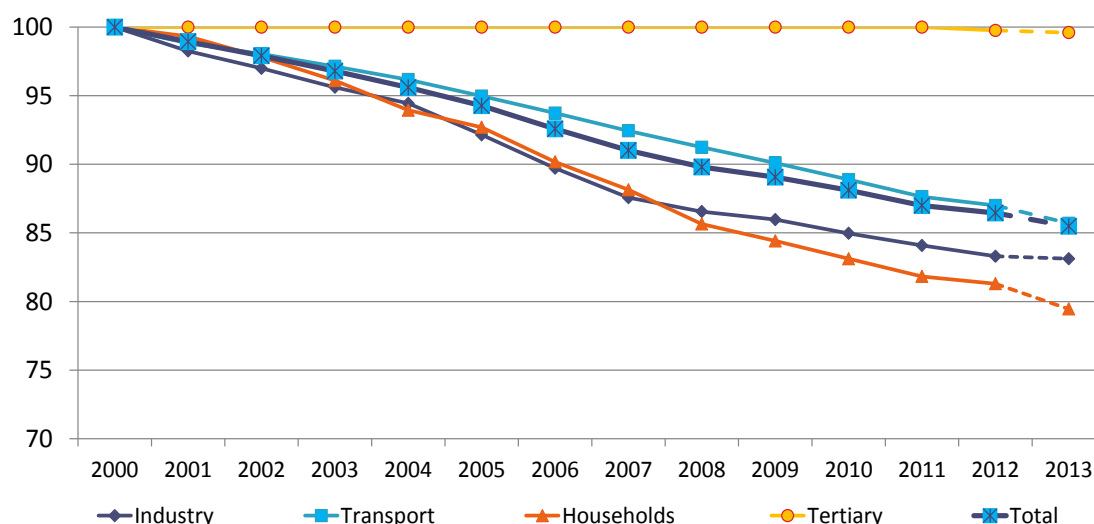


OVERALL ENERGY EFFICIENCY TRENDS AND POLICIES

**Energy efficiency trends**

- Energy efficiency measured with the ODEX<sup>1</sup> improved by 15% at EU level between 2000 and 2013 (1.2%/year). There has been a net slowdown in the energy efficiency progress since the economic crisis: 1%/year since 2007 compared to 1.3%/year between 2000 and 2007.
- The household sector has achieved the largest energy efficiency improvement, with a regular energy efficiency gain (1.7 %/year). Gains for industry have been divided by a factor 2 since 2007. In transport, energy efficiency progress was in line with the average (1.2%/year) and was more rapid for cars than for the freight transport that was severely hit by the economic crisis (fig1).

**Figure 1: Energy efficiency progress in the EU (ODEX)**

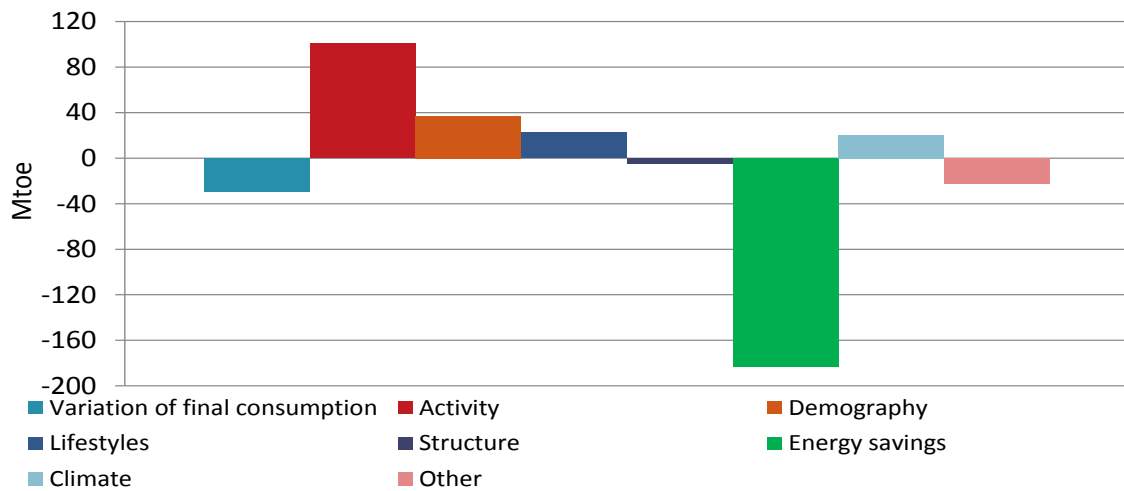


Source: ODYSSEE

- In 2012, the final energy consumption was 30 Mtoe lower than in 2000. This situation is the result of two main balancing effects: growth in the economic activity would have led to an increase of 100 Mtoe while energy savings contributed a reduction in final consumption by 180 Mtoe; other factors explaining the rest of the variation, such as demography, changes in lifestyle, modal shift in transport and structural changes in industry. The European targets as specified in the Energy Efficiency Directive EED are 1483 Mtoe primary energy (excluding non-energy uses) and 1086 Mtoe final energy to be reached in 2020. Data from the ODYSSEE database show that by 2013 primary energy for the EU28 was at 1567 Mtoe and final energy at 1100 Mtoe that is already relatively close to the target (fig2).

