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Energy Efficiency and its contribution to energy security and the 2030 Framework for climate and energy policy

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Contents

Annex I. Report of the public consultation of the Review of progress on energy efficiency

Summary

This report presents the results of the public consultation on the Review of progress towards the 2020 energy efficiency objective and a 2030 energy efficiency policy framework. In total 721 responses were submitted to the on-line public consultation, with 242 organisations, 179 companies and 21 public authorities having taken part. 264 individuals also submitted their contributions to this consultation.

It was pointed out by several stakeholders that energy efficiency is a sound response to the prevailing energy security issue in Europe and also an effective tool for climate mitigation. It triggers innovation and creates new jobs for the EU economy.

Overall, a majority of stakeholders favoured energy efficiency targets or new measures as the right approach to addressing the shortfall (in achieving the 2020 objective), although a number of stakeholders also stated that the reinforced implementation of existing legislation including active policy on infringements is needed. A number of replies indicated other views in this regard. In general, stakeholders representing industry were in favour of targets expressed in terms of energy intensity improvements whilst non-governmental organisations advocated targets expressed as absolute energy savings.

Stakeholders also provided their views on whether further measures are needed at EU level to foster energy efficiency in different sectors such as buildings, industry, transport, electrical equipment and energy generation and distribution.

Many stakeholders indicated that there is still an untapped energy savings potential in **manufacturing** industry, where energy audits and energy management systems could help realise it.

Many respondents stressed that **energy production and supply** should be addressed by adopting mandatory energy efficiency requirements for new power plants and heating distribution systems, also promoting high-efficiency cogeneration. It was stated that a level playing field across the Single Market should be ensured, and that market transparency and better integration including modernisation of the national grids should be ensured.

As regards **buildings**, a majority of respondents acknowledged the need for strengthening the existing policy framework, by revising the Energy Performance of Buildings Directive (2010/31/EU) and establishing a target for 2030 with an intermediate milestone, to better address the renovation of existing buildings. On the other hand, a majority of stakeholders representing the **electrical equipment** sector did not see the need for additional measures

by stressing that the existing framework is sufficient to cover energy efficiency of products.

In order to achieve targets and implement policy measures, it was stated by many stakeholders that additional financing instruments and mechanisms should be put in place at EU level in order to stimulate needed investments in energy efficiency. A number of stakeholders stressed that the European Structural and Investments Funds 2014-2020 and Horizon 2020 are key instruments for implementing energy efficiency policies. Overall, it was emphasised that energy efficiency investments should go hand in hand with reducing the existing market and non-economic barriers and also raising awareness amongst market players about the underlying benefits of energy efficiency.

Finally, the public consultation sought views on what could be the most promising technology solutions in future that could help deliver energy savings in the 2020 and 2030 time horizon, and how their development and uptake could be supported at EU level. Several stakeholders stressed that new energy efficiency technologies and solutions are a crucial element of the 2030 framework and that the right demand side policies should be put in place at EU level. On the other hand, a number of respondents argued that the right technological solutions and technologies are already available in Europe and focus should be placed on promotion of best practice, awareness-raising and information.

A broad range of ideas for possible actions were put forward by respondents. This report explores the feedback in more detail. The policy conclusions drawn by the Commission will be set out separately and are not addressed in the present report.

1. PROCESS

The consultation consisted of a questionnaire in English with both closed and open questions. The on-line questionnaire can be found at the end of this report.

The public consultation complied with the Commission's minimum consultation standards, including the 12 week minimum duration (from 3 February to 28 April 2014). The standard Commission internet tool for Interactive Policy Making (IPM) was used. As participation was voluntary and based on self-selection, the views expressed by respondents are not necessarily representative of the views held by all stakeholders or citizens.

2. STAKEHOLDER COVERAGE

Overall 720 responses from individuals and organisations from 27 Member States were received through the IPM tool (the on-line questionnaire).

Type of stakeholder	Number	Proportion
Organisations	241	34%
Companies	179	25%
Individual citizens	264	36%
Public authorities	21	3%
Other	15	2%
Total number	**720**	**100%**

In total 241 organisations and 179 companies took part in the public consultation. In addition, 21 public authorities and 15 other entities submitted their replies. Furthermore, 264 individual citizens contributed their views to this consultation.

A few additional responses, 13 submissions, were submitted by organisations which did not make use of the web-based interface to reply to the questionnaire. Some of those who replied to the online questionnaire also submitted their position papers. The statistical data in this report refer only to responses made by the 720 responses submitted through the IPM tool. However, the views in all the submitted responses, including those submitted without using the IPM tool, have been considered by the Commission services.

3. STAKEHOLDERS' RECOMMENDATIONS

Public consultation was structured in 2 groups of questions. The first part was of a general nature which focussed on energy efficiency policy options and potential means of setting the binding or indicative targets and measures and the second part focused on energy efficiency in the specific sectors. In addition, the questionnaire contained horizontal questions on financing instruments to mobilise investments for energy efficiency, and also on building the capacity of actors in the energy efficiency sector and on ensuring the necessary technology solutions and their uptake at EU level.

a. Energy efficiency target(s) and measures

This part of the public consultation sought views on possible policy scenarios that could be undertaken to narrow the shortfall of reaching the 20% energy efficiency target by 2020 and also looking into the 2030 perspective. The questions covered the following options:

- Proposing energy efficiency targets;
- Reinforcing the implementation of existing legislation including active policy on infringements;
- Proposing new legislation;
- Other suggestions.

1) Energy efficiency targets

Several stakeholders emphasised that in general energy efficiency efforts should aim at reducing the EU's dependency on imported gas and serve as a political response to ensuring the security of energy supply. Energy efficiency also aims at mitigating climate change and creating new job opportunities for the European economy.

To the multiple-choice question on what could be the right approach to addressing the shortfall (of achieving the 2020 objective), most replies (312 or 43%) indicated a preference for energy efficiency targets, while 294 (41%) stated that the reinforced implementation of existing legislation including active policy of infringements is needed and 136 (19%) replies were in favour of new measures. 321 (48%) replies indicated other views in this regard which have been summarized below in the report.

To the question on how energy efficiency targets should be expressed, 134 (43%) respondents out of those favouring targets replied that these targets should be expressed as absolute energy savings, whilst 60 respondents (20%) indicated that they should be expressed in terms of energy intensity improvements of the economy and economic sectors. Moreover, 91 (29%) respondents believed that the targets should be expressed as a combination of absolute energy savings and energy intensity levels in order to represent a better benchmark upon which to frame a 2030 objective.

To the question at what level these targets should apply, many stakeholders argued that such targets should be set at EU level (218) or national level (207), while 110 favoured targets at sectoral level. Moreover, 221 respondents favoured legally binding targets whereas 70 would prefer indicative targets.

Those respondents that favoured legally binding targets stressed that addressing the shortfall should be closely linked to and consistent with the 2030 targets for energy efficiency. In addition, it was suggested that targets should be set beyond 2030 (until 2050) in order ensure a more stable and predictable environment for investors. Several stakeholders argued that targets should be realistic and achievable, with strictly defined monitoring and verification procedures in place demonstrating effective and credible progress towards achieving these targets, including appropriate sanctions for addressing non-compliance. Moreover, it was suggested that regular review of progress should be carried out on the basis of the intermediate milestones. In general, it was emphasised that binding targets would increase awareness amongst the general public and stakeholders, and that a high ambition level would trigger innovative solutions and create more jobs. Moreover, legally binding targets both at EU and national level would help in reinforcing the Energy Efficiency Directive (2012/27/EU).

Some stakeholders argued that legally binding targets should be set in proportionate terms for each Member State to avoid the situation where some Member States would dramatically under-perform and rely on other Member States to 'carry' them. However, such national targets would need to be accompanied by stricter legal requirements (of the Energy Efficiency Directive) and necessary commitments taken by all relevant actors in order to reach them.

It was also emphasised that an absolute energy savings target must be derived from a bottom-up approach based on the cost-effective energy savings potential for the various sectors, prioritising the sectors with the highest savings potential (e.g. buildings), and using a simplified harmonised calculation methodology and eligibility criteria similar to the requirements laid down in Article 7 and Annex V of the Energy Efficiency Directive. however, other stakeholders stressed that sufficient flexibility should be left to the Member States to take forward the necessary measures.

Some stakeholders stated that sectoral targets should also be considered for 2030 by arguing that binding targets work well in the renewable energy sector, and have provided confidence to investors allowing achieving a major increase of renewable energy sources. In these stakeholders' view lack of binding EU and/or national targets for energy efficiency was a reason for why the technologies have not yet been deployed at a larger scale.

In addition, it was pointed out by a number of respondents that a combination of targets at national and sectoral level should apply, since national targets would better take into account the priority sectors. National objectives should be combined with a sectoral plan to boost, for example, energy efficiency in buildings, taking into account supply-side and demand-side measures and involving the relevant stakeholders.

It was highlighted by many respondents that a large untapped energy savings potential lies within manufacturing industry and it should be addressed properly. This would also increase the competitiveness of EU businesses globally. It was suggested that the differentiation of energy efficiency targets for industry branches is needed by setting separate targets for SMEs and large companies within the same industry branch. Member States could also identify the sector potential in their National Energy Efficiency Action Plans. For instance, one of the quickest paybacks for industry would be investing in thermal insulation.

Moreover, several stakeholders suggested that targets for the buildings sector should reflect the 2050 climate objectives, especially for building renovations, to facilitate investment plans. A target for 2030 also is needed as an intermediate milestone for assessing the achievement of the renovations rate needed for the 2050 objective.

A suggestion was put forward that a legally binding savings target should be put in place for the transport sector. Energy savings targets should also be applied to the defence sector – as already in countries such as the U.S. and Denmark. Several respondents argued that a specific target should also be formulated for heating and cooling sector.

Those respondents who favoured targets expressed in absolute energy savings rather than in terms of energy intensity argued that targets expressed in energy intensity would not ensure a decrease of energy consumption in absolute terms. By contrast, stakeholders preferring targets expressed as intensity argued that absolute energy saving targets would limit economic growth and would lead to deindustrialisation and even carbon leakage. Moreover, it was stressed that the overall EU target should be expressed as an energy intensity target for the industry and service sectors in order to take into account structural effects and economic growth.

2) Reinforcing the implementation of existing legislation

294 respondents (41%) called for further reinforcement of the implementation of the existing legislation, many of them insisting on the more ambitious implementation of the Energy Efficiency of Buildings Directive and Energy Efficiency Directive. In their view these legislative instruments serve as the main driver of energy efficiency across the different sectors.

It was pointed out by several stakeholders that at this stage it is too early to assess the impact of the implementation of the Energy Efficiency Directive as the transposition deadline is still due (on 5 June 2014) and measures need some time to deliver results. This Directive defines a set of key innovative energy efficiency instruments. A better coordination and dialogue between the EU and Member States should be ensured to make the most effective use of the available tools in order to allow better achievement of the savings targets. In addition, it was stressed that a common implementation strategy could be developed engaging all the relevant stakeholders. This could increase the quality, support and ownership of results, help identify best practices, encourage coordination of financing instruments.

A number of respondents emphasised that EU financing is crucial for implementing existing measures, and that financial incentives should be linked to dissemination of best practice in achieving energy savings. Some stakeholders argued that more stringent infringement procedures and sanctions should be put in place to allow better enforcement of the existing legislation. Suggestions were put forward on putting more emphasis on public awareness activities pursued at EU level in order to inform market actors, including industry, about the benefits of saving energy and reducing costs. Energy efficiency in general should be promoted as an instrument for improving industrial competitiveness and serving to combat the energy poverty.

A number of stakeholders believed that energy audit schemes established under Article 8 of the Energy Efficiency Directive should be linked to concrete savings targets. It was also stressed that more stringent actions could help achieving the untapped energy savings potential in manufacturing industry. Moreover, several stakeholders pointed out that the reform of the ETS along with the recently proposed market stability reserve mechanism would better contribute to energy efficiency in the future.

Some stakeholders also pointed to the need for ensuring consistency between the provisions under the Energy Efficiency Directive on the use of energy performance contracting by public authorities and EU rules on public accounting to facilitate the use of energy performance contracting.

3) Proposing new legislation

135 (19%) respondents called for new legislation to foster energy efficiency, which in their view would create stronger demand, reduce remaining economic and non-economic barriers and provide long-term predictability to investors. It was argued that the main issue is the lack of action and ambition level to drive the uptake of energy efficiency. Therefore, new legislation and requirements, for example, aiming at extending the scope of building renovation or implementation of energy audits along with recommendations on cost-effective improvements for enterprises should be further developed.

Several stakeholders put forward concrete ideas for revising the existing EU legislation. Notably, it was pointed out that in order to meet ambitious energy savings objectives for 2030, the 1.5% energy efficiency savings target laid down by Article 7 of the Energy Efficiency Directive should be retained and increased during the 2020-2030 period. It should also be considered whether 1.5% is sufficiently ambitious for the current 2014-2020 obligation period. Moreover, it was suggested that exemptions allowed under the Energy Efficiency Directive could be removed, for example, concerning the transport sector which currently can be excluded from the baseline for calculating the energy efficiency savings targets under Article 7. In addition, it was stressed that exemptions under Article 5 to achieve the 3% annual renovation rate for public buildings should also be removed. The 3% rate should apply to all public buildings (owned or rented) irrespective of floor area and location (without the limitation to central government buildings).

Some stakeholders emphasised that technical standards and definitions should be harmonised in the Energy Performance of Buildings Directive, and that the Energy Performance Certificate should be strengthened by incorporating additional information. Furthermore, a longer term outlook beyond 2020 is needed for the Ecodesign Directive and Energy Labelling Directive. Finally, it was stressed that emission performance standards for the transport sector need to be expanded to other modes of transport.

It was pointed out that new legislation should consider institutional and governance reforms to strengthen accountability at national level for delivering commitments in current and future National Energy Efficiency Plans and to reporting on progress. Economic reforms are also needed to create the enabling environment for energy efficiency. This should be done with the support of appropriate financing and investment measures including State Aid.

4) Other suggestions

322 respondents (45%) used the open option to provide their views on the question on what could be possible policy scenarios to address energy efficiency. Several respondents stated that they favour a single, realistic energy and climate target addressing the reduction of GHG emissions on a global level playing field, complemented by an equal-ranking target for industrial growth. It was also stressed that energy efficiency and renewable energy would in in any case be drawn on in delivering this objective, and the retention of only a single objective would allow avoiding counterproductive effects, such as double regulation. Flexible energy efficiency improvements on a voluntary basis by taking into account specific sectors and national context could be the most effective means to reduce CO_2 emissions and foster economic growth.

Moreover some stakeholders argued that energy efficiency measures should not bring additional costs to sectors already covered by the ETS. Additional energy efficiency targets affecting these sectors would only increase the overall costs.

Several stakeholders stated that improved modelling of energy efficiency and energy savings, and identification of the cost-effective potential for energy savings would provide greater understanding of how energy savings can be achieved and where to concentrate efforts in terms of additional policies and measures and financial support mechanisms. Better understanding of the benefits of the energy savings potential in terms of jobs created, drivers of growth and competitiveness, reduction factors of energy costs, increased energy security and resulting reductions of greenhouse gas emissions would demonstrate that energy efficiency is a correct solution to many of the issues Europe is currently facing. Moreover, discount rates assumed for energy efficiency measures in existing modelling must be reduced in order to be more realistic and prevent unfairly high depicted costs of these measures.

It was argued that industry has a track record in reducing energy intensity as well as emissions. Further reductions must thus be economically justified. In this regard, binding targets and new legislation will only make Europe a less attractive place to invest and result in higher unemployment. Best practice sharing and development and deployment of new technologies could be the most constructive manner to further improve the energy efficiency.

Respondents stressed that in general it is hard to predict the development of the economic activities over the next decade and that energy consumption is correlated with many parameters, including the two most important ones, the level of economic activity in Europe and the cost of energy. Several stakeholders emphasised that energy production should follow economic development and not constrain it. Given the fact that Europe itself cannot produce more energy without endangering its environment, it requires more efficient coordination and cooperation across borders, and an integrated approach including energy storage and distribution that would allow flexible response mechanisms.

4. ENERGY EFFICIENCY AT SECTORAL LEVEL

The public consultation asked whether further measures are needed at EU level to foster energy efficiency in different sectors such as buildings, industry, transport, electrical equipment and energy generation and distribution.

1) Buildings

As regards the buildings sector, 359 respondents (50%) believed that further measures are needed whilst 301 (42%) thought that there is no need for further action, and 60 (8%) respondents had no opinion on this matter.

Many respondents underlined that buildings is one of the economic sectors where massive energy savings could be achieved. However, limited progress so far is often due to the lack of financing and other market barriers. In general, the policy framework for improving the energy performance of existing and new buildings needs to be strengthened and cooperation and coherence should be ensured between different policy and legislation measures, also covering all phases of a building's lifecycle. It was stressed that the implementation of the Energy Performance of Buildings Directive is key and should be supported with the significant EU investment, and that demonstration projects are key to enable increasing the uptake of these technologies from an economic point of view.

A number of respondents stressed that in order to exploit the untapped energy savings potential in buildings, the EU should define a long term objective with intermediate milestones, supported by the right policies and financial schemes to remove market barriers and incentivise renovation. A clear framework should entail wide-scale renovation programmes, the need for a skilled workforce in deep renovation combining building envelope insulation and other measures.

Moreover, it was emphasised that a binding target for 2030 would provide certainty and convergence for long-term financing decisions. Such a target should be set at national level due to different national circumstances, including the climate variations amongst the Member States. Moreover, a target for 2050 could serve as a driver for an increased rate of renovation of existing buildings. In general, cost effective reduction of energy consumption should be given a priority and it should be well reflected in the definition of the nearly zero-energy buildings, including reflecting it in national building renovation strategies under the EED on the basis of agreed mandatory templates for such strategies.

A number of stakeholders stressed the need for long-term EU funding such as the European Structural and Investment Funds to support major renovations, whereby, for example, the level of financing would depend on the achieved savings as a result of the renovation.

Some respondents suggested that minimum performance requirements for rental of existing buildings should be also established at EU level. It was suggested that the Energy Efficiency Directive must put forward measures with the long-term vision that would require extending the 3% renovation rate to all public buildings and publicly supported buildings, set stricter standards than cost-optimal levels for these buildings, require the use of new business models that remove barriers for increased energy efficiency, mandatory requirements for the implementation of cost-effective solutions in buildings. This must also be reflected in the national long- term strategies for building renovations.

It was seen by some stakeholders as important that any additional requirements are set in terms of energy performance rather that pressing for specific technical requirements that might not be cost efficient. In addition, it was suggested that the extension of the scope of requirements for the energy performance of buildings is needed, for example covering also lifts, escalators and moving walkways. Fiscal incentives should also be strengthened, including applying a "polluter pays principle". Stakeholders argued that financing incentives would encourage final consumers and enterprises to better meet the energy savings targets embedded in the EU and national buildings legislation.

A number of stakeholders shared the view that Energy Performance Certificates (EPC) should be strengthened, by making them harmonised at EU level. It is also necessary to improve their overall quality and functions which could foresee mandatory on-site visits and setting up a database at national level. The EPC should be better explained to ensure transparency. Moreover, EPCs should become comprehensive "building passports" to follow each building throughout its lifetime and which could be made publically available in national registries.

Some stakeholders called for revision of the Energy Performance of Buildings Directive and relevant parts of the Energy Efficiency Directive to include a measurable definition of deep renovations and a quantifiable objective to accelerate deep renovations of residential and tertiary buildings. Furthermore, it was emphasised that long term renovation roadmaps need to become a key planning tool setting comprehensive strategies, including financial incentives, in order to refurbish national building stocks. It was also underlined that Member States should introduce legal minimum energy efficiency requirements for rented buildings which are very often the least efficient.

In addition, it was underlined by several respondents that initiatives promoting energy efficiency in buildings should in general follow a holistic approach and focus on the whole value chain covering efficient technologies, district heating and smart metering and billing information. It was stressed that remaining obstacles in national property laws should be removed and that the issue of “split incentives” between landlords and tenants should be properly addressed. In addition, obstacles for effective energy performance contracting should also be tackled.

It was also emphasised by some respondents that participation of SMEs should be facilitated, e.g. SMEs in the construction sector should have access to training as well as access to self-assessment instruments enabling them to check the quality of energy efficiency improvements.

Several respondents called for new measures to trigger mass-scale deep renovation of existing buildings. As regards new buildings, it was stressed that a revised Energy Performance of Buildings Directive should propose a harmonised technical definition of Nearly Zero Efficient Buildings (NZEB) to converge on common nomenclature, objectives and calculation methods, and that buildings-related provisions of the Energy Efficiency Directive (Articles 4 and 5) should be incorporated in the revised Energy Performance of Buildings Directive to have a single and powerful policy instrument.

Moreover, it was also emphasised that Energy Efficiency Obligations should become a useful tool for providing renovation investments and should continue also after 2020.

2) Industry

A majority of stakeholders (424 or 59%) believed that further policy measures are needed at EU level to foster energy efficiency in industry with (192 or 27%) against and (83 or 12%) having no opinion in this regard.

A number of respondents stressed that the market and its technological breakthroughs should play a role in achieving the necessary cost savings. It was also stressed that strong political commitment and legislation are needed to ensure that the cost-effective savings potential in industry is realised. For example, adapting business models to energy efficient production processes would allow producing high quality products at lower cost, thus increasing competitiveness. It was argued by several stakeholders that a strong potential for additional savings and reduced GHG emissions lies in recycling.

A majority of respondents who favoured additional measures addressing energy efficiency in industry suggested that in order to achieve the unrealised energy-saving potential in industry, energy efficiency should become part of strategic decision-making within energy management systems involving a wide range of areas for improvement such as circular economy, resource efficiency, insulation, use of efficient electric motors and variable speed drivers, use of automation and control equipment, monitoring systems and maintenance, including behavioural change.

Moreover, it was emphasised by many stakeholders that there is a great potential associated with energy audits required by the Energy Efficiency Directive; however, this instrument should be strengthened by ensuring that resulting recommendations become mandatory, at least for those recommendations that address actions with a short pay-back period. In addition, energy audits could be extended to cover also SMEs to help smaller companies to find the best solutions to adapt to increasing energy prices. Some stakeholders were more cautious by pleading that existing energy audit requirements should be continued. It was underlined by a number of respondents that energy audit provisions should be used to encourage companies to trigger investment decisions in order to improve energy efficiency in processing and peripheral energy use. In general, additional financial mechanisms and instruments are needed in order to pursue these necessary measures.

Several respondents argued that best practices and benchmarks should be developed to increase the use of energy audits, and that benchmarking should be developed for the relevant industry sectors. An assessment of the cost-effective potential of each particular sector of industry is needed to identify gaps, design tailor-made energy efficiency objectives and measures to target relevant sectors.

Several stakeholders suggested that appropriate energy efficiency benchmarks should be defined in the Best Available Techniques (BAT) reference documents (BREFs). These benchmarks should be used for setting ambition levels and be more frequently reviewed. Moreover, ambitious requirements on energy efficiency in the relevant sector BREF reviews should be adopted.

Some respondents called for voluntary initiatives, to be encouraged through practical and cost-effective support measures, rather than additional mandatory requirements. Such voluntary initiatives, for example, would ensure implementation of practical energy management solutions while avoiding the additional administrative burden stemming from the additional regulations.

To this end, it was argued that greater information for all market actors, especially on the benefits associated with energy efficiency in industry should be promoted, alongside information on concrete solutions, especially for those that have relatively short payback periods. In addition, it was highlighted that specific requirements for facility manager training, workforce development and alignment of training needs and workforce development are needed to achieve the necessary results. It was suggested that "Learning energy efficiency networks" could be an effective instrument to learn about energy saving potentials, particularly for SMEs, and that financial support for the establishment of such networks could be provided at EU level.

Those respondents who were against additional measures expressed views that there is no need for additional targets or other mandatory requirements imposed on the energy intensive industries that are part of the ETS. They argued that new industrial installations are already energy-efficient and that ambitious top-down EU policies would cut investments resulting in higher cost burden for industry. In general, they argued that long term climate and energy policies will only be achieved by working in accordance with economic and growth needs.

It was noted that at industry level, the ETS is the right instrument for energy efficiency improvements. In order to provide incentives for energy efficiency measures the ETS should be strengthened to contribute its role as the central market-based instrument. It was also argued that the ETS should be strengthened as the single steering method in the sector, and that heating and cooling sector should also be included.

Many respondents underlined the need for reforming the ETS in order to contribute in a cost-efficient manner to the reduction of greenhouse gas emissions during the period 2020-2030. Furthermore, it was stressed that it should be ensured that funds generated by ETS are earmarked for further energy efficiency measures in energy intensive industries. However, when reforming the ETS, competitiveness aspects and risks of carbon leakage should be taken into account.

A number of respondents stressed that caution should be employed as regards the implementation of Energy Efficiency Obligation schemes, and that company-specific targets should be avoided, arguing that such targets would diminish early action and add disproportionate administrative burden. Increased costs for industry would hamper the investments needed for expanding the business and would risk delocalisation to third countries. However, it was pointed out that energy intensive industries are contributing with their manufactured products and technologies to energy efficiency in buildings, transport and other economic sectors.

Several respondents perceived high energy prices as a helpful driver to take the necessary action to boost energy efficiency in industry. Nevertheless, others perceived energy efficiency policies as an additional burden to the competitiveness.

Several respondents believed that the completion of the internal energy market would ensure more energy savings in the energy supply and distribution markets. National policies could deliver more as regards the promotion of efficient co-generation and industrial heat recovery in line with the requirements of the Energy Efficiency Directive, as could the linking of regulated remuneration levels for network operators to the achievement of specific energy efficiency targets or connection of co-generation.

Some views were expressed that market failures mean regulatory action is required to motivate businesses to pursue the necessary energy saving actions since raising awareness of energy efficiency alone will not trigger the necessary actions. The EU should learn lessons from national schemes that have used financial instruments to drive energy efficiency as in the UK and Denmark, for example.

Finally, it was stressed by a number of respondents that it is of utmost importance that the existing legislation is implemented and that it is too early to judge whether additional measures are needed before the Energy Efficiency Directive is fully in place.

3) Transport

As regards transport, a majority (473 or 66%) of respondents had the opinion that further policy measures are needed with 102 (14%) respondents being against, and 121 (17%) having no opinion in this regard. Stakeholders in favour of additional energy efficiency measures in transport suggested that existing non-binding measures in transport should be made compulsory and that better integration with other sectoral policies is needed - such as urban development, innovation, financing, public health and regional development and access to resources.

In general, it was stressed by many stakeholders that transport should be one of the priority sectors to address energy efficiency. To this end, a transformation of the entire transport system is needed since it is the largest consumer of final energy. A combination of different measures should be used, e.g. increase in the use of non-road alternatives or taxation policies to achieve a level playing field across the transport modes.

It was argued by some respondents that transport should be covered by the Energy Efficiency Obligations schemes or alternative approaches in order to achieve further energy savings. EU transport policy should aim at reducing energy demand, achieving modal shifts to more efficient transport modes and vehicle efficiency improvements.

In order to improve energy efficiency in transport, the Trans-European Transport Networks (TEN-T) should be strengthened. This could be accomplished by the international, cross-border application of existing logistic concepts and aerodynamic modifications to vehicles. Moreover, new mobility solutions including vehicle and bike pooling and sharing must be further developed, and better integrated into public transport systems. In order to pursue these measures the EU should develop a comprehensive strategy, including investment, incentives and market design.

Moreover, it was stressed by a number of respondents that the provisions of the Fuel Quality Directive on greenhouse gas emissions from fuels should be continued beyond 2020.

Those respondents who favoured additional measures in the transport sector suggested that electrification of transport presents a great opportunity for reducing fuel imports and also GHG emissions. However, the electrification of transport is linked to many questions that need to be addressed in order to make this transition effective. These would include transition guidelines from hybrid to plug-in hybrid and fully electric vehicles, and implications of regional climate for vehicle battery performance. Research should be carried out for the development of alternative and promising battery technology, hydrogen fuel cells, structures for distributor networks and service, public charging infrastructure and grid implications.

To this end, Horizon 2020 could be instrumental in creating a research and/or collaboration platform for responding to these issues. Furthermore, it was stressed that deployment of pilot projects in this area would be essential. Moreover, continued innovation for efficient and clean transport through, for example, superior light-weight and tailored materials such as plastic based composites should be fostered. To make all these innovations happen, a multifaceted approach is needed. Technologies should be developed and different industry sectors, and the research community, should collaborate across the whole value chain.

It was stressed that in order to promote sustainable transport solutions an interoperable, alternative fuels infrastructure in Europe should be put in place, also diffusion of innovative and interoperable technologies that could help save energy and reduce CO_2 emissions. Efficient road lighting and traffic control systems should be fostered on one hand, and obstacles impeding cross-border transport or infrastructures should be removed on the other. To this end, the recently adopted Directive on the Deployment of Alternative Fuels Infrastructure will enable improving the energy efficiency of road transport.

It was pointed out that regulators should ensure that recharging points are compatible with smart grids and that an ambitious minimum number of recharging points is set for 2020 to send the right signal to investors and industry that will produce the necessary technological solutions. In addition, national policy frameworks should be given flexibility to define national targets and objectives for the deployment of an alternative fuels infrastructure. Policy to support standards in electrification of transport can drive optimization of the design of the electricity grid and infrastructure, where features such as load balancing, metering and the charging infrastructure are important.

Overall, demand-side systems together with smart grid solutions will provide an intelligent platform for the smooth integration of electric and plug-in vehicles into the electric grid. It was also stressed that in addition to measures fostering the electrification of transport, other alternative fuels like biofuels from waste and residues or fuels based on power-to-liquid/power-to-gas conversion should be developed for those transport modes that cannot be electrified.

Some stakeholders stated that the Clean Transport Package provides a framework to guide investments and technological developments in alternative fuels and that it also provides a positive signal to national authorities and investors for encouraging the market uptake of alternative fuel vehicles and vessels. However, such measures should be flexible and cost efficient to preserve the competitiveness of the different transport sectors, especially for shipping. As regards maritime transport, international binding measures on reducing CO_2 emissions should be implemented via the International Maritime Organisation.

It was suggested that fostering energy efficiency in transport should be further supported by measures based on detailed EU-wide monitoring of the use of alternative vehicles and impact of their infrastructure on local energy grids to assess the impact of policy measures and their contribution to achieving the EU ambition of reducing the number of conventionally fuelled vehicles in urban areas by 2030. It was argued that although urban sustainable mobility plans are a good way forward, a EU wide roadmap is also needed, which should be developed in close cooperation with the most polluted regions in Europe, setting out the parameters that would determine progress and identify the most energy efficient alternative fuel solutions. Measures such as training schemes to reduce fuel consumption, financial support for mobility management, investment in energy efficient vehicles (CNG, LNG, hybrid and electric vehicles) and telematics services for public transport to ensure a change towards energy efficient mobility should be urgently addressed. Member States could financially support investments for uptake of vehicles propelled by alternative fuels and co-finance the expansion of a supply network for alternative fuels. It was argued that better integrated management of transport infrastructure is needed to increase uptake of more efficient transport modes. Some stakeholders argued that fiscal incentives and tax measures should play a role in this regard, also introducing the "polluter pays principle". It was pointed out that high energy prices have led to the increasing efforts in fostering energy efficiency in transport.

Some respondents called for modal shifts to more efficient transport modes, for example to rail transport or shipping, including also freight. It was argued that rail technologies are already 3 to 4 times cleaner than road or air transport. EU support could be provided via regulations or infrastructure projects. A suggestion was put forward that a carbon tax on petroleum products should be applied to road transport to align its level since rail transport is impacted by the ETS as its main power source, electricity, is covered by the cap-and-trade scheme. This would ensure a level playing field across the transport modes.

On the other hand, some stakeholders argued that forced modal shift should be avoided. Measures should aim at greening individual modes at source and they should not favour one mode over the other and should be technologically neutral. A reflection should be made at EU level on whether a sustainable freight transport network can be best achieved from an economic, social as well as environmental perspective by further electrifying rail infrastructure or by using these funds to electrify main road corridors. The use of taxes and levies in order to change behaviour should be redirected to avoid the situation that these tools are used only for fiscal purposes and are not encouraging greening at source through the earmarking of fiscal revenues. It was stressed that the use of alternative fuels in commercial road transport operations should be further encouraged and their refuelling infrastructure further deployed and harmonised.

It was stated by several stakeholders that public transport plays a key role to improve energy efficiency of transport including shifting from road transport to other transport modes such as railways and ships. Intermodality must become the core principle underlying all mobility policies, especially in public transport where the interplay between services must be enhanced (e.g. with joint planning of networks, coordination of timetables, better information provision, common reservation and ticketing systems, common baggage handling, enhancing passenger rights). Information and communication technologies and services can play a role in fostering this.

As regards emission performance standards, it was stressed by many respondents that existing standards need to be continued and improved further, and that work should continue on standards for heavy-duty vehicles. The next revision of CO_2 emission performance standards for light-duty vehicles shall explore possible options (e.g. energy efficiency parameters, super-credits, tailpipe CO_2 standards or GHG emissions). In addition, CO_2 label should be further discussed by considering possible options such as e.g. absolute or relative CO_2 emission performance levels.

Some views were expressed that ambitious targets for 2025 and 2030 should be set. Targets for 2030 should reflect continued progress and advances in technology. To avoid rebound effects, economic measures such as ETS (at refinery level) and taxation should be applied. It was also pointed out that additional measures are needed to address energy efficiency in aviation and that the EU should push harder to implement the Single European Sky.

4) Electrical equipment

To the question whether additional measures for electrical equipment sector are needed, 259 (36 %) stakeholders replied affirmatively, whilst 279 (39 %) respondents believed that there is no need for further measures, with 159 (22 %) not having any opinion on this matter.

A majority of those who replied affirmatively stressed that even though the Ecodesign Directive (2009/125/EC) and Energy Labelling Directive (2010/30/EU) have contributed to a significant reduction of energy consumption, in the light of the upcoming Review of this legislation several aspects should still be addressed. Concerning the Ecodesign Directive these should be: speeding-up the process that leads to the adoption of implementing regulations, setting minimum requirements that are not quickly outpaced by market developments and strengthening market surveillance by cutting red tape.

As regards the Energy Labelling Directive, there is an urgent need to improve the design of labels. The 2010 decision to add additional classes with plusses instead of ensuring a rescaling of the label has reduced the ability of the label to guide consumers' choices. It was also argued that energy labels should include broader information on other environmental aspects and absolute energy consumption, especially for larger products which have higher overall energy consumption.

It was suggested by several stakeholders that both directives should be reviewed in light of the 2030 framework to foster development of innovative technologies due to a greater predictability for the investors. Several stakeholders also called for increasing synergies and aligning the decision-making process between the ecodesign and energy labelling measures to allow reduced inconsistencies in the drafting phase and speed up the implementation of the measures. Moreover, synergies with other legislation such as the Ecolabel, Green Public Procurement, and recycling, waste and chemical legislation should be ensured.

Several respondents indicated that demand side policies should be designed to stimulate demand for higher efficiency products in the market. It was emphasised that even though the existing ecodesign legislation is sufficient the extension of its scope could be considered. In addition, the ecodesign directive should be coupled with measures speeding up the replacement rate of old equipment such as vouchers or eco-cheques. Furthermore, the directive should seek to optimise not only the end-use equipment, but the entire system in which it operates.

It was pointed out that financial incentives such as reduced VAT rates for the most efficient appliances could also be promoted.

Some stakeholders argued that legislative processes should be accelerated and become more dynamic in order to reflect current market transformation processes. The level of ambition of ecodesign standards needs to be increased. The criterion of least-life-cycle-costs should be reviewed and the criterion of the best available technology (BAT) should be considered as the benchmark. Moreover, the future regulatory framework needs to support innovation as the current framework fails to provide incentives for frontrunners.

A number of stakeholders viewed the importance of electrical equipment sector in the broader energy efficiency policy context, notably seeing it as an integral part of other sectors such as buildings or energy supply, where electric installations and systems play an increasing role to optimise overall energy performance. This is in particular important in the development of smart grids, where the efficient management of infrastructure in combination with efficient appliances interoperating with the future energy system including smart metering would ensure significant energy savings. Furthermore, demand response should provide consumers with real-time control signals motivating them to adjust their consumption. Moreover, peak load management, according to the respondents, was regarded as a significant element that allows optimising the functioning of power plants and the power system as a whole, and also contributes to the security of supply.

It was also suggested that in order to increase the energy efficiency of electrical appliances, manufacturers should be required to conduct a design assessment of their products at an early development stage. Such an assessment, based on generic data, would aim to optimise resource use in the product design together with durability and quality requirements of the specific product. Ultimately, this would drive production towards a best-cost producer model. It was argued that the approach of ecological profiling would not remove the need for specific energy efficiency parameters that could be verified on the product itself.

Some stakeholders argued that the ecodesign directive should omit the use of primary energy conversion factors as these mislead consumers that cannot choose their energy system. The electricity conversion factor should be treated as a CO_2 neutral one in order to meet the 2050 vision of a low carbon future.

It was suggested to set-up a publicly available, producer-supplied product-database for both directives that would improve monitoring and transparency of market development and would facilitate the revision of existing and the drafting of new legislation.

Those respondents who were against additional measures for the electrical equipment sector stated that the Ecodesign Directive and the Energy Labelling Directive already cover most significant aspects of energy efficiency concerning electrical equipment. Instead of adopting new measures, these two pivotal directives should be enforced and implemented, and a comprehensive assessment should be carried out and discussed with stakeholders before launching new initiatives.

Moreover, it was underlined by several stakeholders that the current review of the energy labelling regulation and certain aspects of ecodesign set a favourable framework for increasing energy efficiency in electrical equipment. It was stated that demand-side policies are key for triggering innovative solutions; however, market-based mechanisms should be also considered.

A number of stakeholders argued that any further extension of the scope of the ecodesign directive targeting product groups or industrial systems and processes, in their view would generate complex trade-offs and create more regulatory burden for businesses, especially for SMEs. Thus it is crucial to ensure proper functioning of the decision-making process under the existing directive, especially with regard to the participation and interests of SMEs, and conduct a cost-benefit-analysis of its implementing measures before proposing further ecodesign measures.

On the other hand, some stakeholders acknowledged that the implementation of both directives could be improved. For instance, in order to better address the efficiency potential of business-to-business products within the ecodesign framework, the option of setting generic requirements and developing product-specific standards should be reverted to, since it was argued that many complex products of the capital goods sector have differing applications and as a result no constant operating point so that specific energy efficiency requirements can often not be determined.

5) Energy generation and distribution sectors

418 (58%) stakeholders believed that additional measures are needed to address the energy generation and distribution sectors, while 148 (21%) were opposed to it and 119 (17%) did not have an opinion in this regard.

Those respondents who favoured additional measures for energy generation and distribution suggested that mandatory energy efficiency requirements for new power plants and heating distribution systems are needed. It was stated by several respondents that a level playing field across the Single Market should be ensured, and that market transparency and better integration including modernisation of the national grids should be ensured. The priority should be the completion of the internal market for energy to ensure the energy supply and access to customers in all Member States. To this end, it was emphasised by a number of respondents that the expansion of cross-border infrastructure, in particularly cross-border interconnectors, which also foresees decentralised energy distribution, is required. It was pointed out that the current restrictions regarding the development and improvement of European networks of interconnections should be overcome to foster market integration, diversification of energy supply and energy efficiency. In addition, some respondents underlined that energy trade with third countries should be based on a level playing field.

Moreover, the development of smart grids and high-efficiency district heating systems, including the successful rollout of smart meters should be secured by 2020. Several respondents argued that smart grids including energy buffering and storage are indispensable for an improved interconnectivity and managing the flow of electricity according to demand and supply. It is also important for the integration of renewable energy and the successful liberalisation of energy markets. To this end, the development of standards should be properly addressed due to the involvement of many different sectors along the value chain.

Several stakeholders argued that the rules on market design for electricity and heating should allow more active and informed consumer participation than today, and allow new actors such as aggregators to enter the market. Stakeholders argued that aggregators could also facilitate a more decentralised generation of electricity.

Many respondents emphasised that a regulatory framework developing a sustainable and smart energy system in the EU shall be further harmonised. Moreover, it was stated that a flexible and intelligent energy system would deliver a high level of security of supply and efficiently integrate various sustainable technologies. To this end, emphasis should be put on establishing a 2030 target at EU level for smart infrastructure by taking into account potential of demand-side management and proper measures aiming to improve the efficiency and flexibility of energy networks, on the basis of a holistic approach - in addition to the deployment of efficient equipment such as transformers.

A number of stakeholders emphasised that solutions aiming at increasing flexibility in energy systems are important, as they facilitate the efficient deployment of renewable sources. Demand side management and response measures can contribute to this significantly, helping to reduce the need to build generation capacity, particularly to cover peak loads. Stakeholders regretted that these measures have not been considered on an equal footing to supply side options and their penetration in the system has been limited. Many of these measures are implemented in the distribution grid, which has been overlooked by the Commission in recent legislative initiatives such as the Energy Infrastructure Regulation and the Connecting Europe Facility. Building on the provisions of the Energy Efficiency Directive, the rules for the participation of these solutions in the system should be made clearer by removing remaining barriers. It was suggested that the Large Combustion Plant BREF should be improved to refer to firm provisions for improving energy efficiency in existing plants.

