saves money which can be used for other purposes some of which will again use (more) energy. It is less likely that it leads to buying more equipment of the same sort. Another look on the so called rebound would then be to say that energy efficiency improvements certainly lead to a higher welfare in terms of more opportunities for consumption. If more consumption equals higher welfare is however a different issue that could be discussed either in terms of philosophy or in terms of distribution in the society. It could however hardly be bad to add more opportunities.

Energy efficiency is mostly in policies looked upon as a means to ease the problems associated with growing demand. It could however with the discussion as above be looked upon as one major cause for growth and growing welfare. Calculations of the energy efficiency improvements and the structural changes show that they dwarf the traditional energy resources in "fuelling" the growth in worlds GDP. See figure 2 below that is based on the IEA World Energy Outlook 1998, [14] and figure 3.

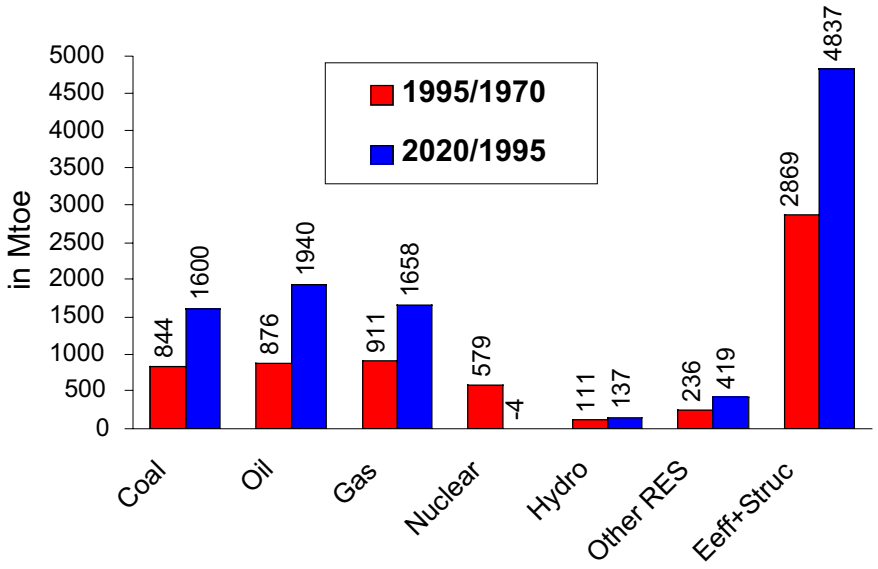

Figure 2: "Fuel" for global economic growth; eff.&str. stands for energy efficiency and structural change, i.e. for the effect of the decrease of energy intensity

[14] Nuclear Energy and Kyoto Protocol in perspective, M Heindler and G. Benke for Nuclear Advisory Board (FAF) of the Austrian Federal Minister for the Environment. Nov. 2000

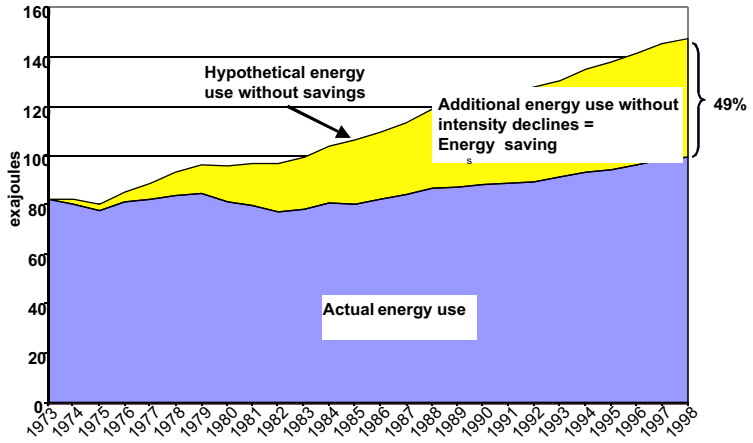

Figure 3: Real and hypothetical energy use under assumption that energy efficiency would not have been improved in some (11) OECD-countries, representing appr. 80% of the energy use in OECD.[15]

Development of policies for energy efficiency

It is possible to distinguish three phases in the development of the last 30 years. From the first emergency period when energy conservation was the aim, to the phase with more elaborated measures to transform the market and into the present new era when energy efficiency in one (of several) measures to attain a sustainable society.

Act I – Energy Conservation

When the IEA in the end of the 1980´s argued for energy conservation policies it was based entirely on economic principles as has been shown above.[16] The market had to be corrected though a considerable degree of the regulated monopoly market with government owned and controlled supply was accepted. The basic points for study and recommendations was:[17]

- There is a considerable potential for improvement on an economic basis in efficiency in energy use
- Limitations in the energy conservation market….., prevent the potential from being used
- Carefully planned government policies could reduce those limitations

As we see, the arguments are actually only one; Economy, but looked upon in a sort of dual fashion. Economy can be planned but execution should be left to actors even though several of them could not act correctly (according to the view of the advisor).

The details of this study were[18]:

i) Potential for improvement up till the year 2000 was 30%. Especially in the buildings sector but also industry, transportation and transformation (!)

[15] 30 years of Energy Use in IEA Countries, OECD/IEA 2004, Figure 3-16
[16] Energy Conservation in IEA Countries, OECD/IEA Paris 1987, p26
[17] Energy Conservation in IEA Countries, OECD/IEA Paris 1987, p 8.
[18] Ibid. pp 9-17

ii) Limitations existed because of:
- Investment criteria on demand side are significantly stricter than on the supply side.
- Market prices (for energy) are not reflecting long term outlook; Prices are not determined on the market; Prices are "held down" by authorities especially on electricity and gas
- Energy prices do not take externalities into account especially not for environment and security
- Lack of information and skills to conserve energy; invisibility of energy use; lack of confidence in energy services; separation of responsibilities for conservation investment and for energy expenditures

iii) Policies and Measures were recommended in several categories:
- Organisation of activities (Bringing energy service industry together; Integrated Resource planning and DSM-activities delivered by the supply side; Supporting NGOs with local networks; Activating governments on all levels)
- Energy pricing and taxation policies (Reflect world market price; Weight energy policy objectives into tax policies; Internalise externalities)
- Government conservation programmes (Information Programmes is a corner stone; Financial incentives (tax incentives, grants, soft loans); Regulations and standards)
- Research, Development and Demonstration (Assessment and feedback important; Also socio-economic studies)
- The exemplary role of governments as energy consumers (investing, monitoring, communicate results)

The liberalisation of the market should provide the actors with more accurate material for their decisions and thus obtain optimal conditions. In hindsight it is interesting to see that first bullet under ii) above is satisfied but second and third bullet is not compatible with the functions of a liberalised market.

Act II – Energy Efficiency, Market Transformation and Climate Change

Several years later the IEA view on energy efficiency has developed and the title chapter of the Energy Efficiency Initiative (EEI) 1997 is "Energy Efficiency, Economy and the Environment. Building block to sustainability". [19] The arguments for energy efficiency are: Environment; Sustainability; Economic prosperity; Personal Comfort; Economic stability. The challenges are to get technological achievements into use faster, be more broadly disseminated and to get the behaviour of users to adapt. The key issues to make this large-scale improvement happen are international co-operation and co-ordination of activities, relying on market forces for innovations and a distribution that will bring along market transformation (technology shift).[20]

The advice was in the form of steps to make a national strategy and contained[21]:
- Establish and maintain an effective market Structure
- Address Consumer needs
- Focus market interest on energy efficiency (products and services)

[19] Energy Efficiency Initiative. Danish Energy Agency, The Energy Charter, OECD/IEA, Paris 1997.
[20] Ibid. P 19
[21] Ibid. Chapter 7

- Ensure access to good technology
- Develop a supportive institutional framework (i.e. rules for actors)
- Act to ensure continuity

The advice is still primarily arguing economic rationality for economically rational actors but has a much scope than the advice for conservation ten years earlier.

This broader view is further emphasised when the IEA celebrates its 25th anniversary 1999 when it is declared that the economical view was still valid but also: "Using less energy means reducing emissions and less ecological damage. Moreover, technology will be the source of cleaner, more climate-friendly devices and processes." [22] Here the necessity of energy efficient technology (Market Transformation) as a prerequisite for development is clearly hinted.

The IEA makes several overviews of the actual policies in their member countries. One type of study, "Dealing with Climate Change", has focused on Climate issues and been published thrice, 2000, 2001 and 2002. In these studies Policies and Measures are recorded and classified in order to see common patterns and to show cases of good practice.

In the study from year 2000[23] enters a view on the characteristics of the decision makers and they are classified according to sector (Residential/Commercial; Gas/Oil/Power Production; Industry; Transport) and for each is recorded their:

- Capital Stock Turnover
- Decision-makers (size, number, incentives, process)
- Policy Developments

The report says, "there is no silver bullet" policy but they isolates a few recommendations that go along the same line as the EEI (Get prices right; Use market approaches; A Mix of policies is required; Monitor and assess impact of policies; Create Institutions[24] to meet the multi-faceted challenge; International co-operation).

In the analysis the classify the instruments that are used as:

- Fiscal (Tax-related; Subsidies)
- Market (Emissions Trading and/or Project based Programmes; Certificates;
- Regulatory (Regulatory Reform; Mandates/Standards; Voluntary Agreements; Labelling)
- R&D (Funding; Incentives; programmes; technology Development)
- Policy Processes (Advice/Aid in implementation; Consultation; Outreach; strategic Planning; Infrastructure Management)

The entire analysis shows an insight and a respect for the complexity of the matter and though it begins in the traditional end (economy and rationality based thereupon) it shows the need for support in many areas for decisions to be environmentally justified.

This study was repeated two years later and basically used the same framework.[25] It was noted that the countries adopted portfolios of Policies and Measures (called PAMs) but that the portfolios varied enormously between the countries. The study then focuses on transport and on renewable energy production.

[22] Energy 2000. Celeberating 25 years of the IEA. P 10.
[23] Dealing with Climate Change, OECD/IEA Paris 2000, Table 4, p 20
[24] They use the expression institutions more synonym to Organisation where the EEI used it synonym to Rules
[25] Dealing with Climate Change, OECD/IEA Paris 2002

The analytical part of this study tries to assess "Optimising of Climate Change Mitigation" and makes traditional remarks about bottom-up studies versus top-down studies. It goes on with study of France, Netherlands and EU as cases and do not come to any distinctive conclusion.

The compilation of information from the countries is highly useful as a catalogue but the analysis shows the same problem as many other IEA-publications. From the outset they look alike and are part of a series (typically the country studies), they have a common framework for descriptions but the analysis are not comparable. The reason is that the studies are made with new staff each time and that there is very little (if any) quality control for the products. Therefore they need active readers that can make use of the facts but do not rely too much in the perceived findings.

Act III – Energy Efficiency for a sustainable future

Again the IEA has an anniversary and has published a study on the how energy use has developed over 30 years.[26] The study is using the disaggregation well known to all the Nordic countries and tries to isolate the causes for change in factors: Activity; Structure and Intensity. The IEA has time series available only for 11 countries but these represent 83 % of all energy use among the IEA members and are therefore very significant.

The conclusion in general is that energy use has grown primarily due to a raise in activity though both structure and intensity has improved considerably. If they had not the energy demand would have been even bigger.

Wealth and Energy use is (and could be) in practice decoupled but we have chosen to take out intensity improvements in growing comfort rather than in reduced use of resources.

There are however reasons to worry, the report says, because:

- The pace of improvement has declined since early 90´s
- Some sector activities with tight link to fossil fuels grow faster than others, notably Transportation and Freight
- Some others are growing in demand for miscellaneous energy services, notably Service sector and households.
- In spite of the focus on GHG-emissions CO2-emissions are growing

Information from this type of study combined with the more detailed view on acting from e.g. the EEI and the climate change studies could be a fruitful way to find elements that are cultural and/or depending on the category of decisions and that could be subject to development of Policies and Measures, PAM.

Energy Policy of the IEA countries are tracked, analysed and described in Annual reviews from the IEA, the latest published 2003.[27] One of the chapters is devoted to energy efficiency. In this edition it is noted that energy policies are asymmetric in the sense that

[26] 30 years of Energy Use in IEA Countries. OECD/IEA Paris 2004.
[27] Energy Policy of the IEA countries, OECD/IEA Paris 2003. Chapter 6, pp 105-110.

they are in majority dealing with energy supply but also that energy policies to affect energy use are difficult since the consumption side is "diffuse".

It is however noted, with reference to the UK white paper, that energy efficiency could achieve about half of the GHG reduction targets up to 2020. It is also stated that such goals run counter to other polices and especially is mentioned liberalisation and deregulation of energy markets to the extent that the prize alone should carry the signal for action. The report then goes on and describes a few tools and their application in more detail:

- Minimum efficiency regulations
- Voluntary efficiency Programmes

Most work analysing trends has as a purpose to make projections for the future. In the IEA work a recent study has been made to compare scenarios and different types of scenarios.[28] In this study there is a distinction made between on one hand ***explorative scenarios*** and on the other hand ***normative***. The former tries to find out what happens in the energy area given different general characteristics in the society and the latter tries to back-cast a needed trajectory from a wished future state (in this case a sustainable society).

The explorative scenarios make three combinations of four possible from technological change (fast or slow) and of public attitude towards global environment (unconcerned or concerned)[29]:

- Clean but not sparkling (slow technology change and public attitude is concerned)
- Dynamic but careless (fast and unconcerned)
- Bright skies (Fast and concerned)

On the implications for technology and policy the study says:" …(Bright skies) is the most favourable from the point of view of meeting the conditions for long-term sustainability, and presents the lowest risks …. from the point of view of security if supply and environmental protection.[30] While this scenario has some clear advantages the study also remarks that technology alone can not be trusted to deliver but that there is a clear case for "political will", which "ultimately depends on social values and priorities: an altogether much more difficult variable to change".[31]

The scenarios also points at some important technology areas where policy could (and should) be more effective among some of them demand side or closely related to demand side, such as:

- CHP and micro-generation
- Stationary fuel cells
- Power generation from renewable sources (solar PV, solar thermal, wind, biomass, hydro-power)
- Appliances
- ICT to optimise performance
- Fewer energy- and material-intensive processes and services
- Passive heating and cooling technologies and architecture in buildings

[28] Energy to 2050. Scenarios for a sustainable future. OECD/IEA, Paris 2003.
[29] Ibid. Chapter 2
[30] Ibid. P 103
[31] Ibid. P 105

- Building management systems
- Fuel efficiency in conventional vehicles
- Hybrid and fuel cell cars
- Hydrogen storage technologies
- Mass transit systems
- Advanced public transport systems

As mentioned this study also tries a normative approach that has a "sustainable development" as result. The policy implications are sketched and seem to rely a bit upon assumptions not fully described in the text.[32]

For the **industry sector** it is said that attention to the bottom line and the price signals and "steady signals" on policies are the main elements. Standards may have a role but "cap and trade systems" would be more effective. This view assumes that the sector is basically acting as profit driven but seems to avoid the issue of long-term versus short-term view in such acting.

For the **residential and commercial sector** is "prescribed" a whole set of interventions, such as; standards, building codes, tax incentives, preferential loans, elimination of perverse subsidies, information. The norms and standards should be gradually tightened and information also for changing of attitudes be maintained and clear.

For the **transport sector** it would be necessary to identify and make use of niche markets to pull certain technologies. Fuel efficiency standards and taxes as well as combinations thereof will be needed. Congestion and noise are factors that could be addressed and it is also mentioned the possibility of planning for better systems and to underpin this by use of developed ICT.

The changing energy efficiency paradigm

Paradigms are defined as "generally accepted views". These, however, changes over time. Such changes sometimes referred to as paradigm shifts, meaning a radical change or a shock. The IEA observation that energy efficiency is slowing down could be an indication that there is a need for a shift. But where, and how? We may see that by first observing where and how it has changed hitherto.

The main elements of the "generally accepted views"

We see that the set of **objectives** has changed rather dramatically over time. From a purely economical concept with some economically derived aspects on security to a much more diversified set of objectives with strong environmentally related components. The set of objectives taken together naturally have economical implications and is therefore often discussed on Cost-Benefit terms and analysed with trade-offs between the relevant components in the set.

As for the **issues** there have been dramatic changes especially in understanding how and by whom changes are made; from the rather simplistic view of the economic man to the more

[32] Ibid. P 150 ff

complex ideas of individual choices based on limited information as well as the notion of asymmetric policies for supply and demand.

The **measures** suggested (at least by the IEA) has not developed in pace with the understanding. They still start of with the economic means targeted to the fully economically rational actor, but admit to growing degree that these will not deliver the full result. And even that they may be wrongly shaped in some cases by limiting the actors when they are not supported by other means.

From an IEA perspective the main **actors** are governments and their administrations. As the market liberalisation has developed the view on involvement from the governments has of course changed and more stress been put on how governments can provide market-based and neutral incentives that enables actors to move towards energy efficiency.

To obtain a large-scale change in the society there are basically only two ways;

- either to **mandate** certain performance levels on the products that use energy
- or to make such performance levels the default of the **market** by their attraction

The strategic problem could be said to be: "How to find the proper actors and arm them with suitable measures to attack the issues and reach the objectives?". In this process the development through time indicates that the perception of the strategic problems has matured. Decisions are made on different levels in the energy system and by actors that have very different access to information, ability to calculate and determine consequences and different values as regards the result. Do they want to save money or do they want to limit the hassle in their lives?

Objectives, Issues, Measures and Actors

In this section we will analyse which are the new and more promising combinations of objectives-issues-measures-actors that can get a bigger impact and mobilise the market forces effectively for the result.

The following tables aims at illustration rather than preciseness, but will give opportunities to discuss and compose more suitable targets for operational activities. We will distinguish between old, new and emerging paradigm again without preciseness but where;

- Old is past time,
- New is present time and
- Emerging is indicated Future.

Objectives See appendix 1

The change in objectives is two-fold. On one hand the original set has been further developed and reformulated. On the other hand new objectives have been added since the societal agenda has changed (e.g. inclusion of climate perspectives) or the societal framework has changed (e.g. with market liberalisation).

The development of objectives has an impact also on measures. If the objective was only one it might have been possible to apply only one measure (or type of measure). With several objectives there may even be internal conflicts between them and there is a need to use and

balance several measure to achieve a reasonable solution that may not solve all problems to the best of each, but to the best of all.

Issues See Appendix 2
In the best of words people would do the right (the optimal?) thing by themselves without hesitation or delay. The right thing is however debatable as described above. Two objectives that are both justifiable could be in conflict with each other. Maybe we will then not be able to do the best thing but we will certainly be able to do better than now. But what is it that's stands between the present solution and a better one? How do we understand and present the issues?