<sup>1</sup> The ODEX is calculated as a weighted average of the energy efficiency gains observed by sector (see sectoral chapters below for their calculation); it is in addition measured as 3 year moving average to limit the effect of short-term fluctuations (imperfect climatic corrections, behavioural factors, business cycles).

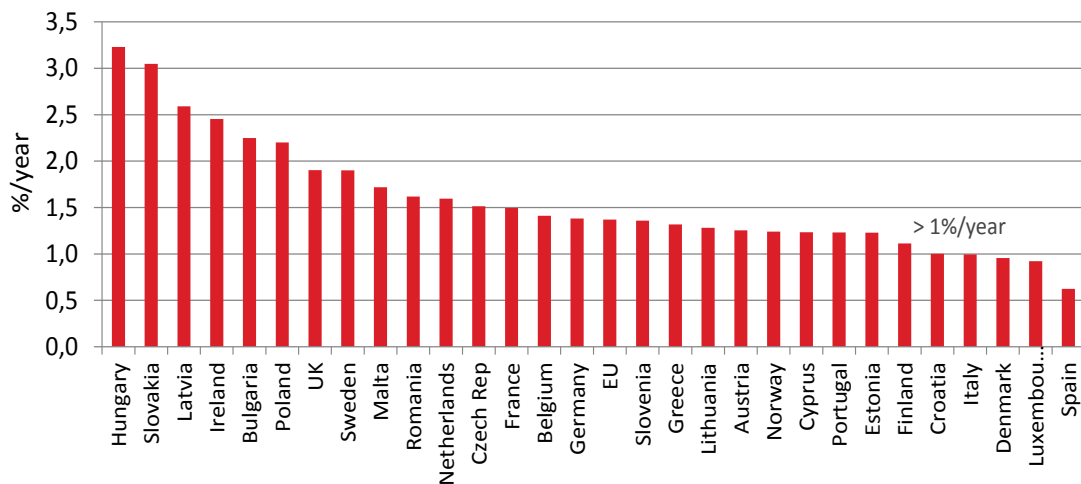
Figure 2: Drivers of final energy consumption variation between 2000 and 2012 (EU)



Source: ODYSSEE decomposition tool <http://www.indicators.odyssee-mure.eu/decomposition.html>

- Without energy savings, final energy consumption would have been around 180 Mtoe higher in 2012 compared to 2000. Around 33% of the savings come from households, 32% from industry, 27% from transport and 8% from tertiary.
- Differences between countries are still large in various aspects notably with respect to annual energy efficiency improvements which for the period 2000-2012 reach from 0.6% annual improvement to 3.3% according to the country (fig 3).

Figure 3: Energy efficiency progress by country<sup>2</sup>



Source: ODYSSEE

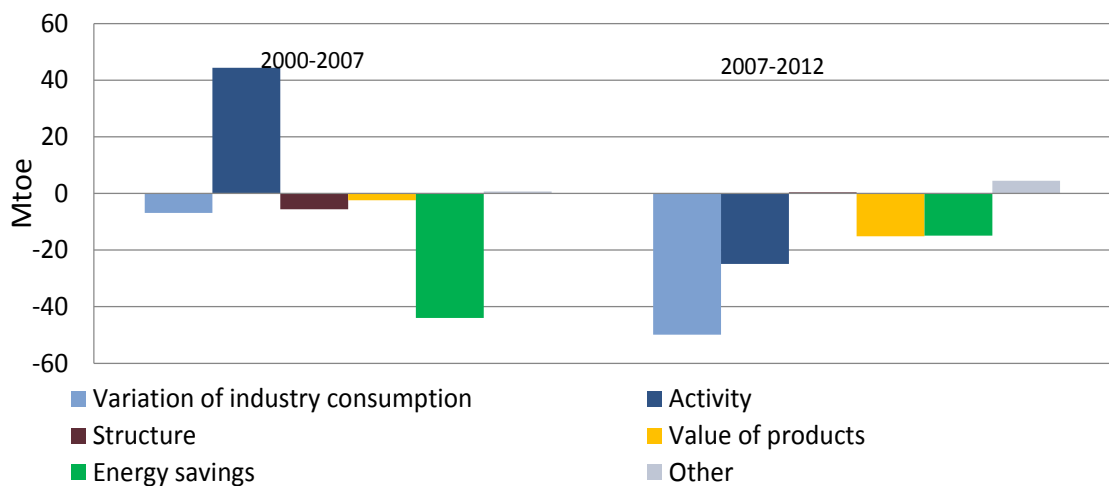
### Energy efficiency policies

<sup>2</sup> Services are not included in the analysis by country due to the difficulty of grasping energy saving with existing data.

