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Greenhouse gas emission trends and projections in Europe 2009

Tracking progress towards Kyoto targets

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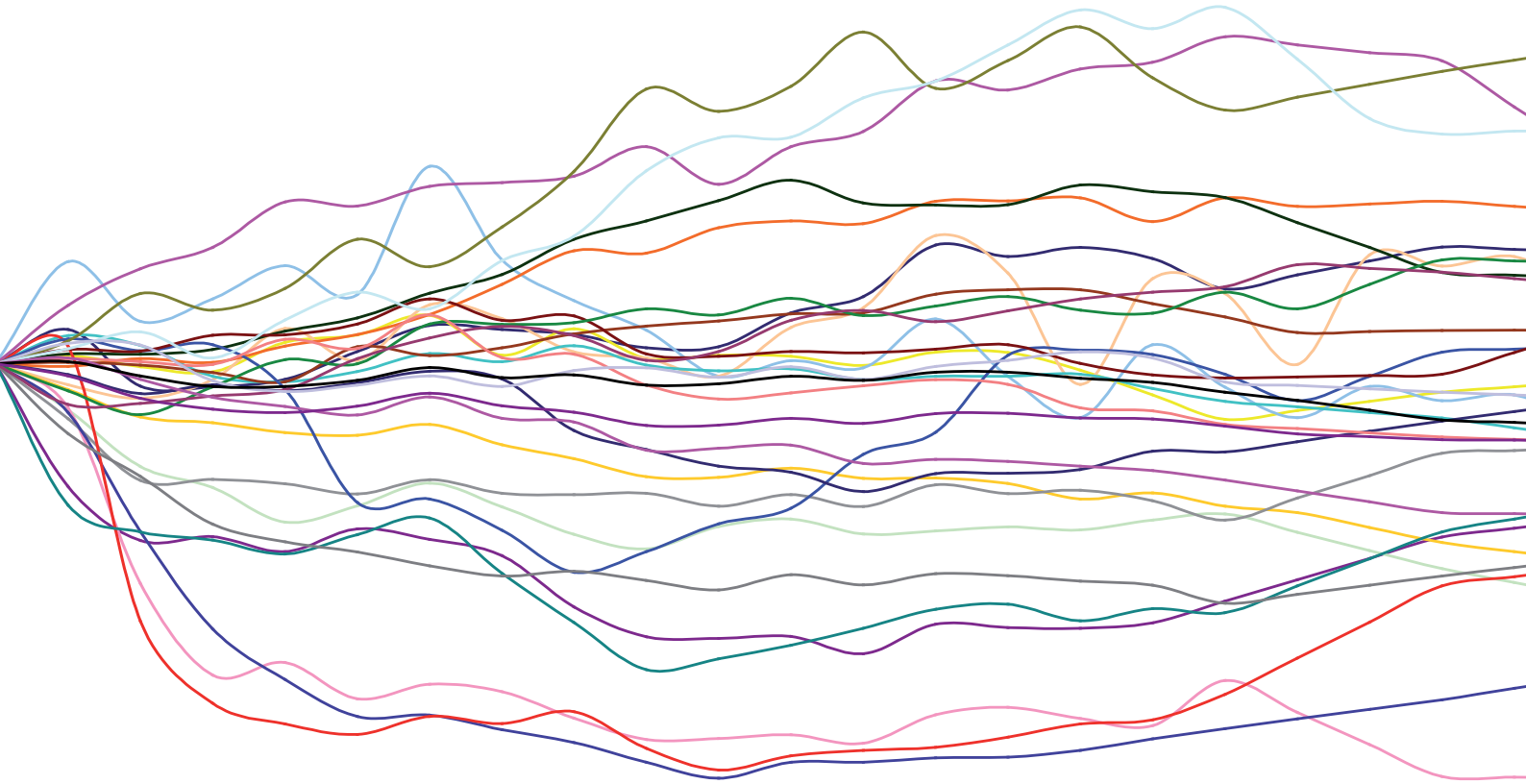

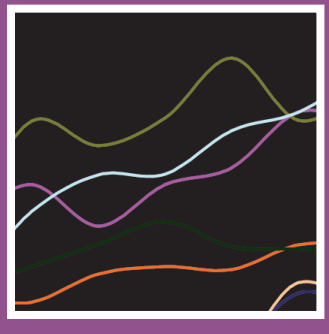

European Environment Agency

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Executive summary

This report presents an analysis of historic and projected trends of greenhouse gas emissions in Europe. It assesses the current and projected progress of EU Member States, EU candidate countries and other EEA member countries towards their respective targets under the Kyoto Protocol and under EU commitments for 2020. This analysis is based on greenhouse gas emissions inventories for 1990 to 2007, available estimates of 2008 emissions and greenhouse gas emission projections for 2010, 2015 and 2020, derived from data and related information reported by EEA member countries. All EEA member countries except Hungary, Iceland, Liechtenstein, Poland and Turkey provided updated information on emission projections and national programmes in 2009.

Greenhouse gas emission trends in Europe are, on the whole, encouraging but developments in transport emissions and the emissions of certain fluorinated gases are alarming.

Greenhouse gas emissions in the European Union are decreasing and are expected to continue to do so with the implementation of all measures planned by Member States. In 2008, for the fourth consecutive year, emissions in the EU decreased to reach their lowest level since 1990. The EU-27 has been achieving significant decoupling of its emissions from economic growth. Greenhouse gas emissions in the EU-27 now represent 11 to 12 % of global greenhouse gas emissions and each EU citizen emits on average 10.2 t CO_2-equivalent every year.

Historic trends of greenhouse gas emissions in the EU during the period 1990–2007 are the result of two sets of opposing factors. On the one hand, emissions have been driven upward by the increases in electricity and heat production by thermal plants (both in absolute terms and in comparison with other sources), industrial activity, transport volumes (passengers and freight) and the share of road transport compared to other modes. On the other hand, large emission reductions occurred in the same period, due to the economic downturn affecting eastern Member States in the 1990s, energy efficiency improvements (in particular by industrial end users and energy industries), a shift from coal to less polluting fuels (in particular gas and biomass) for the production of electricity and heat, and fuel efficiency improvements in vehicles.

Transport still remains the most problematic emitting sector, with upward emission trends (+ 26 % between 1990 and 2007, + 0.5 % between 2006 and 2007) due to an ever-increasing demand for transport of passengers and goods and a preference for road over other less-polluting ground transport modes. International aviation and shipping emissions have increased most of all sectors (+ 110 % and + 60 % respectively between 1990 and 2007).

Of all greenhouse gases, hydrofluorocarbons are the only ones for which emissions have drastically increased between 1990 and 2007 in the EU (+ 125 %), due to their use as a substitute for ozone-depleting substances phased-out under the Montreal Protocol and to the expansion of air conditioning.

The EU-15 is making good progress towards its common Kyoto target. Five EU-15 Member States (France, Germany, Greece, Sweden and the United Kingdom) have already achieved average GHG emission levels below their Kyoto target.

Compliance of Parties to the Kyoto Protocol with their emission targets can only finally be determined in the year 2014, when inventory data for the five-year commitment period 2008–2012 is available. This report assesses progress in two ways: using past emissions on the one hand and emission projections on the other. Taking the first approach, emissions currently available for the latest five-year period are compared to targets for the Kyoto commitment period 2008–2012. This gives an indication of how close countries currently stand to their targets. Taking the second approach, Member State projections for the Kyoto commitment period 2008–2012 are compared to targets. This gives an indication of Member State expectations with regard to their expected performance against their Kyoto targets.

Under the Kyoto Protocol, the 15 countries which were Member States of the EU when the Protocol was agreed (EU-15) are committed to reducing their collective greenhouse gas emissions in the period 2008–2012 to 8 % below levels in a chosen base year. This collective commitment has been translated into differentiated national emission targets for each EU-15 Member State which are binding under EU law.

Looking firstly at present emissions levels, the EU-15 was approximately 6.2 % below its base-year emissions in 2008. During the last five-year period 2004–2008, EU-15 emissions were on average 3.9 % below base-year level, compared to an 8.0 % reduction commitment under the Kyoto Protocol, to be achieved during the period 2008–2012.

Five EU-15 and nine EU-12 Member States (Bulgaria, Czech Republic, Estonia, France, Germany, Greece, Hungary, Latvia, Lithuania, Poland, Romania, Slovak Republic, Sweden and the United Kingdom), and Croatia have already achieved GHG emission levels below their Kyoto target during 2003–2007 or 2004–2008 (Table ES.1).

The EU-15 could reduce its greenhouse gas emissions levels to 8.5 % below the Kyoto base year. This reduction is particularly dependent on the combined emission reductions expected in main emitting countries, in particular France, Germany, Spain and the United Kingdom.

Looking at Member State projections, if all domestic emission reductions take place as a result of the implementation of existing measures, greenhouse gas emissions in the EU-15 will be reduced to 6.8 % below Kyoto base-year levels. A number of Member States anticipate implementing additional measures in order to

Table ES.1 Current progress towards Kyoto targets (domestic emissions and targets only)

Country grouping	Party to the Kyoto Protocol with current average emissions lower than target	Party to the Kyoto Protocol with current average emissions higher than target
EU-15 Member States	• France • Germany • Greece • Sweden • United Kingdom	• EU-15 • Austria • Belgium • Denmark • Finland • Ireland • Italy • Luxembourg • Netherlands • Portugal • Spain
EU-12 Member States	• Bulgaria • Czech Republic • Estonia • Hungary • Latvia • Lithuania • Poland • Romania • Slovakia	• Slovenia
Other EEA member countries, EU candidate country	• Croatia	• Iceland • Liechtenstein • Norway • Switzerland

Note: Current average emissions represent average emissions in the period 2003–2007 except for the EU-15, Denmark, Finland, Germany, Greece, Italy, Luxembourg and Slovenia, where average emissions in the period 2004–2008 estimates are available.
Average emissions are compared to the initial Kyoto or burden-sharing target (initial assigned amount units) for the Kyoto commitment period 2008–2012. The possible use of Kyoto mechanisms and removals from carbon sinks are not taken into account in this table.

Source: EEA, 2009.

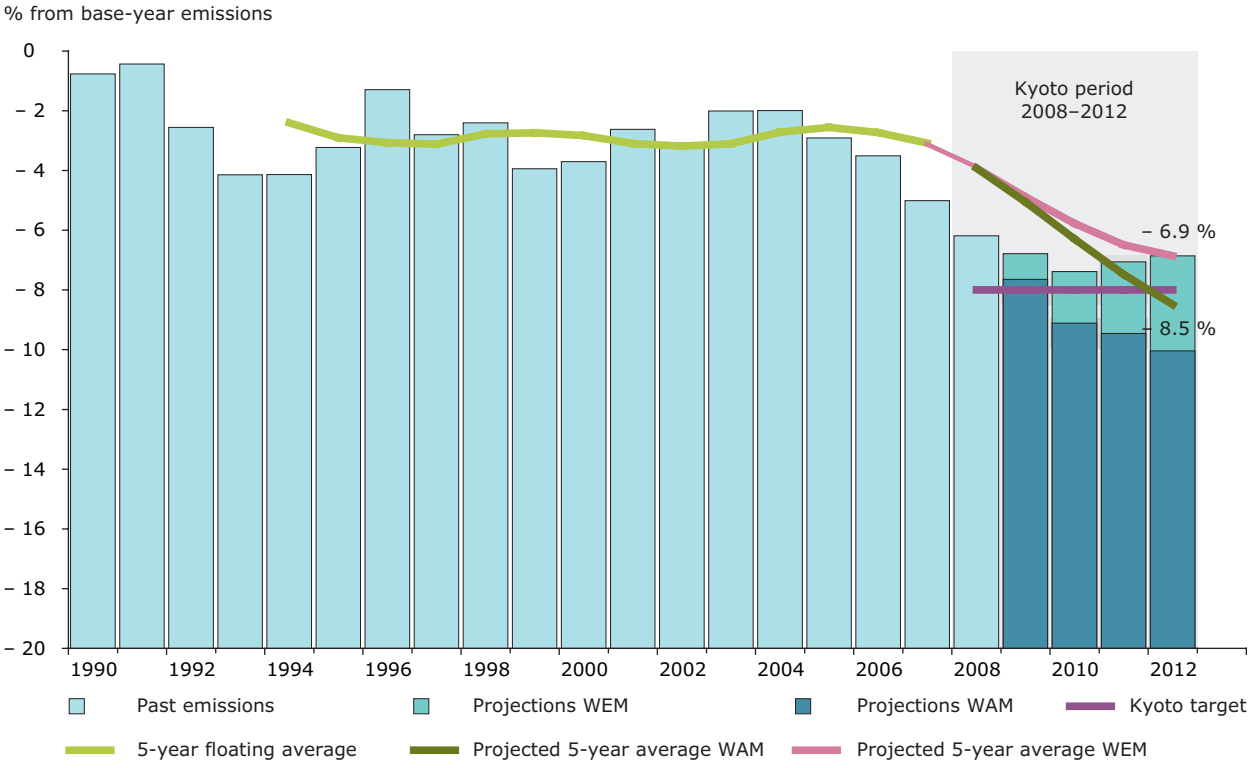
further reduce emissions by 2012. In this instance, EU-15 emissions in the period 2008–2012 would be 8.5 % below base-year emissions (Figure ES.1). This reduction is particularly dependent on the combined emission reductions expected in main emitting countries such as France, Germany, Spain and the United Kingdom. EU-wide policies are expected to contribute towards most of the planned emissions savings by the end of the period 2008–2012, in particular the European Union Emission Trading Scheme (EU ETS), the promotion of renewable energy sources, policies targeting the energy performance of buildings and internal energy market policies. Further implementation of EU legislation on renewable energy, energy end-use efficiency and energy services might also provide additional savings.

The EU-15 could over-achieve its Kyoto target by an average 217 Mt CO_2-equivalent per year over the Kyoto period if all existing and planned additional measures are fully implemented in a timely manner and if Member States use Kyoto mechanisms and enhance carbon sinks as planned. This represents a 5.1 % overachievement beyond the 8 % Kyoto target.

Under the Kyoto Protocol, Parties can increase the quantity of emission rights held (or Kyoto units), which constitute their assigned amount, by using the Kyoto Protocol's flexible mechanisms, as well as by enhancing carbon sinks. The EU ETS, which requires operators of certain industrial installations to meet emission caps during 2008–2012, will also have an effect on the assigned amount of Member States and of the EU-15.

Use of flexible mechanisms by ten Member States to cover the shortfall between expected emissions in 2008–2012 and their total assigned amounts is expected to generate Kyoto units equivalent to 2.2 % of EU-15 base-year levels ([1]). Spain and Italy

Figure ES.1 Projected emission scenarios in the EU-15



Note: WEM: with existing measures (measures implemented or adopted), WAM: with additional measures (planned measures)

Source: EEA, 2009.