Mostly we say it is "Barriers". This metaphor however has the disadvantage to give the impression that barriers are obstacles that once removed automatically leads to improvements. There might be more than barriers. In a study on "technology Deployment" by case studies it was observed that[33]:

"…..case studies were examined from three perspectives on deployment policymaking that have taken shape over the last quarter century:

1. *the **Research, Development and Deployment Perspective**, which focuses on the innovation process, industry strategies and the learning that is associated with new technologies;*

   Mainly concerns Industry in their capacity as suppliers and inventors

2. *the **Market Barriers Perspective**, which characterises the adoption of a new technology as a market process, focuses on decisions made by investors and consumers, and applies the analytical tools of the economist;*

   Mainly concerns Governments (mostly on national but also on regional and municipality level)

3. *the **Market Transformation Perspective**, which focuses on what needs to be done in practical terms to build substantial markets for new energy technologies.*

   Mainly concerns Customers (users) and **Distributors** to the market,

In part the three perspectives are different vocabularies for discussing the same phenomena. Yet they are complementary – each adds something that the others lack"

Table 1 Perspectives on market and concerned parties

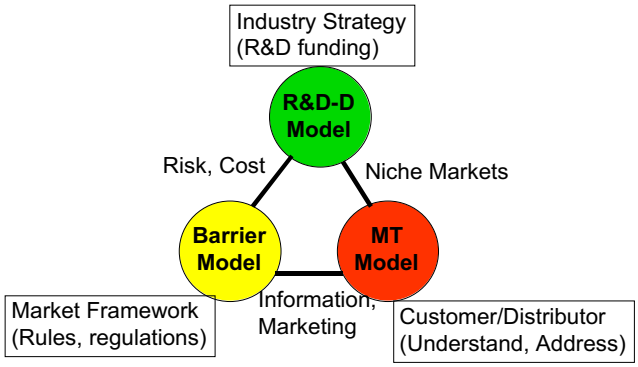

Figure 4: Models/Perspectives and their internal relation, c.f. table 1 above

[33] OECD/IEA 2003 Creating Markets for Energy Technologies", OECD/IEA, Paris,

Fragmentation of measures (one measure for each objective/issue) is practical for analysis but may lead wrong for design of operations. Studies of Technology Deployments suggested that focus should be on purpose of policy packages rather than isolation to a fictional correlation between objective/issue and measure. This approach could give the following "classes"[34]:

- **Serve** the customer
- **Incentivise** the customer
- **Educate** and protect the customer
- **Manifest** the demand for a change
- **Vitalise** conservative business structure
- **Reconsider** existing regulations and rules
- **Enhance** financial framework & conditions
- **Recognise** system aspects

Within these purposes it could be possible to compose policy packages that could also be adjusted accordingly as experience is gained.

Measures See Appendix 3
The market reform has changed some relations between parties and thus put some measures out of use. At the same time new opportunities have opened and some measures may just have to change names to be used! If e.g. DSM cannot be mandated to utilities they could still be brought into the work by (voluntary) agreements and maybe even more so by the trading systems that are emerging.

The development over time seems to go in the direction of handling more complex situations. An understanding that measures have to be tailored to the situation and the purpose. Example: Subsidies are neither good nor bad, but they could be more or less justified and they could give more or less leverage to change the market.

It is possible to give normative advise on combinations of issues and measures as follows.

Measure (Incentive)	BARRIERS	R&D+D	MARKET TRANSFORMATION
Subsidies	Should be based on performance, be neutral to supplier and aim at reducing reluctance for new technologies and applications.	Should be invested in "learning". Attracts and motivates new actors to growing markets.	Activates the distribution to provide products and develop service. Attracts users to new products.
Information	Should enable users to calculate and understand products (use and consequences).	Enables identification of products and manufacturers.	Puts focus on certain performance and is available at sales point when decisions are made.
Taxes, fees, levies	Correct market imperfections, especially externalities	Incentive for industrial development.	Promotes good solutions and steers away from bad.
Regulations	Codifies possibilities to secure transactions and enables fair competition.	Provides continuity in the learning process.	Standards to define products and enables performance to be understood.

Table 2: Measures related to models for market perspectives

[34] OECD/IEA 2003 Creating Markets for Energy Technologies", OECD/IEA, Paris, chapter 7

Actors See Appendix 4
With the changes in objectives and organisation of markets also come changes in conditions for the actors. The macro-world has grown by globalisation of trade and of matters and the micro-world has grown in terms of involved stakeholders. If the projected energy efficiency improvements are not readily delivered by one there may be a case to look for new supplier or to create instruments that make them deliver.

Biased decisions
In the paradigm shift we have traced an important factor is how decisions are made, by whom and on what basis. Part of the understanding of how energy efficiency can be handled is to understand that **decisions are biased**.[35]

<table>
<tr><th colspan="4">Decision Characteristics</th><th colspan="2">Corresponding Characteristics for technology</th></tr>
<tr><th>Frequency of Change</th><th>Basis for choice of replacement</th><th>Energy and savings as objective</th><th>Decision strategy</th><th>Unit size</th><th>End-Use Activity Type</th></tr>
<tr><td>Often</td><td>Habit</td><td>Never</td><td rowspan="3">Mainly along Heuristic rules (if not purely by habit and tradition)</td><td>Very small (20-100 W)</td><td>Household lamps</td></tr>
<tr><td>Regular</td><td>Routine</td><td>Occurs</td><td>Small (100-1000 W)</td><td>Small appliances</td></tr>
<tr><td rowspan="2">Normal</td><td rowspan="2">Planned</td><td rowspan="2">Important</td><td>Small (1-10 kW)</td><td>Commercial maintenance, (e.g. motors)</td></tr>
<tr><td rowspan="2">Rational within delegated responsibilities</td><td rowspan="2">Big by unit size or aggregation (10-5000 kW)</td><td rowspan="2">Industrial & Commercial. Retrofit (e.g. lighting)</td></tr>
<tr><td>Not often</td><td>Calculated</td><td>Important</td></tr>
<tr><td>Seldom</td><td>Investment</td><td>Depends</td><td>Rational in context of purpose</td><td>Huge (> 2 MW)</td><td>Production and process technology (e.g. casting)</td></tr>
</table>

Table 3 Illustration: Consciousness about energy depends on who the consumer is [36]

The good news however is that people act in several capacities and once a positive attitude to energy efficiency improvement is developed it may remain with the person and form future decisions in other areas.

A smooth paradigm shift?

The insight that energy efficiency is not an easily trade-able good, but merely a performance characteristic, embedded in products that are demanded and traded for other purposes, has come gradually. It seems obvious that if energy efficiency should be widespread it has to be

[35] As studied by Kahneman and Tversky people react differently to equal propositions as regards saving money and earning money.
[36] Nilsson, H. and Wene, C.-O. (2002) 'Best Practices in Technology Deployment Policies', Proceedings of ACEEE Summer Study on Energy Efficiency in Buildings, Asilomar, California, 18-23 August, 2002, p. 9.267

accepted and even desired by the public and also easy for them to access. Energy Efficiency is however a BIG thing delivered in small packages.

A wide dissemination of energy efficient goods can be achieved in two ways, either by a **market acceptance** or by **mandating** of such products. Which of the routes that should be taken is generally considered as a political question but is much more depending on the way people perceive and deal with the product. Do they observe and care for the energy characteristics at all? Are these characteristics at all observable?

Some of the efforts to achieve market acceptance have been to **"commoditise"** energy efficiency, e.g. by making them part of a service concept that could be packaged and sold to customers. The trick is to define energy efficiency as a good or to make that part of the good clearly visible and make customers distinguish their choices based on energy efficiency.

a. **Make** a good; such as Energy Performance Contracting sold by Energy Service Companies (ESCO) sometimes with Third Party Financing (TPF).
b. **Show** a good; such as Labelling of products in classes according to performance in classes A-G.

Another type of efforts is to **"tradify"** the handling, e.g. by creating certificates (white, green or black) that can be sold on the market as an evidence to undertaking of energy efficiency improvements. To achieve this, one has to use existing market places and to establish new ones. The dependence between markets might be complicated and should be observed. One way is to create internal trade or trade-offs within companies where they can make a choice between paying (for pollution) or making such installation as to avoid pollution, a sort of internal fee-bate. The Kyoto-mechanisms JI and CDM is a trade-off where it is possible to buy off an obligation from someone else where the required reduction could be achieved at a lower price.

An overview of the different ways to achieve "large-scale" changes is shown in the figure 5 below.

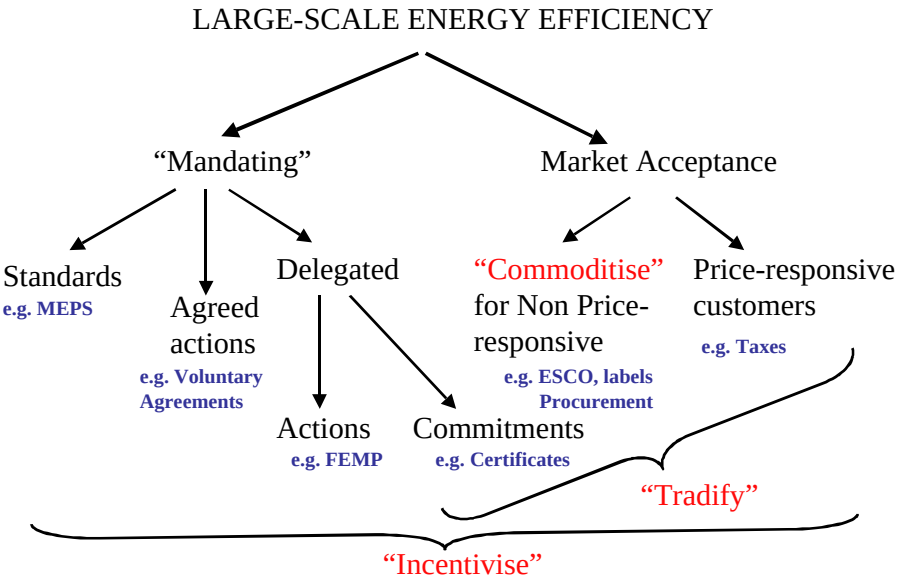

Figure 5: The landscape of up-scaling energy efficiency

Redesigned incentives to address the complexity –
In this section we will make an overview of instruments and/or considerations that could be applied in designing new policies and measures.

a) Commitments and certificates (see also part 2)

Energy utilities used to have an obligation to deliver energy services within their territory (often called DSM) based on the concept of least-cost planning. From an overall perspective it is mostly cheaper to save a kWh than to deliver a new one, especially if investments in capacity had to be made. The utilities could be motivated to deliver the service rather than the kWh if they could recover the cost and make some profit. With deregulation this self-interest was eradicated.

Some countries have now reinvented instruments that put the interest back into the utility business:

- UK has developed the "Energy Efficiency Commitment"
- Italy are developing "White Certificates
- New South Wales in Australia has a system of "white and green" certificates in order to reduce GHG-emissions either by energy efficiency or by renewable fuels
- France has advertised an introduction of "Certificates d´economie d´énergie"
- The European Commission mentions White Certificates in their proposed directive on Energy Services.
- Denmark has obligated their distributors (grid-companies) to deliver energy-services (information) to their customers and to participate in regional energy efficiency groups

b) Cost efficiency

Most policy-design requires measures to be cost-efficient, but do not often consider this concept fully. The specific problem with the requirement for cost-efficiency is that it depends on the perspective, which could be:

- Static, and only regard present costs and prices
- Dynamic, and take into account the development of technology that is inherent in the fact that it is produced in larger volumes and subject to learning on the market. These dynamics of learning reduce both prices and costs. (See learning curves below)
- Holistic, and also take into account that a new (different) product has different performance that should be calculated as well

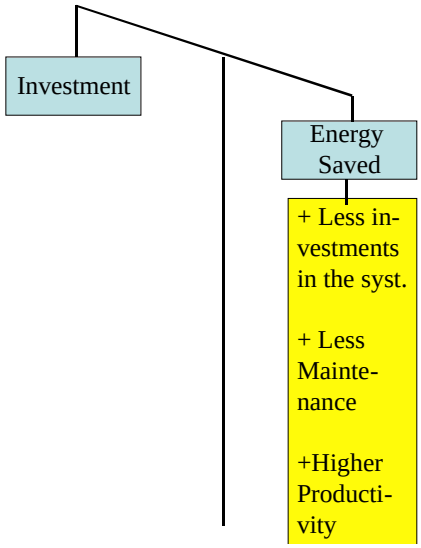

Figure 6: Taking all changes into account

In far too many cases the policies stop with the static perspective on cost-efficiency and thus lock in the society in an old technology paradigm.

c) Learning curves

The learning curve shows the rate of cost-reduction by volume growth (Learning Rate) that is normally in the area of 15-20% by each doubling of the accumulated volume of a technology (OECD/IEA 2000).[37] This is a factor that has been deliberately exploited in several of the cases such as those that deals with large-scale market introduction of Photovoltaic, pushing them towards affordability.

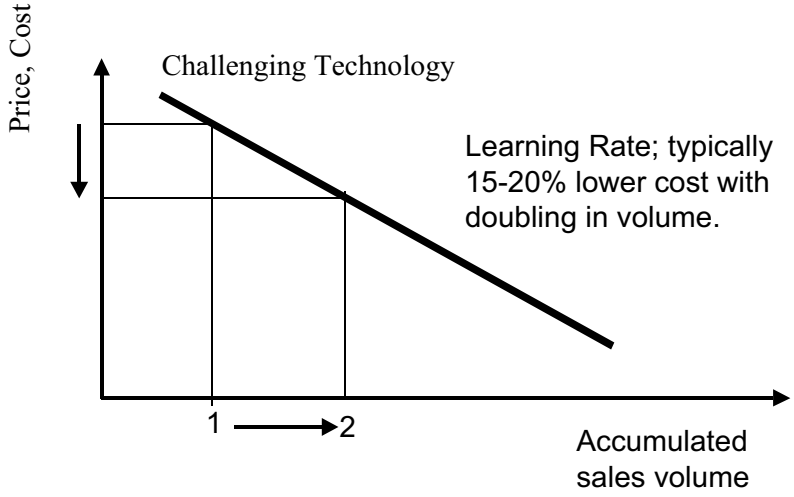

Figure 7: Illustration of Learning Curve (double logarithmic)

This learning applies to ALL parts of a delivery. The manufactured good as well as the installation and service. Many energy efficiency deliveries have a high degree of cost in installation and service over the lifetime.

[37] This curve is regressive in a linear scale but is often used in a double logarithmic where it looks linear.

Reduction of cost in a "learning by using" and "learning by doing" process requires both formal training and hands-on experience.

d) Security/Reliability

Security is improved with more diversification. Lower energy use gives more freedom of choice, i.e. more opportunities to diversify. With High energy use some combinations with supply are made impossible (right hand column in the table below). A high level of energy use means that the society is locked into concentrated energy supply and the special security and reliability problems that follow.

		Type of energy use		
Type of supply		**Low** • LED • Low-temp. heat	**Medium** • CFL • Heat Pump	**High** • Incand. lamp • El. heating
Concentrated Fossil, Nuclear from grid	May require special sites and huge transmission	**OK**	**OK**	**OK**
Decentralised Local, Biofuel	May be regional or local with limited impact on site			**May work**
Scattered PV, Solar heating	May be for direct use or require huge land or bulk volume		**May work**	**Very difficult**

Table 4. Combinations of supply and use.

e) Demand response (Prices, reliability and market function)

The liberalised market still has a long way before it settles satisfactorily. There is still a need to:

- Reduce **Price Volatility** (by improving short term price elasticity)
- Improve **System Reliability** (by reducing peaks and adding to safety margins)
- Enhance **System security** (by reducing dependency on vulnerable supply resources)
- Improve **Restoration capacity** (by dispatching in/after emergency situations)

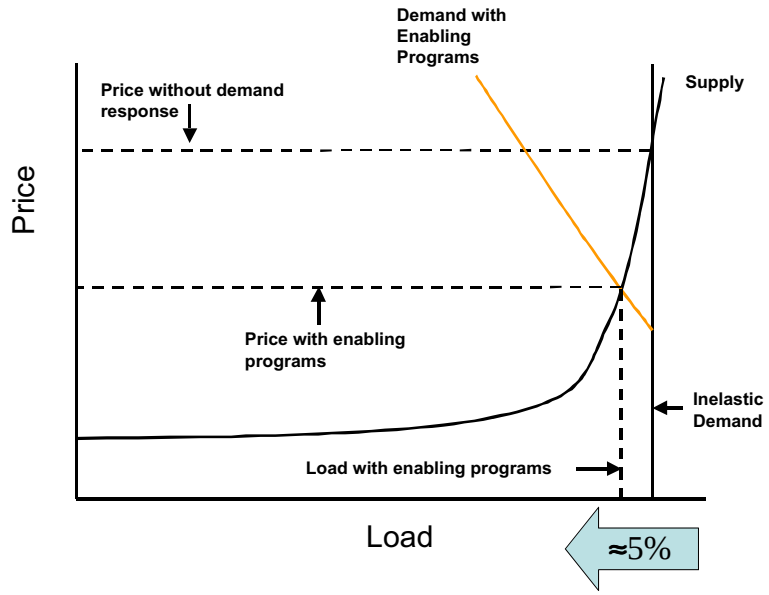

Figure 8: Price impact with and without enabling DR (Demand Response)-programmes

Customers on the market are primarily "price takers" and may in some cases suffer badly from price-spikes in a system with "energy only" pricing and where considerations regarding reserve capacity are guided thereby.

f) Niche markets and learning investments

Figure 9 is an application of the learning curve (see below) AND illustrates how a niche market identification can lead to earlier commercialisation of a technology and that the bill for learning investments can be split between public and private sources.

The new product (the challenger) has to compete with the existing dominant (the incumbent). The advantage for the challenger might be that the learning process may take down the costs rather quickly whereas the incumbent has exhausted such opportunities long ago. Another advantage for the challenger is that there is on the market a higher willingness to pay from some customers (i.e. the niche markets). Some of them are:

- Customers who don't have access to (or do not want to use) the incumbent, B
- Customers who want to show themselves as lead users for their profile, C
- Customers who take up technologies once the have started to prove useful, D

These niche market are fairly well segmented. To make the market move we will have to find the "investors" that could fill in the extra resources needed, A, the "learning investments". This could be the government but also the producers that may want to under-price their product to get it on the ground.

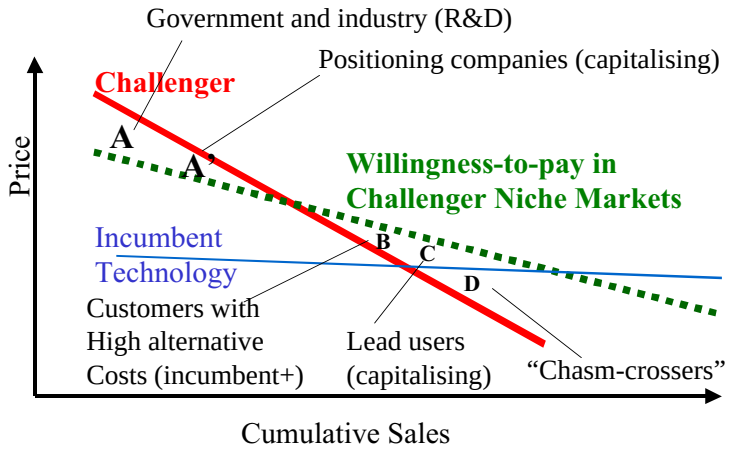

Figure 9: Interplay between niche markets and the experience curve for a technology challenging the incumbent technology in the market.

g) Market Distribution

Manufacturer and the buyers/users are not alone on the scene. A product runs through many hands on its way from the production to the use and many others on its way influence it. These companies, organisations, persons, can be very helpful in underpinning the process but could also be those who stop it. Any activity should carefully analyse these peoples role, ensure their support and also keep an eye on the development and if necessary act to avoid problems.

