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Evaluation of Energy Efficiency Strategies in the Context of the European Energy Service Directive: A Case Study for Austria

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1. Introduction

We evaluate possible strategies to improve end-use efficiency under Directive 2006/32/EC of the European Parliament and Council on energy efficiency and energy services (ESD) in Austria. The main objective of the ESD is to invite the Member States of the European Union to cut their final energy consumption by 9% compared to the business-as-usual development within a period of 9 years ending in 2016. The emphasis is on 'invite' because the European Parliament and the Council could not agree on mandatory energy savings to be fulfilled by the Member States. The aim of the ESD is therefore indicative and Member States are basically only asked to undertake sufficient measures to increase the end-use energy efficiency and submit interim reports to the European Commission every three years. Currently, a new energy efficiency directive (COM(2011)370) proposed by the European Commission in which an even higher saving target auf 20% to be reached in 2020 is demanded, is under review. This new directive is not yet in force.

Basically, the purpose of the ESD is to increase the efficiency of energy end-use cost-effectively. For that reason the ESD sets up a framework for creating the conditions for the development and promotion of a market for energy services. The directive applies to (see Article 2, ESD)

- provider of energy efficiency improvement measures, energy distributors, distribution system operators and retail energy sales businesses;
- final customers, with the exception of companies that are involved in the European Emissions Trading Scheme;
- the armed forces, if its application does not conflict with the nature and primary purpose of the activities of the armed forces and with the exception of material that is used exclusively for military purposes.

In determining the manner in which the ESD is implemented, two options from which the individual Member State can choose are given. The first possible option is to select one or more of the following measures, to be performed by energy distributors, distribution system operators and / or energy trading companies:

- Promotion and offer of competitive priced energy services;

- Promotion and offer of competitive priced energy audits conducted in an independent manner and / or energy efficiency improvement measures;
- Participation in funds and funding procedures.

The second option is to adopt and implement voluntary agreements and / or other market-based instruments such as white certificates. Austria chose the second option. In January 2010, voluntary agreements with several trade associations and interest groups of the energy industry were signed (see Rezessy & Bertoldi (2011) for a discussion of the benefits and draw-backs of voluntary agreements and an overview of such agreements made in other European countries). In late 2009, Austria's Federal Ministry of Economy completed voluntary agreements with the association of the gas and heat supply companies, the association of the Austrian electricity companies, the trade association of the petroleum industry and the trade association of energy trading. The saving target defined in the agreements sum up to 3,020 GWh (14% of the total saving target, see below). This amount must be reached through energy efficiency measures that result in energy savings for end users and the achievements are subject to on-going monitoring. The Austrian calculation methods for energy efficiency measures are described in Adensam et al., (2010). Reichl & Kollmann (2010) give a general discussion of different monitoring paradigms in the context of the ESD.

Interesting (and crucial) about the ESD is the calculation of the overall savings target, which is described in Annex I to the Directive: 9% of the average of the total final energy consumption of a country in the five years prior to the Directive (or the last 5 years for which data are available, in the case of Austria 2001 to 2005) are to be used as the savings target. The total final energy consumption must be corrected of the energy consumption in the segments air traffic, heavy oils, which are used in maritime navigation (not relevant for Austria), and of the final energy consumption of all companies participating in the European emission trading scheme.

For Austria, an indicative savings target of 22,330 GWh to be reached by 2016 was calculated (see Bundesministerium für Wirtschaft und Arbeit (2007)). Thus, the Austrian final energy consumption in order to successfully comply with the directive in 2016 must be 22,330 GWh below the value that would have been the Austrian end-energy consumption without implementing specific energy efficiency measures in the period 2008 to 2016. It also means that the Directive does not require an absolute reduction of final energy consumption under the 2008 level, but simply an attenuation of energy consumption compared to the business-as-usual consumption. Obviously, the assumptions under which the business-as-usual scenario is calculated have significant impact on the size of the savings target. We will not go into detail on this subject, but refer the reader to Reichl & Kollmann (2010) for a more detailed discussion about defining this baseline. Boonekamp (2006) gives a comprehensive overview of the issues involved in quantifying the effects of energy savings and Thomas et al., (2009) discuss the importance of accuratly measuring the effectiveness of the ESD.

A central aspect in this context is that each member state may include improvements in energy efficiency, which had been initiated before 2008, when reporting the energy efficiency improvements achieved. In the case of Austria significant early actions or so-called early savings were achieved through measures such as the Austrian housing subsidies scheme in the past two decades. The responsible Federal Ministry for Economy reports that early savings of 9,200 GWh were achieved and are accounted for in the National Energy Efficiency Action Plan.

Our article is divided into three parts: firstly, we define and analyse potentially appropriate energy efficiency measures and develop policy strategies to support the implementation of these measures. These policy strategies encompass the development of a framework regarding funding and eligibility criteria or the setting of energy efficiency minimum standards. And finally, we evaluate these energy-efficiency strategies according to how they can support the achievement of the ESD target and their impact on key variables of the Austrian economy.

The analysis of energy efficiency measures and strategies extends both on the household sector and industrial and service sector. Thus, an almost complete coverage of the policy-relevant energy consumption is given. However, it must be noted that measures analysed in this study are those that the authors identified as the most effective options for a rapid reduction of final energy consumption, but by no means claim to have a complete list of all potential measures. Especially in the corporate sector large energy savings are often possible by changes in the processes or by restructuring production facilities (see Tanaka (2011) for a meta-study of energy efficiency policies in the industries of IEA countries). A study like this can only analyse energy efficiency measures with a relatively uniform effect on the energy consumption of final customers. Furthermore, the aim of this article is not on showing how the saving effect of individual energy efficiency measures was calculated (see Reichl et al., (2010) for a detailed description of the individual energy efficiency measures underlying our strategies) but on discussing the challenges of a sound analysis of the overall effects of a national energy efficiency strategy and the necessary assumptions that need to be made in doing so.

2. Developing the energy efficiency strategies

We define and analyse five different energy efficiency strategies for Austria. The basis for the development of these strategies is the current subsidy environment in Austria in the year prior to the directive's introduction (2007) as well as the current state of discussion concerning energy efficiency polices in Austria.

Currently the following mechanisms to promote energy efficiency are in use in Austria:

- Ecological tax reform
- Energy Efficiency Information campaigns
- Tax relief for setting energy efficiency measures (especially in the building sector)
- Monetary support for energy audits for companies (especially small and medium sized companies)
- Monetary support for energy efficiency measures of households (for example when inefficient white goods are replaced).

