Toothless tiger? Is the EU action plan on energy efficiency sufficient to reach its target?

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Abstract
Motivated by, inter alia, the increasing energy prices, the security of energy supply and climate change, the new EU "Action Plan for Energy Efficiency: Realising the Potential" (EEAP), sets out the policies and measures required to be implemented over the next six years to achieve the EU's goal of reducing annual primary energy consumption by about 20 % by 2020. By increasing energy efficiency, the security of energy supply and the reduction of carbon emissions are also improved.

The paper will analyse the 20 % target of the new EEAP for the energy demand side by comparison with different recent energy scenarios for the EU. It will therefore review the recommended policies and measures and examine, in which energy demand sectors energy efficiency may be increased and to which extend. The main focus is whether the recommended policies and actions will be sufficient and which additional measures may be useful, if additional measures are needed.

Introduction
On 10th of January 2007, the EU Commission proposed the principles of a new EU energy strategy "An Energy policy for Europe" and announced three major targets:

- The EU should reduce its greenhouse gas emissions by 20 % by 2020 (30 % by 2030, 60-80 % by 2050, if a broad international commitment exists),
- Energy efficiency should be improved by 20 % by 2020 (as already lined out in the EEAP) and
- The share of renewable energies should be raised to 20 % by 2020 (10 % in transport fuels) (Memo 2007).

In this report the commission highlighted the importance of energy efficiency being one of the seven packages to achieve a new and target oriented energy policy (Piebalgs 2007).

Improving energy efficiency has a lot of benefits: an increased competitiveness of the EU economy, advantages for the security of energy supply, emission reductions and therefore a chance to fulfil the Kyoto targets (COM 2006). To increase energy efficiency by 20 % till 2020, as targeted by the Action Plan, 3.3 % annual reductions in energy intensity are needed. 1.8 % efficiency increase is assumed for the baseline scenario, so an additional 1.5 % has to be achieved by additional policies like the EEAP (Boonekamp 2006). To realise this additional increase of energy efficiency, significant investments are necessary. Therefore the Action Plan puts cost effective measures forward. These investments in energy efficiency are safer financial prospects for the future than many investments on the supply side of the energy chain (COM 2006b). The EEAP brings forward actions to be realised or initiated in the period 2007-2012. Further actions will be necessary to realise the full 20 % by 2020 (COM 2006b).

The EEAP covers all end-use sectors (residential, tertiary, public, industry and transport) as well as the energy transformation area. It promotes a wide range of technologies in all end-using sectors. The ten priority actions are:

Table 1: Estimation of total energy saving potential in end-use sectors

Sector	Energy demand (Mtoe) 2005	Energy demand (Mtoe) 2020 (BAU)	Energy saving potential 2020 (Mtoe)	Total energy saving potential 2020 (%)
Residential	280	338	91	27
Tertiary	157	211	63	30
Transport	332	405	105	26
Manufacturing industry	297	382	95	25

Source: COM 2006

1. Appliance and equipment labelling and minimum performance requirements
2. Building performance requirements and "passive houses"
3. Making power generation and distribution more efficient
4. Achieving fuel efficiency of cars
5. Facilitating appropriate financing of energy efficiency investments for enterprises
6. Spurring energy efficiency in the new Member States
7. A coherent use of taxation
8. Raising energy efficiency awareness
9. Energy efficiency in built up areas
10. Foster energy efficiency worldwide

In the annex of the EEAP about 75 proposed measures are listed. These measures are presented with additional background and details and analysed in a Commission Staff Working document. A Report on the Impact Assessment and an Executive Summary of this Impact Report also accompany the Action Plan (SEC (2006) 1173).

In this paper we will analyse the 20 % target of the EEAP by comparison with different recent energy scenarios for the EU. We will therefore review basically the three priority actions (1, 2 and 4) in detail that are directly targeting the energy end use sectors and examine, in which energy demand sectors energy efficiency may be increased by the planned measures and to which extend. Apart from priority action – 3 which is targeting at the supply side – all 6 other actions are important but supportive fields in order to accelerate and support energy efficiency in the demand sectors.

Analysis of the EEAP's priority actions

PRIORITY ACTION 1: IMPLEMENTING THE ECO DESIGN DIRECTIVE

Priority action 1 of the action plan comprises the use of the eco design directive in order to implement minimum energy efficiency standards for a large number of electric appliances in the residential and commercial and partly the industrial sector, and also a couple of non electric appliances such as heating systems and water heaters.

This is an important priority action given the fact that electricity efficiency firstly accounts for a significant share of about 14 % (580 TWh or 55 Mtoe in 2020) of final energy savings vs. BAU (Lechtenböhmer et al. 2005) and secondly is also relevant for reducing energy losses in power plants. The impact analysis of the action plan multiplies electricity savings with a factor of 2.5 in order to reflect this fact and the resulting high relevance of energy efficiency in electricity end use (EC 2006, 16).