Furthermore, respondents stated that greater emphasis should be put on increasing the overall efficiency of the energy system rather than the efficiency of its single components, and that legislation should promote the implementation of energy efficiency measures by distribution system operators rather than by energy producers. Thus, renewed effort should be placed on promoting infrastructure projects aimed at increasing the efficiency of how the different components of energy, and especially electric, systems interact.

Several stakeholders stressed that regulators should encourage the use of smart meters to provide easy and quick access to consumption information in real-time, allow energy-efficient behaviour and a more active participation by consumers through advanced services such as demand response. It was underlined that demand response will enable consumers to become active players rather than passive users.

Moreover, new measures should enable transmission system operators (TSOs) and distribution system operators (DSOs) to take into account the benefits of demand response and energy efficiency programmes prior to investing in regional network capacity. Regulation should ensure that they are rewarded and not penalised for increasing their efficiency. Taking into account their key position in managing the local grid and the consumer's data, DSOs could play a more active role in the implementation of energy efficiency measures at consumer level.

Respondents suggested that an integrated approach to the energy system should be built on the process established under Article 14 of the Energy Efficiency Directive through lowering the thresholds for data collection and conducting the comprehensive assessment, including a more focused approach to waste heat. In order to have a fair burden sharing of the costs incurred by investors and customers, respondents expressed views that the list and the values of the externalities to be used in the cost-benefit analyses should be better explained.

In the context of the implementation of the requirements laid down in Article 15 of the EED, a number of stakeholders stated that EU and national regulators should establish tariff structures that reward an energy efficient operation of the electricity, gas and heating markets. Furthermore, a specific focus should be placed on the power sector, containing tangible CHP elements; possibly building on the existing guarantees of origin for high-efficiency CHP (the establishment at national level of "efficiently generated" electricity could be assessed). It was suggested that the Commission should aim at encouraging national and local authorities to use a system-wide approach via an extension of the scope focused on the power sector which is stipulated in annex VIII of the Energy Efficiency Directive.

As regards decentralised energy production, it was emphasised by a number of stakeholders that it increases energy efficiency thanks to cogeneration plants and thanks to reduced energy losses in transportation as well as infrastructure costs. Thus, local energy production including from renewable energy sources to reach energy efficiency targets should be considered. It was also stressed that ICT should play a role in decentralised energy production and distribution, which helps to optimise energy efficiency and to manage variations in the supply and demand of energy in real time.

Furthermore, it was stated that an inventory of barriers and opportunities for the development of efficient heating and cooling should be carried out based on reliable market data, using modelling that fully reflects the reality of energy use in Europe and the potential of local resources and flows as well as of relevant technologies.

Combined heat and power (CHP) is an important technology. Many industrial stakeholders consider the ETS as the main driver of energy efficiency in the power sector. On the other hand, it was recognised by a number of stakeholders that the implementation of the Energy Efficiency Directive (Article 14) creates potential for high efficiency cogeneration which could increase its development and also ensure its implementation throughout Europe, whilst preserving the competitiveness of EU industry.

It was pointed out by stakeholders representing industry that process industries use most of the heat from cogeneration internally and that the opportunities for economic links between industrial CHP plants and possible users such as district heating would not apply equally around Europe. Therefore, it was argued that promotion of CHP by market-based mechanisms could more appropriate than mandatory rules adopted at EU level. According to the respondents, some national schemes, for example in Italy, have already applied a market-based approach. It was stressed that criteria for determining the economic benefits of projects or installations cannot be the same across the entire EU. To this end, it was emphasised that barriers to the promotion of economic cogeneration should be removed and the need for companies to achieve economically sustainable rates of return on new projects should be recognised.

The significant energy efficiency potential in power generation could be partly tapped by removing derogations on energy efficiency under the Industrial Emissions Directive. The Large Combustion Plant BREF should include clear requirements to deliver energy efficiency improvements, particularly an incremental energy efficiency improvement for all existing combustion plants, and a CHP obligation for new plants. BAT conclusions should be drawn from the existing Energy Efficiency BREF, which should be reviewed without delay according to regular procedures but not become a simple guidance document. Increasing the flexibility of the energy system will improve efficiency and facilitate the deployment of renewable energy.

A number of stakeholders stressed that the EU should ensure that BAT energy efficiency levels are binding for thermal power generation and that a timeline for large combustion plants (LCP) to comply with it should be established. On contrary, it was argued that

Member States are implementing or have implemented strategic reserves or other forms of capacity mechanisms that often extend the lifetime of older power plants without incentivising their improvement.

Some stakeholders suggested that a single capacity mechanism design is needed at EU level, to prevent further fragmentation of the internal energy market. Optimally, this design should incentivise newer, more efficient, flexible, and part-load efficient thermal power generation.

Moreover, care is needed to ensure that European Network Codes are strongly linked to European standards to avoid the possibility of divergent national specifications, which could pose problems for efficient cross-border energy trades and functioning of retail energy markets.

It was also suggested that an Emissions Performance Standard for fossil fuel power plants to improve efficiency is introduced. This would also provide a clear investment signal for the decarbonisation of the sector by complementing the Emission Trading System (ETS). It was stressed that the Emissions Performance Standard is already becoming part of the EU climate and energy policy, following the European Investment Bank's decision to no longer fund power projects that emit more than 550gCO_2/kWh.

6) Financing mechanisms and instruments

A majority of respondents (534 or 74%) replied affirmatively that additional financial mechanisms and instruments are needed at EU level to mobilise investments targeting energy efficiency with 94 (13%) being against and 72 (10%) not having an opinion in this regard.

It was acknowledged by many respondents that access to finance remains the major obstacle to achieve the full energy savings potential across the different sectors. Therefore, more needs to be done to address the gap and the EU has a major role to play by providing a stable policy framework and facilitating long-term, low-rate financing structures as referred to in the recently published report by the Energy Efficiency Financial Institutions Group (EEFIG). Several stakeholders suggested pooling of public funding in appropriate funds and leverage private funding via public money, and that earmarked ETS auction revenue could be used for targeted energy efficiency programmes. Stakeholders argued that financing should apply to a holistic set of measures rather than single measures and that financial and fiscal incentives should be linked to concrete policy measures and targets. It was emphasised that EU funding shall allow reducing the cost of capital for companies (e.g. risk-sharing). Furthermore, it was argued that support is needed for small and medium sized enterprises to facilitate investment in uptake of more efficient technologies.

Several respondents noted that financing dedicated to energy efficiency has been increasing and that the European Structural and Investment Funds 2014-2020 and Horizon 2020 provide good opportunities for financing and should remain key instruments to support the implementation of energy efficiency policies. It was suggested that the individual starting point and progress of each Member State should be taken into account, whilst rewarding achievements and best practice. Some respondents regretted that national governments do not always consider energy efficiency as a priority. It was suggested that a specific EU funded energy efficiency programme would motivate governments who do not have energy efficiency as a priority to make such investments.

It was acknowledged by a number of stakeholders that lessons should be learned from the existing schemes that proved to be successful and that further financial mechanisms and instruments should be set up at EU level to step up the efforts of existing successful instruments such as ELENA, JESSICA, Mobilising Local Energy Investments - Project Development Assistance and the European Energy Efficiency Fund. Respondents stated that these experimental instruments triggered innovation and implementation of feasible, cost-effective and sustainable solutions at decentralised level. Amongst the views on new financing instruments, crowd-funding or cooperative societies were suggested which could provide new investment potential. In addition, an Energy Efficiency National Fund (referred to in Article 20 of the EED) could serve as an effective instrument that could aggregate multiple sources of public finance to leverage additional private investment. A number of respondents argued that such funds should become mandatory in Member States. Some respondents saw the potential in the Energy Performance Contracting mechanism, which could be encouraged through third party financing and loan guarantees in order to ease financing, especially for SMEs.

Many respondents shared views that access to finance for energy efficiency investments should go hand in hand with reducing the barriers by simplifying procedures and raising awareness amongst the market players about the underlying benefits of energy efficiency. Moreover, financing for energy efficiency measures should be provided under affordable and attractive conditions. This could be done via voluntary agreements by banks or subsidising loans for energy efficiency measures through credit lines, guarantees, etc. Such levers should be provided in a non-discriminatory manner to all market actors, which, according to respondents, is currently not the case in all Member States. In general, it was emphasised that effective coordination between public funding sources would allow getting the best leverage from financing instruments.

Furthermore, respondents suggested that Member States should establish "one-stop-shops" to help energy efficiency projects obtain funding. These structures should facilitate aggregation of projects and be accessible at the local level. It was also noted that further efforts should be dedicated to raising awareness of existing and future financial incentives and grants to foster energy efficiency investments. Several respondents stressed that financing should not place a burden on consumers who are already facing the highest level of billing to their homes, especially concerning more vulnerable consumer groups.

In the context of the Energy Tax Directive and the State Aid guidelines on environmental and energy, it was mentioned that Member States could be allowed to apply tax reductions and payback time reductions facilitated by state intervention to counteract negative impacts on competitiveness for globally competing companies. Differentiation of value added tax targeting energy efficiency shall be re-considered at EU level. Moreover, many stakeholders stressed that State Aid rules should not prevent the use of public funds to support public and commercial energy efficiency projects and that guidelines must take a progressive approach on national energy efficiency funding. Therefore, clear guidance on the state aid exemptions would be needed. On the other hand, some respondents called for tightening the rules on state aid in the fields of environment and energy.

Many stakeholders underlined the need for streamlining of financing to address energy efficiency in certain sectors of the economy such as buildings and industry.

As regards industry, views were expressed that pan-European funding is needed to stimulate investments in energy efficiency and that R&D should be promoted to support innovative technologies and solutions. For instance, investment in research and pilot projects for funding more efficient manufacturing processing of energy intensive industries could greatly contribute to the achievement of energy savings. Support for bringing new innovative technologies along the entire value chain to the market is essential, especially in the deployment phase, but should be technology neutral to ensure a level playing field. Some stakeholders from industry regretted that prevailing barriers perceived by industry are payback periods that are longer than businesses often are willing to contemplate. As an option it was suggested that measures identified during energy audits (in line with Article 8 of the Energy Efficiency Directive) which would have a payback time of less than 4 or 5 years should be mandatory. To this end, the increased use of life cycle cost analysis in energy audits (required by Article 8 of the Directive) by industry shall be secured. It was also argued that "green" public procurement and public-private partnerships should be considered. The EU could become more active in the development of risk financing for industrial large scale demonstration projects of new energy efficient technologies. Finally, direct access for energy-intensive manufacturing industry to EU Framework Programmes via e.g. the SPIRE public private partnership should be maintained and intensified.

Concerning the buildings sector, several stakeholders stated that there is an urgent need to ensure stable and long term financing for renovation programmes that goes hand in hand with political will and sufficient public funding for guarantees and incentives to ensure sufficient action in the Member States. It was stated by several respondents that the Renovation Loan in the new round of the European Structural and Investment Funds may provide a good basis for addressing part of the financing challenge is taken up by the Managing Authorities. The building sector was mentioned as a specific case in which bottom-up legislation also for financing would be necessary to correct market failures. Some respondents stressed that incentives are also needed for homeowners and landlords. A suggestion was put forward that a special fund to address renovations of buildings could be established at EU level.

7) Measures to build the capacity of actors in the energy efficiency sector

322 (45%) stakeholders replied affirmatively that additional measures are needed to build the capacity of actors in the energy efficiency sector, whilst 230 (32 %) stated that there is no need and 131 (18%) did not have an opinion in this regard.

A number of respondents stated that there is a need for active stakeholder involvement and interaction of the different market actors within the wider energy system in order to build needed capacity.

Public authorities, including at local and regional level, need EU support to develop long-term visions, update knowledge of the EU *acquis*, best practices and best available technologies, and trigger technical, financial and social innovation in order to ensure the roll-out of large-scale energy efficiency measures and investments. In order to establish a strong energy services market, there is a need to put in place education and training programmes, certification and accreditation schemes. Moreover, several stakeholders stressed that mutual recognition across the EU of professional qualifications in the field of energy efficiency should be considered.

Moreover, respondents emphasised that further awareness raising measures targeting consumers and public authorities should be implemented. Awareness raising campaigns were mentioned as an effective tool to motivate final consumers to implement energy efficiency improvement measures. It was argued that only strong customer demand will ensure the creation of adequate supply of products and services.

As regards public authorities, it was stressed that they should also play an important role by ensuring the necessary framework to facilitate the implementation of energy efficiency measures and functioning of the energy services market.

Concerning municipal authorities, it was suggested that the Covenant of Mayors should receive additional support in order to build the required capacities and disseminate good practices since it allows reaching a large number of municipalities and enables cross-sectoral policies to be implemented at local level.

8) Energy Efficient Technology solutions and their development and uptake at EU level

The public consultation also sought views on what would be the most promising technology solutions that could help deliver energy savings in the 2020 and 2030 time horizon and how their development and uptake can be supported at EU level.

Many stakeholders stressed that the required technologies to deliver the cost-effective energy savings potential to 2030 are already available. However, a strong policy framework, underpinned by a robust 2020 and 2030 energy savings target and measures to achieve it, will give industry the necessary confidence and will send the right signal to investors. It was stressed that a level playing field as regards the uptake of new technologies should be ensured and that technological solutions must also be complemented by non-technological innovation.

In the 2030 time horizon, new forms of decentralized low-carbon heating technologies such as micro-cogeneration, solar thermal, heat pumps, biomass boilers and various hybrid systems have a major role in delivering energy savings. The key advantage of the aforementioned decentralized heating technologies is their adaptability to a broad range of climatic environments and structural conditions. However, it was stressed that the uptake of these technologies requires a clear and stable regulatory framework that incentivises investments for low-carbon heating technologies. Moreover, promotion of energy management and energy auditing standards could play a role (e.g. ISO 5001/ISO 50002, EN16427).

A number of stakeholders emphasised that existing energy performance requirements should be reviewed on a more regular basis, for example, setting more stringent CO_2 emission standards for passenger cars. Also other transport modes could play a role. For instance, shipping has a vast potential for energy savings including more energy efficient engines, hull and propeller cleaning for reducing energy consumption. Some stakeholders also saw the potential for introducing automation and control systems especially in buildings to achieve energy savings.

Respondents stressed that it is equally important to support the development of new market structures and business models in order to accelerate the functioning internal market for energy services, which has been perceived by stakeholders as a driver for energy savings.

Moreover, smart cities and communities could serve as living laboratories to showcase potential solutions. In this context, R&D should play a key role in delivering further energy efficiency improvements. It was suggested that first priority could be the promotion of innovative low-carbon technologies in the context of the Strategic Energy Technologies Plan (SET-Plan), operating under the Smart Cities concept.

5. FURTHER COMMENTS:

As a last open question, the public consultation invited the stakeholders to provide further comments on energy efficiency strategy.

Here it was suggested that the EU should ensure awareness amongst the general public of efficient use of energy, including behavioural change. Moreover, it was stressed by respondents that more rapid and successful approaches are needed to phase-out inefficient products and processes from the EU market, and to ensure that sufficient numbers of experts receive the needed training for different sectors (e.g. residential and commercial buildings, industrial processes) in order to realise the energy efficiency potential in the EU.

It was stressed by several stakeholders that before adopting new measures, the impact of current policies should be analysed and evaluated. This would allow securing the needed investment and ensure better planning of industry, fostering its willingness to invest in new technologies. Stakeholders stated that the diversity of European energy efficiency markets must be taken into account and that the development of the future framework should leave the flexibility to Member States to achieve their efficiency targets.

Annex II - EU and national energy efficiency policies and their implementation

1. TARGETS AND FRAMEWORK INSTRUMENTS

Since 2007 the overall target (20% energy saving by 2020) proved to be an essential part of the regulatory framework providing political momentum, guidance for investors and a clear mandate for the Commission to act. Until 2012 there was some ambiguity as to what the 2020 target actually was. The EED solved this by clearly indicating that it is understood as primary energy consumption in 2020 not exceeding 1483 Mtoe and/or final consumption not exceeding 1086 Mtoe. The target is non-binding but allows the monitoring of Member State progress.

Defined as absolute energy consumption in 2020, the target provides a clear benchmark to measure progress. The economic crisis displayed however the limits of this approach: if the economy had developed at the rate projected in 2007 when the target was set, the projected gap would be significantly higher. Therefore even if the target is achieved some of the identified cost-effective saving potential for 2020 will remain untapped.

In its Article 7, The EED provides a powerful overarching policy instrument which obliges Member States to achieve average annual energy savings - nominally of 1.5% and, including exceptions, of at least 1.125% - on energy sales by obliging utilities to implement energy efficiency measures among final users, or through alternative measures with the same effect. Such schemes are already implemented in a number of Member States with some success. This will potentially act as a strong driver of energy efficiency as such schemes overcome several market failures, provide a stable source of financing and stimulate the development of the ESCO (energy services company) market. They should improve finance supply and incentives for building renovation.

At present, sixteen Member States have chosen an energy efficiency obligation scheme, twelve in combination with other measures. Four Member States have opted solely for an energy efficiency obligation scheme and twelve intend to achieve their energy efficiency savings targets only with the alternative measures.[1] It is considered that this policy instrument will serve as a strong driver of energy efficiency in the EU over the coming years, although it remains to be seen how well Member States will fare in terms of implementation. The 2016 review of Article 7 will assess the impact and effectiveness of this instrument.

Some cross-sectoral policies and measures lead to energy efficiency benefits. These include the Emissions Trading Directive, energy taxes and the greenhouse gas Effort Sharing Decision (ESD). Policies promoting renewable energy also lead to primary energy efficiency gains because many renewable energy sources, such as hydro, wind and solar PV, have attributed to them an efficiency factor of 1; thus, the penetration of renewable energy, in particular in power generation, reduces primary energy consumption.

[1] Study by CE Delft for European Commission, 2014

2. EFFICIENCY REQUIREMENTS FOR BUILDINGS AND PRODUCTS

With the EED, the recast of the Energy Performance of Buildings Directive (EPBD) and the implementing measures under the Ecodesign and Energy Labelling Directives (e.g. for boilers and lighting), a comprehensive regulatory framework for energy efficiency in buildings is now in place at the EU level.

This includes minimum energy performance requirements for new buildings and for existing buildings undergoing major renovation; energy performance certificates (EPCs) for buildings that are constructed, sold or rented out; and inspections of heating and air-conditioning systems; long-term building renovation roadmaps; and a requirement to renovate central government buildings.

The scale of potential improvements is vast: a recent analysis[2] shows that in the majority of Member States current efficiency requirements for new buildings, existing buildings undergoing major renovations and retrofitted or replaced elements of the envelope are significantly less stringent than cost-optimal levels, in some cases by a factor of two. Nevertheless, the effect of energy performance standards for buildings is hampered by the often limited volume of new construction and the low renovation rate (below 1% of the building stock per year in many Member States).

Compliance checking and quality control of EPCs and of inspection of heating and cooling systems is critical to tap the saving potential of buildings. Enforcement of EPCs remains an issue; for example in 2011 only 7 Member States checked the presence of EPCs at the moment of sale/renting transactions[3]. The reliability of EPCs also requires improvement and fraud needs to be avoided. Limited compliance checking of energy performance requirements in new and renovated buildings may also reduce the impact of the regulatory requirements. For instance, there is evidence of only 12 Member States having carried out quality checks of the calculation for new and existing building certificates.

Ecodesign and energy labelling requirements for energy-related products have shown their effect in improving the design of products, guiding consumers towards efficient appliances and driving a cost-effective market transformation towards more efficient products. With the recently adopted requirements for space and water heaters, requirements will cover almost the entirety of energy consumption in the household sector and a significant share in the tertiary and industrial sectors. An engineering calculation estimates that the combined savings from these measures will total 760 TWh in 2020[4]. Seven further priority product groups have been identified under a new Working Plan (including windows, servers and data centres, steam boilers and water-related products) with projected savings of around 500 TWh in 2030.

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[2] Potential implications of minimum EP requirements from cost-optimal calculations, Concerted Action report

[3] Implementing the Energy Performance of Buildings Directive ; Concerted Action report , ADENE, 2013, October 2013

[4] It has not so far proved possible to make a comparable economic calculation.

The Directives are currently being reviewed. The review has identified two key issues that hamper the full energy savings potential of this policy to be captured. First, a lack of sufficient market surveillance means that non-compliant products remain on the market and consumers may be misled when buying energy labelled products. This undermines the internal market, a level playing field for industry and the trust that consumers have in the energy label. Second, the A+, A++ and A+++ energy labelling scales that were introduced during the last revision of the energy labelling Directive have been shown to negatively affect consumers' willingness to choose more energy efficient products.

3. ENERGY GENERATION, TRANSMISSION AND DISTRIBUTION

Energy efficiency in supply was first covered by EU legislation in the Cogeneration Directive (2004/8/EC), which focused on the promotion of high-efficiency cogeneration, i.e. cogeneration achieving at least a 10% primary energy saving (PES) compared to separate heat and electricity production. The Directive set common calculation methodologies for the efficiency of cogeneration, established grid system rules on a par with electricity from renewable sources and required the creation of guarantees of origin systems for electricity from high-efficiency cogeneration.

The Directive did not prove to be effective in promoting cogeneration. The share of electricity from cogeneration in Europe remained unchanged at around 10-11% despite an identified economic potential of 21% share in EU.

The Energy Efficiency Directive incorporates all the mandatory parts of the Cogeneration Directive and enlarges its scope. It covers heating and cooling in general. It strengthens grid system and authorisation rules for cogeneration. It requires Member States to prepare a comprehensive assessment of the potential for high-efficiency cogeneration and efficient district heating and cooling based on cost-benefit analysis covering the national territory. Member States must take adequate measures to realise the economic potential for high-efficiency cogeneration and efficient district heating and cooling. New or substantially refurbished power generation and industrial installations above 20 MW must be subject to a cost-benefit analysis on the possibility of using cogeneration and/or district heating/cooling. The outcome of the country-level and installation level cost-benefit analyses must be reflected in authorizations or permits.

The EED also includes provisions linked to the management of the grid. Electricity regulators must provide incentives for TSOs and DSOs to make available to energy retailers and customers system services permitting them to take advantage of the energy efficiency potential of smart grids. They must also not prevent DSOs, , TSOs and energy retailers from offering, as system services, in "organised electricity markets" measures to: shift customers' demand from peak to off-peak (taking into account the availability of renewable energy, energy from cogeneration and distributed generation); induce them to reduce demand; store energy; or connect or dispatch electricity from distributed generators. Optimisation of demand will be also driven by provisions on appropriate metering and billing of end-users' energy consumption.

4. TRANSPORT

Energy efficiency in the transport sector is addressed through energy efficiency improvements in the transport modes themselves (e.g. minimum requirements, labelling), integration of transport modes and the internalisation of externalities in the cost of transport.

Following the recent revision of EU regulations on CO_2 emission standards for passenger cars and light commercial vehicles, the fleet average to be achieved for new passenger cars is 130 grams of CO_2 per kilometre (g/km) by 2015 and 95g/km by 2021. This compares to an average of 160g/km in 2007. The Vans Regulation limits CO_2 emissions from new vans to a fleet average of 175 95g/km by 2017 and 147 g/km by 2020. This compares to an average of 203g/km in 2007. A strategy for reducing Heavy Duty Vehicles' fuel consumption and CO_2 emissions has been recently adopted[5].

Fuel efficiency standards are complemented by CO_2 labelling of vehicles and tyre labelling. The tyre labelling regulation has already led to 80% of tyres sold on the European market showing their performance levels to consumers in a transparent manner.

Specifications on the provision of EU-wide multimodal travel information services and of real-time traffic information services are in preparation and are expected to be adopted by the Commission by the end of 2014. Work is ongoing on the standardisation of ICT to support the interoperability of cooperative systems for intelligent transport.

The Commission proposal of April 2011 for a revised Energy Taxation Directive aims at encouraging an energy efficient and environmentally-friendly use of fuels by making a link between tax rates and the fuels' energy and CO_2 characteristics. The proposal is under discussion in the Council.

Since the beginning of 2012, emissions from aviation have been included in the ETS. The amendments to MARPOL Annex VI Regulations for the prevention of air pollution from ships entered into force on 1 January 2013, adding a new chapter on energy efficiency for ships to make mandatory the Energy Efficiency Design Index (EEDI), for new ships, and the Ship Energy Efficiency Management Plan (SEEMP) for all ships. Recent international agreements targeting reduced GHG emissions in the maritime and aviation sectors will also improve these modes' efficiency. In October 2013 the ICAO Assembly agreed to develop by 2016 a global MBM to apply it by 2020. On maritime emissions, the Commission presented a strategy to integrate the sector in the EU’s greenhouse gas reduction policies and will work with International Maritime Organisation on a global approach to achieve the necessary emissions reductions through the most appropriate measures[6].

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[5] COM(2014) 285 final

[6] COM (2013) 479

5. FINANCING, TECHNICAL SUPPORT AND CAPACITY BUILDING

Energy efficiency investment worldwide has been growing, reaching $300 bn in 2011[7]. This has been driven by more favourable regulatory environments[8] and by evidence of the business case for such investments[9].

Under the previous Multiannual Financial Framework (2007-2013), the European Union has provided increasing financial support for energy efficiency measures and investments through a wide range of programmes and funding instruments, including the EU Cohesion Policy fundings, the European Energy Efficiency Fund (EEE F) and the Intelligent Energy Europe Programme II as indicated in Table below.

Table 23: Funding for energy efficiency under the previous Multiannual Financial Framework (2007-2013)

Funding Source	Instruments/mechanisms	Total funding available	Funding for EE
Cohesion Policy funding	Operational Programmes incl. financial instruments	€ 10.6 billion for sustainable energy (RES & EE)	€ 6.1 billion for EE, co-generation and energy management
Research Funding	FP 7 (e.g. Concerto, E2B PPP, Smart Cities)	€ 2.35 billion for Energy research	€ 290 million for energy efficiency
Enlargement Policy Funding	IFI facilities (SMEFF, MFF, EEFF)	€ 552,3 million (381,5 +117,8 +53 respectively)	About one third of total funding for projects in industry and buildings
Programme for European Energy Recovery (EEPR)	European Energy Efficiency Fund (EEE F)	€ 265 million	70% of funding to be dedicated to energy efficiency
Competitiveness and Innovation Funding (CIP)	Intelligent Energy Europe Programme (including ELENA) Information and Communication	Approximately € 730 million for each programme	About 50% of the funding was dedicated to energy efficiency in all sectors

[7] IEA (2013), Energy efficiency market report 2013

[8] Regulatory requirements concerning the energy efficiency of buildings are being tightened in a number of countries, with the EU leading the way. These requirements push the average performance of buildings upward. Buildings with low performance are losing value as the benchmark moves up and may be difficult to sell since they will require upgrades to meet legal requirements.

[9] For example in the US, buildings with an Energy Star label have stronger financial performance than similar unlabelled buildings: 13.5 per cent higher market values, 10 per cent lower utility costs, 5.9 per cent higher net income per square foot, 4.8 per cent higher rents and 1 per cent higher occupancy rates. In the EU an analysis of developments in several Member States concluded that a one grade increase on the scale of a building Energy Performance Certificate corresponded to an approximately 4% increase in its values

	Technologies Policy Support Programme (ICT PSP)		

Under the EU Cohesion Policy funding 2007-2013, EUR 12.5 billion of programme funding was channelled through 870 specific Financial Instruments, out of which EUR 444 million through 16 Financial Instruments in eight Member States for energy efficiency and renewable energy. So far (2012 data), of the latter amount, EUR 90 million was disbursed to final recipients through 13 392 loans.

Under the Intelligent Energy Europe Programme, EUR 148 million has been earmarked for project development assistance under the ELENA Facility (implemented through the EIB, KfW, EBRD and CEB) and the "Mobilising Local Energy Investments" strand of the IEE Programme (implemented via EACI/EASME). The grant support is provided to public authorities to develop and launch sustainable energy investments, with a minimum leverage (EU grant to total investment launched) of 1:20 and 1:15, respectively. So far, EUR 81.2 million has been provided to 56 projects, expected to lead to investment worth EUR 4.032 billion.

Under the European Programme for Economic Recovery, the Commission together with participating Financial Institutions has piloted the set-up and operation of the dedicated European Energy Efficiency Fund (EEE F), where EU contribution of EUR 125 million has been matched by additional EUR 140 million provided by the European Investment Bank, Cassa Depositi e Prestiti and Deutsche Bank, under the Fund management by the latter. As of end March 2014, EUR 217 million has been allocated to 13 investment projects.

An initial assessment of these instruments suggests that (a) there has been some success in addressing the market failures that hamper the uptake of energy-efficient solutions; (b) EU level instruments like EEE F help providing long term innovative financing models and replication but have more difficulty to overcome market fragmentation; (c) differences in national circumstances, cultures and financial systems mean that a single European solution, such as an EU-wide equivalent to Germany's KfW, is not the answer, and what might be needed instead is a robust framework enabling better understanding, knowledge, transparency, performance measurement and de-risking at the EU level, accompanied by tailored Financial Instruments at the appropriate level, closer to final beneficiaries.

EU funding has been complemented at the Member state level, where prevailing public finance support has been provided through grants and subsidies, followed by soft loans. Only few Member States experimented with tax incentives and market based instruments (such as white certificates) so far.

Table 24: Energy efficiency support provided in the EU Member States[10]

	AT	BE	BG	CY	CZ	DE	DK	EE	ES	FI	FR	GR	HU	HR
Grants/subsidies	X	X	X	X	X	X		X	X	X	X	X	X	X
Loans		X	X		X	X		X	X		X	X	X	X
Tax incentives		X					X			X	X			
EEO/WC		X					X				X			

	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Grants/subsidies	X	X	X	X	X	X	X	X	X	X		X	X	
Loans			X				X	X		X			X	X
Tax incentives		X					X							
EEO/WC		X												X

Hand in hand with the evolving policy framework, as well as with the realisation that the main problem to address is potentially not the lack of funding but rather its accessibility and affordability, the provided EU financial support has extended its nature from pure grants towards more sophisticated and investment-linked support, addressing the issues related to capacity (to structure bankable investments) and sub-optimal investment levels (caused by the risk-aversion attitude of investors and lenders or affordability for borrowers, among other issues). It became increasingly clear that public finance should be rather used as a trigger for the private capital participation, through various forms of financial Instruments (such as risk-sharing or credit enhancement mechanisms).

The experience gained so far has been reflected in the design of the new Multiannual Financial Framework for the years 2014 – 2020. The regulations for the new set of EU Programmes bring a different understanding of the role of public funds in the area of energy efficiency.

Table 25: Energy efficiency funding allocation under the Multiannual Financial Framework for the years 2014-2020

Funding Source	Instruments/mechanisms	Total funding available	Funding for EE
European Structural and Investment Funds	Operational Programmes incl. financial instruments (e.g. off -the-shelf instruments etc)	Minimum € 27 billion for low-carbon economy investments including energy efficiency	to be defined in the Operational Programmes
Research Funding	Horizon 2020 (e.g. Energy Efficiency, E2B PPP, SPIRE PPP,	€ 5.6 billion for the whole energy challenge	ca € 840 million for energy efficiency

[10] JRC (2014): Draft report on financing of energy efficiency in buildings

	Smart Cities)		including the ELENA Facility not including the funding for EeB PPP and SPIRE PPP
Programme for European Energy Recovery (EEPR)	European Energy Efficiency Fund (EEE F)	€ 48 million (under first closing) plus expected further capital after second closing	70% of funding to be dedicated to energy efficiency
LIFE +	EIB guarantee facility for retail banking sector for EE lending	€80 million (launch phase 2014 – 2017)	full allocation

The implementation principles for the European Structural and Investment Funds (stress that public funding should complement private investments, leveraging it and not crowding it out; call on Member States to consider creating value for energy savings through market mechanisms before public funding (energy saving obligations, energy service companies (ESCOs)…); highlight that financial instruments should be used where potential for private revenue or cost savings is sufficient and remind that grants should be used primarily for social objectives, to support innovative technologies and investments going beyond minimum energy requirements, thus making sure that energy savings achieved with the public funding support are above those that would be achieved at the "business as usual" level (without the public support).

The European Structural and Investment Funds for the first time ring-fence[11] a significant EUR 27 billion (estimated minimum) specifically for low carbon economy investments including energy efficiency. Managing Authorities are particularly encouraged to set up financial instruments using their allocation to leverage additional private capital participation while providing market based support instruments (such as tailored loans or guarantees). To ease and speed-up the application of Financial instruments, "off-the-shelf" instruments are being designed by the Commission, to set the framework upon which faster replication of financial instruments can be enabled. In the area of energy efficiency, the "Renovation Loan" off-the-shelf instrument is under preparation, based on a risk-sharing loan model.

The new EU Programme for Research and Innovation, Horizon 2020, addresses the innovation challenges of the EU and incorporates elements of the previous research and innovation programmes, FP7 and Competitiveness and Innovation Programme (Intelligent Energy Europe). The Horizon 2020 earmarks EUR 5.6 billion for energy, out of which at least EUR 840 million is planned to be allocated for energy efficiency part of the

[11] A minimum 12%, 15% or 20% of the ERDF allocation has to be invested into the "shift to low-carbon economy" investments in less developed, transition and more developed regions of the EU, respectively.

programme, addressing both technology-related and non-technology-related innovation challenges. It also continues to provide specific support for development and launch of innovative investments, expanding its scope to private sector operators. Elena Facility continues under the programme.
Further, the LIFE + Work programme 2014-2017 has earmarked EUR 80m for a new EU risk-sharing (guarantee) facility with the EIB - "Private Finance for Energy Efficiency" Instrument, dedicated to extend the provision and enhance the affordability/attractiveness of debt financing for energy efficiency investments at the retail lending level.

Finally, the European Energy Efficiency Fund (EEE F), still remains operational, investing into sustainable energy projects, with (as of 31/3/2014) EUR 48 million still available and expected second closing which would bring additional investors to achieve its target size of EUR 600 million.

Annex III - Decomposition analysis of energy consumption trends at EU and Member State level.

1. METHODOLOGY

The decomposition analysis is based on the LMDI (Logarithmic Mean Divisia Index) method[12]. This method has two main advantages[13]:

- In difference to other methods used, for example the simple Laspeyre factorization method**Error! Bookmark not defined.**, the LMDI does not generate residuals which cannot be explained

- The method is easily applied to a larger number of factors which is not the case for other decomposition methods which generate quite complex formulae in such cases.

The analysis of primary energy consumption is carried out at two levels:

- First the energy conversion sector is analysed as a whole by distinguishing three energy sector branches: electricity, heat and other sectors (which comprises solid fuels, petroleum products, gas, renewable and wastes not used for electricity or heat generation) (Level 1, see Figure 6).

- Second the developments in the electricity and heat sector are analysed in greater detail (level 2, see Figure 2).

Level 1 analysis takes into account:

- Changes in energy available for final consumption[14], excluding non-energy uses
- Changes in the distribution losses across all energy sector branches
- Changes in the energy sector consumption
- Changes in the structure of the energy sector (mainly the influence from the increasing penetration of the electricity sector, which has a lower conversion efficiency as compared to the other branches of the energy sector).
- Changes in the efficiency of the electricity and heat sector (which is mainly driven by the structural change within the electricity sector, in particular by the penetration of renewable, see below).

[12] See for example http://www.ise.nus.edu.sg/staff/angbw/pdf/A_Simple_Guide_to_LMDI.pdf. We use the LMDI-I method. A more complex LMDI-II method has also been developed.

[13] See for example B.W. Ang: The LMDI approach to decomposition analysis: a practical guide, Energy Policy Volume 33, Issue 7, May 2005, Pages 867–871

[14] This differs from final energy consumption in a minor manner through the inclusion of statistical differences.

Figure 6: Structure for the Level-1-Analysis of changes in Primary Energy Consumption

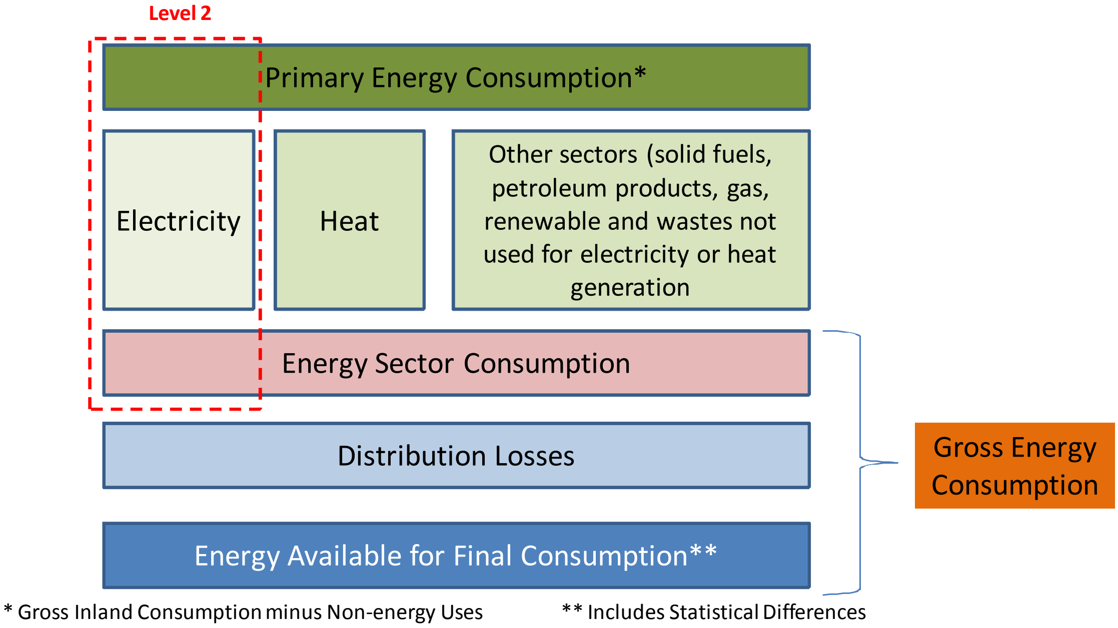
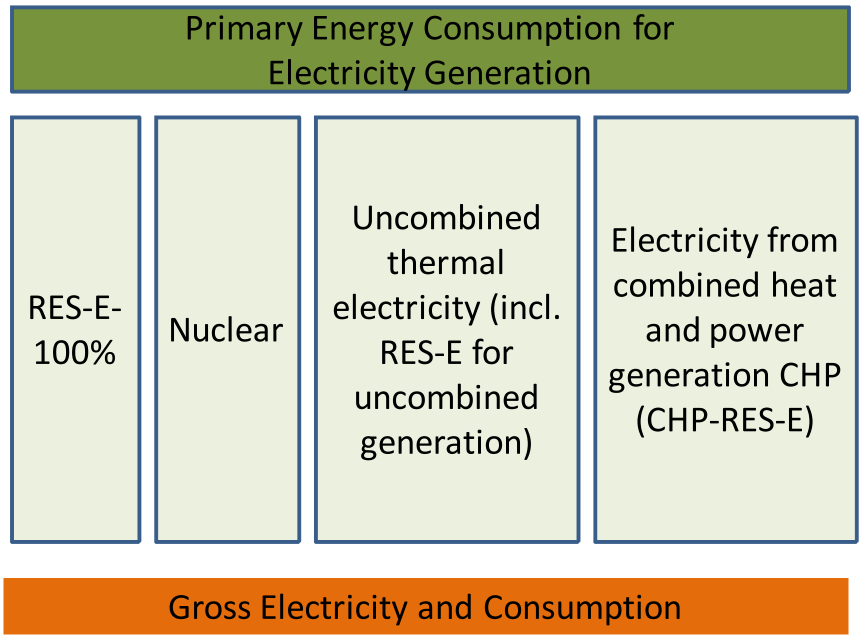


Figure 7: Structure for the Level-2-Analysis of changes in Primary Energy Consumption (impact of electricity sector)



Level 2 analysis with a focus on the electricity sector (**Error! Reference source not found.**) takes into account:

- The change in Gross Electricity Consumption (which includes distribution losses and electricity consumption of the energy sector

- The penetration of "100% efficiency renewables" (RES-E-100%), that is wind energy, solar PV, hydro power, wave/ocean/tidal energy[15].
- The decrease in the share of nuclear (with a nominal conversion efficiency of 33%) due to the phase-our strategies in some Member States
- The penetration of electricity from Combined Heat and Power generation CHP
- The efficiency improvement in uncombined thermal electricity generation (including renewable/wastes for uncombined generation.