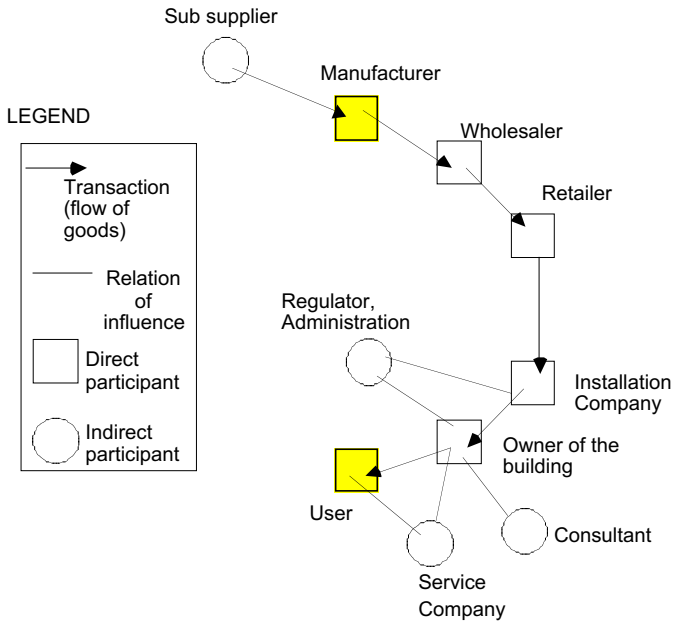

Figure 10: Illustration of distribution and value chain.

h) Moving the market. Procurement, labels and standards. (see part 2)

Procurements, initiated and/or led by the public sector, have been more and more used as instruments to get sustainable changes in terms of performance of goods sold on the

market. Such procurements are used both to launch new products to the market and to raise the volume for products with superior performance characteristics. The procurements might have to be accompanied by other activities that are aimed at making market actors more apt to participate in the process of change. Such a process eventually requires a total change of the market and will entail NEW products, MORE of good products and LESS of bad products, see figures below.

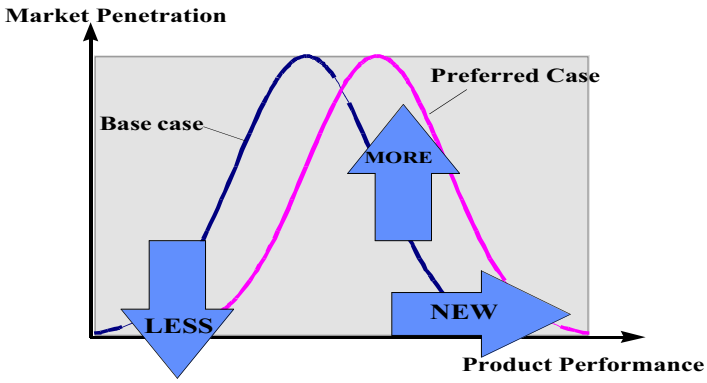

Figure 11: Effect of market transformation on product performance (Source: Nilsson (1996))

If we instead try to see on what sort of instruments that move the market we get the following picture

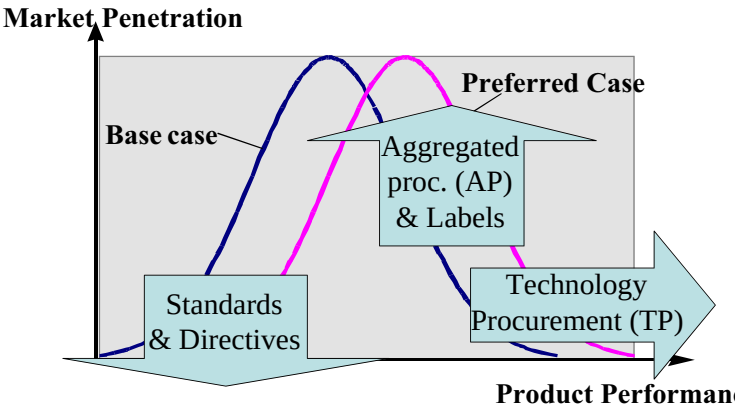

Figure 12: Effect of market transformation on product performance and the associated type of measures (Source: Nilsson (1996))

Procurement of this sort has been used for the specific purposes of defence material in most countries for a long time but also for development of large infrastructure systems such as power supply, telecommunication, road building water and sewage treatment etc., all characterised by having one or a few large buyers and equally larges suppliers of equipment and systems. The new element in procurement is the application to “fragmented markets” with many buyers and also many (potential) suppliers. This change again has been motivated both for the reason of the buyers who need to aggregate their capacities to get the attention of the suppliers to produce things more suited to their needs, and for the suppliers who need “well informed” and able customers for development of products of such a sort that will get a demand. Naturally not all buyers and not all suppliers have such interests, which sometimes causes discussions over the need for public intervention. It is therefore necessary to remember

that a procurement in principle should be open to all to participate but will only apply to those who have the will and the skill to do so. It is further essential to remember that the final goal is a change of total market behaviour and that the participation of those who spearhead as buyers and suppliers is a vehicle to pull of the change.

i) Public Procurement to lead the market (see part 2)

Public procurement has potential for huge leverage effects. It could be used both to boost the market for good products and to push the frontier for new products with improved performance, technology procurements.

US Presidents George Bush[38] and Bill Clinton have issued ”Executive Orders” calling for government energy management activities. Co-ordination of this is made by The Federal Energy Management Program **(FEMP)** who helps other agencies identify and systematically pursue their energy-efficiency opportunities. FEMP is responsible for supporting all agencies with information and education, energy audits, and data monitoring that allows performance comparisons. The mission of FEMP is to reduce the cost of government by advancing energy efficiency, water conservation and the use of renewable energy. FEMP's aim is not only to achieve those goals set forth in law and several Executive Orders, but also those which are inherent in sound management of Federal financial and personnel resources. (Borg)

The Federal Energy Management Program (FEMP) has developed a number of initiatives to support energy-efficient purchasing by the federal government. The Energy Policy Act of 1992 (EPAct) and Executive Order 12902, issued March 1994 directs federal agencies to purchase energy-efficient products based on minimum life-cycle cost criteria. The Executive Order directs agencies to purchase products in the upper 25% of energy and water efficiency for comparable products, or at least 10% more efficient than U.S. DOE national standards, see figure below. (Johnson, McKane, Harris)

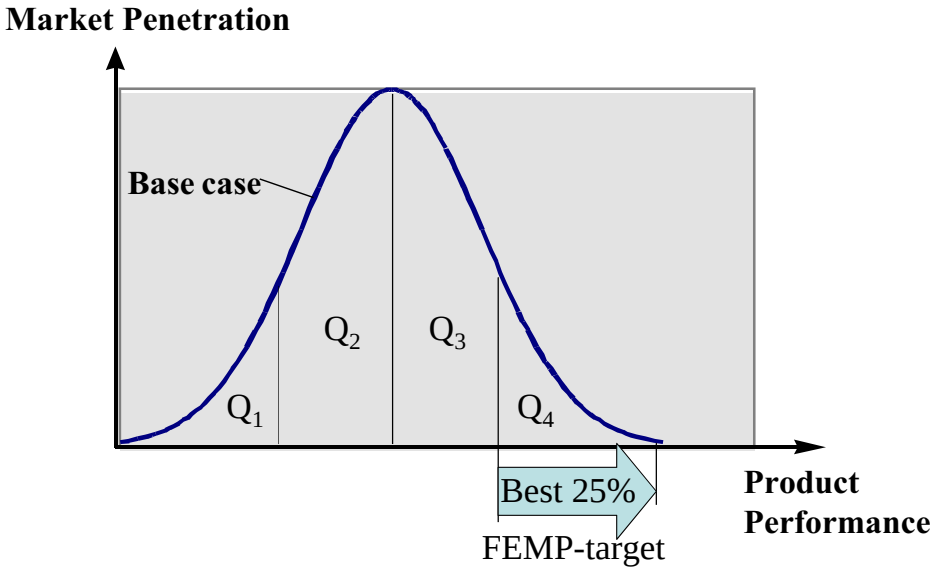

Figure 13: Target area for FEMP.

[38] President #41

Although headquartered at the US Department of Energy, the Federal Energy Management Program serves all Federal agencies. FEMP provides technical assistance for project identification, alternative methods of financing projects, technical support and training necessary to successfully implement projects, and transfer of knowledge about successful projects to encourage others to take similar actions.[39] FEMP relies heavily on the DOE National Laboratories to provide technical support. A long-term benefit of these activities is building an infrastructure in Federal agencies that institutionalises energy efficiency as a good business practice. (Borg)

j) Standards (See also part 2)

One of the problems with minimum standards is that technology development makes them obsolete and that they focus on the least a manufacturer can get away with. In Japan the "top-runner" standard tries to change the concept.

In general standards and labelling system could be made dynamic to cover for changes and to make the interaction with market and development more responsive. Requirements should be recognising the Best Available Technology (BAT) and the gradual improvement thereof.[40] This view on dynamics is applicable to both labelling and standards.

- Requirements could be strengthened **over time** and announced in advance to allow industry to comply. A time delay (Td) for the WAT (Worst Allowed Technology) to be phased out might be necessary.
- The **requirement span** between BAT, as observed on the market, and minimum standard could be fixed (and also change over time). Scrapping fees (just as for cars) could be considered for equipment that is exchanged (e.g. refrigerators) to prevent a second-hand market with low standard.

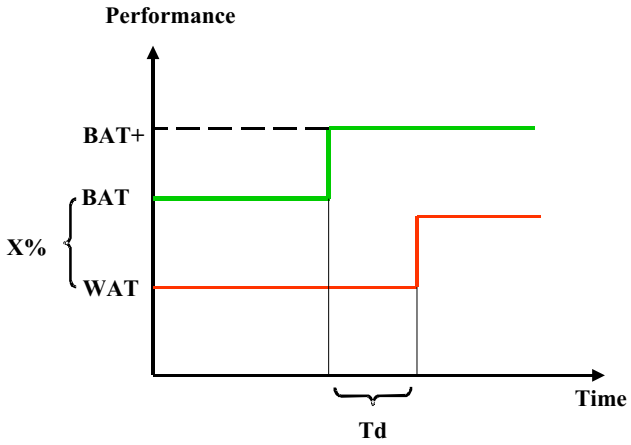

Figure 14: Connecting Minimum Technology (WAT) to best Technology (BAT) and change as time goes by to new levels focused on BAT+

- **Promotional activities** could be based on a market pull to use and supply not only BAT but ask for better (BAT+). When campaigns, subsidies and procurements are considered

[39] See example on support as regards e.g. CFL lighting on http://www.eere.gov/femp/procurement/compact_fluor_lamp.html

[40] Compare with the Japanese "Top-Runner" Programme, which have such dynamic elements though not fully developed.

they should adjust their promotion scheme accordingly (e.g. progressive VAT-reduction according to performance)

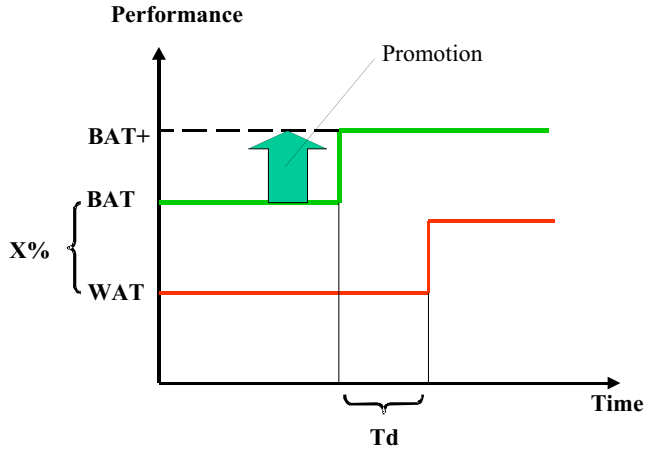

Figure 15: Promoting focused on BAT+ to speed up the process of change

- Labelling should be considered to give specific information about equipment performance as being of **base or peak load related**. From a systems perspective and, for the customer from a perspective of security of delivery, the difference is very relevant.

- Performance requirements could be directed towards the **single product** or towards the **total output of products** from a manufacturer. The former more applicable for minimum standard and the latter more to drive development. A combination of the two views could be considered.

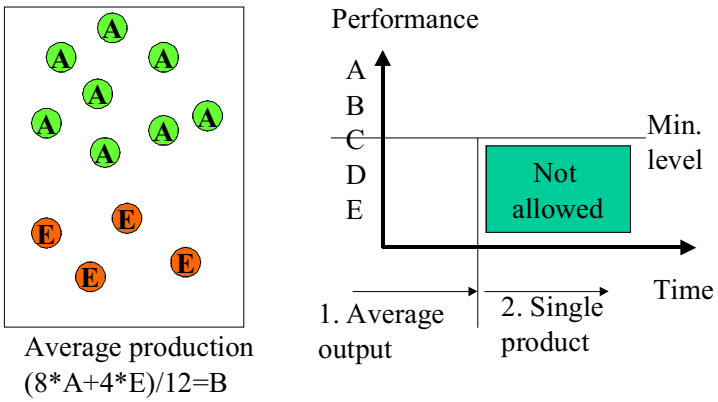

Figure 16: Requirements could be on single products or on average output

- This perspective could also open for a **bonus/penalty system** related to climate or environment issues and even trading of emissions

k) Feebate

"A blend of fee and rebate, this is an idea that seeks to improve energy efficiency and reduce pollution. For example, when you bought a new car, you would pay an extra fee if it were an inefficient user of fuel, or alternatively get a rebate if it were energy-efficient. The neutral point would be set so that fees and rebates balanced, so it became neither an inflationary measure nor a disguised tax. Similar schemes have been proposed to reduce the consumption of water and other resources and as a way to improve the energy efficiency of new buildings. The term is mainly to be found in the USA; it has been around since the early 1990s at least (it appeared in Bill Clinton's 1992 campaign literature), and limited schemes have been applied in some places, though usually not under this name. Initiatives that penalise heavy users (gas-guzzler taxes, for example) strictly aren't ***feebate*** *schemes, as there's no rebate element; others, like the British licence-tax reductions for small cars, should equally fall outside its scope, as there's no explicit balancing penalty. But most environmentalists seem to use the term loosely to mean any tax or charge that is scaled to encourage economy; the word is still mostly to be found in the jargon of such groups."*[41]

"One of the first feebates was Sweden's Nitrogen Tax. The tax revenue collected from power generators is refunded to participants based on the amount of nitrogen oxide produced per unit of energy (a rough surrogate for the facility's production efficiency relative to NOx emissions). In the first year alone, NOx emissions fell by 35%, and investment in abatement technology increased. This system creates a dynamic where heavier polluters transfer resources to lighter polluters.

As the Swedish and other European examples illustrate, the revenue neutral feebate model offers a particularly effective method of attaining a domestic environmental objective (reduced emissions) while minimizing adverse competitiveness impacts and creating incentives for ongoing technological innovation and production efficiency gains. The Swedish example also suggests that a feebate can work within a relatively small market."[42]

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Institutional framework – Roles and actors

Policies and Measures for improving energy efficiency are designed and undertaken subject to influence of an institutional framework set by several "outside" forces and sometimes for other purposes and with another perspective than energy. Actors will have to find their solutions within this framework. The framework constitutes rules that to some extent limits actions but in a wider perspective facilitates partnerships and transactions by its definition of "products" and marketplaces. The following is an orientation of some of the main frameworks, and their associated actors, of importance for Denmark in its undertakings for improved energy efficiency.

[41] http://www.worldwidewords.org/turnsofphrase/tp-fee1.htm
[42] http://www.smartregulation.gc.ca/en/06/01/su-11c.asp#ftn5

EU directives

The draft Energy Services Directive, COM(2003) 739 final

The Directive invites Members States to remove barriers for companies (such as energy service companies) to offer energy services and energy efficiency programmes and to adopt national targets of annual 1% cumulative savings to promote energy end-use and energy efficiency.

The Directive will promote harmonisation by developing the market for energy efficiency and energy services (Art 95). The objectives are:

- To promote cost-effective energy efficiency by the use of targets, mechanisms, incentives and institutional, financial and legal frameworks to remove market barriers and imperfections.
- To develop and transform the energy efficiency market into a commercially viable and self-sustaining market.
- To develop a market for integrated energy services (energy and technology).
- Ensure that a good example is set by the public sector regarding investments, maintenance and other expenditures for energy consuming equipment by adopting a target of 1.5%, in terms of annual improvement of energy efficiency in the public sector.
- Ensure that retail suppliers or distributors actively promote energy services and/or energy audits.
- Appoint a body for the supervision of the savings obligation.
- Take measures to introduce innovative tariffs and grid-bound energy.
- Ensure that end-users are provided with competitively priced individual metering and informative billing reflecting annual consumption.

Examples to proposed means to achieve these objectives include obligations for Member States to provide schemes to ensure technical competence of energy service providers and mutual recognition (Art. 8) and availability of third-party financing, energy performance and similar instruments (Art. 9).

The Council Energy Working Party has examined the Directive. Even though the delegations agree on the importance of managing supply and demand within the internal market, a number of he Directive's provisions have been criticised for being too interventionist and complex. A majority of the delegations also questions the need for mandatory national targets (although a majority accepts national indicative targets) for reaching the objectives of the Directive.

After the initial debate, the European Parliament decided to postpone the adoption of a first reading opinion of the Directive after the newly elected Parliament had taken up its mandate in July 2004. The opinions are now not expected until the end of 2004[43].

Directive on the energy performance of buildings (2002/91/EC)[44]

"The Directive concerns the residential sector and the tertiary sector (offices, public buildings, etc.).

[43] Report of the EU Council, ENER 132 CODEC 698, 7 May 2004
[44] http://europa.eu.int/scadplus/leg/en/lvb/l27042.htm

The four main aspects of the proposed general framework are as follows:

** a common **methodology for calculating** the integrated energy performance of buildings;*
** **minimum standards on the energy performance** of new buildings and existing buildings that are subject to major renovation;*
** systems for the **energy certification**;*
** regular **inspection** of boilers and central air-conditioning systems in*

The minimum standards for buildings are calculated on the basis of the above methodology. The Member States are responsible for setting the minimum standards.

Energy performance certificates should be made available when buildings are constructed, sold or rented out.

Final date for implementation in the Member States: 04.01.2006"

Buildings are the largest energy users and residential and commercial sector accounts for some 40% of the energy used in the EU. The cost effective savings potential within this group is calculated to be as high as 22% up till the year 2010.

Eco-design requirements for Energy-Using Products, COM(2003) 453 final

Production, distribution, use and end of life management of energy-using products (EuP) is associated with a considerable number of important impacts on the environment such as climate change linked to energy consumption, consumption of other materials and natural resources such as water, waste generation and release of hazardous substances. Integrating environmental considerations as early as possible into the product development process is therefore considered as the most effective way of introducing changes and improvements to products.

The objective of the proposed Directive On establishing a framework for the setting of Eco-design requirements for Energy-Using Products (EuP) aims to create a comprehensive and coherent legislative framework for the integration of **environmental aspects in the design and development of energy-using products** (such as electrical and electronic devices or heating equipment). The framework should:

- ensure the free movement of energy-using products within the EU,
- improve the overall environmental performance of these products and thereby protect the environment,
- contribute to the security of energy supply and enhance the competitiveness of the EU economy,
- preserve the interests of both industry and consumers.

The proposed framework Directive is in principle applicable to **any product using energy** to perform the function for which it was designed, manufactured and put on the market. (All energy sources are covered but it is likely that only those using electricity, solid, liquid and gaseous fuels will be the subject of implementing measures).

The proposal does not introduce directly binding requirements for specific products, but defines **conditions and criteria** for setting, through subsequent implementing measures, requirements regarding environmentally relevant product characteristics (such as energy consumption).