The currently existing measures and mechanisms to promote energy efficiency are not sufficient under the given conditions and requirements to fulfil the ESD target which is strongly undermined when looking at the pre-ESD period: between 1990 and 2007, Austria`s overall final energy intensity has decreased by only 4% (compare Jellinek (2009) for a description of sectoral energy intensities in Austria). We therefore assume that technical progress is accelerated by the funding measures in our strategies. Also, additional strategies are proposed to promote energy saving measures in the industrial sector. Firstly, to increase funding rates, energy efficiency funds are launched, which support the implementation of energy efficiency technologies in domestic companies. Energy efficiency funds have already been introduced in Denmark, Norway, Great Britain and some U.S. States (Irrek et al., (2004) give a comprehensive discussion of the potential effectiveness of energy efficiency funds and an overview of international experiences.) They not only offer funding but also consultancy, present energy-efficiency-related information and have a wide range of motivational incentives.

Secondly, minimum standards are a tool to increase energy efficiency and are based on the market's best technologies. In developing the scenarios it is assumed that all eligible firms meet the requirements for the use of funds. We assume that only cost-effective energy efficient technologies are promoted.

All scenarios are based on existing technologies only. Calculations for the development of energy saving in the industrial and service sector are based on literature reviews and a survey of opinion leaders from the energy sector. In our framework - starting in the base year 2008 - for the two strategies *'Intensive monetary promotion of energy efficiency enhancing technologies'* and *'Intensive monetary subsidies of energy efficiency enhancing technologies with simultaneous introduction of minimum standards'*, two scenarios for possible energy savings are designed. For the strategy *'Introduction of minimum standards for energy efficiency-enhancing technologies'*, only one scenario was developed. These scenarios are supposed to show different developments, depending on the strategy chosen.

The five evaluated energy efficiency strategies are:

- Introduction of energetic minimum standards (*Min Stand*)
- Intensive monetary subsidies of energy efficiency enhancing technologies, moderate intensity = funding quote is increased to 40% (*IMF mid*)
- Intensive monetary subsidy with simultaneous introduction of minimum standards, moderate intensity = funding quote is increased to 40% (*IMF-US mid*)
- Intensive monetary subsidies of energy efficiency enhancing technologies, high intensity = funding quote is increased to 50% (*IMF high*)
- Intensive monetary subsidies of energy efficiency enhancing technologies with simultaneous introduction of minimum standards, high intensity = funding quote is increased to 50% (IMF-US high)

The scenarios *IMF mid* and *IMF high* focus on the optimization of the promotion policy by increasing the rate of funding. The scenario *Min Stand* focuses on the impact of the introduction of minimum standards for energy-efficient technologies and the potential savings achievable. The scenarios *IMF-US mid* and *IMF-US high* combine the use of intensive monetary support with the introduction of minimum standards.

We assume that all companies that apply for funding are eligible for funding and thus get the full financial support. Furthermore, we assume that new investments have to result in at least 15% energy savings compared to the industry average and for replacements over 20% of energy savings have to be achieved in order to be eligible for funding (compare Emnid, 2005). According to this, by optimizing support policies the implementation rate of energy efficiency measures in companies is expected to increase. We analyse these effects in the two scenarios *IMF mid* and *IMF high*. In the first case, the predicted funding rate is 40% and in the second case companies receive a funding of 50% of their investment costs. The following table gives an overview of the five strategies as well as of their underlying assumptions.

Measures		*Min Stand*	*IMF mid*	*IMF-US mid*	*IMF high*	*IMF-US high*
Renovation of buildings/heat dissipation	From 2011	No change to 2007	FQ: 60% of investment	FQ: 50% of investment	FQ: 60% of investment	FQ: 50% of investment
	From 2012	Buildings built before 1980 have to be renovated within 15 years	No change to business as usual	Buildings built before 1980 have to be renovated within 15 years	No change to business as usual	Buildings built before 1980 have to be renovated within 15 years
Heat supply	From 2011	No change to 2007	FQ: 30% of investment (45% for combined solar thermal systems)	FQ: 15% of investment (30% for combined solar thermal systems)	FQ: 30% of investment (45% for combined solar thermal systems)	FQ: 15% of investment (30% for combined solar thermal systems)
	From 2012	Obligatory use of condensing heating technology; in case of building renovation obligatory installation of solar heat systems	No change to business as usual	Obligatory use of condensing heating technology; in case of building renovation obligatory installation of solar heat systems	No change to business as usual	Obligatory use of condensing heating technology; in case of building renovation obligatory installation of solar heat systems
Lighting & Stand By	From 2011	No change to business as usual				
	From 2012	Directive Nr. 244/2009 EG Directive Nr. 1275/2009	No change to business as usual	Directive Nr. 244/2009 EG Directive Nr. 1275/2008	No change to business as usual	Directive Nr. 244/2009 EG Directive Nr. 1275/2008
White goods	From 2011	No change to 2007	FQ: 30% of investment with linear reduction to 0% in 2014	FQ: 30% of investment with linear reduction to 0% in 2014	FQ: 30% of investment	FQ: 30% of investment with linear reduction to 0% in 2014
	From 2012	Dynamic standards from 2011 on, A++ within 4 yours	No change to business as usual	Dynamic standards from 2011 on, A++ within 4 yours	No change to business as usual	Dynamic standards from 2011 on, A++ within 4 yours
individual transport	From 2011	No change to 2007	750 € for each full hybrid and natural gas-dedicated vehicle	750 € for each full hybrid and natural gas-dedicated vehicle	750 € for each full hybrid and natural gas-dedicated vehicle	750 € for each full hybrid and natural gas-dedicated vehicle
Public transport	From 2011		Funding of 40% of costs	Funding of 40% of costs	Funding of 40% of costs	Funding of 40% of costs

Table 1. Main characteristics of the strategies; FQ: funding quota

The strategy *MinStand* is the only one that does not set new incentives by imposing new subsidies, while the other strategies all use new subsidies as incentives for energy efficiency actions. Another aspect of the strategy *MinStand* is that all costs of the energy efficiency measures are carried by end-customers. Especially for households, this may lead to social imbalances but does not need to. Schiellerup (2002) for example shows in a case study for Great Britain, that the introduction of minimum standards for cold appliances let to considerable savings on the consumers' side. In contrast, Galvin (2010) calculate that raising the minimum standard that needs to be reached in the thermal insulation of an existing house to be eligible for subsidies may prevent renovation activities among low-income households significantly. Concerning the firms that are subject to European and international competition, the cost shifting that is possibly associated with the proposed energy efficiency measures can negatively influence their cost structure. Any introduction of minimum standards without financial support for end-customers thus needs to be carefully analysed.