- Across the countries and within a sector there are considerable variations in the approaches to energy efficiency policy. The reason for this may be that due to cultural differences and social habits, measures have different effectiveness according to the country context. It raises, however, also the question whether the national set of measures can be extended to include new types of measure which have not been specifically experienced in the past in the country.
- Though there is some dynamics in the overall national mix of measure types, the sectorial measure mix remains relatively stable. Fiscal measures astonishingly play a little role in the measure mix, except for the transport sector, though the implementation of the National Energy Efficiency Action Plans (NEEAPs) seems to improve this.
- The recent economic and financial crisis, from 2008 to 2012, has had a profound effect on the policy making within Europe, especially in countries most strongly hit by the crisis. Financial support programmes have generally been reduced in those countries although on some occasions subsidies for energy efficiency were used to stabilise the economy. The latter approach could have been more largely used to counter the economic crisis, given that energy efficiency measures tend to support the local economy.
- The analysis of measures adopted on behalf of the National Energy Efficiency Action Plans NEEAPs and the Art. 7 of the Energy Efficiency Directive EED at national level shows that the influence of the EU energy efficiency policy set became even more important recently than it had been since its adoption.
- Energy Saving Obligations have become an important instrument which many countries have introduced or are in the process of introduction due to the Energy Efficiency Directive: 16 countries have reported to rely on energy efficiency obligation schemes, generally combined with additional policy measures. The other countries will only rely on the so called “alternative policies” as authorised by the Directive”.
- The process of the National Energy Efficiency Action Plans NEEAPs was a large success with respect to evaluation practices, which have spread the use of quantitative evaluation methods across the Member States.

### Energy efficiency trends

- Industrial energy consumption remained roughly stable at EU level between 2000 and 2007 and has decreased rapidly since then with a contraction twice faster than industrial activity itself.
- As a result, industrial consumption was in 2013 17% below its 2000 level at EU level and only represented 25 % of the energy used by final consumers, compared to 29% in 2000.
- Between 2000 and 2007, the stability of consumption was the result of the balance between the increase in industrial activity and energy savings.
- Since 2007, more than half of the reduction in consumption was linked to the decrease in industrial activity and only one fourth to energy savings.
- Energy savings were 2.5 times lower since 2007 than over 2000-2007, as there has been a slowdown in energy efficiency progress measured by ODEX. This index is calculated by weighting trends in the specific energy consumption indices of 14 individual branches, using as weight their share in the total industry consumption since the recession (0.9%/year since 2007 compared to 1.9%/year before), because of a slower progress in most branches and even an absence of improvement for some others (e.g. steel, cement, machinery). On average, energy efficiency has improved by 1.4%/year in the EU industry sector since 2000.
- This slower progress in energy efficiency is due to the recession, as the consumption trend did not follow the reduction of activity, because, on the one hand the large equipment did not operate at full capacity and were thus less efficient, and, on the other hand, part of the consumption is independent of the level of production. (fig 4)
- **Figure 4: Energy efficiency progress by country in the industry sector**<sup>3</sup>