According to a scenario analysis developed on behalf of WWF European Policy Office (Lechtenböhmer et al. 2005) final electricity demand can be reduced by about 17 % vs. BAU (see figure 1). The largest share of savings can be achieved in the residential sector with about 28 % (by 2020) reduction of electricity consumption vs. BAU. Here potential savings are split between appliances (typical white goods will account for about a third of the expected savings), lighting and electronic equipment for another third, and heating, cooking and sanitary hot water generation for the last third of the potential.

The action plan gives a long list of the most important appliances used in the residential and commercial sector as well as some cross cutting technologies used in industry as well, which are currently studied in order to implement minimum energy efficiency standards under the eco design directive. For all of these, minimum energy efficiency standards are planned to become effective by about 2009. The product groups being studied are:

- boilers and combi-boilers (gas/oil/electric)
- water heaters (gas/oil/electric)
- personal computers (desktops & laptops) and computer monitors
- imaging equipment: copiers, faxes, printers, scanners, multifunctional
- devices
- consumer electronics; televisions
- standby and off-mode losses of energy-using products
- battery chargers and external power supplies
- office lighting
- (public) street lighting
- residential room conditioning appliances (air condition and ventilation)
- electric motors (1-150 kW)
- commercial refrigerators and freezers, including chillers, display cabinets
- vending machines
- domestic refrigerators and freezers
- domestic dishwashers and washing machines.

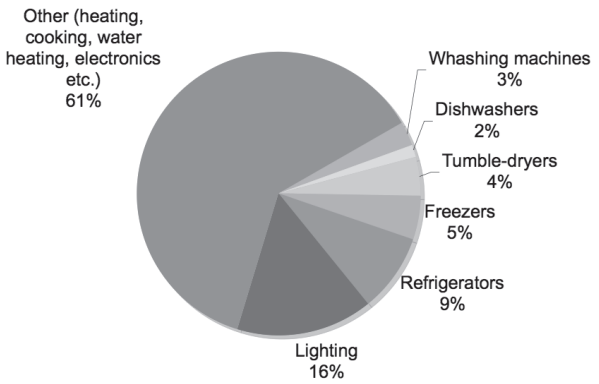

Figure 1: Electricity savings in the residential and commercial sector by appliance vs. BAU by 2020

- Further studies[1] are to be started in 2007.
- However, minimum standards for important electricity uses such as industrial lighting, commercial air conditioning and electric heating systems are not under preparation but only listed as planned activities.

Electric Appliances

If the planned minimum standards will be implemented as foreseen in the action plan they will be effective from 2009 on. This means that by 2020 12 model years or (almost) the total stock of residential and commercial electric appliances will have been covered by the action. Figure 2 shows two examples, which are representative for typical appliances. They show how the minimum standards could become effective for wet and for cold appliances. Wet appliances, which are expected in the scenario to deliver 175 TWh/a savings vs. BAU in 2020, already have a large market share of highly efficient appliances, and further increases partly need the development and market introduction of new technology e.g. ultrasonic washing machines (cp. EC 2006, 26). The figure shows that for washing machines a minimum standard set at class A together with a market shift to a currently not officially available standard of A+ would be necessary to increase energy efficiency of washing machines by 17 % vs. the current status (no further improvement in BAU assumed). For residential cold appliances, i.e. fridges and freezers, the potential vs. the current status – which will improve even under BAU conditions – would be about 40 % (30 % improvement vs. BAU is assumed in the scenario). This would mean as well setting a minimum standard at class A and further supporting the development and market introduction of new and even more efficient technology.

With regards to electricity savings, priority action 1 has the potential to secure a rough third of the savings potentials of the typical appliances (including a significant share of consumer electronics and office equipment) in the residential and the commercial sector – if the standards set will be really ambitious (typically cutting that part of the market below efficiency

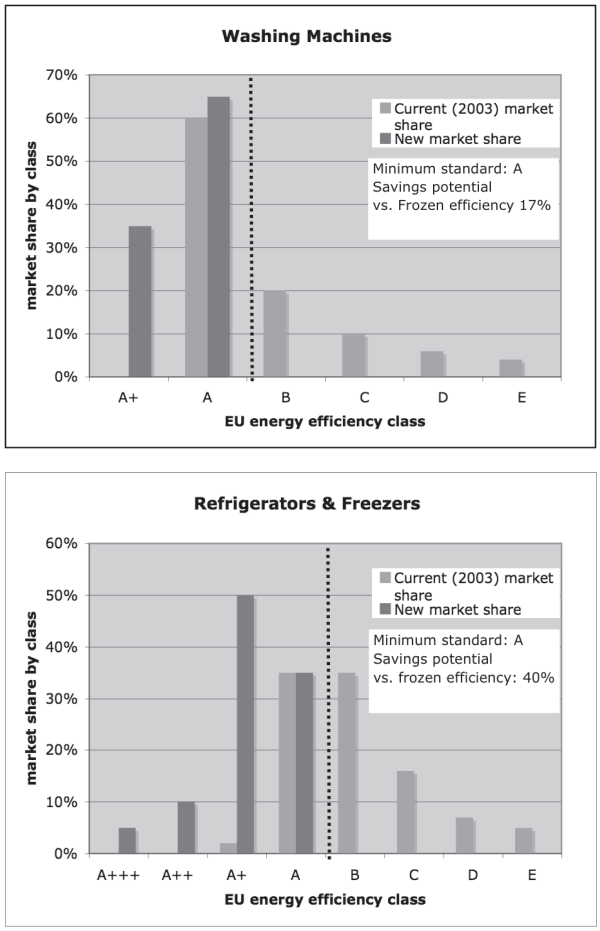

Figure 2: Electricity savings potential by minimum standards of washing machines and cold appliances. Source: Own calculations.