2. RESULTS EU LEVEL

Figure 8: Decomposition analysis of changes in primary energy consumption 2008-2012 (Level 1)

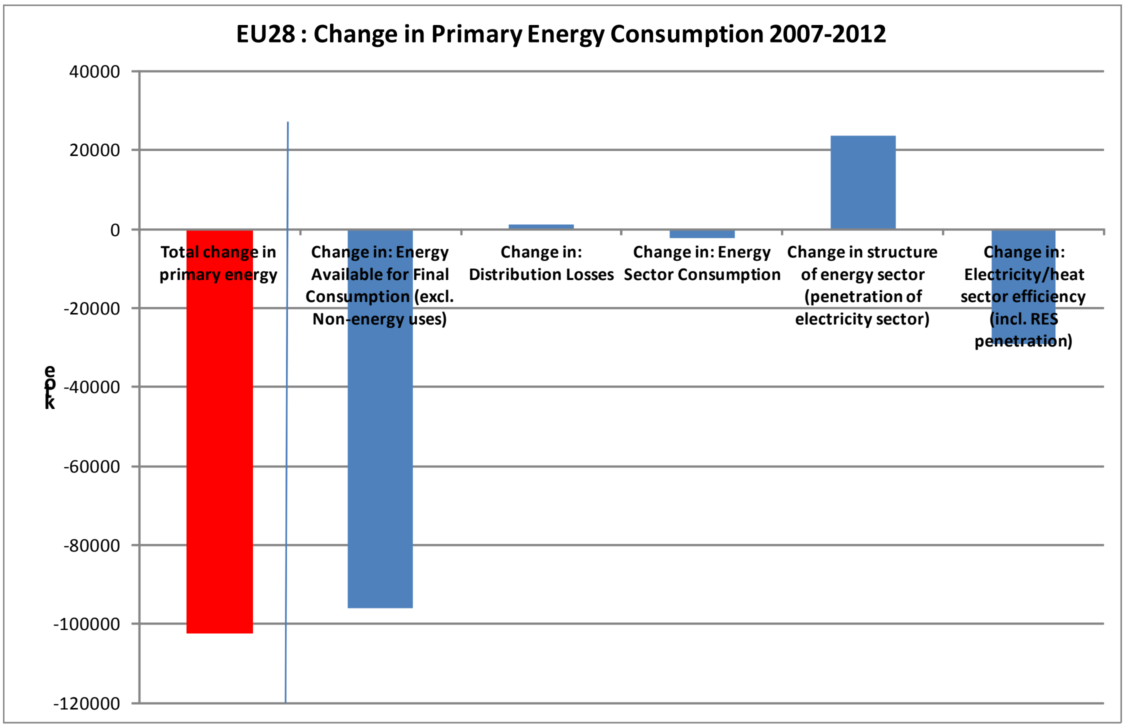


Figure 8 shows the Level-1 analysis of Primary Energy Consumption:

- The total change in Primary Energy Consumption in the period 2008-2012[16] was -100 Mtoe.[17]

[15] Note that solar thermal (both Concentrated Solar Power CSP and solar thermal for heat provision) are not accounted for in the same manner in Eurostat balances as are the other RES100%. These are directly accounted for in Gross Inland Consumption and are passed through to the electricity sector as Interproduct Returns. Solar Thermal (CSP) enters the transformation inputs as the solar heat is converted to steam.

[16] Starting year of the factor analysis is 2007 as the last year before the period 2008-2012 under consideration

[17] All graphs and figures in this annex are primarily based on input data from Eurostat

- The main reason for the decrease was the decrease in final energy which amounted to -70 Mtoe from 2008 to 2012 but which in primary energy terms translates to -96 Mtoe.
- Distribution losses (+1.3 Mtoe, possibly due to a penetration of distributed renewables) and Energy Sector Consumption (-2.3 Mtoe) had smaller influence on the changes in primary energy consumption.
- A comparatively large increase in primary energy with +24 Mtoe came from the further penetration of the electricity sector in the structure of the energy sector branches.
- This was more than counterbalanced with -29 Mtoe by an improvement in the electricity sector efficiency, which in fact comprises different factors of influence, among others the penetration of RES-E-100%, see the analysis at Level-2.

Figure 9: Decomposition analysis of changes in primary energy consumption 2000-2012 (Level 1)

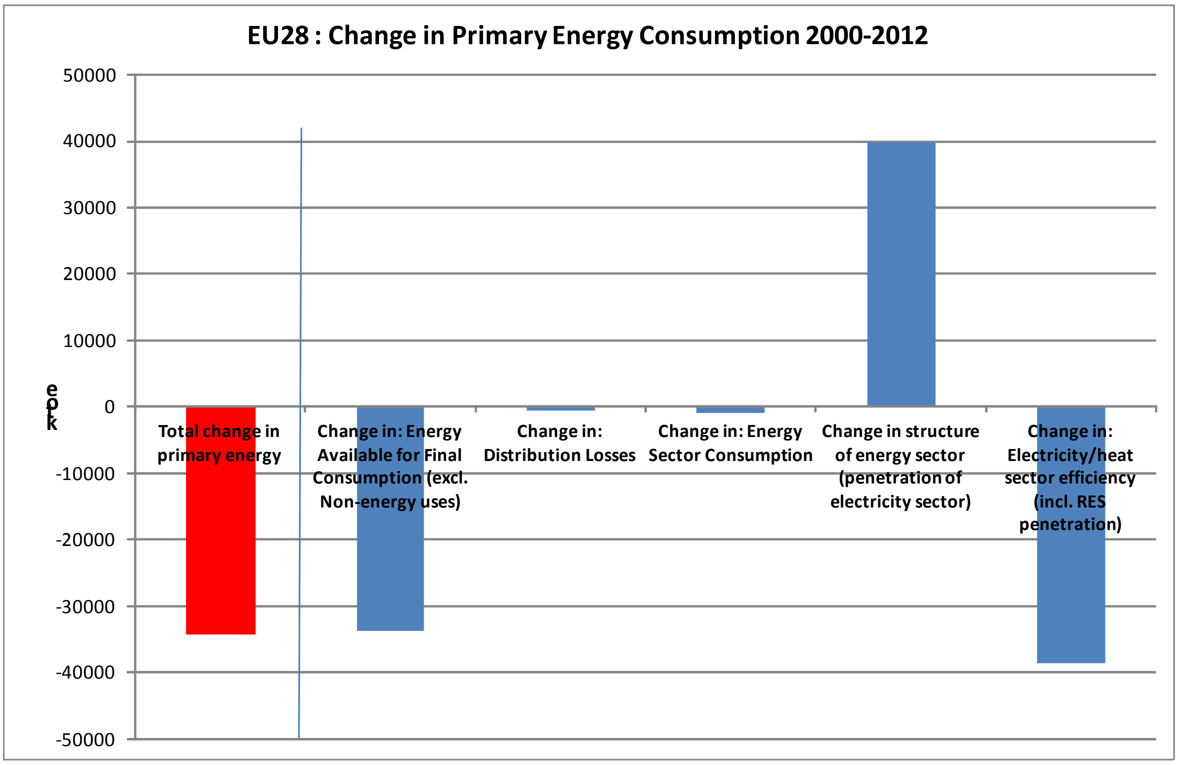


Figure 9 shows for comparison purposes the decomposition analysis for the longer time period 2000-2012. The main differences with the analysis for the period 2008 to 2012 is that primary energy is decreasing less (-34 Mtoe), that the penetration of the electricity sector was more pronounced (+40 Mtoe) but which was also nearly totally counterbalanced by the developments in electricity sector efficiency (-39 Mtoe).

Level-2 analysis shows the details of what happened in the electricity conversion from primary energy consumption to gross electricity consumption (Figure 10):

- The total change in primary energy consumption due to electricity generation was -34 Mtoe in the period 2008-2012. This was the combined effect of a decrease in gross electricity consumption (impact -15 Mtoe in primary energy terms), a change in the structure of electricity generation which induced a reduction of 29 Mtoe in primary energy, a worsening in thermal electricity generation which induced an increase in primary energy consumption of 10 Mtoe (possibly due to partly low capacity use of part of the thermal power plants).
- The structural effects were due to four individual components:
  - The increasing penetration of RES-E-100 and CHP electricity increased Primary Energy Consumption by 18 Mtoe and 0.4 Mtoe respectively.
  - However, this was by far overcompensated by the decrease in nuclear (-5 Mtoe primary energy) and uncombined thermal power generation (-42 Mtoe) with their much lower efficiencies.

For comparison Figure 11 shows the same analysis for the longer period from 2000 to 2012. The main difference is that the electricity sector still increased primary energy consumption by 11 Mtoe, especially to the still strong increase in gross electricity demand (+46 Mtoe in primary energy terms), the counterbalancing effect of the structure changes in electricity generation (-49 Mtoe)

Figure 10: Decomposition analysis of changes in primary energy consumption due to electricity generation 2008-2012 (Level 2)

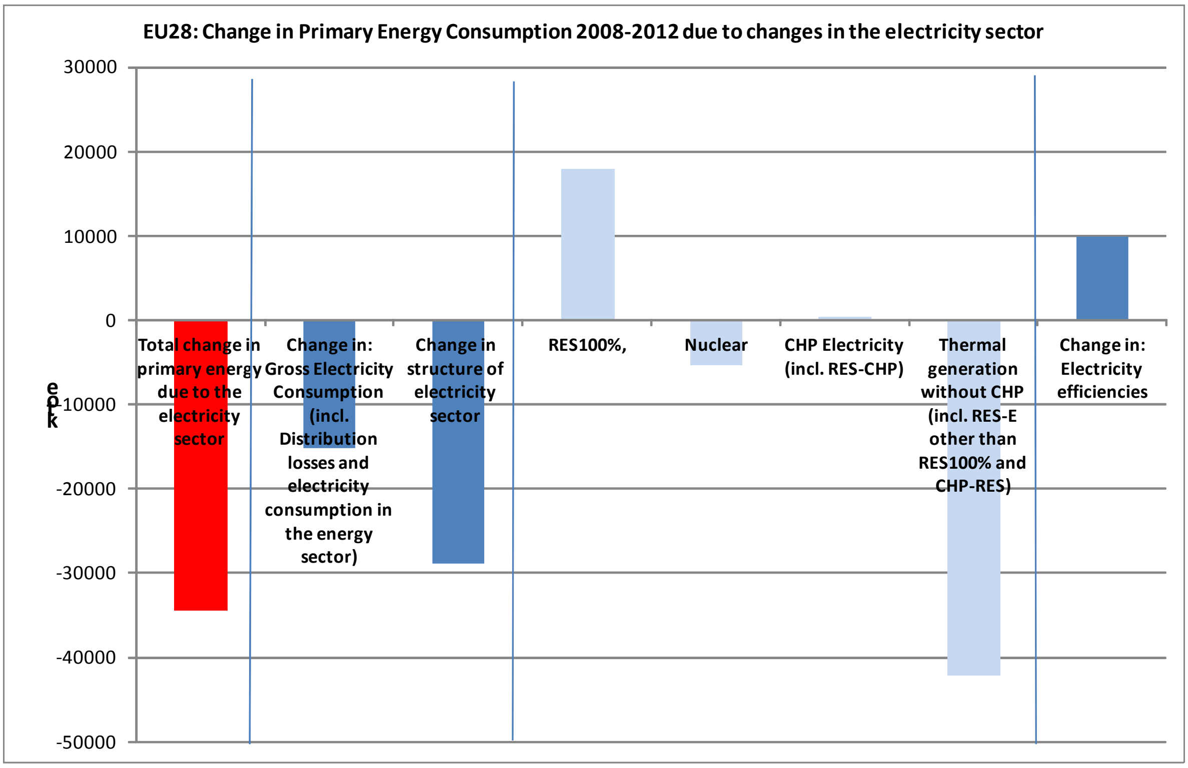
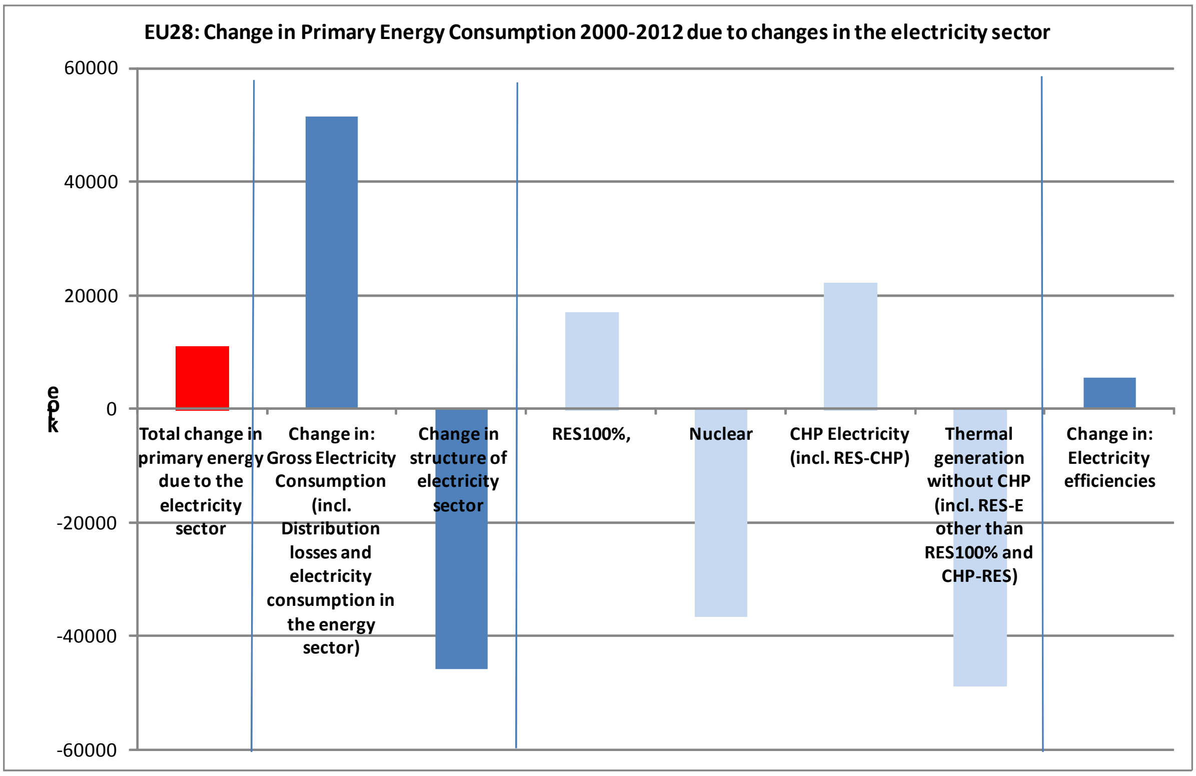


Figure 11: Decomposition analysis of changes in primary energy consumption due to electricity generation 2000-2012 (Level 2)



2.1. Decomposition analysis of final energy consumption

In the previous section we identified as the main driver for the decrease in primary energy consumption from 2008 to 2012 the decrease in final energy which amounted to -67.1 Mtoe but which in primary energy terms translated to -96 Mtoe. In this section we will analyse the details of the different final demand sector to the change of -67.1 Mtoe. An overview is provided by Figure 12. This change is due to changes in activity levels in the different sectors with nearly -33 Mtoe, further counter balancing impacts of structural changes in industry, modal shift in transport as well as comfort and social factors, climatic differences between the beginning and the end of the period, and finally an important contribution of energy efficiency with a reduction of nearly 53 Mtoe in the historic period 2008-2012 (around 10.5 Mtoe or 1.0% annually compared to the overall final energy demand in 2012). More sectoral details can be found in the following section. This comprises both the impacts of autonomous energy savings and the impacts of energy efficiency measures.

Figure 12: Decomposition analysis of changes in final energy consumption 2008-2012

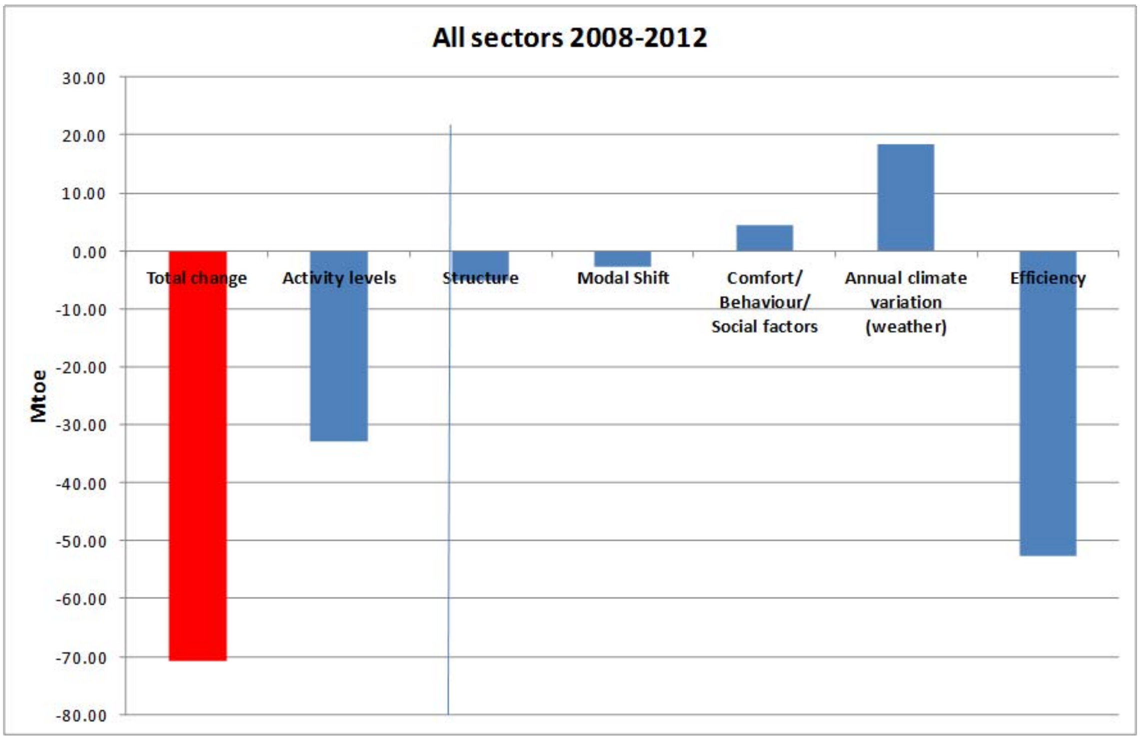


Figure 13: Decomposition analysis of changes in final energy consumption 2000-2012

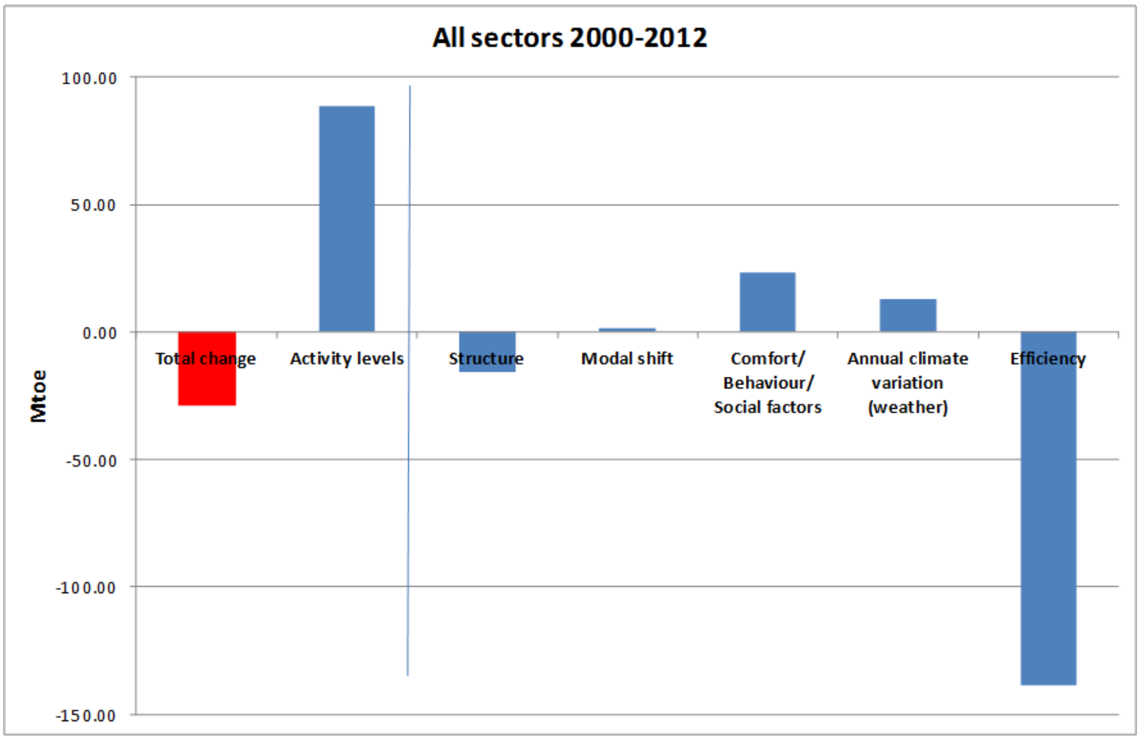


Figure 13 provides the same information for the longer period 2000 to 2012. The main difference with the period 2008 to 2012 is that activity changes were contributing to an increase in final energy consumption, as well as comfort factors, while energy efficiency improved more strongly with 11.5 Mtoe annual savings or 1.05% of final energy consumption of 2012. As an overall result final energy decreased since 2000 only by around 28 Mtoe, as up to 2005 final energy demand was still increasing.

2.2. Sectoral results of the decomposition analysis of final energy consumption

Figure 14 shows that industry and transport reduced most final energy consumption in 2008-2012 while in 2000-2012 mainly industry contributed while services strongly increased final energy consumption in the longer period. However the reasons for this development were quite different from sector to sector:

- The **residential sector** (Figure 15) had quite important contributions to energy efficiency in 2008 to 2012 with 1.3% of energy consumption saved annually. However this was compensated by the increase in activity (population), social factors (less persons in dwellings, hence more dwellings), comfort/behavior (e.g. more heated surfaces in homes) and by climatic influences (as 2012 was a cold year as compared to the reference year 2007 for this period).

- For **industry** (Figure 16) activity effects (impact of the economic crisis), structural effects as well as efficiency effects all contributed to reduce energy consumption in the period 2008-2012, while in the longer period 2000-2012 the activity effect was positive. However, the savings rate has slowed down to below 0.96% annual savings in the period 2008 to 2012 as compared to 1.40% over the longer period 2000-2012.

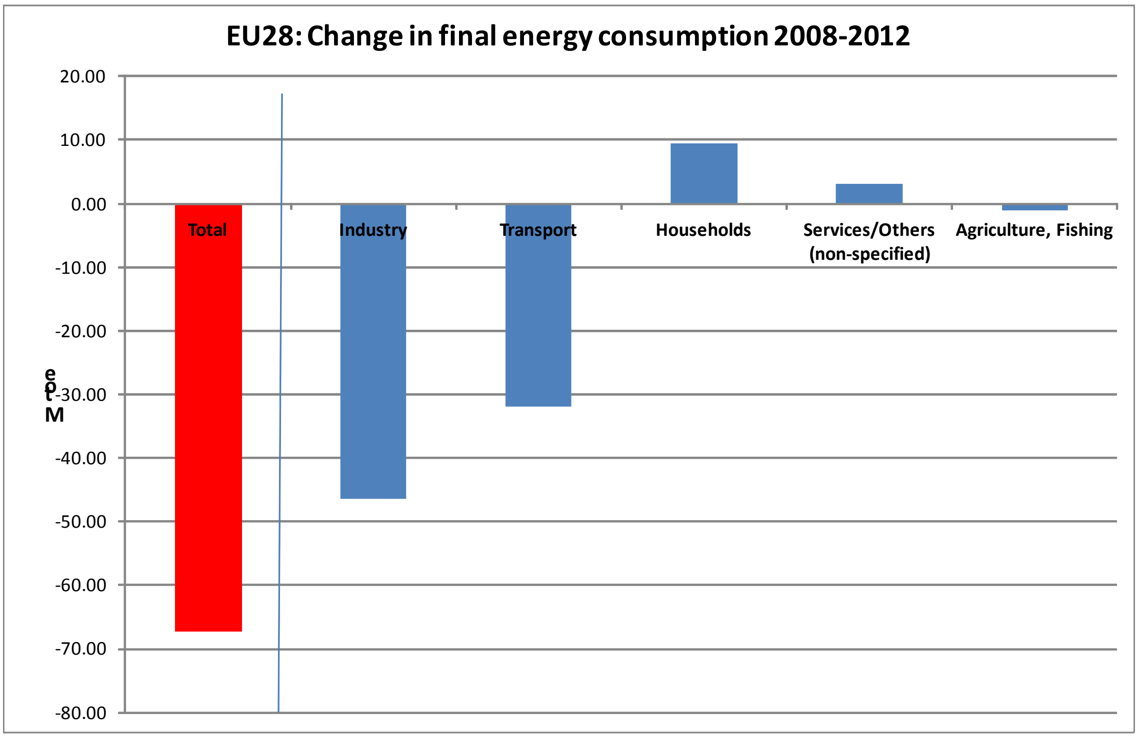
- For **passenger transport** (Figure 17) efficiency effects (CO_2 standards) strongly contributed to the reduction in energy consumption while activity effects were modest compared to the longer period 2000-2012. As passenger transport is less influenced by the impacts of economic down-turn, this is also a sign of saturation effects in transport. The annual savings rate is with 2.2% per year quite high.

- **Goods transport** (Figure 18) is like industry strongly impacted by the economic development, hence a negative activity effect from 2008 to 2012. The efficiency effect is reversed (annual increase 0.1% per year between 2008 and 2012.

- In **Services** efficiency effects cannot be separated from structural effects at the level of the EU as a whole but only for some MS.

- **Agriculture, fishing and other sectors** (Figure 19) is mainly dominated by efficiency changes which may also contain nevertheless some structural changes.

Figure 14: Sectoral decomposition of changes in final energy consumption 2008-2012 and 2000-2012



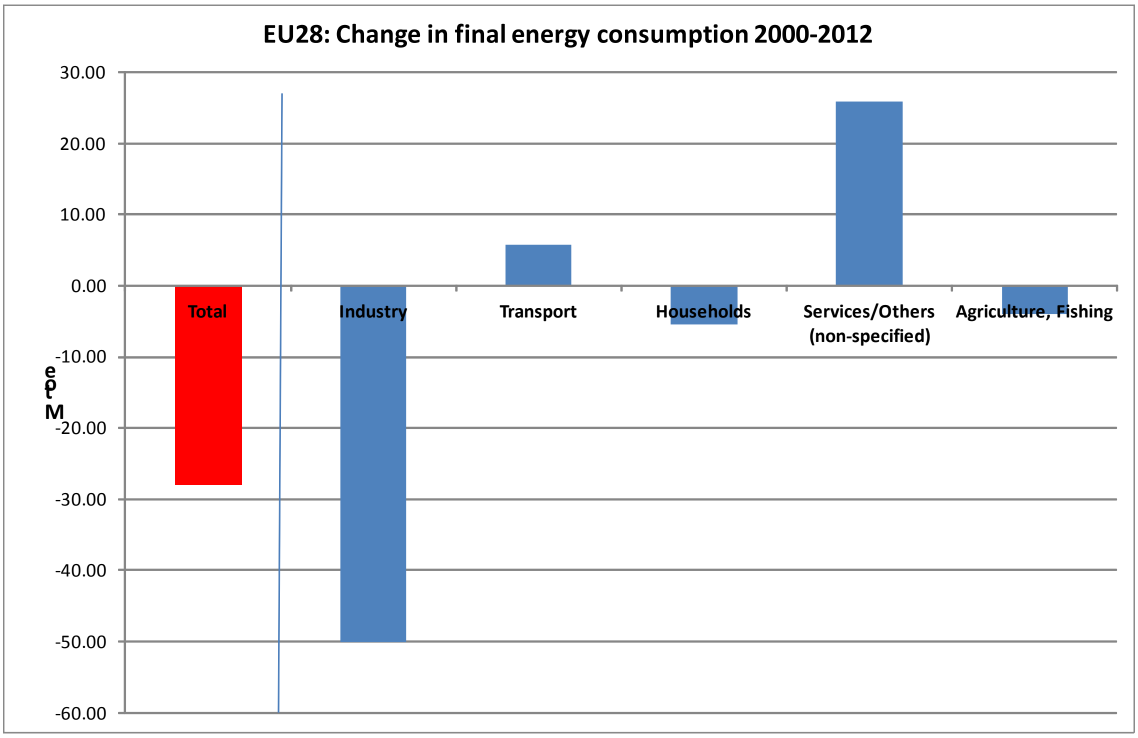
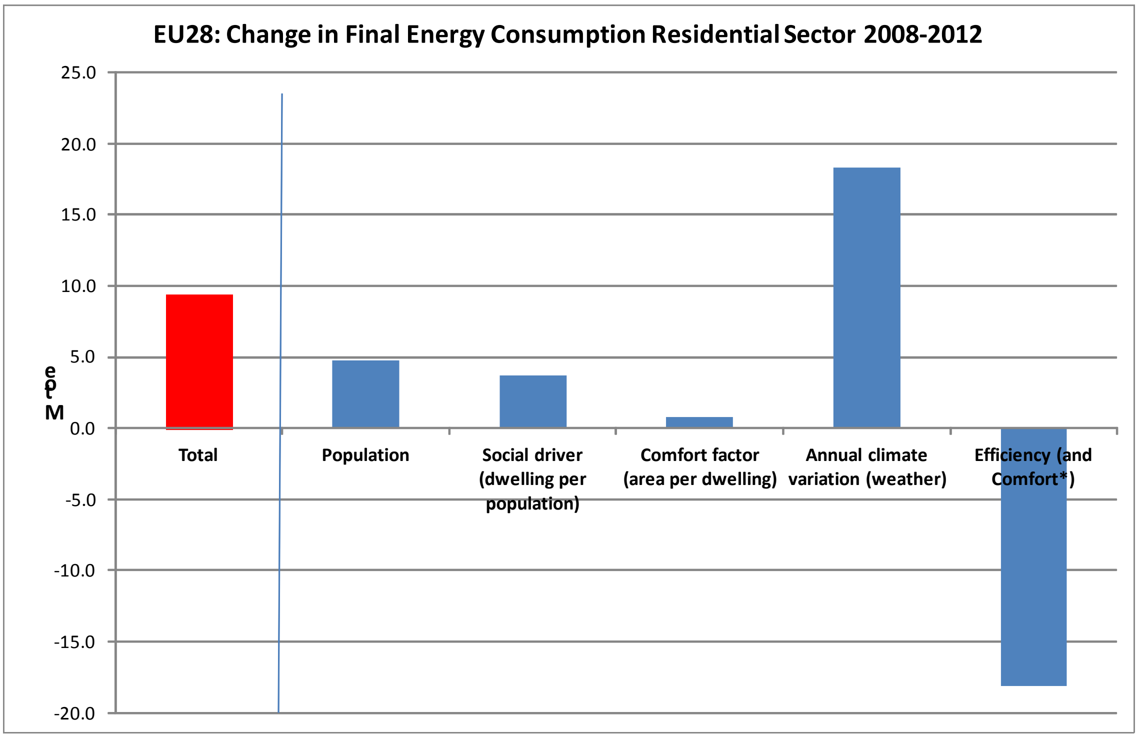
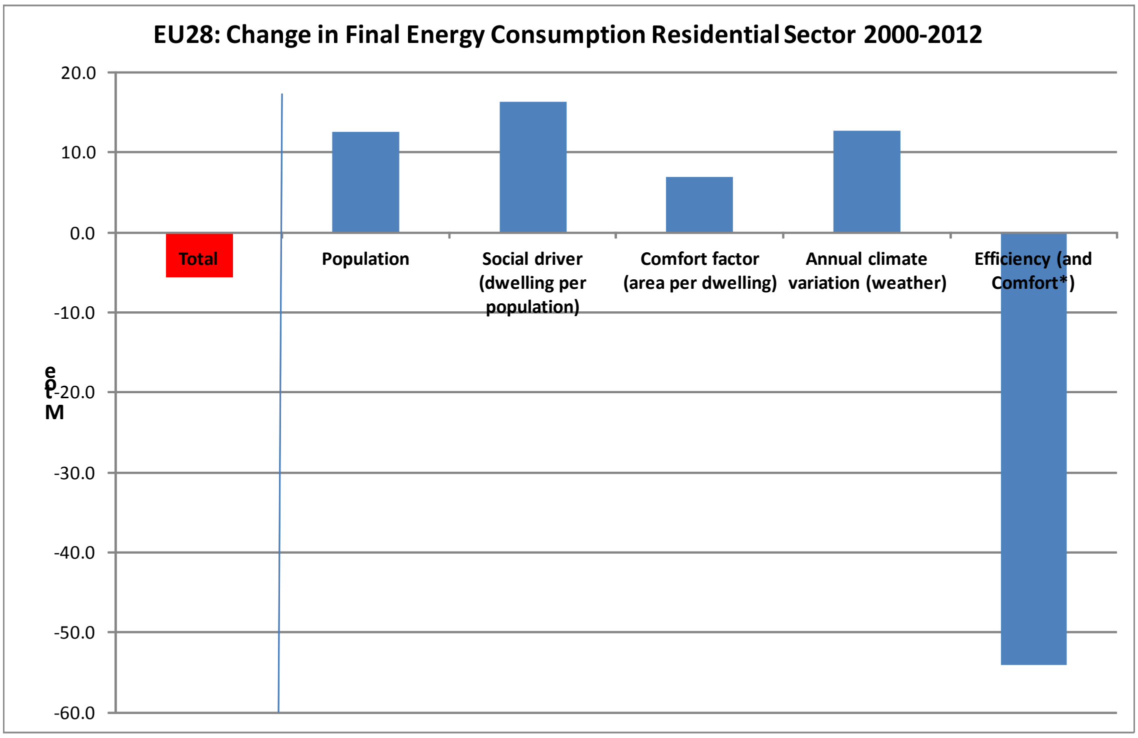


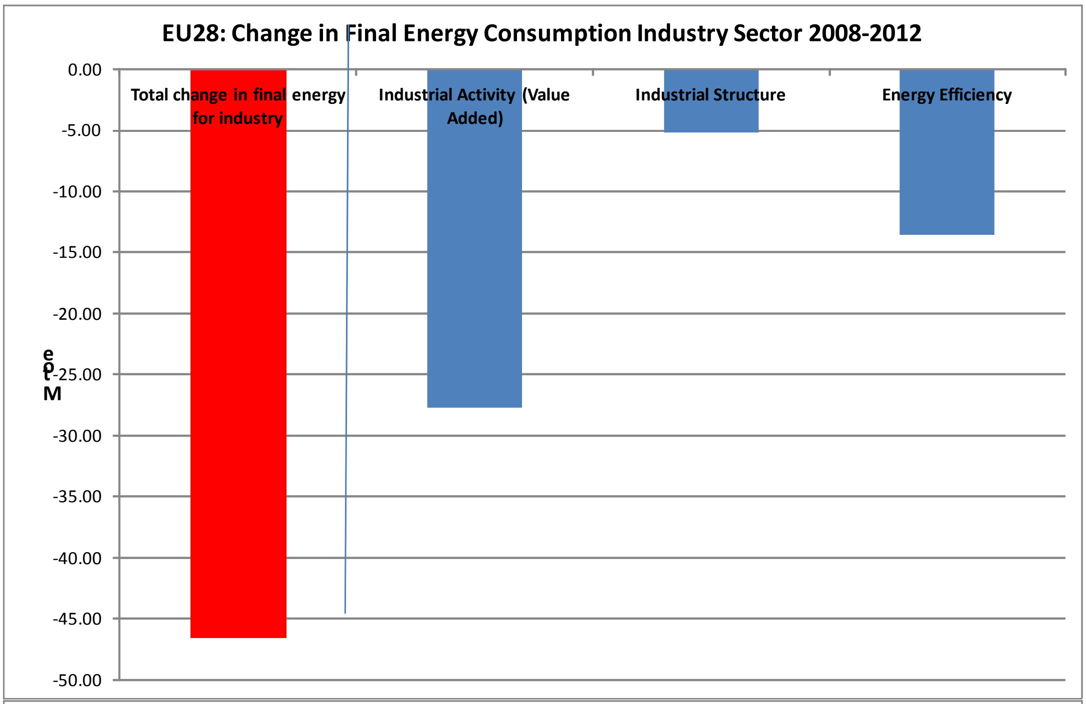
Figure 15: Sectoral decomposition analysis (residential sector) of changes in final energy consumption 2008-2012 and 2000-2012

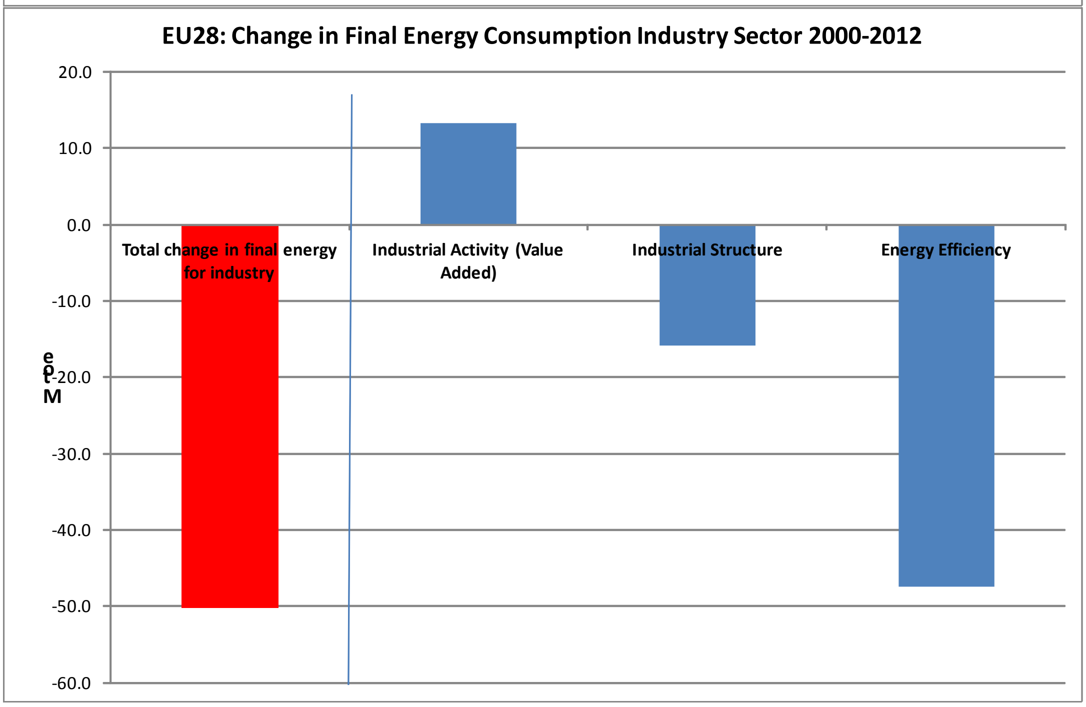




Note: The sector is broken down to the applications space heating, sanitary water heating, cooking and electric appliances/lighting. Some comfort factors in the trend towards more smaller electric appliances per dwelling could not be separated from efficiency effects for data reasons.