([1]) Based on information reported Member States under the Monitoring Mechanism Decision. Here, only Hungary reports net sales of Kyoto units. However, latest information available from other sources indicates that additional transfers of Kyoto units are taking place between at least eight EU-15 and six EU-12 Member States.

are expected to make a significant contribution to the overall anticipated increase of the EU-15's assigned amount.

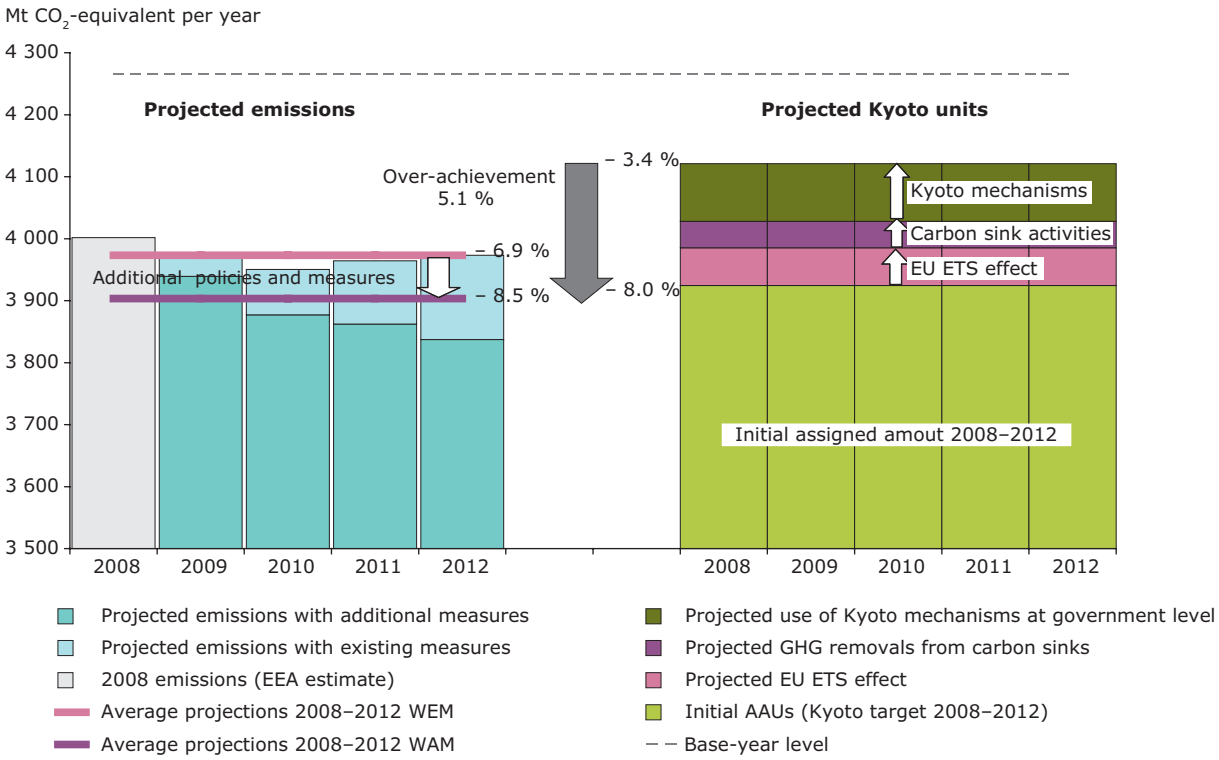
The EU ETS is expected to result in important reductions of domestic EU emissions. In addition, EU ETS operators may also acquire emission allowances or project-based credits using the Kyoto flexible mechanisms. It is estimated that such acquisitions would increase the EU-15's assigned amount by approximately 1.4 % of EU-15 base-year levels. In comparison, in 2008 ETS operators in the EU-15 had to purchase the equivalent of 3.9 % of EU-15 base-year emissions in order to comply with their obligations.

CO_2 removals from the atmosphere due to enhancement of carbon sinks (e.g. through improved forest management) are expected to generate Kyoto units equivalent to 1.0 % of base-year levels.

Overall, if all existing and planned additional measures are fully implemented in a timely manner, the EU-15 could over-achieve its Kyoto target by an average 217 Mt CO_2-equivalent per year over the Kyoto period, which represents 5.1 % of base-year emissions. This represents the difference between EU-15 projected emissions over 2008–2012 (8.5 % below the base-year) and the EU-15 total assigned amount, expected to be increased from the initial level 8 % below the base year to a level 3.4 % below the base year (Figure ES.2). The projected achievement of its Kyoto target by the EU-15 relies on each single EU-15 Member State achieving its own burden-sharing target through domestic emission reductions, enhancement of carbon sinks and use of Kyoto mechanisms. Should any EU-15 Member State miss its own target, the EU-15 would need to rely on the use of surplus Kyoto units from other Member States at the end of the commitment period in order to fill any shortfall.

All but one EU Member State as well as all other EEA member countries anticipate that they will meet their commitments under the Kyoto Protocol. To ensure that domestic

Figure ES.2 Summary of EU-15 projections of greenhouse gas emissions compared to projected Kyoto units



Note: The left section shows the projected emissions considering domestic measures (existing and additional) and is showing them as average 2008–2012 emissions (lines) and annual emissions (bars). The right section shows the projected amount of Kyoto units (emission rights) by the end of the commitment period, which is the initial EC assigned amount, the contribution of the EU ETS, carbon sink removals and use of Kyoto mechanisms.

Source: EEA, 2009.

emission reductions contribute toward targets, governments should focus on reducing emissions in the sectors not covered by the EU ETS (for example the transport, residential and agriculture sectors).

Through the second national allocation plans for the period 2008–2012, Member States have fixed the overall contribution that the EU ETS will provide towards reaching burden-sharing or Kyoto targets at national level. Therefore governments should focus on reducing emissions in the sectors not covered by the EU ETS (for example the transport, residential and agriculture sectors). Although the economic downturn is likely to trigger lower greenhouse gas emissions in most sectors, it is now only the emission reductions in the non-ETS sectors that are needed in order for Member States to comply with their Kyoto or burden-sharing targets. Success here will determine the extent to which governments will need to use the Kyoto flexible mechanisms (acquisition of Kyoto units from other parties to the Kyoto Protocol), if at all, to achieve their targets.

France, Germany, Greece, Sweden and the United Kingdom expect that they will maintain emission levels below their burden-sharing targets with the existing measures in place. Further emission reductions from additional domestic policies and measures, along with CO_2 removal from carbon sink activities, are projected to lead to over-achievement of the burden-sharing targets for these countries. These countries do not plan to rely on acquiring extra Kyoto units to meet their targets.

The planned domestic actions in the ten remaining EU-15 Member States will not be sufficient to reduce national GHG emission below their burden sharing targets. Nine of these Member States expect to meet their target through planned domestic action, carbon sink activities and use of Kyoto mechanisms (Figure ES.3).

Only Austria does not expect to reach its burden-sharing target under current arrangements. Domestic emission reductions, the use of Kyoto mechanisms as currently planned and emission removals from carbon sink activities will not suffice to meet the target. However, the projections reported by Austria do not reflect the current economic downturn, and recent GDP growth estimates are much lower than those that Austria has used in their projections.

Compared to the EEA analysis from 2008, Denmark, Italy and Spain are now expected to reach their burden-sharing target. Denmark has now reported updated projections that take into account recent measures in the energy sector. Italy now expects higher CO_2 removal from carbon sinks than last year. Spain now expects a more intensive use of the Kyoto flexible mechanisms. The EU ETS, which was not fully factored in the 2008 EEA analysis, will also play an important role in bringing additional allowances or credits from Kyoto mechanisms to these countries — thereby increasing their assigned amounts.

In the EU-12, the emissions reductions achieved since 1990 are such that, despite the expected emission increases from current levels, all Member States with a Kyoto target expect to meet or over-achieve their Kyoto targets. This will result in a surplus of Kyoto units. Slovenia is the only EU-12 Member State which anticipates that it will need to use the Kyoto mechanisms to meet its target. Cyprus and Malta do not have a target under the Kyoto Protocol.

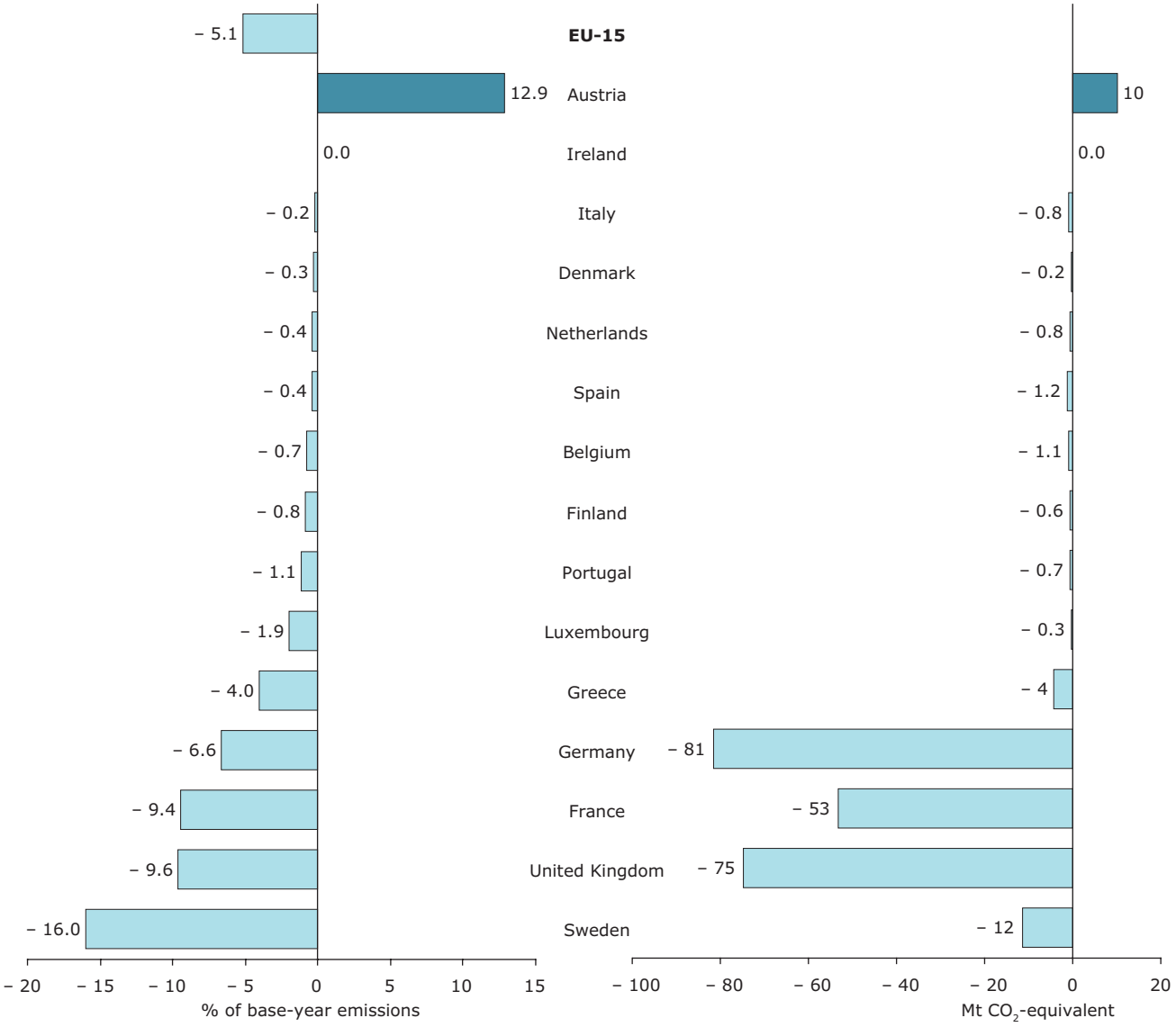
The other EEA member countries which have Kyoto targets (Iceland, Liechtenstein, Norway and Switzerland) and the EU candidate country Croatia, project that they will meet their target through a combination of domestic emission reductions, carbon sink removals and use of the Kyoto mechanisms.

In 2009 the progress of EU-15 Member States towards their targets was assessed, for the first time, by focusing on projections of their non-ETS emissions. In the future, new indicators with a focus on these non-ETS emissions will be used to track the annual progress of Member States towards their targets.

The EU-27 is making good progress towards its 2020 emission reduction target of – 20 % and the implementation of planned additional measures is expected to bring domestic emissions down to 14 % below 1990 levels.

The EU-27 is estimated to have reduced domestic greenhouse gas emissions by approximately 10.7 % between 1990 and 2008. The EU-27 is more than halfway through achieving its unilateral target of – 20 % by 2020, accounting for domestic emission reductions only. Full implementation of the planned additional measures is expected to bring EU-27 domestic emissions down to 14 % below 1990 levels by 2020, thus potentially delivering almost three quarters of EU's unilateral 2020 commitment through domestic measures only (Figure ES.4). These projected domestic emission reductions in the EU-27 could be larger if more than the current 11 Member States had accounted

Figure ES.3 Projected gap between EU-15 GHG emissions and Kyoto units (emission rights) during the Kyoto commitment period 2008–2012



Note: EU-15 figure in absolute terms (– 217 Mt CO_2-equivalent) not represented due to significantly higher scale.
Countries are ranked by increasing absolute gap between their 2008–2012 projected emissions in the sectors not covered by the EU ETS and their corresponding Kyoto target.
Projections from most Member States, including Austria, do not fully reflect the effects of the economic recession.