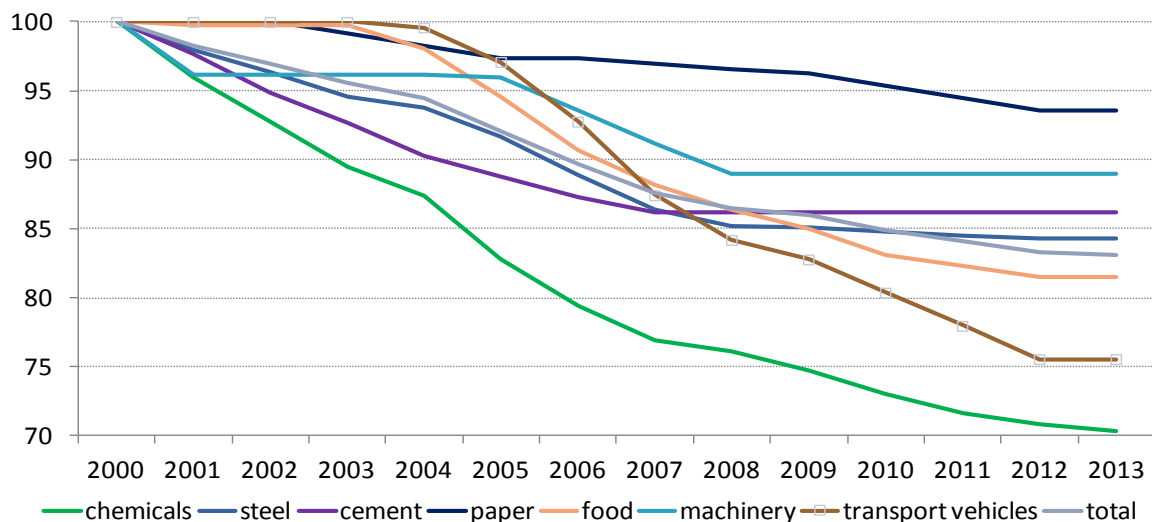
Source: ODYSSEE decomposition facility

- The market share of electricity, biomass and heat in industry has progressed significantly (+4 points for electricity since 2000; +3 points each for biomass and heat).

<sup>3</sup> Services are not included in the analysis by country due to the difficulty of grasping energy saving with existing data.

- Chemical industry is the main energy consuming branch with 19% of total industrial consumption in 2013, followed by steel with 18%; while the share of chemicals is progressing (+1.5 points at EU level since 2000), the share of steel is declining (- 2 points).
- Since 2007 energy consumption has decreased in all industrial branches: steel and non-metallic minerals experienced the strongest reduction: consumption 25% lower in 2013 than in 2000 (fig 5).

**Figure 5: Energy efficiency index (ODEX) in industry (EU, 2000-2013)**



Source: ODYSSEE

### **Energy efficiency policies**

- Financial measures are the by far the dominating measure type in industry in almost all EU Member States (in terms of the number of measures). Around half of the policies addressing energy efficiency in industry can be attributed to this type. However, in many countries the remaining part of the policies in place includes a broad mix of other types (incl. new market-based instruments).
- The financial crisis since mid-2008 did not considerably change the dominance of financial measures. They are still dominating the policy mix and became even more important since 2013. Only in some countries which were hardest hit by the crisis (esp. Ireland, Portugal, Italy, Spain and Greece), no or only very few new financial measures have been implemented after 2008.
- The Energy Efficiency Directive (2012/27/EU) also triggered new energy efficiency policies in the Member States. With regard to industry, these are especially measures introduced under Article 7 (energy efficiency obligations and/or alternative measures), mandatory audits (Article 8) and new certification/qualification schemes. NEEAP measures, i.e. measures reported in the NEEAP 1 and/or NEEAP 2 and/or NEEAP 3, constitute about 50% of the total measures in the industrial sector in MURE.
- Energy audits and energy management can be seen as important instruments to identify existing economic energy efficiency potentials through the systematic implementation of

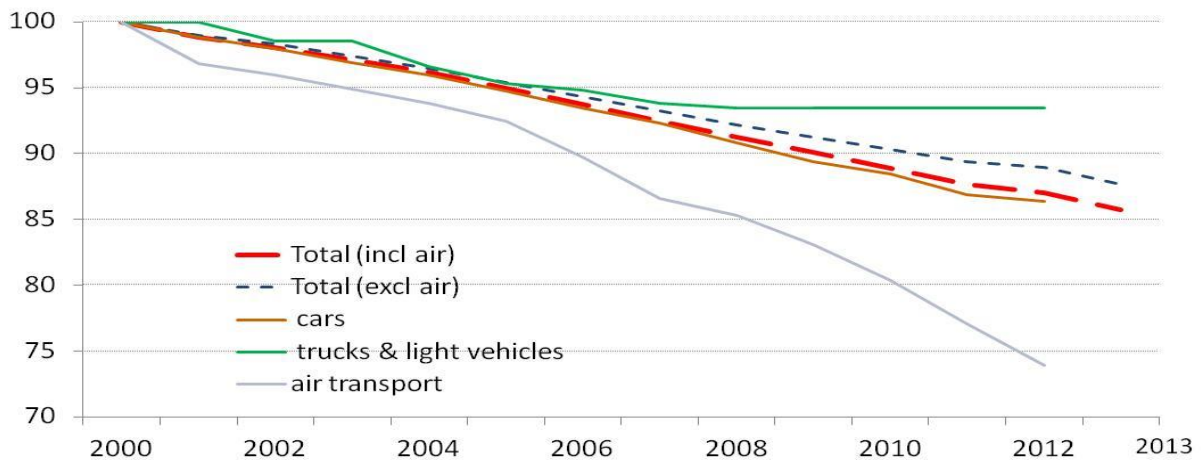
procedures to gain knowledge and develop a strategy to achieve energy efficiency targets. Insofar they play a crucial role in a policy mix for the industrial sector. One central element to a wider spread of this kind of instruments in Europe is the implementation of Article 8 of the EED, which is, however, delayed in several Member States. To the date of June 2015, some Member States did not even deliver a national response to Article 8 to the European Commission.