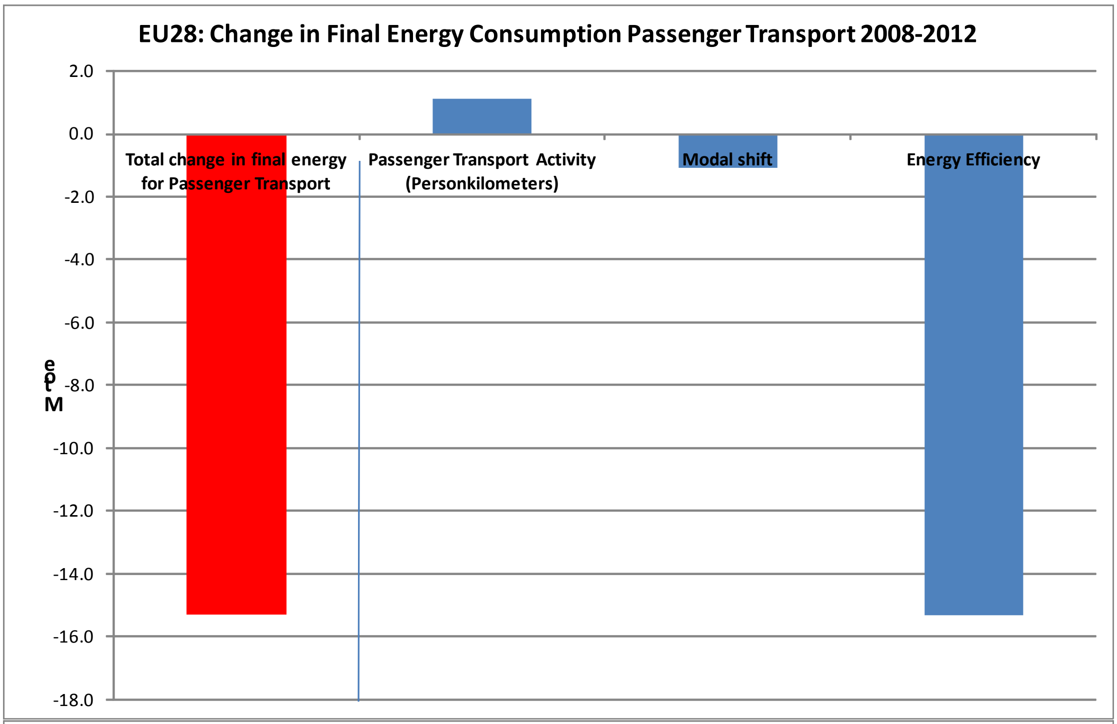
Figure 16: Sectoral decomposition analysis (industry sector) of changes in final energy consumption 2008-2012 and 2000-2012 (lower figure)

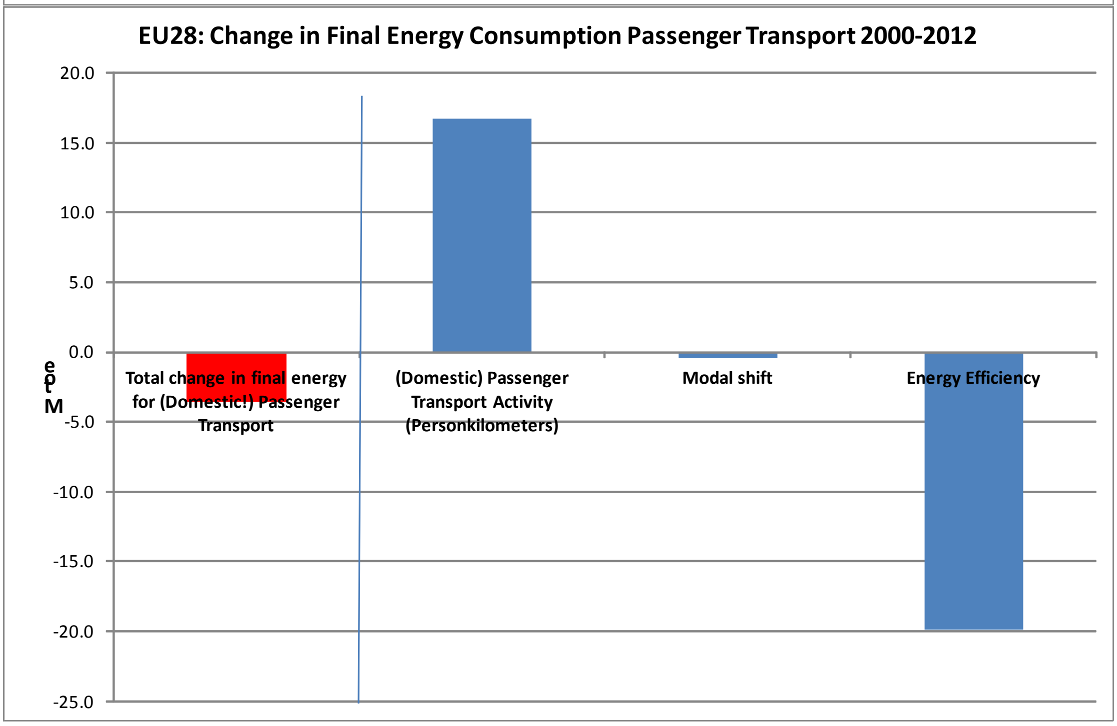




Note: the impacts of the industrial structure are based on the NACE-2 decomposition as used in the energy balance. Further structural changes at lower levels are small.

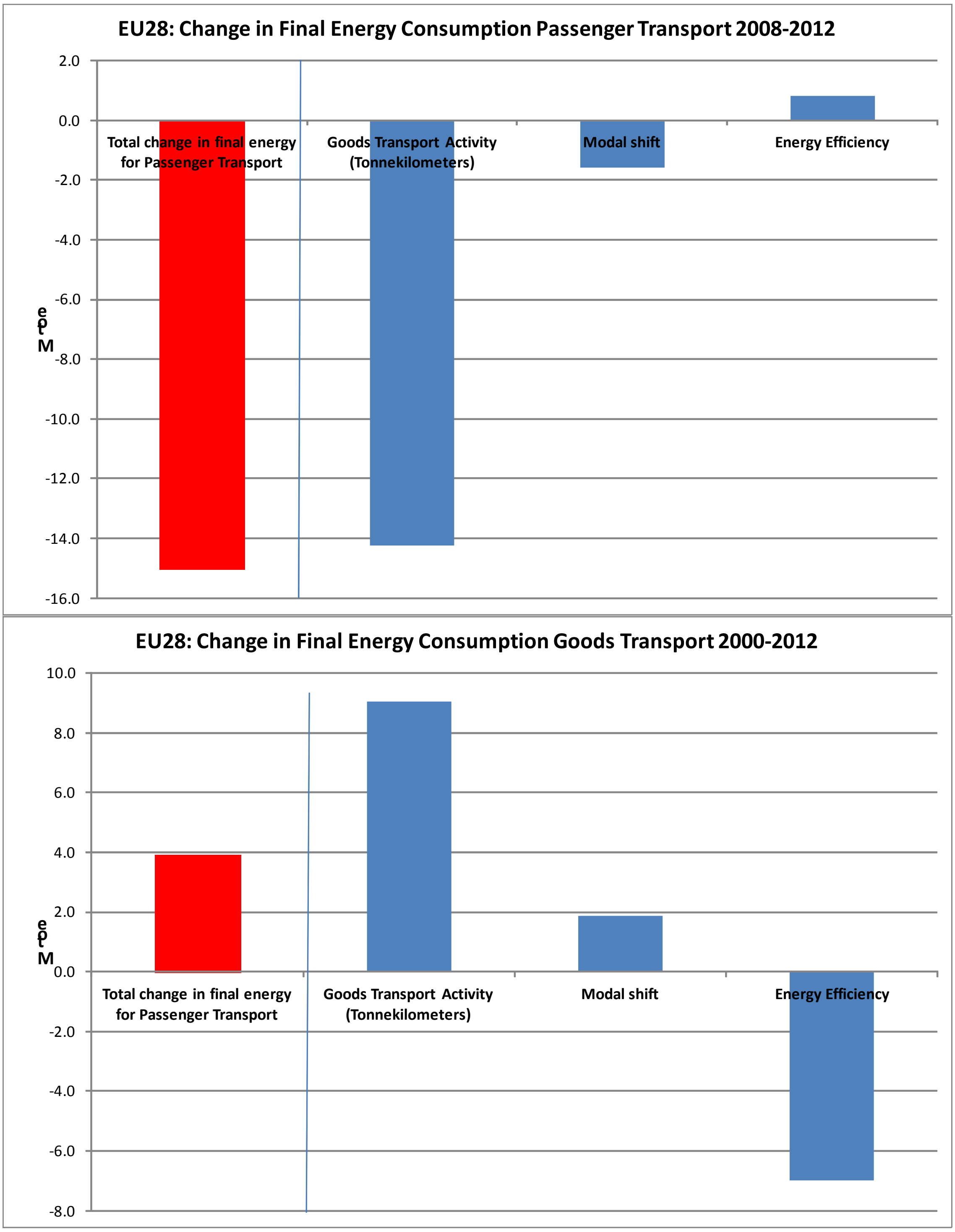
Figure 17: Sectoral decomposition analysis (passenger transport sector) of changes in final energy consumption 2008-2012 (upper figures) and 2000-2012 (lower figure)





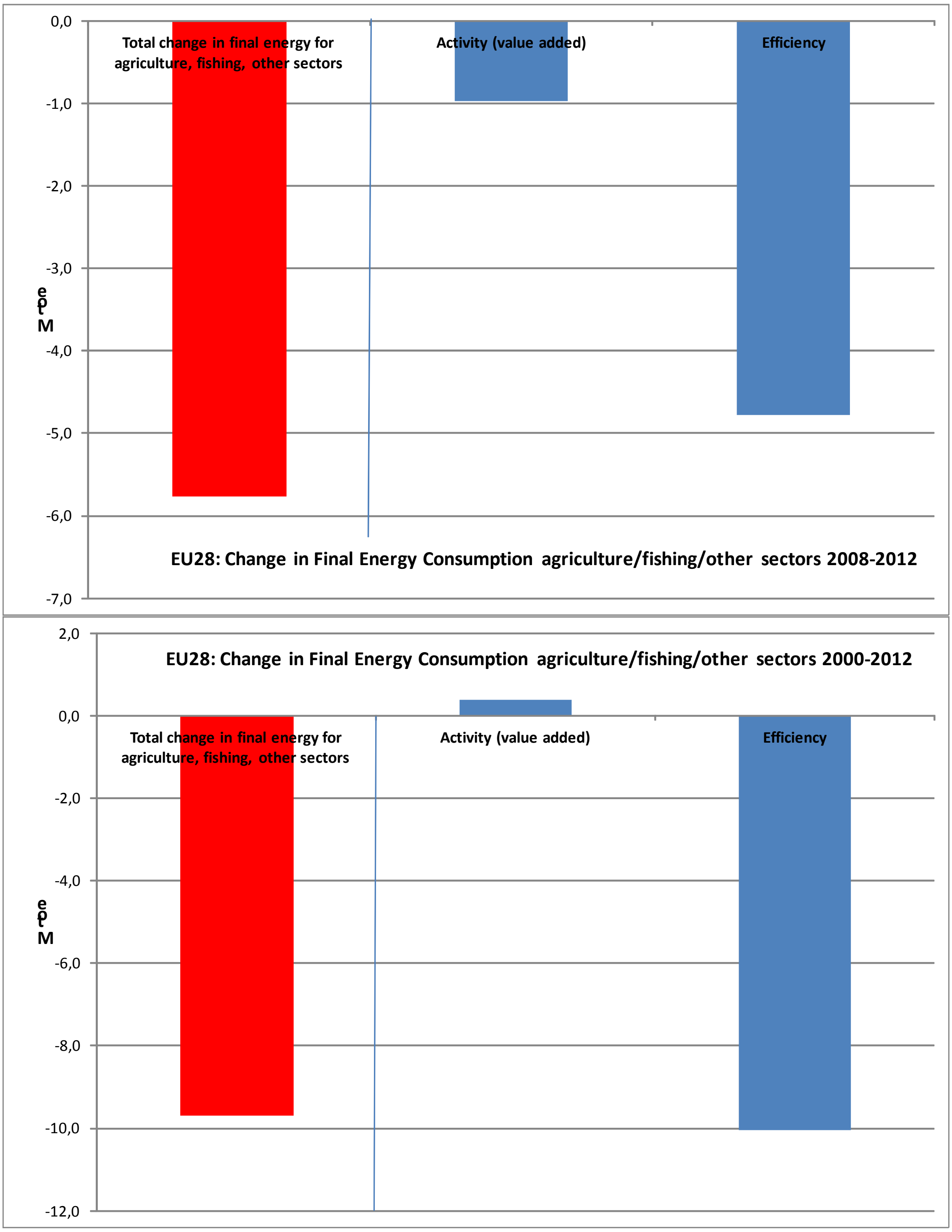
Note: Passenger transport is broken down to the modes road, rail, and domestic air transport. International air traffic is considered separately as it is not in competition with other modes for modal shift. Further details can be provided from the database.

Figure 18: Sectoral decomposition analysis (goods transport sector) of changes in final energy consumption 2008-2012 (upper figures) and 2000-2012 (lower figure)



Note: Goods transport is broken down to the modes road, rail, inland water ways and pipelines. Further details can be provided from the database.

Figure 19: Sectoral decomposition analysis (agriculture sector) of changes in final energy consumption 2008-2012 (upper figures) and 2000-2012 (lower figure)



Note: Agriculture, fishing and other sectors is broken down into an activity effect and energy efficiency effect only as no further details are available.

3. Country-specific analysis

In this section key selected country comparisons for the decomposition analysis. Are shown. For comparison purpose the changes in the different factors are provided on an annual basis and normalized to the final or primary energy consumption of 2012 for the country (change in percent of final/primary energy per year). The main observations are as follows:

Final energy (Figure 20 and Figure 21)

- While the annual total changes in final energy was still increasing in a number of countries in the period 2000-2012, especially in eastern Member States, it was decreasing in nearly all Member States in the period 2008-2012.
- This was largely due to the impact of the financial and economic crisis as seen by the activity component, which was still largely contributing to the increase in final energy in the period 2000-2012, while it was reducing final consumption since 2008.
- The structural component was also contributing to the reduction in final energy on average in both periods but the changes were mixed across the countries.
- Comfort/behaviour and social factors were contributing in both periods to the increase in energy consumption though less in the period since 2008
- The impact of annual climate variations (weather impact) was to increase final consumption due to the fact that the end year 2012 was colder than both 2000 and 2007 (the base year for the 2008-2012 analysis) which in the period 2000-2012 appeared as rather warm years.
- The energy efficiency factor contributed to reduce final energy consumption by around 1% per year in both periods but it slowed down in the shorter period 2008-2012 due to impacts of the economic crisis which for example in industry or goods transport has a negative impact on energy consumption due to lower capacity uses.

Primary energy (Figure 22 and Figure 23):

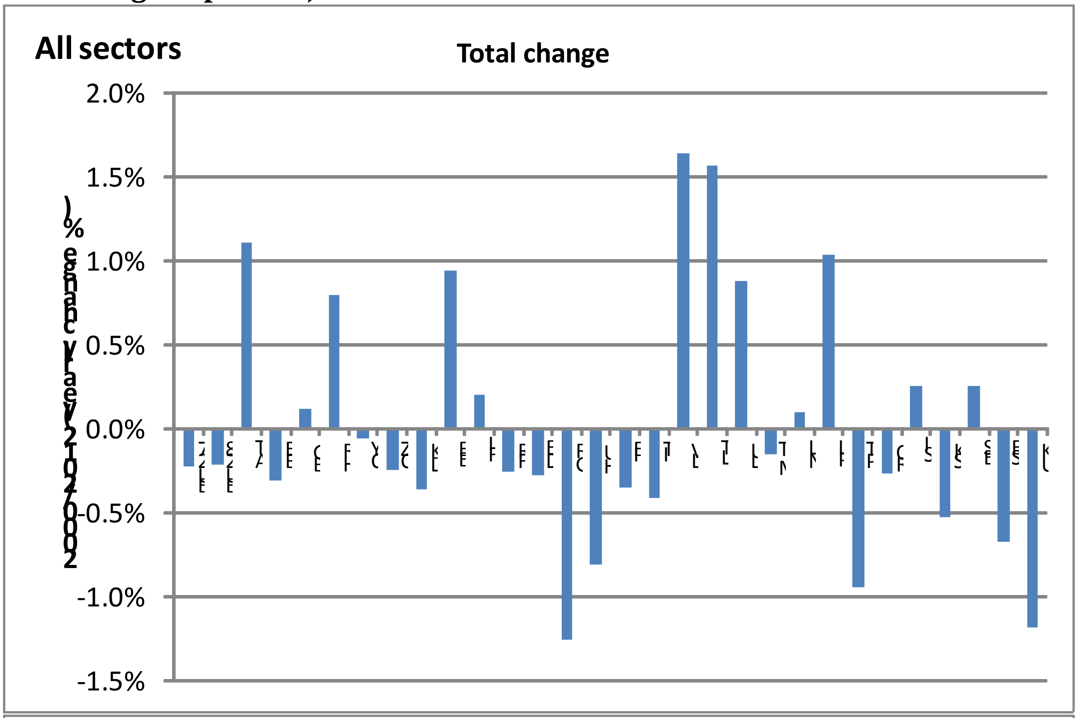
- Primary energy reflects partly the changes in final energy consumption and the changes in the conversion sector. Hence, the total change in primary energy is differing across countries and is influenced by different factors. Overall, primary energy consumption decreased since 2008.

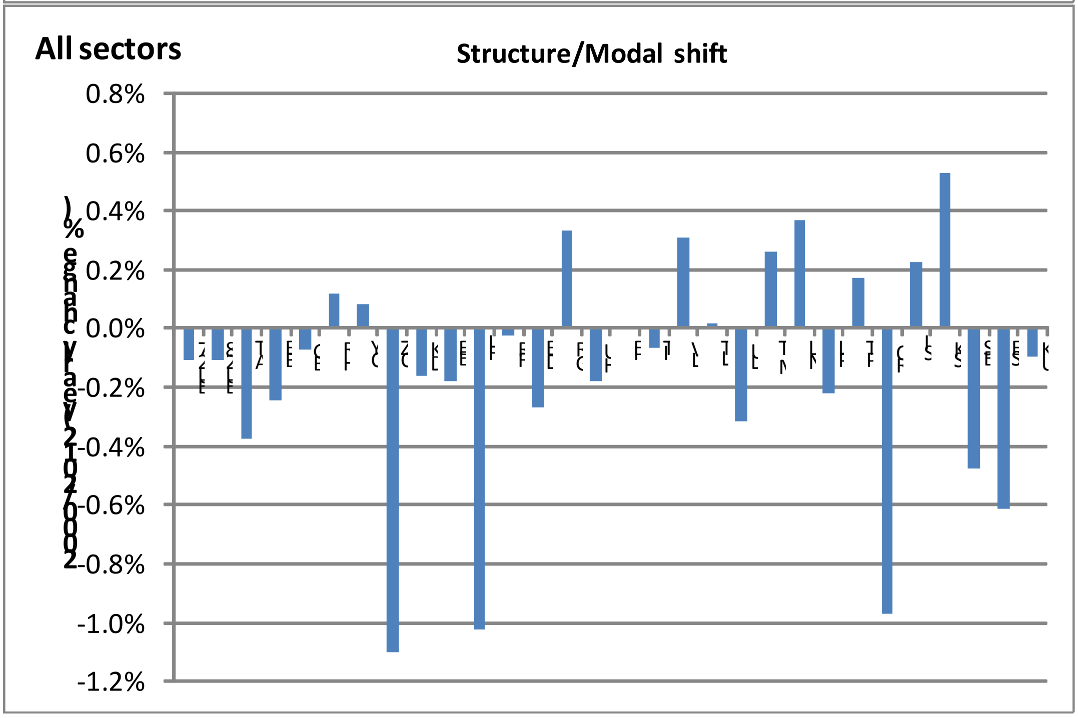
- Activities (demand for energy available for final demand) drove the primary energy demand up in the total period 2000-2012 but contributed to an increase since 2008. This is due to the combined impact of the different factors impacting on final energy and discussed in the previous section.
- Both distribution losses and own consumption in the energy sector overall contributed to reduce primary energy consumption but comparatively little in comparison with other factors.
- Structural change in the energy conversion sector was impacting negatively the consumption of primary energy with the penetration of the electricity sector which as a lower efficiency than the other parts of the conversion sector. The impact was, however, less pronounced in the period since 2008.
- Energy efficiency in the transformation sector contributed strongly to mitigate the impacts of the structural change. This was in particular due to the electricity sector itself (see the next section), which changing shares in renewable energy sources and CHP.

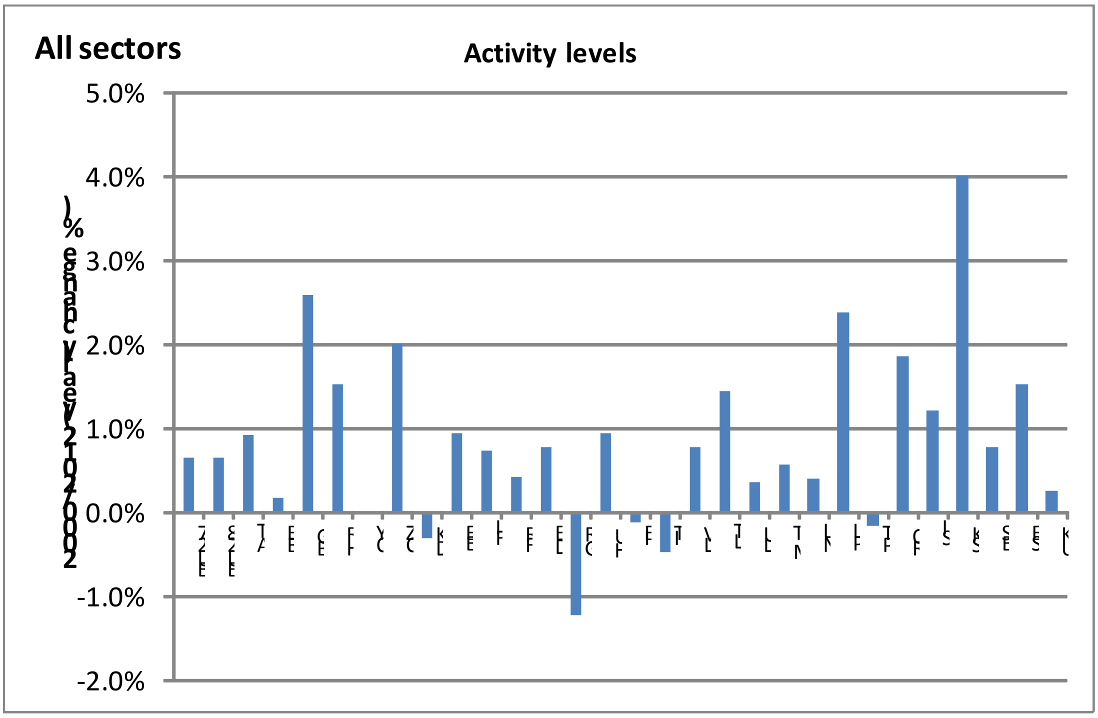
Changes in primary energy due to electricity generation (Figure 24 and Figure 25)

- The electricity sector was strongly contributing to the different changes in primary energy as discussed in the previous section. In the period 2000-2012 primary energy was increasing due the strong increase in gross final electricity demand in all countries (activity effect). This effect slowed down and even reversed in the period since 2008 that is less demand for gross electricity demand contributed to reduce primary energy demand for electricity generation
- A large impact came from structural change in the electricity generation, away from thermal power generation and nuclear towards more renewable (with 100% nominal efficiency) and CHP in some countries.
- The efficiency of (thermal) power plants contributed to an increase in primary energy consumption in the period since 2008, possibly due to lower capacities uses of thermal power plants (under the combined impacts of the penetration of renewable and the lowered demand for electricity since 2008).

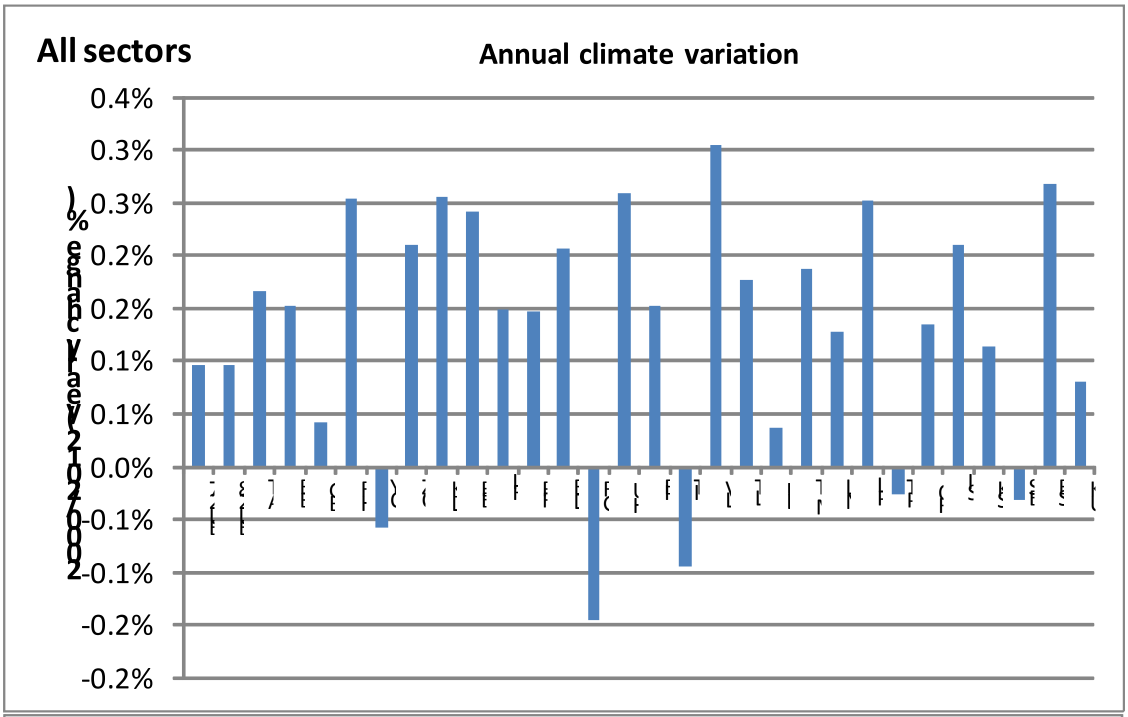
Figure 20: Total change in final energy consumption and different factors 2000-2012 (annual change in percent)

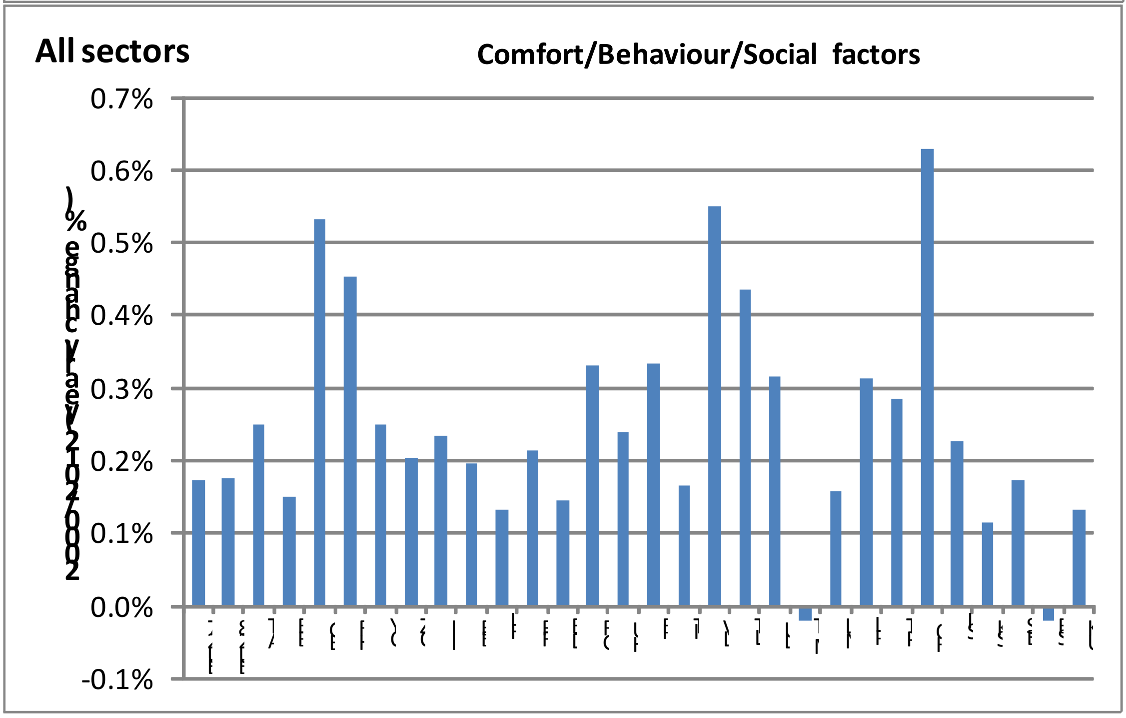






All sectors
Activity levels
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%


All sectors
Annual climate variation
0.4%
0.3%
0.3%
0.2%
0.2%
0.1%
0.1%
0.0%
-0.1%
-0.1%
-0.2%
-0.2%


All sectors
Comfort/Behaviour/Social factors
0.7%
0.6%
0.5%
0.4%
0.3%
0.2%
0.1%
0.0%
-0.1%

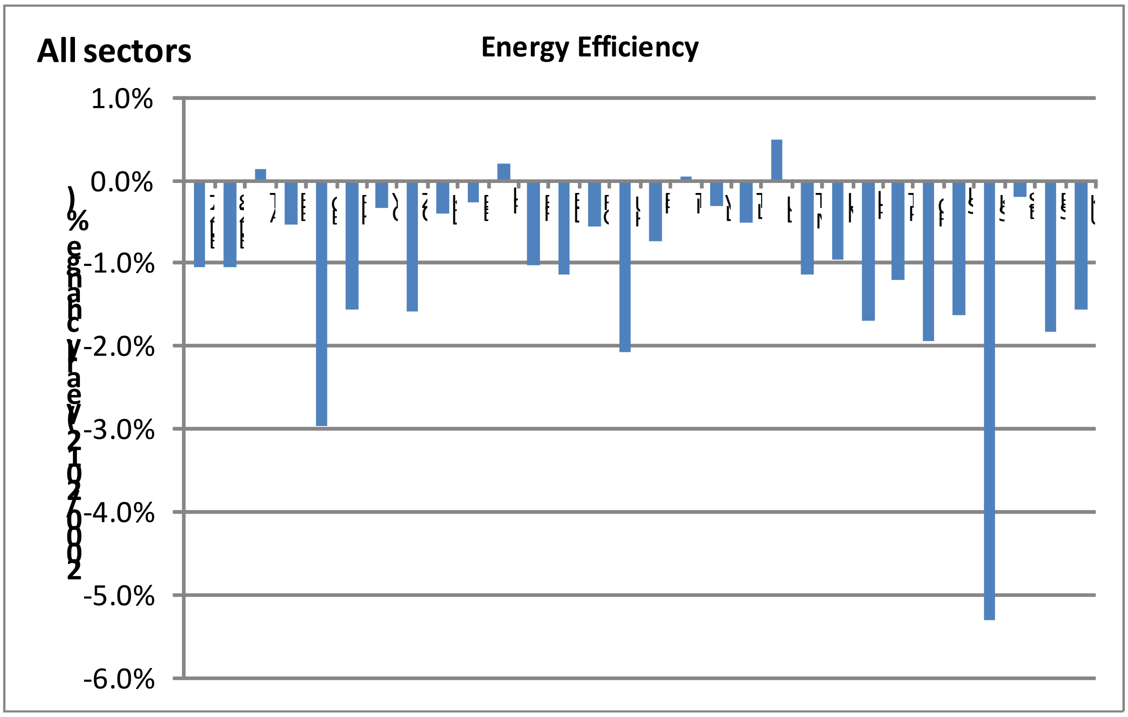
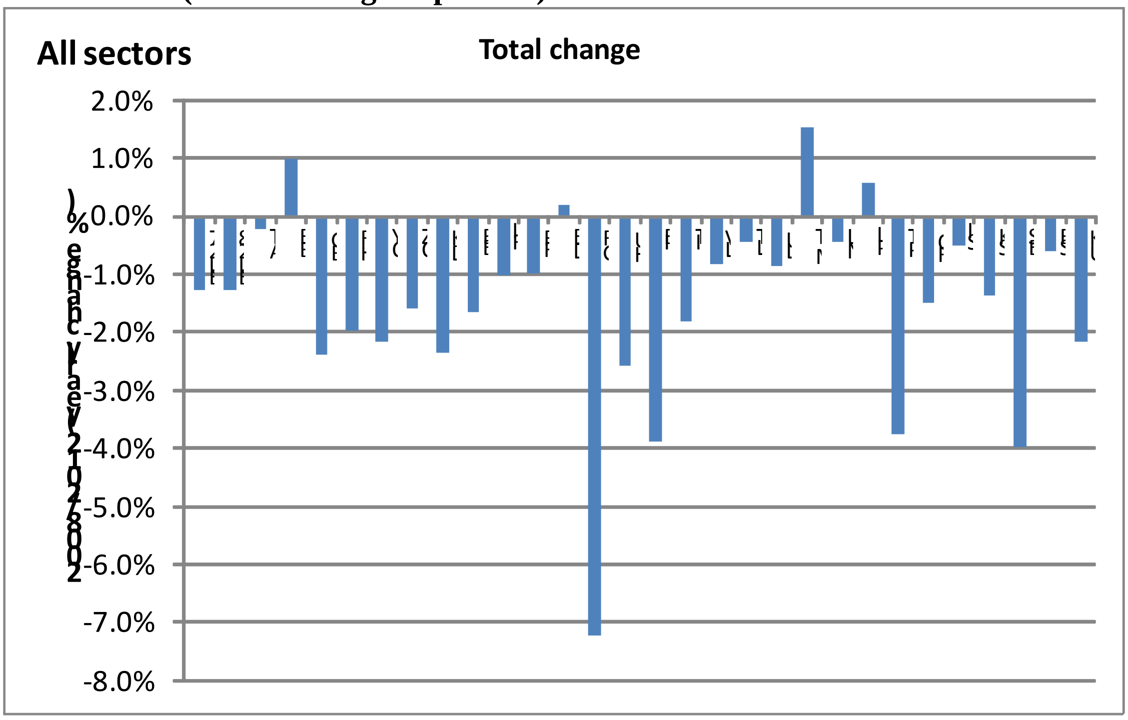
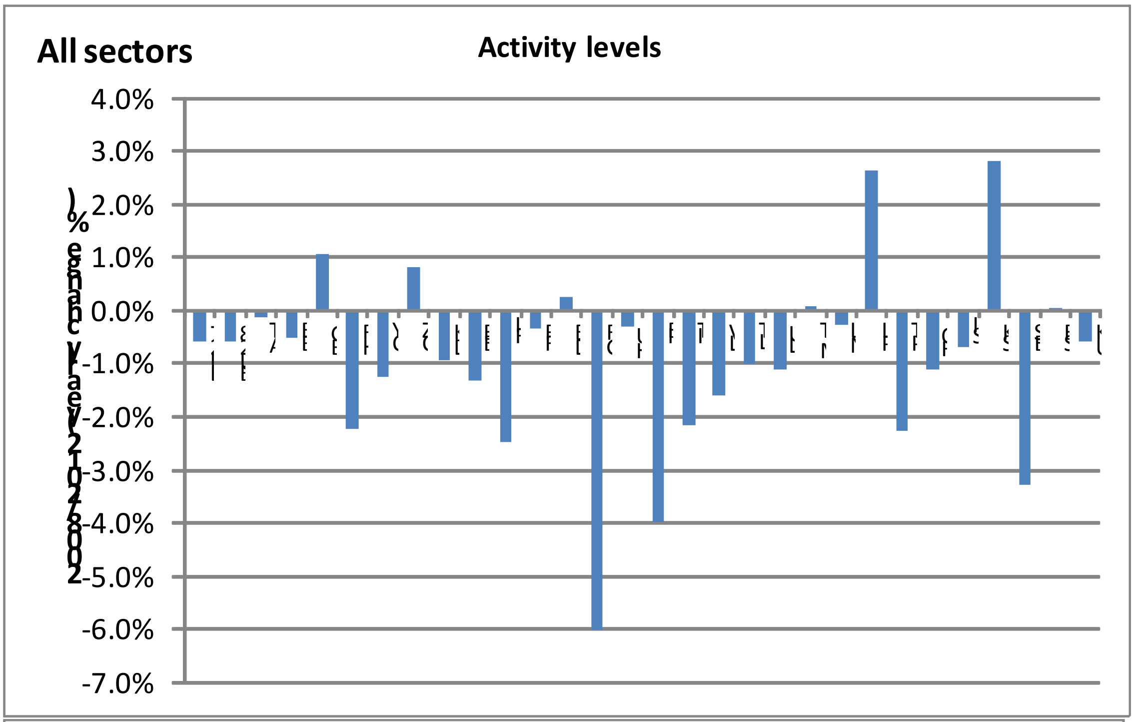
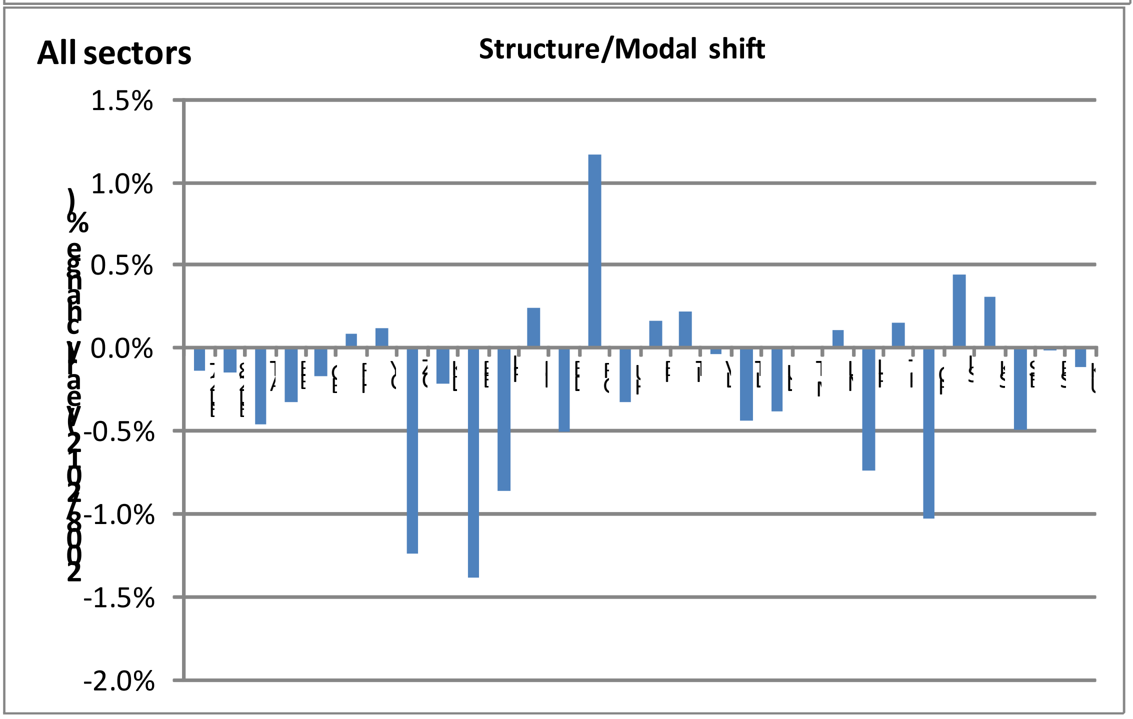
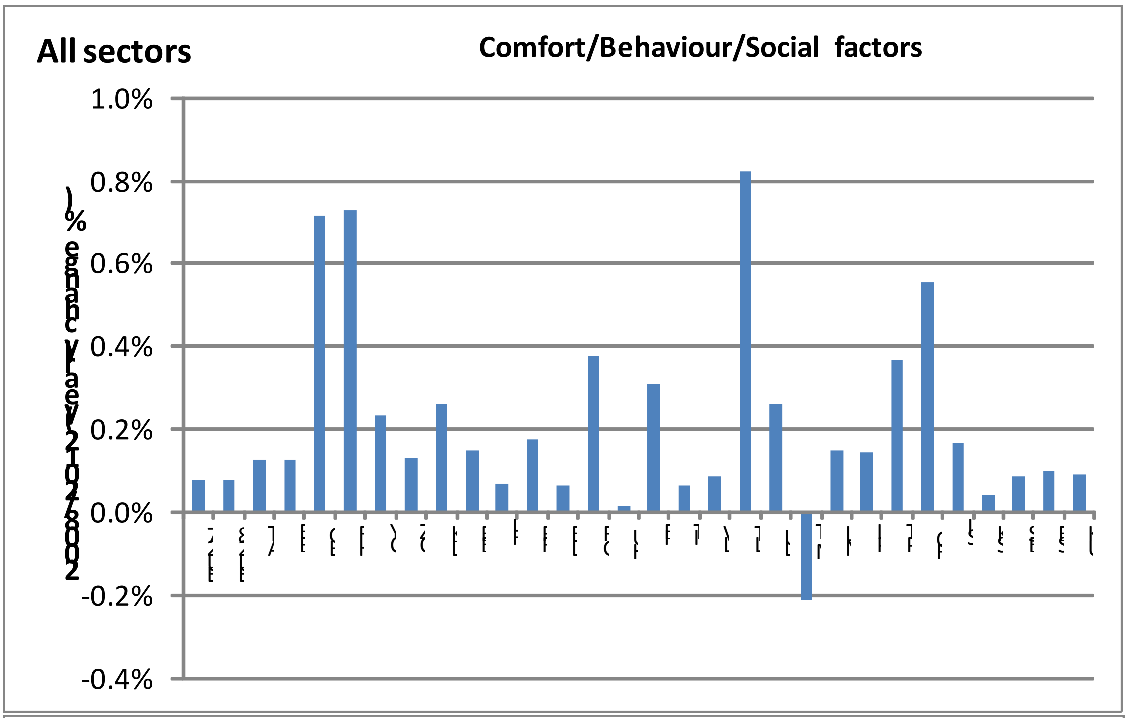