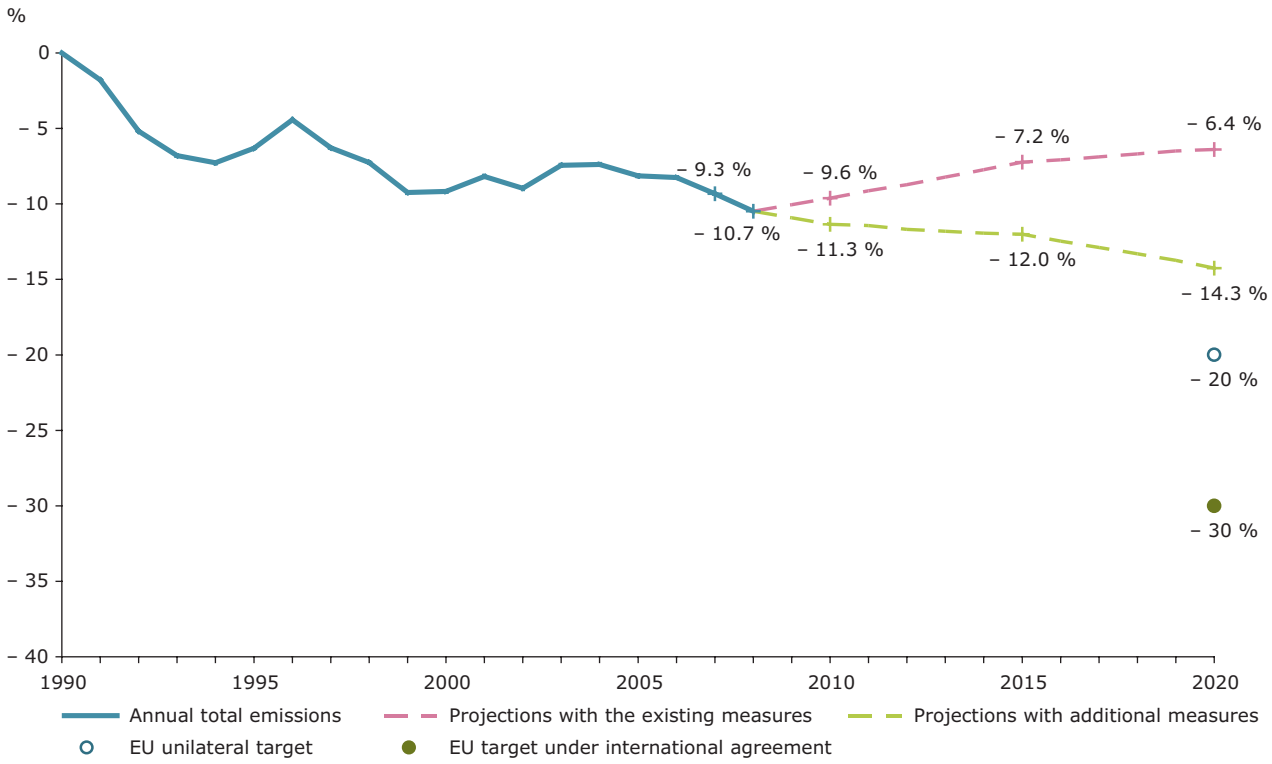
Source: EEA, 2009.

for the effects of the EU climate change and energy package in their projections of domestic emissions by 2020. In addition, the potential use of flexible mechanisms in the period 2013–2020, in line with the EU climate and energy package, could further reduce EU-27 emissions.

In the sectors not covered by the EU ETS, additional measures addressing energy use (energy performance of buildings) and transport (modal shift, biofuels and car efficiency) are expected to play an important role in meeting the national 2020 targets. In the agriculture sector, very little emission reductions are projected from both existing and additional measures for 2010 and 2020. Agriculture is the sector where the least absolute and relative reductions are expected, despite contributing 9 % of the EU-27 total emissions in 2007.

Quantitative estimates from Member States so far lack consistency and completeness to allow an accurate quantification of savings at the EU level, in particular for newly adopted EU policies. The European Commission estimates that eco-efficiency requirements of energy-using products, the inclusion of aviation in EU ETS, the strategy for CO_2 from cars and new requirements on fuel quality will bring important emission reductions by 2020. In addition, part of the reduction towards the 2020 targets could be achieved through use of flexible mechanisms both in the trading and in the non-trading sectors, as foreseen in the climate and energy package.

Figure ES.4 EU-27 GHG emission trends and projections to 2020



Note: Emissions from international aviation, although included in the 2020 target, are not taken into account in this figure (past trends, projections and targets).

Source: EEA, 2009.

1 Introduction

1.1 Objective

This eighth annual report presents an assessment of progress of European countries towards limiting their anthropogenic emissions of greenhouse gases, achieving their emission targets under the Kyoto Protocol and achieving the reduction objectives of the European Union for 2020. The report analyses both actual progress, based on greenhouse gas emissions trends between 1990 and 2007, and projected progress, based on projections of future GHG emissions, compared with targets under the Kyoto Protocol.

The report supports and complements the annual progress report of the European Commission to the Council and European Parliament, which is required under Council Decision No 280/2004/EC of the European Parliament and of the Council of 11 February 2004 concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol (the EU Monitoring Mechanism) and its implementing provisions (Commission Decision 2005/166/EC of 10 February 2005 laying down rules implementing Decision No 280/2004/EC of the European Parliament and of the Council concerning a mechanism for monitoring Community greenhouse gas emissions and for implementing the Kyoto Protocol). It also supports the Fifth National Communication from the European Community under the UN Framework Convention on Climate Change (UNFCCC), due for submission before 1 January 2010.

1.2 Scope

The report covers:

- the European Community (EC);
- the 27 Member States of the European Union (EU), which are all members of the European Environment Agency (EEA);
- the five other EEA member countries (Iceland, Liechtenstein, Norway, Switzerland and Turkey);
- Croatia, which is, with Turkey, an EU candidate country for which accession negotiations have been opened ([2]).

This assessment is most detailed for the pre-2004 Member States (EU-15). These are covered by the 'EU burden-sharing agreement' which lays down differentiated emission limits for each of the 15 Member States, with the aim of ensuring that the EU-15 meets its overall reduction commitment under the Kyoto Protocol. Cyprus, Malta and Turkey ([3]) do not have a target under the Kyoto Protocol, but the limited available data are presented here.

1.3 Progress assessment

The assessment of actual progress, i.e. whether countries are currently on track towards their individual targets, is based on an analysis of their past greenhouse gas emissions from 1990 until 2007 or, when estimates are available, until 2008.

The assessment of projected progress, i.e. whether countries are projected to reach their targets under the Kyoto Protocol (2008–2012) or not, is based on available information reported by Member States as follows:

- 2007 greenhouse gas emissions or, when available, 2008 emissions estimates;
- projections by countries of their greenhouse gas emissions for the years 2010 and 2015 or, when available, for the full Kyoto period 2008–2012;

([2]) Accession negotiations have not been opened yet for the third EU candidate country (the former Yugoslav Republic of Macedonia).
([3]) Turkey acceded to the Kyoto Protocol on 5 February 2009.

- expected reductions from existing and planned domestic policies and measures ([4]);
- projected shortfall or surplus of allowances at national level by EU ETS operators by the end of the second trading period 2008–2012;
- expected CO_2 removals from carbon sink activities (land use, land-use change and forestry (LULUCF));
- intended use of the Kyoto flexible mechanisms at government level.

In addition, an assessment of EU-27 projected progress towards 2020 targets is provided, based on Member States projections for 2020.

1.4 Data sources

The countries covered by this report are subject to two main reporting requirements concerning greenhouse gas emissions. Each year, all must submit their annual GHG inventory under UNFCCC reporting requirement. In addition, under the EU Monitoring Mechanism, Member States must submit biannually to the European Commission new information on greenhouse gas projections and national programmes as well as on indicators to monitor and evaluate progress with policies and measures.

The data and analyses presented are mostly based on:

- the *Annual European Community GHG inventory report* ([5]) submitted to the UNFCCC in 2009 (1990–2007 emissions of the EU and of all Member States);
- the *Initial Report of the European Community* submitted to the UNFCCC in 2007 ([6]) and its subsequent review report by the UNFCCC published in 2008 ([7]), which determines the final assigned amounts for each Party to the Kyoto Protocol;
- the reports submitted by Member States to the European Commission for the assessment of projected progress towards meeting their emission limitation and reduction commitments, with descriptions of policies and measures (as required under the EU Monitoring Mechanism Decision);
- the Community Independent Transaction Log (CITL) for verified emissions under the EU Emission Trading Scheme, second national allocation plans (NAPs) and the subsequent European Commission decisions;
- EEA estimates of 2008 EU emissions ([8]) and estimates of 2008 emissions submitted by seven Member States.

Additional information was obtained from other documents, such as national communications to the UNFCCC. All data available up to mid May 2009 were included, although supplemental information, resubmissions due to corrections or comments were accepted at a later stage.

1.5 Main data updates compared to the 2008 report

Most of the data used for this analysis are new compared to the 2008 report, since all countries delivered 2009 GHG inventory reports to the UNFCCC and almost all EU Member States submitted new projection data in 2009 under EU reporting requirements.

While GHG inventories submitted under the UNFCCC cover a period until 2007, the analysis of GHG trends is for the first time complemented with an estimate by EEA and its ETC/ACC of recent (2008) EU-15 and EU-27 greenhouse gas emissions, based on additional data sources. In addition, seven Member States reported their own estimate of their 2008 greenhouse gas emissions, which were taken into account in the present report.

Most countries could not fully include the effects of the global recession in their GHG projections. This is because of the long delays necessary

([4]) Domestic policies and measures are those taking place within the national boundaries. Existing policies and measures are those for which one or more of the following applies: (a) national legislation is in force; (b) one or more voluntary agreements have been established; (c) financial resources have been allocated; (d) human resources have been mobilised; (e) an official government decision has been made and there is a clear commitment to proceed with implementation. Additional (planned) policies and measures are options under discussion with a realistic chance of being adopted and implemented in time to influence the emissions during the commitment period.
([5]) EEA, 2009a.
([6]) EEA, 2006.
([7]) UNFCCC, 2008.
([8]) These estimates are based mainly on ETS verified emissions; Eurostat statistics on energy supply and use, industrial output and agriculture, and emission factors from UNFCCC reporting.

Table 1.1 Overview of updated information submitted by Member States

Country	Update on emission inventory	Update on projections	Update on policies and measures	Update on past indicators	Update on projected indicators	Estimate of 2008 GHG emissions
Austria	2009	2009	2009	2009	2009	NA
Belgium	2009	2009	2009	2009	2009	NA
Bulgaria	2009	2009	2009	2009	2009	NA
Czech Republic	2009	2009	2009	2009	2009	NA
Cyprus	2009	2009	2009	2009	2009	NA
Denmark	2009	2009	2009	2009	2009	Available
Estonia	2009	2009	2009	2009	2009	NA
Finland	2009	2009	2009	2009	2009	Available
France	2009	2009	2009	2009	2009	NA
Germany	2009	2009	2009	2009	2009	Available
Greece	2009	2009	2009	2009	2009	Available
Hungary (*)	2009	2007	2008	2009	2008	NA
Ireland	2009	2009	2009	2009	2009	NA
Italy	2009	2009	2009	2009	2009	Available
Latvia	2009	2009	2009	2009	2009	NA
Lithuania	2009	2009	2009	2009	2009	NA
Luxembourg	2009	2009	2009	2009	2009	Available
Netherlands	2009	2009	2009	2009	2009	NA
Malta	2009	2009	2009	2009	2009	NA
Poland	2009	2007	2008	2009	2008	NA
Portugal	2009	2009	2009	2009	2009	NA
Romania	2009	2009	2009	2009	2009	NA
Slovakia	2009	2009	2009	2009	2009	NA
Slovenia	2009	2009	2009	2009	2009	Available
Spain	2009	2009	2009	2009	2009	NA
Sweden	2009	2009	2009	2009	2009	NA
United Kingdom	2009	2009	2009	2009	2009	NA
Total 2009 updates (EU-15)	**15**	**15**	**15**	**15**	**15**	**6**
Total 2009 updates (EU-27)	**27**	**25**	**25**	**27**	**25**	**7**
Croatia	2009	2006	NA	NA	NA	NA
Iceland	2009	2006	NA	NA	NA	NA
Liechtenstein	2009	2006	NA	NA	NA	NA
Norway	2009	2009	2009	NA	NA	Available
Switzerland	2009	2009	NA	NA	NA	NA
Turkey	2009	2007	NA	NA	NA	NA
Total 2009 updates (all countries)	**33**	**27**	**26**	**27**	**25**	**8**

Note: The year listed in the columns refers to the latest submission, which has been used for the respective data.
NA stands for 'not available'.
(*) New information received in September 2009, not taken into account.

Source: EEA, 2009.

for determining GDP scenarios before running projection models that take these new parameters into account. Nevertheless, seven countries (Belgium, Czech Republic, Spain, Greece, Italy, Ireland and Lithuania and) reported that their projections do take these effects into account. In addition, several other countries reported additional projections that took the economic downturn into account, although they were not detailed enough or consistent with long-term projected trends, so were not included in the present analysis.

Almost all the information presented in this report was reported by countries in 2009 (Table 1.1). Only Poland did not report new emission projections. Hungary submitted new information in September 2009. Due to time constraints, only the information on the use of Kyoto mechanisms could be taken into account (not the projections). The information submitted by certain countries on past and projected indicators to monitor and evaluate progress with policies and measures was still incomplete.

Due to important emissions recalculations reported in Germany's 2009 GHG inventory report, the data set on emission projections was significantly inconsistent with past emission trends. Total and sectoral projected emissions were consequently adjusted by EEA to obtain consistency between past and projected emission trends. This adjustment did not affect the projected progress of Germany towards its target. Detailed information on the quality of projections reported by Member States, national GHG emission trends, projections, policies and measures, and methodologies (including references) is presented in Annex A.8.

2 Greenhouse gas emissions trends, 1990–2008

- Based on a recent EEA analysis, in 2008 EU-15 and EU-27 GHG emissions ([9]) reached their lowest level since 1990. Between 1990 and 2008, GHG emissions decreased by around 10.7 % in the EU-27 and by around 5.5 % in the EU-15.
- GHG emissions in the EU-27 represent around 12 % of global GHG emissions, excluding net CO_2 removals from land use, land-use change and forestry (LULUCF). Including global emissions from deforestation, the share would be around 11 %.
- An EU citizen emits an average of 10.2 t CO_2-equivalent every year, which is above the world average of approximately 6.7 t CO_2-equivalent per capita. Greenhouse gas emissions per capita vary widely among European countries.
- The EU-27 is one of the world's least emission intensive economies, with an emission intensity of 473 g CO_2 per euro of GDP in 2007. Emission intensities have declined in all EU-27 Member States between 1990 and 2007, with an average decline of 37 % for the EU-27 and 33 % in the EU-15.
- In the EU-27, the five EU-15 Member States emitting the most greenhouse gas are, by decreasing order: Germany, the United Kingdom, Italy, France and Spain and. In the EU-12, Poland emits the most GHG. In 2007, the EU-15 accounted for 80 % of all EU-27 emissions.
- Between 1990 and 2007, the largest absolute emission reductions took place in Germany, the United Kingdom and in most EU-12 Member States, while emissions increased most (in absolute terms) in southern EU-15 Member States (Spain, Italy, Greece and Portugal). The largest increase among all EEA member countries occurred in Turkey, where emissions doubled over the period.
- Energy-related GHG emissions represent 80 % of total GHG emissions in the EU-27. In the EU-27, most GHG is emitted by the production of electricity and heat, road transportation, fossil fuel combustion in households and in manufacturing industries, agriculture and the iron and steel industry. Carbon dioxide (CO_2) emissions account for 83 % of total GHG emissions, while methane (CH_4) and nitrous oxide (N_2O) represent each 8 % and 7 % respectively of total emissions.
- Between 2006 and 2007, GHG emissions decreased by 1.2 % in the EU-27 and by 1.6 % in the EU-15. This decrease was mainly due to large reductions in emissions from fuel combustion in households and services due to a warmer winter, and high fuel prices. This trend was dominated by reductions in Germany.
- Hydrofluorocarbons (HFCs) are the only greenhouse gases for which emissions have drastically increased between 1990 and 2007, due to the development of refrigeration and air conditioning.
- Between 1990 and 2007, EU-15 GHG emissions decreased by 4.3 %. They increased in the sectors energy supply (+ 1 %) and transport (+ 24 %). In all other main emitting sectors, greenhouse gas emissions decreased between 1990 and 2007 with the highest decrease in relative terms achieved in the waste sector (– 39 %).