While several energy efficiency measures are already in place for small and medium enterprises (SMEs), such as subsidy schemes for energy audits and energy efficiency measures which exist in a variety of countries, more tailored programmes are needed to address their special needs.

**Energy efficiency trends**

- The energy consumption of the transport sector has been decreasing quite rapidly since 2007 in the EU (1.6 %/year).
- Around 40% of that reduction is due to the economic recession, with a decrease in freight traffic and the stability of passenger traffic, and almost 60% to energy savings, mostly from passenger cars.
- As a result of these trends, consumption in 2013 was almost at the same level as in 2000 at EU level and in France and between 3 and 10% below in Germany, Italy, UK and Spain.
- Since 2007, the economic crisis resulted in a remarkable drop in the traffic of goods which was in 2012 11% lower than in 2007 at EU level. Passenger traffic remained stable despite population growth because of a slight decrease in passenger mobility (i.e. in km travelled per capita in one year). In addition, in most countries the average annual distance travelled by car has been decreasing since 2007.
- The energy efficiency (measured by ODEX<sup>4</sup>) has been improved by 1.2%/year in the EU between 2000 and 2013. Greater progresses have been achieved for both cars and airplanes than in the rest of the sector. Energy efficiency progress has slowed down for trucks and light freight vehicles since 2005 and has even virtually stopped since 2007: the dramatic fall down in freight traffic by road (by 2.5%/year over 2007-2012) led to a less efficient operation of trucks, as shown by the sharp decrease in load factors (trucks are less loaded and there is an increase in empty running) (fig 6).

**Figure 6: Energy efficiency trend in the transport sector by modes (EU 2000-2013)**



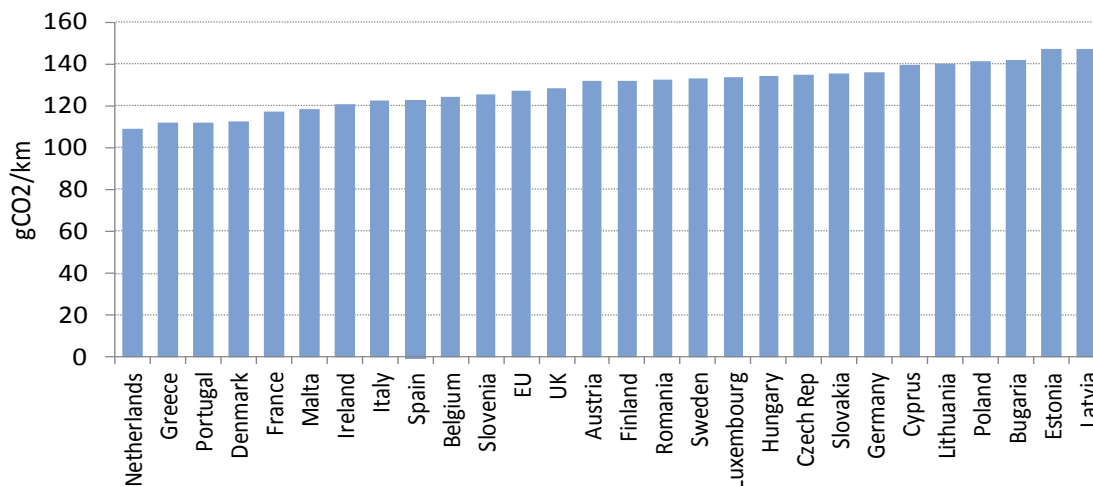
Source: Odyssee

<sup>4</sup> ODEX is a weighted average of the energy efficiency progress of each transport mode based on the following specific consumption: l/100 km for cars, buses and motorcycles; goe per tkm for freight transport; toe/passenger for air transport and goe per pkm for passenger rail. Only the trends of the main modes are shown.