For each strategy under consideration, the evaluation consists of three steps:

1. a comparative-static analysis of the total potential energy savings achieved by a promotion of end-use energy efficiency,
2. a comparative-static analysis of the investment costs and the induced changes in energy demand in the respective strategy ,
3. a dynamic analysis of the economic effects induced by the respective end-energy-efficiency strategy in Austria.

The considered strategies and packages of measures are compared to a baseline scenario in each case. This baseline scenario anticipates the development of energy consumption and economic development of Austria without any measures to promote energy efficiency.

2.1 Definition and Analysis of appropriate energy efficiency measures

The aim of the analysis is to determine whether the implementation of the energy efficiency strategies can be realized cost-effectively or not. For that, the cost-efficiency of a single energy efficiency measure has to be assessed. Basically, an energy efficiency measure is cost-effective when:

$$C_K \leq V_K = \sum_{t=1}^{T} = \left(\left[P_t \left(F_C - F_N \right) \right] / \left(1 + r \right)^t \right) \qquad (1)$$

with C_K being the total cost of the energy efficiency measure, V_K representing the present value of energy savings that can be achieved by the measure, P_t the energy price at time t, F_C the amount of the energy source that is used before the implementation of the measure, F_N the amount of the energy source, which is used after implementation. T is the lifetime of the measure and r is the discount rate. Equation (1) was used for the calculation of all analysed energy efficiency measures. When interpreting the cost-efficiency of an energy efficiency measure, the following aspects need to be considered:

- The more the energy price P_t increases over the lifetime of the energy efficiency measure, the more likely is the energy efficiency measure cost-effective.
- The higher the interest rate, the lower the present value of expected energy savings.

- The calculation assumes that the annual savings remain constant and equal to the initial value, while in reality it may be more fluctuant and depending on external influences (for example on climatic influences).

In the calculations, any annual maintenance or repair costs are neglected. The disposal of old appliances is free of charge (except only problematic substances like asbestos). The calculations assume that the installer of the new appliance ensures the proper disposal of the replaced appliance.

All of the potentials presented throughout this article represent realistic, socio-economic potentials. That is, for every period considered, those potentials are considered that are realizable by ambitious policies. The behaviour of a particular stock of energy consuming objects over time is shaped by several factors. Probably the most important parameter is the lifetime of an object. If an object reaches the end of its life, is must be replaced. Assuming a uniform lifetime, excluding any exchanges before the end of the lifetime, any given stock is completely replaced within its lifetime. Therefore, the parameter '*life time*' is especially important for the analysis of the savings potentials.

In addition to the technical lifetime of an object, also the rate of early replacement has a major influence on how long it takes to replace the stock of objects completely. It is not trivial to determine this parameter, because data of product lifetimes already include these early exchanges; i.e. the replacement of the product before it no longer meets its technical function. Therefore, within this project any early replacement is considered as a rise above naturally defined replacement (i.e. by historical experience) rates. In the field of renovation of buildings and heat supply systems, the potential shown in this article represents such a rise in early replacements. At times, this rate fluctuates between the different measures. The reasons for this are not only the different cost-efficiencies of the measures but also the fact that the rates of early exchanges are higher, especially when the user experiences a noticeable increase in comfort of setting a measure. If such a comfort factor is not given - the insulation of hot water pipes may serve as an example - actions are perceived as less urgent as they are less visible.

Another distinguishing criterion is the required investment. With increasing investment, risks also increase. Furthermore, the market penetration of technologies and the extent of disturbance during implementation of the measures have an impact. For the topics *electrical load* and *traffic*, we assume that there is no premature replacement of products.

2.2 Energetic and Economic Effects of relevant energy efficiency measures

For this study, a variety of energy efficiency measures was analysed. For each of these measures, the expected energy savings per implementation (households) or per unit of current energy consumption (services and goods production) was calculated. Based on these individual savings, subsequently, the potential of these measures for the reduction of annual energy consumption in the target year 2016 was calculated and comprehensive strategies were designed. As mentioned before, we do not go into detail about individual measures, but present the overall saving potentials of a whole group of measures. For example, the replacement of inefficient white goods as presented below is the sum of five individual energy efficiency measures: the replacement of inefficient refrigerators, of inefficient washing machines, of inefficient laundry dryers, of inefficient dish washers as well as of inefficient electric-cookers.

The potentials presented here are to be interpreted as additive. This means that for example, the potential savings realized by a partial restoration of the building envelope are calculated in a way so that further savings can be credited for an additional installation of a highly efficient heating system. If, for example by replacing all windows and doors in a house from the building period 1945 to 1970 savings of 3,600 kWh per year are achieved and at the same time a solar thermal plant with 20 m^2 is installed, the creditable savings are 3,600 kWh + 6,000 kWh = 9,600 kWh.

Again it should be noted that these savings each represent average values and are therefore suitable for the consideration of energy efficiency measures that are implemented in high numbers and yield a comparably uniform saving effect, but cannot be applied to individual objects for business considerations.

2.2.1 Saving potential of energy efficiency measures in the household sector

The highest potential in the household sector comes from space heating. Under the headline *space heating* thermal preparation, thermal rehabilitation of buildings, an efficient building envelope for new buildings and heat distribution are comprised. With full implementation of the realistically feasible measures in this area the final energy consumption in 2016 would be around 20,176 GWh lower than in the business-as-usual scenario.

Concerning *electric lighting* the replacement of bulbs (without lamp replacement) is analysed for the household sector. We calculate a potential for reducing the annual energy consumption for lighting in 2016 by 1,126 GWh compared to the business-as-usual scenario for 2016.

Under the topic *electrical applications* (except electric lighting) in households a potential for reducing the annual energy consumption in 2016 by 1,885 GWh is calculated compared to the business-as-usual scenario for 2016. These potentials are composed of a reduction of the stand-by consumption of household appliances including consumer electronics and a rapidly increasing penetration of highly efficient white goods.

By maximizing the activities in the area of *individual transport*, savings in energy consumption of 1,173 GWh can be achieved in 2016 compared to the business-as-usual scenario. The following table 2 gives an overview of the possible savings realized by measures in household measures.

2.2.2 Saving potential of energy efficiency measures in the production of goods and services

We now turn to the realisable potentials in the industrial and service sector which are shown in Table 3. Again, energy efficiency measures in *space heating* yield the highest savings (space heating preparation, distribution and thermal remediation). These savings amount to 5,355 GWh. Concerning *electrical applications* (lighting, compressed air optimization, ventilation and air conditioning systems, optimization of pump systems and process refrigeration) annual savings of 4,960 GWh are possible in 2016.