Before an energy-using product covered by the Directive's implementing measures is placed on the market, CE conformity marking shall be affixed and a declaration of conformity issued, whereby the manufacturer (or its authorised representative) ensures and declares that the product complies with relevant provisions of the implementing measure (Art. 4).

Methods for setting the eco-design requirements are provided in Annex I-II. Annex II concerns the level of requirements also in terms of energy efficiency: "In concerning energy consumption in use, the level of energy efficiency or consumption shall be set aiming at the life cycle cost minimum to final users for representative EuP models".

The European Parliament finalised its first reading on the proposal in April 2004 and the Council of Ministers reached a political agreement in June 2004. [45]

The Commission has issued its detailed opinion on the amendment proposed by the European Parliament (reflecting the Commission position after the first reading). The updated Commission position will also be communicated to the European Parliament.

Directive on promotion of cogeneration based on a useful heat demand in the internal energy market (2004/8/ec)[46]

"There is a considerable potential for expanding the use of CHP in Europe. Only a minor part of the residential heat demand in EU is covered by district heating. In addition there is a considerable potential for small/micro scale CHP in the market for individual boilers in existing as well as new Member States. A further uptake of CHP in Europe will likely be linked to a move towards the use of cleaner and local energy resources, e.g. natural gas, biomass or waste. Thus CHP can help fulfilling also the EU objectives of increasing the fuel diversity and securing supply.

District heating share in residential heat market
Approx. 7% in EU Member States
Approx. 38% in Accession Countries

CHP share in district heating and cooling (DHC)
Member States: approx. 70%

[45] http://europa.eu.int/comm/enterprise/eco_design/index.htm
[46] http://www.opet-chp.net/chpdirective.asp

Accession Countries: approx. 52%

In the short term the intention of the Directive is to support existing CHP installations and create a level playing field in the market. In the medium and long term the intention of the Directive is to ensure that high efficiency CHP is taken into consideration whenever new capacity is planned. It sets a number of criteria for an obligatory analysis of the national potential for high efficiency CHP (including small scale) in each Member State.

The Member States are obliged to ensure objective, transparent and non-discriminatory procedures for grid access, tariff criteria and administration.

Definitions
***Small** scale CHP: units below 1 MWe*
***Micro** scale CHP: units below 50 kWe*
***High efficiency** CHP: primary energy savings of at least 10% compared to separate production".*

If the electricity cogeneration share has increased from **11%** in 1998 to **18% in 2010,** energy savings can be estimated to **3-4%** of total EU gross consumption.[47]

Cogeneration is beneficial for **security of energy supply**, a key objective of European Energy policy, as outlined in the November 2000 Commission's Green Paper:

- diversification of the fuel-mix
- increased regional self-sufficiency
- increased physical security through the atomisation of production in various places less vulnerable to terrorist attacks

Relevance for Denmark.

Denmark has an advantage in many respects by its already established system for labelling of buildings, use of labelling for several other areas than those covered in the directives, extensive use of CHP and established co-operation as regards DSM with the utility sector.

Institutions are well set to push the frontier further if that should be the wish of Denmark, e.g. to expand CHP technology into small scale, to ensure that product standard goes in the forefront of performance of goods and services, etc.

The Kyoto-agreement applied, National Allocation Plans

Linking NAP and energy efficiency policy (see also part 2)

The Emissions Trading Directive (2003/87/EC) states:
This Directive will encourage the use of energy efficient technologies, including Combined heat and power technology, producing less emissions per unit of output, while the future directive of the European Parliament and of the Council on the promotion of

[47] Information package from the EC DG-TREN 2002.

cogeneration based on useful heat demand in the internal energy market will specifically promote heat and power technology" (p. 20 in the preamble)

Article 1 state:
"This Directive establishes a scheme for green house gas emission allowance trading within the Community……in order to promote reductions of green house gas emissions in a cost-effective and economically efficient manner".

Member States shall decide upon the quantity of allowances for the three-year period beginning 1 January 2005 (Art 11.1), for the five-year period beginning 1 January 2008 and for each subsequent five- year period (Art 11.2).
Each Member State shall develop a national plan stating the total quantity of allowances for each period and how it proposes to allocate them (Article 9).

Criteria for NAPs

The National Allocation Plan works with:

- A macro level that defines the national emissions budget and determines the total quantity of allowances to be allocated and
- A micro level for the intended allocation of allowances to operators of individual installations. It also sets out the volume of emission allowances to be set aside for the new entrants reserve.

The macro level must be consistent with national climate protection targets (Kyoto).

Micro level and the distribution of allowances
The micro level defines the methods, rules and criteria which determine allocation decisions and the question of what allowances will be granted to the various installations on the basis of the available data.
Quantities must be consistent with the macro level to ensure that the overall quantity of allowances does not exceed or fall short of the quantity envisaged of the macro level. Principles applied include:

- Grandfathering; allocation based on an installation's historical emissions in a references period, and
- Benchmarking; allocation based on the average specific emissions in a references period.

Annex III of the Emissions Trading Directive defines the criteria for the National Allocation Plan. Annex I specifies the activities and Annex II the greenhouse gases applied in the directive

On the basis of the experience of the Directive and the achieved progress of the monitoring of green house gas emissions and in the light of developments in an international context, the Commission shall draw up a report on the application of the Directive (Art 30). The report shall consider issues as:

- The amendment of Annex I to include other relevant sectors (chemicals, aluminium and transport sectors) and the inclusion of other green house gas emissions listed in Annex II.
- The relationship of Community emission allowance trading with the international emissions trading (starting 2008).
- The use of credits from project mechanisms.

- The relationship of emissions trading with other policies and measures (at Member State and Community level) including taxation with the same objectives.
- The functioning of the allowance market, covering in particular market disturbances.

The report shall be submitted to the European Parliament by 30 June 2006 and be followed by appropriate proposals.

Kyoto-mechanisms (Trading and flexible)

The Kyoto protocol established several methods including the flexibility mechanisms that should facilitate for the developed countries (Annex B countries) to find lower costs to meet their national emission targets. Some of these mechanisms are deliberately formed to target projects and smaller scale solutions[48], the CDM and the JI. Thus use of these could be a way to release some of the huge demand side potential.

<table>
<tr><th colspan="2">Instrument</th><th colspan="2">Character</th><th>Comments</th></tr>
<tr><td rowspan="3">Flexible Mechanisms</td><td>Clean Development Mechanism, CDM (article 12)</td><td rowspan="2">Project based trading</td><td>With non-Annex B countries
from 2000
Delivers “Certified Emission Reductions” (CER)</td><td rowspan="2">Use of these mechanisms shall be “supplementary” to domestic actions.
The project- achieved reductions shall be “additional” to those that would otherwise occur, i.e. compared to the “baseline”.</td></tr>
<tr><td>Joint Implementation, JI (article 6)</td><td>Between Annex I countries
From 2008
Delivers “Emission Reduction Units” (ERU)</td></tr>
<tr><td>Emission Trading, ET (article 17)</td><td colspan="2">Between Annex B countries
From 2008
Trade (part of) “Assigned Amounts” of emission (AA)</td><td>The European Trading System (ETS) will be “linked” with CDM</td></tr>
<tr><td colspan="2">Forming of bubbles (article 4)</td><td colspan="2">Burden sharing between countries.</td><td></td></tr>
<tr><td colspan="2">Banking and borrowing (article 3.13)</td><td colspan="2">Banking allowed for subsequent commitment periods. Borrowing only within the period.</td><td></td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="2">Activities Implemented Jointly, AIJ (Conference of the Parties Decision 5/CP.1)</td><td colspan="2">Pilot Programme to test and analyse methods for future JI and CDM</td><td>Have been recognised as an opportunity for “learning by doing”</td></tr>
</table>

Table 5: Overview of Kyoto-mechanisms and their applicability.

Relevance for Denmark.

Emissions in Denmark are decreasing significantly, but there is a large gap between the cap of allocated emissions in the National Allocation Plan and the Kyoto

[48] For CDM according to UNFCCC Decision 17/CP.7 (FCCC/CP/2001/13/Add.2) small scale is defined as:
(i) Renewable energy project activities with a maximum output capacity equivalent of up to 15 megawatts (or an appropriate equivalent);
(ii) Energy efficiency improvement project activities which reduce energy consumption, on the supply and/or demand side, by up to the equivalent of 15 gigawatt/hours per year;
(iii) Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 15 kilotonnes of carbon dioxide equivalent annually;

commitments. In a study of the National Allocation Plans it was stated for Denmark that[49]:

- The Danish NAP allocates significantly less than BAU (roughly 15% below).
- The difference between Cap and Kyoto commitment can be partly explained by looking at the Danish JI/CDM programme, and the Danish Climate Policy. For non-ETS sectors, further policies and measures will be developed. However, the Danish Climate Policy recognises a shortfall of 20-25 Mtonne CO2e in the commitment period.

An extensive Danish use of the flexible mechanisms would seem inevitable. This would certainly have some focus on areas where Danish industry is strong, like wind, renewable fuels, CHP, but could be extended to energy efficiency.

The state purchase is intended to reduce the gap and fulfil Denmark's climate obligations for the 2008-2012 period. According to the Danish NAP, a total of DEK 335 Million has been allocated to state purchase of JI and CDM credits. An annual allocation of DEK 200 Million is budgeted for the years 2005, 2006 and 2007.During the 2003-2007 year period, the total allocation will amount to DEK 935 Million. The purchase is not earmarked to cover domestic emissions from particular sectors.

Stakeholders on the liberalised market

Changes in responsibility and incentives have been remarkable with the liberalisation of the markets. There are basically two parameters of importance to consider for a full understanding of the behaviour on the market; **structure and ownership**.[50] Structure deals with the relationship between actors/role in the system[51]:

		System type			
Actor/Role in system		**Vertically Integrated Regulated Monopoly**	**Unbundled monopoly, Monopsonistic**	**Unbundled limited (wholesale) competition,**	**Unbundled full competition**
Institutional framework	**Government(s), Regulation**	Controls the monopolies on a company level. Possibly also as owner of the transmission grid			Controls natural monopolies by regulatory framework. Could own transmission
	System-function responsibility	With the monopoly (stated criteria?)	?		Different models, often "regulated" from the transmission perspective

[49] Analysis of the National Allocation Plans for the EU Emission Trading Scheme, Ecofys UK for DEFRA. http://www.ecofys.co.uk/uk/publications/documents/Interim_Report_NAP_Evaluation_180804.pdf
[50] ELECTRICITY SECTOR DEREGULATION IN THE APEC REGION, March 2000, chapter 4
[51] See also Energy Policy 31 (2003) pp 405-430 "Public policy analysis of energy efficiency and load management in changing electricity business

<table>
<tr><td rowspan="6">Value-Chain</td><td>Generators</td><td rowspan="2">Utility controlled</td><td colspan="3">Separated from other functions</td></tr>
<tr><td>Transmission</td><td colspan="2">Could be separate or joined with distribution.
Responsible for system function (reserve capacity)</td><td>Separated</td></tr>
<tr><td>Wholesale Market</td><td>Non-existent</td><td>Could exist as “single buyer” entity</td><td>Open for generators and retailers (distribution)</td><td>Open for generators and all sorts of retailers</td></tr>
<tr><td>Distributors</td><td colspan="3" rowspan="2">Utility controlled monopoly with obligation to serve in their region (franchise area)</td><td>Natural regulated monopoly</td></tr>
<tr><td>Retailers</td><td>Free to buy from any generator</td><td>Could be “independent”, i.e. even without distribution network</td></tr>
<tr><td>Brokers</td><td colspan="3">Non-existent</td><td>Traders of electricity</td></tr>
<tr><td colspan="2">Consumer</td><td colspan="3">Must buy within their region (franchise area)

Some large end-users may buy directly from the generator or from the wholesale market.</td><td>Could buy from any sort of supplier (generator, retailer, broker)</td></tr>
</table>

Table 6: The development of the value chain on the supply market

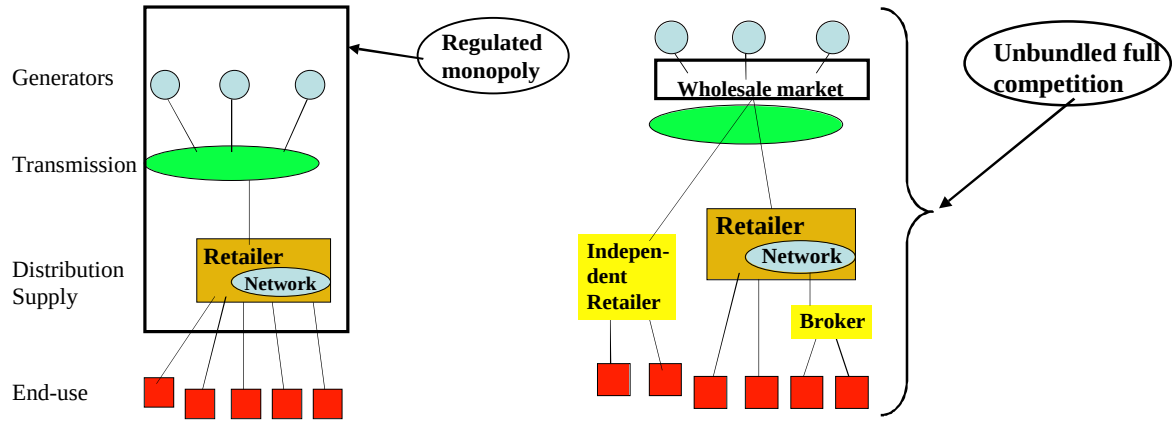

Figure 17: Different Supply Market Organisations

Ownership has some importance for the incentive structure and the use of measures. With a high degree of public ownership (government or municipalities) these companies may be “regulated” by their internal rules and or by so called “social contracts”. With a high degree of private ownership the framework for regulation has to be more stringent and exact. When the ownership and the company activity also become international the obligations to serve for any other purpose than company profit are reduced.

Incentives are changed with the market organisation. With a vertical integration the utility can have a benefit from reducing the use of energy if the cost for supplying is higher. If that value-chain is disconnected, as it is with unbundling, the calculation for this benefit falls on the customer who normally has less capability to make such a choice. DSM-activities are hence occurring more seldom in the unbundled systems.

The retailers that own a grid may still have an interest to provide DSM that reduces their need to upgrade networks (cables, lines, transformers). In some countries there have further been developed certificates and commitments that strengthen the incentive for the retailers by obliging them to act for energy efficiency.

		Company motivation for DSM to…		
Company and value chain		…Avoid new capacity	…Use existing capacity	…Positioning on the market
Vertically integrated companies		YES	YES	NO
Unbundled	Generators	NO	YES	--
	Wires (Transmission and Distribution)	YES	YES	NO
	Retailers, Brokers	NO	NO	SOME

Table 7: Incentives to do self-interest DSM

Relevance of the market organisation for Denmark.

The Danish market is interconnected with mainly the Nordic system and interacts closely in the market activities. The market is unbundled and with full competition but there are however only a few big generating companies who are generating within a CO2 allowance scheme since the year 2000. Their interest in DSM is thus limited to capacity utilisation i.e. DR with short-term applications to reduce power peaks.

The Local Distribution companies are by law co-operating with municipalities within their concession area to provide both information and activities to improve energy end-use.

The mind-set, the experiences and the network is a very good basis for further development of energy efficiency activities.

The role of municipalities

The IEA DSM-Programme has studied more in detail how municipalities can act on the liberalised market to promote and ensure energy efficiency. Twelve key LESSONS from their guidelines are available on the web-site, which also names best-practices selected from several countries: http://www.energie-cites.org/meels/index.php/cat/1/id/7/

These lessons comprise:

- Energy efficiency explicitly on the agenda of local administration
- Access to specialist competence to monitor status and development
- Aggregation of demand in purchases/procurement to get good deals
- Aggregation in development of energy services (energy performance contracts)

- Metering and true cost-allocation to be the basis for decisions
- Municipality owned utilities can develop choices and services
- Technology for distributed generation gives a power to chose
- Local concessions is a way to deliver sustainable energy policies
- The local authority as planner (and regulator) controls development
- A clear strategy is necessary to show will and guide demand
- Structures should be tailored to keep long-term commitment (free from swings in political cycles)
- Public goods require handling by non-profit structures

This project also delivered numerous case studies available from the web site mentioned

Relevance of the municipalities for Denmark.

Denmark has a strong tradition of municipality co-operation of the sort that the IEA work proposes and the ongoing work in "Energisparudvalgene" continues this tradition.

International co-operation

Denmark has since long a tradition to work within, and to take leading responsibilities in International work. This is valid both for highly formalised and regular government level work, such as the UN-FCCC, the IEA, with its different Implementing Agreements and the Energy Charter, and for more targeted and theme focused work such as within the ECEEE and the Euroheat and Power. Danish experts are well recognised and are held in high respect.

Actors; The benefit and scope for their acting

The European Union has in its directives calculated the potentials for cost-efficient measures and mostly the potential is in the area of 20% lower energy use than presently.

> *"For industry this potential is estimated to be approximately 17% of current final consumption, realisable by 2010. For the domestic and tertiary sector, it is 22% and for transport 14%, excluding modal shifts. Total final energy consumption in the EU is thus approximately 20% higher than can be justified on purely economic grounds.".* [52]

These potentials are based on the assumption that costs to reduce the energy use are less than the costs to supply the energy for the same use, see "high cost" in the illustration below. If the calculations have incorporated also other savings, e.g. savings in maintenance and savings in reduced heat load, the potential could have been even higher, see "low cost" in the illustration. The conclusion is that even~~h~~ a conservative estimate shows a very high potential.

All actors on the market would not be equally keen on and benefiting from realisation of these potentials. As shown there are two major ways to get a large-scale impact; by mandating a change and by getting a market acceptance, none of them necessarily excluding the other and the both sometimes supporting each other. As shown in this chapter some actors may be quite reluctant in improving the energy performance but may be teased to participate and find benefits from participation or from a more economic use of their own facilities.[53]

[52] The draft Energy Services Directive, COM(2003) 739 final

[53] Sometimes crudely referred to in English litterature as "The rat must smell the cheese".

Relevance to Denmark from institutional setting

It is striking that many of the new tasks imposed from the global and regional commitments have been applied, at least in part, in Denmark already for some time. Danish actors from government and industry also have through their activity in the international work acquired a profile and a status that most likely will benefit them further in achieving their goals. In all one could say that the team of Danish actors are well trained both as individuals and as a team for the future play.

