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Options and potentials for energy end-use efficiency and energy services

SUMMARY

Final report on behalf of E.ON AG

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1 Introduction

New challenges are lying ahead of Europe's electricity and heating fuel markets in the decades to come. 2005's oil price increases may be a sign of a beginning shortage on world energy markets, which might be caused by the still high energy demand in the OECD countries and the rapid development of emerging economies such as China and India. A number of recent analyses and forecasts has found that Europe will need to build around 200,000 MW of new or replacement power generation capacity by 2020, of which around 40,000 MW in Germany alone.

Against this background, saving energy through improved energy end-use efficiency is receiving renewed attention from all levels of governance – from the OECD to the EU (cf. The Green Paper on energy efficiency from July 2005) to national politics. Significant opportunities for shaping demand are existing both for electricity and for fuels used for space, water, and process heating purposes. The question, therefore, is how energy companies can make a Business Case out of these potentials.

Therefore, the objectives of this research project by the Wuppertal Institute for E.ON AG have been

- to provide a holistic overview of technical options for energy end-use efficiency,
- to quantify the potential for energy end-use efficiency in Germany and to assess the transferability of these results to other European countries,
- particularly, to analyse the (additional) investment needed for the identified technologies and potentials, and
- to identify, based on this analysis, an analysis of energy service activities and marketing of energy companies in Germany and other countries, possible and promising future areas of activity of energy companies with respect to energy saving programmes and services for different customer groups.

This English summary of the project's final report contains

- a short explanation of the analysis of the technical and economic potential (chapter 2.1), a number of graphs showing the results on potential and costs of energy-efficient technologies and systems (chapter 2.2), and a short assessmment of the transferability of these results to other European countries (chapter 2.3),
- general considerations on energy end-use efficiency and energy services as a strategic business area (chapter 3.1), conclusions from an overview of energy efficiency programmes and services by the E.ON group as compared to its competitors (chapter 3.2), and first thoughts about how to improve existing and to develop new areas of activity, with their potential market and environment (chapter 3.3),
- and a conclusion with an outlook on possible further investigations (chapter 4).

2 Energy end-use efficiency – options and potentials

2.1 Analysis of the technical and economic potential for Germany

As the first step for the selection of technology areas with a high energy saving potential, the current (2003) **energy consumption was differentiated** by the three sectors – residential sector (private households), commercial and public services, and industry – and the relevant end uses.

Private households in Germany are consuming appr. 140 TWh of electricity and 631 TWh of heating fuels a year. Around 40 % of the electricity is used for space and water heating and cooking, followed by the increasing field of information, commmunication, and entertainment electronics (17 %). Cold appliances (15 %), lighting (10 %), and circulators in the heating and hot water systems (5 %) are important too. Almost 90 % of the non-electricity fuels are being used for space heating, another 10 % for water heating.

The **commercial and public service sector** has an annual consumption of 135 TWh of electricity and 294 TWh of other fuels (excluding for transport). The main single electricity use in this sector is artificial lighting (28 %). Electric motors and drives for different end uses such as ventilation, cooling, pumping, elevators, and production together account for another 40 % of the electricity. As for the household sector, electricity use for information and communication technology is increasing (11 %). Space heating dominates the use of other fuels (63 %), followed by process heat (17 %) and hot water (9 %).

German **Industry** uses 210 TWh of electricity and 435 TWh of other fuels per year. Electric motors and drives for production, pumping, ventilation, cooling, and compressed air are dominant in electricity use, with almost two thirds of the total. Electric process heat comes next, with around 25 %, followed by lighting (9 %). Production processes need 84 % of the other fuels, but space heating is not to be neglected either (14 %).

As the second step, around 70 energy efficiency technologies and measures able to provide major energy efficiency improvements for these 18 fields of end uses were selected for the analysis.

The third step was the analysis of the energy saving potential, the benefits and costs for each of these 70 technologies and measures. Before we continue with presenting the results, it is useful to consider why at all there are cost-effective potentials for saving energy.

Excursion: Why are there cost-effective potentials for saving energy through energy end-use efficiency?

Cost effectiveness is only a **necessary, but not a sufficient precondition** for the decision to invest in an energy efficiency measure. Many factors are influencing the process from the first impulse, via the activition, and planning, to the final decision, and the implementation.

The main reason, why a big part of the cost-effective potential for energy end-use efficiency is not being harnessed, are manifold **structural, economic, and socio-psychological barriers**. Among the most important of these barriers are:

- a lack of motivation and information, not only with consumers, but also with providers of appliances, installations, and buildings (e.g. installation contractors, trade, engineers and architects, manufacturers). This barrier is aggravated by the fact that the energy efficiency potential is split into many small and medium-size measures;
- financial restrictions, be they a lack of capital in public and private households, be they a priority for investment into a company's core business;
- split incentives – those who could invest would not reap the benefits of saved energy costs and vice versa, and
- risk aversion, again both on the demand and supply sides of technology markets.

All those market barriers contribute to the fact that the technology markets themselves **only realise a smaller part** of the **cost-effective potential of saving energy** through energy end-use efficiency. There remains an unused potential of additional energy conservation and CO_2 reduction, which is often cost-effective from the perspectives both of national economy and the consumer. The task of this study is to identify this part of the potential that will not be realised by the technology markets themselves.

2.2 Potentials and costs of energy-efficient technologies and systems solutions

The analysis of all 70 identified technologies and measures regarding the potential for saving and/or substituting end-use energy and for the reduction of CO_2-emissions, as well as the analysis of costs and cost effectiveness was carried out in the same raster using the same framework data. The analyses were made for 2005, 2010 and 2015 and consider the interactions between individual measures, such as thermal insulation and the replacement of a heating system. The basic assumptions regarding interest rates, long-run marginal energy system costs saved by society, energy prices saved by the consumer, and CO_2 emissions factors, were defined in agreement between E.ON and the Wuppertal Institute.

Regarding the years 2010 and 2015, the potential that can actually be developed for a technology was calculated on the basis of **reinvestment cycles**. In most cases, the decision for the most efficient technical alternative will only be cost-effective, if modernisation or renovation works have already become necessary. At the same time, a possible increase in the stock of developed areas, appliances and units was taken into consideration. Therefore, the potentials which are calculated for the years 2010 and 2015 are called

dynamic potentials. Additionally, a **hypothetical static total potential** was calculated for 2003 on the basis of the respective stock of an end-use technology. The following question is answered: to what extent would energy consumption for the respective end-use change, if all technology were converted to the best energy efficiency level at once?

The result of analysing all individual technologies and system solutions can be presented in different ways. In order to define the ecological efficiency, it is reasonable to identify the particular **CO_2 emissions reductions,** thereby allowing a comparison between the different measures for electricity and heating fuel savings, and fuel switching. The total CO_2 reduction for all reduction technologies and for all sectors is shown in Figure 1. Here, **measures** which aim at the same end-use and which are implemented in the same technology markets, have been **summarised**. The CO_2 reductions of each individual measure were added together, for the costs of conserved energy and the costs of CO_2 abatement, the weighted averages were calculated. Thus, it is possible to compare the CO_2 reduction potentials and the net costs of saved energy resulting from different end-uses and technology markets. The technology markets are partially overarching different sectors.