Measure	*Potential Savings*
Domestic water system	1,806 GWh
Heating systems (of which 75% are combination of domestic water and heating systems)	6,504 GWh
Building envelop in new buildings (without savings from efficient in-house systems	1,661 GWh
Thermal building renovation	6,622 GWh
Heat distribution system	3,583 GWh
Electric Lighting	1,126 GWh
White goods	812 GWh
Stand-by consumption	1,073 GWh
Individual Transport	1.173 GWh
Total	***24,360 GWh***

Table 2. Measures related to the total potential reduction of annual energy consumption in the household sector in 2016.

High energy savings are also possible in *freight transportation*. But these savings are only achievable through radical structural measures with long-term nature. The presented potential to reduce annual energy consumption in 2016 is thus only 720 GWh compared to the year 2008 therefore relatively low compared to the total consumption in this sector of about 26,000 GWh (without kerosene and LPG).

Measure	*Potential Savings*
Lighting	1,150 GWh
Compressed air optimization	460 GWh
Air conditioning and ventilation	1,600 GWh
Optimization of pumping systems	650 GWh
process cooling	1,102 GWh
Thermal building Renovation	2,403 GWh
Preparation of space heating and its distribution	2,952 GWh
Freight transport	720 GWh
Total	11,037 GWh

Table 3. Measures related to the total potential reduction of annual energy consumption in the services and goods production in 2016, own calculations

Of all the measures presented in Table 3, freight transport points out as it is a highly important sector for long-term energy efficiency improvement as well as for significant reductions in greenhouse gases. Obstacles to rapid structural changes are manifold: Liimatainen & Pöllänen (2010) argue that on the one hand, policy makers are reluctant to touch upon these sensitive issues as they need significant behavioural changes of companies and customers. On the other hand, they show in an analysis of the freight transport sector in Finland that this sector is highly dependent on the overall economic circumstances and was therefore severely hit by the recent economic crisis during which indicators like average payload and vehicle utilization rate significantly dropped.

2.3 Underlying assumptions

From a scientific perspective, it is indispensable to make a number of assumptions when analysing the economic effects of the studied energy-efficiency strategies for Austria. In the following these assumptions - both for the comparative-static as well as for the dynamic economic analysis are - summarized.

Assumption 1: Reaction of the households to changes in their consumption patterns

The reaction of households to measures initiated by changes in the consumption structure (e.g. increased non-energy consumption by purchasing new circulating pumps) requires assumptions about how those expenditure are financed by each household. Here, a central factor is the choice between substitution within the non-energy consumption and financing out of the total savings of households. Similarly, an assumption is needed on how the monetary savings are used. Depending on the strategy, we vary the proportion of financing from savings from 33% to 100%.

Assumption 2: Reactions of companies to changes in their investment behaviour

The need for assumptions on the response to measures that initiate changes in their investment behaviour is as important for companies as it is for households. Companies decide whether to respond to changes in their cost structure with a substitution within the investment or a change in their reserves. Our assumptions are based on a survey undertaken by Brüggemann (2005) in 2005. She interviewed 4,100 companies in Germany and showed that 79% of those companies financed energy efficiency measures with own resources. 42% of the companies also took bank loans. In our analysis we vary the proportion of funding from reserves, depending on the strategy, between 33% and 100%.

Assumption 3: Borrowing of the public sector

The additional expenditure of the public sector (direct subsidies, infrastructure investments, etc.) during the evaluation of the strategies does not lead to cutting of other spending in the public budget: There is no reaction or adaptation of other public expenditure and revenues in the analysis; they are funded by additional debt. However, in the individual evaluations of interventions also the induced changes in public revenues from energy taxes and taxes of VAT revenue from private consumption and wage tax revenue are calculated.

Assumption 4: Simulation horizon to the year 2020

All analysed energy efficiency measures start on January 1, 2008 and end on December 31, 2016. After this date, no further additional strategies are realized, the effect of the strategies installed prior to that date will be displayed in the dynamic economic analysis, however, until 2020.

Assumption 5: Time costs and external effects (like abatement costs of greenhouse gas emissions)

As part of the dynamic economic analysis neither time costs, which particularly exist in the transport segment, nor any external costs such as damage costs of greenhouse gas, air pollutant emissions or noise costs are included. The analysis of these parameters cannot be part of the present study for reasons of capacity. The fact that these potential costs are not included does not mean that they do not exist.

Assumption 6: Technological Progress

For the overall observation period, technology that was state of the art in 2008 is used. The technological developments to be expected by 2016 are not predictable, but due to the comparably short time horizon are considered of low importance for the sake of this study. New – improved – technologies would only be of major importance in our analysis if a high penetration rate was to be expected.

Assumption 7: Funding rates and tax rate of the public authorities in the measures

The analysis of the individual measures uses - over the entire observation period – the support schemes valid in Austria in the year 2008. Due to the partly inhomogeneous systems in Austria's nine federal states weighted averages were used. Similarly, taxes and levies are given by the values used in 2008 and remain constant for the entire observation period.

Assumption 8: Development of energy prices until 2016

By assumption, the price of electricity is 18.26 €cent/kWh; the price of heat energy is 6.5 €cent/kWh, which reflects the Austrian price level in the year 2008. For an analysis of the influence of energy prices, discount rates and inflation on the cost-efficiency of the measures underlying the energy efficiency strategies, see (Reichl, et al., 2010).

Assumption 9: Customer adoption of different measures and additional overhead costs

In the course of this study, no analysis of the customer acceptance regarding the specific actions is conducted. This would need to be done by the use of elaborate methods (interviews ...). Such surveys could be conducted during the time in which the individual strategies are carried out to evaluate customers' acceptance. Furthermore, it should be noted that additional overhead costs such as consulting, training; PR, etc. were not included in the study.

Assumption 11: Economic cycles, and current international economic crisis

A study with a medium-to long-term time horizon in the observation period, as represented by this study, cannot comment specifically on exact future or current business cycles. As a consequence, the present study - also because of the lack of available data - does not consider the current financial and economic crisis. In an economic crisis, especially if the financing of certain activities or actions (including households and businesses) are significantly negatively concerned, it is likely that there may be delays in the implementation of individual measures and strategies. Marino et al., (2011) who give an overview of the European energy service market mention that the economic crisis made the access to finance more difficult and has negatively influenced the initiation and development of new energy efficiency projects.