class A) and if other measures supporting development and market introduction of new higher efficiency appliances are very actively pursued as well, e.g., in the framework of the Directive on energy end-use efficiency and energy services. Electricity savings in heat generation and lighting, as well as air conditioning however are not fully covered by the measures of priority action 1. Here other measures are necessary as well. The buildings directive is needed to reduce heating demand and should be extended to support fuel switching from electricity to other sources in space heating and sanitary hot water generation, as these are not covered by priority action 1 (see below).

It can thus be resumed that the priority action 1 will be an important action to save electricity. It has to be implemented as planned, together with high – and as best dynamic standards and combined with the new dynamic labelling scheme and other measures. However, it will not harvest all potentials. Particularly substitution of electric heating, lighting and air conditioning are not fully covered yet. Here it is still necessary to further improve action to include electricity savings into e.g. the buildings directive and to speed up the process of introducing minimum standards for domestic (and industrial) lighting, commercial air conditioning and electric heating systems.

1. On solid fuel small combustion installations, laundry dryers, vacuum cleaners, complex set top boxes and domestic lighting.

Table 2: Additional heating energy saving potential in residential and commercial buildings

Mtoe		Action Plan (EEAP)	Lechten-böhmer et al.	Ecofys	Impact Assessment	
		by 2020	by 2020	2002-2015	total potential (2009-2020)	realistic potential (2009-2020)
Residential	**Insulation**		41			
	Heating		32	154		
	Total	91	73	154		
Tertiary	**Insulation**					
	Heating			63		
	Total	63	45	63		
Res.&Tert.	**Insulation**					
	Heating					
	Total	**154**	**118**	**217**	**125**	**80**

Sources: Action Plan (2006), Lechtenböhmer et al. (2005), Ecofys (2005), COM (2006b)

Boilers

Boilers, which are the central part of typical heating systems, are listed in the EEAP as a product to be regulated under the eco-design directive. The adoption of minimum standards is planned for the end of 2008. This means that the directive will cover a good deal – but definitely not all boilers by 2020. Boilers have a typical lifetime of 12 to 15 years, comparable to other appliances. However, in reality a large share of older equipment is still operational (16 % of all oil fired boilers and 9 % of all gas fired boilers in Germany are older than 22 years (Schornsteinfegerstatistik 2005)) which indicates that de facto higher standing times are being achieved – and limits the potential of minimum standards targeted at new/refurbished equipment. In Lechtenböhmer et al. (2005) about 10 % of energy savings are expected as result of an average increase of heating system efficiency from 76 % as expected under BAU conditions to about 86 %. Iles et al. (2003, p326) assume that in order to achieve this scenario from 2005 on all heating systems sold will have an average efficiency of 10 % higher than BAU, which would be equivalent to a market share 50 % of condensing boilers achieved by minimum standards combined with labelling and other information instruments. Temporary subsidies could also be instrumental in achieving a market breakthrough for condensing boilers.

This scenario will be delayed by at least 4 years due to the current timing of the EEAP. Thus in order to still be able to achieve the assumed savings, it would be necessary to make the condensing boiler mandatory at least for the bulk of all heating systems in the moderate and colder climates from 2009 and further support technologies that use combined heat and power generation. With these measures the 10 % savings by 2020 of residential heating demand (plus savings in sanitary hot water generation) could still be achieved. Additional requirements for the integration of solar collectors into the heating systems – where appropriate – could further improve the environmental performance in this important segment. However, such a scenario sets high expectations into the standard to be set by the eco design directive; particularly with regards to oil fired heating systems, for which the condensing boiler is still at the early stage of market introduction (and the energy savings potential of the technology is smaller than with natural gas). Additional instruments such as labelling, information campaigns, financial incentives and measures to accelerate technological development are necessary.

An important existing policy strengthening the effects of minimum energy efficiency standards and energy labelling is the EU Directive on energy end-use efficiency and energy services (2006/32/EC). It is a framework for all kinds of energy efficiency programmes and energy services, providing packages of information, training, and financing or financial incentives. It will therefore help to increase the market share of the most energy-efficient appliances by, e.g., rebates for purchasing them, promoting awareness of labels and of economic and other benefits of energy-efficient appliances, etc. It will thereby help to make the energy efficiency levels of minimum energy efficiency standards and energy labelling more dynamic.