- The average specific consumption of the car fleet decreased from 8.1 l/100 km in 1995 to 6.8 l/100 km in 2012 at EU level, thanks to the progress achieved with new cars.
- The reduction in the specific consumption of new cars has accelerated since 2007 (3.7%/year compared to 1.5% between 2000 and 2007), mainly because of EU regulations on labelling, emission standards and national fiscal policies promoting the purchase of low emission cars. This acceleration was especially rapid in The Netherlands, Ireland, Sweden, Denmark, Finland and UK, where it was above 4%/year.
- There are now 11 countries with a specific consumption of new cars below 5 l/100km with Portugal, the Netherlands and Denmark in the lower range. The high share of diesel cars largely explains the good performances of these countries.
- All countries aim at decreasing the share of road in transport, as a way to decrease consumption and emissions. The results are not as bright as the share of public transport in total passenger traffic was the same in 2012 as in 2000 at EU level (18.5%) and the share of rail and waterways has been decreasing for freight transport.
- The stability in the share of public transport is the result of opposite trends with a decrease in the majority of countries but an increase in 11 countries, among which the largest countries. The Czech Republic and Austria have the highest use of public transport (around 3000 km/year/person), compared to an EU average around 2000 km. Belgium and Italy recorded the highest progression in the share of public transport since 2000 (over 3 points).
- For freight, The Netherlands and Sweden account for the best practices as they are the countries with the highest share of rail and water transport (respectively 53 and 46%) and among the countries where this share is progressing.
- For road transport, alternative fuels (natural gas and biofuels) supplied around 5% of the consumption in the EU in 2013, of which 90% for biofuels. Around ¾ of the biofuel is biodiesel. Sweden is the leader for alternative fuels in transport, followed by France and Bulgaria.
- The transport sector represents an increasing share of total CO<sub>2</sub> emissions of final consumers: 43% in 2012 compared to 32% in 1990. Emissions from road freight transport were 33% higher in 2012 than in 1990 and made up 35% of the sector's emissions in 2012. Emissions from cars have been decreasing since 2000 because of the significant reduction in the specific emissions of new cars.
- In 6 countries, the specific emissions of new cars were below 120 g CO<sub>2</sub>/km in 2013 (The Netherlands, Greece, Portugal, Denmark, France and Malta) and in total 12 countries were below the EU mandatory limit of 130g for 2015 for cars manufacturers. The share of low emissions new cars (i.e. below 100 gCO<sub>2</sub>/km) increased from 2.5% in 2010 to 15% in 2013 at EU level (fig 7).



**Figure 7: Average CO<sub>2</sub> emissions of new cars (2013)**



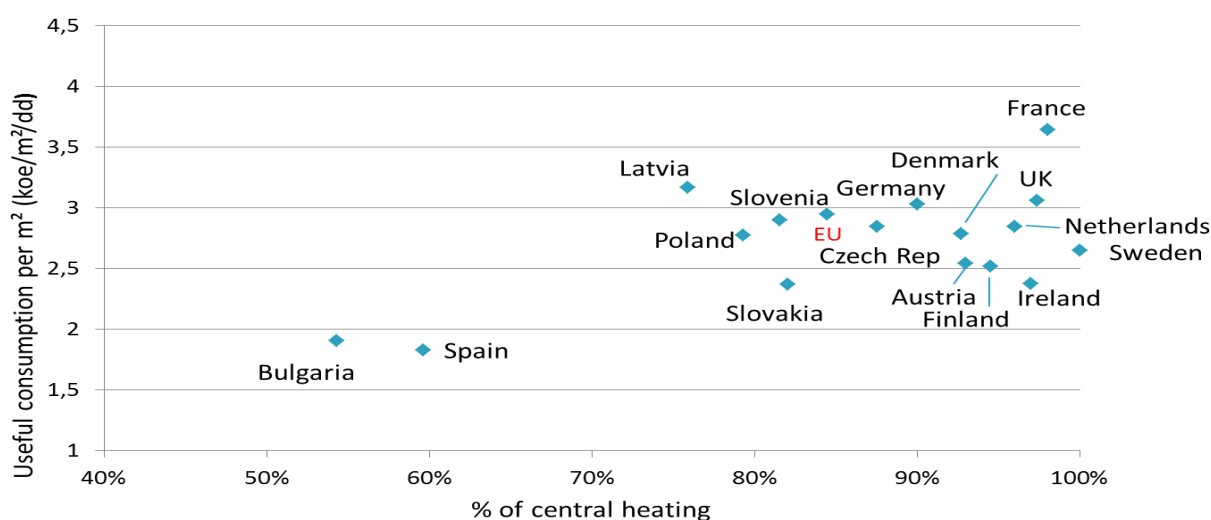
Source: ODYSSEE-EEA

### ***Energy efficiency policies***

- The majority of the transport measures (about 70% of the total) concern the passenger modes with particular emphasis on the private car, and this is reflected in the corresponding energy consumption and traffic trends. In contrast, the approximately 30% of policy measures that directly or indirectly affect freight transport do not seem to have had a tangible impact on the corresponding energy efficiency and traffic indicators.
- In the same way the approximately 100 measures that address modal shift have not yet been able to noticeably affect passenger mobility habits and freight transport logistics and organization. Positive signs of change are indeed coming from some countries, especially with regards to the passenger modes, but it is too early to judge whether this is due to the measures that have been implemented or to the economic crisis. The energy efficiency potential of modal shifting is very high but is far from being realised.
- The energy efficiency improvements achieved in the private passenger mode seem to be mainly due to three sets of measures that represent the bulk of the energy efficiency policies enacted in this sector (based on the number and the estimated impact of these policies): those concerning the energy and CO<sub>2</sub> standards for new cars, those addressed to renew the car fleets and those addressed to traffic management. But to achieve a concrete and irreversible impact on the energy efficiency trends of this sector it is necessary to envisage integrated intervention strategies that impact on all the vehicle energy efficiency components (market, use) and on the mobility patterns.
- In contrast to the household and services sectors, in the transport sector EU legislation does not represent the major driver for the implementation of policies and measures. The transport measures related to the EU legislation represent only 20% of total ongoing measures and the majority of them have been issued in the period 2000 – 2010. This means that the issuing of purely national measures is still rather high in this sector, with the possible exception of the measures concerning the introduction of biofuel in the fuel market that generally refer to the corresponding EU Directive (2003/30/EC). Measures in the transport sector consist mainly in subsidies and fiscal measures such as the Bonus/Malus scheme in France.