Assumption 12: Energy savings through renovation of old buildings

These calculations are based on energy performance certificates (heating demand calculation) and do not consider the individual user behaviour (expansion of living space, ventilation behaviour, heating characteristics, etc.). Studies show that the user's behaviour can significantly reduce the potential savings due to the heating requirements of building renovations (compare Sanders & Phillipson (2006) for a review of related papers). For this study, due to the lack of a publicly available comprehensive and statistically usable data material, no adjustment of the shifts of the heat consumption through a change in the individual user behaviour is considered.

3. Costs and realized energy savings of the strategies

In the following, the effects of the analysed energy efficiency strategies and the associated capital costs are presented.

3.1 Energetic effects of the strategies

Firstly, in Table 4, the expected savings under each strategy for the household sector, the service sector, and the production of physical goods are shown. The sum of savings in these sectors allows meeting the savings targets of 22,330 GWh, but the target is not achieved under all strategies. However, it should also be pointed out explicitly that Austria has already undertaken efforts to improve energy efficiency before 2008, and these early actions can be credited to the ESD target. The extent to which Austria can succeed in being allowed to count its pre-2008 energy efficiency improvements on to the target, contributes significantly to how ambitious the savings target has to be interpreted. Should the savings target solely have to be achieved by the strategies analysed here, and have to be realized only in the period 2008 to 2016, then only the strategies *IMF US mid*-and *IMF-US high* deliver overall savings that are high enough to meet the target.

Year	***MinStand***		***IMF mid***		***IMF-US mid***		***IMF high***		***IMF-US high***	
	HH	*Service/Goods*	*HH*	*Service/Goods*	*HH*	*Service/Goods*	*HH*	*Service/ Goods*	*HH*	*Service/Goods*
	in GWh									
2008	462	316	638	506	638	633	638	696	638	886
2009	925	633	1,315	1,013	1,315	1,266	1,315	1,392	1,315	1,772
2010	1,597	949	2,677	1,519	2,635	1,899	2,677	2,089	2,635	2,659
2011	2,288	1,266	4,213	2,026	4,048	2,533	4,213	2,786	4,048	3,546
2012	3,280	1,582	5,897	2,531	7,794	3,164	5,897	3,480	7,794	4,430
2013	4,350	1,898	7,777	3,037	10,329	3,796	7,777	4,176	10,329	5,315
2014	5,489	2,215	9,829	3,543	13,023	4,429	9,829	4,872	13,023	6,201
2015	6,589	2,531	12,102	4,049	15,741	5,062	12,102	5,568	15,741	7,086
2016	7,746	2,848	14,602	4,557	18,656	5,696	14,602	6,266	18,656	7,974
Total in 2016	**10,594**		**19,159**		**24,352**		**20,868**		**26,630**	

Table 4. Reductions in energy demand in the energy efficiency strategies, without early-actions.

3.2 Necessary expenditures

Table 5 shows the expected expenditure for the implementation of the respective energy efficiency strategies in the period 2008 to 2016. These expenditures are the sum of consumers' as well as corporate spending and all possible subsidies. Not included in these expenses are the expenses for the administration of the strategy.

For all strategies in the household sector, a strong rise in spending on energy efficiency measures is expected. Acceptance and implementation readiness is assumed to rise with the duration of the strategies. In the industrial and service sector, given assumptions about energy prices and a constant funding quota, no dynamic development is expected in the investment strategies. The impacts of the programs are therefore considered to yield a uniform effect over the whole observation period. The anticipated expenditure (sum of all expenditures between 2008 and 2016) lies between € 13.7 billion and € 34.8 billion.

How do these numbers compare to current Austrian activities? Between 1993 and 2008 3,781 projects were realized with the support of public funding that targeted the efficient use of energy. The overall investment amounted to 467 Mio. € and was support with 94 Mio. €. In the year 2008, funding of 22.1 Mio. € was given to 881 projects (see Bundesministerium für Land- und Forstwirtschaft, 2008).

Year	*MinStand*		*IMF mid*		*IMF-US mid*		*IMF high*		*IMF-US high*	
	HH	*Service/Goods*	*HH*	*Service/ Goods*	*HH*	*Service/Goods*	*HH*	*Service/Goods*	*HH*	*Service/ Goods*
	in Mio. €									
2008	648	325	992	519	992	649	992	714	992	909
2009	648	325	1,074	519	1,074	649	1,074	714	1,074	909
2010	648	325	2,010	519	1,654	649	2,010	714	1,654	909
2011	736	325	2,288	519	1,883	649	2,288	714	1,883	909
2012	1,370	325	2,552	519	3,707	649	2,552	714	3,707	909
2013	1,539	325	2,889	519	3,932	649	2,889	714	3,932	909
2014	1,666	325	3,221	519	4,148	649	3,221	714	4,148	909
2015	1,744	325	3,652	519	4,420	649	3,652	714	4,420	909
2016	1,779	325	4,125	519	4,768	649	4,125	714	4,768	909
Total	***10,778***	***2,925***	***22,803***	***4,671***	***26,578***	***5,841***	***22,803***	***6,426***	***26,578***	***8,181***

Table 5. Expenditures for the energy efficiency strategies; sum of private expenditures and public funding; HH: Households; Services/Goods: production of goods and services.

3.3 Costs of the strategies and expected reduction of energy costs

Table 6 shows the expected expenditure or investment in energy efficiency measures compared to the consequential reduction in expenditure for energy in the respective years. The expected expenditures exceed the expected reduction in energy bills in every year in the period under consideration. This mainly shows that the short horizon of the directive of 9 years, is suitable to force rapid action from the Member States, but is too short in connection with assessing the economic viability of energy efficiency programs.

Even though many energy efficiency measures are paid off from a business point of view after a few years, in the context of the ESD, efforts must be intensified until the last year of the Directive to achieve the targets. This necessarily results in an investment that exceeds the expected reduction of energy expenditure in the term of validity of the ESD.

Year	*Min Stand*		*IMF mid*		*IMF-US mid*		*IMF high*		*IMF-US high*	
	Exp.	*Cost Red.*	*Exp.*	*Cost Red.*	*Exp.*	*Cost Red.*	*Exp.*	*Cost Red.*	*Exp.*	*Cost Red.*
	in Mio. €									
2008	973	55	1,511	92	1,641	103	1,706	109	1,901	125
2009	973	110	1,593	188	1,723	211	1,788	222	1,983	255
2010	973	211	2,529	339	2,303	404	2,724	389	2,563	471
2011	1,061	298	2,807	500	2,532	587	3,002	567	2,791	676
2012	1,695	403	3,071	671	4,356	920	3,266	754	4,615	1,031
2013	1,863	516	3,408	858	4,581	1,176	3,603	958	4,841	1,309
2014	1,990	635	3,740	1,057	4,797	1,444	3,935	1,173	5,057	1,599
2015	2,069	753	4,171	1,270	5,069	1,708	4,366	1,403	5,329	1,889
2016	**2,104**	**875**	**4,644**	**1,497**	**5,417**	**1,992**	**4,839**	**1,647**	**5,677**	**2,191**

Table 6. Expenditures for energy efficiency strategies and induced reductions in expenditures for energy; Exp.: Expenditures for energy efficiency strategy; Cost Red.: Reduction of costs.