Furthermore, the energy efficiency programmes and services implemented under the Directive on energy end-use efficiency and energy services will be most important for stimulating energy efficiency improvement in existing buildings, including the heating, ventilation, air conditioning, and lighting systems installed therein.

PRIORITY ACTION 2: BUILDING PERFORMANCE REQUIREMENTS AND "PASSIVE HOUSES"

Priority Action 2 discusses the energy saving potential in the building sector. About 40 % of the European energy consumption is used for buildings; too much of it is wasted because of inefficient heating and cooling systems and lighting (Memo 2006). As the number of households and the living space per inhabitant is still growing in the EU (with a catch up demand for the new member states), the energy consumption of buildings is also growing in the residential sector.

In the building sector a saving potential of 28% is estimated (COM 2006). Actions in this sector cover households as well as the tertiary sector. Most studies calculate the energy saving potential of these two sectors separately. In table 2 the assumed/calculated saving potentials of different studies and the EEAP are compared. Whilst the Impact Assessment Report for the EEAP and Ecofys (Ecofys 2005) only calculate the potential of an expansion of the "Energy Performance of Buildings Directive" to smaller buildings, the WWF Study done by the Lechtenböhmer et al (2005) calculates the saving potential of optimised heating systems as well as the impact of better insu-

Table 3: Expert forecasts for new building insulation standards

Standard		U-Value		cm of insulation	
		before 1975	2006	before 1975	2006
Cold climatic zone	**Roof**	0,50	0,13	7	27
	Facade	0,50	0,17	7	21
	Floor	0,50	0,17	7	21
	Windows	3,00	1,33	–	–
Moderate climatic zone	**Roof**	1,50	0,23	2	15
	Facade	1,50	0,38	2	9
	Floor	1,20	0,41	3	9
	Windows	3,50	1,68	–	–
Warm climatic zone	**Roof**	3,40	0,43	1	8
	Facade	2,60	0,48	1	7
	Floor	3,40	0,48	1	7
	Windows	4,20	2,71	–	–

Sources: Ecofys 2005 and own calculations based on Ecofys 2005 and 2004

lation. The increasing efficiency of heating systems is not part of priority action 2, but part of priority action 1 and therefore was discussed in the previous chapter.

Before the impacts of an expanded "Energy Performance of Buildings Directive" are discussed, some general remarks on this directive are appropriate. The Directive includes requirements for:

- Methods for energy efficiency calculation of buildings,
- Minimum standards for the energy efficiency of new buildings,
- Minimum standards for the energy efficiency of existing large buildings (renovated),
- Energy Certification of buildings and
- Regular inspections of heating and cooling systems (2002/91/EU).

(to be concretised and implemented by the Member States). The transposition deadline for this directive was January 2006, but most Member States have experienced delays and have requested extra time - up to three years in a few cases. The state of implementation will be reviewed in 2007. During 2007 and 2008, a study will be carried out to analyse the costs and benefits of setting EU minimum performance standards for different types of new and renovated buildings for different EU climate zones. Here integrated performance requirements as well as building component requirements will be considered. In the same time frame an impact assessment of the extended use of passive heating and cooling, as well as renewable energies to complement or replace conventional heating and cooling will be carried out. By end of 2008, the Commission will develop a strategy for very low energy and passive houses. Based on this, minimum energy performance requirements (kWh/m^2) for new and renovated buildings should be proposed in 2009. Also in 2009, proposals of measures for financing investments will be presented and the Commission will propose a significant lowering of the limit value for minimum performance requirements for major renovations. In the same year an expansion of the role of the public sector to demonstrate new technologies and methods should be recommended. The Commission will make a proposal to strengthen and accelerate the energy efficiency criteria in the Construction Products Directive in 2008 by (SEC (2006) 1173).

According to the MURE database, the existing "Energy Performance of Buildings Directive" would have had a technical energy saving potential of 83 Mtoe in 2010 if started in 2002 and fully implemented in its original form. The "Impact Assessment" assumes that 125 Mtoe may be saved until 2020, if the Directive is started in 2009. If smaller buildings are included, a saving of 250 Mtoe is possible (COM 2006 b). But only 90 % of the existing stock is considered by the extended Directive. Additionally private renovations avoid the >25 % rule of the directive as they are done part by part. Therefore a realistic additional saving potential of only 80 Mtoe is estimated in this report (COM 2006 b).