Appendix 1: Objectives
NOTE: Shaded area denotes "less important or not mentioned"

Objective		Paradigm		
Type	**Aspect**	**Old**	**New**	**Emerging**
Economy	Long term effects (depletion)	X	Has been qualified with Sustainability concerns (see below)	
	Return on investments	X	True but not emphasised	
	Flexibility in investments	X	True but such fine-tuning has little realism in application	
	Cost-efficiency	(X) Implicit or not considered since acting had a value in itself	Short term Cost-Benefit analysis of actions (ceteris paribus)	Long term analysis of learning and including system considerations
Sustainability[54]	Weak	NA	Economic	?
	Strong		NA	Ecologic
Environment	Local	Local "Public concern"	X	X
	Regional		Verified impact from emissions	X
	Global			Global Climate
Security/ Reliability	Diversification	Any fuel but oil	1. Energy efficiency 2. Renewable fuels	
	Reliability (uninterrupted delivery)	Was mainly an issue for the supplying companies and inherent in their concession	Load curtailment (Programmes and campaigns)	Demand Response
Distribution of welfare	BAT+[55] to achieve wide spread services		Present technologies need to be improved by a factor >10 if western welfare should be globally accessed. [56]	
	LDC Electrification and fighting of poverty			Dealt with by a G8 Task Force.[57]
Innovations for industrial development	-			Se especially the Lisbon strategy.[58]

[54] Sustainability is not a concept that is equally understood by all. Sometimes a division is made between a **weak definition** that says that if the sum of man-made and natures capital is constant (or growing) over time the development is sustainable. Under these circumstances we may deplete the resources of the earth IF it results in a capital with higher value.
A **strong definition** does not allow such depletion but says that natural capital may not be used in the process but has to remain

[55] Best Available Technology = BAT ; "BAT+" denotes an improvement beyond BAT

[56] See WEA, World Energy Assessment, UNDP 2000

[57] http://www.renewabletaskforce.org/report.asp

[58] The Lisbon strategy, March 2000

Appendix 2: Issues
NOTE: Shaded area denotes "less important or not mentioned"

<table>
<tr><th colspan="2">Issues</th><th colspan="3">Paradigm</th></tr>
<tr><th>Type</th><th>Aspect</th><th>Old</th><th>New</th><th>Emerging</th></tr>
<tr><td rowspan="9">Barriers are preventing optimality</td><td>a. (Lack of) Information</td><td rowspan="9">Price carried the necessary information to customers who basically are inclined to make economically correct decisions (a-e)

Some market imperfections should be straightened (f-i)</td><td colspan="2" rowspan="2">The governments can reduce barriers related to price and customer knowledge about product (performance and consequences) and thus help putting the market place in order</td></tr>
<tr><td>b. (Transaction) Costs</td></tr>
<tr><td>c. Risk perception</td><td colspan="2" rowspan="7">Liberalisation is the norm but has to be supported with proper (non-intrusive) regulation.</td></tr>
<tr><td>d. High "first cost"</td></tr>
<tr><td>e. Price distortion (externalities)</td></tr>
<tr><td>f. Split incentives</td><td rowspan="6">Niche markets can be identified and dealt with to provide "learning investments".</td></tr>
<tr><td>g. (Inadequate) Regulation</td></tr>
<tr><td>h. Capital Stock Turnover Rates</td></tr>
<tr><td>i. Technology Specific (skill to handle)</td></tr>
<tr><td rowspan="3">Research, development and demonstration</td><td>Existing technology</td><td></td><td rowspan="3">Research could also bring better applications of existing technologies.</td><td rowspan="3">Public Procurement could pull introduction of technologies

Feedback from market deployment spurs R&D that provides new and more wide-spread technologies</td></tr>
<tr><td>Technologies with Few known solutions (Applied Research)</td><td rowspan="2">Research produced knowledge that the market actors turned to products when the market was ready to accept them</td></tr>
<tr><td>Technologies without known solutions (Basic Research</td><td>Observe the area</td></tr>
<tr><td rowspan="4">Market Transformation</td><td>New Products (BAT+)</td><td></td><td rowspan="3">Attempts to:
* get new products,
* sell more of good ones and
* phase-out the bad</td><td rowspan="4">Comprehensive changes that addresses full market transformation by e.g. dynamic standards and by addressing customer concerns more distinctly.</td></tr>
<tr><td>Good Products (BAT)</td><td>Primary promotion of BAT as complement in isntallation</td></tr>
<tr><td>Bad products</td><td></td></tr>
<tr><td>The role of Industry and distribution</td><td>Advisers and information should guide customers.</td><td>Training of staff and establishment of Service Companies</td></tr>
<tr><td>Governance</td><td>-</td><td>Government obligation</td><td>Market forces alone</td><td>Government leadership</td></tr>
</table>

Appendix 3: Measures
NOTE: Shaded area denotes "less important or not mentioned"

Measures		Paradigm		
Type[59]	**Aspect**	**Old**	**New**	**Emerging**
Information	-	The economic man acted from rationally once correctly informed. Money was carrot and stick.	Search for and communication of "best practices".	Identification of niche markets and exploitation of learning investments. Tax (feebate) to encourage price sensitive actors.
Fiscal and Economic	Tax including exemption		Primarily to include externalities	
	Subsidy		Should be avoided not to distort the market	
Market	Emissions Trading	The market are individuals who act as above.	Recognised and tested	* Commitments and certificates within "universal" trading. * Use of public procurement as "power" to change
	Certificates			
	Procurement		Limited technology procurement. Some govt. based systems (e.g. FEMP)	
Regulatory	Regulatory reform		Made utility DSM based on self-interest impossible	Incorporation of Demand Response and certificates in regulation.
	Voluntary Agreements		**Strong** (legally binding) and **weak** (non-binding) on branch and company levels.	
	Standards		Developed systems to make information available at sales point.	Made more sensitive to technology changes both to follow and to drive changes (e.g. Top-runner)
	Labels			
R&D	Funding	R&D and eventually demonstration releases dissemination automatically	Wider perspective to encompass applications and use of products. Programmes to develop niches	Improved feedback from market and correlation between R&D and Dissemination
	Incentives			
	Programmes			
	Development/ Demonstration			
Policy Processes	Consultation and Outreach[60]	* Independent advisors and government planning guide the market. * Utilities could be mandated with DSM	Planning has become more indicative. Central authorities are "left in the dark" as regards infrastructure status.	More considerations as regards BAT+ and the relation to GHG emissions and to welfare issues??
	Strategic Planning			
	Infrastructure Management			

[59] These typologies vary enormously. This one is primarily inspired by, and taken from, Dealing with Climate Change, OECD/IEA Paris 2000

[60] Outrech in the IEA terminology comes very close to "Information"

Appendix 4: Actors
NOTE: Shaded area denotes "less important or not mentioned"

<table>
<tr><th colspan="2">Actors</th><th colspan="3">Paradigm</th></tr>
<tr><th>Type</th><th>Aspect</th><th>Old</th><th>New</th><th>Emerging</th></tr>
<tr><td rowspan="3">Governments and their agencies</td><td>Supranational</td><td></td><td>Directives and monitoring from EC</td><td rowspan="3">Comprehensive international programmes?</td></tr>
<tr><td>National</td><td rowspan="3">Plan and implement in hierarchical order</td><td>Non-intrusive monitoring</td></tr>
<tr><td>Regional/Local</td></tr>
<tr><td>Agencies</td><td>Programmes primarily to monitor.</td></tr>
<tr><td rowspan="6">Utilities</td><td>Generators</td><td rowspan="5">Vertical integration under regulatory control. High degree of societal consciousness</td><td rowspan="2">Not a part of business</td><td>GHG obligations</td></tr>
<tr><td>Pool for trading</td><td>Demand Response (DR) aggregation (in bidding?)</td></tr>
<tr><td>Transmission/ System Operators</td><td rowspan="2">Some interest to reduce overcapacity and to secure reliability</td><td rowspan="2">Engaged in Commitments and Certificate trading</td></tr>
<tr><td>Distributors</td></tr>
<tr><td>Suppliers</td><td rowspan="2">Not a part of business</td><td rowspan="2">DR aggregators?</td></tr>
<tr><td>Traders</td><td></td></tr>
<tr><td rowspan="4">Market actors</td><td>Manufacturers</td><td rowspan="4">The market delivers once it find the profit. Just scale up the business</td><td colspan="2">Interest to keep "green" profile.</td></tr>
<tr><td>Installation (Service Companies)</td><td colspan="2" rowspan="2">Specialisation in Energy Services and Performance Contracts</td></tr>
<tr><td>Consultants</td></tr>
<tr><td>Customers</td><td colspan="2">Aggregated and subscribers to "agreements"</td></tr>
</table>

Part 2: Managing the Complexity of Energy Efficiency. Cases and (new) methods. Policy and Measures cases

White Certificates, Energy Efficiency Commitments

The general idea with certificates and commitments is to release the huge hidden potentials for energy efficiency improvements by recruiting energy utilities as partners in the distribution of energy efficient products to the market. The certificates/commitments (obligations) serve both:

- as a means to distribute the responsibility between the concerned parties and
- to impose a scarcity on the market that translates into tradability (of the obligations and also of the achievements).

By the tradability it will be possible to improve cost efficiency of the activities and to use market mechanisms for the delivery to the final users.

The experience from the UK Energy Efficiency Commitments (EEC)

In the UK, the ministry (DEFRA) sets the overall targets, the regulatory authority (Ofgem) administer and monitor THE compliance. DEFRA has set suppliers a total target of 62 TWh of fuel-standardised energy savings to be met in efficiency improvements from April 2002 to March 2005.[61] Ofgem is responsible for dividing the overall EEC obligation between the suppliers. All supplier groups with 15,000 or more domestic gas or electricity customers will have a target.

One way of helping household consumers to make energy efficient choices is by reducing the purchase price of energy efficiency products, particularly where this incentive can be coupled with clear information about energy efficiency. Reducing the up-front cost of products to consumers is how the Energy Efficiency Commitment (EEC) in United Kingdom works. When the cost is sufficiently low consumers are much more easily persuaded that it is in their interest to buy energy efficient products. Recorded percentage of achieved energy savings[62]

Measure	Year 1	Year 2
Insulation	60	57
Lighting	20	23
Appliances	13	12
Heating	7	8

Table 8. EEC (UK) activities

EEC has been demonstrated to be a cost-effective policy. EEC has, since April 2002, further improved the efficiency with which energy saving measures are delivered to the consumer, with the result that the overall cost-effectiveness of EEC is – £150/tC saved[63]. The assumed

[61] http://www.defra.gov.uk/environment/energy/eec/index.htm
[62] Ofgem: A report for the Secretary of State for Environment, Food and Rural Affairs. July 2004 178/04
[63] Carbondioxide has an atomweight of 44 and of which carbon is 12, i.e. 27%. Thus £150 per ton C corresponds roughly to a CO2-price of £40 (150*0.27)

average cost of EEC to energy suppliers is £3.60 per fuel per customer per year, but this cost is not necessarily passed directly on to customers. To put this indicative figure in context, fuel bills in the UK average around £300 per fuel per year, so this contribution equates to just over 1% of household bills. These costs are more than outweighed by the benefits householders enjoy in the form of reduced fuel bills or increased comfort from installing the cut-price energy efficiency measures on offer. These benefits continue for the lifetime of the measure (10–40 years).[64]

The current EEC is expected to achieve carbon savings in the region of 0.4 MtC by 2010, relative to the Climate Change Programme baseline.

The experience from Italy

Italy has issued a system that will oblige the distributors to act, but it has for different reasons not yet come into force. The Italian system is tailored to involve distribution companies both for gas and for electricity if they have more than 100 000 customers.[65].

- gas: 22 distributors; 9.630.000 customers (total: about 16 millions)
- electricity: 8 distributors; 98% of total customers

The proposed target for the Italian system was that savings should grow steadily over time compared to business as usual (BAU) and thus contribute to some 5-15% of the Italian Kyoto-target.

Year	***Target (Mtoe/yr)***	
	Electricity distributors	*Gas distributors*
2005	0,1	0,1
2006	0,2	0,2
2007	0,4	0,4
2008	0,8	0,7
2009	1,6	1,3

Characteristics of the Intended system:.

a) Targets have to be achieved by energy savings projects
b) Projects may be implemented by:
   - distributors directly or via controlled companies)
   - ESCOs (still to develop)
c) Eligible projects;
   - only demand-side actions
   - There is an illustrative list: 14 classes of projects with more than 35 sub-classes
d) Energy Efficiency Certificates (TEE) market
   - certificates issued by AEEG following verification
   - certificates issued to electricity and gas distributors or ESCOs
   - tradable via bilateral contracts or in the TEE market
   - three types (electricity, gas, fossil fuels savings)
   - banking may be allowed

[64] Extracted from "Energy Efficiency: The Government's Plan for Action", DEFRA April 2004
[65] What is up in Italy. Market liberalization, Tariff Regulation and Incentives to Promote Energy Efficiency in End-Use Sectors. Marcella Pavan, AEEG, ACEEE Summer Study 2002.
The Italian energy saving obligation to gas and electricity distribution companies. Lorenzo Pagliano et al. ECEEE Summer Study 2003.

e) Annual compliance control
f) Sanctions for non-compliance

The experience from New South Wales

New South Wales has created a greenhouse gas abatement scheme that runs from 2003 to 2012 and with the aim to reduce the per capita emission of GHG-equivalent from 8.65 to 7.27 tonnes per year. [66]

Benchmark participants are allocated a share and are required to reduce their emission to this level by use of abatement certificates. Participants could be:

- electricity retailers,
- electricity customers buying directly from the Australian National Market,
- electricity generators
- certain other parties with large consumption

Abatement can be from the following activities:

- Low-emission generation of electricity
- Reduced consumption (Demand Side Abatement)
- Carbon Sequestration
- Other reductions from on-site with certain elective participants

The NSW scheme is thus a mix of white, green and black certificates.

The plans for France[67]

France is considering to introduce a white certificates scheme to run from 2005 with target value to reduce energy consumptions with:

- Electricity suppliers with 34 TWh
- Gas suppliers with 10.5 TWh
- Heat suppliers with 1.5 TWh
- Fuel oil suppliers 7.5 TWh

Suppliers that deliver more than 40 TWh per year will be mandated. All energy efficiency activities in all sectors will be allowed if they are additional and the eligible party can deliver over a "threshold".

Draft programmes:

Exclusions:

- energy savings coming from only substitution between fossil energies;
- energy savings from installations implied in the European trading system

Discussed measures:

- low energy light bulbs
- loft insulation
- double glazing

[66] www.greenousegas.nsw.gov.au

[67] ProPaCC Workshop, Karlsruhe 5 March 2004: "White Certificates as an element of Climate Policy in France" and "The draft French Energy Law and White Certifcate System", Robert Angioletti, EU & eceee expert seminar Septmber 21, 2004.

- installation of heating control mechanisms
- efficient domestic appliances
- replacement of boilers or water heaters by more efficient equipment
- fitting of insulating jackets to water heaters
- fitting of heating control mechanisms
- boiler maintenance
- creation of wood-fired heating systems for district heating or in industry

On the design of certificate systems

There are a number of cases for "White Certificates" But most of them are in an early state of development. The issues for a design of white certificates are several. A first consideration could be on how white certificates relate to other systems with similar intentions, like GHG-emissions trading (black certificates), Renewable Energy Commitments, REC, (Green certificates) and energy efficiency commitments, EEC (White certificates). The relations between these "markets" have to be thought through more in detail. One distinction is the choice of "operator". **Who will be mandated** to undertake actions, see figure below (source R. Baron, IEA)[68]? See also section below "Incentives for whom?".

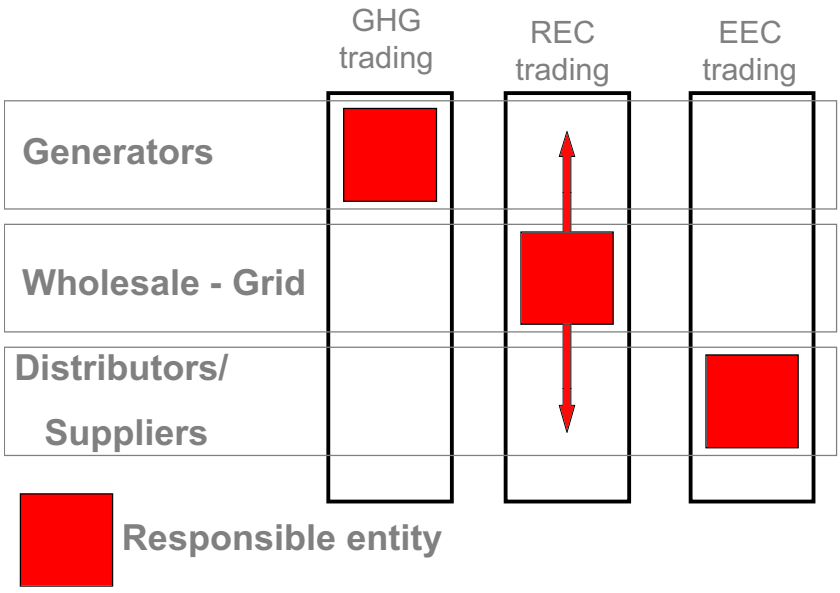

Figure 18: Different "markets" for trading black (GHG), green (REC) and white (EEC trading) certificates

Closely related to appointment of mandated entity is the **choice of energy/fuels** that will be targeted and there are examples across the range electricity, gas, heat and fossil fuels. Since additionality is required and verification is necessary there must be some "standardisation" of **eligible projects**. There must be some **authority to operate and regulate** the system and they need access to relevant expertise as regards technology may have importance also for the choice of energy.

[68] See http:// dsm.iea.org/ for proceedings from "Energy Efficiency Certificate Trading" In Milan, Italy, on 17 April 2002 at CESI.

The target sector is also closely related to the choice of mandated entity. Firstly, the choice will have to do with an estimate of the potential that can be released with this particular instrument, but also which of the possible choices have best access to (and credibility with) the type of customer that is targeted.

Delivery of the services on the market is yet another issue. One of the ideas with the certificates is that it should promote cost-efficient solutions and that such could be developed and delivered by specialists. It seems likely that there could be a bigger role for Energy Services and companies to deliver such.[69]

Finally the **tradability** of the certificates is an issue. Should they just be an object to clear the obligations between mandated parties or should they have a further value and thus challenge parties to develop not only technological creativity but also financial? Will there be room for a marketplace and maybe even for transfer of obligations between periods (banking) or use of brokers?

The basic design of a market place can be visualised as in the figure below (source Antonio Capozza, CESI, Italy).

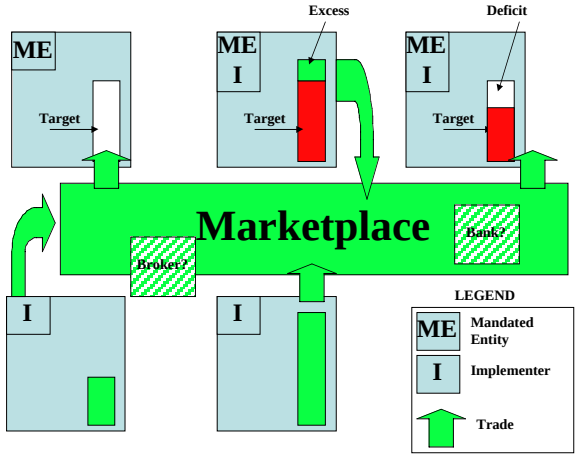

Figure 19: Market organisation and the actors

Issue	Concern	UK	Italy	France	NSW
Energy/fuel (eligible projects, authority to regulate)	Electricity	X	X	X	X
	Gas	X	X	X	
	Heat			X	
	Fossil Fuel		X	For heating	X
Mandated entity	Distributor		Gas, Electr.		
	Supplier	X		X	X (Retailer)
	Generators				X
	Customers				X
Target sector	Households	X	X	X	
	Commercial			X	
	Industry			X	X
	Transport			X	

[69] "White and Green" project, forthcoming report.

Issue	Concern	UK	Italy	France	NSW
Target action	Energy efficiency	X	X	X	X
	Renewable fuel		SOME		X
Delivery by (Implementer)	The mandated	X	X		?
	ESCO		X		?
	Other Agents	X (Service companies or contractors)			?
Tradability	Free		X		?
	Limited	X			?