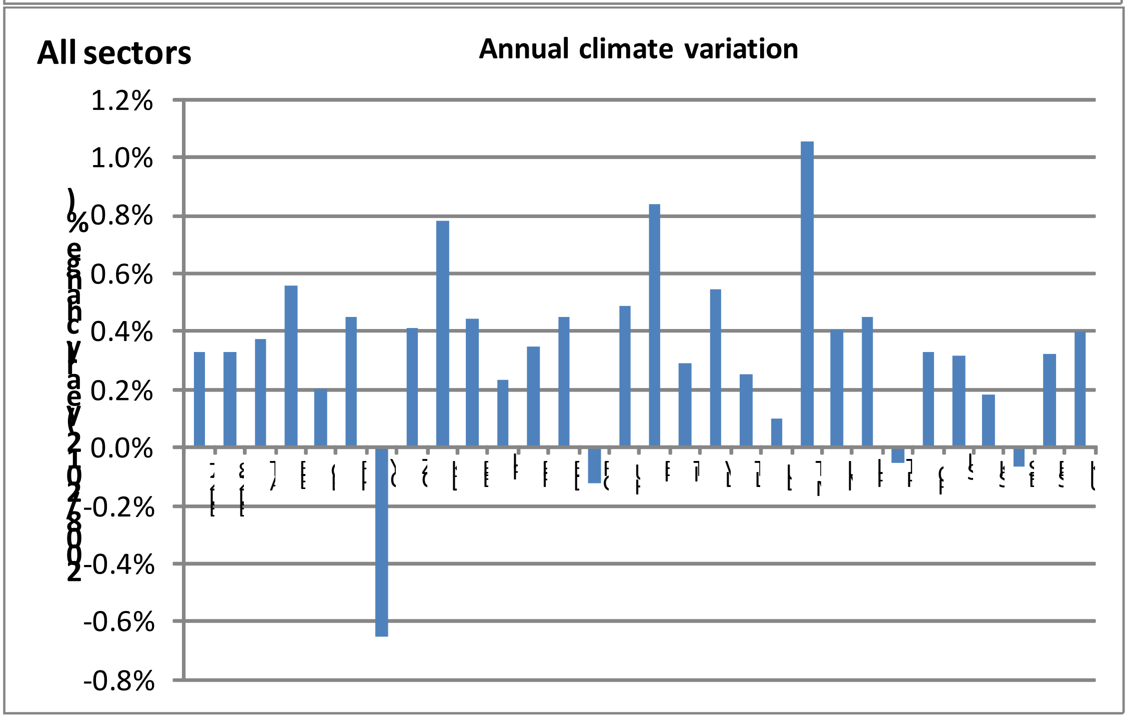
Figure 21: Total change in final energy consumption and different factors 2008 (incl.)-2012 (annual change in percent)




All sectors
Activity levels
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
-4.0%
-5.0%
-6.0%
-7.0%


All sectors
Structure/Modal shift
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%


All sectors
Comfort/Behaviour/Social factors
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
-0.2%
-0.4%


All sectors
Annual climate variation
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
-0.2%
-0.4%
-0.6%
-0.8%

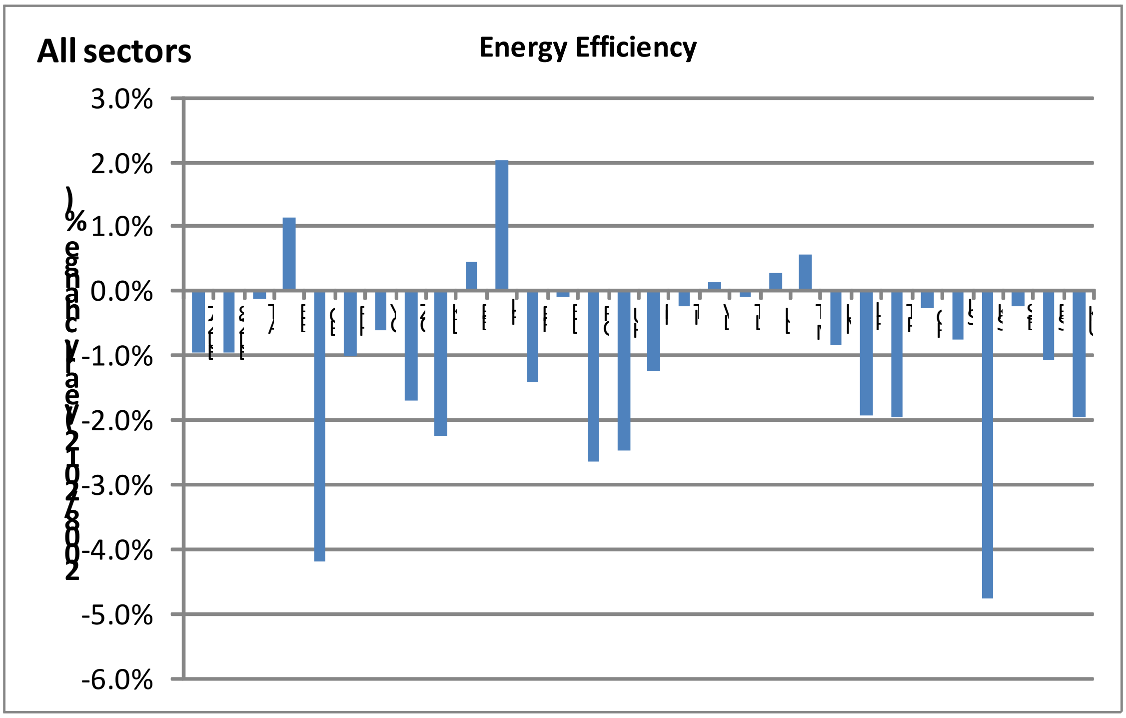
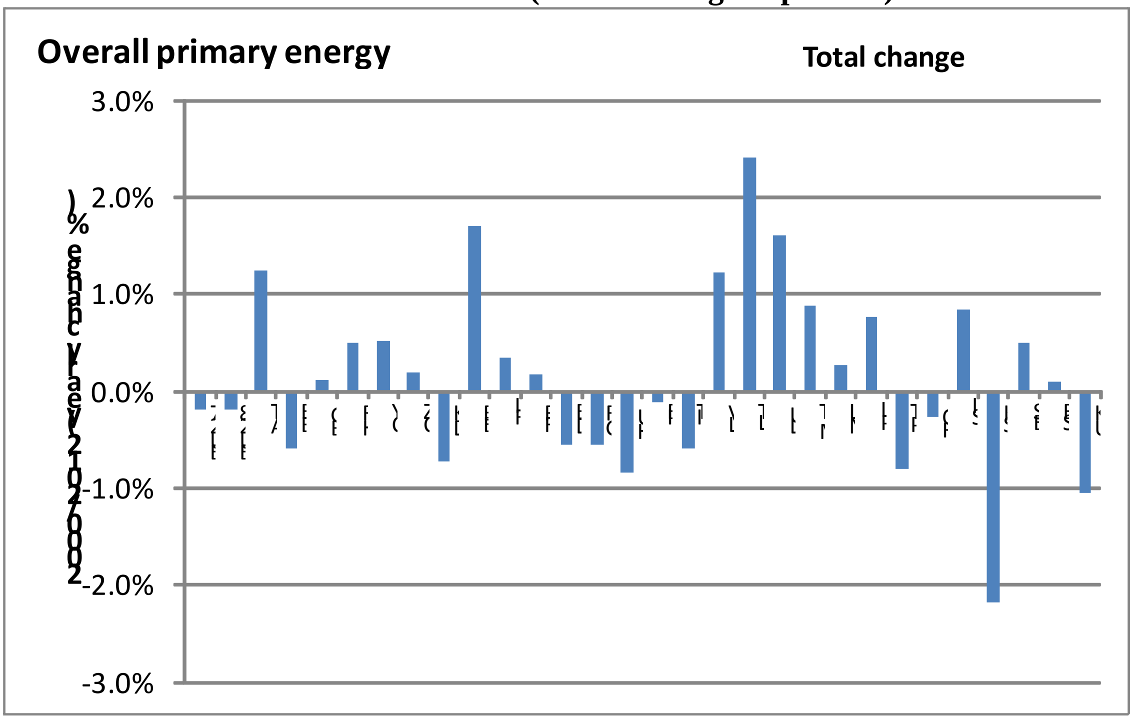
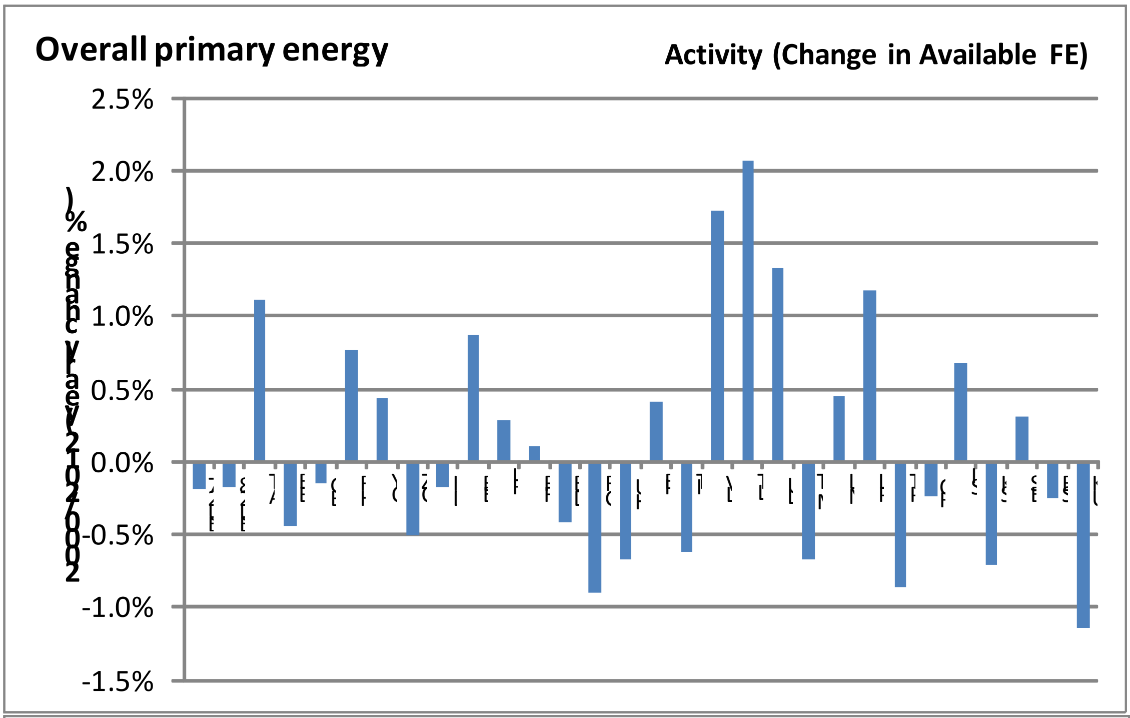
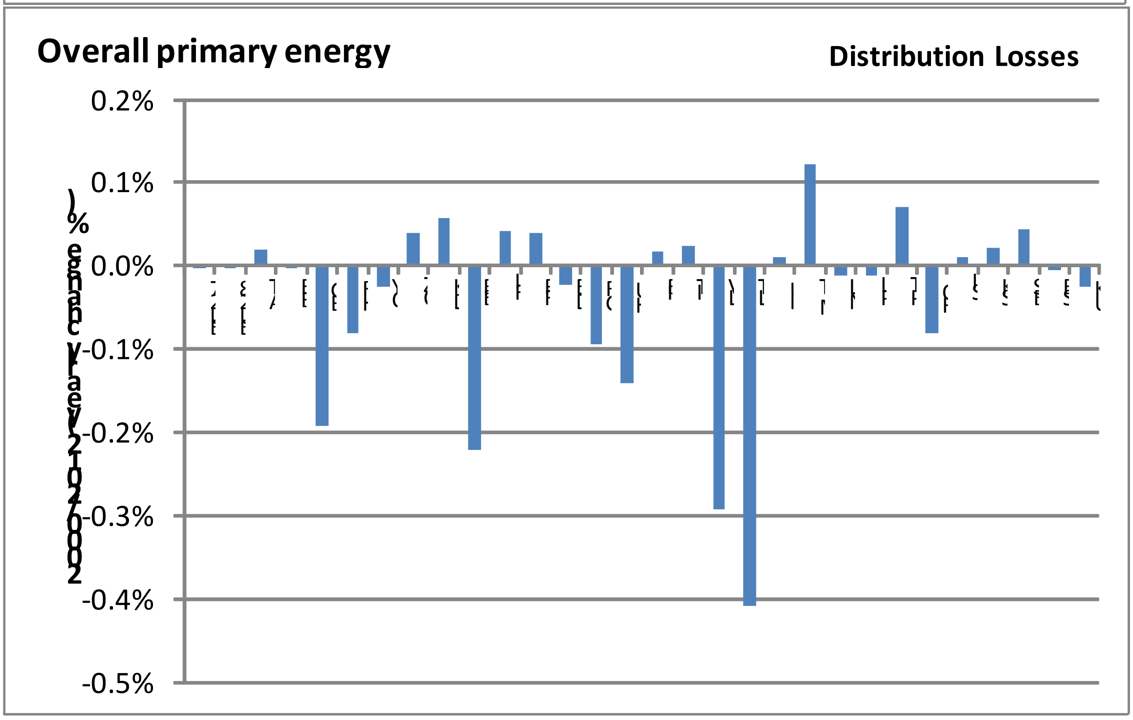
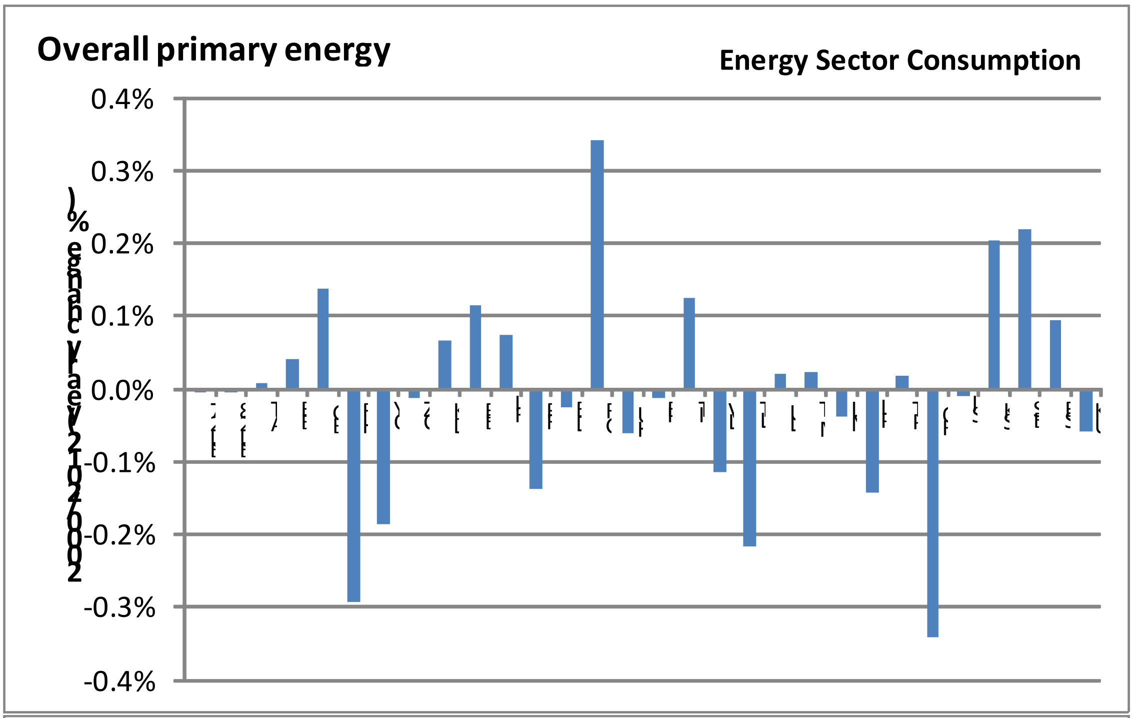


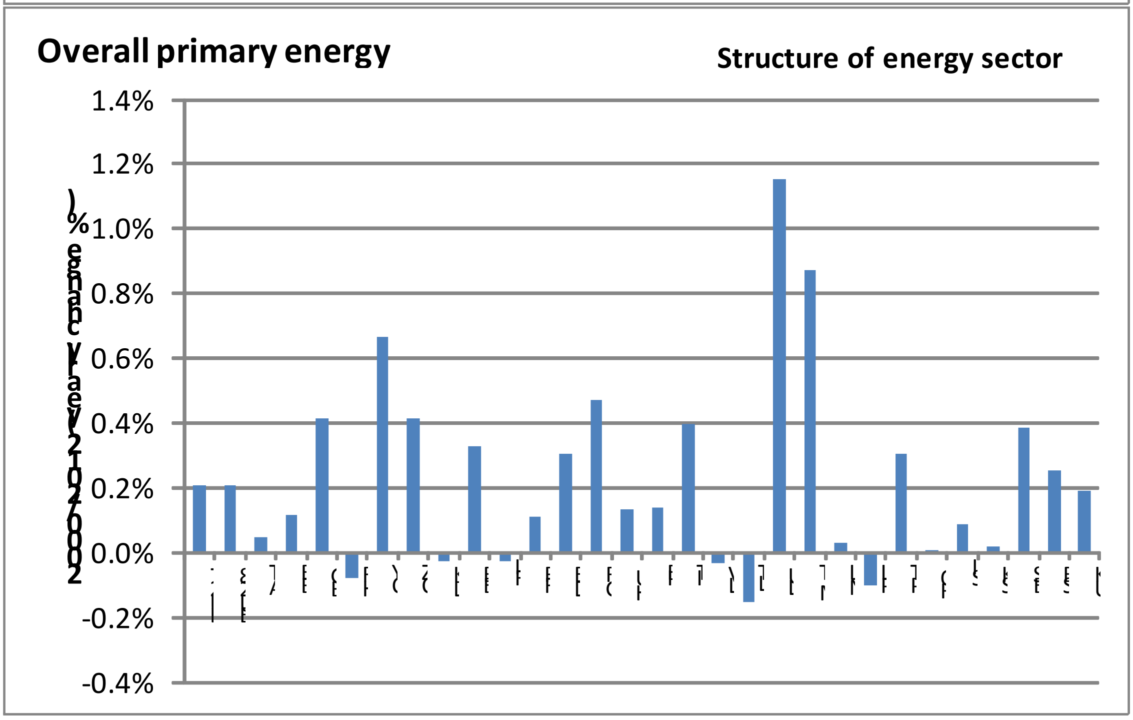
Figure 22: Total change in primary energy consumption (excl. non-energy uses) and different factors 2000-2012 (annual change in percent)




Overall primary energy
Activity (Change in Available FE)
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%


Overall primary energy
Distribution Losses
0.2%
0.1%
0.0%
-0.1%
-0.2%
-0.3%
-0.4%
-0.5%


Overall primary energy
Energy Sector Consumption
0.4%
0.3%
0.2%
0.1%
0.0%
-0.1%
-0.2%
-0.3%
-0.4%


Overall primary energy
Structure of energy sector
1.4%
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
-0.2%
-0.4%

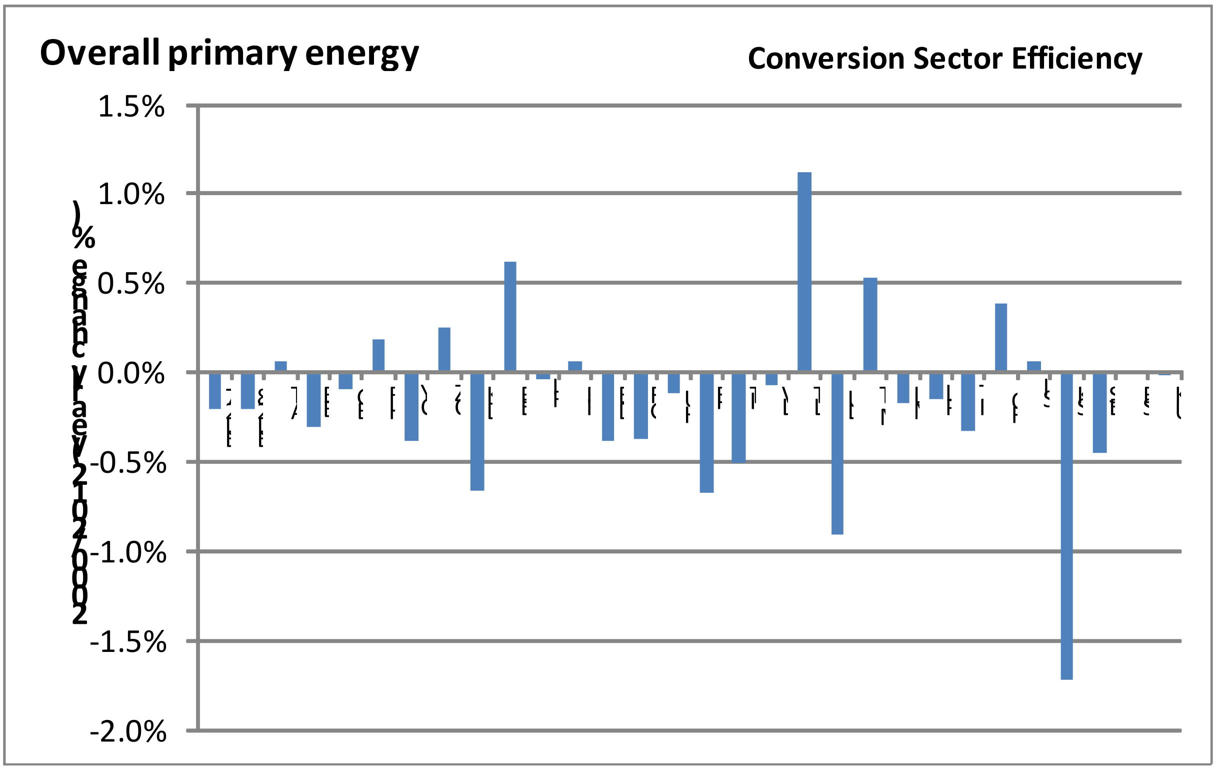
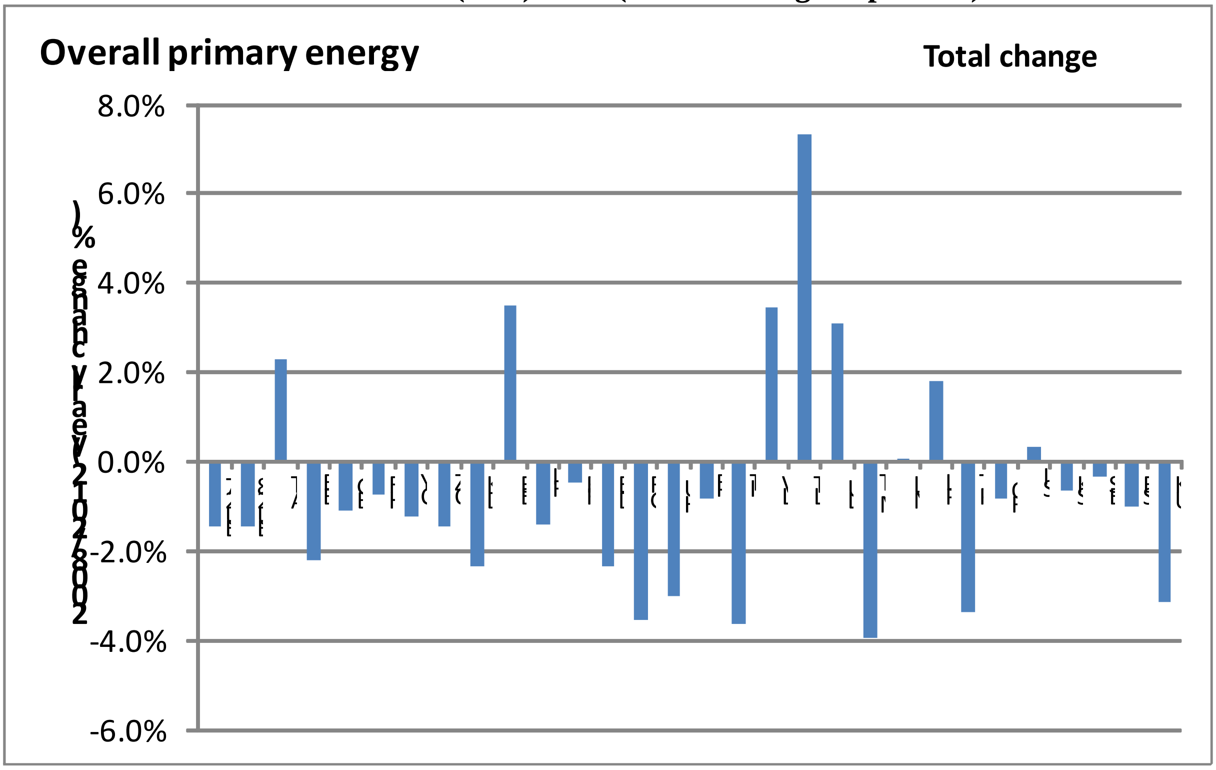
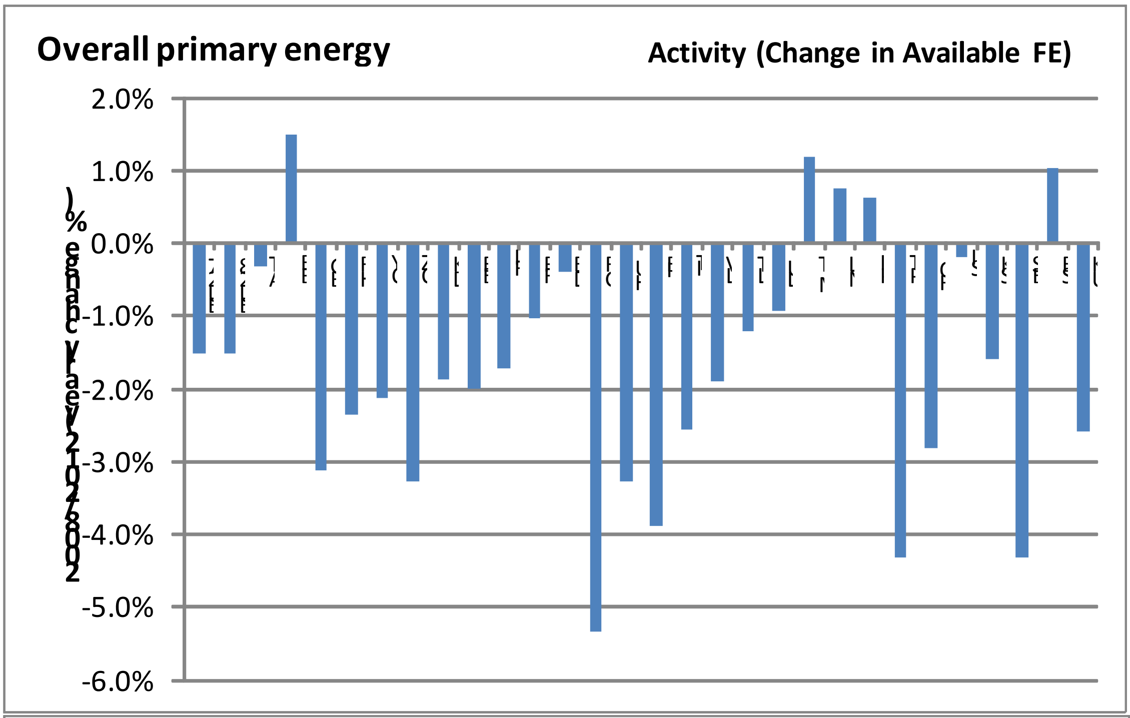
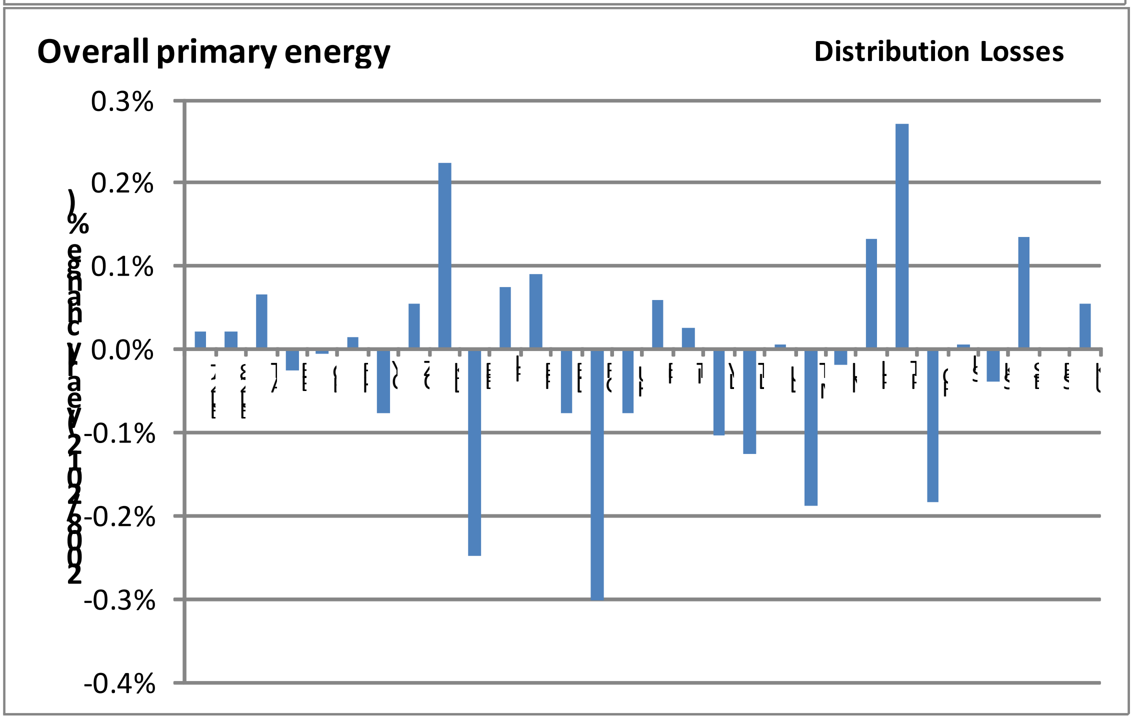
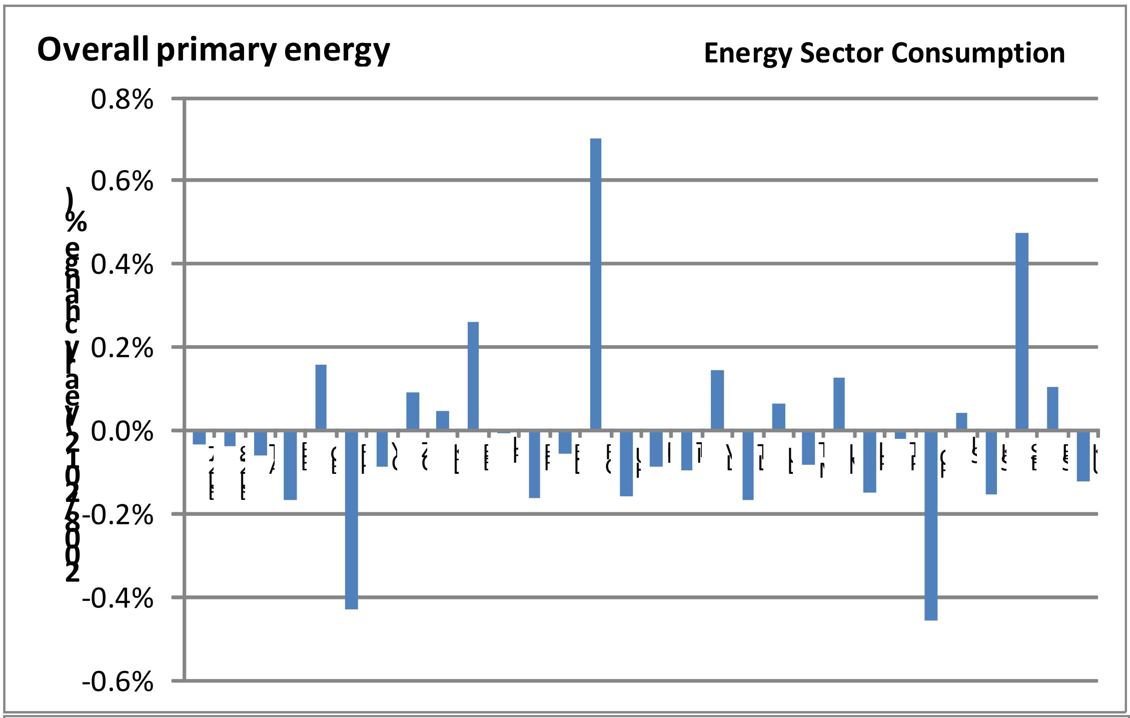


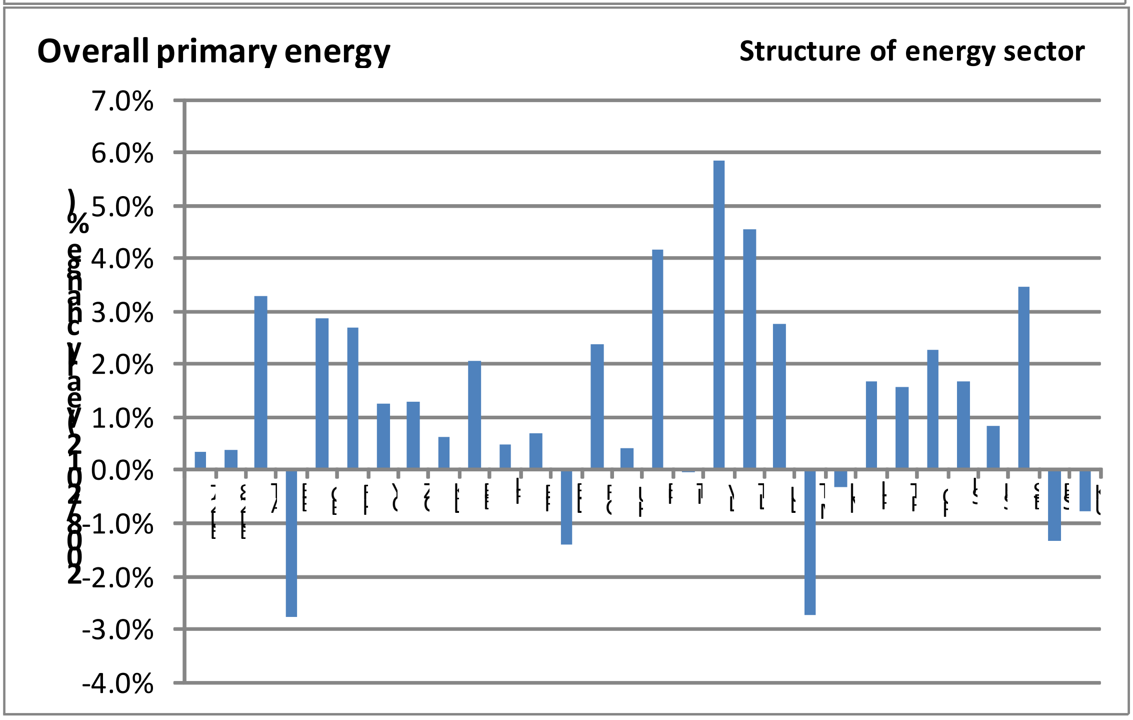
Figure 23: Total change in primary energy consumption (excl. non-energy uses) and different factors 2008 (incl.)-2012 (annual change in percent)




Overall primary energy
Activity (Change in Available FE)
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
-4.0%
-5.0%
-6.0%


Overall primary energy
Distribution Losses
0.3%
0.2%
0.1%
0.0%
-0.1%
-0.2%
-0.3%
-0.4%


Overall primary energy
Energy Sector Consumption
0.8%
0.6%
0.4%
0.2%
0.0%
-0.2%
-0.4%
-0.6%


Overall primary energy
Structure of energy sector
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
-4.0%

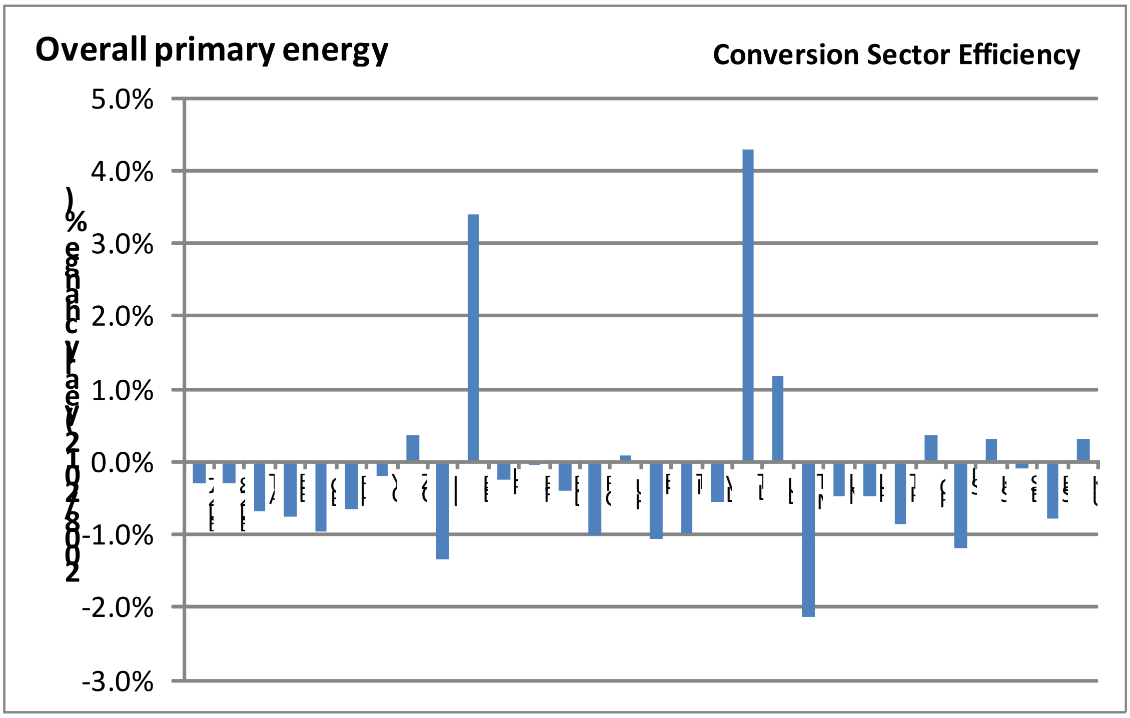
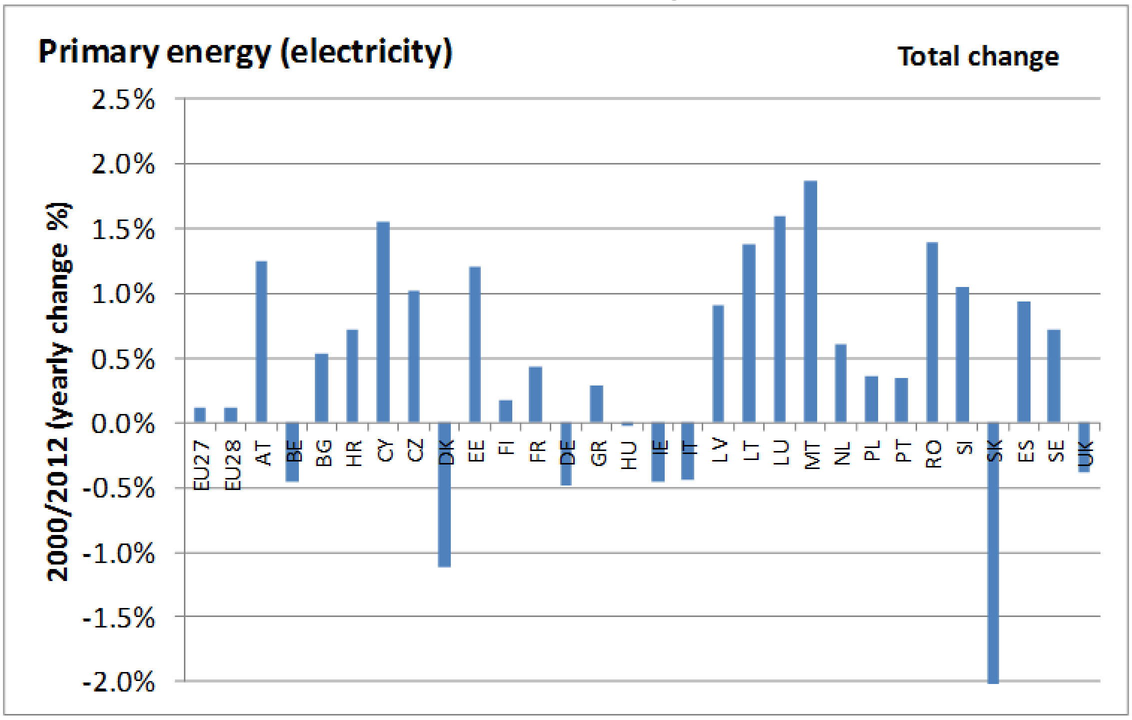
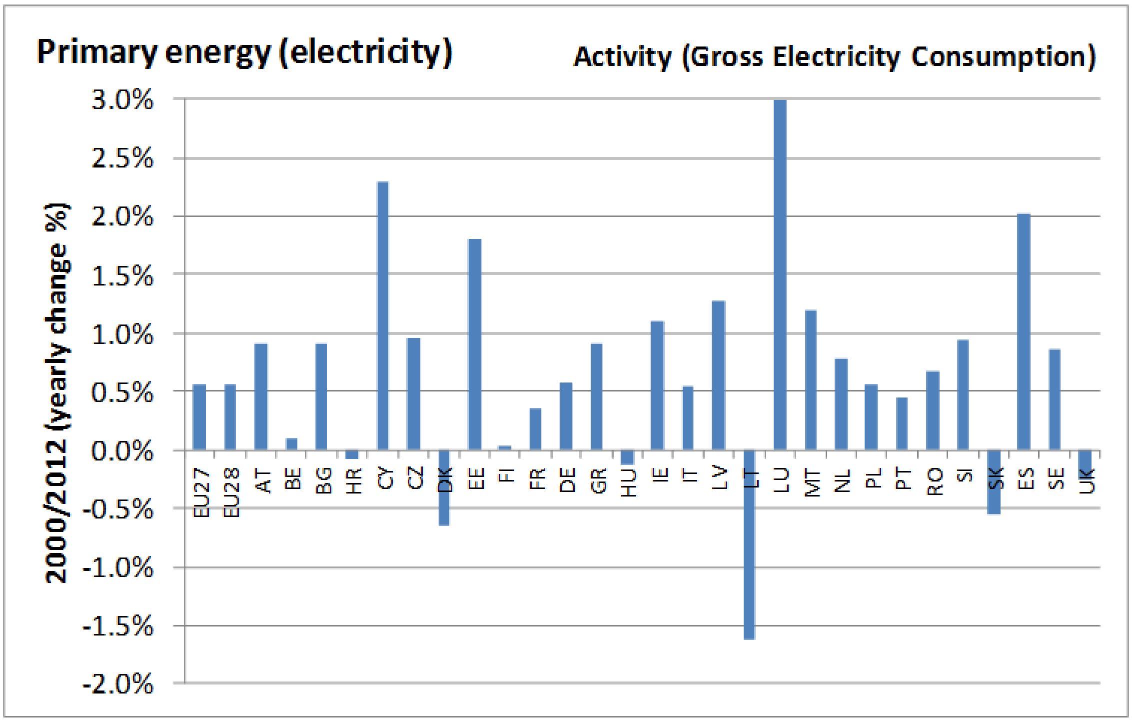
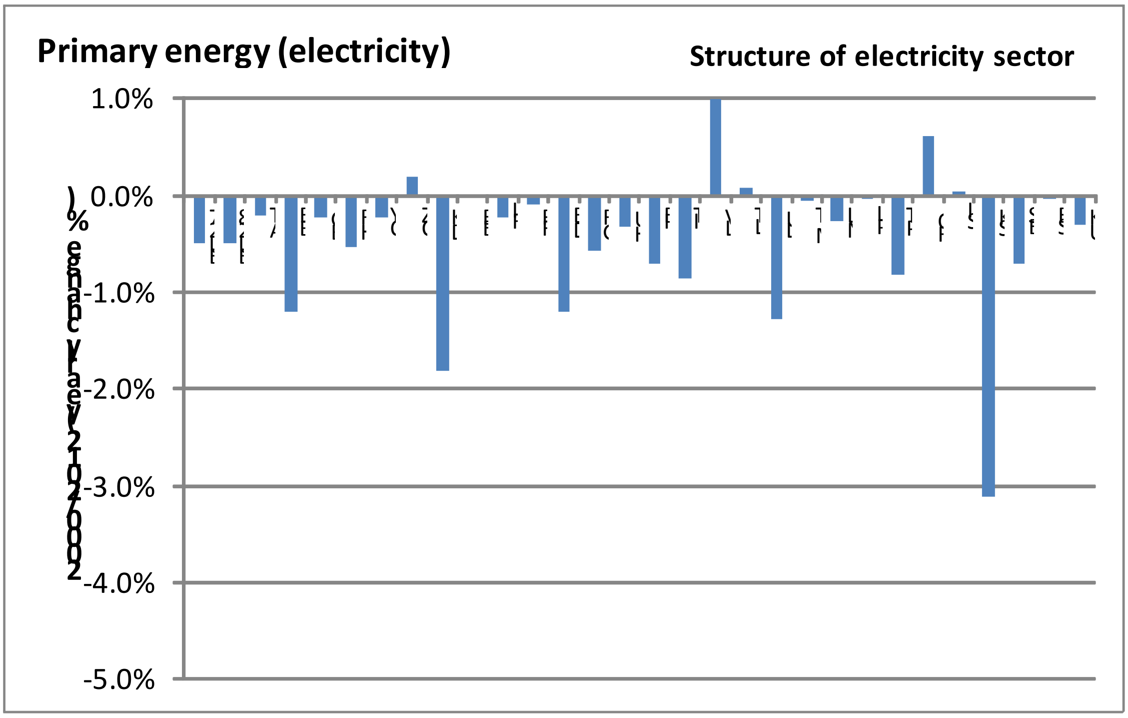