Table 7 presents the cost parameters of the analysed energy efficiency strategies in relation to each unit of energy. The average cost of energy-efficient technologies varies, depending on the strategy, from 129 to 143 cents per $kWh_{creditable}$ in 2016. This means that on average, from 2008 to 2016 135 cents must be invested for 1 $kWh_{creditable}$ to the savings target in 2016. The installed energy efficiency measures are in effect before, during and after 2016 so that these costs are distributed on the life of the energy efficiency measure in a business perspective (and not with regard to the policy). Especially with long-life measures often high rates of return are noted.

Strategy	*Total credible energy savings in 2016*	*Total expenditure for energy efficiency measures*	*of which public funding*	*Total expenditures per kWh credible*	*of which public funding per kWh credible*
Minimum Standards	10,593 GWh	13,699 Mio. €	876 Mio. €	129.3 Cent	6.4 Cent
IMF mid	19,156 GWh	27,476 Mio. €	13,442 Mio. €	143.4 Cent	48.9 Cent
IMF-US mid	24,349 GWh	32,420 Mio. €	12,708 Mio. €	133.1 Cent	39.2 Cent
IMF high	20,865 GWh	29,229 Mio. €	14,785 Mio. €	140.1 Cent	50.6 Cent
IMF-US high	26,627 GWh	34,756 Mio. €	14,460 Mio. €	130.5 Cent	41.6 Cent

Table 7. Creditable reductions in the target year of 2016, Policy and monetary parameters of the respective strategy, own calculations.

Table 7 shows the expected eligible savings of each strategy in the target year 2016 and the cost parameters of their implementation. The total expenditure per $kWh_{creditable}$ describes the necessary investments to reduce energy consumption compared to the business-as-usual scenario by exactly 1 kWh in 2016. Since this unit of energy is, however, saved not only in 2016 (even if it is credited to the policy goal only in 2016), these measures save energy costs depending on the nature and durability of action for up to 25 years.

It is obvious, that the scenario *Min Stand* is the most cost-effective option regarding the total necessary funding. The total expenditure required for the implementation is almost entirely covered by the consumer and companies - and not the funding bodies. Acceptance and financial viability and social equity, however need to be considered critically. Furthermore, this strategy even though it ambitiously adopts minimum standards can only achieve savings in the target year of the directive of 10,593 GWh. Even with full credit for early actions claimed by Austria and early savings amounting to approximately 9,600 GWh, the savings target of 22,330 GWh is only achievable by an unexpected positive development of end-use efficiency in the period 2008 to 2016 with this strategy.

3.4 Energy savings by energy source

Table 8 shows the expected savings of the analysed strategies separated by energy sources. Of particular interest are the percentage shares of the savings generated by the strategies of the (policy relevant) consumption in 2005. While in the most ambitious strategy, *IMF-US high*, a reduction of energy consumption for all energy sources by more than 10% is expected compared to the business-as-usual scenario, it is not possible to reduce vehicle fuel consumption in sufficient dimensions. As described before, structural measures are essential for the reduction of fuel consumption in the transport sector, so that a real turnaround can be achieved. Especially in the field of freight logistics, but also in the field of public transport, the horizon until 2016 appears to be insufficiently short.

Furthermore, it is obvious that electricity consumption which has an average yearly growth rate of about 1.5% (10-year average in Austria), cannot be reduced below the level of 2008 even in the ambitious *IMF-US high*. For energy sources like coal and coal products, a significant decrease in the absolute consumption at 2008 levels is to be expected.

Strategy	*Electricity*	*Natural Gas*	*Vehicle Fuels*	*Fuel oil*	*Renewables*	*Coal and Coal Products*	*Others*
	in GWh						
Min Stan	3,160	2,385	108	1,820	2,658	246	216
IMF mid	4,100	2,860	2,892	3,512	4,994	434	364
IMF-US mid	6,210	3,769	2,935	4,251	6,189	540	454
IMF high	4,677	3,351	2,957	3,589	5,315	511	463
IMF-US high	6,980	4,424	3,022	4,354	6,618	642	586
	in % of the end-energy consumption 2005 which is relevant for the ESD savings target						
Min Stan	7.0%	6.0%	0.1%	6.8%	6.4%	12.0%	6.2%
IMF mid	9.1%	7.2%	2.9%	13.1%	12.0%	21.2%	10.4%
IMF-US mid	13.7%	9.4%	3.0%	15.8%	14.9%	26.3%	12.9%
IMF high	10.3%	8.4%	3.0%	13.4%	12.8%	24.9%	13.2%
IMF-US high	15.4%	11.1%	3.1%	16.2%	15.9%	31.3%	16.7%

Table 8. expected creditable energy savings in the target year 2016 realized by the energy efficiency strategies.

Our results, especially concerning shifts in the energy source composition of end-energy demand, are solemnly based on the analysis of the impacts of the ESD. Apart from the improvement of energy efficiency, the European Union has set two other major energy policy goals: 1) a reduction in EU greenhouse gas emissions of at least 20% below 1990 levels as well as a 20% share of EU energy consumption to come from renewable resources. With a look at the CO_2- and renewable energy targets, complementary end-energy efficiency improvement policies would support target achievements, especially if the energy efficiency measures – as presented in our approach - are realized cost-effectively. As the interaction of the various European Union energy policies is not the subject of our analysis, we will not go into detail on this matter but point the reader to Philibert (2011).

4. Economic effects of the strategies

In the following, the effects of the energy efficiency strategies on the three variables *gross domestic product*, *employment* and *energy-related public revenue* are presented.

When interpreting the results it must be stressed again that they are to be understood in comparison to the business-as-usual scenario. The reported values thus give the difference to the development of the observed variables in each year, in a situation without the implementation of the analysed energy efficiency strategies.