As the Directive leaves the definition of the new standards to the Member States, Ecofys used the following "expert forecasts" of insulation standards to calculate the energy saving potential, as can be seen in the table below. Three different climatic zones with different insulation standards were calculated. The overall savings potential results, if all existing and new buildings are renovated or built with the latest standard of 2006 (including all smaller buildings). As can be seen in the table below, depending on the climatic zone and the age of the buildings, the current standard of insulation differs significantly. To reach the same standard as a new building, a house build before 1975 in a warm climate needs additional 7 cm of insulation for the roof, 6 cm for the outer walls and 6 cm for the floor, for example. If all buildings were renovated at once an additional investment of 1750 billion Euros would be needed, which would mean an additional 44 % of annual expenses. This would not be cost effective. Therefore a second possibility with a stepwise renovation was calculated. Beginning 2006 an annual investment of 25 billion Euros is needed, additional to BAU, if all buildings should be renovated until 2015. In this calculation the energy cost-savings are higher than the investments, so a stepwise renovation can be done in a cost effective way - the yearly benefits

Table 4: Standards of the "Energieeinsparverordnung"

U-Values of the building types	U-Values (W/m²K)	EnEV standard for renovated buildings (depending on the building type)		Ecofys assumptions: build after 2006
		most buildings	some buildings	
moderate	Roof	0,30	0,25	0,23
climatic	Facade	0,35	0,45	0,38
zone	Floor	0,40	0,50	0,41
	Windows	1,70		1,68

Source: Ecofys 2005 and EnEV 2006

rise above the yearly expenses before the end of the lifetime of the first renovations (Ecofys 2005). The Ecofys study also clarifies, that the emission reductions of single family buildings have a significant impact on the total energy saving potential, as their external surfaces - relative to their living space - are larger than those of compact large dwellings. Therefore they have a higher specific energy consumption for heating.

For a WWF study, Lechtenböhmer et al. (2005) differentiated two energy saving strategies: first, a strengthened effort concerning the insulation of building components such as roofs, windows and the entire building envelope, going beyond the current provisions of the EU Directive on energy performance of buildings by including all new buildings and those of the existing stock that are undergoing considerable reconstructions. This will achieve a reduction of 15 % in energy demand. Here the relative energy saving potential for the new member states is estimated to be even bigger due to an older average building stock and – on average – poorer performance of insulation. Second, an increase of the energy efficiency of the heating system by 10 %, which leads to a reduction in energy demand of more than 11 % by 2020 in the EU 15 (cf. Iles 2003, BRE et al 2002). Here, too, the new member states have an even higher saving potential (WI 2005). Lechtenböhmer et al (2005) assumed that roughly 80 % of the potential might be realised. In the tertiary and service sector, which has the second largest growth rate in energy demand, the energy saving potential in space heating is about 32 %, in air conditioning about 17 %. Both is possible by using low-energy buildings/offices (with thick insulation), the retrofitting of existing buildings to the low-energy standard, using natural and/or highly efficient heating and cooling systems (incl. solar) (WI 2005).

The EEAP assumes a potential of 154 Mtoe/a, not explicitly dividing this potential in heating, insulation and electricity saving potential. To utilise the potential of the building sector, the Action Plan recommends to extend the coverage of the directive concerning the efficiency of buildings by also including smaller buildings. This proposal should be made and agreed in 2009.

Currently, roughly about 1,5 % of the existing buildings are renovated each year. If this share is expanded to 3 %[2] by additional policies, in the time frame from 2009 and 2020 about 36 % of all buildings could be renovated. As about 10 % of the buildings existing in 2010 will have been built after 2002 (Ecofys 2005), it is assumed that these buildings are not renovated with 2006 standards. Therefore 40% of the buildings build before 2002 are assumed to be renovated until 2020, so only 40 % of the total saving potential, which may be reached by a better insulation, may be realised by this time. This means 47 Mtoe may be saved by insulating older buildings, calculated with the total saving potential of the Ecofys study (Ecofys 2005). As the assumed lifetime of the outer surface of buildings and insulation is about 30 to 40 years, only buildings build or renovated before 1990 would be renovated if no special encouragement is made by the policies or by increasing energy prices.

In the northern and moderate climate zones of Europe, quite high insulation standards already exist. For example the standards of the German "Energieeinsparverordnung EnEV" (Energy Saving Directive) for renovated buildings are already almost as high as the standards assumed by Ecofys for a moderate climate[3].

As this regulation already was implemented in 2002, its impacts should be included in the BAU scenario calculations and no additional saving potential for the EEAP exists in this region by better insulation. Possibly the eastern and southern European countries are able to absorb this loss of saving potential. The rest of the aspired 20 to 28 % energy saving for the building sector have to be reached with other measures, such as tightening insulations standards further towards low energy or passive house standards, focussing on high insulation levels in refurbishment of existing buildings, increasing the rate of refurbishment to, e.g., 3 % per year, and increased energy efficiency of heating systems and electrical equipment or similar actions. These latter kinds of actions are also covered by the EEAP, mostly by Priority Action 1.

As said above, the energy efficiency programmes and services implemented under the Directive on energy end-use efficiency and energy services will be most important for stimulating energy efficiency improvement in existing buildings, including the heating, ventilation, air conditioning, and lighting systems installed therein.

PRIORITY ACTION 4: TRANSPORT SECTOR

The EEAP indicates an energy saving potential in the transport sector of 105 Mtoe or 26 % in 2020 compared to a business as usual (BAU) development resulting in a final energy demand of 405 Mtoe. The share of the transport sector in the overall energy saving potential in the end-use sectors amounts to 27 % (compared to 390 Mtoe overall saving potential). In contrast to this potential the newest energy and transport scenario published by the Directorate-General for Energy and Transport

2. To use the whole saving potential about 7,5 % of all buildings have to be renovated each year, which is five times as much as today.