**Energy efficiency trends**

- Household energy efficiency as measured by ODEX<sup>5</sup>, has improved by 1.8%/year at EU level in the period 2000-2012, thanks to the energy efficiency improvement for space heating and the diffusion of more efficient new electrical appliances (e.g. labels A+ to A++).
- The household energy consumption per dwelling has been decreasing regularly in most countries since 2000 (1.5%/year at EU level). Since 2008, electricity consumption per household has also decreased in many countries.
- The efficiency of household space heating, measured in kWh or GJ/m<sup>2</sup>, has improved steadily since 2000, by around 2.3%/year at EU level. The reasons are the deployment of more efficient new buildings and heating appliances and the renovation of existing dwellings. The low volume of construction since 2009 has, however, limited the impact of new dwellings standards. As a result of these trends, the share of space heating in total household consumption is declining (4 percentage points less than in 2000).
- Austria, Ireland, Finland and Sweden countries turn out to have the most performing dwellings for a diffusion level of central heating systems close to the saturation and the average actual efficiency for electric and gas heating (fig 8) .

**Figure 8: Energy use for space heating per m<sup>2</sup> and degree day (2012)**

Source: ODYSSEE

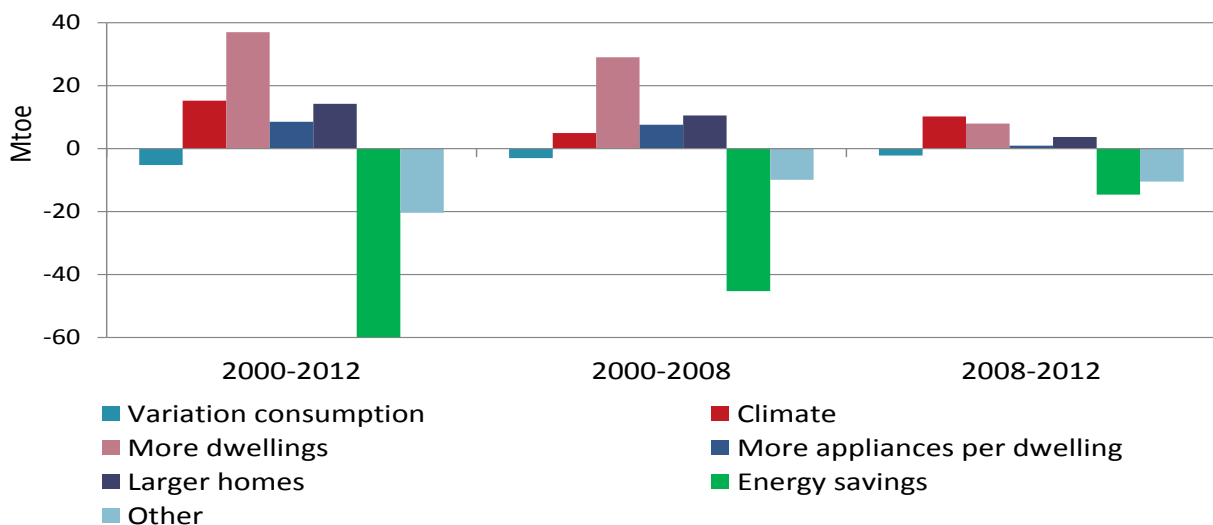
- The consumption of small electrical appliances has been growing rapidly until 2007 so that they now represent a higher share of the total consumption of appliances than large

<sup>5</sup> ODEX for households weights the energy efficiency progress by end-use and appliance measured, from changes in specific consumption, as follows: heating (koe/m<sup>2</sup>), water heating, cooking (toe/dwelling), refrigerators, freezers, washing machine, dishwashers and TVs (kWh/year).

appliances. Large appliances are more and more efficient, with efficiency gains around 35% for cold appliances (refrigerators and freezers), washing machines and dish washers since 1990, thanks to labelling and eco-design regulations.