Figure 24: Total change in primary energy consumption for electricity generation and different factors 2000-2012 (annual change in percent)




Primary energy (electricity)
Activity (Gross Electricity Consumption)
2000/2012 (yearly change %)
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
-0.5%
-1.0%
-1.5%
-2.0%
EU27
EU28
AT
BE
BG
HR
CY
CZ
DK
EE
FI
FR
DE
GR
HU
IE
IT
LV
LT
LU
MT
NL
PL
PT
RO
SI
SK
ES
SE
UK


Primary energy (electricity)
Structure of electricity sector
1.0%
0.0%
-1.0%
-2.0%
-3.0%
-4.0%
-5.0%

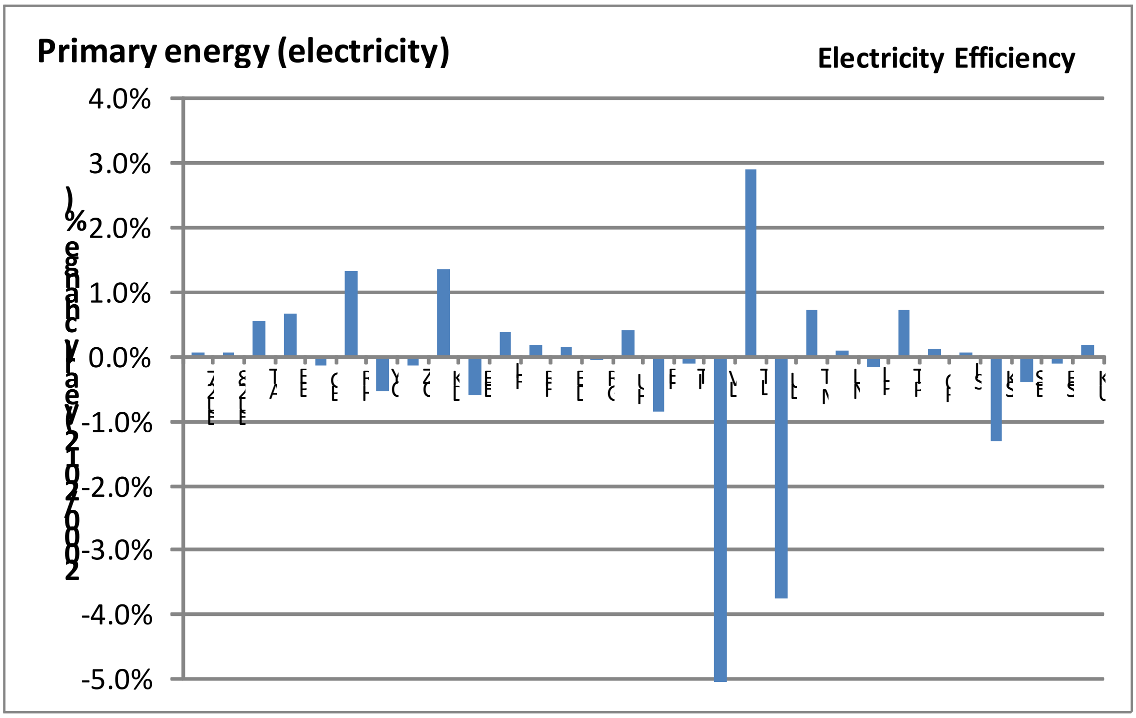
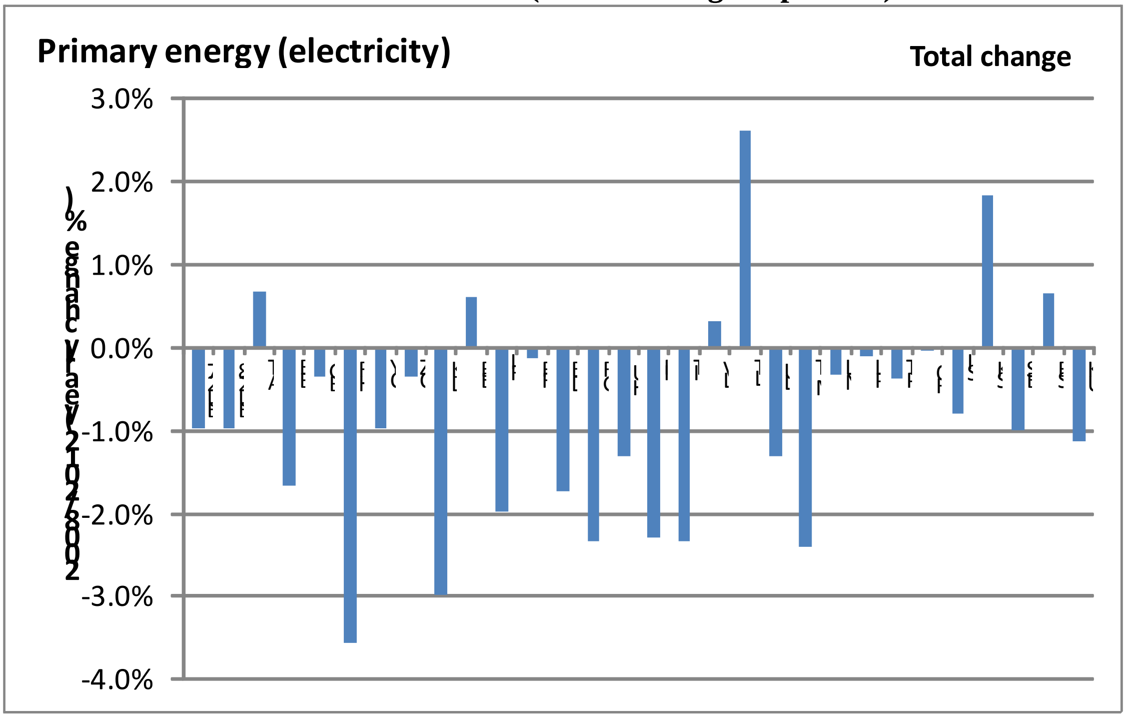
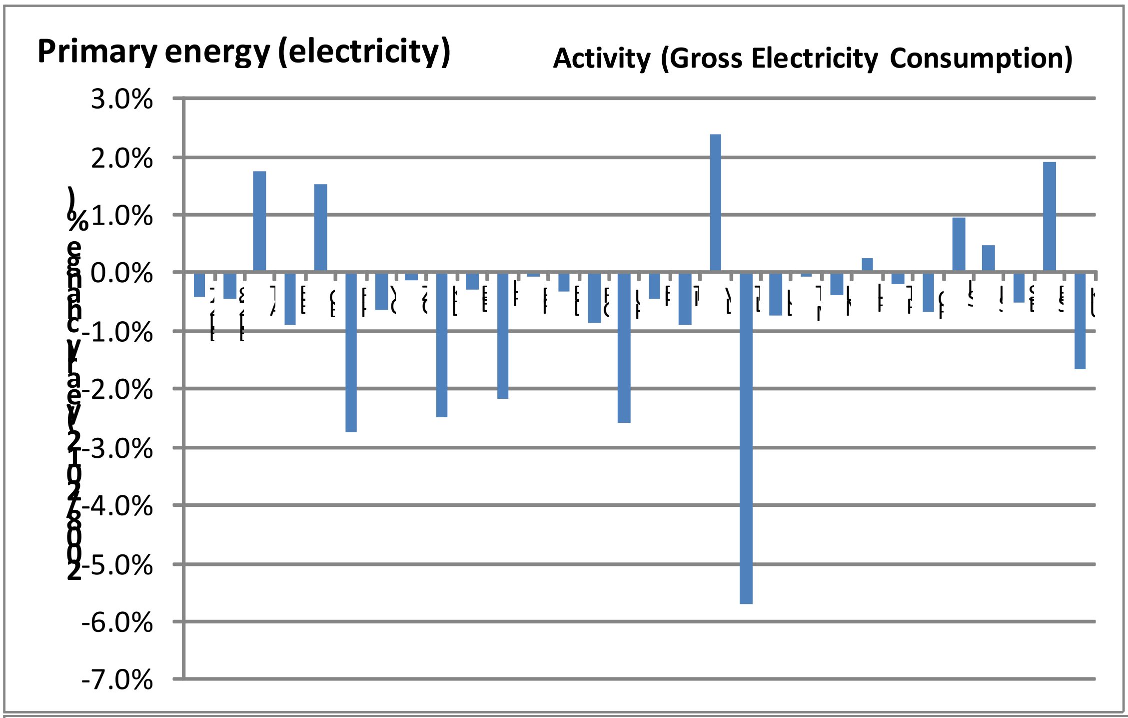
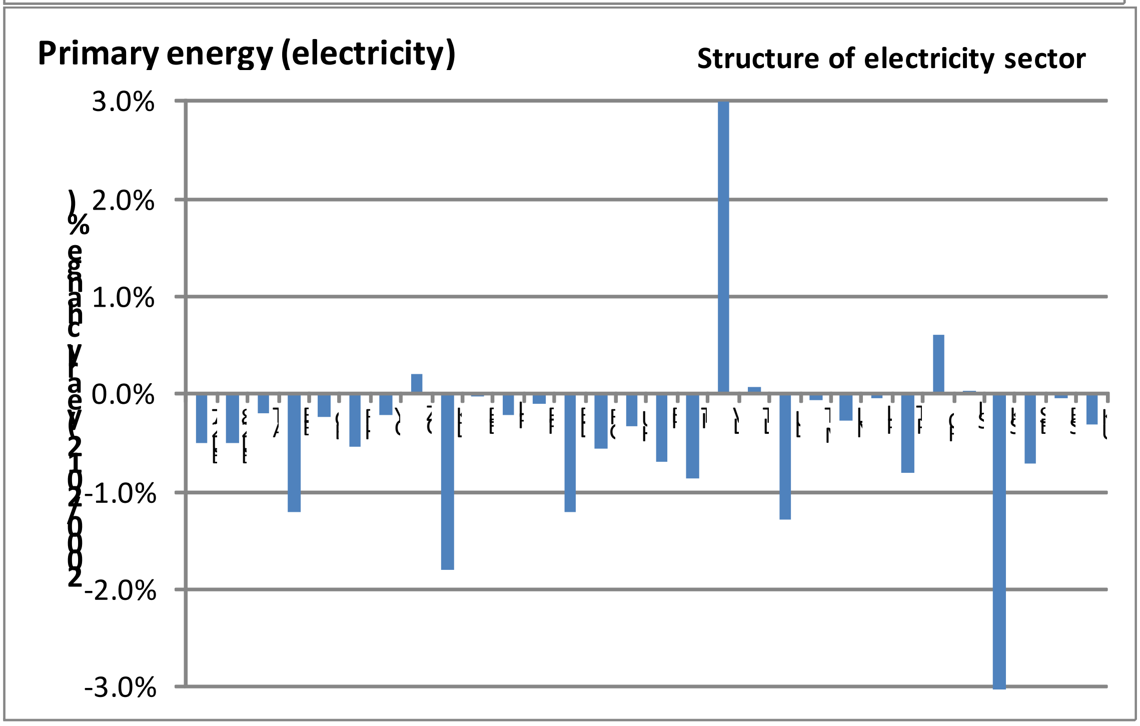
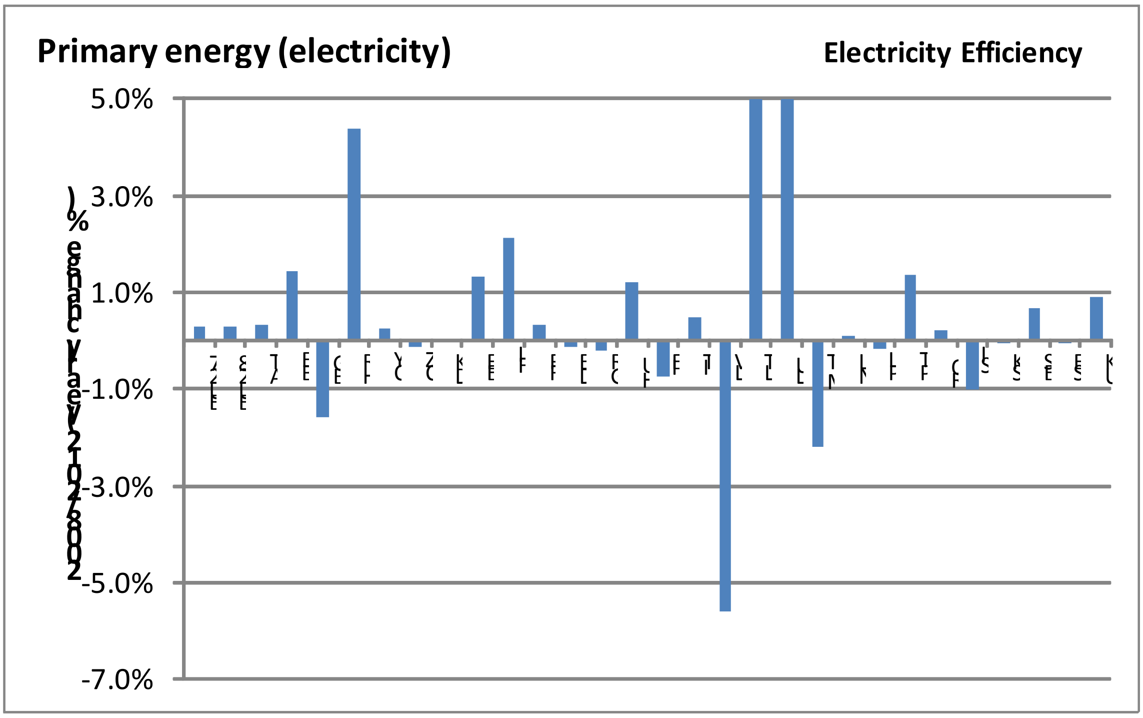


Figure 25: Total change in primary energy consumption for electricity generation and different factors 2000-2012 (annual change in percent)




Primary energy (electricity)
Activity (Gross Electricity Consumption)
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%
-4.0%
-5.0%
-6.0%
-7.0%


Primary energy (electricity)
Structure of electricity sector
3.0%
2.0%
1.0%
0.0%
-1.0%
-2.0%
-3.0%



Primary energy (electricity)
Electricity Efficiency
5.0%
3.0%
1.0%
-1.0%
-3.0%
-5.0%
-7.0%

Annex IV. Analysis of sectoral correlations between changes in GDP and final energy consumption

1. Correlation analysis

An analysis of the linear correlation of change in GDP (ΔGDP) to the change in final energy consumption within all sectors has been performed. In the figures the change in energy consumption is plotted against ΔGDP for the period from 2000 to 2011 (to 2010 for transport due to lack of 2011 data), each data point representing a member state. A linear fit was performed and the R^2 value of the fit was computed (a broken line is added to indicate the hypothetical perfect linear dependency with an inclination of one). While the residential and tertiary sectors are uncorrelated to ΔGDP, the industry sector shows signs of correlation and the transport sector is strongly linear correlated to ΔGDP.

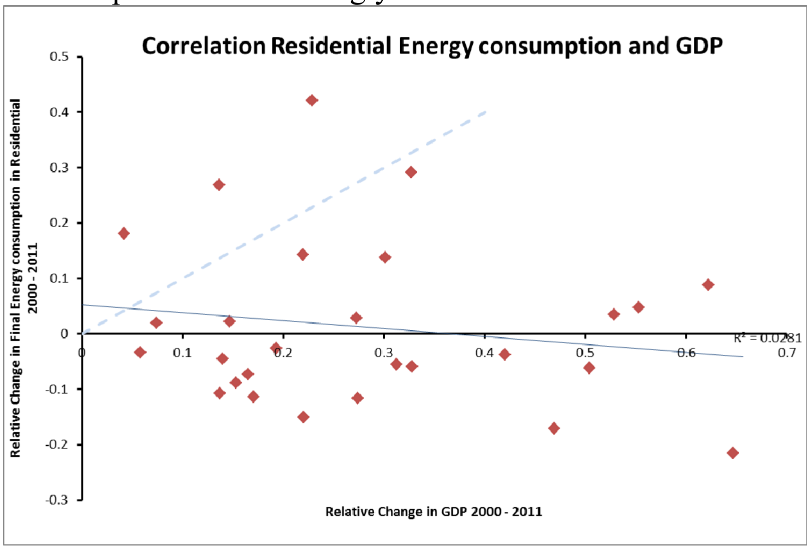


Figure 26: Correlation between energy consumption in the residential sector and ΔGDP

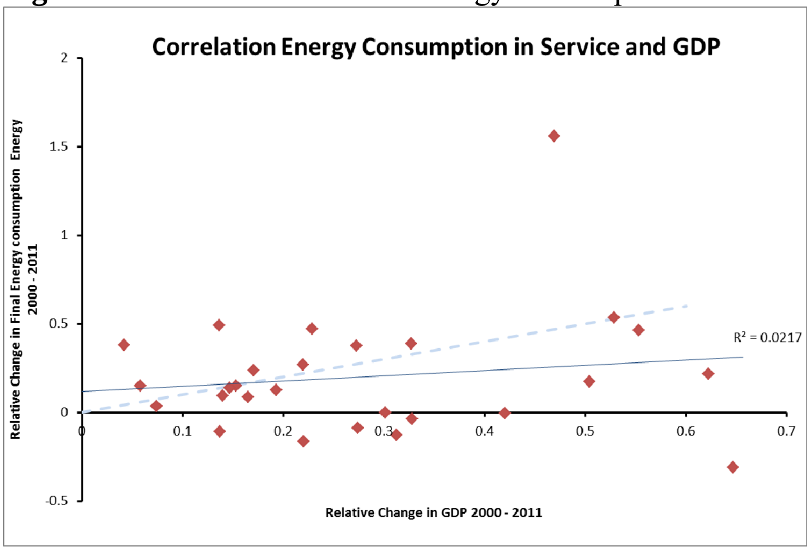


Figure 27: Correlation between energy consumption in the tertiary sector and ΔGDP

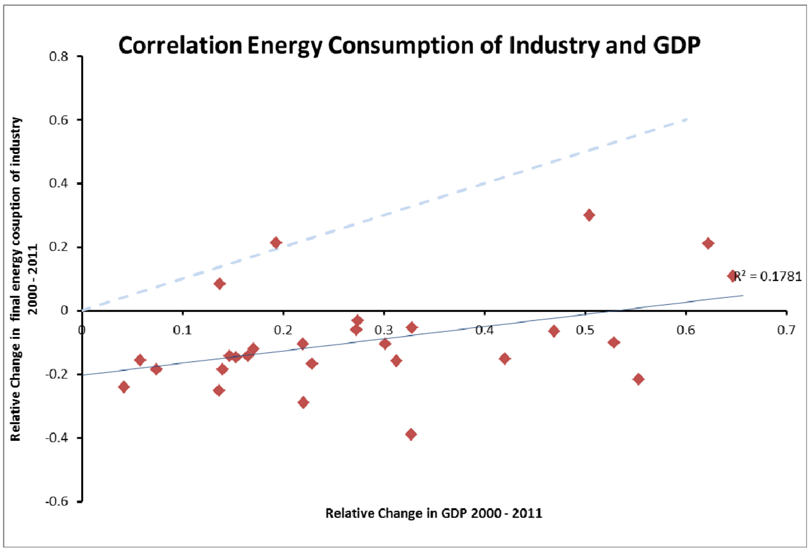


Figure 28: Correlation between energy consumption in the industrial sector and ΔGDP

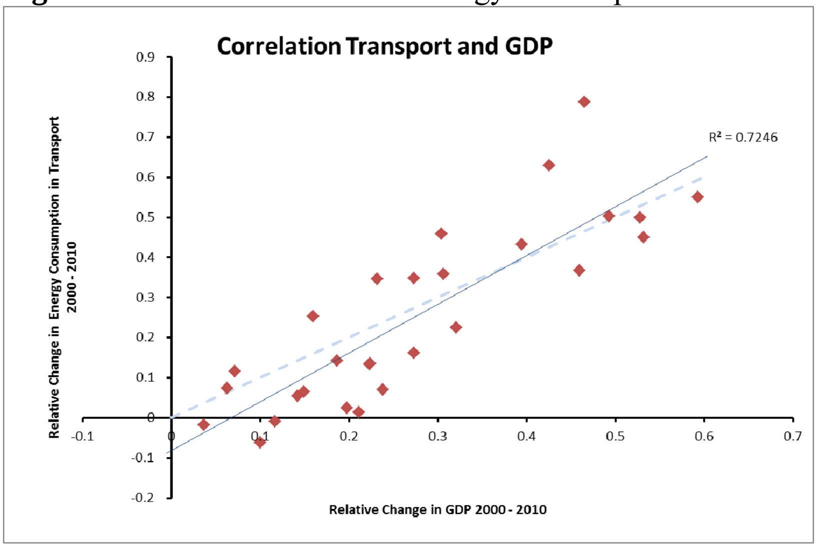


Figure 29: Correlation between energy consumption in the transport sector and ΔGDP

Annex V: PRIMES Methodology and modelling assumptions

1. PRIMES model

PRIMES which is a partial-equilibrium model of the energy system, was used for setting the EU 2020 targets (including energy efficiency), the Low Carbon Economy and Energy 2050 Roadmaps as well as the 2030 policy framework for climate and energy. The PRIMES model is suitable for analysing the impacts of different sets of energy efficiency policies on the energy system as a whole, notably on the fuel mix, GHG emissions, investment needs and energy purchases as well as overall system costs. It is also suitable for analysing the interaction of policies promoting energy efficiency with policies driving the GHG abatement and promotion of RES.

Modelling with PRIMES was therefore used to create the scenarios that illustrate different policy options presented in this IA (in terms of different levels of energy efficiency ambition) and to compare their impacts on

- Energy system with strong focus on security of supply
- Competitiveness
- Sustainability

2. Coherence with the 2030 Communication and its underlying Impact Assessment

The focus in the modelling exercise that underpins this IA is on energy efficiency, investigating different levels of ambition of energy efficiency policies, as the impacts of GHG and RES policies were already analysed in detail in the 2030 IA.

The PRIMES modelling results underpinning the 2030 IA were used as a starting point to make the two modelling exercises consistent. In particular, the proposals of the 2030 framework regarding binding targets for GHG emission reductions and RES share in final energy consumption by 2030 were reflected in this modelling exercise. Both exercises also focused on decarbonisation perspective in 2050..

3. Reference scenarios

This analysis is based on the PRIMES Reference Scenario 2013 "EU Energy, Transport and GHG Emissions – Trends to 2050"[18] ("Reference"), which was also used in the 2030 Impact Assessment (PRIMES model and data version of 2012-2013). In general, the purpose of a reference scenario in the IA context is to serve as a basis projection to which policy scenarios can be compared and thus their net effect assessed. In defining the Reference, a statistical update has been performed around end of 2012, when year 2010 statistics were fully available. Projection of exogenous variables to PRIMES, such as world fossil fuel prices,

[18] http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2050_update_2013.pdf

GDP, population and production by sector of activity, has taken place via dedicated modelling exercises, in the last quarter of 2012, reflecting views and data available at that time. Similarly, the assumptions about future evolution of costs and performance of various energy demand and supply technologies have been consolidated in the beginning of 2013. A reference scenario follows the logic of including only policy measures which have been adopted until a certain cut-off date, without including new policies not yet officially adopted. In the Reference, which has been published in December 2013, the cut-off date was spring 2012 (the EED was therefore included although with fairly conservative assumptions).

In order to have the most accurate review the effects of possible new energy efficiency measures and their overall level of ambition and to measure precisely how close is the EU to achieve the 20% energy efficiency target in 2020, it was necessary to update this Reference Scenario 2013 with regard to recently adopted and proposed policies with regard to energy consumption. The update of the Reference is called the Reference Plus Scenario ("Reference+") and in addition to all assumptions of the Reference, it also features the policies that were adopted (and in addition some relevant acts proposed by the Commission) between spring 2012 and January 2014, namely:

- In transport sector: additional initiatives in the field of transport proposed by the Commission: new EU rules for safer and more environmental lorries; Clean Power for Transport package concerning the infrastructure for alternative fuels; Forth railways package; Single European Sky) and several measures at MS level (road charging for Hungary, Belgium and UK and a bonus system for silent wagons for rail freight in the Netherlands and Denmark).

- New eco-design and labelling legislation together with updated evaluation of potential savings from existing legislation.

- The recently agreed revision of the F-gas regulation, adopted in March 2014. The additional F-gas emissions reduction in 2030 has been estimated for every MS based on GAINS marginal abatement cost curves and for simplicity kept constant afterwards. For 2025 it is assumed that half of the 2030 effect occurs.

- In addition, most up-to-date information on transposition of EED is included, which leads to small revisions of assumptions on the implementation of the national obligation schemes and alternative measures that the Member States notified under art. 7 of the EED[19], as follows:
    - Sweden does not exclude the energy consumption of the transport sector while calculating the energy savings for 2014 – 2020.
    - Denmark does not use the 25% exception and even goes beyond the obligations of art. 7 EED.
    - France has well developed plans for implementing fully the 75% of the 10.5%

[19] In general, in PRIMES a conservative approach is taken. It is assumed that the MS do not fully implement the obligations laid down in the EED, including with regard to art. 7 EED.

Commission's proposals which do not have a clear timeline for adoption and where the content of the final agreements is rather uncertain have not been included in the Reference+. Two important cases omitted from the Reference+ are the Energy Taxation Directive proposal and the proposal for the structural reform of ETS ("Market Stability Reserve") which were not included for this reason.

Also the Commissions regulation (EU) No 176/2014 to determine the volumes of greenhouse gas emission allowances to be auctioned in 2013-2020 was not taken into account. As the focus for this analysis until 2020 is on the progress regarding energy savings the backloading of allowances within 2013-2020 is of less importance and the analysis beyond 2020 is not affected by this structural measure.

The resulting changes from the Reference projection are very small on the EU level. In comparison to the Reference, the Reference+ scenario mainly shows small reduction of energy demand (more specifically, there is a slightly lower demand in transport, notably in aviation, and slightly lower demand in non-ETS sectors including for electricity). Regarding the ratio of energy savings as percentage of 2010 consumption, the Reference+ achieves 5.1% by 2020 which is a little above the 5.0% shown in the Reference 2013 projection. In terms of the rate of savings in primary energy consumption relative to PRIMES 2007 projection, the Reference+ projection achieves 17% in 2020 and 21% in 2030, which are virtually unchanged to the 16.8% in 2020 and 21% in 2030 ratios projected in the Reference.

In terms of the RES share in the final consumption, the Reference+ achieves 20.96% by 2020, which is virtually equal to the 20.88% achieved by Reference. The impacts on the ETS sector are also small and the modelling found no justification to modify the equilibrium ETS prices which are maintained as in Reference.

The inclusion of the F-gas regulation in the Reference+ leads to higher reduction of non-CO2 emissions post 2020 relative to the Reference. In particular, in 2030 the non-CO2 emissions reduction in the Reference+ is 42% relative to 1990, with the respective figure being 38% in the Reference. The difference in total GHG emissions reduction is however small (33% reduction in comparison to 1990 instead of 32% in 2030), as non-CO2 emissions constitute a small percentage of overall emissions.

To sum up, Reference+ is a projection very similar to the Reference; the only noticeable differences are a very small reduction of energy demand in 2020, which is a consequence of updated assumptions regarding the implementation of the energy efficiency legislation and also of a few additional policies considered for the transport sector, and the reduction of non-CO2 emissions due to the implementation of the revised F-gas regulation.

The described updates above were the only changes made regarding the Reference. All other PRIMES assumptions for instance regarding the GDP projections and the population growth, imported fossil fuel prices and technology costs are the same as in the Reference.

While Reference+ has an important role in identifying the exact progress in reaching the 2020 target, for reasons of comparability with the 2030 IA all the results of the energy efficiency scenarios are compared against the Reference.

4. <u>Assumptions used in Energy efficiency scenarios</u>

The aim of this PRIMES modelling exercise regarding the 2020 time horizon is to assess the progress towards the 2020 target on energy efficiency. With regard to the 2030 time horizon, the aim is to find the optimal level of energy efficiency ambition and identify, broadly, measures to deliver it, which combined with the targets proposed in the 2030 Communication, will improve Europe's security of supply, competitiveness and sustainability. The mix of energy efficiency policies is not altered among the scenarios (it always follows the logic of current legislation) and only the overall level of ambition intensifies.

Six scenarios were thus quantified, assuming a stepwise increase in the intensity of energy efficiency efforts after 2020 in all final energy demand sectors, which are targeted by the current policy measures. These scenarios achieve energy savings in 2030 (relative to PRIMES 2007 projections for 2030) of 27.4% (EE27 scenario), 28.3% (EE28), 29.3% (EE29) 30.7% (EE30), 35.0% (EE35) and 39.8% (EE40).

As described above, the overall level of ambition of different energy efficiency policies is progressively increased. The policy mix on energy efficiency - includes the following measures:

- Increasing energy efficiency of houses and buildings by means of a continued energy savings obligation.
- Elimination of market failures and imperfections (e.g. ESCOs, labelling, information campaigns, addressing landlord-tenant problems) reflected in the reduction of discount rates.
- Increased uptake of advanced technologies by stricter Ecodesign standards and improved labelling.
- Increased uptake of BAT in industry through energy efficiency policies in this sector (e.g. voluntary agreements).
- Higher penetration of district heating and CHP through promotion of investments in CHP and in distributed steam and heat networks.
- Measures limiting grid losses.
- Measures reducing energy consumption in transport, notably stricter CO2 standards for light duty vehicles (passenger cars and light commercial vehicles).
- Measures leading to improvements in the fuel efficiency of heavy duty vehicles (HDVs), ambitious vehicle taxation reforms to shift to CO2 based taxation, internalisation of external costs, wide deployment of intelligent transport systems, development of infrastructure for alternative power-trains and other soft measures like fuel labelling and eco-driving in line with the measures put forward in the 2011 White Paper on Transport. Importantly, intensity of these measures is not intensified across the scenarios.

The modelling assumptions used to drive energy savings are summarized below:

a) Energy Efficiency Obligations for Houses and Buildings:
Increasing energy efficiency obligations related to thermal integrity of dwellings is simulated by varying the energy efficiency values[20], which apply by country and also for the EU as a whole. Energy efficiency values increase by scenario and in time and drive a faster pace of investments in renovations, as well as increasing deepness of renovations from an energy perspective. New buildings codes are common under all scenarios, however demolishment rate and enforcement of building codes slightly vary by EE scenario. National policies towards stronger renovation (mirrored by the efficiency values at national scale) increase gradually across the EE scenarios, and are more harmonized across the EU in the ambitious cases. The energy efficiency values act in the model only in the sectors of residential and office buildings and exert effects on energy efficiency investment and behaviour as shadow prices associated to a virtual energy saving obligation. This process is equivalent of having an estimation about the degree of achievement of the obligation under Article 7 of the Energy Efficiency Directive by country and over time, assuming that EED is implemented and enhanced beyond 2020; this estimation is then mirrored in the model projections by varying the energy efficiency values. Because the largest part of energy consumption in these sectors is taking place for heating/cooling purposes, the energy efficiency values and the ensuing investment to improve thermal integrity constitute is by far the main driver of increasing energy saving performance measured according to Article 7.

The degree of renovation per year (as % of stock) is historically of the order of 1% but the energy-related part of the renovation works is not necessarily high in the absence of energy-oriented incentives. In other words it matters for energy savings how deep the renovation goes in insulations and other interventions which improve thermal integrity of houses and buildings. Apart from renovation pace and its deepness, energy efficiency progress is also influenced by the energy-related strictness of the building codes which concern new constructions and by the rate of demolishment. The rates of demolishment and of new construction are, however, small in the EU and are driven by demographics and economic growth which evolve slowly in Europe. The building codes are already today very strict in

[20] Efficiency values are a key modelling instrument used to simulate energy saving obligations in the sectors of houses and office buildings. The efficiency value is measured in EUR/toe-saved and can be seen as a threshold which indicate as profitable all portions of energy saving investment which have an annual marginal energy saving cost equal or below the threshold value. The efficiency value is the additional amount that has to be borne annually for a limited period of time incurring as a unit cost above average fuel price in order to economize over fuel payments for an unlimited period of time due to the energy saving investment.

In the model, the efficiency value is perceived by the demand actors as a virtual marginal value stemming from energy savings: it makes profitable all portions of the cost-potential curve (with increasing slope) of energy saving investment possibilities which are positioned below that value and thus the corresponding energy saving investments are selected and deliver energy savings over subsequent periods of time.

The logic of setting the levels of efficiency values in a scenario context is to iterate until a certain pre-determined energy saving amount is obtained from scenario results. In this sense, the efficiency values are not policy instruments, but the ensuing energy saving amounts can be considered as targets or obligations and so they are policy instruments. The PRIMES model does not cover the details of policies which enforce such a target or obligation. Nonetheless, considerations of accompanying policies which aim at enabling more effective implementation of the target/obligation can be mirrored in the model assumptions, as for example the change in discount rates related to the assumption of implementing the targets as obligations on utilities (see below for more details).

most EU countries regarding the thermal integrity of new houses and buildings, thanks to national policies and the revised EPBD. It is assumed in the projections, already in the Reference Scenario, that the building code standards become very strict in all countries to a horizon of 2020 and a few years later, and remain at very strict levels until 2050. But because the rate of new constructions is small, achieving significant energy savings in the short/medium term cannot be obtained only through the new constructions. It is mainly renovation rhythm and its deepness that matter for that purpose.

Please see in Annex VII projections of renovation rates.

b) **Reduced discount rates due to policy implementation**:

Individuals perceive a series of risk factors, lack information and have limited access to funding when considering energy saving investment in their premises. The risk factors are technical, administrative and institutional. Lack of information is important concerning the future performance and robustness of interventions when e.g. renovating a house. Barriers also stem from the different interests and competences between owners and tenants of houses. One of the most important barriers is the limited access that individuals have to capital markets. Access to funding and cash flows depends on individual's income and is particularly difficult for the majority of individuals which have income below a threshold. Using individual savings for energy saving renovations is hardly possible in most cases as individuals associate very high opportunity costs (shadow interest rate) to savings and in general to the drawing of funding. According to the empirical literature, all the above barriers but most of all the lack of access to funding, explain why individuals use very high values of subjective discount rates when assessing costs and benefits of energy saving investments.

Subjective discount rates are used in PRIMES to model the higher costs of consumers due to the above described market failures in the decision making. Without any policies to remove these market failures the sectoral discount rates in the second column of the figure below were used for the decision making in PRIMES. Because of the implementation of the EED by June 2014, it is assumed in the Reference that a widespread penetration of ESCOs or similar institutions and mainly the legislative provisions that savings obligations apply on utilities which have to make sure efficiency investment at their consumer premises will change the environment for decision making in the tertiary sector and for households on energy saving investments. To reflect the removal of market barriers in the Reference due to the EED, the sectoral discount rates were lowered in the two sectors from 2015 on and mainly from 2020 onwards (see column three and four of the figure below). For instance, the involvement of utilities and ESCOs implies removal of risk factors regarding technical, administrative and institutional issues, and also implies lower interest rates as these large organizations collectively bargain with banks the funding of energy investment projects and also collectively manage the individual project risks. As a result, the subjective discount rates which prevail in capital-budgeting decisions when such decisions are taken solely by individuals are reduced, moving closer to business interest rates.

Figure 30: Discount rates used in PRIMES assumed in the Reference Scenario 2013

Discount rates (in real terms)	Standard discount rates of PRIMES	Modified discount rates due to EED	
		2015	2020 - 2050
Power generation	9%	9%	9%
Industry	12%	12%	12%
Tertiary	12%	11%	10%
Public transport	8%	8%	8%
Trucks and inland navigation	12%	12%	12%
Private cars	17.5%	17.5%	17.5%
Households	17.5%	14.75%	12%

Source: Primes

Already in the 2030IA, it is assumed for some scenarios (notably GHG40/EE and GHG40/EE/RES30) that the energy efficiency policies continue and intensify after 2020.

Consequently, discount rates for these scenarios with more ambitious EE post 2020 have been further lowered compared to the Reference. This reflects that economic actors become more familiar with EE and market failures are being tackled successfully through the implementation of energy efficiency policies. Wide deployment of energy performance contracting (EPC) and stronger penetration of ESCOs is mirrored by a further reduction of discount rates for households and services as presented in the Table below. In addition, strengthening of European or national policies with regard to energy efficiency financing and awareness rising of energy efficiency will lower the discount rates for customers.

The discount rates is this IA were not lowered below levels that were included in the 2030 IA, even for the most ambitious energy efficiency scenarios. It has to be also borne in mind that the more ambitious scenarios are in terms of energy efficiency, the higher the level of investments, resulting in more restricted lending conditions (due to higher exposure of banks to this specific sector and higher competition for capital as the EE investments increase).