4.1 MOVE

For the assessment of the economic effects of the energy efficiency measures, the economic model MOVE is used. MOVE is a macroeconomic time series model and was developed for modelling the effects of economic and energetic measures in Austria. MOVE provides forecasts for macro-economic parameters like GDP, budget, inflation, employment, investment, energetic and non-energetic consumption, and increase of transport costs for different economic sectors. MOVE includes an economy module accounting for 12 economic sectors, an energy module, and an ecological module. The energy part is not limited to energy consumption; it also accounts for energy flows to generate secondary energy sources, the production of primary energy as well as energy imports and exports. A further feature of the MOVE model is an emission tool showing the changes in all relevant type of emissions, since energy use implies an impact on the environment in most cases (compare Tichler (2008) for a detailed presentation of MOVE).

4.2 Economic effects of the energy efficiency strategies

The analysis shows that the two key economic variables, *gross domestic product* and *employment* are positively influenced by increased investment in energy-efficient technologies. An investment in this area is effective in the domestic economy in an above-average level, as these measures are often provided by labour-intensive industries. The energy-efficiency strategies analysed here can therefore be understood not only as instruments to achieve the objectives of the ESD, but rather as an integral part of a future-oriented and ecologically sustainable economic policy.

The effects of the analysed strategies on the gross domestic product are shown in Table 9. They are each calculated as the difference to the business-as-usual scenario, that is the development of the gross domestic product without the investments made to improve energy efficiency that were initiated by the strategies under consideration. To interpret these results in each case the assumptions about the financing of the measures are of great importance. With the exception of the strategy *MinStand* - which transmits almost all the investment burden on the consumer - common to all strategies is that both the end user and the state are acting as financing partners. The actual amount of investment on the part of consumers and the state's participation in the form of grants is given in Table 7.

Effects on the gross domestic product (in% of nominal GDP at an assumed 2.5% annual growth)										
	MinStand		*IMF mid*		*IMF-US mid*		*IMF high*		*IMF-US high*	
	in %									
2008	0.29	0.47	0.53	0.77	0.62	0.89	0.74	0.98	0.88	1.17
2009	0.39	0.61	0.72	1.02	0.82	1.16	0.97	1.29	1.15	1.51
2010	0.44	0.67	1.07	1.39	1.03	1.46	1.35	1.69	1.39	1.84
2011	0.47	0.72	1.26	1.6	1.15	1.63	1.55	1.9	1.52	2.02
2012	0.55	0.92	1.38	1.75	1.61	2.2	1.67	2.05	1.99	2.6
2013	0.6	1.04	1.5	1.89	1.82	2.48	1.79	2.19	2.2	2.87
2014	0.64	1.11	1.61	2.02	1.93	2.62	1.91	2.33	2.31	3.02
2015	0.66	1.16	1.73	2.17	2.01	2.74	2.03	2.48	2.4	3.14
2016	0.68	1.19	1.86	2.33	2.1	2.86	2.16	2.65	2.49	3.26
*Effects on the labour market (change in% points to the unemployment rate *)*										
2008	-0.08	-0.15	-0.15	-0.25	-0.18	-0.29	-0.22	-0.32	-0.26	-0.39
2009	-0.11	-0.2	-0.21	-0.32	-0.24	-0.38	-0.29	-0.42	-0.34	-0.49
2010	-0.11	-0.2	-0.26	-0.38	-0.26	-0.41	-0.34	-0.47	-0.37	-0.53
2011	-0.12	-0.2	-0.31	-0.44	-0.28	-0.45	-0.39	-0.53	-0.39	-0.57
2012	-0.13	-0.25	-0.33	-0.47	-0.36	-0.57	-0.41	-0.56	-0.48	-0.7
2013	-0.15	-0.3	-0.36	-0.51	-0.44	-0.68	-0.44	-0.61	-0.56	-0.81
2014	-0.16	-0.31	-0.39	-0.56	-0.45	-0.7	-0.48	-0.65	-0.58	-0.84
2015	-0.17	-0.33	-0.43	-0.61	-0.48	-0.74	-0.51	-0.71	-0.61	-0.89
2016	-0.17	-0.35	-0.47	-0.67	-0.51	-0.79	-0.56	-0.77	-0.64	-0.94
*Effects on energy-related taxes and charges (in% of revenue value 2008 *)*										
2008	-0.07	-0.05	-0.12	-0.08	-0.13	-0.08	-0.11	-0.07	-0.11	-0.07
2009	-0.2	-0.18	-0.34	-0.31	-0.38	-0.34	-0.38	-0.34	-0.43	-0.39
2010	-0.41	-0.39	-0.77	-0.73	-1.01	-0.97	-0.84	-0.8	-1	-0.96
2011	-0.59	-0.57	-1.21	-1.18	-1.62	-1.57	-1.33	-1.29	-1.57	-1.51
2012	-0.82	-0.78	-1.69	-1.65	-2.5	-2.43	-1.84	-1.8	-2.41	-2.34
2013	-1.06	-1.02	-2.22	-2.17	-3.28	-3.21	-2.41	-2.36	-3.13	-3.06
2014	-1.31	-1.26	-2.78	-2.73	-4.12	-4.04	-3.01	-2.96	-3.9	-3.82
2015	-1.57	-1.52	-3.37	-3.32	-4.94	-4.86	-3.64	-3.58	-4.66	-4.58
2016	-1.83	-1.78	-3.99	-3.94	-5.8	-5.72	-4.3	-4.24	-5.45	-5.36

Table 9. Economic effects of the energy efficiency strategies.

The financing of government subsidies can always be done in two ways: 1) by a shift in expenditures and 2) by a corresponding (new) debt. The calculations presented here are based on alternative 2), ie there is no response or adaptation of other public expenditures and revenues.

The financing of measures on the side of end customers (households and businesses) can occur in three ways: 1) by access to capital reserves and savings, and 2) through debt financing, and 3) a reduction of expenditure for other goods / investment. As part of the calculations performed here, two different rates of funding from reserves / savings and loans are presented: one scenario with a 33% ratio, and a scenario with a 100% ratio.

A comprehensive overview of ways of financing energy efficiency measures and overcoming barriers is given in Rezessy & Bertoldi (2010).

With a 33% funding ratio, 67% of the investments needed on behave of the end customers (ie after deduction of subsidies) are funded by a reduction in the expenditures for other goods. At a 100% rate, there is no such shift in expenditures and the investment in energy efficiency is fully mobilized additionally. Table 9 shows that all strategies have a significantly positive impact on gross domestic product, and thus on economic growth.

From the figures it is apparent that the funding of measures on the part of end users through recourse to reserves / savings or by borrowing has a higher positive influence on GDP, than a high proportion of financing through expenditures shifting. It is also obvious that the progressive alignment of strategies with a constant intensification of investment incentives accelerates economic growth annually until 2016. Again it should be noted, that the GDP effects in Table 9 are only fully effective if the subsidies are to 100% financed by (re-) debt. The simultaneous implementation of the strategies described here and political measures for counter financing, such as the greening of the tax system - keyword: CO_2 tax - requires separate consideration.