3. For new buildings a primary energy approach is used, which includes the heating system, but in most cases the insulation of new buildings has to be as good as for renovated buildings or even better.

Table 5: Energy Saving Potential in the Transport Sector

Transport Mode	Energy Saving (ktoe)		Share of total saving %	
	Transport Activity (vs. BAU)	Fuel efficiency	Transport activity	Fuel efficiency
Public Road Transport	-1'380	6	-1.3%	0.0%
Passenger Cars	4'532	49'541	4.2%	45.7%
Road Freight Transport	19'182	16'851	17.7%	15.5%
Aviation	10'480	7'786	9.7%	7.2%
Inland Navigation	-1'004	0	-0.9%	0.0%
Train transport	-1'715	-3	-1.6%	0.0%
Total Energy Savings	30'095	74'182	27.8%	68.4%
Activity + Efficiency		108'378		100.0%
Energy Demand Increase		-4'102		
Net Energy Savings		104'276		

Source: Own calculations based on Lechtenböhmer et al. 2005

(DG TREN) of the European Commission highlights a final energy demand of 367.8 Mtoe in the high efficiency case. The scenario of the DG TREN will realise only about one third of the energy saving potential in the transport sector compared to the action plan on energy efficiency. This clearly indicates the need for more ambitious policies and measures to increase the energy efficiency in the European transport sector.

Scenario analysis carried out by the WI (Lechtenböhmer et al. 2005) presents policies and measures for the transport sector to reach a reduction of 105 Mtoe in the year 2020 compared to the business as usual development.[4] In this scenario analysis, the energy saving potential of various policies and measures in different transport modes is quantified (cf. table 5[5]).

The highest energy saving potential is identified in improving the fuel efficiency of passenger cars with a share of 45.7 % of total energy saving (equivalent to 49.5 Mtoe). This saving potential is achieved with an average specific CO_2 Emission of 107 g CO_2/ vkm of the whole passenger car fleet in 2020. Only with very ambitious and enhanced emissions targets for the fleet of new cars from 2012 on, this fuel efficiency improvement can be realised. A variety of technological options exists or can be developed within the coming years to decrease the fuel consumption of vehicles and to meet the specific emission targets. In the EEAP, a target of 120 g CO_2 / vkm is set for 2012, which will not be sufficient to reach the energy saving potential of the scenario analysis for passenger cars done by Lechtenböhmer et al (2005). The EEAP considers further actions to improve the fuel efficiency of cars like ensuring to use the correct tyre pressure, improving the rolling resistance of tyres, implementing minimum efficiency requirements for air-conditioning systems for vehicles. Furthermore driver education for fuel efficient driving and the amended Car Fuel Efficiency Labelling Directive (1999/94/EC) are considered. In the transport scenario calculated by Lechtenböhmer et al (2005), policies and measures aiming at the tyre pressure, air-conditioning systems and labelling of vehicles are not explicitly considered. In addition to the mentioned measures the European Commission intends to implement car taxation depending on the CO_2 emissions of passenger cars (COM 2005), which could partly lower transport demand and stimulate the demand for fuel efficient passenger cars. All in all, only when all measures on fuel efficiency and transport demand will be realised in a target-oriented way within the next five years, the ambitious targets for fuel saving of passenger cars can be achieved. Considering total and specific CO_2 Emissions of vehicles, biofuels can make a major contribution to emission reductions (almost 30 % of total CO_2 emissions reductions) and should not be counted misleadingly as measures to improve the fuel efficiency of vehicles (Lechtenböhmer et al 2005).

The improvement of fuel efficiency in the freight transport sector accounts for 15.5 % of the total saving potential. Trucks will face slower energy efficiency improvements by technological development than passenger cars, but starting on a higher level of fuel efficiency. Nevertheless measures like driver training, efficient air-conditioning and ensuring the correct tyre pressure will make still an important contribution to overall energy efficiency. Furthermore a variety of technological options can be implemented to decrease the fuel consumption of trucks (Bates et al 2001). Actions directly targeting heavy duty vehicles are not explicitly mentioned in the EEAP. Only a footnote in the Analysis of the Action Plan indicates actions planned by the European Commission aiming at heavy duty vehicles (SEC 2006). However, concrete measures and timetables for improving energy efficiency are not given. In contrast to heavy-duty vehicles, it is announced to include light-commercial vehicles into the future strategy concerning vehicle fleet emission targets (SEC 2006). The optimisation of logistics and traffic management systems can result in decreasing fuel consumption for heavy-duty and light-commercial vehicles, too. Both measures are not explicitly mentioned in the context

4. In this scenario analysis the BAU scenario of Mantzos (2003) with a final energy demand of 428 Mtoe in 2020 was used as a baseline development, resulting in a 24.3 % energy saving potential. The EEAP indicates a final energy demand of 405 Mtoe in 2020 related to the recent BAU scenario from Mantzos (2005). We assume that almost the same energy saving potential can be realised even with a slightly lower BAU final energy consumption of 405 Mtoe in 2020.