Table 26: Discount rates in the energy efficiency policies scenarios

Discount Rates of the Residential Sector (%)	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	2030 IA*
Reference	17.5	17.5	14.75	12	12	12	12	12	12	12	
EE 27	17.5	17.5	14.75	12	11.7	10.5	10.2	10.2	10.2	10.2	GHG35/EE®
EE 28	17.5	17.5	14.75	12	11.7	10.5	10.2	10.2	10.2	10.2	GHG35/EE®
EE 29	17.5	17.5	14.75	12	11.7	10.5	10.2	10.2	10.2	10.2	GHG35/EE®
EE 30	17.5	17.5	14.75	12	11	10	9.5	9	9	9	GHG40/EE GHG45/EE/RES35
EE 35 EE 40	17.5	17.5	14.75	12	10	10	9	9	9	9	

Discount Rates of the Tertiary sector (%)	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	2030 IA*
Reference	12	12	11	10	10	10	10	10	10	10	
EE 27	12	12	11	10	9.7	9.2	9	9	9	9	GHG35/EE®
EE 28	12	12	11	10	9.7	9.2	9	9	9	9	GHG35/EE®
EE 29	12	12	11	10	9.7	9.2	9	9	9	9	GHG35/EE®
EE 30	12	12	11	10	9.5	9	8.5	8.5	8.5	8.5	GHG40/EE GHG45/EE/RES35
EE 35 EE 40	12	12	11	10	9	9	8.5	8.5	8.5	8.5	

(*) discount rates used are exactly the same as in 2030 IA scenarios listed in this column
Source: PRIMES

The discount rates assumed for the transport sector are differentiated between decision making for private car choice, business transport choice and decision making for the choice of transport means in public transport. For the latter the model uses low discount rates reflecting either business practices (12% e.g. private trucks and aviation) or policies in sectors regulated by the state (8% e.g. rail, busses). For private cars the model assumes high discount rates (17.5%) which reflect perception of risks by individuals and eventual limited access to cash flow. The high discount rates in car choices have consequences for market penetration of electric vehicles which have significantly higher upfront costs but much lower operating costs than conventional cars.

The discount rates for the transport sector are kept unchanged from 2030 IA in the energy efficiency scenarios.

For the industrial and energy supply sectors the discount rates assumed in the reference scenario are in line with business practices and range between 7 and 9% (the lower end applies to infrastructure subject to state regulation). A WACC at that level is reasonable and can be seen as a weighted sum of an interest rate applied on equity and a bank lending rate, the latter being lower than the former.

The industrial WACC values are also kept unchanged from 2030 IA in the energy efficiency scenarios for industry and energy supply sectors.

c) Anticipation of enforcement of eco-design regulations

The eco-design policy aims at reducing energy consumption of energy-using equipment and appliances by promoting product varieties which embed higher energy efficiency. Depending on implementing measures and voluntary agreements, the eco-design regulations certify specific energy consumption by product variety and eventually provides for mandatory requirements for certain products. The requirements impose a minimum bound on energy performance of products. The bounds are set for the next two to five years. This implies that the menu of technologies for consumer choices in the future is restricted to product varieties which have performances exceeding the minimum threshold value. Obviously the menu of choice will allow selecting technologies which perform above minimum threshold value; the choice will depend on relative costs, perception of technical risks and the policy context. The eco-design regulations, combined with the labelling directive, are playing an important role to remove uncertainties regarding technical risks and those stemming from lack of information.

The model represents a generic set of technologies (ordinary, improved, advanced, future, etc.) by product type. The technologies have increasingly higher energy efficiency performance at higher upfront cost. Choice of technology by product type is simulated within the economic optimization problem which drives actors' decision making. Technology costs are perceived to be higher than under conditions of market maturity, so as to reflect learning, scale return and subjective risk factors. All these elements improve under active efficiency policies implying that advanced technologies are adopted earlier than under reference conditions and that learning is accelerated. The technical characteristics of projected technologies are modified in a scenario if they are inferior to eco-design regulations as assumed in this scenario.

The reference scenario is assumed to include the currently adopted eco-design regulations to a horizon of 2020. This implies that technologies until 2020 comply with the regulations and that beyond 2020 all projected technologies perform equally or better than the regulations. The menu of choice obviously includes technologies that perform above the regulations' thresholds. As mentioned their uptake by consumers depend on economic conditions.

For the energy efficiency scenarios, it is assumed that beyond 2020 the eco-design regulations increase the performance requirements and also that the policy context, including the beneficial effects from labelling, is such that the consumers increasingly trust in advanced technology and perceive lower costs by neglecting risk factors. This mechanism is numerically escalated in a range from Reference to the most ambitious energy efficiency scenario. The resulting early uptake of advanced technology is modelled to induce acceleration of learning making them cheaper and more efficient as they are getting towards commercial maturity. So, the dynamic uptake of advanced technologies by consumers has subsequently effects on the progress of these technologies. As higher volumes of advanced technologies are chosen by consumers, production of such technologies moves further on the learning curve; thus efficiency improvements occur faster. At the same time, with increasing efficiency performance the cost of investment in these technologies is increasing. Modelling parameters that represent these two aspects of technology performance (increased efficiency and increased investment cost) of the available technologies are modified accordingly.

Overall, the effect of the eco-design regulation and other measures can be summarized in increased uptake of efficient technologies due to removal of barriers in respect to consumer information (reduction of perception cost) and in increased rate of improvements of the technical characteristics of technologies due to learning effects. Therefore, the average efficiency of equipment used by the residential and household sectors is improving both because more efficient technologies penetrate the market and because the technologies themselves are becoming more efficient faster. These benefits are partly offset by rebound effects which are inherent in the modelling and are of course limited by technical potential of performance improvement by type of product. So in very ambitious energy efficiency scenarios, the projections show some degree of saturation in the rate of improvement of performance of energy using equipment and appliances.

It should be noted that the eco-design policy was already included in the reference scenario EE-policies package, with considerable effects on the uptake of more efficient technologies and the technology progress. In the EE scenarios the intensity of eco-design policy is assumed to increase after 2020 which adds effects on the modelling of a context with intense energy efficiency measures, which induce further uptake of advanced technologies. Therefore, as mentioned, across the EE scenarios the perception of the cost is reduced and techno-economic characteristics are improved.

To the 2030 horizon, the effects of eco-design are simulated to intensify relative to the reference scenario and across the EE scenarios. Moving from 2030 to 2050, the effects are simulated to intensify further relative to the 2020-2030 period and approach technical potential in the very ambitious cases. The learning effects are modelled to be relatively lower until 2030 than after 2030.

Please see in Annex VII projections on rates of improvement of energy using equipment in residential sector.

d) <u>Anticipation of enforcement of best available techniques (BAT) in Industry</u>

Energy efficiency progress in the industrial sector in the energy efficiency scenarios occurs through the deployment of BAT (best available techniques), both vertically and horizontally; vertically refers to technologies associated with the equipment used for specific industrial process; horizontally, refers to systems that affect all industrial processes, such as energy control systems and heat recovery systems.

Regarding the technologies at the level of equipment, the menu of candidate for investment BATs is the same in all energy efficiency scenarios. What varies among scenarios is their uptake, depending on the intensity of energy efficiency policies assumed. Similar to what has been described in the previous section for the technologies in the residential and tertiary sectors, anticipation of increased energy efficiency savings results in moderation of the perception of risk associated with advanced technologies, and in acceleration of their maturity and uptake. This effect is represented in the energy efficiency scenarios through modifying the parameters that reflect the perception of cost. The risk associated to anticipation does not refer to technical risk or lack of information but rather refers to regulatory risk: in the context of strong efficiency policy, as also in the context of strong emission reduction policies, industry anticipates that enforcement is likely to become more stringent in the future and so in order to avoid locking-in inferior technologies increases the uptake of advance, hence more efficient technologies.

Regarding the horizontal BAT, their deployment leads to energy savings at all process levels. These horizontal technologies are not the same as the technologies for the equipment associated to the various processes. Such horizontal possibilities mainly include energy control systems and heat recovery systems. They also follow BAT specifications. The model database includes engineering estimations of potential amounts of energy savings due to deployment of horizontal BAT, such as control systems and heat recovery. The degree of exploitation of this potential depends on relative costs and prices and also on exogenous model parameters which reflect the degree of anticipation of future emission cutting commitments, the degree of enforcement of BAT promoting policies and generally the intensity of the policy context enabling such savings. The values of the parameters controlling the pace of uptake of BAT technologies in industry for horizontal energy saving purposes is escalating across the EE scenarios, so as to mirror the assumptions about increasing energy efficiency ambition across the scenarios. The model considers a maximum potential for energy savings from horizontal BAT adoption, which is different by sector and by country. The energy efficiency scenarios are designed to exploit partly the maximum potential at a degree reflecting the intensity of energy efficiency ambition by scenario. Therefore the uptake of horizontal BAT increases by scenario but is limited by potential. Moreover, each scenario is assumed to follow a different path towards achieving this potential.

Overall, the uptake of BAT (vertical and horizontal) in industry contributes to decreasing energy intensity of the sector. This leads to higher reduction of energy consumption per unit of industrial output in the more ambitious scenarios than in the policy scenario with a lower level of energy efficiency.

Please see in Annex VII projections on industry savings potential.

e) **DH and CHP**:

Energy efficiency policies induce efficiency improvements on the supply side through the promotion of investments in CHP and in distributed steam and heat networks. These investments are combined with incentives on the consumer side to shift towards heating through district heating, both in the residential and the tertiary sectors. This results in a larger number of dwellings in the residential sector having access to distributed heat networks, which in turn allows for further participation of CHP in heat/steam supply.

To simulate this effect, a parameter is utilized that controls the substitution of heating through individual (non-central) heating equipment with district heating. The choice of shifting to district heating is endogenous and depends on its economic viability; what the model is controlling is the availability of district heating in the menu of candidate technologies for space heating, which in the EE-scenarios is increasing. As a result, the number of households that are connected to district heating is increasing in the EE scenarios. In parallel the share of CHP in heat/steam supply is increasing. Both are necessary to increase overall efficiency in primary energy trends, because district heating alone, without CHP, can have lower efficiency performance, overall, than other configurations based on individually operating equipment for heating.

This is not to imply that the only factor resulting in increasing CHP in steam generation is the penetration of district heating. In a context with intense energy efficiency policies CHP penetrates both steam and electricity generation as a result of a combination of factors, including the CHP promotion policies and the increased requirements for energy efficiency in general. In the modelling exercise for the EE policies scenarios, CHP penetration was not facilitated through the modification of relevant parameters, as is the case for district heating penetration. The level of facilitation is similar to the reference scenarios, which already assumes considerable penetration of CHP. Further penetration in the EE policies scenarios is thus the result of the increasing use of district heating and of increased requirements of the supply side for energy savings. But CHP penetration depends also on economics which are influenced by scale parameters: the larger the volume of heat/steam and electricity demand, the more economic CHP projects can be. Increasing energy efficiency reduces volumes of steam/heat and electricity demand which goes against the economics of CHP projects for reasons of lower return to scale. Variability of load also acts to the detriment of CHP. In the context of high emission reduction targets, clean power solutions such as nuclear and RES are economically and technically superior options than CHP which is obliged to use fossil fuels, at least to a certain degree, given the biomass resources are limited and clean hydrogen is not yet a mature option. So in the long term the projections show limited increase in CHP and further limitations are shown in the context of the highly ambitious scenario.

Please see in Annex VII projections on % of households connected to district heating networks and in Chapter 5 the CHP indicator.

f) More efficiency grids

Modification of specific parameters has been used as an approach to represent the improvement of the rate of grid losses due to smother load factor in electricity demand enabled by smart metering and generally demand response measures. Energy efficiency implies lower demand for electricity and generally lower electrical charge in power grids thus lower losses. The rate of reduction of grid losses across scenarios is assumed to be small as the potential for reducing grid losses through smoothing the load curve is limited.

Please see in Chapter 5 projections on electricity grid losses.

g) Transport policies

Additional measures for transport could contribute to energy savings in a 2030 perspective. These measures included in the policy scenarios draw on the 2011 White Paper on Transport and imply that the scope of the EED (Art 7) remains unchanged in relation to transport. These measures are expected to mainly contribute beyond 2020.

The CO2 standards for cars and vans are key assumption leading to reduction of energy consumption. The standards are tightened progressively within the energy efficiency scenarios according to the table below.

Table 27: Assumptions on CO2 standards (g/km) for cars and light commercial vehicles (vans) across scenarios

cars							
	2020	2025	2030	2035	2040	2045	2050
EE27	95	85	76	64	37	32	26
EE28	95	85	75	63	37	32	26
EE29	95	85	74	62	36	31	26
EE30	95	85	72	60	35	30	25
EE35	95	85	70	50	25	18	17
EE40	95	85	70	50	25	18	17

vans							
	2020	2025	2030	2035	2040	2045	2050
all scenarios	147	130	110	90	70	65	60

Source: PRIMES

In addition, all energy efficiency scenarios assume in line with the IA accompanying the 2011 White Paper on Transport:

- Measures leading to improvements in specific fuel consumption of heavy duty vehicles of about 1.1% per year between years 2010 and 2030, as well as for the period 2030 to 2050.
- Full internalisation of the costs of infrastructure wear and tear, congestion, air pollution and noise in the pricing of transport for all modes by 2050. The charges are set at 100% of the values of the external costs from "Handbook on estimation of external costs in the transport sector"[21]).
- In each Member State that did not introduce a CO2-related element, at least 25% of the total tax revenue from registration and annual circulation taxes, respectively, would originate in the CO2 based element of each of these taxes starting with 2020. From 2025 at least 50% of the total tax revenue from both the annual circulation tax and the registration tax would originate in the CO2 based element of each of these taxes.
- The elimination of the favourable tax treatment of company cars (and of the corresponding fuel use) by changes in car ownership, vehicle size in the fleet and fuel consumption, based on the findings of a study commissioned by DG TAXUD[22].
- The wide deployment of intelligent transport systems in road and waterborne transport is gradually implemented starting from 2020.
- Measures concerning railways and aviation
- Development of infrastructure for alternative powertrains

These measures are not progressively intensified across the scenarios.

5. Modelling of non-ETS emission reductions

In this modelling exercise, the so called carbon values for the non-ETS sector which were used in the 2030 Impact Assessment were not applied. In the energy efficiency scenarios, the non-ETS sector is modelled with the above mentioned concrete energy efficiency policies. Therefore, the use of such a carbon value, which is the shadow price of the overall emissions reduction constraint was not necessary.

[21] Source: http://ec.europa.eu/transport/themes/sustainable/doc/2008_costs_handbook.pdf

[22] See page 44 of the TAXUD study: http://ec.europa.eu/taxation_customs/resources/documents/taxation/gen_info/economic_analysis/tax_papers/taxation_paper_22_en.pdf

Carbon values in the non-ETS sector do not directly affect emitters budget but they alter the relative costs of energy forms, because the use of fossil fuels would be perceived as including the carbon value. Due to carbon values, the consumption is reduced because emissions due to the use of fuels/technologies have a higher perceived price (substitution effect) but these are no carbon emission payments which would reduce emitters' budget (no income effect). This means that carbon values in the non-ETS sector would lead to fuel switching. In addition, carbon values also induce additional non-CO2 emission reductions in non-energy sectors. The carbon value mirrors a large variety of unknown policies needed to achieve the overall carbon constraint of all sectors. The overall emission reduction target should be allocated across sectors to minimise total abatement costs. Carbon values are used to achieve a cost-efficient split of abatement policies between the ETS and the non-ETS when implementing an overall emissions constraint. As in practice no market-based emission trading system is implemented for the non-ETS system, the optimal distribution of efforts regarding GHG emission reduction between the ETS and the non-ETS sector was modelled with the help of carbon values in the 2030 Impact Assessment.

In the modelling work for the 2030 Communication the overall GHG emission reduction constraint/target was specified for 2030. The volume of the ETS cap was determined in this modelling exercise. For sectors belonging to ETS, the emission abatement instruments were modelled in a way that they reflect the design of the ETS Directive. For the non-ETS sectors a carbon value which is equal to the ETS carbon price of the ETS sector was assumed since for the time being no specific policies or measures are in place for the non-ETS sector. The carbon value is used as a shadow value of an emission reduction target in the non-ETS sectors, which is not a priori known. For the non-ETS sector the results shows which fuel/technology switch is necessary and at which costs to meet the target.

The optimal level of overall GHG reduction in 2030 was calculated in the 2030 IA. For the ETS sector where a concrete policy – the ETS system – is in place, it was established in the 2030 Communication that the linear reduction factor should be reduced after 2020 from 1.74 % to 2.2%. As in the non-ETS sector no concrete policies to reduce emissions are in place carbon values were used to model the contribution in emission reductions of this sector. Beyond 2030, tighter CO2 standards for light duty vehicles were also assumed. In contrast, in this IA, the focus is on choosing the right policy instruments for the non-ETS sectors.

6. Enabling settings

In the context of the modelling exercise for the 2030 Communication, some of the scenario assumptions have been organized in two groups, one called reference settings and the other enabling settings. The former group assumes that actors in the energy sectors do not anticipate strong GHG emission reduction commitments in the time period after 2020 and decarbonisation in 2050 perspective and so they do not necessarily take all actions that are necessary to achieve optimal levels of infrastructure, technology learning and market coordination. In contrast, the enabling settings mean that because of good anticipation of future GHG emission reduction commitments, all conditions are met in infrastructure, technology learning, public acceptance and market coordination so as to enable the decarbonisation or in other words to maximize the effectiveness of policy instrument which aim at driving strong GHG emission cuts. Consequently, GHG emission cuts are more difficult, hence more costly, under reference settings compared to enabling settings.

In order to ensure that enabling settings do happen in reality, it necessary to put concrete policies in place, but by definition the actual policy instruments which are conceived for driving GHG emission cuts effectively are not included in the settings, which include only the background and basic actions (e.g. support for research, development and innovation, infrastructure development, etc.) which are meant to facilitate the actual drivers of GHG emission cuts. This means that it is assumed that enabling policies ensure the availability of necessary infrastructure, progress in R&D, broad social acceptance of technologies to reach the decarbonisation in 2050.

Box 1: Enabling conditions

Main enabling conditions include:

- Development at large scale of intelligent grids and metering as well as management systems for recharging of car batteries to facilitate demand response in power markets.
- Development of infrastructure to harvest decentralised as well as remote RES for power generation; this is produced by a streamlining of permitting procedures, higher investment, timely availability of technology and appropriate price signal by smart and net metering.
- Development of carbon transportation and storage infrastructure as well as public acceptance of the technology that leads to the faster development of CCS.
- Technological progress enabling mix of hydrogen and bio-gas in gas supply and possibility to use hydrogen-based storage.
- Development of electric vehicles battery technology combined with development of battery recharging infrastructure and public acceptance of electric vehicles leading to transport electrification.
- Accelerated innovation in biofuels in particular enabling strong emission reduction in transport activities for which electrification is not possible.

The underlying modelling of the 2030 Communication is based on an ambitious commitment to reduce greenhouse gas emissions in line with the 2050 roadmaps. In addition, the proposed EU-wide target of at least 27% RES share in final energy consumption was based on scenarios which assumed enabling settings.

For these reasons, in the modelling exercise presented in this IA enabling conditions were used in the PRIMES modelling as well - except for EE policies. With regard to EE the enabling settings were replaced by concrete policies which were intensified in the policy scenarios.

7. Modelling of ETS

For comparability purposes to the 2030 IA, the overall cumulative GHG emissions up to 2050 are equalized to the projections of the GHG40 scenario from 2030 IA, i.e. a scenario achieving 40% emission reductions in 2030 and 80% emission reductions in 2050 (mainly driven by uniform carbon prices and carbon values). Similarly as in the 2030 IA, the EU ETS is modelled in the energy efficiency scenarios via carbon prices. These are varied in the scenarios until the cumulative ETS emissions approximate the cumulative ETS emissions of GHG40.

8. Modelling of RES

In the 2030 Communication, a binding European target of at least 27% RES was proposed for 2030. In the PRIMES modelling conducted for this IA, this target was also set as a constraint and the RES values have been used in order to achieve this target. RES values are consequently increasing in comparison to the Reference scenario.

9. Modelling of non-CO2 emissions reductions

The modelling approach of not using carbon values implies that there is no incentive for additional non-CO2 emission reductions beyond those achieved in the Reference scenario. Moreover, the policies to reduce non-CO2 GHG emissions do not belong to the domain of the energy efficiency (mainly agriculture and waste treatment are concerned). On the other hand, for the consistency reasons with 2030 IA (notably reaching the 40% GHG target), some assumptions had to be made for these emissions.

Consequently, all scenarios feature assumptions on policies which reduce non-CO2 GHG emissions. The volume of reduction of these emissions as achieved by the GHG40 scenario from the 2030 IA has been used as a starting point. In the GHG40 a certain amount of non-CO2 GHG emissions reduction was necessary in order to reach 40% GHG reduction in 2030. Because of the higher level of energy savings in the EE policy scenario modelled in this IA the contribution of non-CO2 GHG emissions to achieve the 40% GHG target decreases (but is uniform across the policy scenarios in order to ensure comparability).

10. Modelling of EED implementation

Art. 7 of the EED requires Member States to establish policy measures – either energy efficiency obligation schemes – or alternative policy measures ((e.g. financing, fiscal, voluntary, and information measures) to reach certain amount of new, cumulative energy savings over 2014-2020 period.

In line with the provisions of the Directive, it is assumed that transport sector is excluded as the Directive stipulates that the transport sector can be partially or fully excluded (for Denmark and Sweden the transport sector has not been excluded). The possibility for exclusion of industrial activities covered by the ETS industries also exists, subject to a deliberate of choice of the MS concerned. In the Reference scenario, ETS industries have therefore not been included in the modelling of the energy savings obligation. However, this choice is part of the flexibility options within the on maximum 25% limit of the amount of energy savings referred to in paragraph 1 of Article 7.

Given the overlaps of article 7 with other requirements of the EED the expected saving obligations by country was specified as part of the policy assumptions. In implementing the

Directive, Member States will decide on which provisions and alternatives to use, reflecting their specific circumstances.

The table below illustrate the projected energy savings achieved by residential, tertiary and industries due to the EED implementation (mainly article 7 EED). The numbers expresses the difference as percentage of energy consumption in 2010.

Table 28: Reduction of final energy demand in industries, residential and tertiary due to the Energy Efficiency Directive (EED) – in comparison to 2010.

Indicator	Ref	Decarbonisation Scenarios					
		EE27	EE28	EE29	EE30	EE35	EE40
Reduction of final energy demand due to the EED in 2020 (Savings as % of 2010 consumption of scenario w/o EED)	-6.5%	-7.8%	-7.8%	-7.8%	-8.3%	-8.5%	-8.6%
Reduction of final energy demand due to the EED in 2030 (Savings as % of 2010 consumption of scenario w/o EED)	-7.7%	-16.8%	-19.8%	-22.3%	-25.1%	-33.9%	-43.6%

Source: Primes 2014

Annex VI. E3ME and GEM-E3 Methodology

The results on macro-economic impacts are based on the PRIMES results for the scenarios achieving respectively 25, 28, 30, 35 and 40% energy efficiency targets. The scenario with 25% energy savings has ambition similar to GHG40 scenario but is built on the PRIMES scenario that has concrete EE policies rather than carbon values - for better comparability with other scenarios. The macro-economic modelling building on EE27 and EE29 scenarios would likely have very similar outcome to results presented for EE28 and EE30, with little additional insight brought to the analysis – for practical reasons, smaller number of scenarios is therefore presented..

The five scenarios analysed in this IA have escalating levels of energy savings efforts after 2020, which are made possible by the significant investments in all final energy demand sectors. These investments are the key driver of the macro-economic impacts. In this IA, similarly to 2030 IA, two models have been applied to assess the macro-economic impacts representing different schools of economic thought and reflecting current uncertainty about the best way of assessing these impacts. Application of two different models enables not only to establish a range of possible impacts but also to identify the conditions necessary for maximising the positive impacts.

Theoretical background and assumptions

In this IA, the models E3ME and GEM-E3 have been applied to assess the impacts on GDP and employment of policy scenarios with escalating levels of energy savings efforts. Both models enable to assess complex interactions between different sectors of economy and to compare the results to respective baselines (please note that because of different assumption applied by the models also the baselines produced by each model are different).

The path and magnitude of investment in energy efficiency in each scenario together with other important drivers such as energy prices or overall energy balances are taken from projections made in PRIMES: the E3ME and GEM-E3 models are then calibrated to represent these changes in the energy system so that their economy-wide impacts can be modelled. The two macroeconomic models have many similarities. However, there are also important differences that arise from their underlying assumptions and respective structures. E3ME is a macro-econometric model, based on a post-Keynesian framework; GEM-E3 is a general equilibrium model that draws strongly on neoclassical economic theory and optimising behaviour of economic agents.

Due to these theoretical differences, the two models will in some cases lead to differing results. Any differences in results may be traced to the different model structures:

- A key difference between the two approaches is the modelling of supply and demand. In general equilibrium models (like GEM-E3), there is an assumption that markets will always clear because agents behave optimally. This is achieved through the full adjustment of prices which allow supply to equal demand and thus a ‘general’ equilibrium is reached and maintained throughout the system.

  In contrast, post-Keynesian econometric models do not adhere to the ‘general’ equilibrium rule; instead demand and supply only partly adjust due to persistent market imperfections and resulting imbalances may remain a long-run feature of the economy. The degree of adjustment is derived from econometric evidence of historical non-optimal behaviour. Therefore the level of output, which is a function of the level of demand, may continue to be less than potential supply or a scenario in which demand increases can also see an increase in output.

- Another important difference is that in GEM-E3, capital markets are assumed to operate in an optimal manner. Since output and savings cannot be boosted by higher demand, the requirement that investment must be funded from savings implies that crowding out of certain investment must take place due to the capital resource constraint which is imposed at a global level. Therefore additional investment requirement in energy efficiency projects implies lower capital availability for the remaining sectors, unless there is also an increase in savings (either domestically, through a reduction in consumption, or through international financial flows (see below)).
- In E3ME, investment in one particular sector does not automatically lead to a crowding out effect on investment in other sectors. This relates to the model's underlying approach, which does not assume optimisation in markets. If there is spare capacity in the baseline case, then it is possible for there to be an increase in investment in the scenarios without necessarily having a reduction in investment elsewhere: the national income identity that savings equals investment is met either by the higher savings associated with a higher level of output or by capital inflows from abroad (see below).[23] If the investment is financed externally, then, again, the treatment between the two modelling approaches differs. In GEM-E3, investment is usually made subject to a binding capital constraint, meaning that investment cannot be financed through larger current account deficits. Therefore, in order to maintain the current account size relative to GDP, the terms of trade need to deteriorate to bring about a shift in production towards exports.

  In contrast E3ME does not hold a capital constraint rule at country level and therefore additional funding from abroad is possible. This increases the current account deficit but there is no assumption that the terms of trade will deteriorate to close the deficit.
- Due to market clearing assumptions in general equilibrium models like GEM-E3 wages, like prices, adjust automatically so that the supply and demand of labour reach a state of equilibrium. The implication of this is that there is no involuntary unemployment in classical general equilibrium models. However, GEM-E3 does allow for labour market frictions, meaning that limited unemployment is a possible outcome. In E3ME, as in other non-equilibrium models, the response of wages to lower labour demand and the subsequent reaction of labour demand are estimated on the basis of historical experience: typically these responses are insufficient to prevent unemployment from rising when labour demand falls.

[23] This is an important distinction between the modelling, which should not, however, be overstated – in particular it is important to note that in these scenarios the direct investment in energy efficiency is funded through higher domestic savings rates that are imposed through taxation.

In both models, therefore, the impact on employment depends on the stock of available labour; if there are no spare labour resources available then boosts to labour demand will push up wages rather than employment levels. Wages consequently are based upon a bargaining equation which is dependent on the slack in the labour market.

In both the GEM-E3 and E3ME modelling an **assumption has been made about the use of ETS revenue**, which is to remain with the government in order to finance the energy efficiency investments.

- In general, GEM-E3 allows for the recycling of additional public revenues (in this case from ETS) via reduction in employers' social security contributions, lump-sum payments to households, subsidies to RES, etc. This option is applied in cases where the simulated policies generate additional public revenues from reference. This is particularly the case in decarbonisation scenarios where carbon prices increase so as to drive lower GHGs emissions. In all the energy efficiency scenarios presented in this IA, the ETS revenues are modelled to remain with the government and be allocated to lower the employers' social security contributions.[24].

- In E3ME, the revenues from the ETS allowances that are auctioned to the Power generation sector are recycled into a fund that is used to finance energy efficiency investment in other sectors. In the baseline, the value of ETS allowances purchased by the power generation sector is used to reduce direct income taxes. In the policy scenarios, auctioned ETS allowances (from power generation and industry sectors) are used to fund the investment in energy efficiency, with the balance (either surplus or deficit) made up by adjusting income tax rates. The scenarios are therefore 'revenue neutral' with no direct changes on Member State government balances.

GEM-E3 model

Table below provides a theoretical summary of the changes induced in GEM-E3 and the expected effects and outcomes. The system is subjected to an initial change associated with energy efficiency targets and the undertaking of related expenditures. Expenditures are financed by both households and the production sectors of the economy.

[24] The assumption is made already in the Reference case that recycling of the ETS revenues happens via the reduction of employer's social security contribution. It is also assumed that the government policy on employment remains the same in the energy efficiency scenarios and the lower rate of social security contributions remains the same as in the reference case (even though the revenue from ETS would decline as the scenarios become more ambitious). Such an approach enables to compare the net effects on EE policies.

Table 29: Changes and effects from energy efficiency expenditures

Change simulated	Trigger effects	Outcome	Total effect on the economy
Increase in expenditures in energy efficiency	Increase in demand for sectors providing inputs to energy efficiency improvements projects	Positive effect on activity and employment in sectors providing inputs to energy efficiency projects	Depending on the net effect of contradicting outcomes combining economy expansion (Keynesian multiplier) effects and negative effects stemming from crowding out and pressures on primary factor markets
Increase in energy savings	Reduced energy demand and energy related imports	Negative effect on activity and employment in energy sectors. Reduction of energy imports dependence. Positive effects on all sectors which see lower variable costs in purchasing energy commodities.	
Financing scheme	Increase in energy efficiency related expenditures	Crowding out effects due to equity-based funding. Crowding out effects due to funding from borrowed capital, possible increase in interest rates and higher cost of capital, slowdown of productive investment in other sectors of activity consumption reduction, deterioration in terms of trade, etc.	

Source: E3M Lab notes

The energy efficiency policies lead to higher expenditures by firms, the public sector and the households to implement investment in building insulation and renovation or in industrial processing helping to lower energy consumption per unit of output. In addition they promote the purchase of more expensive equipment, appliances or vehicles which are more energy efficient than the existing cheaper varieties. The main macroeconomic effects of these policies on the EU economy are summarized below:

a) Keynesian multiplier effect: the additional energy efficiency expenditure, relative to a reference scenario, implies higher demand for goods and equipment which are used to implement energy efficiency improvement and lower demand for energy commodities; this shift implies higher demand for domestically produced goods and services and less imports of energy in the EU countries; thus overall demand increases driven by a Keynesian multiplier effect and as the goods and services replacing energy are more labour intensive in their production, employment and activity tend to increase in the energy efficiency scenarios relative to the reference.

b) Crowding out effects on primary production factors and on capital markets: the incremental activity generated by the energy efficiency expenditures requires higher financial amounts and higher amounts of production factors (especially labour) than in the reference scenario. Depending on the tightness conditions in the markets of capital and labour, pressures on capital and labour prices will be experienced which implies higher scarcity of primary production factors and capital as used in other sectors of the economy.

If financing conditions are favourable, the financial closure can be managed at a broad geographical scale and not at a country level. It also implies that appropriate leveraging can accommodate financing over a long period of time at low interest rates. If financing conditions are not favourable, a country will have to draw the funding to the detriment of other financing, probably also prior to implementation of the energy efficiency project. So the degree of crowding out effects due to capital market tightness can vary depending on assumed conditions. Similarly, the labour market conditions influence the impact of energy efficiency expenditures on wage rates. If unemployment is high and if the labour market is sufficiently flexible, the increase in demand for labour may not imply higher wage rates and thus impacts on costs and prices will be limited. Conversely, tightness in labour supply or rigidities in the labour market will imply increase in real wage rates as a result of energy efficiency expenditures, which could be detrimental to competitiveness in foreign markets and will offset employment increasing trends. Crowding out effects due to changes in the costs of primary production factors can vary in intensity depending on assumptions and will be experienced in all sectors of the economy.

c) Income effects due to higher costs: the energy efficiency substitution essentially is an exchange of reduced variable operating costs over time with higher upfront costs. Depending on the technical parameters of the energy efficiency expenditure by sector and also on the intensity of energy efficiency ambition, the present value of costs of the energy efficiency cash flow may be less or more expensive than the alternative which consists of keeping variable operating costs unchanged.

   The energy efficiency potential is known to exhibit decreasing return to scale in the sense that, beyond a certain level, incremental energy efficiency requires increasing marginal expenditures per unit of energy savings. Due to this feature, cost-effectiveness of energy efficiency expenditures decreases with the amount of energy savings targeted. So beyond a certain threshold, it is possible that the present value of energy efficiency cash flows implies higher costs than keeping energy consumption unchanged. In principle this situation is unlikely and can only occur in analytical studies which assume that the majority (if not all) of the cost effective energy efficiency expenditures take place already in the reference scenario Otherwise, the income effect will tend to increase with the level of ambition of the energy efficiency policy due to the diseconomies of scale.

d) Foreign competitiveness effects: Currently the EU economies are strongly exposed to foreign competition both in the intra-EU and in the global markets. The relative competitiveness of the domestic economy can be potentially weakened as a result of eventual pressures in primary production factor markets leading to higher interest or wage rates Under such circumstances, exports will decrease and imports will increase and thus domestic activity will tend to reduce implying offsetting of increasing trends due to the multiplier effect.

e) Positive externalities in technology: Implementing ambitious energy efficiency improvement implies usage of more advanced technologies which may profit from increased market potential to become commercially mature with higher performance and lower unit cost. This is a kind of positive externality through learning by doing. Its occurrence depends on the nature of technology, the size of the market, the spill-over conditions and other factors. Positive externalities alleviate both the income and the foreign competitiveness effects.

The net outcome on economic activity and employment depends on the equilibrium resulting between the forces described in the last column of the table. On a positive outcome, activity increases as a result of increased demand for inputs in energy efficiency projects. Following this change, employment in the sectors also tends to increase (with noticeable effects as construction sector is fairly labour intensive). On the negative side, activity and employment tend to decrease in the energy sectors and in sectors affected by lower consumption and potential loss of competitiveness (in foreign trade) due to crowding out effects.

The policy scenarios analysed in this IA have assumed very significant increase of expenditures for energy efficiency purposes especially in the period until 2030. These expenditures are assumed to be partly financed by the economic agents (households and firms) and partly by the economies' aggregate savings.

Consequently, a fairly realistic approach has been adopted assuming that the financing of the energy efficiency expenditures from saving resources in the economy is effectively leveraged throughout the projection period (till 2050); this implies less pressure until 2030 and a smaller crowding out effect. Should a full funding of the energy efficiency expenditures was made through the closure with savings till 2030, the macroeconomic impacts would be found increasingly negative after 2030 and higher in magnitude.

E3ME model

In the scenarios modelled for this IA, E3ME uses the following outputs from the PRIMES model:

- Energy balances
- Energy prices
- CO2 prices
- Investment costs

As noted above, an additional assumption is made about how the investment is financed, using ETS auction revenues, with income tax rates adjusted to achieve revenue neutrality.

The figure below summarises how these inputs (the top half of the diagram) affect key macroeconomic indicators in the model (the lower half). Although it is not possible to capture all the interactions in a single diagram, the most important ones are included. The main ways in which GDP is affected are:

- Higher electricity prices and CO2 prices, which feed through to the prices of final products, depending on the rate of cost pass-through in the sectors involved (which is estimated empirically). Higher product prices will both reduce the purchasing power of domestic households (leading to lower real incomes and expenditure) and will adversely affect the competitiveness of European firms (leading to a worsening trade balance). In both cases the result will be a reduction in GDP.

- The revenue recycling, through changes to income tax rates, will also affect household incomes. In the scenarios with high levels of energy efficiency, income tax rates must increase to fund the measures. Reduced household income will lead to lower rates of spending and lower GDP.

- Higher rates of investment will provide a boost to output in the construction and engineering sectors and their associated supply chains. Investment itself is a component of GDP and so the changes in investment have a direct impact.

- For most European countries, a reduction in energy demand will lead to reduced imports of fossil fuels, as long as Europe remains dependent on imported fuels. Resources that would have been spent on imported fuels may instead be spent on domestically-produced goods (households) or returned in the form of higher profits (businesses), in both cases providing a boost to GDP.

The net impact on GDP is the sum of these separate impacts. The impacts on employment are determined by a combination of the GDP impact and the sectoral pattern of output. As the scenarios modelled in this IA are based on a shift from energy to labour-intensive activities it is reasonable to expect employment to increase. As described below, this outcome is conditional on labour being available and wage rates not increasing to any significant extent.

Employment and multiplier effects

As noted above, E3ME does not assume an optimal starting point so it is possible for output to increase unless there are capacity constraints (see below). In addition, multiplier effects are a standard feature of the modelling results.

Type I multiplier effects occur through the supply chains that are represented in the model's input-output structure. In these scenarios, it is mainly the basic manufacturing sectors (e.g. metals, cement) that supply the sectors that produce and install investment goods. These supply chains may cross borders, with activity levels in one country allowed to influence those in its trading partners.

Type II multiplier effects are shown in the diagram as the loop from GDP to employment, real incomes and household expenditure. Essentially, higher employment levels and incomes are able to stimulate spending in other parts of the economy (e.g. in the retail sector), leading to further output and job creation. A positive feedback from this loop depends on there being available workers to meet an increase in the demand for labour; otherwise the result will instead be higher wages and inflation.

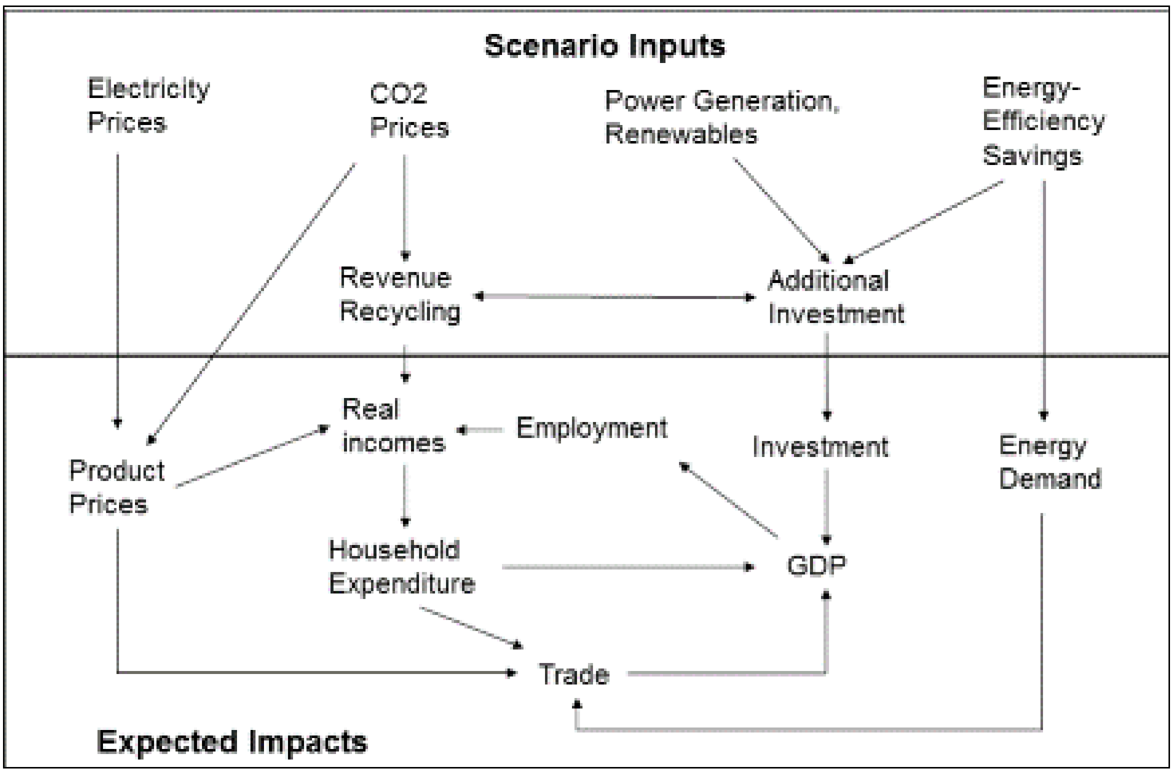
Capacity constraints

Economists engage in efforts to estimate the 'output gap' and economic capacity at national level but there is no agreed definition and very few estimates at sectoral level. Over time, new investment can add to capacity. E3ME's equation structure allows prices to increase as output moves beyond a 'normal' or expected level, but does not attempt to estimate or impose an absolute level of capacity for industry production. This approach is in contrast to the CGE modelling approach, where the economy as a whole is effectively operating at capacity to begin with.