2.1 Current greenhouse gas emission levels in Europe

Based on the information submitted in May 2009 under the UNFCCC, in 2007 the EU-27 emitted a total of 5 045 million tonnes CO_2-equivalent (Mt CO_2-equivalent) greenhouse gases, excluding net CO_2 removals from land use, land-use change and forestry (LULUCF) and emissions from international bunkers (international aviation and international

([9]) Unless otherwise noted, total GHG emissions do not include emissions from international bunkers (international aviation and maritime transport) and exclude removals from LULUCF (carbon sink activities).

maritime transport). Including international bunkers, these emissions were 5 360 Mt CO_2-equivalent. This represents the lowest emission level achieved in the EU-27 during the whole period 1990–2007.

Based on these data:

- the EU accounts for about 12.4 % of global GHG emissions. If emissions from deforestation were included, the share would fall to 10.9 %, since deforestation occurs mostly outside the EU ([10]);
- an EU citizen emits on average 10.2 t CO_2-equivalent, well above the world average of around 7 t CO_2-equivalent per capita;
- the European Union economy generates approximately 473 g CO_2-equivalent per euro of GDP, which is one of the lowest levels among the major GHG emitting countries worldwide ([11]).

In the EU-15, 2007 total GHG emissions were 4 052 Mt CO_2-equivalent, excluding LULUCF and emissions from international bunkers. This was 4 % lower than 1990 emissions and the lowest level recorded over the whole period 1990–2007. In the EU-12, GHG emissions were 993 Mt CO_2-equivalent. Although still 25 % lower than in 1990, this level is the highest recorded since 1999.

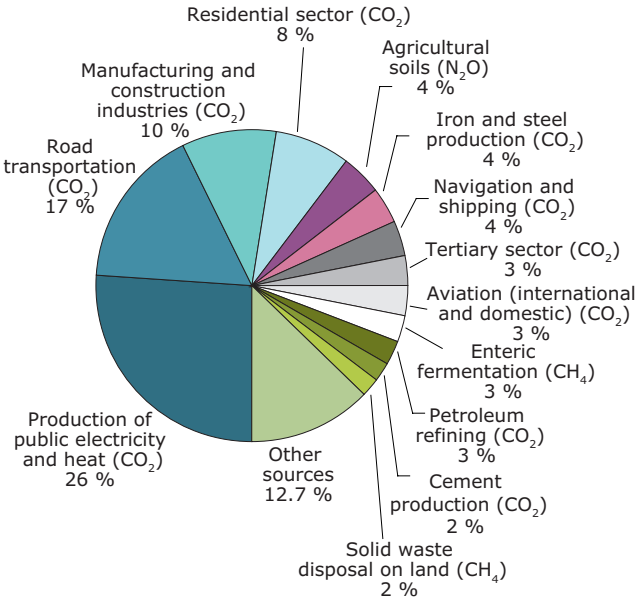
In August 2009, for the first time, the EEA published its own estimates of EU-wide total greenhouse gas emissions for the previous year ([12]). According to these estimates, the decreasing trend in EU greenhouse gas emissions continued in 2008. Based on these estimates, 2008 greenhouse gas emissions in the EU-27 stand approximately 10.7 % below the 1990 level while in the EU-15 they stand 5.5 % below 1990 levels and 6.2 % below the Kyoto base-year emissions.

Two activities are responsible for the largest shares of greenhouse gas emissions (Figure 2.1) the production of public electricity and heat from fossil fuel combustion by the energy industry and road transportation (freight and passengers). More details on the main drivers responsible for emission trends in theses sectors are presented in Chapter 1.

Energy-related emissions account for about 80 % of total greenhouse gas emissions in the EU-27 (81 % in the EU-15).

As a consequence of the role played by fossil fuel combustion, CO_2 is the predominant greenhouse gas emitted, accounting for 83 % of total GHG emissions (excluding LULUCF and international bunkers). About 93 % of this CO_2 originates from the combustion of fossil fuels, and the remaining 7 % from specific industrial processes (e.g. production of cement, chemicals, iron and steel). Methane (CH_4) and nitrous oxide (N_2O), mainly due to agriculture and waste management, account for about 8 % and 7 % respectively of total emissions, while fluorinated gases (F-gases) from industrial processes represent 2 % of total emissions (Figure 2.2).

Figure 2.1 Greenhouse gas emissions in the EU-27 by main source activity, 2007



Note: For detailed analysis of the key sources, cf. Annex A.1.

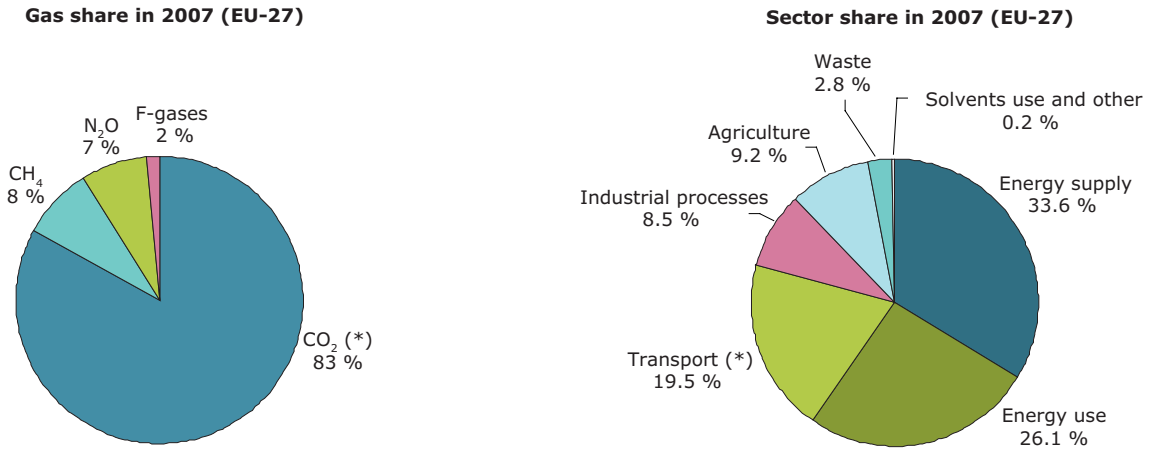
Source: EEA, 2009.

([10]) Source for world emissions: European Commission, Joint Research Centre (JRC)/Netherlands Environmental Assessment Agency (PBL). Emission Database for Global Atmospheric Research (EDGAR), release version 4.0. http://edgar.jrc.ec.europa.eu, 2009; source for EU-27 emissions: EEA, Annual European Community greenhouse gas inventory 1990–2007 and inventory report 2009 www.eea.europa.eu/publications/european-community-greenhouse-gas-inventory-2009.

([11]) Climate Analysis Indicators Tool (CAIT) Version 5.0. (Washington, DC: World Resources Institute, 2008).

([12]) Seven EU Member States (Denmark, Finland, Germany, Greece, Italy, Luxembourg and Slovenia), as well as Norway, also reported their own estimates of total GHG emissions in 2008. These estimates were used in the present assessment of these countries' progress towards their Kyoto targets.

Figure 2.2 Greenhouse gas emissions in the EU-27 by gas and sector, 2007

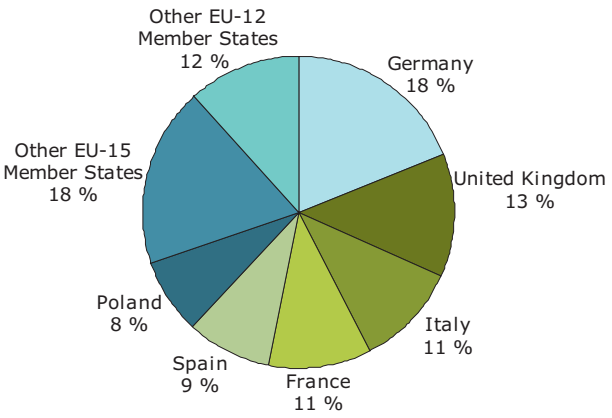


Note: * Emissions from international aviation and international maritime navigation, which are not covered by the Kyoto Protocol, are not included here. If included in the total, the share of CO_2 and the share of transport would reach 84 % and 24 % respectively of total EU-27 GHG emissions in 2007.

Source: EEA, 2009.

Eighty percent of total EU-27 GHG emissions are generated in the EU-15 (whilst the latter represents 79 % of the whole EU-27 population). The five largest GHG emitters in the EU-27 are all EU-15 Member States: Germany, the United Kingdom, Italy, France and Spain. Together, they account for more than 60 % of EU-27 GHG emissions (Figure 2.3). In the EU-12, Poland emits the most GHG. However, these six countries do not rank among the highest emitters per capita in the EU (Figure 2.8).

Figure 2.3 Greenhouse gas emissions in the EU-27 by main emitting country, 2007



Source: EEA, 2009.

Greenhouse gas emissions per capita show significant differences across European countries. Emissions per capita are correlated to the energy intensity (primary energy consumption per capita) and the energy mix (affecting the level of emissions by energy unit produced) of each country. Turkey, Latvia, Romania, and Sweden have the lowest GHG emissions per capita among all EEA member countries. This can be explained by low levels of final energy use per capita in these countries (Turkey having the lowest) ([13]). In addition, more than 55 % of the electricity produced in Latvia comes from hydropower, and in Sweden in 2007 it was almost 45 % (the same share for nuclear power). The relatively high levels of GHG emissions per capita observed in Luxembourg, Estonia, Ireland, Finland and Iceland can be explained by:

- the high level of 'road fuel exports' ([14]) from Luxembourg to neighbouring countries;
- the importance of the agriculture sector and related CH_4 and N_2O emissions in Ireland, and

([13]) EEA, 2008b.

([14]) Fuel bought in Luxembourg but burned outside the country by people and by truck drivers crossing the countries as well as by the relatively important cross-border commuting workforce (more than 25 % of the resident population), because of lower fuel taxes compared to neighbour countries. Luxembourg estimates that fuel exports could be responsible for up to 40 % of its total greenhouse gas emissions. Other countries, such as Austria and Ireland, also experience fuel tourism and road fuel export.

the relatively low share of renewable energy for energy supply;
- the severe climatic conditions requiring a significant use of energy per capita in Finland and Iceland, despite a significant use of renewable energy sources (and nuclear energy in Finland) for energy supply in both countries. In addition, Finland has an energy-intensive export industry, which raises per capita emissions;
- emission in Estonia is also highly dependent on climatic conditions: electricity generation from conventional power plants increased by 25 % between 2006 and 2007, which resulted in higher per capita emissions than in previous years.

The emissions intensity of a country, measured as the level of emission per unit of economic output (measured in GDP), reflect a country's:

- level of energy efficiency;
- overall economic structure (including the carbon content of goods imported and exported);
- carbon content of the energy consumed in the country.

Emission intensities differ greatly among EU Member States ([15]). The five Member States with the lowest emission intensities are all EU-15 Member States, while the seven Member States with the highest emission intensities are all EU-12 Member States (Figure 2.9). This regional difference could be explained by deindustrialisation and offshoring in the traditional (labour-intensive) manufacturing sectors affecting the majority of EU-15 Member States, transitions towards low-carbon economies, reflected to some extent in low levels of energy use per GDP ([16]) (the United Kingdom, Austria, Italy) and the share of renewable energy sources and nuclear energy in the fuel mix. Sweden and France have high shares of renewable and nuclear energy, while Austria relies strongly on hydropower; this results in the lowest levels of GHG emission per GDP in the EU. Liechtenstein, Switzerland and Norway have also relatively low emission intensities compared to other European countries. The importance of the low-carbon financial sector in the economies of Liechtenstein and Switzerland explains the relatively low emission intensities compared to other European countries. In Norway, the large share of hydropower for electricity production explains the low GHG emission intensity.

2.2 Greenhouse gas emission trends since 1990

2.2.1 2007–2008

Based on the recent EEA estimates, EU-27 greenhouse gas emissions in 2008 were about 1.5 % lower than in 2007, while they decreased by about 1.3 % in the EU-15. This decline in emissions in 2008 was due largely to lower CO_2 emissions from fossil fuel combustion in the energy, industry and transport sectors. The 2008 emission reductions reflect the effects of the global economic recession that began in 2008, which resulted in reduced industrial output and reduced energy consumption by industry, and correspondingly reduced freight transport. The reductions are also apparent in the verified emissions from the European Union Emission Trading Scheme (EU ETS) for 2008, where total EU-27 emissions decreased by 3.9 % between 2007 and 2008.

2.2.2 2006–2007

In 2007, EU emissions fell for the third consecutive year. Between 2006 and 2007, total GHG emissions in the EU-27 fell by 1.2 %. This overall decrease was caused by emission decreases in the EU-15 of 1.6 %, although emissions rose slightly by 0.4 % in the EU-12.

At the Member State level, 17 countries recorded a reduction in greenhouse gas emissions in 2007 compared to 2006 (Figure 2.5). About 40 % of the EU-27 net reduction was accounted for by Germany. This was largely the result of lower use of fossil fuels, mainly heating oil, in the residential sector.

The largest emission reduction in relative terms occurred in Denmark (– 6.2 %). High electricity production from wind (and less coal input to power stations) and a good hydro year in both Norway and Sweden contributed to this decline. Interestingly, in Germany and France emissions from transport decreased, and in Italy and the United Kingdom they stabilised.