Table 9. Design of trading schemes (Certificates, Commitments)

A special consideration in the choice of mandated entity is how they can handle and create incentives and hence if they will support the system or be adversaries to it.

Incentives for whom?

With the fragmentation of the value-chain from generators to users it is almost inevitable that efficiency improvements with a clear societal gain will be a loss for someone in the chain and that the loser do not find co-operation for the common good in his best interest. When and if that occurs it will require an analysis of interests and possible reactions from the parties concerned. Obligations to work for energy efficiency, whether in forms of certificates-commitments, emission caps or negotiated agreements, will release a reaction to offset the consequences.

Reactions

In the following we will illustrate possible reactions and assume that companies primarily work to keep their profit or to enlarge it.

Company situation: Companies could, depending on the environment in which it acts, react in three different ways:

- **Take the blow** themselves and reduce their profit
- **Pass on the costs** to their customers by just raising the price
- **Accommodate the requirements** by changing their business and their cost-level, e.g. reducing peak-load and losses, engaging in active energy services deliveries

We will illustrate the basic reactions with a “static” bar-chart where we assume that the companies get an obligation having the value 10 and that cuts into their turnover of 100 that is equally divided between profit and costs.

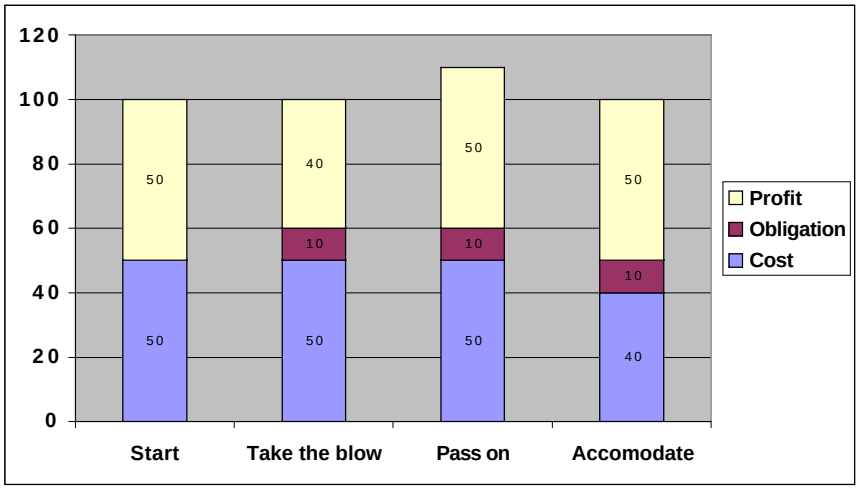

Figure 20. Distribution of company result (%) for different regulation frameworks, base case

Consequences of the obligation itself: Observe that the costs for the obligations in this analysis is assumed to be costs to leverage a higher profit for those who benefit from lower energy use, i.e. users, customers, environment, society as a whole etc. The sales from the companies that have the obligation will thus drop. For illustration we assume it drops with 10 units (10%) and that the costs are proportional to the reduced sales.

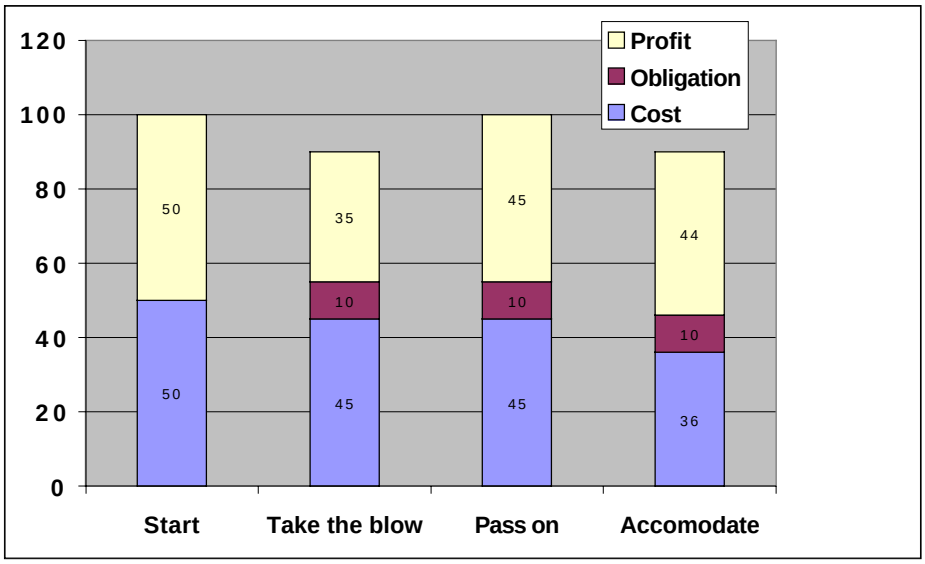

Figure 21. Distribution of company result (%) for different regulation frameworks. Case reduced sales

Handling the obligation: We now widen our perspective to also see how the companies will deal with the obligation itself. The obligation is generally to reduce the physical output of the product the company sells or delivers to a user/customer.

- **Take the blow companies:** will find their profit drastically reduced both by the reduction in sales (at fixed price) and by having to pay to fulfil the obligations.

They may want to find cost-efficient solutions for their obligations and keep up their profit. Such solutions could however also be less sustainable (cream skimming).

- **Pass on companies:** will not care as much but would have some incentive to be cost-efficient.
  They may want to spend more on quality solutions since their profit is hurt less than others.

- **Accomodating companies:** Will find their profit somewhat reduced but not as much since they have deliberately tried to reduce their cost for acquisition and handling of the products.
  They may want to go further and also earn back some of their spending e.g. by engagement in Energy Service Companies and or demand response activities as a service to customers.

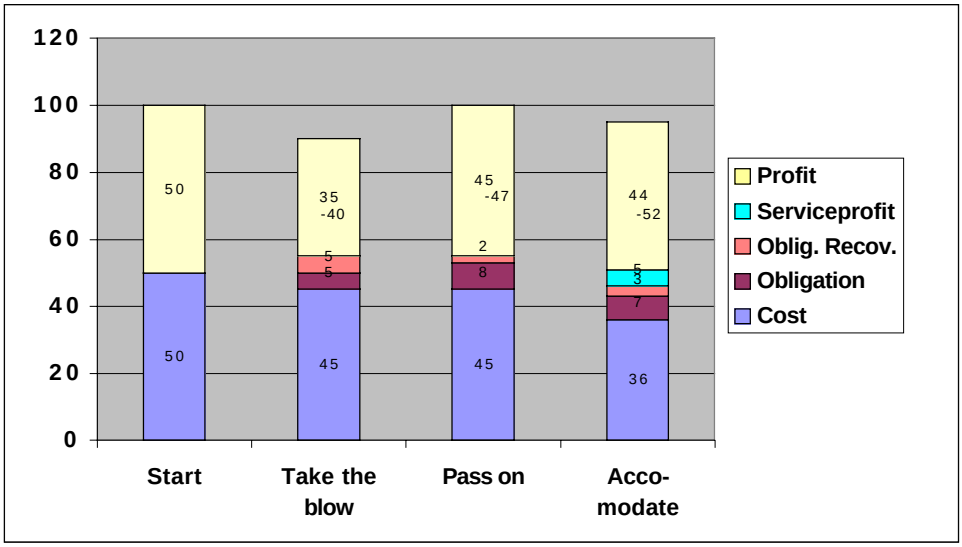

Figure 22. Distribution of company result (%) for different regulation frameworks.
Overall opportunities in different regulation frameworks

The above illustrations are purely hypothetical but indicate that accommodating companies may turn obligations to their business-advantage and not only reduce the impact. It also indicates that differences in choice of action to serve the obligation and that companies in a squeezed position will on one hand try to be cost-efficient but on the other hand may chose less valuable options and also be generally reluctant to the obligations. Such reluctance may make them adversaries rather than allies.

Which sort of companies could then be cast in the models?

- Distributions companies; Transport energy and have their revenues from a fee that is partly energy-related. They could also create revenue from services to customers. They have capital costs for installations, and cost for maintenance and operations that partly depends on the amount of energy they transport and they have to cover losses in the installations.

  Their revenue could be subject to regulation either on price or on costs for the activity.

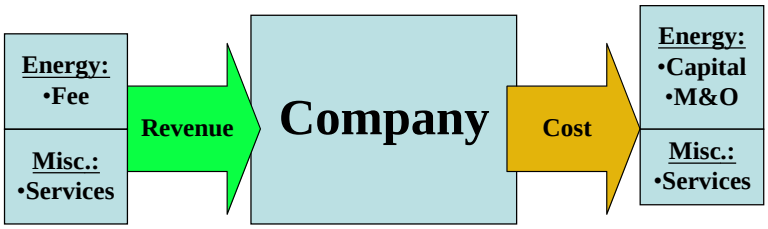

Figure 23. Company situation. Base case

The distribution companies could:
Take the blow – if they are severely regulated with a capped level on the fee or if the cost level is fixed by standards, contracts or rules.
Pass on the costs – if the regulation accepts this either as a rule or by a lax acceptance process applied ex post.
Accommodate –

c) if the company is expanding and/or finds cost reduction by targeted measures to reduce loss, avoid (or postpone) upgrading of capital as a natural activity
d) if the regulation allows for services to be part of the activities or if the company can engage in service activities of its own or inspire to such.

- Retailers (energy supply companies); Commissions energy for customers. Revenue from pricing to customer where a great deal of differentiation in terms of customer-classes is possible. The company could develop a profile with differentiation based on services to the customers. Costs are primarily energy bought from a wholesale market and/or from generators on contracts.

  Requirements from government to provide a certain amount of "green" energy could be a part of the costs that also could be passed on directly to the customer.

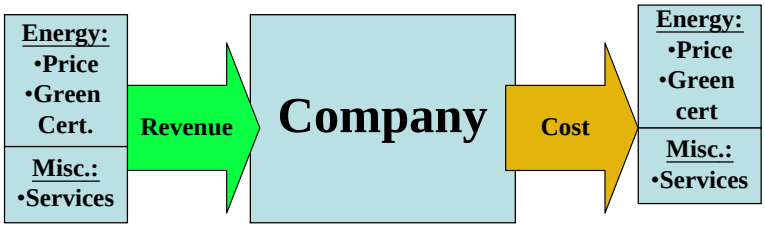

Figure 23. Company situation when costs are passed on

Retail companies are in theory competing for customers on price. Price spread and customer mobility indicate that customers may have preferences or could care for other things in a manner that allows companies to keep up prices. Companies also try to differentiate their products by use of different means in construction of contracts and/or services.

The retail companies could:
Take the blow – if they are in tough price competition overall or for some major group of customers and if opportunities to differentiate are low.

Pass on the costs – if they have a preferred status with their customers due to credibility or differentiation in product. The use of green certificates could have an inherent construction that allows the costs to be passed on.
Accommodate – to attract customers by creation of a different product that also contains energy efficiency improvements

Policy conclusion
The issue for policies that include obligations is not necessarily the choice of "interface" to the market, i.e. type of company that should operate the obligation. The context in which the companies operate in their national market may make the choice natural but in either case the following issues have to be addressed in the design of policy:

- Nature of "inefficiency" to be dealt with: Is it admissible to find cheap (cost-efficient) solutions that may be less sustainable or is focus on more complex and more sustainable changes in installations. Examples of the former could be household lighting and the latter commercial air-conditioning
- Technical measures and customer categories. Who holds and handles the sites where the changes could be made, who makes the decisions and with what target (economy, value, comfort)? Which types of companies reach these customer categories and have the best credibility?
- Regulation and market characteristic. How do the companies function and how will they be allowed to perform? Accommodation (see above) would be the preferable attitude since then the company (distribution or retailer) would be a partner to fulfil the obligation rather than an adversary.

ESCOs

The general idea with Energy Saving Companies is simply that the energy end-user does not need energy but the services that energy provides. These services require an input of capital, energy and maintenance and the same level of services could be reached at lower cost with a different input of capital and maintenance. To make the change the end-user is often handicapped whereas a professional supplier of Energy Services (ESCO) could do it better and cheaper.

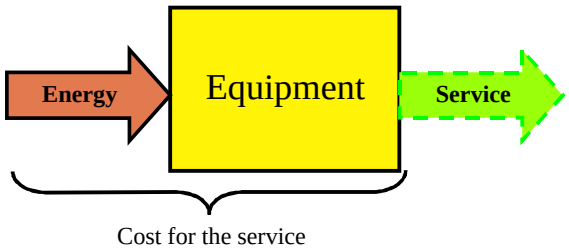

Figure 24. Total costing for services

When looking a bit closer to the subject there are other issues involved that are of importance for the choice and for the success, such as verification, risk considerations, ownership issues, etc.

According to the US Association NAESCO: "An ESCO, or Energy Service Company, is a business that develops, installs, and finances projects designed to improve the energy efficiency and maintenance costs for facilities over a seven to 10 year time period. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with the project. Typically, they offer the following services:

- **develop**, design, and finance energy efficiency projects;
- **install** and maintain the energy efficient equipment involved;
- **measure**, monitor, and verify the project's energy savings; and
- **assume the risk**, that the project will save the amount of energy guaranteed.

These services are bundled into the project's cost and are repaid through the savings generated.[70]

Different types of ESCOs

Within this framework there is room to put focus on different aspects and especially to " commodities" the products, i.e. describe the concrete offers that should attract customers. Some companies stress the output and sell **Performance Contracting**, others stress the risk and needs for capital and sell **Third Party Financing**.

For purposes related to the European Buildings directive there is a proposal to define the Energy Performance Contracting to: "***Energy Performance Contracting is a contractual agreement between the owner and/or user of a facility and the ESCO to improve the energy efficiency of energy systems as a result of investments, services or complete energy services.***

[70] http://www.naesco.org/meminfo.htm

The ESCO offers guarantees for the performance of the building or the energy systems and the ESCO is paid in relation to the actual performance."[71]

The ESCO retrieves their cost and get their profit from the savings, which are defined as the less costs for energy+operations+maintenance during the contract period. After the contract period the savings all accrue to the benefit of the customer, see figure below.

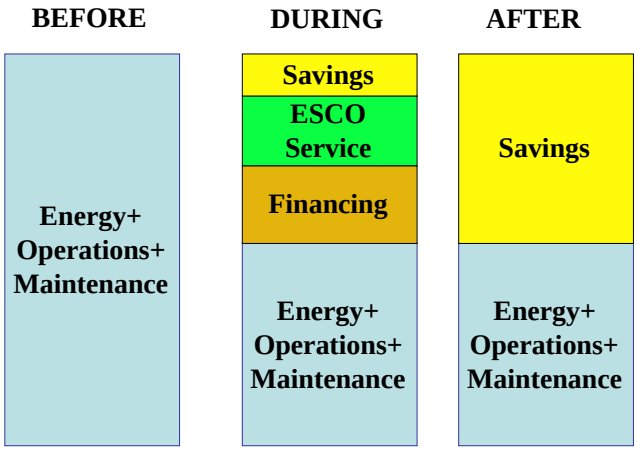

Figure 24: ESCO principles

ESCOs operate with either[72]:

- **Shared Savings** where the ESCO takes the financing responsibility and takes all the profit till investments are repaid (called first out) or part thereof
- **Guaranteed savings** where the owner takes the financing responsibility (maybe with some advice from the ESCO).

A variation to the ESCO-theme is the **PICO** (Public Internal Performance Contracting) where the service is provided within a unit of the public authority. One case has been developed and known as **Intracting.** In southern Germany and in Austria there has been also been a strong societal involvement in development of the concepts. One such is called "Intracting" which is shaping of ESCO services within the municipalities own organisation.[73] Budgetary constraints have prevented numerous local administrations from undertaking effective and necessary energy conservation investments. Individual local authority departments have often been unable to implement measures themselves. The city of Stuttgart has developed a new financing system termed 'Intracting'. This takes up the idea of contracting but operates entirely with city administration budget funds. It has done so since 1995, with growing success.

In Graz, Austria, a system called **"Thermoprofit"** has been developed in which local administration co-operates with enterprises to develop and sustain a market for energy services. The Thermoprofit Network consists of suppliers of total service packages – the so-called Thermoprofit partners. Primarily, Thermoprofit partners are prime contractors. They co-operate with regional enterprises in the execution of projects and thus contribute to

[71] Final Management report from EA DSM-Programme Annex X. Reports can be obtained from http://dsm.iea.org
[72] IEA DSM-Programme Annex X, presentations by Hans Westling and Antonio Capozza.
[73] http://www.energie-cites.org/BD/PDF/stu-int-en.pdf

stimulating the economy of the respective region. The have also developed a system for incentives with premium/penalties, see figure below.

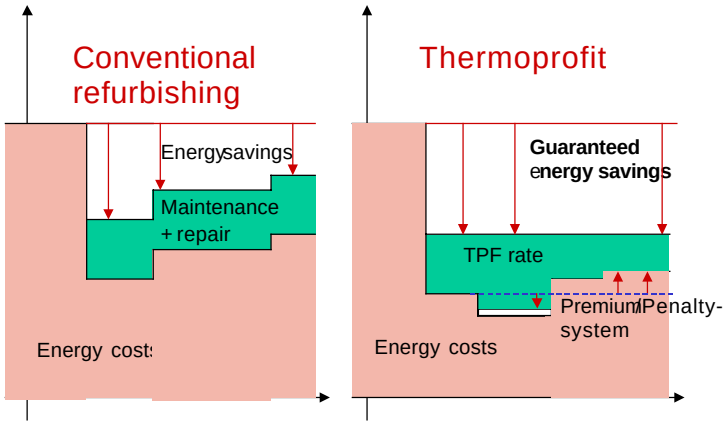

Figure 25: The Thermoprofit idea

	ESCO Featured Delivery	
	Performance	**Financing**
Profit	Guaranteed savings	Shared savings
Form	• Inhouse (e.g. PICO) • External (ESCO)	

Table 10: ESCO Typology

ESCOs Fictions or reality?

ESCOs exist in most countries but with great variations in success. The IEA DSM-Programme Annex X has a list of "problems" which probably could be read differently in different countries depending on their respective cultural, economical and political context. The following issues have to be addressed and could be used as a checklist:

- **Credibility and trust:** Who delivers and with what competence? What capacity has the ESCO and the customer? Who takes the risks?
- **Process and Procurement:** Legal framework and specification skill
- **Contracts:** Standard
- **Financing:** Institutions and reference, guarantees, insurances
- **Measurement and Verification:** Protocols and procedures
- **Market:** Experience and cases

A Market Potential estimate has been made in the IEA work mentioned and shows a huge potential if the basic problems can be overcome.[74]

Region	Market 2001 (MUSD)	Total potential (BUSD)	Market penetration (%)
Europe	135	63	0.2
Japan	64-196	19	1

[74] Summary report appendix 2 from EA DSM-Programme Annex X.

USA	1800-2000	63	3

Table 11. ESCO Market assessment

The EC Buildings directive will certainly put ESCO on the agenda and will probably be a strong factor to pull the issues further.

A recent Swedish Study that has focused on Energy Services from utilities on a deregulated market claims that ESCOs do not really deliver much added value but rather a lot of advice that seldom are implemented.[75] Development of a mandatory certificate system seems to be a way of putting force into the good intentions of ESCOs.

[75] Energitjänster på en avreglerad marknad. För en effektivare energianvändning?, Mikael Bergmasth och Mats Strid, Handelshögskolan vid Göteborgs Universitet, 2004.