In this figure, the curves of **net costs of conserved energy** (bold line) and of **net costs of CO_2 reduction** (thin line) represent, from a macroeconomic view, the measures in an ascending order relative to the average net costs of conserved energy in Euro per kWh of conserved or substituted energy (electricity or heating fuel). Net costs of conserved energy are the additional costs of each individual technology less the long-run avoided system costs for the supply of electricity and heating fuels.

The additional costs of technical or organisational energy efficiency measures in relation to a kWh saved are calculated from the additional costs of an energy-efficient or energy efficiency technology compared to the costs of a baseline technology. The latter are the costs that arise when a ‚normal' reinvestment or refurbishment is implemented anyway, using technology that confirms to minimal standards or market average. Any investment in highly energy-efficient technology will immediately or later replace an investment in a less energy-efficient, business-as-usual technology – for which we use the term ‚baseline technology' here. The costs for that baseline technology will be incurred in any case and may thus not be counted towards the energy efficiency measure. In the case of thermal insulation, e.g. the additional costs are those for mounting a layer of insulation material, when the building's façade will be renovated anyway.

For a number of measures, there is **a large bandwidth of additional costs**. As an example, the additional costs for thermal insulation according to the passive house standard (i.e. achieving a heating energy performance of only 10 to 20 $kWh/m^2/year$) can vary a lot between suppliers. Sources show a variation in additional costs between 15 and 130 Euros per m^2 of living space. Another reason for wide variations in additional costs can be that measures differ not only in energy efficiency, but also in other features that are difficult to monetise. Subjective valuations for such features were not taken into account within our quantitative assessment. An example is the additional space in the basement that may be gained through replacing an oil-based heating system by another heating system. Such additional benefits, and the value given to them by consumers, may be decisive for an investment decision in practice.

Therefore, when we present the results of our analysis on values for additional costs in the following, it should be noted that these are **always average values for additional costs**, derived from the analysis of **an average case**. For the planning of an investment decision, however, the individual case should always be taken as the basis, particularly for more complex measures. The assumptions for the average additional costs were based on manyfold references in the literature, research on technologies and market data, and experiences of the Wuppertal Institute from our own pilot projects; these assumptions were intensively discussed with E.ON AG and E.ON Energie AG staff. In particular, the assumptions for the areas of space heating, water heating, cooking, and, in the residential sector, for clothes washing and drying, dish washing, and circulators for heating systems were fixed in joint discussions with the division 'end use technology' (Anwendungstechnik) of E.ON Ruhrgas AG.

All measures with net costs of saved or substituted energy below zero are **cost-effective from the perspective of society**. Measures with net costs above zero, in turn, cause additional costs even after deduction of the avoided energy system costs.

Thus, it will be cost-effective from the perspective of society to apply the examined efficiency technologies and measures for **saving more than 120 million tons of CO_2 per year until 2015**. Especially insulation of buildings, the hydraulic optimisation in the residential, commercial, public and industrial sector as well as the savings of process heat and the installation of pumps with frequency converters in the commercial, public and industrial sector can considerably contribute to cost-effective energy savings and CO_2 reductions.

Additionally, the net costs of CO_2 reduction in Euro per ton for each individual technology are shown from a total resource cost perspective (thin line in figure 1). Applying this indicator, **most of the analysed potentials are cost-effective too**, i.e. the costs of CO_2-abatement are below the expected price per certificate of 10 Euro per ton. When calculating the costs of CO_2 reduction, we did not include the price of a certificate in the avoided energy costs. However, there are mathematical problems especially in the case of resources with a negative value of CO_2-abatement costs, thus not allowing the comparison between measures for saving an end-use energy and fuel switching measures (Thomas 2001).

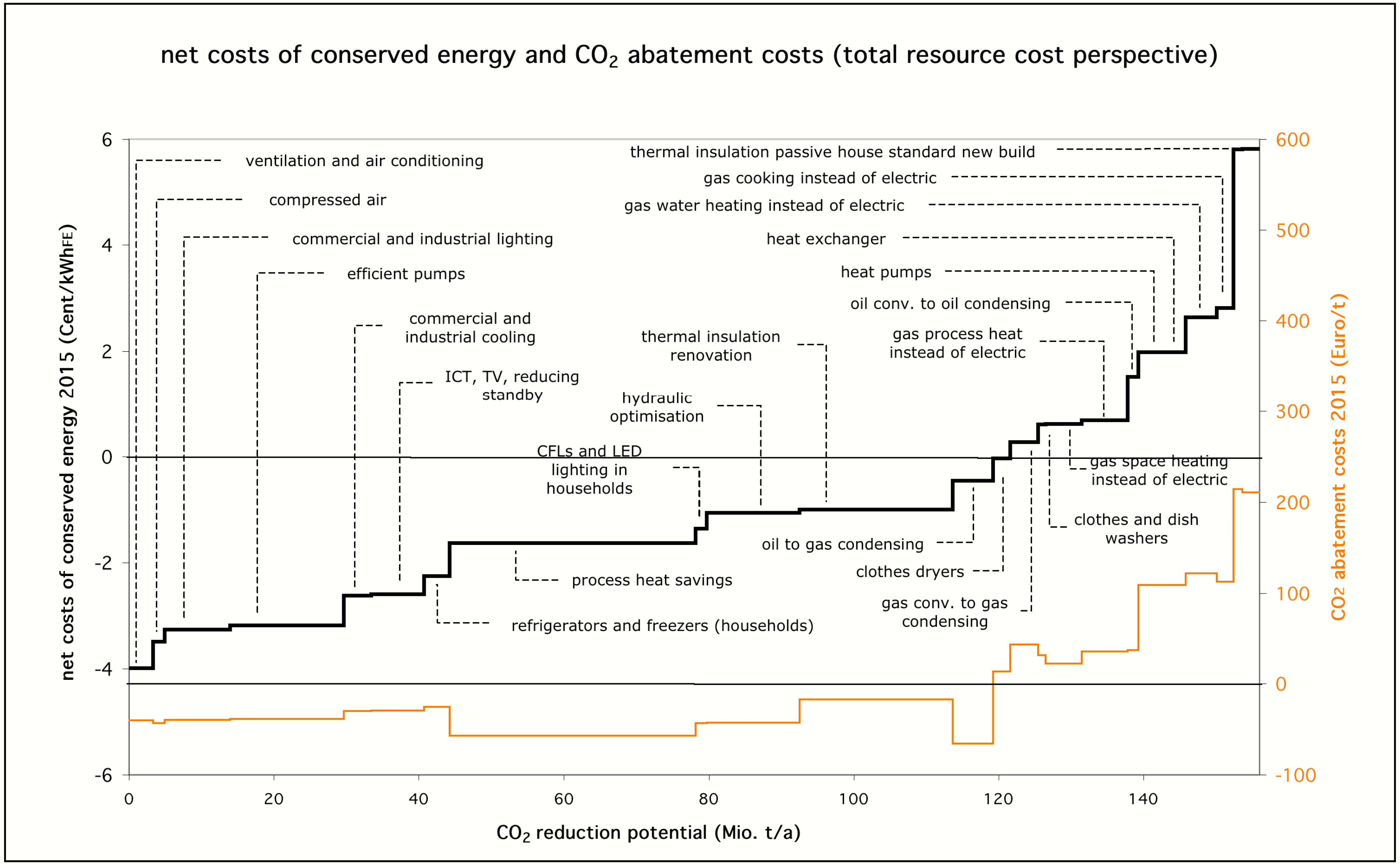
We also calculated the costs of conserved energy from the customer's perspective. Generally, the picture is quite similar to the perspective of society, i.e. measures that are cost-effective for society will also be so for the customers. Usually, the net cost savings are even higher despite using a real discount rate of 8 % instead of 4 % for the societal perspective, since the customer also saves taxes on energy. Therefore, a number of measures that on average are bearing net costs for society, are cost-effective for the consumers. These are gas condensing boilers, efficient clothes and dish washers, and fuel switching from electricity to gas for space and water heating. Recently, energy prices have even increased above the levels assumed for the calculations within this project, which makes investments in energy efficiency even more profitable for the consumers.