Table 9 also shows that all strategies have a significantly positive impact on employment. Investments in energy efficiency are effective in labour-intensive industries. Furthermore, by the savings in energy costs, additional funds are released which supports a further shift of consumption and investment from the less labour-intensive energy production and energy import to more labour-intensive market areas.

Overall, the strategies analysed here show that achieving a reduction in the unemployment rate in the order of 0.5 to 1.0%-points below the level of the business-as-usual scenario is possible by 2016. The presented energy efficiency strategies, especially those with intensification of funding, can thus be understood as a contribution to long-term recovery of the labour market.

Furthermore, Table 9 illustrates the effects of the analysed strategies on energy-related public revenues between 2008 and 2016. These effects are again each calculated as the difference to the business-as-usual scenario. The state receives significant public revenues from the taxation of energy sources. The reduction of energy consumption therefore inevitably leads to a reduction of public revenues. The strategies analysed here furthermore aim at substantially reducing fossil fuels consumption that is subject to higher taxation than the consumption of renewable energy sources.

The shortfall in public revenue resulting from this adds up to about 5% of the public revenues from energy-related taxes and fees in the business-as-usual scenario.

5. Conclusions

Achieving the objectives of the European Directive 2006/32/EC on energy efficiency is possible for Austria, but requires an intensification of existing activities. The potential for energy efficiency measures analysed in this report exceed Austria's savings target by almost 50%, but these potentials need to be exploited by 2/3 to reach the target. A potential utilization of 2/3 is only possible by maximizing the efforts and by intensive funding policy instruments.

The analysis shows that funding policy instruments are most effective when combined with the introduction of minimum standards. Such systems, minimum standards for energy efficiency of appliances and energy consumption, both in households, in the business sector and the Public sector, displace inefficient consumption units and fully support the development of new energy-efficient technologies. Special attention should be placed on a European solution for the introduction of minimum standards to broaden the pressure on manufacturers of energy-consuming equipment and systems. Besides the presentation of potential savings and the effectiveness of different intensities of monetary support of energy efficiency measures, this study also examines the economic effects of these measures. The analysed energy-efficiency strategies are not only effective tools for reducing energy consumption and emissions of greenhouse gases, but also as programs to boost the economy and the labour market. This is mainly due to the fact that effective investments in energy efficiency have to be made in labour-intensive sectors. Furthermore, these energy savings also have a positive effect on disposable income, which supports a further shift of consumption and investment in the less labour-intensive energy production and energy imports into more labour-intensive sectors.

From the results of this study, the authors derive the following priority to-do's for Austria's energy policy to achieve the objectives of the directive on energy efficiency and to sustainably reduce energy consumption in Austria.

Rapid decision-making for an energy efficiency strategy: The results presented in this study clearly show that the objectives of the ESD are accomplishable only if the actions are carried out rapidly and progressive. In this sense, a strategy has to be defined as soon as possible so that its entry into force is not further delayed.

To-Do 2: Rapid decision for an energy efficiency strategy. Only with undelayed action, the success of the strategies described can be achieved. Especially the comparably short duration of the ESD needs to be kept in mind.

Precise preparation and definition of individual instruments: In this study we describe possible strategies and the nature of the necessary minimum standards. But a detailed elaboration of the funding instruments and limits for energy-consuming appliances cannot be made in a study like this. Especially when it comes to minimum standards there barely are adequate structures (outside the construction area) to establish such a system in Austria. To achieve the savings targets of the ESD in due time, a rapid implementation of such structures is necessary. Above all, a broad involvement of stakeholders is mandatory.

To-Do 3.a: Creation of an orderly process for the preparation of specific educational tools and limits for energy consuming appliances and their applications with the involvement of stakeholders.

To-Do 3.b: Rapid creation of structures for the on-going establishment and administration of minimum standards for energy consuming appliances and systems. The Japanese Top Runner program can serve as a model, if minimum standards are introduced at European level.

Social compatibility of the measures examined: The introduction of minimum standards forces households to purchase equipment that is probably more expensive than one with lower energy efficiency. On the one hand this may lead to a situation in which inefficient units remain longer in the household; on the other hand, it may also lead to additional financial burdens for economically less well-off households. To avoid jeopardizing the introduction of minimum standards, keeping the measures socially balanced, these aspects must be taken into account in developing the instruments and measures.

To-Do 4: Consideration of social aspects in the design of minimum standards and funding instruments.

Financing of Grants: depending on the energy efficiency strategy chosen, state funding is needed on different levels. In this study, it is not expected that this funding is cost-neutral - that is through redeployment of the budget. As a way to finance the subsidies, the introduction of a tax on greenhouse gases is proposed. In this context it is essential to determine both the economic effects and the achieved additional savings in advance to ascertain that the economically most efficient strategy is chosen.

To-Do 5: Development of instruments to finance the subsidies and accurate analysis of the economic effects of these instruments to optimize their impact and compatibility.

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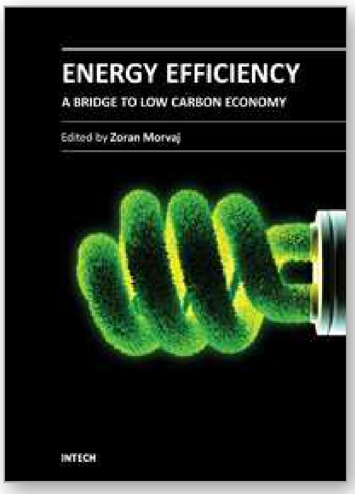

Energy Efficiency - A Bridge to Low Carbon Economy
Edited by Dr. Zoran Morvaj

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Energy efficiency is finally a common sense term. Nowadays almost everyone knows that using energy more efficiently saves money, reduces the emissions of greenhouse gasses and lowers dependence on imported fossil fuels. We are living in a fossil age at the peak of its strength. Competition for securing resources for fuelling economic development is increasing, price of fuels will increase while availability of would gradually decline. Small nations will be first to suffer if caught unprepared in the midst of the struggle for resources among the large players. Here it is where energy efficiency has a potential to lead toward the natural next step - transition away from imported fossil fuels! Someone said that the only thing more harmful then fossil fuel is fossilized thinking. It is our sincere hope that some of chapters in this book will influence you to take a fresh look at the transition to low carbon economy and the role that energy efficiency can play in that process.

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