5. Energy Demand Increase: In public road transport, train transport and inland navigation the transport activity and therefore the energy demand increases caused by modal shift. The transport demand of the other transport modes decreases resulting in energy savings as a net effect.

Table 6: Modal Shift in the Transport Sector

Transport Mode	BAU 2020	WI P&M 2020	Delta WI P&M – BAU	
Passenger Transport (Gpkm)	**8251**	**8029**	**-222**	**-2.7%**
Road Transport	6321	6210	-112	-1.8%
Public road transport	533	639	106	19.9%
Private cars and motorcycles	5788	5571	-218	-3.8%
Train transport	479	618	139	29.0%
Aviation	1403	1154	-249	-17.8%
Inland navigation	47	47	0	0.0%
Freight Transport (Gtkm)	**3340**	**3168**	**-172**	**-5.2%**
Road freight transport	2517	2216	-301	-11.9%
Train	420	485	65	15.4%
Inland navigation	403	467	64	15.8%

Source: own calculations based on Lechtenböhmer et al (2005) and Mantzos (2003)

of road freight transport in the EEAP, so that energy savings related to road freight transport activity could not be realised in the same way as indicated in the scenario calculated by Lechtenböhmer et al (2005).

In the aviation sector, fuel efficiency is a relevant topic due to its environmental impact and the economic aspects for airlines. Several sources assume significant energy saving potentials for air planes in the next decades (Lee (2003). Zimmermann (2006)). The EEAP mentions the introduction of fuel taxation, improving air traffic management and logistics and the inclusion of aviation in the emission trading scheme. The transport activity decrease (- 1.4 % pa against BAU) and fuel efficiency increase (+ 1 % pa against BAU) suggested in the scenario of Lechtenböhmer et al (2005) can be achieved, if all measures are implemented successfully until 2012. The consideration of market-based instruments in the aviation and navigation sector is announced without pointing out concrete measures, so that these effects cannot be discussed.

The EEAP recognises that modal shift and co-modality are key elements to achieve the energy saving targets. In line with these statements, the scenario of Lechtenböhmer et al (2005) shows the effects of modal shifts caused by measures influencing the transport demand of the different transport modes (cf. table 6).

In comparison to the BAU scenario, the total passenger transport activity decreases by 2.7 % in 2020, enabling a slight overall transport demand reduction. In the policies and measures scenario public road transport (+ 20 %) and passenger train transport (+ 29 %) are remarkably higher, whereas aviation (- 18 %) and private cars and motorcycles (- 4 %) decrease compared to the BAU scenario. In the freight transport sector the transport activity of trucks decreases by 12 % and of train transport and inland navigation increases by around 15.5 %. Altogether the reduction of transport activity and the highlighted modal-shift result in a final energy demand reduction of about 30 Mtoe contributing to 28.5 % to the energy saving potential in the transport sector. In the end the scenario analysis shows the importance of fostering explicitly modal-shift in passenger and freight transport in Europe.

All in all, the importance of fuel efficiency and energy saving in the European transport sector is evident. The EEAP considers a variety of measures which have to be implemented consequently and without delay to reach the ambitious targets mentioned. The most important objective is to implement and improve binding specific emission targets not only for passenger cars but also for light-commercial vehicles, heavy-duty vehicles and aeroplanes. The chances seem currently increasing that such binding targets can be achieved. This objective should be supported by all mentioned measures focusing on technological developments (e.g. tyre pressure monitoring, minimum efficiency standards for air-conditionings, traffic management systems) and on consumer behaviour (e.g. labelling, driver training). Besides this the support of modal shift and co-modality is of highest importance. To shift transport demand to transport modes with best fuel efficiencies like public road transport or train transport with a variety of measures (e.g. fuel efficiency or emission related taxes, emission trading scheme) can contribute to total energy saving up to 30 %.

Again, energy efficiency programmes and services implemented under the Directive on energy end-use efficiency and energy services will play an important role in realising such supportive measures. They might promote, e.g., the car CO_2 label; the purchase of energy-efficient vehicles, tyres, and lubricants; eco-driving; car-sharing; and modal shifts.

Overall conclusion

The EU "Action Plan for Energy Efficiency: Realising the Potential" (EEAP) sets the target of reducing energy demand by 20 % by 2020 vs. BAU. This is one of the most important cornerstones of the current energy strategy of the EU. Together with the planned 20% share of renewable energy sources by 2020, energy efficiency contributes significantly to reducing both the risks of energy security, and the GHG emissions of the EU by 20 to 30 % vs. 1990 by 2020.

Our analysis of the direct energy demand side oriented priority actions 1, 2 and 4 of the EEAP tries to answer the question if the policies and measures stipulated in the action plan will be sufficient to reach the ambitious but clearly important and necessary target of reducing energy demand by 20 % by 2020 vs. BAU[6].