In order to demonstrate the relations, we compare the identified dynamic potentials for 2010 and 2015 and the hypothetic static total potential with the overall consumption and green house emissions in 2003 (shown in figures 2 to 4).

The residual value called "remaining energy consumption" or "remaining CO_2 emissions", however, does not mean that the consumption or the emissions can absolutely be reduced exactly to this value by energy efficiency until 2020 or 2030. It is quite possible, that, in general tendancy, energy consumption will considerably increase, so that the actual decline of consumption caused by energy end-use efficiency will be much more lower. Another question is, which part of the total technical-economical potential of energy end-use efficiency that exists compared to the baseline development, can actually be implemented by energy efficiency services and governmental policy instruments for information, advice, financing etc. Answering all these questions would require an extensive scenario analysis, which is not the objective of this study.

Furthermore, offers for energy services and governmental policy instruments would cause additional implementation costs, which can only by defined by analysing concrete services, programmes and instruments. But this analysis is not the objective of this study either. We would like to point out that these services, programmes and instruments will reduce the transaction costs and other barriers for customers, thus helping to realise the potentials. Even if the investments in the technical measures and the implementation costs are added together, energy efficiency activities often remain highly cost-effective for customers and society (cf., e.g., Wuppertal Institute 2002).

Fig. 1: CO_2 reduction potentials in Germany until 2015, aggregated across all sectors; average net costs of conserved energy (bold line) and CO_2 abatement costs (thin line) compared to the costs of measures that would have been installed in a baseline scenario, and net of avoided long-run marginal system costs of energy supply (hence net costs), from the total resource cost perspective



Source: Wuppertal Institute

Fig. 2: Dynamic and static electricity saving potentials (net) in Germany, compared by sectors with the respective total consumption in 2003

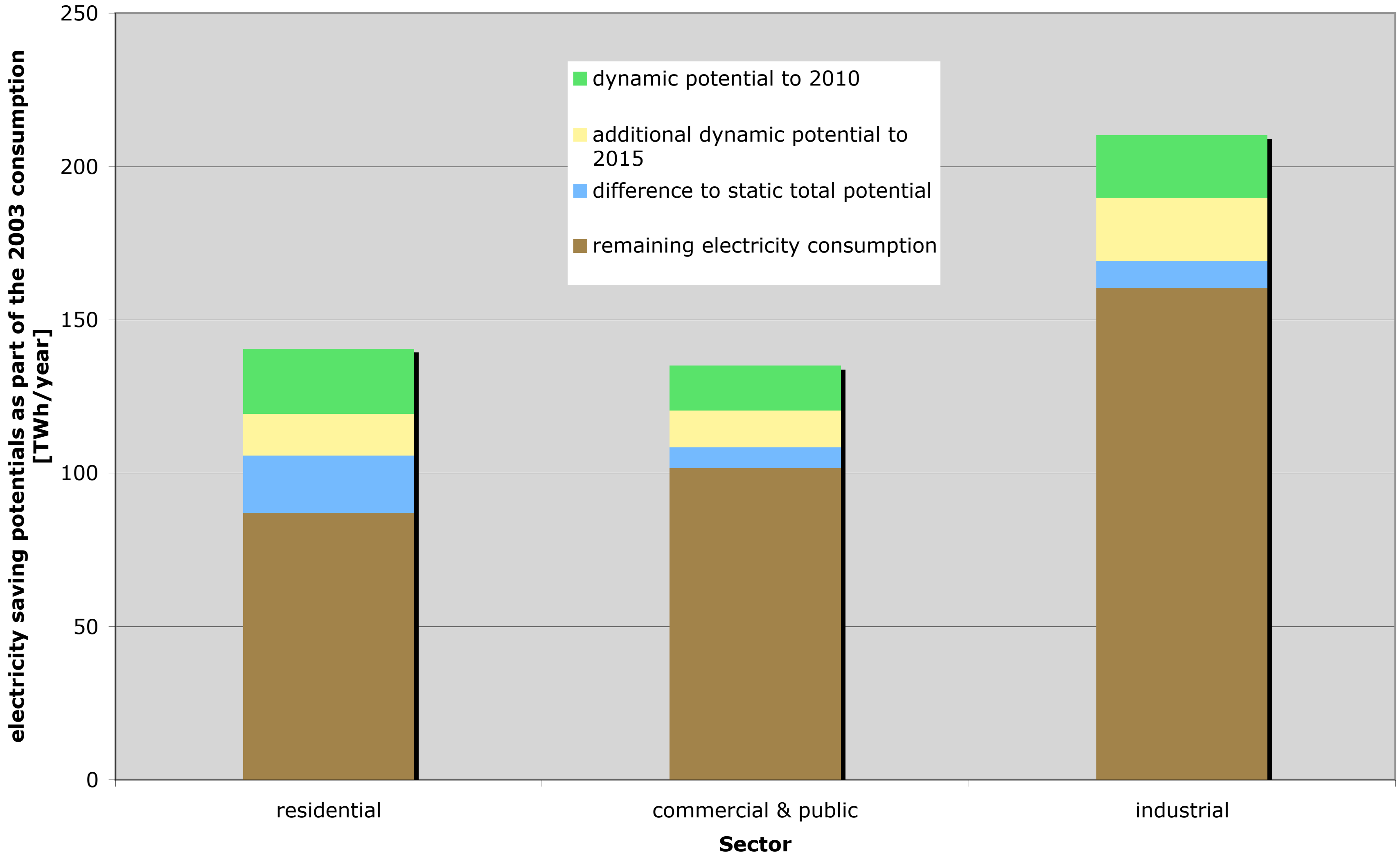


Fig. 3: Dynamic and static saving potential for heating fuels and district heat (net) in Germany, compared by sectors to the respective total consumption in 2003