The Japanese Top-Runner Programme

The Japanese top-runner program is based on a radically different thinking than most other national programmes by taking technology development into consideration. Standards are developed to give the industry incentives to improve products towards the best instead of just meeting an average goal or a minimum performance level.[76]

A standard level is set in accordance with the best possible performance at a certain year (top-runner). A target year is set when (in principle) all products on the market should have reached this level. Thus the technology development is fuelled by example and peer pressure. Penalties exist but targets are set without the intention that all products should meet the standard value!

Products (equipment) selected for the program meets at least one of the following criteria:

- It is used in large quantities in Japan
- It consumes substantial amounts of energy in its use
- Is in particular need of improvement

Presently standards exist for:

1. **Vehicles** (passenger and freight)
2. **Installation equipment** (Air conditioners, Fluorescent light, Refrigerators, Space Heaters, Gas Cooking appliances, Gas water heaters, Oil water heaters, Electric Toilet Seats, Transformers)
3. **Home electronics** (TV, Video recorders)
4. **Office equipment** (Copying Machines, Computers, magnetic Disk Units, Vending machines)

The mechanics of System

Target years are usually chosen within a period of 4 to 8 years. There is some preference for 2010 since it is the target year for the Kyoto-agreement.

Achievement of the target could be either by:

- Weighted average of the manufacturers production or
- All products individually

Manufacturers are obliged to display the performance level either numerically or by use of a specially designed label. The label has a special indication (in green) for standard achieved or (in white) if not achieved.

The ministry follows the performance and advice manufacturers about achievement. If they do not follow the advice the case is made public and orders given to adopt the advice. If they still do not penalties can be imposed.

[76] www.ecjj.or.jp/top_runner

Only companies with technical and financial capabilities can be advised (as mentioned). Manufacturers whose production, or import, falls below a certain amount are not targeted but **ALL** have the display obligation.

Achievements

It is reported that for air conditioners it took four years to break even between the investments in more advanced products and the savings in running costs.

Voluntary Agreements

The term voluntary agreements are used to describe a wide range of industry actions including: industrial covenants, negotiated agreements, self-regulation, codes of conduct, and eco-contracts. They are defined as: ***An agreement between government and industry to facilitate voluntary action with a desirable social outcome, which is encouraged by the government, to be undertaken by the participant based on the participant's self-interest.***[77]

VAs do *not* include actions that are undertaken without government initiative (or through the initiative of non-governmental bodies) or that are undertaken at government mandate. Within this definition, several characteristics differentiate VAs: the manner in which targets or goals are set, the nature of participant commitment, the degree of regulatory (or fiscal) threat, and the mix of VA participation incentives. Based on these key characteristics there are four major types of VAs.

- ***Target-Based VAs***, also called negotiated agreements, include negotiated targets that are legally-binding, which pre-empt future regulatory requirements, or are tied to a strong regulatory threat.
- ***Performance-Based VAs*** are based on negotiated performance goals that are not legally binding nor explicitly designed to pre-empt future regulatory requirements.
- ***Co-operative R&D VAs*** focus on spurring new technology developments that advance the best practice frontier, rather than improving best practice in and of itself
- ***Monitoring and reporting*** is a component of most VAs, but can be a type of VA.

Denmark and Netherlands are forerunners in the use of Voluntary Agreements and they have both used strong and clear forms such as target based and performance based agreements.

Findings in an IEA survey and analysis of Agreements include[78]:

- They can achieve stated objectives, sometimes even exceeding those of minimum regulatory standards, and help integrate economic and environmental goals. There are questions though about the effect of VAs in terms of energy efficiency gains over and above what might happen in their absence.
- Results can be achieved relatively quickly and overall improvements in economic efficiency is likely to be higher compared to traditional regulation.
- A high level of participation in VAs is important to their success.
- Monitoring and reporting of VAs is very important to track progress.

A study on Netherlands claims that 25-50% of the improvements can be attributed to the Agreements and that they are 50-75% more effective in terms of cost than other measures to achieve energy efficiency.[79] The study set seven rules for Voluntary Agreements:

- The government must have a strong negotiation position
- Targets and timetables should be clear
- Government must provide long-lasting support
- Big companies are more important to target
- Physical monitoring must be arranged

[77] Energy Efficiency Initiative, OECD/IEA Paris 1997.

[78] IEA, *Voluntary Actions for Energy-Related CO_2 Abatement*, OECD, (Paris) 1997.

[79] "Are voluntary agreements effective?" Kornelis Blok and martin Rietbergen for an IEA Workshop February 22, 2001.

- There must be clear monitoring guidelines
- Independent verification is necessary

Further support to the thinking of strong government "interest" in the performance achieved can be traced in the Finish system where Voluntary Agreements is one part of a three instrument package. The other two instruments are Energy Audits and Government Subsidies.[80]

[80] Heikki Väisänen, Ministry of Trade and Industry, Finland. EU & eceee expert seminar Septmber 21, 2004.

Public Procurement

The largest energy users and biggest purchasers of energy using equipment in a country are often government facilities. By focusing investments, procurement practices and practices on energy efficient buildings, products and services, the public sector can create a buyer-led shift in the market toward energy efficiency.

A study that was conducted by a seven-country team within the Commission's SAVE programme from 2001 to 2002, PROST [81], shows that substantial gains can be made through energy-efficient public procurement: With annual additional investments in energy efficiency of 80 million Euro, energy savings worth up to 12 billion Euro per year could be achieved in the public sector in EU-15. The report outlines a number of policy scenarios for the public sector in the EU to demonstrate how public purchasing and energy management could influence energy efficiency. It also quantifies the potential for energy and cost savings and the GHG reductions linked to the savings.

The Public Procurement Directives[82] clarifies that public authorities can adopt environmental considerations into their procurement procedures in many ways. Still, only some 19% of all public administrations practice green purchasing to a significant amount (by using environmental criteria in more than half of their purchases). Important barriers for good energy management practices pertaining to procurement are:

- Insufficient knowledge of procurement legislation.
- Split incentive to managers. (Investment- and management budgets are split).
- Lack of investment culture. (Investments for future economic returns are not a part of the culture).
- Complexity of public procurement.

The European Commission has produced a handbook on Green Public Procurement that explains how public purchasers can consider environmental aspects, including energy efficiency, in public procurement.

Peps

Peps is a collaborative effort to assist and promote energy conservation programmes in governments around the world. It is directed by Lawrence Berkely National Laboratory, Alliance to save energy, IIEC [83] and ICLEI.

The efforts that Peps aim to promote, ranges from efficient product purchasing initiatives to performance contracting.[84] Successful experiences from the Federal Energy Management Program of the US Energy Department (see below) and Mexico's federal energy conservation agency, CONAE and other efforts are used as models.

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[81] Public Procurement of Energy Efficient Technologies, http://www.eceee.org/library_links/prost.lasso

[82] IP/04/150, adopted on 31 March 2004

[83] International Institute for Energy Conservation - a global non-profit organisation working for sustainable energy solutions to developing countries and economies in transition

[84] http://www.pepsonline.org/

Examples of energy efficient procurement strategies

The US government has adopted overall goals for energy savings in federal building facilities. The goals include specific policies in buying energy-efficient products that qualify for the Energy Star-label and products that are among the 25% most efficient models on the market (for categories without an Energy Star-label), see also below.

In Brazil, the national energy efficiency agency, PROCEL, provided grants and low-interest loans to retrofit 16 ministry buildings from 1997. Some 40 GWh/year was saved through retrofit investments targeted public buildings and additionally 100 GWh/year was saved from street lighting retrofits. PROCEL plans to invest 7.6 million dollars in public building energy and water efficiency programs from 2001-2004.

Despite a modest budget and few employees, the Federal Buildings Initiative[85] in Canada has leveraged private sector funding and made large efficiency gains in the federal building stock. After ten years, retrofits in some 7000 buildings have been made, and savings of almost 20 million dollars per year. GHG emissions of Canada's federal agencies have fallen approximately 20% over the same period.

The UK public procurement policy[86] is characterised by a clear signal to government departments to purchase energy efficient products. Government departments have had a goal of 1% reduction per annum in energy consumption in government estate. The government's procurement policy is based on Value for Money, defined as "the optimum combination of whole lifetime cost and quality to meet the user's requirements".

The US FEMP-system

Starting with the oil embargo in the mid-1970s, the US federal government enacted legislation and regulations concerning energy efficiency in public facilities and purchasing. A series of Presidential Executive Orders also direct federal agencies to undertake activities to promote energy efficiency in facilities and operations.

Executive order 13123 includes specific directives addressed to federal agencies. It assigns a broad co-ordination and technical assistance role of FEMP – the Department of Energy's Federal Energy Management Program[87]. Federal agencies are required to reduce their energy use by 35% by 2010 compared to 1985 levels. To help agencies to reaching this target, FEMP offer services as the management of interagency working groups, policy guidance and legislative updates and tracking.

FEMP works to reduce the cost and environmental impact of the Federal government by advancing energy efficiency and water conservation. The programme promotes the use of distributed and renewable energy, and improving utility management decisions at Federal

[85] http://oee.nrcan.gc.ca/fbi/home_page.cfm
[86] Greening Government Operations Green Guide for Buyers
87 www.eere.energy.gov/femp

sites. It assists agencies in finding innovative energy efficient solutions and address the responsibilities of the agencies in programme areas as:

- Equipment procurement
- New construction/retrofits
- Operation and maintenance
- Utility Management

Major elements of the programme include:

- Facility on-site **audits** to identify energy (and water)-saving measures
- **Technical support** in planning and undertaking Energy Saving Performance Contracts (using ESCOs).
- **Design assistance** for energy efficient construction or renovation of facilities.
- **Recommendations** on energy efficient public procurement of products (see above, under Public procurement).
- **Tracking and reporting** of energy efficiency and renewable energy activities of governments.

FEMP also provides expert assistance to agencies seeking projects financing. Methods used are Energy Savings Performance Contracts (ESPCs), Utility Service Contracts (UESCs), rebates and public benefit funds. FEMP also provide analytic software tools for project screening to help agencies to find the most energy efficient investments.

FEMPs communication programmes aimed to increase federal employees' awareness of the programme include newsletter, web site, annual awards and workshops. The technical workshops cover areas as project financing, life-cycle costs and sustainable design.

Each federal agency must submit to the President and Congress:

- an annual report,
- an implementation plan,
- an energy scorecard, and
- an energy management data report

The annual report describes the activities in implementing the requirements of energy conservation legislation and the Executive Order 13123. The implementation plan describes how the activities to meet the energy efficiency goals will be carried out, the scorecard highlights the achievements to date in meeting the goals and the use of specific tools (such as alternative financing and targeted procurement).

The most recently published report[88] includes information on energy consumption in federal buildings, operations, vehicles and equipment. It shows that energy efficiency has increased in federal activities, although some opportunities still remain. Findings from the report include:

- Energy consumption in federal government buildings decreased 21.8% from the 1985 report.
- The total site-delivered energy consumption decreased 30.9% from the 1985 report.
- Six agencies have exceeded a 20% reduction in building energy use per square foot from the 1985 base year.

[88] The Annual Report on Federal Energy Management for Fiscal Year (FY) 2001

Country cases

United Kingdom
UK has a formal Energy Efficiency Action Plan, dated April 2004, and that is based on the UK long term goal to reduce GHG-emissions by 60% till the year 2050. The plan is a remarkable piece of comprehensiveness and demonstrates the full development of the energy efficiency paradigm as described in part 1 of this paper. In this plan energy efficiency has multiple objectives (environment, economy and business development) that forges the pieces together to support and motivate each other. It clearly states that UK will take a leading role and have its industry to gain from this. It is notable that the UK distinctly has coupled energy efficiency and the climate issues and further made this coupling part and parcel of their ambitions in their preparations as president for the next G8-summit.[89]

The plan acknowledges several issues that go beyond the mere symptoms and right to the heart of the matters by stating and elaborating that key barriers are behavioural and organisational. It recognises the hassle for individuals to undertake even profitable measures, which could be ranked high in terms of cost-efficiency (short payback) terms, but is low in terms of actual money reward. Therefore measures and incentives have to be cut differently to appeal to the actions of individuals. The creation of the trusts (Energy and Carbon Saving) and the use of energy efficiency commitments are clear signs of the perceived need to engage individual action by aggregation.

The policies and measures are tailored to fit the circumstances in each sector in terms of releasing potential efficiency resources and targeting of key issues that enables and motivates actors to participate, e.g.

- Households are targeted by the use of energy efficiency commitments (EEC)
- The decent homes programme targets social housing
- Building Regulations are upgraded for both new and refurbished buildings
- Industry will be activated via the emissions trading scheme but also incentivised by the Climate Change Levy and targeted tax allowances
- The Government intends to show a strong leadership in the public sector
- Product standards will be raised in a Market Transformation Programme
- Local authorities are addressed as “Beacon Councils”
- Business will be supported and activated by the trusts /energy Saving Trust and Carbon Saving Trust)
- Support will be given to innovations in low-carbon technologies
- A package of efforts will address Good Quality CHP
- Energy Service deliveries from suppliers will be further investigated in a pilot scheme
- The UK drives formation of an outreach programme (REEEP) that addresses both the use of renewable fuels and energy efficiency.

[89] PM speech on climate change [14 September 2004] http://www.number-10.gov.uk/output/Page6333.asp

UK and the Allocation of emission rights

A special concern is the actions that could save electricity with the sub-sector (transport, industry and buildings) and from which the energy sector will gain the impact on CO2-emissions, see figure below. Who will have the incentive to pursue that they are undertaken? The actor in the served sector will only see the price as a motivator and the energy sector will not feel motivation as long as he is within his allowed cap for emissions.[90]

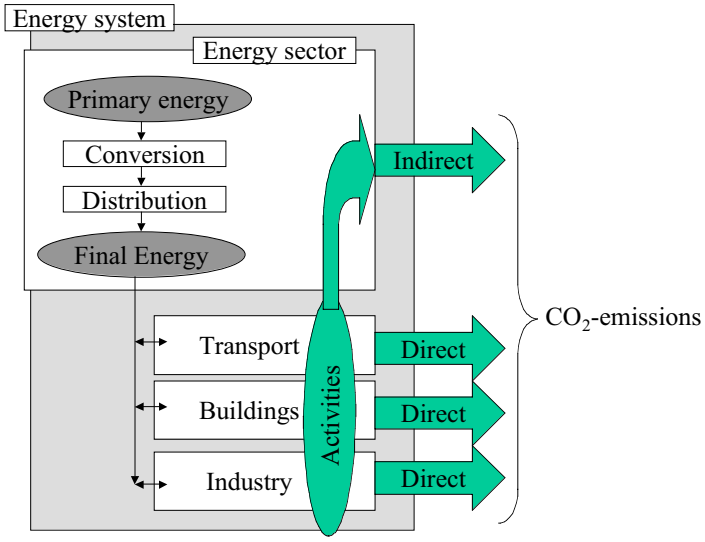

Figure 26: Direct and indirect impact on GHG emissions by savings

If the served sectors realised their potential in full the benefits for the energy sector in terms of CO2 could be considerable, however at a price of lost sales of their product with the present technology, see example in table below.

	Demand Side indirect (benefiting the Supply side)	Demand Side (direct)			SUM
	Energy Prod.	Industry	Buildings	Transport	
Range	0-9	1-6	1-8	2-12	13-19
Median	6	3	3	4	18
Arithmetic Average	6	3	3	5	17
Decisions type in sector	Corporate, Political	Formalised Corporate	Operational, Individual, Comfort	Individual	
"Societal concern" in decision	High	Important	Some	Little	

Table 12: Indication of savings potential (% of total CO_2-emissions) and correlation to structure for decisions to realise the potential.[91]

[90] C.f: UK Energy efficiency Action Plan, April 2004, paragraph 204

[91] Implementing climate related measures: Will the Kyoto mechanisms release the demand side potential?, Hans Nilsson ECEEE 2003. The estimates in the table relates to global conditions.

France

The French Programme seems to be less sophisticated in terms of complexity than that of UK but still with high ambitions. The draft programme[92] is based on an analysis of threats where climate change and market uncertainties are dominant, and does not as the UK recognise (in writing) the opportunities except than in arriving to a lower level of risk.

In the analysis it is however noted that the development of China and India will have a great impact on the future market and on climate, which further sharpens the need to become less dependent on energy per se and on import of energy. It is also stated that France aims at a reduction of GHG-emissions with 25% till the year 2050.

The sectoral analysis points out several weak spots in the energy demand and several areas where changes in technologies and customer behaviour merits monitoring. It is furthermore stated that there are three priorities for the policy:

- Improve the efficient use of energy
- Improve the diversification of energy supply
- Keep all options open (and especially the nuclear)

Therefore it is almost a surprise that the suggestion for measures is so weak. The only new suggestion that is elaborated is to introduce "White Certificates". The EC Building directives will be implemented and some tax credits used. There are also some not specific declarations about an extended use of voluntary agreements and that the government should be exemplary in its own activities (buildings and transport).

France claims in the proposal quite a success in reduction of domestic use of energy for heating, from 323 kWh/m2, year the year 1973 to 180 kWh/m2, year the year 2000.[93] A success partly offset by a more extensive use of brown goods 18 kWh/apartment 1973 to 321 kWh/apartment 1998. The latter in focus for efforts to standardise lower consumption levels, notably for stand-by power.

USA

The energy policy in the US is by and large executed on a state level. The federal initiatives are to a primarily geared at providing the opportunities to act locally, which in practice means that the federal programmes are mostly technology-oriented. The federal government provides technology (and technology performance-based) options that can be used locally just as the EU does.

The process for a new energy bill put before the congress 2003 shows initiatives in the following areas[94]:

- Standards and labelling; Standards could be set either in legislation or by rulemaking from Department of Energy, DOE, and Environmental Protection Agency, EPA. The Energy Star Programme is a high quality standard that draws it success from the attraction for suppliers to use the label where the standard level is set in rulemaking.

[92] Livre Blanc sur les énergies. 7 Novembre 2003.
[93] This decline in energi intensity is NOT substantiated. In e.g. the IEA "30 years of energi use in IEA countries" figure 5.8 an improvement of some 10% is recorded fro France instead of the 45% mentioned here.
[94] ACEEE Comparison of energy-efficiency related sections of house and senate energy bills.

Equipment mentioned is lighting (exit signs, traffic light, torchieres, CFLs and fixtures) transformers and battery chargers (for stand-by power), commercial space equipment (vending machines, refrigerators, ceiling fans), heating equipment (furnace fans, unit heaters). A revision of the energy label (guide) is proposed.

- Tax incentives; Credits are proposed for new homes (that reduce energy use by 30% compared to a reference), existing homes (that reduce their use by 30%), manufacturers for high-efficiency washing-machines and refrigerators, hybrid and fuel cell vehicles, CHP in the range 50 kW-15 MW, fuel cell power plants > 500W, Micro turbines, Residential Air conditioners, heat pump, furnaces and water heaters with high efficiency, Ground source heat pumps.

  It is worth to notice that decentralised power has moved into the area of energy efficiency.

- Demand Response; Real-time metering (tax incentives) and pricing (for public utility commissions, PUC, to decide), water meters in multifamily housing (tax incentives), interconnection and net metering (to allow distributed generation). DOE and FERC to give assistance for Demand Response Programmes.

- Transportation; Studies on options to reduce fuel usage “by a significant percentage”. Federal fleets should reduce average fuel use.

- Maintenance of HVAC; Training Programme for SME

- Industrial voluntary commitments; Industry energy intensity should be reduced 2.5% annually in the period 2004-2014.