Total GHG emissions increased most in Spain, Bulgaria and Greece. In all three countries, emissions from public electricity and heat

([15]) To eliminate the differences in price levels between countries, allow meaningful volume comparisons of GDP across European countries and benchmark country performance in a particular year, GDP at market prices is converted to purchasing power standard (PPS). The currency conversion rates both convert to a common currency and equalise the purchasing power of different currencies.
([16]) EEA, 2008b.

consumption were the main contributors. Spain continued its upward trend in greenhouse gas emissions. In 2007, the electricity output from nuclear power stations in this country was lower than expected — replaced by fossil fuels — and road transport demand increased. In relative terms, Estonia recorded the highest increase in emissions in 2007. This was due to a very steep increase in the use of coal for the production of heat and electricity (electricity generation from conventional thermal power plants rose by 25 %).

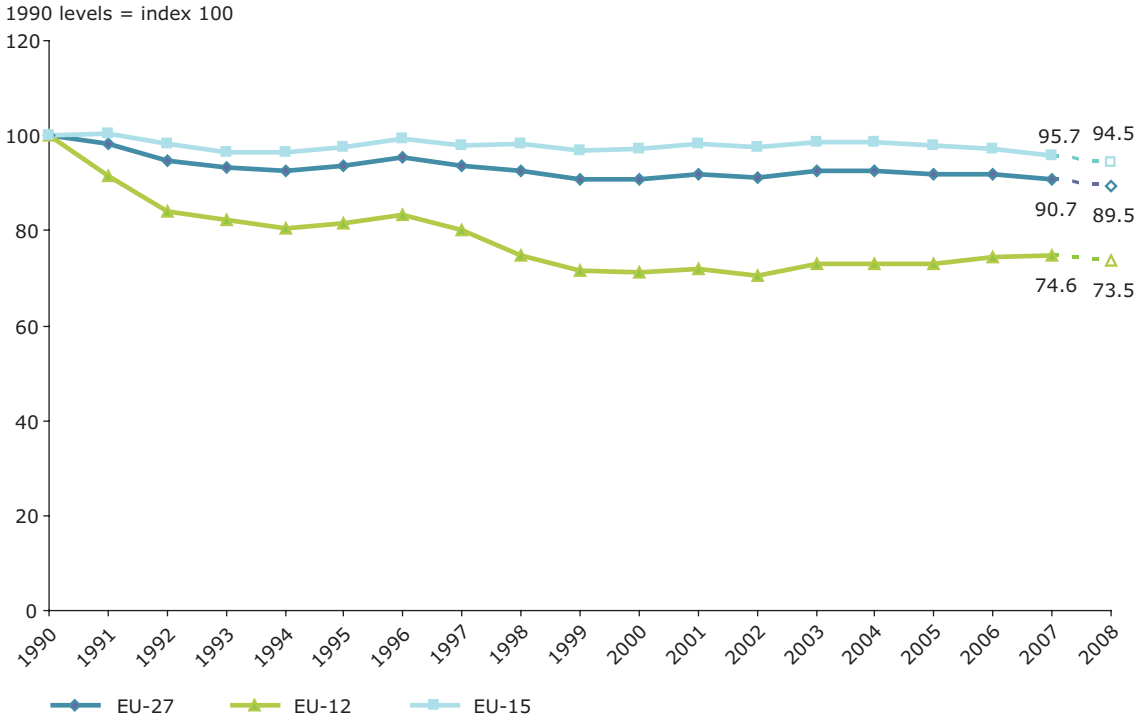
Switzerland experienced a sharp decrease in emissions between 2006 and 2007 (– 3.6 %) reaching the lowest level since 1997.

2.2.3 1990–2007

Between 1990 and 2007, total EU-27 GHG emissions (without LULUCF) decreased by 9.3 % (Figure 2.4). This overall change is the result of GHG emissions reductions of 4.3 % in the EU-15 and emission reductions of 25.4 % in the EU-12. A large part of these reductions took place during the 1990s (Figure 2.4). The overall EU GHG emission trend between 1990 and 2007 was dominated by the two largest emitters Germany and the United Kingdom, which together achieved GHG emission reductions equivalent to more than half of the absolute total emission reduction. Important absolute emissions reductions were also achieved by EU-12 Member States: Bulgaria, Czech Republic, Poland and Romania. This overall decrease was partly offset by the important emission increases in Spain and, to a lesser extent, Italy (Figures 2.6 and 2.7).

The trends in GHG emission relative to GDP in the EU indicate an overall decoupling of EU economies from emissions over time. Between 1990 and 2007, per GDP emissions decreased by 37 % in the EU-27 (GDP increase of 45 % while emissions decreased by 9 %) and by 33 % in the EU-15 (GDP increase of 44 % with a 4 % reduction in GHG emission). Emission intensities of EU-15 and EU-27 economies have been continuously decreasing since 1995, except in 1996–1997 and 2003–2004 (Figure 2.10). Between 1990 and 2007, remarkable increases in GDP occurred in parallel with significantly lower increases or even decreases in GHG emission, especially in Ireland, Latvia, Lithuania and the Slovak Republic. In 2007, the economies of most EU-12 Member States were more intensive in

Figure 2.4 Greenhouse gas emission trends in the EU-27, the EU-15 and the EU-12, 1990–2007 and 2008 estimates



Note: GHG emissions presented refer to total GHG emissions without LULUCF.

Source: EEA, 2009a.

Figure 2.5 Changes in greenhouse gas emissions in Europe, between 2006 and 2007

Note: GHG emissions presented refer to total GHG emissions without LULUCF.

Source: EEA, 2009.

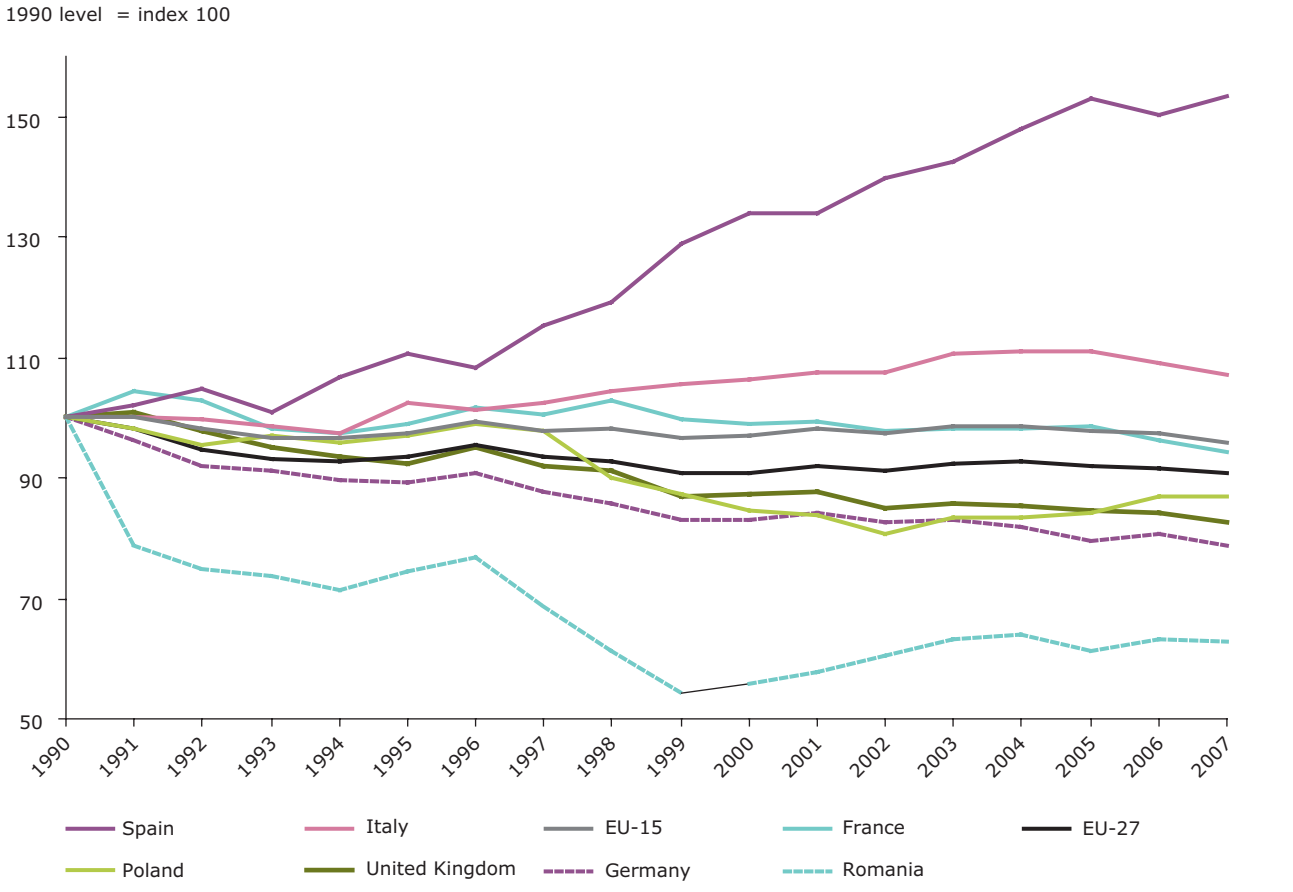
emissions than in EU-15 Member States (Figure 2.9, left graph). Turkey is the only EEA member country for which emission intensity increased between 1990 and 2007 (9 %).

GHG emission trends are also well decoupled from population growth at EU level: between 1990 and 2007, absolute GHG emissions in the EU-27 declined by 9.3 % while population grew by 5.3 %. Consequently, per capita emissions decreased by 14 % during the period (1.6 tonne CO_2-equivalent per capita). This decrease mostly occurred during the 1990s. Between 2000 and 2007, per capita emissions decreased by 5.1 % in the EU-15 while they rose by 7.1 % in the EU-12. Between 1990 and 2007, per capita GHG emissions increased most in Spain, Portugal, Cyprus and Malta. Of EEA member countries, Turkey experienced the largest increase (75 %). However in all these countries, per capita emissions have remained below the EU-27 average (except in Cyprus, which has now higher than average per capita emissions).

Total GHG emissions, emissions per GDP and per capita emissions are driven by a number of factors mostly affecting fossil fuel combustion, the main source of greenhouse gas emissions in Europe. The nature of these factors can be very diverse although some of these are interlinked (socio-economic, demographic, climatic, technological, structural, etc.), as the analysis of 1990–2007 GHG trends in Europe shows:

- EU-27 emissions decreased by 7 % between 1990 and 1998, due to the economic decline that affected mostly Eastern Europe during the early 1990s and a following period of restructuring. Heavily polluting and energy-intensive industries were closed and energy efficiency improvements in power and heating plants

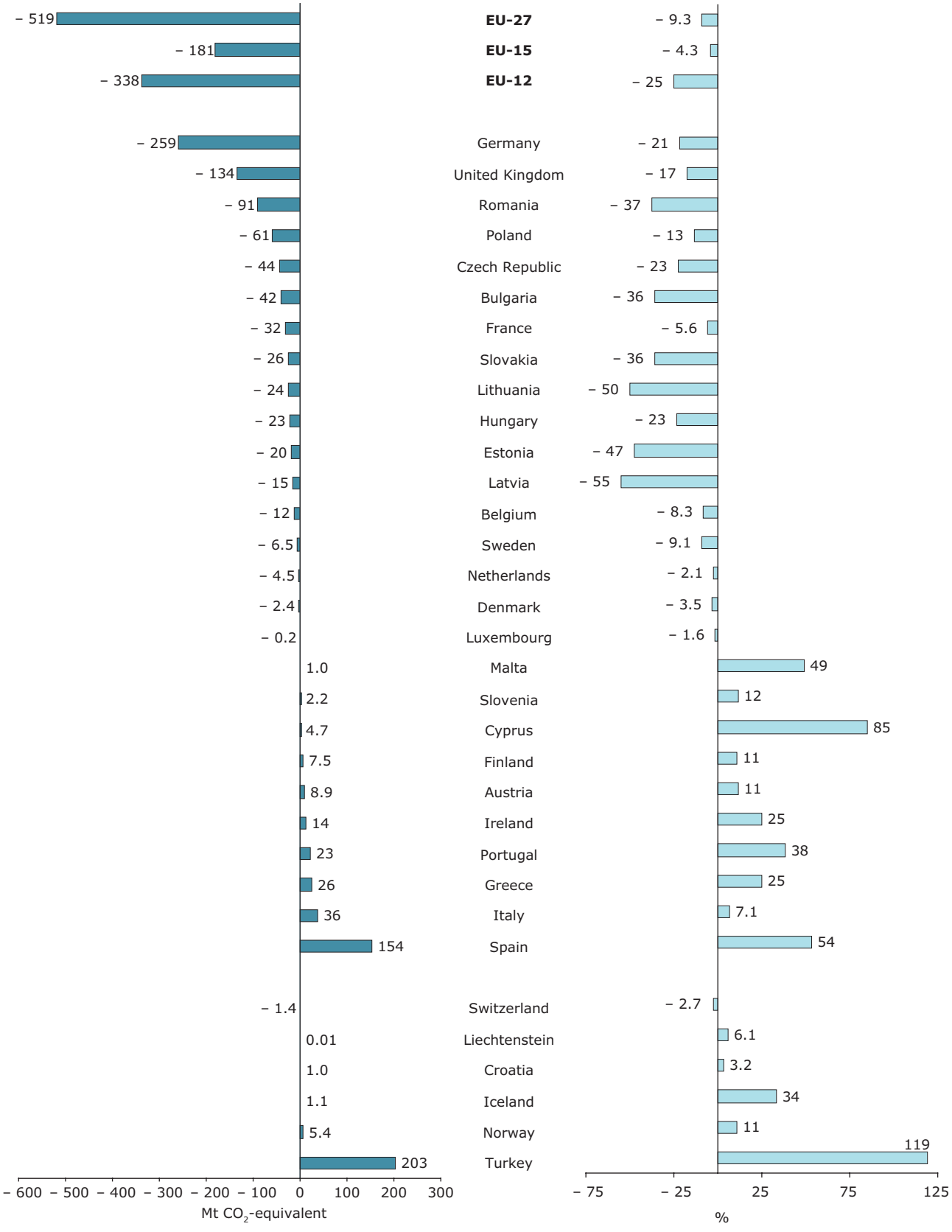
Figure 2.6 Greenhouse gas emission trends in the EU and main emitting Member States, 1990–2007



Note: GHG emissions presented refer to total GHG emissions without LULUCF.

Source: EEA, 2009.