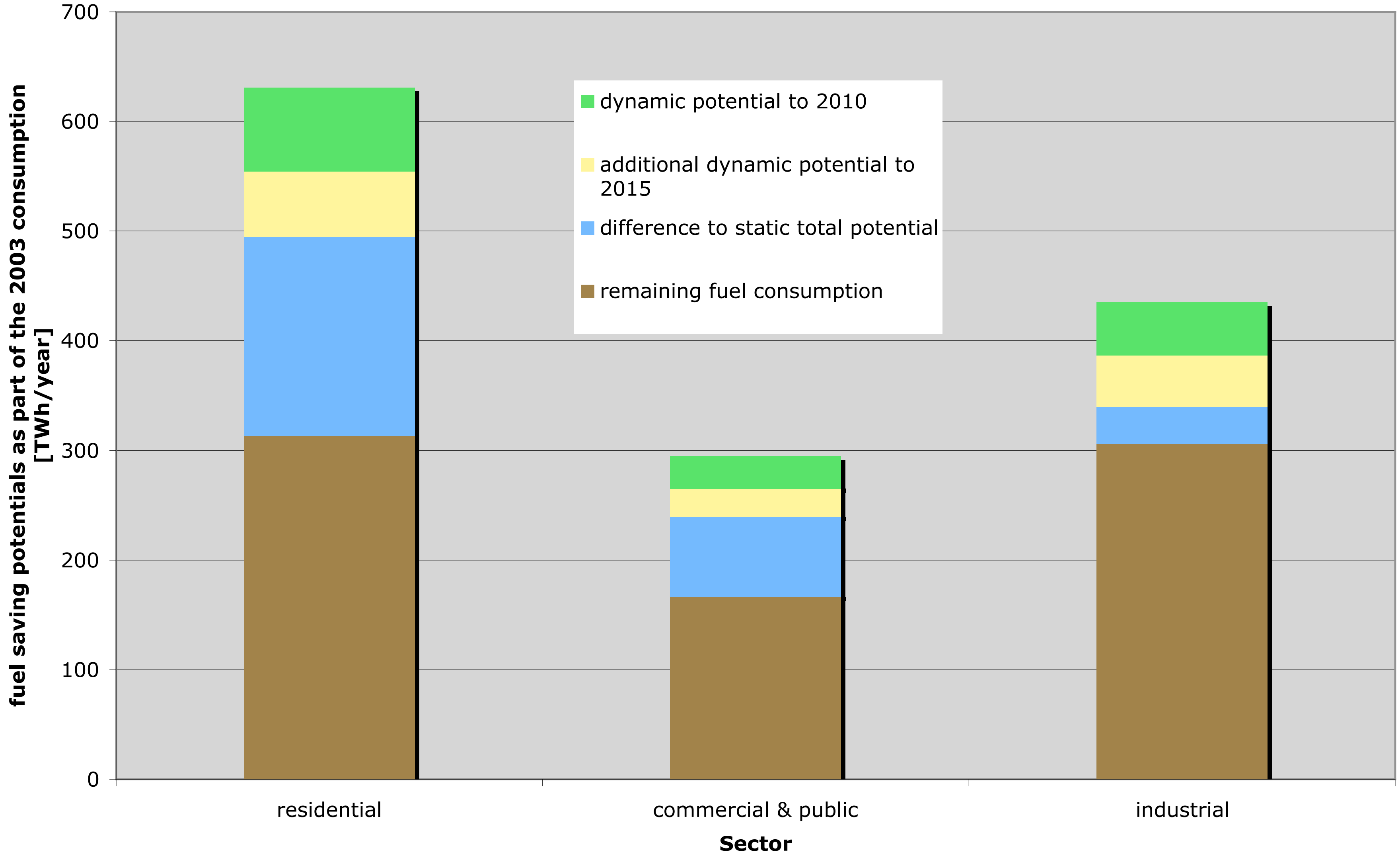
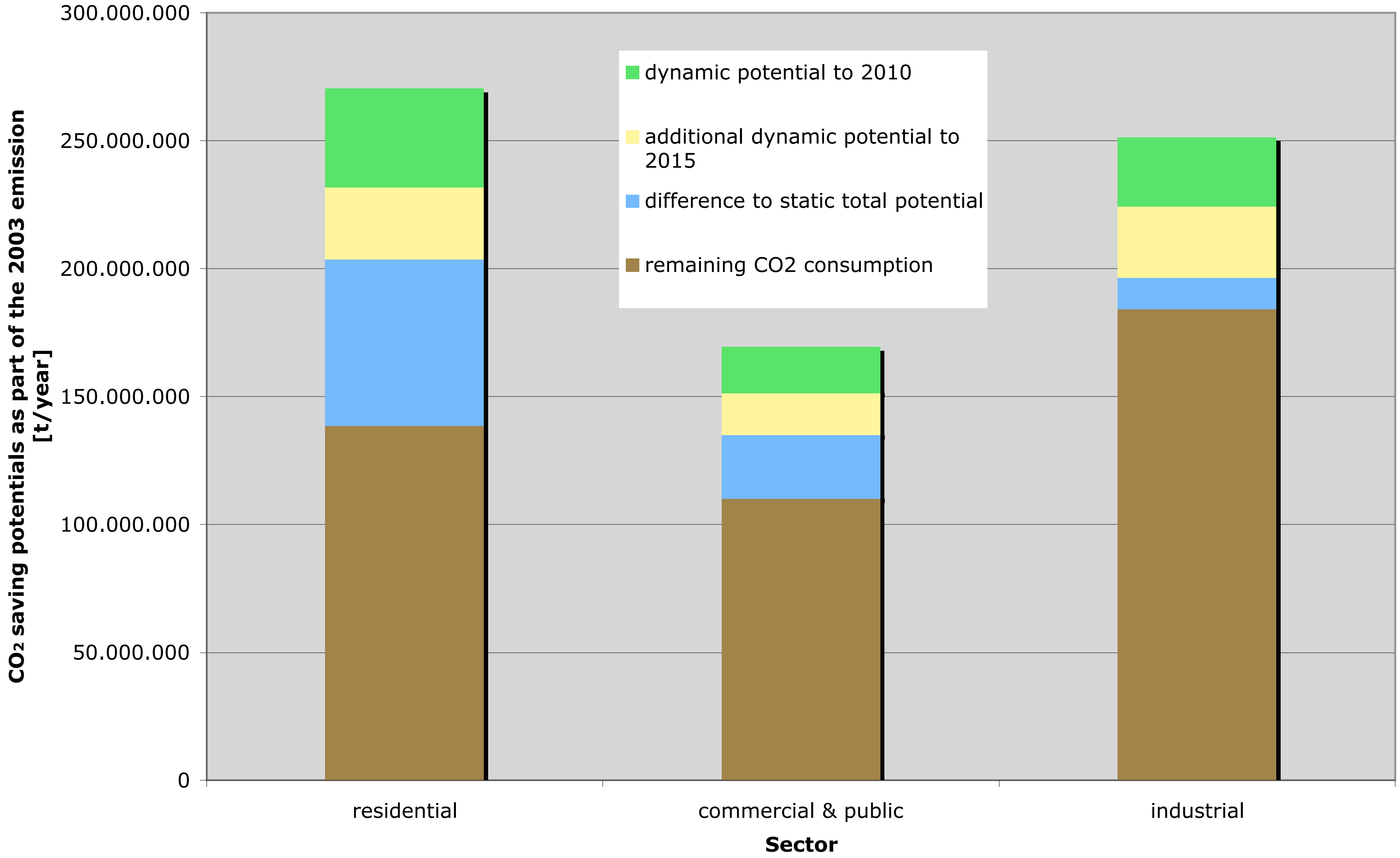


Fig. 4: Dynamic and static greenhouse gas reduction potentials from energy end-use efficiency in Germany, compared by sectors to the respective total consumption in 2003



2.3 Transferabillity to other European countries

In particular, electricity consumption in Europe is expected to increase significantly in the next years. According to the business-as-usual scenario, an increase of 32 % until 2010 and of 54 % until 2020 compared to 1995 is expected (Blok 2005).