The exception to this in E3ME is the labour market, where there is a clear constraint imposed by the available labour force. As the economy moves towards full employment, further increases in labour demand translate into higher wage rates, leading to a crowding out of labour (increases in one sector drive up wage rates and reduce employment elsewhere). Nevertheless, this representation is still not complete; as with other modelling approaches, there is an implicit assumption that the workforce has the necessary skills to fill the available vacancies.

Overall, it is up to the model user to determine whether the scenarios that are being modelled breach constraints that are likely to exist in reality but are not recognised formally in the modelling framework. For marginal changes it is reasonable to assume that it would be possible to adjust production patterns to meet the additional demands placed on the economy. For the more ambitious scenarios, however, there is a much higher degree of uncertainty around the model results and a supplementary analysis would be required to investigate whether the changes are possible.

Figure 31: E3ME structure



Source: E3ME

Annex VII: Additional modelling results

In addition to the results shown in the main text of this IA some more details are given in this annex on the effects of the different energy efficiency scenarios.

1. PRIMES modelling

Buildings renovation

As described in the Annex V on the PRIMES methodology and modelling assumptions, the energy savings obligations related to the thermal integrity of dwellings is increased for the different energy efficiency scenarios by varying the energy efficiency values. The projected renovation rates escalate across scenarios mainly in the time period until 2030 reflecting the assumption that the efficiency ambition varies in the scenarios mainly for 2030. The average renovation rate increases from 1.37 % in 2021-2030 in the Reference to 2.42% in the most ambitious energy efficiency scenario. Beyond 2030 the renovation rates decrease again.

The deepness of renovation in relation to energy is projected to double in the decade of 2020 compared to the previous decade. The average energy savings after renovation increase from 31,47% in Reference to more than 46% in the very ambitious energy efficiency scenarios in the period 2021-2030.

Table 30: Renovation projections (average) in the various scenarios

(%)	Average renovation rate EU28			Average energy saving % after renovation EU28		
	2015-2020	**2021-2030**	**2031-2050**	**2015-2020**	**2021-2030**	**2031-2050**
Reference 2013	1,28	1,37	1,11	20,91	31,47	35,68
EE27	1,44	1,67	1,11	21,78	40,73	42,73
EE28	1,48	1,84	1,15	21,93	43,55	45,79
EE29	1,53	2,11	1,22	22,04	45,04	47,55
EE30	1,61	2,21	1,26	22,08	45,82	48,48
EE35D	1,64	2,39	1,32	22,10	46,19	48,84
EE40	1,65	2,42	1,33	22,11	46,18	48,85

Source: PRIMES 2014

The question arises how these levels benchmark against existing practice, i.e. are they realistic. Renovation rates observed across the different Member States vary greatly. They depend on several circumstances, such as the state of the economy. More importantly, these rates also depend on whether specific programmes were deployed at a given time in a given Member State. This points to the conclusion that well-targeted policies can significantly increase renovation rates. Renovations rates observed in recent years across the different MS and EEA range from 0.36% in Lithuania to 3.5% in the Netherlands in the case of residential and from 1.5% in Norway to 2.75% in Lithuania in the case of non-residential[25].

Energy-using equipment and appliances

In the tables below, the indicators of energy efficiency improvement by category (improvement of output compared to a fixed energy input) of equipment or appliance, grouped by purpose of use, is shown for the residential and the tertiary sector. The resolution of the PRIMES model is lower than the list of products considered in the Ecodesign regulations. In addition, the model has limited representation of engineering bottom-up information regarding the use of each equipment. Therefore, direct comparisons of model projections with Ecodesign regulations is hardly possible; comparison can only be drawn from projections of energy efficiency improvements by category of energy use.

With regard to the 2030 horizon, the effects of eco-design are simulated to intensify relative to the Reference and across the EE scenarios. Moving from 2030 to 2050, the effects are simulated to intensify further and approach technical potential in the very ambitious cases. The learning effects are modelled to be relatively lower until 2030 than after 2030.

It can be seen in the tables below that with increasing levels of policies focusing on the reduction of the perceived costs of advanced technologies and policies aiming to improve the technical characteristics of technologies the equipment output is projected to increase significantly over the next years in the more ambitious scenarios.

Table 31: Indicative ratios of improvement of energy using equipment in residential sector

Avg. Energy Efficiency improvement in equipment as effectively used by scenario, relative to 2010 (in % change)

	2020	2030	2050	2020	2030	2050
	Heating			Cooling		
Reference	7,7	18,8	28,8	17,6	28,3	62,1
EE27	11,3	28,1	44,4	22,6	66,0	115,2
EE28	11,4	28,8	46,5	22,5	65,5	115,1
EE29	11,6	29,2	47,7	22,5	65,4	115,0
EE30	13,2	30,7	49,4	24,5	73,1	124,3
EE35	14,2	31,3	50,5	25,9	76,4	129,0
EE40	14,1	31,3	50,8	25,8	76,9	129,1
	Water heating			Cooking		
Reference	10,7	17,9	26,5	3,9	6,4	9,3
EE27	11,6	19,9	23,1	5,5	14,6	32,7
EE28	11,6	19,9	23,1	5,6	15,3	34,2
EE29	11,6	19,9	23,2	5,7	15,6	35,0

[25] Europe's buildings under the microscope, BPIE, 2011

EE30	12,0	20,9	24,7	7,0	18,9	40,5
EE35	12,2	21,7	25,9	8,0	21,3	43,5
EE40	12,2	21,6	26,1	8,1	21,2	43,6
	Lighting			**White appliances**		
Reference	163,7	372,9	400,2	45,9	60,5	66,3
EE27	184,7	380,3	415,0	47,3	69,2	82,9
EE28	184,6	380,2	414,9	48,0	69,4	83,3
EE29	181,4	377,1	414,9	47,3	69,3	83,2
EE30	185,5	380,6	414,8	48,0	70,7	89,7
EE35	186,9	381,2	414,7	48,3	71,0	96,4
EE40	186,1	380,7	414,6	48,6	70,9	96,4
	Black appliances			**Central boilers**		
Reference	18,2	27,9	30,3	11,2	23,6	45,9
EE27	19,0	34,6	49,0	14,1	31,7	57,3
EE28	19,0	34,5	49,0	14,1	31,6	57,0
EE29	19,0	34,5	49,0	14,0	31,5	57,0
EE30	19,1	34,7	53,7	15,5	32,7	58,5
EE35	19,1	34,9	60,3	16,2	33,6	59,7
EE40	19,1	34,8	60,5	16,2	33,6	60,3
	Gas heaters			**Heat pumps**		
Reference	14,2	28,1	49,1	18,1	35,5	61,5
EE27	16,3	33,5	57,7	20,7	44,4	73,2
EE28	16,3	33,4	57,5	20,8	44,5	73,1
EE29	16,3	33,3	57,5	21,0	44,4	73,3
EE30	17,0	34,3	59,0	22,8	46,3	75,3
EE35	17,5	34,8	60,1	23,5	47,3	77,0
EE40	17,5	34,8	60,7	23,4	47,2	77,9

Source: PRIMES 2014

Table 32: Indicative ratios of improvement of energy using equipment in tertiary sector

Avg. Energy Efficiency improvement in equipment as effectively used by scenario, relative to 2010 (in % change)

	2020	2030	2050	2020	2030	2050
	Heating			**Cooling**		
Reference	15,6	36,7	49,8	16,3	27,2	44,7
EE27	19,1	49,8	58,7	17,4	30,2	55,0
EE28	19,3	54,9	63,7	17,4	30,1	54,9
EE29	19,8	57,3	66,6	17,4	30,1	54,9
EE30	21,0	59,2	68,0	17,7	31,1	56,6
EE35	22,0	60,3	68,2	17,8	31,5	57,1
EE40	22,1	59,5	67,5	17,8	31,7	57,2

	Lighting			Electric appliances		
Reference	156,8	374,3	394,4	5,5	21,3	54,1
EE27	225,0	371,6	392,8	6,9	27,7	63,9
EE28	224,7	371,3	392,8	6,9	27,4	63,4
EE29	224,2	371,2	392,8	6,9	27,2	63,3
EE30	235,9	372,5	394,5	7,3	28,9	65,7
EE35	242,5	375,5	395,0	7,7	29,8	66,6
EE40	240,1	375,1	395,9	7,5	30,4	66,8
	Greenhouses-agriculture			Pumping in agriculture		
Reference	3,9	7,4	9,8	9,8	16,4	28,1
EE27	5,3	11,9	22,5	10,3	19,2	68,0
EE28	5,3	11,9	22,4	10,3	19,3	68,3
EE29	5,3	11,9	22,5	10,4	19,5	68,4
EE30	5,8	14,0	26,7	10,6	20,0	68,8
EE35	6,2	15,0	28,7	10,7	20,5	68,8
EE40	6,2	15,0	28,7	10,8	20,3	68,5

Source: PRIMES 2014

The modelling of product efficiency is based on currently-available technologies, i.e. it does not assume technological breakthroughs therefore it can be considered as realistic or even conservative.

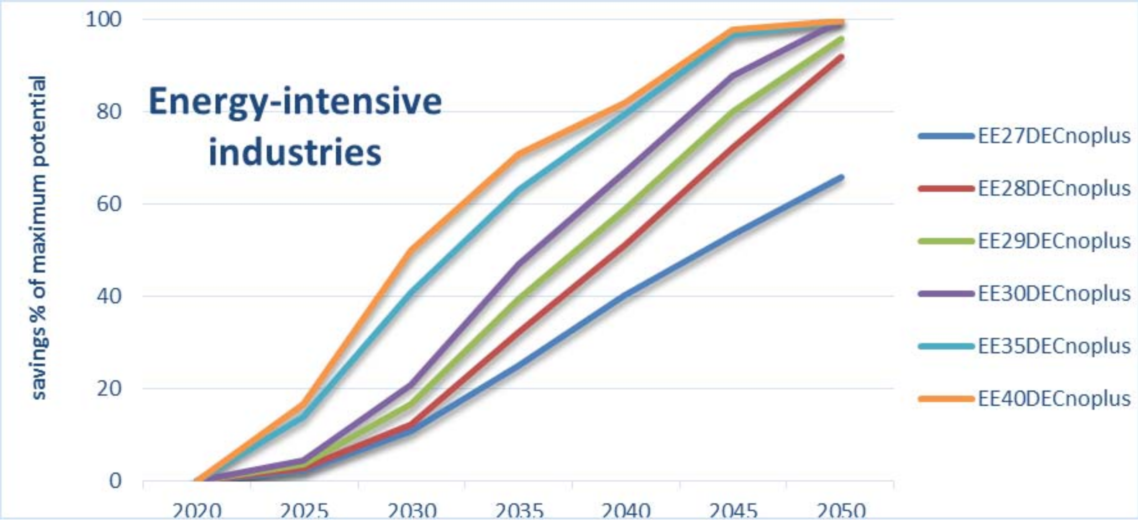
Best available technology in industry

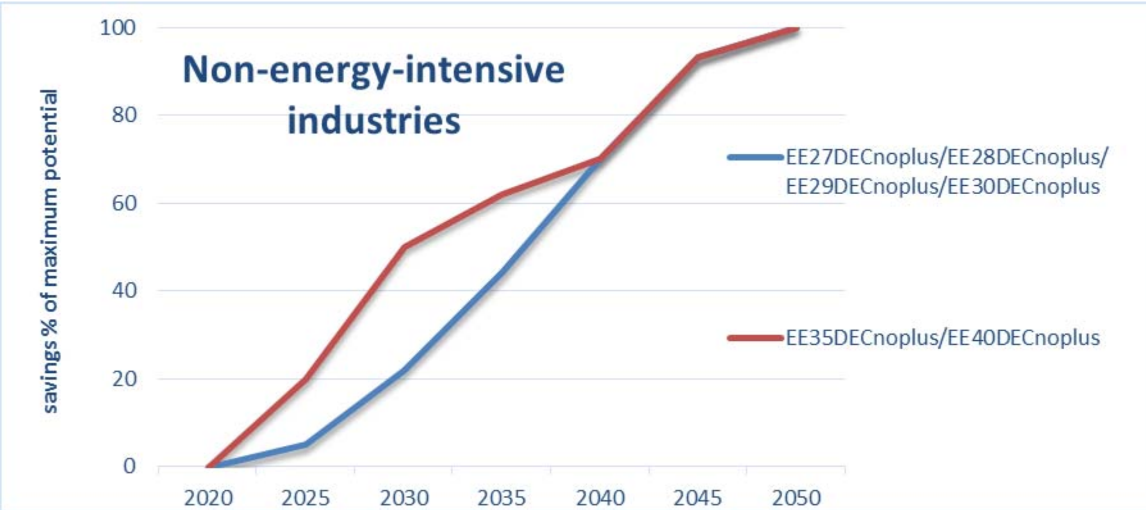
As described in the Annex V on the PRIMES methodology and modelling assumptions the uptake of BAT in industry is varied across the energy efficiency scenarios.

Regarding the horizontal BAT, their deployment leads to energy savings at all process levels. PRIMES considers a maximum potential for energy savings from horizontal BAT adoption, which is different by sector and by country. The energy efficiency scenarios are designed to exploit partly the maximum potential, at a degree reflecting the intensity of energy efficiency ambition by scenario. Therefore the uptake of horizontal BAT increases by scenario but is limited by potential.

As shown in the figure below, in the EE27 scenario, the energy savings potential that energy intensive industry is able to exploit in 2030 is assumed to be app. 11% of its maximum level. Already in the EE29 scenario this figure increases considerably, reaching by 2030 16.5%. In the EE30, EE35 and EE 40 scenarios, energy intensive industries can exploit even larger percentages of their maximum savings potential, reaching for the most ambitious scenario 50%. These savings further increase in longer term perspective. In non-energy intensive industries, the differences are assumed only between the moderate and ambitious scenarios.

Figure 32: Assumed uptake of horizontal energy saving BATs in the industrial sector as % of maximum potential





Source: PRIMES 2014

CHP and district heating

In the six energy efficiency scenarios different levels of policies focusing on district heating and the penetration of CHP are modelled. This leads to a visible increase from 11% to 14% of households connected to district heating networks in 2030. Beyond 2030, further increases in the shares can be seen in the most ambitious scenarios.

Table 33: % of households connected to district heating networks

% of households connected to district heating networks	2010	2020	2030	2050
Reference 2013	9	10	11	11
EE27	9	10	11	16

EE28	9	10	11	16
EE29	9	10	11	15
EE30	9	10	12	15
EE35	9	10	14	15
EE40	9	10	14	16

Source: PRIMES 2014

These numbers are fairly conservative: even in the ambitious scenarios the share of CHP (see Chapter 5) and district heating does not increase substantially, mainly due to a lower heat demand associated with better insulated buildings. In a study by Aalborg University the share of district heating is substantially greater with a 30% share in 2030[26].

POLES modelling

In addition to the PRIMES, GEM-E3 and E3ME model the POLES model was used to analyse the effects of different levels of energy savings on the international fuel prices due to reduced energy demand.

POLES is a simulation model to develop long-term energy supply and demand scenarios for different regions of the world. It includes modelling of primary fuel supply and international fuel markets. It can give some insights on the effect of energy policies with respect on the impact on prices as it does not take international fuel prices as an exogenous input parameter as in other models. Therefore, it is possible to project impacts of EE policies on prices of internationally-traded fuels, namely the coal, gas and oil prices.

In order to analyse the impact on the fuel prices of the scenarios analysed with PRIMES, the POLES model was calibrated to reproduce the PRIMES reference case on the aggregated EU level in terms of energy consumption.[27]

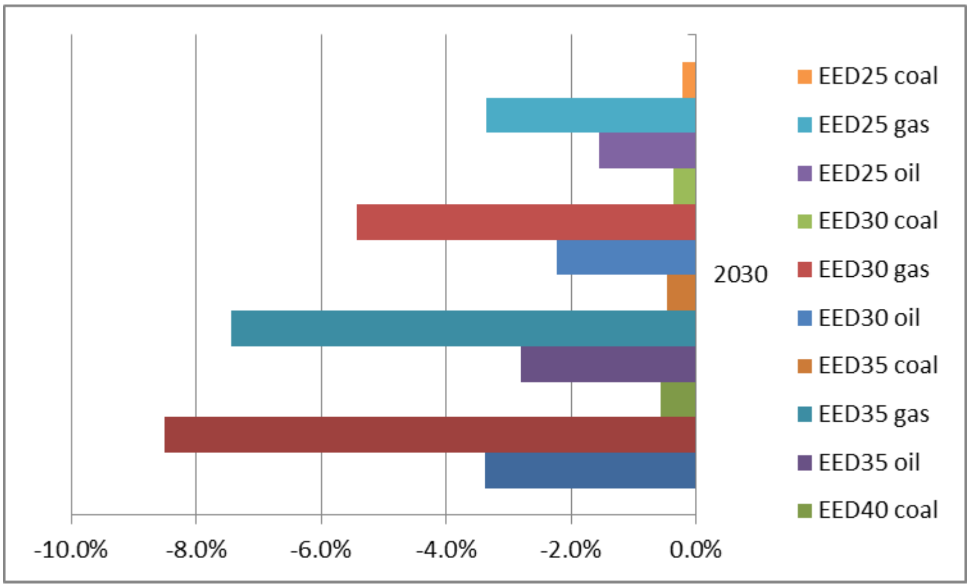
Starting from that Reference, the final energy consumptions as produced by the PRIMES model for the EE scenarios were reproduced with the POLES model[28]. The relative changes of the energy demand with respect to the reference result in a set of different prices in POLES. These relative price changes are reported and can be used as an estimate of the impact of reduced energy use due to EE policies in the EU on the international fuel prices.

[26] Heat Roadmap 2050, Aalborg University, 2013.

[27] Please note that the international energy prices in that POLES reference case are not the same as assumed in the PRIMES scenarios.

[28] Similarly as for macro-economic modelling with GEM-E3 and E3ME, the POLES scenarios that have been modelled build upon PRIMES scenarios with 25, 28, 30, 35 and 40% energy savings. The scenario with 25% energy savings has ambition similar to GHG40 scenario but is built on the PRIMES scenario that has concrete EE policies rather than carbon values - for better comparability with other scenarios. The macro-economic modelling building on EE27 and EE29 scenarios would likely have very similar outcome to results presented in the chapter for EE28 and EE30, with little additional insight brought to the analysis – for practical reasons, smaller number of scenarios is consequently presented.

Figure 33: Projected impacts of EE policies on international fuel prices (in%)



Source: POLES

It is projected that European EE policies would have an impact on international fossil fuel prices. Especially the gas price could be lower. This can be explained because of the significant reduction of the gas demand in the EE scenarios in the EU. The missing flexibility of the gas infrastructure produces a higher price effect on the European gas markets since the gas producers cannot easily redirect their fuel exports to other markets.

As these results were not fed back into the PRIMES model it is not possible to quantify possible rebound effects of decreasing global coal, gas and oil prices. The bigger the decrease of global coal, gas and oil prices is the more important it would be to use these decreased prices in PRIMES again to show the rebound effects on the European energy consumption, GDP and employment again. This has to be taken into account when interpreting these modelling results.

Annex VIII. Overview of national energy efficiency measures investigated by Fraunhofer and their expected impact[29]

Identifier in MURE or other source	Measure Code	Starting impact year	Country	Sector	Title	Updated impact (Mtoe) 2016	2020
AU36		2009	Austria	Transport	Subsidies for scrapping of old cars		
AU18		2008	Austria	Cross-Cutting	Transport measures of the Climate and Energy Fund		
AU21		2008	Austria	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy Certificates for Build		
AU26		2009	Austria	Residential	National recovery plan / renovation voucher	0.039	0.092
AU28		2008	Austria	Residential	Smart Metering and Informative Billing		
		2011	Austria	Cross-Cutting	Price impact of Green Electricity Act	0.003	0.006
BEL24		2009	Belgium	Residential	Flanders - Reduction in property tax		
BEL25		2009	Belgium	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Brussels - Act structurally or	0.091	0.143
BEL28		2012	Belgium	Residential	Wallonia - Potential impact of AEE (Employment Environment Alliance)	0.052	0.052
BEL8		2009	Belgium	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Wallonia - Thermal regulatic	0.056	0.056
BEL7		2008	Belgium	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Brussels - Act structurally or		
BEL14		2012	Belgium	Tertiary	Brussels - Impose a plan for reduction of energy consumption on major consumers ("PLAGE": Loca	0.026	0.026
BEL15		2013	Belgium	Tertiary	Brussels - Make performance of an energy audit mandatory for any building of more than 3500 m²	0.025	0.025
BEL19		2009	Belgium	Tertiary	Flanders - Reduction in property tax		
BEL20		2008	Belgium	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Wallonia - Thermal regulati		
BEL27		2012	Belgium	Tertiary	Wallonia - Potential impact of AEE (Employment Environment Alliance)		
BEL19		2008	Belgium	Transport	Wallonia - Financial incentives or funding devoted to transport	0.055	0.055
BEL4		2008	Belgium	Transport	Wallonia - Saving measures for transport in the public sector	0.012	0.012
BEL37		2012	Belgium	Residential	Wallonia - ECOPACK (Zero-rated eco-loan)		
FL-M1		2014	Belgium	Industry	Flanders: Energy policy agreement with companies operating under the verifiable emission	0.123	0.286
FL-M2		2014	Belgium	Industry	Flanders: Energy policy agreement with companies not operating under the verifiable emission	0.031	0.072
FL-M3		2014	Belgium	Cross-Cutting	Flanders: Grant for roof insulation		0.165
FL-M4		2014	Belgium	Cross-Cutting	Flanders: Grant for wall insulation		0.018
FL-M5		2014	Belgium	Cross-Cutting	Flanders: Grant for cellar or floor insulation		0.003
FL-M6		2014	Belgium	Cross-Cutting	Flanders: Grant for high efficiency glazing		0.036
W-M1		2014	Belgium	Industry	Wallonia: Voluntary agreements 2nd generation	0.045	0.105
W-M2		2014	Belgium	Industry	Wallonia: New voluntary agreements in preparation	0.014	0.032
W-M3		2013	Belgium	Cross-Cutting	Wallonia: Subsidies to energy efficiency in buildings (UREBA ordinaire AGW 28/03/2013)	0.007	0.016
W-M4		2013	Belgium	Cross-Cutting	Wallonia: Subsidies to energy efficiency in buildings (UREBA exceptionnel AGW28/03/2013)	0.005	0.011
W-M5		2012	Belgium	Cross-Cutting	Wallonia: Subsidies+soft loan for social housing (ECO PACKS FLFNW et ECO PACKS SWCS AGW	0.007	0.017
W-M6		2013?	Belgium	Cross-Cutting	Wallonia: Subsidies for thermal building rehabilitation (Réhabilitation logement améliorable	0.025	0.059
W-M7		2010	Belgium	Cross-Cutting	Wallonia: Subsidies for thermal building rehabilitation (Primes énergie AM 22/03/2010 - pour	0.076	0.178
W-M8		2010	Belgium	Industry	Wallonia: Subsidies for energy efficiency in industry (Primes énergie AM 22/03/2010 - industrie)	0.001	0.003
BL-M1_8			Belgium	Cross-Cutting	Brussels region: Bundle of 8 mesures. Most important Measure 6: PRIMES ENERGIE (Subsidy progr	0.053	0.115
		2014	Bulgaria	Cross-Cutting	Energy efficiency obligation	0.104	0.340
		2014	Croatia	Residential	Programme of incentives to improve outer envelopes of single-family houses	0.004	0.009
		2014	Croatia	Residential	Programme of incentives for heating system replacement	0.007	0.016
		2014	Croatia	Cross-Cutting	Programme of incentives to use renewable energy sources (RES)	0.003	0.008
		2014	Croatia	Cross-Cutting	Energy audits and energy certification of buildings		
		2014	Croatia	Residential	Aid for the preparation of project documentation for building renovation		
		2014	Croatia	Residential	Integral multi-dwelling unit renovation incentives	0.026	0.061
		2014	Croatia	Residential	Individual thermal energy consumption metering system installation	0.029	0.029
		2014	Croatia	Cross-Cutting	Increasing the number of nearly zero-energy buildings	0.008	0.022
		2012	Croatia	Tertiary	Energy renovation of public sector buildings programme	0.013	0.024
		2012	Croatia	Tertiary	Energy renovation of commercial non-residential buildings	0.035	0.065
		2011	Croatia	Industry	Introduction of efficient electric motor drives	0.020	0.024
		2007	Croatia	Industry	CO2 emissions fees		
		2011	Croatia	Transport	Financial aid for energy-efficient vehicles	0.009	0.031
		2011	Croatia	Transport	Advanced regulation of traffic intersections equipped with intelligent traffic lights	0.004	0.026
		2013	Croatia	Transport	Introduction of a special environmental fee payment scheme for motor vehicles	0.012	0.040
CY4		2008	Cyprus	Industry	EU-related: Amended EU Emission Trading Scheme (Directive 2009/29/EC) - Emission Trading Scheme (2008-2012)		
CY3		2011	Cyprus	Tertiary	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Eco design requirements for		
CY8		2010	Cyprus	Tertiary	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Information, awareness, training for ene		
CY15		2008	Cyprus	Transport	Express Bus transportation to airports		
CY18		2011	Cyprus	Transport	EU-related: Promotion of clean and energy-efficient road transport vehicles (Directive 2009/33/EC) - Law for the public pu		
CY5		2008	Cyprus	Cross-Cutting	EU-related: Passenger Car Labelling on fuel economy rating (Directive 1999/94/EC) - Energy label of new passenger cars		
CY4		2011	Cyprus	Residential	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - Efficiency requirements for en		
CY13		2008	Cyprus	Transport	Fiscal incentives for old cars scrapping		
CY14		2013	Cyprus	Transport	Registration fee and annual vehicle tax reduction for clean vehicles.		
CY17		2010	Cyprus	Transport	National Strategy for the development / upgrading of public transport		
CY5		2013	Cyprus	Transport	EU-related: Fiscal Measures to Promote Car Fuel Efficiency - Vehicle taxation based on CO2 criteria		
CY11		2014	Cyprus	Residential	Net metering scheme was introduced for the promotion of small residential photovoltaic systems		
CY19		2013	Cyprus	Transport	EU-related: Energy labelling of tyres (Regulation 1222/2009/EC) - Law for the implementation of energy labelling of tyre:		
CY20		2010	Cyprus	Transport	Creating Infrastructure for using bicycles		
			Cyprus	Residential	*Measure Package Residential sector*	0.049	0.058
			Cyprus	Tertiary	*Measure Package Tertiary sector*	0.007	0.009
			Cyprus	Industry	*Measure Package Industry*	0.000	0.000
			Cyprus	Transport	*Measure Package Transport*	0.001	0.001

[29] The list includes significant planned and existing measures in 15 Member States covering 91.5% of EU primary energy consumption. The impact corresponding to the measures in the remaining Member States was based on the extrapolation of results for the 15 Member States covered.

CZ9	2008	Czech Reput	Industry	Promotion of energy efficiency in the Operational Programme Industry and Innovation	0.163	0.379
CZ6	2009	Czech Reput	Tertiary	EU-related: Energy Labelling Office Equipment (Energy Star) - (Uplatnini dohody o Energy Star o ka	0.008	0.013
CZ8	2011	Czech Reput	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Extension of the role of pub	0.041	0.069
CZ9	2010	Czech Reput	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Electric energy savings in th	0.012	0.022
CZ7	2010	Czech Reput	Transport	EU-related: Emission performance standards new passenger cars (Regulation 443/2009/EC) -)	0.037	0.146
CZ40	2008	Czech Reput	Cross-Cutting	Taxes on registration of a new cars		
CZ42	2008	Czech Reput	Cross-Cutting	Emission performance standards new passenger cars (Regulation 443/2009/EC)		
CZ49	2008	Czech Reput	Cross-Cutting	Community framework for the taxation of energy products and electricity (Directive 2003/96/EC)		
CZ54	2010	Czech Reput	Cross-Cutting	Promotion of clean and energy-efficient road transport vehicles (Directive 2009/33/EC)		
CZ55	2014	Czech Reput	Cross-Cutting	Passenger Car Labelling on fuel economy rating (Directive 1999/94/EC)		
CZ10	2011	Czech Reput	Industry	Support of voluntary commitments to energy savings	0.026	0.095
CZ18	2009	Czech Reput	Residential	Electric energy savings in the area of household lighting	0.023	0.044
CZ19	2009	Czech Reput	Residential	Green Savings Programme	0.063	0.222
DK31	2011	Denmark	Residential	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) -		
DK31	2011	Denmark	Residential	EU-related: Performance of Heat Generators for Space Heating/Hot Water (Directive 92/42/EEC) -		
DK33	2010	Denmark	Residential	Scrapping scheme for oil-fired boilers		
DK15	2009	Denmark	Transport	A green certification of communes and transporters		
DK16	2008	Denmark	Transport	Modular concept road train field operational trial		
DK17	2010	Denmark	Transport	Fiscal incentive scheme aimed at better aerodynamics for heavy goods vehicles		
DK7	2010	Denmark	Cross-Cutting	Energy Conservation Programme for Truck and Van Transport		
DK8	2008	Denmark	Cross-Cutting	Energy Conservation Programme for Public Transport		
DK12	2010	Denmark	Transport	Eco driving - energy efficient driving technique		
DK12	2010	Denmark	Transport	Eco driving - energy efficient driving technique		
DK14	2009	Denmark	Transport	Guidelines for green procurement of vehicles		
DK18	2009	Denmark	Transport	Energy and emission regulations for taxis, limos and healthcare transportations		
DK10	2012	Denmark	Cross-Cutting	Danish Energy Agreement 2012		
DK5	2013	Denmark	Industry	Renewable energy for production processes		
DK34	2008	Denmark	Residential	Knowledge centre for energy savings in buildings		
DK35	2009	Denmark	Residential	EU-related: Recast Ecodesign Directive for Energy-related Products (Directive 2009/125/EC) - EU		
DK36	2012	Denmark	Residential	Information effort for energy efficiency regarding end-users (sparenergi.dk)		
DK37	2012	Denmark	Residential	Strategy for energy renovation		
DK38	2012	Denmark	Residential	Build up skills		
DK39	2013	Denmark	Residential	Fund for advancement of alternatives to oil and natural gas boilers		
DK11	2008	Denmark	Tertiary	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Inspection of		
DK6	2012	Denmark	Cross-Cutting	Energy-policy agreement of 22 March 2012: Update of the The Energy Companies' saving effort	0.629	1.503
EST10	2008	Estonia	Industry	The programme of technology investment support for manufacturers		
EST15	2008	Estonia	Residential	Minimum energy performance requirements (for buildings)		
EST16	2008	Estonia	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy performance of buildings		
EST16	2008	Estonia	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy performance of buildings		
EST17	2008	Estonia	Residential	National Development Plan for Housing Sector 2008-2013		
EST18	2010	Estonia	Residential	Building design and construction supervision support for apartment associations for making preparations for major renovati		
EST19	2010	Estonia	Residential	Support scheme for reconstruction of apartment buildings		
EST20	2012	Estonia	Residential	Drawing up instructions and/or regulation on application of individual energy cost calculations		
EST21	2009	Estonia	Residential	The programme of renovation loan for apartment buildings (under the OperationalProgramme for the Development of the l		
EST22	2014	Estonia	Residential	Devisal of the principles of the support scheme for renovation of private houses with an aim of achieving energy savings, ar		
EST24	2008	Estonia	Residential	Construction of sample buildings on the territories of local authorities in compliance with the standard for low-energy build		
EST25	2012	Estonia	Residential	More detailed specification of procedures and development of aids for certifyingcompliance with the minimum requiremer		
EST29	2011	Estonia	Residential	Carrying out surveys on energy consumption of households		
EST8	2008	Estonia	Tertiary	Minimum energy performance requirements (for buildings)		
EST9	2008	Estonia	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Energy performance of buildings		
EST11	2008	Estonia	Tertiary	Development of legislative acts on environmentally friendly public procurements and the related instruction materials		
EST14	2010	Estonia	Tertiary	Provision of training on environmentally friendly public procurements, development and distribution of respective informa		
EST17	2009	Estonia	Tertiary	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - A requirement to have an energy perform		
EST18	2011	Estonia	Tertiary	Obligations for building managers stipulated in the State Assets Act		
EST26	2009	Estonia	Tertiary	Informing local authority officials of regulation on energy performance of buildings		
EST29	2011	Estonia	Tertiary	Increasing the awareness of clients commissioning construction or design work, green public procurements		
EST30	2008	Estonia	Tertiary	Information dissemination among public sector managers and officials engaged in building management		
EST10	2011	Estonia	Transport	Energy conservation criteria in public procurements for motor vehicles		
EST13	2011	Estonia	Transport	A pilot project for electric cars		
EST15	2010	Estonia	Transport	Free parking for electric cars		
EST21	2009	Estonia	Transport	To create a national public transport planning system that would take into account local needs and eliminate public transpo		
EST7	2011	Estonia	Transport	Investments in energy efficient public transport vehicles		
EST9	2011	Estonia	Transport	Investments in electric transport		
EST9	2011	Estonia	Transport	Investments in electric transport		
EST13	2013	Estonia	Cross-Cutting	Energy Efficiency Agreement for Freight Transport and Logistics 2008-2016		
	2014	Estonia	Cross-Cutting	Energy and CO2 taxes	0.044	0.102
	2014	Estonia	Cross-Cutting	Financing schemes:		
	2014	Estonia	Tertiary	- Renovation of street lighting	0.002	0.005
	2014	Estonia	Industry	- Energy and resource efficiency of companies	0.004	0.010
	2014	Estonia	Residential	- Reconstruction of apartment buildings	0.010	0.023

FIN21	2009	Finland	Industry	Energy Advice to SMEs		
FIN28	2010	Finland	Residential	Coordinated energy advice to the consumers		
FIN29	2010	Finland	Residential	Energy Efficiency Agreement of the Property and Building Sector - Rental Property Action Plan		
FIN31	2008	Finland	Residential	Building code D5: guidelines on the calculation of power and energy needs for heating of buildings		
FIN33	2011	Finland	Residential	Building code D1: Water and Drainage Systems for Properties		
FIN28	2010	Finland	Tertiary	Building code D3: Orders for energy efficiency in buildings		
FIN19	2008	Finland	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Periodic inspections of air conditioning systems		
FIN20	2010	Finland	Tertiary	Mandatory energy efficiency plans in the public sector		
FIN21	2011	Finland	Tertiary	Energy Efficiency Agreement of the Property and Building Sector - Commercial Property Action Plan		
FIN24	2008	Finland	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory energy efficiency certificates for buildings		
FIN29	2009	Finland	Tertiary	Renovation of State Property Stock		
FIN30	2009	Finland	Tertiary	Improving energy efficiency in new construction for the state		
FIN35	2009	Finland	Tertiary	Energy Advice for SMEs		
FIN22	2008	Finland	Transport	Car Tax Revision		
FIN24	2008	Finland	Transport	EU-related: Promotion of Biofuels or other Renewable Fuels for Transport (Directive 2003/30/EC) - Mandatory introduction		
FIN25	2010	Finland	Transport	Mobility Management Programme		
FIN26	2011	Finland	Transport	Promoting walking and cycling		
FIN27	2009	Finland	Transport	EU-related: Emission performance standards new passenger cars (Regulation 443/2009/EC) - Improving the energy efficienc		
FIN29	2014	Finland	Transport	EU-related: CO2 Standards for Light Duty Vehicles - Improving the energy efficiency of vans		
FIN31	2012	Finland	Transport	EU-related: Procurement of clean and energy-efficient road transport vehicles		
FIN32	2010	Finland	Transport	Vehicle tax revision		
FIN17	2010	Finland	Cross-Cutting	EU-related: Energy End-use Efficiency and Energy Services ESD (Directive 2006/32/EC) - Law on		
FIN19	2011	Finland	Industry	Analysis model for steam-condensate systems		
FIN7	2010	Finland	Residential	Building codes C3 and C4: Thermal insulation		
FIN32	2008	Finland	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Mandatory energy efficiency certificates for buildings		
FIN14	2010	Finland	Tertiary	Farm Energy Programme		
FIN23	2010	Finland	Tertiary	Energy efficiency in server halls		
FIN32	2008	Finland	Tertiary	Fresh grain silos		
FIN33	2008	Finland	Tertiary	Unheated cattle buildings		
FIN18	2008	Finland	Transport	Energy Efficiency Agreement for Freight Transport and Logistics 2008-2016		
FIN19	2008	Finland	Transport	Energy Efficiency Agreement for Public Transport 2008-2016		
FIN28	2012	Finland	Transport	EU-related: Energy labelling of tyres (Regulation 1222/2009/EC) - Energy labelling of tyres		
FIN10	2008	Finland	Cross-Cutting	Long-Term National Climate and Energy Strategy 2008		
FIN12	2009	Finland	Cross-Cutting	EU-related: Ecodesign Directive for Energy-using Products (Directive 2005/32/EC) - Ecological		
FIN14	2010	Finland	Cross-Cutting	Government decision on energy efficiency measures on 4 February 2010		
FIN16	2011	Finland	Cross-Cutting	Support to renewables		
FIN23	2011	Finland	Industry	National Roadmap: Ensuring Energy Efficiency Competence in Construction		
FIN34	2013	Finland	Residential	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Decree on		
FIN37	2012	Finland	Tertiary	National focal point for sustainable public procurement		
FIN36	2009	Finland	Tertiary	Environmental programmes for state organisations and the Eco-Office		
		Finland	***Total***	***Total***	1.579	2.142
FRA15		France	Industry	OSEO subsidised Green Loans		
FRA28		France	Residential	Sustainable building training scheme		
FRA31		France	Residential	Zero-rated eco-loan		
FRA40		France	Residential	"Modernising buildings and cities" programme		
FRA42		France	Residential	Targeting of aid for housing purchase towards BBC dwellings		
FRA43		France	Residential	Social housing eco-loan		
FRA48		France	Residential	EU-related: Energy Performance of Buildings EPBD Recast (Directive 2010/31/EU) - Building codes " RT 2012"		
FRA49		France	Residential	Feasibility study for energy supplies		
FRA51		France	Residential	Evaluation of energy performance of co-ownerships		
FRA52		France	Residential	Exemption from property tax on existing buildings for BBC dwellings		
FRA55		France	Residential	Change to co-ownership decision-making rules		
FRA57		France	Residential	Distribution of energy savings between owner/landlord and tenant		
FRA17		France	Tertiary	Energy advisors for local authorities		
FRA15		France	Tertiary	"Modeming building and cities" programme		
FRA18		France	Tertiary	Feasibility study for energy supplies		
FRA20		France	Tertiary	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Thermal Regulations for existing buildings		
FRA22		France	Transport	Volontary agreements		
FRA24		France	Transport	The national plan : "clean vehicle"		
FRA29		France	Transport	Sea motorways		
FRA31		France	Transport	Employer responsibility for half of the cost of public transport season tickets		
FRA33		France	Transport	EU-related: Promotion of clean and energy-efficient road transport vehicles (Directive 2009/33/EC) - European regulation or		
FRA36		France	Transport	Development of non-motorised and active modes		
FRA37		France	Transport	CO2 display and OEET		
FRA38		France	Transport	Voluntary commitment by the FNTV		
FRA39		France	Transport	Voluntary commitment in the aviation sector		
FRA14		France	Cross-Cutting	Improvements in Public Transport Networks		
FRA16		France	Cross-Cutting	EU-related: Passenger Car Labelling on fuel economy rating (Directive 1999/94/EC) - Energy and CO2 labelling for new cars		
FRA17		France	Cross-Cutting	EU-related: Passenger Car Labelling on fuel economy rating (Directive 1999/94/EC) - Energy and CO2 labelling for new cars		
FRA18		France	Cross-Cutting	EU-related: Passenger Car Labelling on fuel economy rating (Directive 1999/94/EC) - Energy and CO2 labelling for new cars		
FRA19		France	Cross-Cutting	Replacement and promotion of Low Polluting Vehicles		
FRA2		France	Cross-Cutting	Replacement and promotion of Low Polluting Vehicles		
FRA20		France	Cross-Cutting	Urban mobility plans		
FRA3		France	Cross-Cutting	EU-related: Emission performance standards new passenger cars (Regulation 443/2009/EC) -) - Emissions based Annual Mot		
FRA53		France	Residential	Targeting of Scellier aid for rental investment towards BBC dwellings		
FRA50		France	Residential	EU-related: Energy Performance of Buildings (Directive 2002/91/EC) - Thermal Regulations for existing buildings "RT 2007"		
FRA54		France	Residential	Relief from property tax on existing buildings for households		
FRA60		France	Residential	Measures to tackle fuel poverty		
FRA19		France	Tertiary	Obligation regarding work in existing service buildings		
		France	***Buildings***	***Measure Package Buildings***	8.745	11.205
		France	***Transport***	***Measure Package Transport***	1.330	2.240
		France	***Industry***	***Measure Package Industry***	0.120	0.180
		France	***Tertiary***	***Measure Package Tertiary sector***		