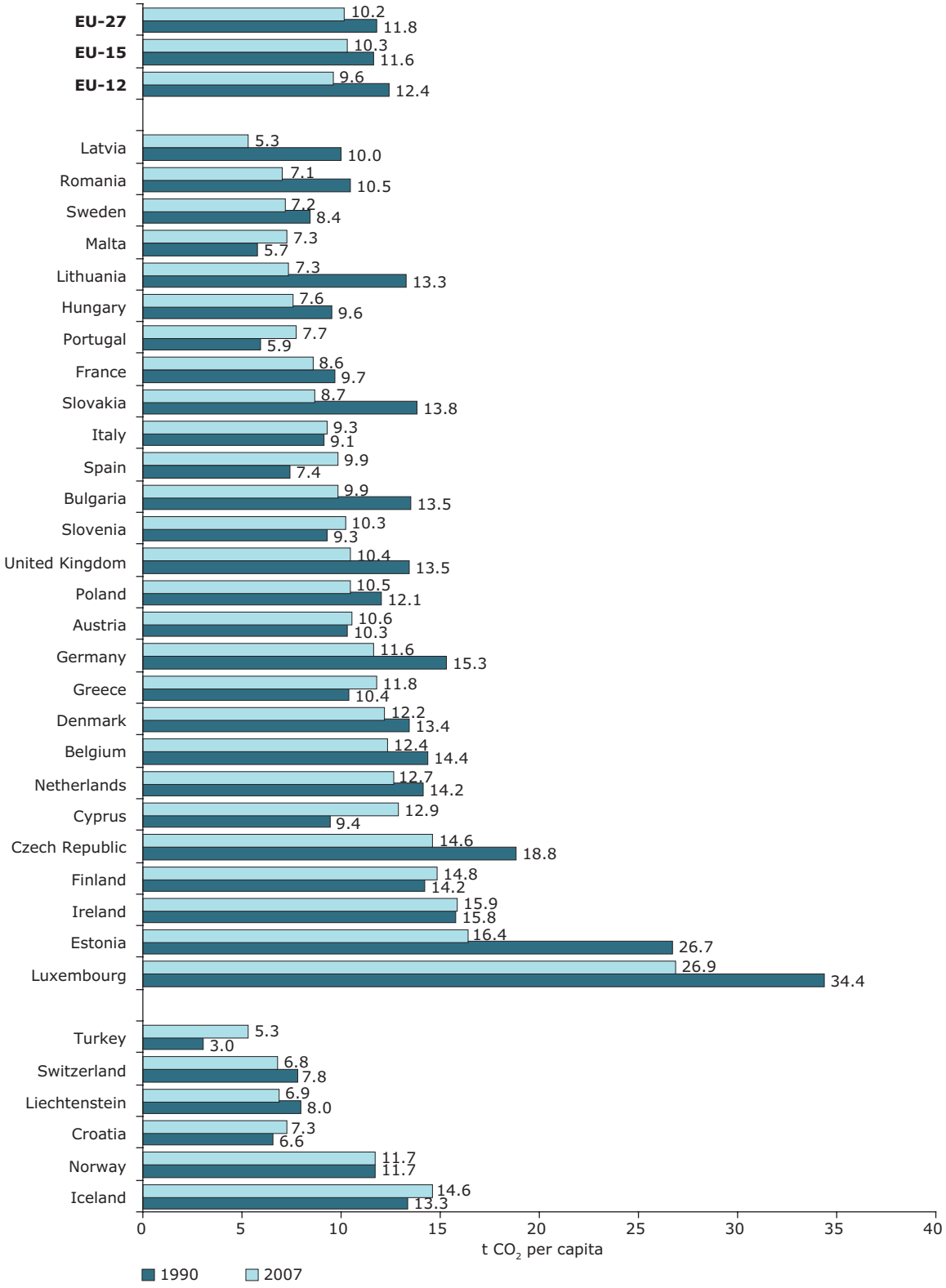
Figure 2.7 Changes in greenhouse gas emissions in Europe, 1990–2007



Note: GHG emissions presented refer to total GHG emissions without LULUCF.

Source: EEA, 2009.

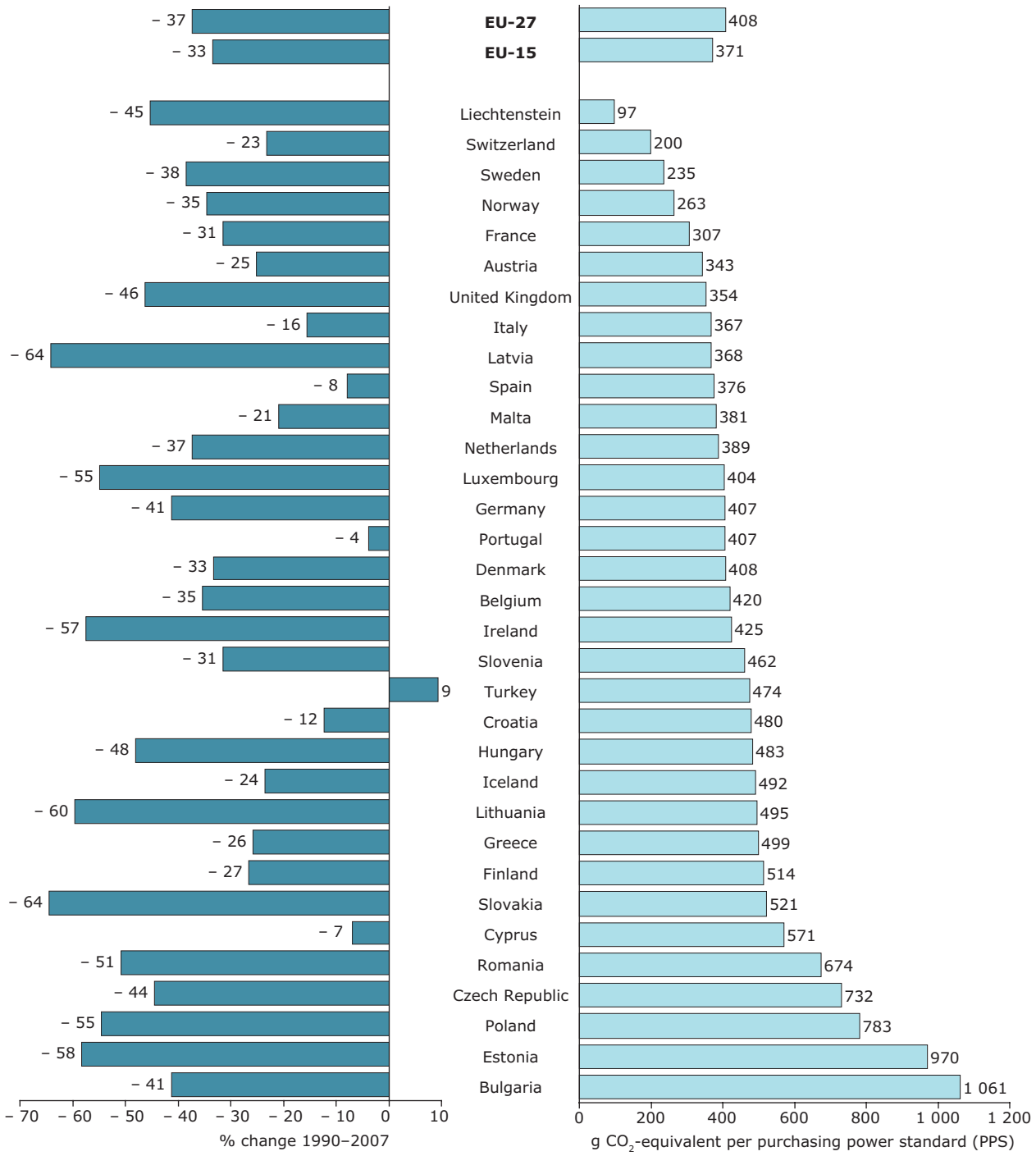
Figure 2.8 Greenhouse gas emissions per capita in Europe in 1990 and 2007



Note: For 1990 population data, the population of the French overseas territories (DOM) provided by the French statistical office was added to the total population of France *métropolitaine* provided by Eurostat. Post-1990 population data from Eurostat covers the whole French territory, including overseas territories.

Source: EEA 2009a; Eurostat.

Figure 2.9 Relative economic intensity of greenhouse gas emissions in Europe in 2007 (index EU-27 = 100) and change in the economic intensity of greenhouse gas emissions in Europe, 1990–2007



Note: The chart on the left shows the greenhouse gas economic intensity (i.e. greenhouse gases divided by GDP) for each country in 2007 relative to the EU-27. GDP here is measured in purchasing power standards (PPS). PPS in Liechtenstein were estimated from the purchasing power of the Swiss franc, using Eurostat national accounts, and estimates of GDP at current prices from the UN millennium indicators.
In the chart on the right, the starting year for the calculation of the change in the economic intensities of greenhouse gas emissions was 1990. Because of lack of GDP data, few exceptions apply: Estonia (1993), Slovak Republic (1992), Malta, Bulgaria and Hungary (1991), Croatia (1995). To be consistent, the reference year for greenhouse gas emissions in these countries is the same as for GDP.

Source: EEA, Eurostat, UN, and European Commission.

were achieved. Romania was responsible for about half of the total EU-27 change between 1990 and 1991. The emission reductions that took place in (former Eastern) Germany in the early 1990s accounted for a significant part of the reductions observed at EU-15 level. Important emission reductions also took place in France and the United Kingdom during that period, in particular in energy industries, manufacturing industries and other energy sectors. In the United Kingdom this reduction in emissions was due to a switch from solid fuels to gaseous fuels.

- In 1996, an emission increase in comparison to the previous year was recorded in most EU Member States. It was due to a particularly severe winter, which led to increased energy consumption from households for heating. In Italy, this emission peak from households was counterbalanced by a strong decrease in emissions from energy industries, which resulted in an overall decrease in total emission in Italy.
- Between 1996 and 1999, emissions in the EU-15 decreased, mainly due to reductions in emissions from chemical industries (adipic acid production) in the United Kingdom, Germany and France, and from production of halocarbons in the Netherlands and the United Kingdom. Emissions in Italy increased during this period, due to considerable increased emissions from the energy sector. Between 1997 and 1998, emission reductions in Poland were responsible for most of total EU-27 emission reductions. Emissions peaked in France in 1998, as all emissions from fuel combustion in the energy sector increased despite reduced emissions from chemical industries.
- Between 1999 and 2004, emission trends in the EU-15 and EU-12 were comparable (Figure 2.4). The overall increase in emissions was mainly driven by increasing energy consumption from final users. The hot summer in 2003 was responsible for high emissions because it reduced hydropower availability, which led to an increased output from thermal power production.
- Since 2004, final energy demand in the household sector and the tertiary sector in the EU-15 has been decreasing, which has resulted in decreasing total emissions. Germany, France, Belgium, Italy and the Netherlands made significant contributions to this overall EU-15 trend. On the other hand, emissions have been increasing since 2004 in the EU-12. This was mostly due to transport and industrial processes. These countries seem to be repeating the experience of countries like Ireland, Portugal and Spain, which, starting from a relatively low transport level, experienced high economic growth accompanied by strong growth in transport and related greenhouse gas emissions.

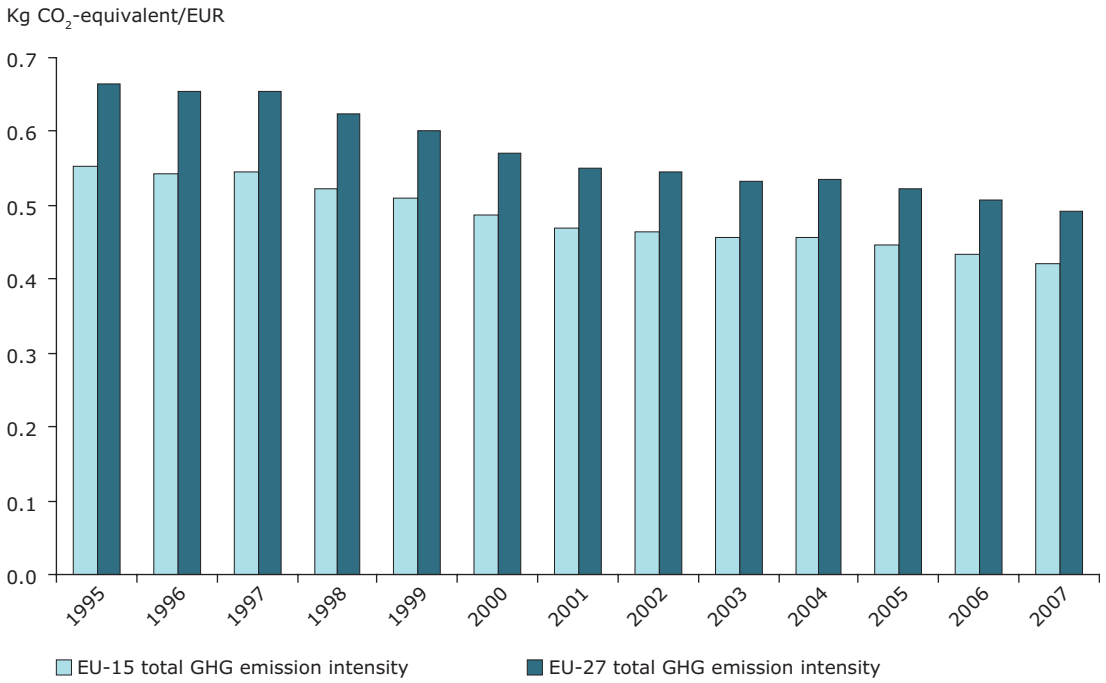
All the other EEA member countries except Switzerland have experienced an increase in their total GHG emissions between 1990 and 2007 (Figure 2.7), including a doubling of total emissions in Turkey during the period. This last increase is mainly attributed to the country's important demographic growth (+ 25 % over the period) and economic development. However, emissions per capita of 5.3 t CO_2-equivalent are still relatively low compared to other European countries. After a sharp decrease observed between 1990 and 1994, GHG emissions in Croatia have been increasing and in 2007 reached their highest level, 3 % above 1990 levels.

2.3 Trends by greenhouse gas

CO_2 represents more than 80 % of all greenhouse gas emission in the EU in 2007. Consequently, small relative trends result in significant changes in emissions, compared with other greenhouse gases. The decrease in total GHG emission observed between 2006 and 2007 in the EU-27 and in the EU-15 was almost exclusively due to a decrease in CO_2 emission (Figure 2.11). This decrease was mostly observed in the fossil fuel combustion for direct energy use by households and industry. CO_2 is the only greenhouse gas for which diverging trends were observed between EU-12 and EU-15 countries between 1990 and 2007 (Figure 2.12). During that period, the relative change in CO_2 emissions was smaller than for any other gas in the EU-27 and in the EU-15. However, CO_2 was still responsible for the largest decrease in absolute terms in the EU-27; this decrease mainly resulted from the economic downturn affecting EU-12 economies in the 1990s. This trend opposed the overall increase in CO_2 emissions that resulted from a period of strong economic development for some EU-15 economies, in particular Spain and Italy.