The electricity consumption in Europe can be divided roughly into one quarter in private households, one further quarter in the public and commercial sector and one half in the industrial sector and is thus similiar to the German electricity consumption.

Regarding fuel consumption, a slight decrease is obvious, except from the transport sector.

Differences in energy saving potentials and costs of conserved energy in the individual countries can result from different consumption structures, i.e. differencies of consumption shares for certain end-uses or sectors, and from different shares of energy sources. On the other hand, the level of energy efficiency that already exists or has been achieved, can be different. In the context of this study, we can only point out on such differences. Further quantitative details have to be subject of succeeding examination.

2.3.1 Residential Sector

Within Europe, the differences of consumption structures originate from climatic, cultural and economic conditions.

An example is the obvious north-south slope for lighting, the higher share of old, energy-wasting refrigerators and washing machines in Eastern Europe, whereas the use of freezers often represents the different habits of eating.

Dishwashers and tumble-driers, however, are nearly exclusively used in Western Europe, but the number of such devices in Eastern Europe will rapidly increase in the following years.

Especially in Southern Europe the use of air conditioners is increasing, but in Central Europe, too, mobile air conditioners are becoming more and more popular.

With regard to the remaining electricity end-uses such as information and communication technologies, there are no differences within the European countries. But the use of manifold small devices is increasing. Without taking countermeasures, this increase will result in a higher standby consumption.

With regard to the heating sector, there are great differences between the European countries due to the different climatic and economic conditions. In Northern and Eastern Europe, there is a higher demand due to the chilly climate. However, significant reductions of consumption have been achieved by continuous improvements of insulation standards, even if there is still a great backlag concerning exisiting buildings.

Only after market-orientated structures were built up in the Eastern European countries, possible efficiency potentials on this sector attracted attention, being comparatively high just for this reason.

The energy sources for heating, too, are different within the European countries. The share of electricity consumption for heating is very high in France and in the Scandinavian countries, whereas natural gas and oil is the main heating source in Central Europe, and in the Eastern European countries the application of solid fuels such as black coal and lignite is prevailing.

Altogether it can be noticed that the examined measures are principally transferable, provided that a couple of regional distinctions are taken into consideration. Therefore, the **implications** resulting from the **measures** which are most promising regarding their potential and efficiency are **basically transferable**. The measures, however, normally require a **country-specific analysis** of the market situation, as for example the available technologies, the efficiency of the existing stock, additional costs of efficient technologies, etc.

2.3.2 Commercial, Public and Industrial Sector

In the commercial, public and industrial sectors consumption structures are comparable between the European countries, in particular regarding cross-cutting technologies, which represent the major part of the analysed measures.

In Germany as well as in the European industry, electric motors are the major in electricity end-use. According to studies (Harmelink et al. 2003) an economic energy efficiency potential of 215 TWh per year is existing. The necessary measures are not different from the conclusions, which were made for Germany. Pumps and motors for air conditioning are included here, units, which are especially widespread in the southern European countries.

According to our experiences from several EU projects (for instance regarding the public sector or lighting) the technical standards in Northern Europe, with regard to energy efficiency in end-uses electricity consumption, are roughly comparable with German standards, but are lower in Southern and Eastern Europe. Accordingly, the percentage of energy efficiency potentials in these countries is higher than in Germany. But very often, the energy-efficient technologies are not well introduced on the markets and therefore additional costs are higher than in Germany.

The large efficiency potentials of the remaining fields, too, as process heat and lighting are comparable. Special attention has to be given to the increasing energy consumption of information and communication appliances in all European countries (Green Net Project, 2004).

3 Energy end-use efficiency as a business case

3.1 Energy end use efficiency and energy service activities as a strategic line of business

In chapter 2.1, various market barriers were identified which strongly block the full exploitation of the existing energy end-use efficiency potential. These barriers, however, open up **great opportunities** for E.ON companies, if they act as professional in the field of energy end-use efficiency as they do in energy production, transport, and supply. E.ON could help customers – who are no energy saving professionals – exploiting their energy efficiency potential and share the profit with them. If E.ON does not get active in this business area, there is the risk that competitors or the state itself are going to support customers in saving energy.

A strategic **orientation towards energy service activities including a range of energy efficiency measures for customers** thus offers **fundamental advantages** compared to focussing business activities exclusively on energy production, transport, and supply:

- In contrast to end-use energy, energy service activities can be sold easier to potential as well as to existing customers.
- Energy service activities offer a higher added value and open up new turnover and profit potential.
- Energy service activities lead to long-term contracts with customers and improve customers relations.
- The orientation towards energy service activities underlines competence and shows that the company is taking social responsibility, a factor which can be crucial when looking at cases of privatization and the sale of shares.
- Risks are reduced through less investment in energy production. Emission targets can be achieved easier and the adaptation to political demands is facilitated.

In order to come to conclusions for a future E.ON strategy, future business fields, and the range of energy efficiency activities to offer against the background of the current market development, E.ON's current offer of energy efficiency activities will be examined and compared to those of competitors in the following.

One has to differentiate between

- **Energy efficiency services** like energy performance contracting, paid-for energy analyses or load management, which are paid for by the customers or market actors who directly benefit from the energy efficiency activity.
- **Energy efficiency programmes** that typically combine information, practical guidance, training of the technology suppliers, and possibly financial incentives for customers. The customers or market actors who directly benefit from them do not pay

for these programmes. Rather, customers usually pay back the achieved cost savings in the following years collectively, making use, in most cases, of a special financing scheme.

3.2 Overview of E.ON's current offer and comparison with E.ON's competitors

3.2.1 Overview of energy efficiency activities

The project examined **E.ON's state of the art concerning** the offered range and the implementation of energy efficiency activities for different E.ON customer groups in different countries. The analysis was concentrated on E.ON companies in Germany, Sweden, the United Kingdom, and the USA (as of spring/summer 2005). It is based on documents supplied by E.ON, further research on the Internet, and oral information from E.ON staff.

On the whole, there is **a broad variety and a wide range** of energy efficiency activities. In the course of this project, dozens of energy efficiency offers or products by E.ON companies have been identified, of which 20 were analysed in more detail. Yet E.ON lacks a clear profile; innovative products, like the Energy Explorer, are only available in certain regions (except for E.ON Ultra Air).

Energy Efficiency Activities offered by E.ON companies focus on

- **Profitable services independent from the delivery of energy carriers,** like compressed air contracting. The market share of E.ON companies in these sectors is, however, usually small.
- **Information, communication, and consulting activities** for different customer groups as well as minor services, like the traditional rent of measurement devices or discounts for small appliances, e.g. power savers. These activities are mainly designed to increase customers' loyalty. However, it has to be taken into account that some customers prefer consulting guidance activities.
- **Services to industry, commerce and public sector, directly connected to contracts for the delivery of energy** (load management by E.ON Mitte, Funds for energy saving measures in public authorities by E.ON Bayern, etc.). These services usually have quantifiable customer loyalty effects.
- **Financial incentive programmes**, depending on the respective framework (cf. chapter 3.2.2).