6. We leave out the supply side (priority 3) and the supportive actions 5 to 10. The latter are indispensable for a successful implementation of the action plan. But they are currently not linked directly to efficiency targets in a certain sector or field. So it is assumed that they are meant to support the actions mentioned in priority actions 1 to 4.

As scenario analyses by Lechtenböhmer et al. (2005a, b) show, the 20 % energy demand reduction vs. BAU will be mainly achieved in the transport sector, the residential and the commercial sector and to a lower extent in industry. As industry is – at least partly – covered by the European Emission Trading Scheme[7] no particular emphasis is laid on this sector by the EEAP. Priority action 1 is targeted at energy using products and appliances such as boilers, circulation pumps, washing machines, refrigerators, office equipment etc., which can be found in the residential and commercial sector as well as in industry. Priority action 2 is targeted at energy standards of residential and commercial buildings and priority action 4 at the transport sector. Other priority actions are targeted at the energy supply side and at specific policies and measures, including international cooperation.

The analysis of those three priority actions shows that the commission has undoubtedly tied up a strong package of measures. However in all three fields, electricity consumption, space heating, and transport, gaps are remaining and timely and powerful implementation of the proposed actions is crucial. With regards to electricity consumption, the planned energy savings can only be achieved if the minimum standards under preparation and planned are set at a very tough and dynamic level, banning practically all equipment worse than 'A'. The standards have to be supported by labelling and information as well as co-operative and public procurement and other measures, including temporary subsidies where appropriate, to further improve the standards available in the market. Electric heating and air-conditioning as well as substitution of electric heating and warm water generation are further important fields for energy efficiency and need additional action, e.g. under the framework of the buildings directive.

With regards to space heating, three central fields of action can be identified: Minimum standards for boilers under the eco-design directive (priority action 1), improved and extended performance standards under the buildings directive (priority action 2) and – clearly under-represented in the EEAP – the acceleration of energetic modernisation of existing buildings[8]. The boilers are among the appliances for which minimum standards are currently prepared. The condensing boiler needs to be made mandatory for almost all new appliances in order to still contribute significantly to the planned efficiency targets. Supporting actions would be mainly market introduction support of condensing boilers for oil, support for renewable heating systems and co generation. The buildings directive should be strengthened and expanded as soon as possible and implementation should be speeded up and enforced. Additional emphasis is necessary to better include air-conditioning and lighting into the directive. However, the decisive factor for achieving energy savings in buildings is to achieve the much higher but still cost-effective energy efficiency levels feasible in ongoing building refurbishments, and to accelerate energetic modernisation from current levels of annual refurbishments between 1 and 2 percent to at least 3 or more percent per year. To meet this need the EEAP has yet to be improved and the commission and the member states need to create policy packages including significant financial incentives, information and, if possible, also legal obligations. Such policy packages are perfect energy efficiency improvement measures for achieving the indicative 9 % annual energy savings target by 2016 in the context of the Directive on energy end-use efficiency and energy services.

In the transport sector the efficiency targets could be achieved with a mix of energy efficiency improvements in all transport modes, particularly in cars and in light and heavy duty trucks, and of a set of demand mitigating measures. However, the target of 120 g of CO_2 emissions per vehicle km set in the EEAP is extremely important but probably not sufficient to achieve the efficiency target. Particularly biofuel use should not be factored into this target. Action on heavy duty vehicles has to be added and the measures targeting at reducing the transport demand and shifting the modal split to more efficient modes have to be strong and timely. The inclusion of air transport into the ETS would be an important means to achieve the necessary energy demand reductions in this sector.

Over all demand sectors, the Directive on energy end-use efficiency and energy services is estimated to achieve about half of the 20 % additional energy savings targeted by the EEAP by 2020. If Member States achieve the indicative target of 1 % per year, and if the Directive will be prolonged on equal terms at least until 2020, the savings would be 13 % of the consumption in the base period. However, the Directive does not cover all energy use, the most notable exception being the sectors subject to the EU emissions trading scheme (Boonekamp 2006).

In total we can conclude that many important measures have been proposed in the EEAP but, firstly they now have to be implemented in a timely manner and in a tough way in order to achieve their full effect. Furthermore there are still important gaps in the bundle that have to be closed, e.g. the issue of achieving the full cost-effective potential in each renovation, and increasing the speed of renovation of residential and commercial buildings. In conclusion, this means that the measures stipulated by the EEAP are not yet sufficient to fully harness the savings potential as intended by the action plan. Besides the implementation of the plans proposals this means that further meaningful actions such as those suggested in this paper have to be taken soon to reach the targets set. This is particularly important taken into account the long lead time of the instruments and the long life time of the energy using products and equipment.

The tiger is by no means toothless but has to immediately jump far and to strongly bite.

7. See the discussion of the interactions between the ETS and energy efficiency policies and measures in Lechtenböhmer et al. 2005a.

8. However, three priority actions touch this field by trying to raise awareness, spur financing, particular in the new member states and e.g. by reduced VAT and improved planning etc. No concrete targets for energetic modernisation of buildings have been set in the EEAP.

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