- The specific consumption per dwelling for lighting has decreased since 2000 in half of EU countries and at the EU level thanks to the diffusion of CFLs and LEDs.
- The increasing number of dwellings and appliances contribute to raise the household energy consumption. Their effect is however counterbalanced by the energy efficiency improvements. Without these savings since 2000 the energy consumption of households would have been 60 Mtoe higher in 2012 at EU level (fig 9).

**Figure 9: Drivers of the energy consumption variations for households (EU-2000-2012)**



Source: ODYSSEE decomposition tool (<http://www.indicators.odyssee-mure.eu/decomposition.html>)

### **Energy efficiency policies**

- EU legislation is a major driver in policies and measures implemented in the household and services sectors. New measures have mainly focused on the implementation of EU legislation which has required massive effort and resources. The introduction of purely national new measures has, therefore, been limited. Examples of areas where further attention to the implementation of EU legislation is needed are:
  - Building refurbishment renovation strategies: there is room for improving the existing strategies and all countries have not yet adopted them;
  - Energy certificates: there is still need for better visibility, consumer trust must be increased and databases on the certificates need to be developed;
  - Public procurement: energy efficiency is not yet systematically integrated into public procurement processes.
- Smart meters and informative billing are empowering consumers to make better decisions and change behavior. However, these need to be backed up by other energy services such as tailored advice as well as financing opportunities to actually induce change.

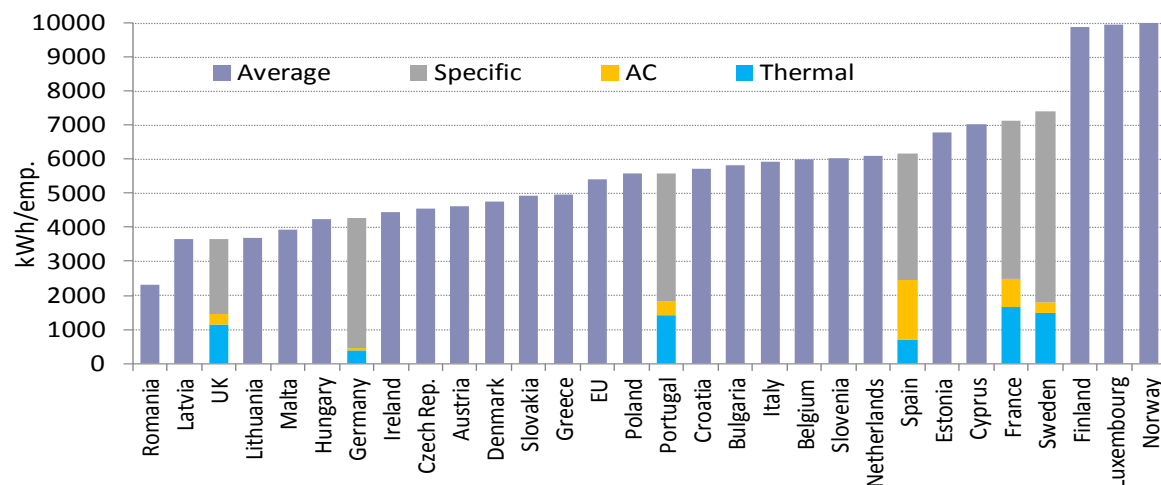
- Renewable energy production in buildings is promoted by a multitude of policies and measures. As a result, production of heat by heat pumps and solar is increasing. However, there are still considerable barriers in sales of surplus electricity to the network.
- Energy efficiency and renewable energy entail multiple benefits beyond energy savings and CO<sub>2</sub> emission reductions. It is important to recognize them in program design and evaluation in order to have a full view of the impacts. One example is economic gains which go well beyond savings in energy bills.

## SERVICES

### Energy efficiency trends

- Energy consumption in the tertiary sector increased rather rapidly until 2008, and has been decreasing since the economic downturn, by 1.5%/year.
- Electricity consumption has continued growing since 2008 but at a slower pace (1.1%/year, against +3%/year before).
- The energy intensity of services has decreased in almost three quarters of the countries, with a larger reduction for countries with high intensity in 2000; this also means that in one fourth of the countries it is still increasing.
- Norway, Sweden, Finland and Luxembourg use by far the largest amount of electricity per employee (more than twice the EU average); for Norway and Finland and, to a lesser extent, Sweden, it is has to do with electric heating. Most countries use between 4000 and 7000 kWh per employee (Fig 10).
- Electricity consumption per employee is increasing in most countries in particular in southern countries, because of the penetration of air conditioning. The high growth for East European countries is linked to their fast economic growth, at least until the crisis. This indicator is also influenced by the number of employees to provide services that tend to reduce rapidly everywhere. A reduction in this indicator may reveal more productivity and competitiveness decrease in a company than an energy efficiency increase.

Figure10: Electricity consumption per employee in services by end use (2012)



Source: ODYSSEE