It has to be noted that there are **interactions** not only between end-use energy supply and energy efficiency supply, but also between the different energy efficiency activities themselves: for example, information, communication, and consultancy activities, like E.ON Consult or the Energy Explorer, can lead to further projects with customers, e.g. energy performance contracting schemes.

When looking at the examined examples of energy efficiency services offered by competitors, it becomes clear that their activities are similar to E.ON's. The examples show that sales and success of energy efficiency services can actually **vary** to a great extent depending on the kind of service offered. This applies especially to Direct Heat Services. Essential factors are experience, know how, as well as professional design, communication, and implementation.

In the end, energy efficiency activities can contribute to the image of **the energy company as an overall energy service provider** interested in offering **tailor-made solutions for energy-related problems**. Yet broadening the activities and business fields „beyond the electricity or gas meter" would mean to change E.ON's strategy of focussing on its core business as it stands today, particularly in Sweden and in Germany.

There is a striking variety of similar energy efficiency activities within the E.ON group that are all promoted in different ways – a potential for **synergies, optimisation, and cost reduction.**

3.2.2 Institutional frameworks in the different countries

When analysing and evaluating these activities, one has to consider that **institutional frameworks for energy efficiency activities for energy companies differ to a great extent in the different countries**, despite the trend to promote energy end-use efficiency. These frameworks are the main factors shaping the different programmes and services.

The **United Kingdom**, for example, introduced in the course of liberalisation a supportive framework for energy efficiency activities, including particularly the Energy Efficiency Commitment. Many States in the **US** allow companies to refinance accepted Demand Side Management programmes; this accounts for liberalised as well as less liberalised energy markets. To the contrary, **Germany**'s energy companies have not been allowed to refinance cost-effective programmes via raising energy prices after the liberalisation process began. There is the need for a new overall supportive framework, like an Energy Efficiency Fund as proposed by the Wuppertal Institute or schemes as they have been implemented, e.g., in the USA or the UK. The general conditions in **Sweden** can be compared to Germany. A supportive framework with additional policy instruments would be necessary to stimulate the market for energy efficient products and services as well as to enable energy companies to play a greater role in these markets.

3.3 Further development of current and possible future activities

3.3.1 General recommendations for strategic development

Based on our analysis and taking into account the rising energy prices as well as increasing public activities to improve energy efficiency, the following strategic development of E.ON's energy efficiency activities is recommended:

1. **Optimisation of existing energy efficiency activities:**
   - Save money through **Standardisation**
     Precise definition of products and interfaces between products. Make good practice of single companies a standard for all companies of the group. Avoid doing the product development twice, i.e. by different companies of the group. Central analysis of the practical experiences with the products gained by the different E.ON companies.
   - Enhance attractiveness and image through **consistent, standardised appearance**
     An attractive and consistent appearance contributes to an image and a corporate identity signalling a clear concept of energy efficiency services, a clear strategic orientation, and a distinct product range.
   - Balance central standardisation and adaptation to the needs of individual customers through **step-by-step development**.
2. **The Basic Strategic Decision**
   Before developing the current energy efficiency activities any further, a central strategic question has to be answered: Should the company develop into a comprehensive service provider including energy efficiency services or is the company to keep its focus on the supply of energy carriers? In case E.ON decides it wants to turn into an „overall service provider“, the company gains additional turnover and profit. In order to achieve this, internal procedures, structures and resources have to be provided for the development and implementation of energy efficiency activities, since experience shows that offering energy efficiency activities in parallel to the daily business with energy carriers is not successful. Therefore,, initial costs have to be faced, which can, however, be reduced by making use of the experiences gained in the EON group itself as well by competitors.
3. **Stand out against competitors**
   Another crucial element for a successful extension of energy efficiency activities is to stand out against competitors. This does not only apply to competing companies in the energy sector, but also to the increasing number of independent energy consultants and engineering offices, and even to some producers of installations and appliances. Some of the latter offer, for example, tools for analysis and planning which optimise their products’ energy efficiency.

Another strategic issue is related to **costs and benefits** as well as the economical point balance from the perspective of an **energy supplier**:

The **direct economical benefits** of an energy efficiency activity for a vertically integrated energy company consist of

- **Direct revenue** from an energy efficiency programme or an energy efficiency service
- The **avoidable long-run marginal costs of energy supply**. The long-run marginal costs from the perspective of an energy company are calculated analogously to the

calculation of total resource cost for society, but with the specific interest rate for the energy company

- **Higher customer loyalty** because of intensified contacts to the customer. However, it is difficult to evaluate this kind of benefits in monetary terms.

In certain cases it can also be useful to account for higher avoided costs, depending on the situation, e.g. to avoid investment on the energy supply side (building of mains, reinforcement of the grid). This largely depends on the development of total demand and the existence of bottle-necks.

As regards the costs, they comprise **investment, product development and product marketing as well transaction costs** of an energy efficiency activity, as long far as the energy company has to account for them.

In the monopoly era, utilities maintained that if they offered energy efficiency activities, they would lose net revenue, i.e. the difference between the lost turnover and the avoided marginal costs of energy supply. However, with liberalised markets and increasing public policy support for energy efficiency measures one can assume that

- there is an increasing number of suppliers of energy efficiency programmes and services, who support the energy company's costumer in saving energy, if the energy company does not do it itself,
- in case of lower short-term marginal power production costs compared to competitors, the net lost revenue from generation can, in principle, be partly compensated by selling energy to the electricity exchange. One has to consider, however, that this will get increasingly difficult when energy saving increases, as long as the production capacity is larger than demand,
- an effective regulatory practice makes sure that reduced transport of energy through the network will not reduce net revenue and profits, i.e. transmission and distribution rates will be allowed to increase, if costs are not reduced due to the decreasing transport of energy.

All these economic effects can only be analysed when looking at concrete activities. This accounts especially for **investment, product development and product marketing as well transaction costs** of an energy efficiency activity. However, this was not part of the project contract, and therefore impossible to do within the frame of this project.

3.3.2 Profitable measures and fields of activity from the the customer's point of view and from the macroeconomic perspective

When deciding on which energy efficiency activity to chose during such a process of further development, the focus should generally be on the following profitable areas of technology and fields of end-use:

- Saving of fuel for process heat in the industry
- Heat optimisation / hydraulic adjustment / factor-4-circulation pumps in households

- Thermal insulation following the low energy house standard and renewal of edificial heating systems (exchange of gas / oil boilers)
- Efficient pumps in industry, commercial, and public sector
- Efficient ventilation and air conditioning in industry, commercial, and public sector
- Optimised setting of installations (ventilation, pumps, engines) in industry, commercial, and public sector
- Reduced standby electricity consumption in ICT and TV's as well in trade, commerce, and services
- Efficient process cooling and production of compressed air in industry
- Efficient lighting in all sectors
- Efficient cooling of groceries through ready-to-use, efficient refrigerators in the commercial sector
- Efficient refrigerators and freezers, hot fill for clothes and dish washers, and efficient clothes dryers in households
- Electricity substitution in households, trade, commerce and services (fuel-switching for space and water heating, cooking and cooling)
- Heat recovery in industry and commerce
- Optimisation of air conditioning of mobile phone base stations.