Fluorinated gases used in industrial processes represent only 1.5 % of EU total emissions in CO_2 equivalent. Nevertheless, in the short term (2006−2007) and the long term (1990−2007) they account for the largest relative variations in the EU. These trends are similar in the EU-15 and EU-27. While emissions of PFCs have decreased continuously, emissions of HFCs keep increasing. HFCs represent the only gases for which net

Figure 2.10 Change in greenhouse gas emissions intensities in the EU, 1995–2007



Note: GDP in constant (chain-linked volumes, reference year 2000 (at 2000 exchange rates). Values start only in 1995 because of missing data for 13 Member States (Belgium, Bulgaria, Cyprus, Czech Republic, Greece, Hungary, Ireland, Lithuania, Luxembourg, Malta, Poland, Portugal and Romania).

Source: Eurostat (http://epp.eurostat.ec.europa.eu/portal/page/portal/national_accounts/data/database#); EEA.

emission increases have been observed since 1990 in the EU-27 (up by more than 125 % in the 17-year period). This increase is due to the phase-out of ozone-depleting substances such as chlorofluorocarbons (CFCs) under the Montreal Protocol and the replacement of these substances with HFCs in the production of cooling devices such as air conditioning and refrigeration. The increase is also consistent with both warmer climatic conditions in Europe and higher comfort standards.

CH_4 emissions have been continuously declining in the whole EU since 1990, as a consequence of a decrease of coal mining and post-mining activities, as well as improved management of solid waste and waste landfills. CH_4 was actually responsible for the largest decrease in total GHG emissions in the EU-15 between 1990 and 2007.

N_2O emission reductions were relatively limited between 2006 and 2007 compared with other gases. Between 1990 and 2007, decreasing trends were observed, mainly due to the reduction in fertiliser use on agricultural soils and the decrease of emissions from nitric acid production. These decreases were partly offset by the introduction of catalytic converters for road transport.

2.4 Sectoral trends

2.4.1 2006–2007 trends

The main reductions of EU-27 emissions occurred in the residential/household and services sectors (included in the category 'Energy use (households and services)' in Figure 2.13). The residential sector represents one of the largest sources of greenhouse gas emissions in the EU.

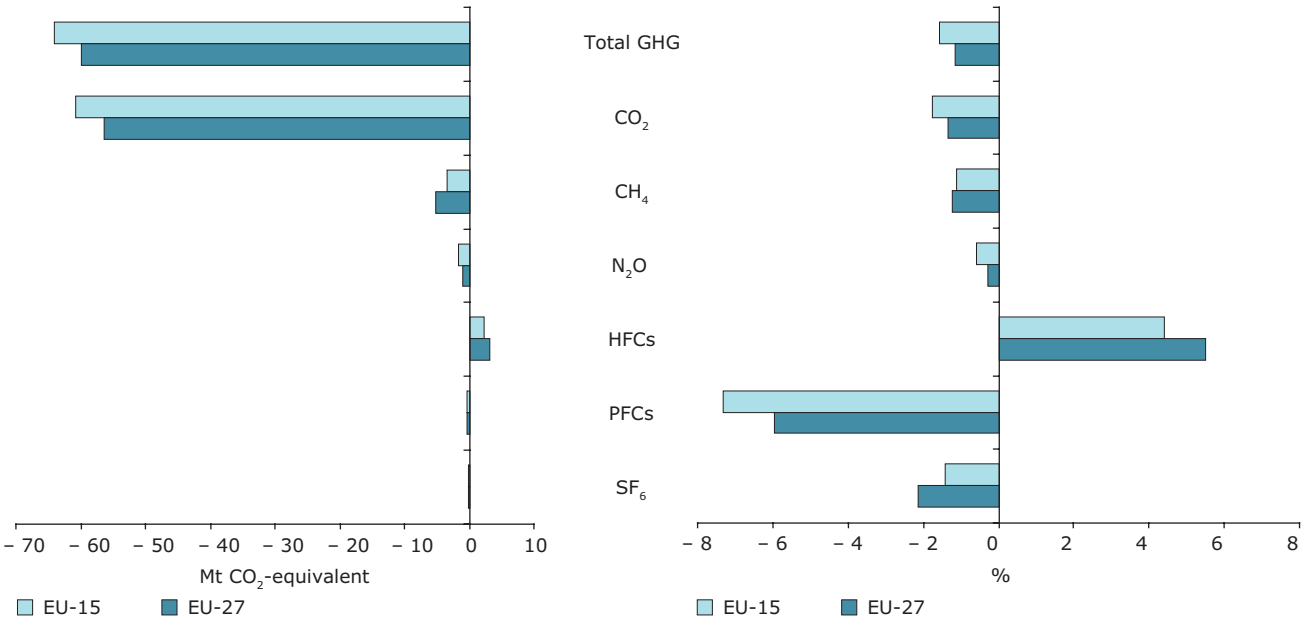
Lower CO_2 emission from households (– 55 Mt CO_2-equivalent) was the main cause of the decrease in total EU-27 GHG emissions in 2007 compared to 2006. This was the result of a combination of two factors:

- a change in fuel mix (higher share in biomass use compared to other energy sources), following a trend that has now been observed for several years;

- particular climatic and economic conditions in 2007 compared to 2006, which resulted in lower fuel sales and energy use for heating.

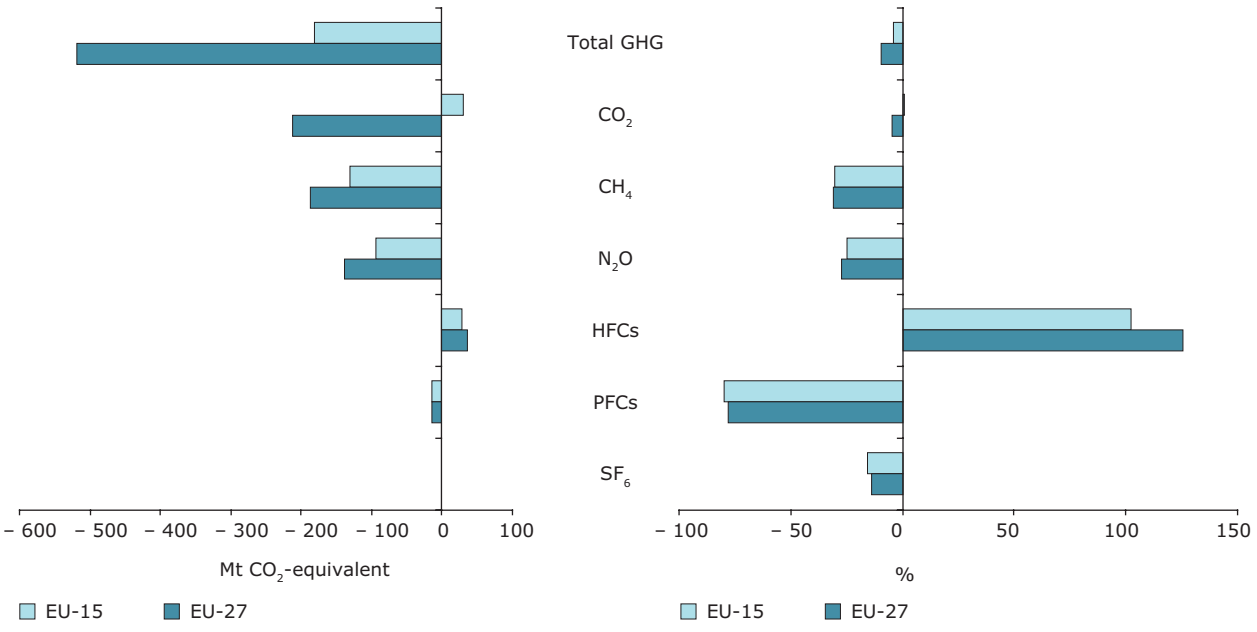
Germany seems to be the main contributor to the EU reduction in greenhouse gas emissions in 2007. This is largely due to a big decline in fuel use, mainly oil, and related CO_2 emissions from households; a sharp reduction in heating needs because of a warmer year; and the influence of price developments, including the decision to increase VAT. Similar developments, i.e. decreased heating needs because of a warmer

Figure 2.11 Changes in EU greenhouse gas emissions by gas, 2006–2007



Source: EEA, 2009.

Figure 2.12 Changes in EU greenhouse gas emissions by gas, 1990–2007



Source: EEA, 2009.

winter and fast price increases, were largely shared by all EU Member States (cf. Section 3.3.2).

Emissions from energy use in manufacturing industries also decreased in the EU-27, the decreasing trend of the EU-15 Member States offsetting the increasing trend of the EU-12 Member States.

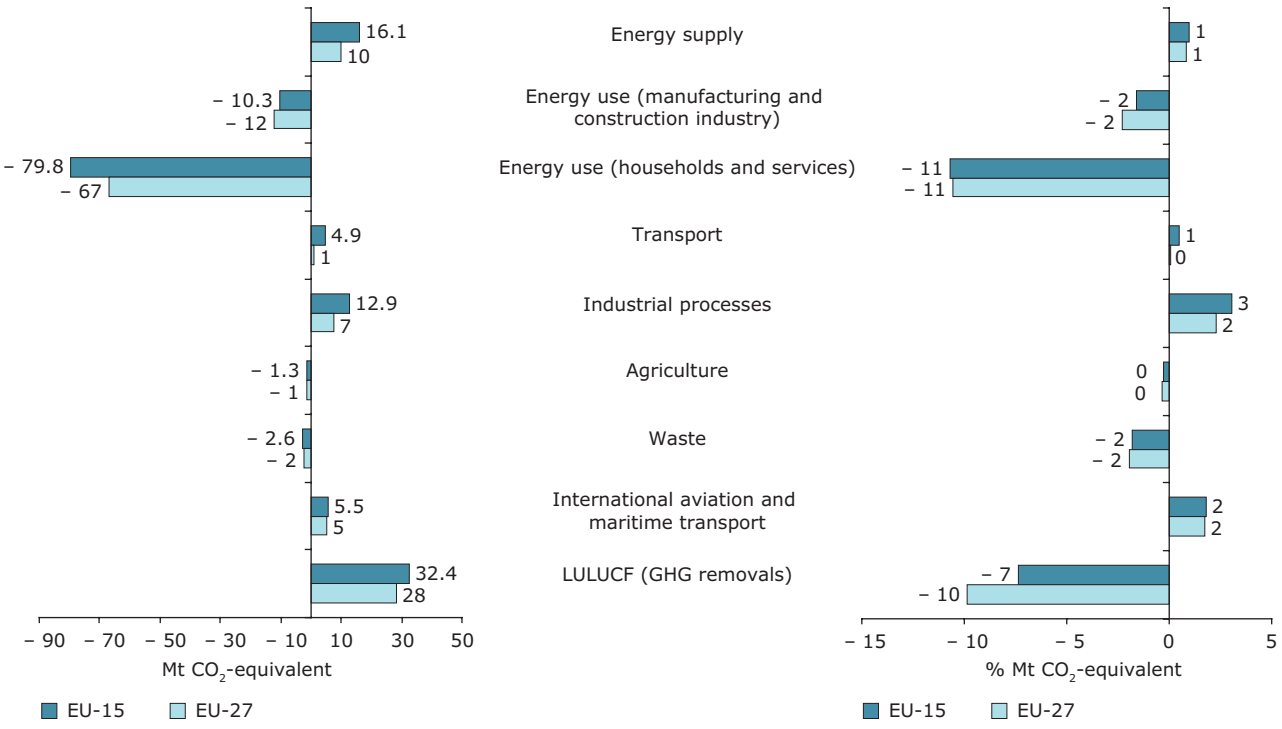
On the negative side, HFC emissions from refrigeration and air conditioning continued to increase (cf. Section 2.3). Similarly, road transport emissions increased again in 2007. Emissions from international aviation and maritime transport, currently not included in the national greenhouse gas totals under the UNFCCC and Kyoto Protocol, also continued to rise, increasing by 1.8 % in the EU-27. Emissions from international aviation (including intra-EU flights) rose by 3.7 Mt CO_2-equivalent and those from international shipping by 1.8 Mt CO_2-equivalent. EU greenhouse gas emissions from international aviation are lower than for international maritime transport but are growing significantly more rapidly. The average annual EU-27 growth rates since 1990 were 4.5 % and 2.9 %, respectively. Together, the two sectors currently account for about 6 % of total greenhouse gas emissions.

Carbon sinks removed also less CO_2 in 2007 than in 2006.

2.4.2 1990–2007 trends

Socio-economic changes and selective measures taken to reduce GHG emissions can influence the contribution of a specific sector to total GHG emissions. However, between 1990 and 2007, the ranking of the main sectors has not changed and the percentage contribution to total GHG emissions (including international bunkers and excluding LULUCF) has only changed moderately in the EU-27. Transport is still by far the sector with the largest increase in GHG emissions, both in absolute and relative terms, both including and excluding the fast-rising emissions from international bunkers (Figure 2.14). There was no other sector in which an emission increase could be observed during the period in the EU-27. However in the EU-15, emissions from energy industries increased by 1 %. This picture at a much-aggregated level hides some important differences within one main sector. The apparent decreasing trend in emissions from industrial processes is in fact the result of a very large increase in HFC emissions from refrigeration and air conditioning equipment and decreases in other GHG

Figure 2.13 Changes in EU-15 and EU-27 emissions and removals by sector, 2006–2007



Source: EEA, 2009.

Table 2.1 Sources responsible for the largest changes in GHG emissions in the EU, 2006–2007

Source category	EU-27	EU-15
	Mt CO_2–equivalent	
Public electricity and heat production (CO_2 from 1A1a)	+ 15.0	+ 10.7
Road transport (CO_2 from 1A3b)	+ 5.3	+ 1.7
Cement production (CO_2 from 2A1)	+ 4.5	+ 2.0
Consumption of halocarbons (HFC from 2F)	+ 4.0	+ 3.1
Manufacture of solid fuels (CO_2 from 1A1c)	+ 3.6	+ 1.0
Fugitive emissions (CH_4 from 1B)	– 3.1	– 2.2
Iron and steel production (CO_2 from 1A2a + 2C1)	– 3.8	– 2.2
Manufacturing industries (excl. iron and steel) (energy-related CO_2 from 1A2 excl. 1A2a)	– 4.7	– 8.2
Households and services (CO_2 from 1A4)	– 79.1	– 66.8
Total change 2006–2007	**– 59.8**	**– 64.0**

Note: The source categories correspond to the nomenclature defined by the IPCC in its guidelines for estimating and reporting greenhouse gas emissions under the UNFCCC.

Source: EEA, 2009.