- High-Performance public buildings and schools will receive grants. Special funds for public and assisted housing

- Federal energy efficiency; The FEMP-programme extended e.g. on energy services (performance contracting).

- Appliance rebates; 50 MUSD annually

Detailed information about areas and programmes is found on http://www.eere.energy.gov/

The Kyoto-Agreement and Energy Efficiency

The Kyoto-agreement aims at reducing emission of Greenhouse Gases, GHG. The construction of the agreement is such that there is a clear focus on trading and on measures undertaken by those who emit the GHG. Energy Efficiency measures to improve end-use is either not in the focus of the debate/concern or just taken for granted. And yet the potential for energy efficiency improvements is compared to most other measures high and such improvements are the only ones that have a "absolute" effect on the GHG-emissions by terminating the cause.

In this part we will investigate if and how energy efficiency is handled in the National Allocations Plans, NAP, recently made for the EU Emissions Trading Scheme, ETS, and then consider to what extent the energy suppliers could have a role to promote energy efficiency further.

Linking National Allocation Plans, NAP, and energy efficiency policy.

Annex III of the Emissions Trading Directive defines the criteria for the National Allocation Plan. Below follows a summary of selected criteria and examples of how they are applied in allocation plans in different countries. In the following we make an overview of relevant criterions and give examples on how energy efficiency is handled in NAPs presented hitherto.

Criterion 1 – **Consistency with Kyoto commitments**
Criterion 1 in Annex III requires Member States to consider consistency with the Kyoto Protocol, national energy policies and national climate change programme when allocating allowances.

The criterion is mandatory and sets the Kyoto targets as a "cap" for allocated emission allowances, but enables the state to go beyond the target.

Example

- A country that have chosen to go beyond the target is the UK: The UK's commitment under the Burden Sharing Agreement[95] is to reduce its emissions of greenhouse gases by 12.5% below base year. In addition, the UK has a domestic goal of moving towards a 20% reduction in CO2 emissions by 2010. The UK Energy White Paper sets the framework of putting the country on a path to a reduction in CO2 emissions of 60 % by 2050 , and states that the EU Emissions Trading Scheme will be "the central plank for our future emissions strategy".

Within the scope of climate change commitments, adjustments can be made to specific circumstances. For example, if effective national policies are applied to sources outside the trading scheme, more allowances can be allocated to covered installations.

National energy policies may also lead to adjustments, such as measures for provision of required levels of energy if e.g. a Members State has committed itself to phase out nuclear

[95] Coucil Decision 2002/358/EC

installations on it territory. The adjustment of allocations within the commitments/policies is regulated by criterion 3.

Methods for calculating the potential

Calculation for assessing the reduction potential can be made in a top-down or a bottom-up approach. Most NAP has used top-down calculations, which returns lower estimates for potentials than bottom-up. A consequence could be that there is a larger potential to harvest and that the NAPs are systematically conservative in their estimates.

In the Swedish NAP a macroeconomic assessment of the effects of the introduction of different carbon dioxide emissions has been used (SOU 2000:23). The calculations imply that the greatest potential emission reductions are to be found in housing and buildings and in the public and commercial sector. The reduction potential for the industry has been considered as much less, especially in the iron and steel industry, chemical industry and petroleum refineries.

The starting point in the UK NAP has been to estimate total projected emissions for 2010 and then consider the additional savings that the EU emissions trading sectors should deliver. The sector allocations have then been calculated by applying the details of the emissions projections in a combination of top-down and bottom-up methodologies and by taking account of the additional savings from the emissions trading, ETS.

Criterion 2 – **Consistency with assessment**

The total quantity of allowances shall be consistent with assessments of actual and projected progress towards fulfilling the Member States' contributions to the Community's commitments. The Commission undertakes an annual assessment of Member States' actual and projected emissions in total (by sector and by GHG).

This criterion intends to ensure that the total allocation is consistent with pre-existing, publicly available and objective assessments of actual and projected emissions. Consistency according to the criterion is ensured of the total quantity of allowances allocated to the ETS covered installations do not exceed actual and projected emissions in those assessments.

A draft analysis of the National Plans for the trading scheme for 2005-2007, made by consultancy Ecofys evaluates the fulfilment of criteria 1 and 2. The evaluation focuses on progress towards meeting the Kyoto target and the assessment of development of emissions. It also compares to caps emissions to Business as Usual (BaU)-scenarios, a comparison that indicates the environmental additionality of the emission-trading scheme.

Conclusions from the evaluation are:

- That the caps of the Member States generally are below the expected BaU emissions, i.e. most of the countries evaluated in the study will reduce emissions from the participating sectors
- The caps are generally less strict than if the trading sector would make an equal contribution to meeting the Kyoto target. The majority (except for UK, Germany, Lithuania and Latvia) will not require cuts to an extent proportionate with the proportionate with requirements under the Kyoto Protocol.
- Several countries indicate the need to use CDM/JI credit purchasing in order to meet the targets. Although twelve of the examined plans state that the shortfall will

be compensated, at least partly, through the protocol's flexible mechanisms, still only three of the countries have made significant moves to use this potential.

Criterion 3 - **Potential to reduce emissions**
Quantities of allowances shall be consistent with the potential, including the technological potential, of activities covered by this scheme to reduce emissions. Member States may base their distribution of allowances on average emissions of greenhouse gases by product in each activity and achievable progress in each activity.

This criterion is mandatory in part; it **must** be applied in determining the total quantity of allowances and it **may** be applied in determining the quantity per activity.

On a macro-level the overall allocation has to reflect the relative differences in the potential between the total covered and the total non-covered activities. A least cost approach should be applied, and the assessment has to be based on where the least-expensive reduction potential is to be found.

Examples

- In the Danish NAP consideration has been taken to the fact that the sectors included in the emission trading system (ETS-covered sectors) have a cheaper reduction potential than the non-covered sectors. A higher pressure has been/is applied through domestic taxes and regulation of emissions from non-ETS-covered sectors (energy- and CO2-taxes for this sector being among the highest in the western world).
- In Sweden, the share of the ETS-covered sector of the overall emissions has increased during the last ten years. This is partly explained by energy carbon dioxide taxation that has resulted in a transition from individual to district heating and a decrease of emissions in the transport sector. Consideration has also been taken to an expected increase of emissions in the trading sector due to favourable development with increased production.

On a micro-level a Member State may apply the criterion to determine separate quantities per *activity* (as opposed to installation, as in criterion 7 below). Applied, the allowances should reflect the relative differences in the potential amongst individual covered activities. This part of criterion 3 is not often considered in the NAPs[96].

Criterion 4 – **Consistency with other legislation**
The Plan shall be consistent with other Community legislative and policy instruments. Account should be taken of unavoidable increases in emissions resulting from new legislative requirements. The allocation plan should thus not contravene the provisions of other new Community legislation or policies. The allowances should not be allocated if other legislation implies the reduction of emissions even without the trading scheme. The first sentence is mandatory and applies to both unavoidable increases and decreases of emissions.

Examples

- The Netherlands: The Sustainable Energy Directive[97] requires that electricity generated with sustainable fuels accounts for a 9 % share of Dutch electricity consumption in 2010. This will partly be achieved by additional burning of biomass in coal-fired power stations. In order to achieve this, a coal covenant has

[96] Ecofys, Analysis of the National Allocation Plans for the E Emissions Trading Sceme, August 2004
[97] 2001/77/EC

been signed between the government and the energy sector. In the covenant it was agreed that in total producers will emit 3.2 megatons less of CO2 (in the period 2008-2012) by burning biomass instead of coal in coal-fired power stations. Separate agreements have then been concluded with each installation. 37.5% of these agreements will be realised in the period 2005-2007, something that has led to adjustments of the allocations of emissions.

- Austria has made correction for expected increase of emissions from refineries due to the influence of the Directive of reduction of sulphur in certain liquid fuels (Directive 99/32/EG).
- The German NAP estimates that the impact of Community legislation will be less than 10% in the first phase and is therefore considered as non-substantial.
- The UK NAP considers regulations such as the taxation on energy products, provisions of energy performance in buildings, voluntary agreements with car manufacturers, ambient air quality assessments, limited values for certain air pollutants among other provisions.

Criterion 6- **New entrants**

The plan shall contain information on the manner in which new entrants will be able to begin participating in the emissions trading scheme. The treatment of installations starting operation in the course of a trading period – new entrants – differ depending on the allocation method chosen for existing installations. No specific decisions are needed if allowances are sold, but if the majority of allowances are free, there are several opportunities to integrate new entrants to the market. The size of a reserve shall be justified with references to the expected number of new entrants during the trading period.

The Commissions guidance[98] outlines three options to integrate new entrants in the system;

a) by having installations purchasing allowances,
b) auctioning and
c) by providing free allowances from a reserve.

The Commission will, however, also assess any other option if notified in the NAP. If allowances are sold or auctioned, a Member State may cancel remaining allowances and reissue a corresponding quantity for auctioning in the subsequent period. Most NAPs will provide new entrants with allowances from a reserve. The consequences of the reserves being too small or too large differ.[99]

Banking

Allowances can be banked, i.e. put aside and used in a subsequent period (Art 13.2 of the Emissions Trading Directive). Remaining allowances for the period that is about to terminate are then cancelled and replaced by allowances for the period to begin. Each Member State will decide whether allowances granted for the first trading period can be banked for 2008.

Banking encourages early reductions in emissions and offers operators more innovation and flexibility in scheduling their measures. It also reduces volatility in the price of allowances towards the end of the trading period.

The German NAP however foresees a problem with banking from the period 2005-2007 for later use in the subsequent period, since it would increase the total allowances during that

[98] COM(2003)830 final
[99] Ecofys, Analysis of the National Allocation Plans for the E Emissions Trading Sceme, August 2004

period. Moreover, national Kyoto targets would be jeopardised further by the lack of harmonisation with regard to banking arrangements in Europe, since the differences may lead to substantial international inflows of allowances. Germany will therefore not permit banking from the first to the second trading period

Criterion 7 - **Early Action**
The plan may accommodate early action and shall contain information on the manner in which early action is taken into account. Benchmarks derived from reference documents, concerning the best available technologies, may be employed by Member States in developing their National Allocation Plans, and these benchmarks can incorporate an element of accommodating early action.

In other words; fewer allowances will be available for *installations* that have not undertaken early action, whereas installations that already have reduced GHG emissions in the absence of or beyond legal mandates should not be disadvantaged and thus be compensated with more allowances.

Examples

- In the Netherlands, early action has been considered by looking at performance of energy efficiency. The existing policy of voluntary agreements on energy efficiency has been taken into account. If an installation has performed better than was required under the agreement, it is awarded with extra allowances (and the opposite applies to installations that have under-performed the agreement).
- Early actions considered in the Danish NAP by using a relatively long base period for calculation of historical emissions as the basis for allocation for all sectors excluding electricity production. It has been supplemented by the use of a sectoral benchmark as the basis for allocation in the electricity sector.
- Early action has been taken into account through an early base year and/or benchmarking in Estonia, Finland, France, Germany, Netherlands, UK, Italy, Slovenia and Latvia.

Criterion 8 - **Clean Technology**
The plan shall contain information in which clean technology, including energy efficient technologies, are taken into account. The criterion is optional and cannot be combined with criterion 7. Criterion 8 does not define what constitutes clean technology, but the guidance of implementation[100] of the criteria refers to ”clean or energy efficient technology that has a lower technological reduction potential than a comparable installation not using such a technology”.

The criteria is related to the above mentioned criteria and can be seen an extension of criterion 3 to the installation level (criterion 3 covers installations with a *relatively* low reduction potential). An installation using clean technology has a lower technological reduction potential which may reflect the allocation.

Examples

- Ireland does not apply the criterion of clean technology since the Emissions Trading Directive is considered to be already an automatic driver for the use of energy efficient technologies.
- Finland (draft NAP) defines clean technology as the utilisation of renewable energy sources and to the efficiency of energy use, e.g. in the form of a high

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performance. The criterion has been taken into account when defining the total quantity of emission allowances and the potential for emissions reduction.

- Clean technologies are taken into account in the NAPs of Italy, Ireland (only CHP), Estonia, Lithuania, Austria, Belgium, Finland, France, (energy efficiency), Germany (bonus on CHP), UK, Sweden, Spain and Portugal. In some of these countries account has been taken not explicitly but indirectly.

Conclusions as regards energy efficiency

With few exceptions energy efficiency, as a tool to help fulfil the Kyoto-obligations, is not explicitly mentioned. This attitude could be justified at this stage since drawing up the NAPs is a first step to prepare the trading regime. Once the trading scheme has begun to function it is assume that those actors that have allowances should themselves find their way to, when needed, either apply physical measures or buy allowances. Thus the society will find an economically effective (least-cost) solution.

This will in theory work well and also hold the promise to work for energy efficiency if the actors have control over their energy-use and the capacity to identify which of the two solutions that is most suitable for them. Since a substantial part of the GHG-emissions comes from energy suppliers pursuing energy efficiency improvements may need support both to be recognised, assessed and implemented.

A special issue is the allocations and the relations between the trading sector and the non-trading sector. In a report made of 12 Allocation plans it is stated that "…most countries have allocated generously to the trading sector. The allocation has been based on future needs. ….Many countries will have to make large reductions in the non-trading sector."[101]

Energy Suppliers and energy efficiency

There are many studies trying to predict the market for GHG once it starts. The unknown factors are several and the estimates for prices vary widely. There is however (if anything) that indicate that energy suppliers from self-interest should promote energy efficiency to be undertaken at their customers premises.

In theory they could motivate such activity in the case their allowances to emit CO2 is insufficient for them, but as long as:

- they keep their emissions below cap they have no incentive
- the price for allowances is low, it is far easier to enter a known market and buy new allowances than enter an unknown to buy down your excess with reduced demand on your core product
- price of allowances is high enough to affect marginal prices on the spot market and your company have low-carbon (and low-cost) production the new price level adds to the "wind-fall" profit

[101] Analysis of national allocation plans for the EU ETS. IVL Svenska Miljöinstitutet. IVL Report B1591. August 2004

The ETS will thus not add incentives to the utility business to promote energy efficiency improvements but has to be developed. Such could be:

- To allow banking (and even to consider a favourable interest rate) from deliberate and verified utility-DSM, for the future periods when the allowances have to be reduced further. This could be equivalent to "Early Actions".
- Develop an equal green-white trade and even an "Exchange rate" between Green certificates and DSM
- Develop a climate partnership package in which reduced allowances by DSM-actions will give other favours (in line with criterion 4, see above)

The price level on the margin is a function of fuel and technology used (kg CO2/ kWh), see diagram below (calculated with a price of 6 DKK/USD). These prices however require a demand above zero, which is not the case if all (most) concerned are working below their cap allowance.

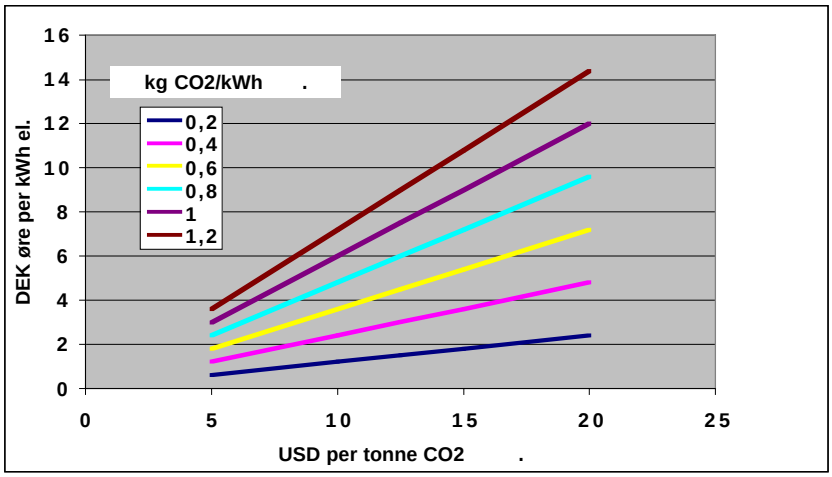

Figure 27. Cost for CO2 per kWh at different prices for Co2 and different technologies

In a recent study by ECON the estimate is that in the first period 2005-2007 the price will be low to zero.[102] For the period 2008-2012 the project a price level of 8-13 €/tonne (10-15 USD/tonne).

[102] EU Emission Trading Scheme and the effect on the price of electricity, ECON Analysis AB.

Acronyms and abbreviations

AEEG	Autorità per l'Energia Elettrica e il Gas. (The Italian Regulatory Authority)
AP	Aggregated procurement; see Procurement
BAT	Best Available Technology
BAT+	Improvement beyond BAT
BaU	Business as Usual
Black Certificates	GHG emissions trading
Carbon Sequestration	Long-term storage of carbon in the terrestrial biosphere
CFL	Compact Fluorescent Lamp
CHP	Combined heat and power
DEFRA	(UK) Department of Energy Food and Rural Affairs
DHC	District Heating and Cooling
DOE	(US) Department of Energy
DR programmes	Demand Response Programmes
DSM	Demand Side Management
EEC	Energy Efficiency Commitment; UK energy saving programme
EEI	Energy Efficiency Initiative (The IEA, ENS and Energy Charter preparatory work for the Environment Ministers Conference in Aarhus 1998)
EPA	(US) Environmental Protection Agency
EPC	Energy Performance Contracting; contractual agreement between and owner/user of a facility and an ESCO aimed to improve energy efficiency
ESCO	Energy Service Company; business that develops, installs and finances projects designed to improve energy efficiency and maintenance costs for facilities
ESPC	Energy Saving Performance Contracts
ETS	(EU) Emissions Trading System; system of gas emission allowance trading under the EU Emissions Trading Directive
Feebate	A combination of fee and rebate aiming to improve energy efficiency and reduce pollution
FEMP	Federal Energy Management Programme
GHG emissions trading	Sometimes nicknamed “Black certificates” to distinguish from green and white.
Green Certificates	Renewable Energy Commitments
ICT	Information and Communication Technologies
IEA	International Energy Agency
JI/CDM	Joint Implementation/Clean Development Mechanisms; flexible mechanisms of the Kyoto protocol
LDC	Less Developed Countries
LED	Light emitting diode
NAESCO	(US) National Association of Energy Service Companies
NAP	National Allocation Plan; a plan where Member States decide the quantity and distribution of allowances within the Emissions Trading System (ETS)
Ofgem	(UK) The Office of Gas and Electricity Markets

PAM	Policies and measures
PICO	Public Internal Performance Contracting; variation of an ESCO-scheme, where the service is provided within the unit of a public authority
Procurement; Technology Procurement (TP)	Method of commercialising new technologies by aggregating purchasers who issue functional specifications for technologies that are not available on the market
Procurement; Aggregated Procurement	In this context…Procurement aimed to launch new products to the market and to raise the volume for products with markets best characteristics
PUC	Public Utility Commission (in the U.S.)
R&D	Research and Development
R&D-D	R&D and Demonstration or R&D and Deployment (depending on circumstances)
REC	Renewable Energy Commitments; Green Certificates
SME	Small and Medium Sized Enterprises
TEE	Energy Efficiency Certificates (on the Italian market)
TP	Technology Procurement; see Procurement
TPF	Third Party Financing
UESC	Utility Service Contracts
Voluntary Agreements	A range of industry actions including industrial covenants, negotiated agreements, self-regulation, codes of conduct and eco-contracts
WAT	Worst Available Technology
White Certificates	Energy Efficiency Commitments