According to the results of the analysis presented in chapter 2, for about two thirds of these technology or end-use areas, pay-back times of energy efficiency measures for the customers are below 4 years, and hence, internal rates of return in excess of 30 %, based on the additional investment in the technical measures. There should thus, in principle, be room enough for covering the additional transaction costs of an energy efficiency service or programme, and still allowing a profit sharing between the customer and the energy company.

Table 1: Economic results of aggregation of all energy efficiency measures which are economical in year 2015 differentiated by technology or end-use area (not taking into account transaction costs of implementation) – Industry and Trade, Commerce, and Services

Technology or end-use area	CO_2 reduction potential [t/a]	Net electricity savings [TWh/ year]	Net fuel savings [TWh/ year]	Net benefit for society [Mio. Euro/year]	Net benefit for customers [Mio. Euro/ year]	Payback time for customer [years]	IRR for customer [%]
INDUSTRY							
Pumps	9,822,007	15		477	712	2.9	40.5%
Process heat (substitution, fuel savings)	34,829,505	16	82	1,648	1,979	3.1	51.2%
Process cooling	1,287,167	2		63	92	3.3	34.2%
Compressed air	1,608,517	2		86	123	3.4	34.6%
Lighting	2,357,468	4		124	178	3.7	47.0%
Ventilation and air conditioning	1,812,076	2	1	88	118	4.1	35.2%
Thermal insulation + renewal of edificial heating system (exchange of gas/oil boilers)	1,215,562		4	63	61	7.8	76.8%
Heat recovery	353,423		2	13	5	11.3	10.8%
Total	**53,285,725**	**41**	**88**	**2,560**	**3,268**		

Source: Own calculation of Wuppertal Institute, 2006. The payback times are dynamic ones. Saved CO_2 certificates are valued at 10 Euro/t CO_2 in the calculation of the net benefit for society. From the customer perspective, they are implicitly included in the energy prices assumed.

Table 2: Economic results of aggregation of all energy efficiency measures which are economical in year 2015 differentiated by technology or end-use area (not taking into account transaction costs of implementation) –Trade, Commerce, and Services

Technology or end-use area	**CO_2 reduction potential [t/a]**	**Net electri-city savings [TWh/ year]**	**Net fuel sa-vings [TWh/ year]**	**Net bene-fit for society [Mio. Eu-ro/year]**	**Net benefit for custo mers [Mio. Euro/ year]**	**Pay-back time for custo mer [years]**	**IRR for custo -mer [%]**
TRADE, COMMERCE, AND SERVICES							
Air conditioning of mobile phone base stations	880,631	1		61	116	0.9	376.0 %
Reduced standby electricity consumpti-on in ICT's	2,403,365	4		77	204	1.8	53.2%
Pumps	3,638,068	6		175	374	2.2	51.7%
Indoor lighting	6,115,493	9		325	656	2.7	61.2%
Ventilation and air conditioning	1,504,589	2	1	72	136	3.2	44.7%
Cooling / freezing	2,528,431	4		90	210	3.9	31.0%
Process heat (substi-tution, fuel savings)	5,461,394	1	16	168	211	5.1	21.9%
Cooking (substituting electricity by gas)	411,380	1	-1	6	33	6.5	18.7%
Street lighting and traffic signal lighting	584,071	1		0	21	6.9	14.8%
Hot water (substitu-ting electricity by gas)	305,926	1	-1	-6	15	9.6	12.8%
Heat recovery	1,155,030		5	39	20	10.6	11.5%
Thermal insulation + renewal of edificial heating system (ex-change of gas/oil boilers)	3,616,294		16	198	104	13.1	37.3%
Total	**28,604,671**	**29**	**35**	**1,204**	**2,099**		

Source: Own calculation of Wuppertal Institute, 2006. The payback times are dynamic ones. Saved CO_2 certificates are valued at 10 Euro/t CO_2 in the calculation of the net benefit for society. From the customer perspective, they are implicitly included in the energy prices assumed.

Table 3: Economic results of aggregation of all energy efficiency measures which are economical in year 2015 differentiated by technology or end-use area (not taking into account transaction costs of implementation) – Private Households

Technology or end-use area	CO_2 reducti-on po-tential [t/a]	Net e-lectrici-ty sa-vings [TWh/ year]	Net fuel sa-vings [TWh/ year]	Net benefit for society [Mio. Euro/year]	Net bene-fit for custo mers [Mio. Euro/ year]	Pay-back time for custo mer [years]	IRR for custo-mer [%]
PRIVATE HOUSEHOLDES							
Reduced standby electricity consumpti-on in audio/video equipment and TV's	3,987,426	6		150	801	1.1	100.9%
Dish washer (hot fill)	172,373	1	-1	4	59	1.9	59.0%
Lighting	1,521,422	2		81	325	1.8	87.5%
Refrigerators and freezers (A+, A++)	3,551,945	5		122	677	2.1	52.5%
Heat optimisation (exchange of pumps, hydraulic adjustment)	14,986,14 6	4	43	562	1,751	2.7	43.9%
Dryers	2,364,142	5	-3	2	412	3.5	38.9%
Washing machines (A+, hot fill)	829,897	2	-1	-20	125	6.8	24.4%
Thermal insulation + renewal of edificial heating system (ex-change of gas/oil boilers)	18,901,68 7		68	512	1,158	9.0	16.6%
Electricity substitution (space and water heating)	6,854,786	15	-18	-253	243	10.6	11.8%
Total	**53,169,82 3**	**40**	**87**	**1,160**	**5,550**		

Source: Own calculation of Wuppertal Institute, 2006. The payback times are dynamic ones. Saved CO_2 certificates are valued at 10 Euro/t CO_2 in the calculation of the net benefit for society. From the customer perspective, they are implicitly included in the energy prices assumed.

3.3.3 Strategic options for E.ON

We advise E.ON to

- Set up a **discrete division "services"** with a focus on energy efficiency services. This branch can expect a multiplication of its turnover within a few years. As a result, energy efficiency services develop from a mere marketing and sales instrument aiming at strengthening customer loyalty into a measure that independently generates turnover and profit,
- Concentrate on **cross-sectional technology** (e.g. optimisation of heating, ventilation and air conditioning systems, circulation pumps, lighting) when setting up en-

ergy efficiency services and to introduce individual measures that need special expertise and experience, like the field of process heat, later,

- Use the tool **Energy Explorer** as a standard tool in every E.ON company and to develop it further making use of the experience gained with *Energieloopen* in Sweden, thus making it a unique selling point,
- Focus on promising **cross sectional technology and / or end-use technology areas** within a **competence centre approach**; thus, to follow the successfully implemented E.ON Ultra Air approach and to apply it to other areas,
- Offer the developed energy efficiency service concept via a special **partner concept** to the different E.ON energy supply companies as well as to other energy suppliers E.ON is engaged in or E.ON supplies energy for further distribution.

3.3.4 The E.ON competence centre approach

The central idea behind the competence centre concept is to develop national **competence centres** that have or aim at **leadership in energy efficiency in a clearly defined promising area of technology or end use**, or possibly in a certain customer segment. These centres would be based on existing or newly founded organisational entities within the E.ON group or partner companies E.ON is closely engaged with. This approach would clearly stand out against EnBW's approach to concentrate on certain business sectors and RWE's process optimisation approach in being innovative, and technology and / or end-use orientated.

Possible target groups should be larger trade, commerce, and service customers as well as the industry. The main reason for choosing these target groups is the profitability of the energy efficiency activities, taking the transaction costs that have to be expected into account (however, a higher positive impact on company image could be achieved by focussing household customers). We propose to address the business customer groups through local customer agents and a parallel central marketing:

1. First customer contact related to energy efficiency as a **low-cost entry**
2. **More detailed analysis if needed (e.g. with E.ON tool "Energy Explorer")**
3. **Single technology or end-use related offers as required:** the existing compressed air-offer in cooperation with the Ultra Air competence centre should be continued. Further offers should focus first on **efficient pumps** for industry and commerce. This field could be enlarged in a later step by **efficient circulation pumps / optimisation of heating systems / hydraulic balance for all sectors**. Further cross sectional technology fields for such a competence centre would be **ventilation and air conditioning**, and **lighting**. Whether the centre should deal with **process heating or cooling** or not, should be subject of further examination.

It is thus not intended to follow a „we do everything around energy" concept but to demonstrate general competence in the field energy / energy efficiency / energy services through leadership in **key areas**.

The offers will be developed **centrally** in national competence centres in **close cooperation with external partners in manufacturing industry, engineering offices, and trade** as well as possibly with their associations, like VDMA and ZVEI (modelled on the examples ENEX, Ultra Air). These competence centres manage the local distribution of the offers centrally; further, the centres are responsible for analysis and further development of the offered services. The selling of the energy efficiency services has to be organised **locally** as it requires marketability and close contact to the customer. The competence centre has to ensure to precise balancing between central and local activities in both the development and the testing phase.

The differentiation of the E.ON concept against big competitors and municipal energy companies developed in this paper offers the opportunity for E.ON to develop **comparative advantages** and to communicate these accordingly. The concept can be realised even under today's basic conditions, especially when focussing on larger trade, commerce, and services as well as industry customers.

However, the concept can only work if the market leadership in the respective energy efficiency field can really be achieved through cooperation with suitable partners and internal personnel development.

Depending on the general framework, it can be profitable or even necessary to offer further energy efficiency services or energy efficiency programmes. The expected growth in the field of energy performance **contracting**, for example, makes it worth turning to this business area, possibly with a concept aiming at integrating elements of energy performance contracting into the much more common schemes of third-party financing and contracting for investments and operation in the supply of heat, cold, and electricity from on-site generation facilities. This should be done in a way harmonised among the E.ON companies and closely associated with the competence centres.

If further **energy efficiency programmes** are offered, apart from programmes to promote natural gas, will depend, in the end, on the political framework in the respective country, which allow for – or even call for, as in the case of E.ON UK – such activities.

3.3.5 First steps to implement the competence centre approach

The following steps to implement the competence centre approach should be taken, in addition to the proposed standardisation, harmonisation, and step-by-step development of the current energy efficiency activities within the E.ON group:

1. **Basic strategic decisions:**
   Is a stronger orientation towards (energy efficiency) services accepted? In what way is the current concept of concentration on energy supply changed accordingly?
   Which target groups should be addressed?
   Which internal procedures, structures and resources will be provided for the new orientation towards energy efficiency?

2. **Deeper analysis of starting point**
   Are the proposed technologies / fields of application chosen correctly?
   Do competences / experience exist within the E.ON group?
3. **Analysis and evaluation of possible partners**
   Choose and involve the most competent and experienced energy efficiency partners in the respective areas.
4. **Product development**
   A concrete competence centre offer with modular structure is developed, based on the knowledge of the market situation, the existing energy efficiency potential, internal as well as external competence, and the general strategy adopted. Parameters to be fixed are mission and vision, system of aims / ends, product / customer portfolio, the development of internal and external personnel, and the controlling of the competence centre.
5. **Testing** of the competence centre's supply in a test market and, if necessary, a further development.
6. **E.ON-wide implementation,** inclusion into partner concept and offer to target groups / marketing.

4 Conclusion and outlook

Spurred by the current challenges for energy and environment policy, energy end-use efficiency is rapidly gaining importance in the public debate. Both the European Commission, e.g. in the Green Paper on Energy Efficiency of June 2005 and the planned Action Plan on Energy Efficiency, or in the Green Paper on Energy Policy of March 2006, and the German federal government in its status report for the ‚Energy Summit' of 3 April 2006, highlight energy end-use efficiency as a key action for improving security of energy supply as well as the competitiveness of our economy, and for mitigating climate change. It is, therefore, recommendable that the energy supply industries pay stronger attention to this matter as well.

As a result of this study, it has been possible to produce a comprehensive update of the knowledge on **potentials and costs for energy end-use efficiency** in Germany. A good foundation has, thereby, been created for an assessment of promising technical areas for improving energy efficiency in the three sectors private households, commercial and public services, and industry.

As has been analysed in chapter 2.3, the conclusions about the most interesting technology fields in terms of potential and cost effectiveness can be transferred in principle to the situation in other European countries. However, a country-specific analysis of the market situation for these technology fields will then usually be necessary, covering issues such as technologies and products available, stock average energy efficiency, and additional costs of energy-efficient vs. baseline technology.

Furthermore, it was possible to provide a broad overview of **energy efficiency services, consultancy, and incentive programmes offered by companies of the E.ON group** in Germany, Great Britain, Sweden, and the USA. However, we found that the available data do not allow a comparison nor, usually, an assessment of the effectiveness and cost effectiveness of these activities. On the other hand, it was possible to show that E.ON companies possess similarly good competences and experiences with energy efficiency services and programmes as their competitors. However, synergy potentials within the group have not yet been exploited.

Based on the technical and economic potential identified in this study, the experiences with energy services that exist within the E.ON group, and the necessity to distinguish oneself from the competition, we developed the idea of the **E.ON competence centres**. These centres could work towards achieving **leadership in energy end-use efficiency markets** in a clearly defined area of technology or end use, or maybe a certain customer segment. First considerations on the concept of the competence centres and on first steps towards realisation were made in chapter 3.3.

Further research could, therefore, particularly concern the following areas:

- a country-specific analysis of the market situation, e.g. on available technologies, efficiency in the existing stock, additional costs of efficient technologies, etc., in selected target countries,

- detailed development of the E.ON competence centre concept, with an analysis of economic results for E.ON, and consultancy during the development and field testing of the concept,
- in this context, concrete analyses of technologies, market structures, barriers, packages of services with their cost effectiveness and market chances, for selected technology areas such as pumps, ventilation and air conditioning, office lighting,
- finally, a detailed and complex scenario analysis of the development of the overall energy consumption with and without energy efficiency activities by energy companies, the state, or other players.

Depending on the development of the political framework (e.g. the national implementation of the Directive on Energy End-use Efficiency and Energy Services), the analysis of energy efficiency programmes could be of interest as well. In addition, the potential impact of the Directive on E.ON companies and their activities in general could be examined. This may concern both an impact upon energy sales from potentially increased efforts of Member States to save energy, and an impact on potential business fields in energy end-use efficiency, and their economic attractiveness. The latter would also be influenced by the national implementation of article 6 of the Directive, which requires the Member States to give to the energy supply industries a certain role in the improvement of energy end-use efficiency.

5 References

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