Table 2.2 Sources responsible for the largest changes in GHG emissions in the EU, 1990–2007

Source category	EU-27	EU-15
	Mt CO_2-equivalent	
Road transport (CO_2 from 1A3b)	+ 200.7	+ 156.9
Consumption of halocarbons (HFC from 2F)	+ 60.7	+ 54.2
Production of halocarbons HFC from 2E)	– 25.6	– 25.6
Manufacture of solid fuels (CO_2 from 1A1c)	– 34.9	– 38.5
Enteric fermentation (CH_4 from 4A)	– 35.6	– 13.3
Iron and steel production (CO_2 from 1A2a+2C1)	– 47.7	– 32.1
Adipic acid production (N_2O from 2B3)	– 50.9	– 50.0
Public electricity and heat production (CO_2 from 1A1a)	– 58.8	+ 79.4
Fugitive emissions (CH_4 from 1B)	– 66.8	– 45.8
Agricultural soils (N_2O from 4D)	– 67.0	– 32.8
Solid waste disposal (CH_4 from 6A)	– 68.2	– 64.4
Manufacturing industries (excl. iron and steel) (energy-related CO_2 from 1A2 excl. 1A2a)	– 137.5	– 66.7
Households and services (CO_2 from 1A4)	– 141.1	– 84.2
Total change 1990–2007	**– 518.7**	**– 180.9**

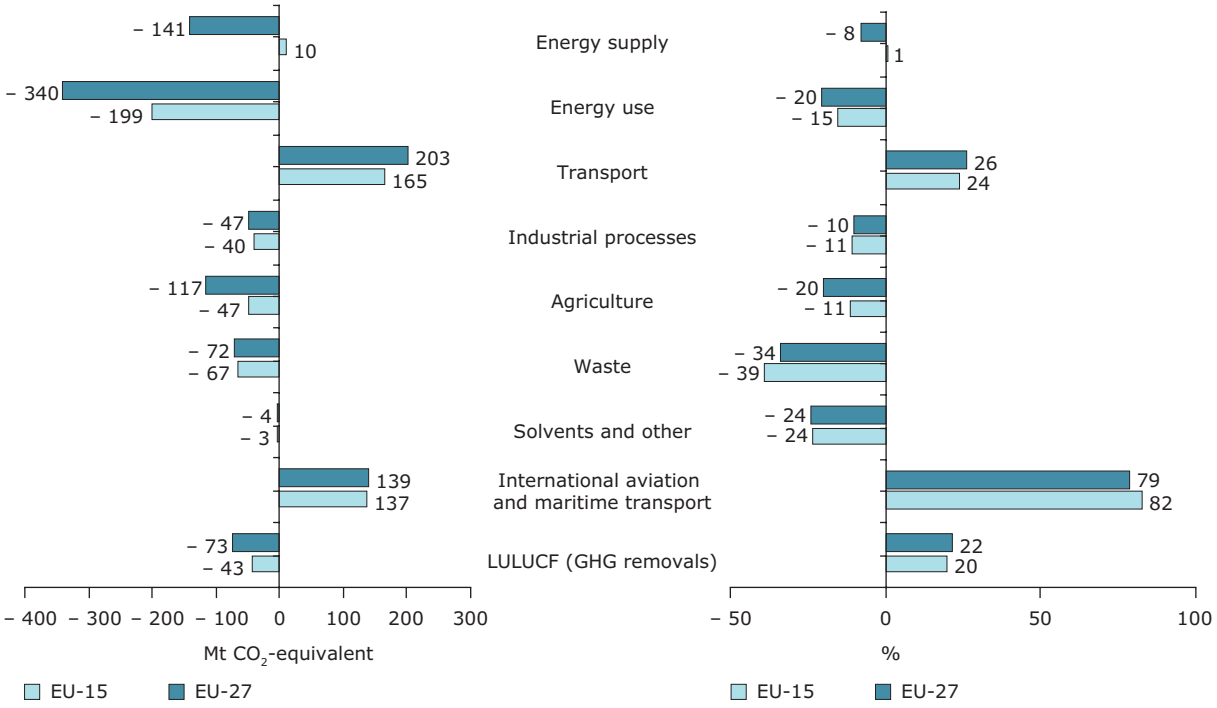
Note: As the table only presents the emission sources that have increased/decreased by more than 20 Mt CO_2-equivalent, the sum for each country grouping EU-27/EU-15 does not necessarily match the total change listed at the bottom of the table.

Source: EEA, 2009.

emissions from industrial sectors such as the chemical industry and the metal production industry (Table 2.2). The largest relative reduction in GHG emissions was achieved in the waste sector, with a relative reduction of 34 % (Figure 2.14). This reduction was mainly a result of decreased organic carbon content in the landfill waste, decreased amount of waste disposal on land and the installation of landfill gas recovery on all new sites as required by the EU Landfill Directive (Directive 1999/31/EC).

Emission removals from land use, land-use change and forestry (LULUCF) have increased in the EU-15 and the EU-27. This means that carbon sink activities removed more GHG emissions from the atmosphere in 2007 than they did in 1990.

Figure 2.14 Changes in EU-15 and EU-27 emissions and removals by sector, 1990–2007



Source: EEA, 2009.

3 Main drivers of GHG emission trends

- Between 1990 and 2007, greenhouse gas emissions in Europe have been driven upward by many factors, including increasing production of public electricity and heat by thermal plants, both in absolute terms and in comparison with other sources; economic growth in manufacturing industries; increasing transport demand for passengers and freight; increasing share of road transport compared to other transport modes; increasing household size; and demographic growth.
- During the same period, significant emission reductions have been achieved, driven by, for example, the economic downturn affecting eastern Member States in the 1990s; energy efficiency improvements (in particular by industrial end users and energy industries); fuel efficiency improvements in vehicles; a shift from coal to less polluting fuels (in particular gas and biomass) for the production of electricity and heat; higher fuel prices; a shift from petrol to diesel road vehicles; and increasing average temperatures in Europe.

3.1 Overview for the energy and transport sectors

GHG emissions related to the combustion of fossil fuels for energy use (energy and transport sectors) represent more than 80 % of the total greenhouse gas emissions in Europe. This chapter focuses on the factors affecting these emission trends. It does not explore in detail the links between these drivers and the effects of the policies and measures implemented in the EU to reduce GHG emissions (cf. Chapter 6).

Sectoral emission trends can be analysed by decomposition, which identifies the contribution of the main drivers to the overall trends. Based on the decomposition analyses carried out by the EEA on several sub-sectors of the energy sector (public electricity and heat production, energy use from manufacturing industries, energy use from households and energy use for transport), the main drivers of CO_2 emission trends between 1990 and 2007 in Europe can be identified (Table 3.1):

- emissions are driven upward mainly due to increasing demand for electricity and heat, economic growth in manufacturing industries and increasing transport demand;
- emission reductions have been achieved by important energy efficiency improvements, the fuel shift from coal or oil to gas and fuel efficiency improvements in vehicles.

Some of the drivers presented in Table 3.1 are detailed into the following categories:

- 'public electricity and heat production' corresponds to the combustion of fossil fuels by energy industries to produce electricity or heat, that will later be consumed by end users (other industries, households, services, etc.);
- 'manufacturing and construction industries' and 'households (residential sector)' correspond to the combustion of fossil fuels directly by end users to generate electricity or heat.

3.2 Energy supply (public electricity and heat, oil refining)

EU-27 greenhouse gas emissions from energy industries decreased by 8 % between 1990 and 2007. However, despite efficiency improvements in the sector, emissions have increased by 1 % in the EU-15 between 1990 and 2007, driven by increasing demand for electricity. Energy-related GHG emissions have been targeted by a number of EU policies addressing the promotion of cogeneration (Directive 2004/8/EC), the promotion of renewable energy sources for electricity production (Directive

Table 3.1 Main drivers of CO_2 emission trends in the energy sector (including transport)

Driving forces		Emission change, 1990–2007 (Mt CO_2-equivalent)	
		EU-27	EU-15
Negative drivers (increase in GHG emissions)	Increasing demand for electricity and heat	354	336
	Economic growth in manufacturing industry	258	183
	Increasing transport demand	240	230
	Freight	91	91
	Passengers	148	139
	Increasing share of road transport (compared to other modes)	111	51
	Freight	85	44
	Passengers	27	7
	Increasing size of households	72	55
	Demographic growth	22	27
Positive drivers (decrease in GHG emissions)	Energy efficiency improvements	– 623	– 352
	Manufacturing industry	– 342	– 161
	Public electricity and heat production (energy industry)	– 243	– 163
	Households	– 39	– 28
	Shift from coal/oil to gas for electricity and heat production	– 214	– 214
	Public electricity and heat production	– 109	– 128
	Manufacturing industry	– 58	– 50
	Households	– 48	– 34
	Improved fuel efficiency of vehicles	– 139	– 117
	Passenger cars	– 90	– 89
	Freight	– 49	– 29
	Increasing share of biomass	– 112	– 77
	Public electricity and heat production	– 50	– 43
	Manufacturing industry	– 33	– 24
	Households	– 29	– 10
	Increasing share of thermal plants for electricity and heat supply	– 62	– 15
	Households	– 50	– 49
	Public electricity and heat production	– 11	78
	Manufacturing industry	– 1	– 44
	Shift to diesel vehicles	– 19	– 17
	Passengers	– 11	– 10
	Freight	– 8	– 7
	Warmer average temperatures	– 15	– 15

Source: EEA, 2009 (cf. Sections 3.2, 3.3 and 3.4).

2001/77/EC) and the taxation of energy products (Directive 2003/96/EC).

Public electricity and heat production was the single greatest source of CO_2 emissions in 2007, contributing 28 % to total GHG emissions in the EU-27 (25 % in the EU-15). The decomposition analysis (Figure 3.1) shows that for the EU-15, during the period 1990–2007, the increasing output from plants to produce public electricity and heat and — to a lesser extent — the shift towards thermal power production was partly offset by fuel efficiency gains and a shift from coal to gas. The shift towards biomass had a smaller, but still positive effect. A large part of the efficiency gains and the fuel shift occurred in the 1990s. Since 2000, a marked shift towards thermal power and heat production can be observed, which means that thermal power plants mostly cover increased energy demand.

A notable difference between the EU-15 and EU-27 is that in the EU-27 the share of thermal power and heat production did not increase from 1990 to 2007. This is mainly due to a strong decline in district

heat production and a shift towards nuclear power production in the new Member States. In addition, efficiency improvements in the EU-27 before 2000 gave more results in the EU-12, due to the economic restructuring.

Sharp changes in annual emissions can also be caused by fluctuations in the energy system due to climatic variations (in particular in Mediterranean and Nordic countries).

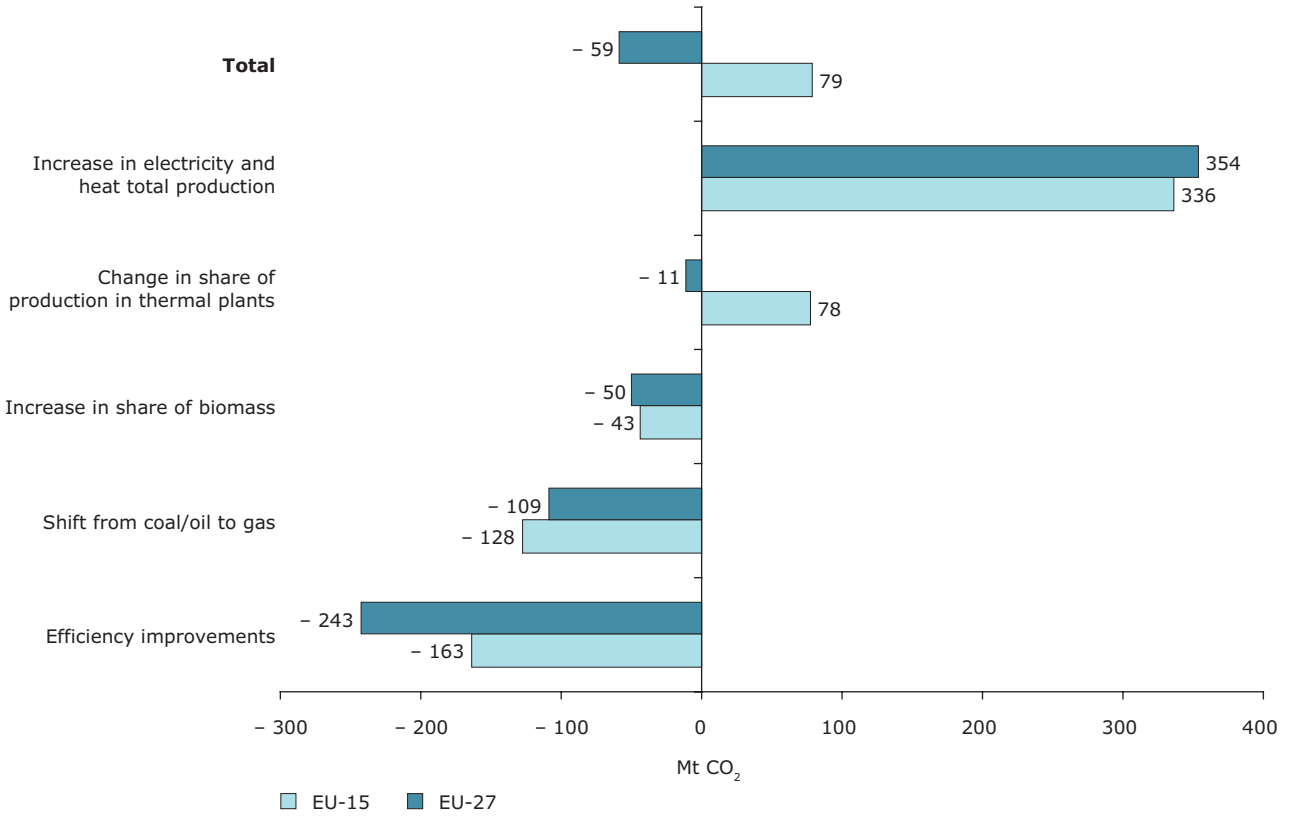
3.3 Energy use (direct fuel combustion), excluding the transport sector

EU-27 greenhouse gas emissions from energy use have fallen by 20 % since 1990. Energy users can be split into two main categories: industrial users (in particular manufacturing and construction industry) and households.

3.3.1 Manufacturing and construction industries

CO_2 emissions resulting from fuel combustion in manufacturing industries amount to 13 % of total GHG emissions, but have decreased by 22 % since 1990. The main reasons for the decrease are improvements in final energy efficiency and — to a much lesser extent — the fuel shift from coal to gas (Figure 3.2). Final energy efficiency has been constantly improving since 1990, whereas most of the shift from coal to gas was achieved before 2000. The main differences between the EU-15 and EU-27 analyses are:

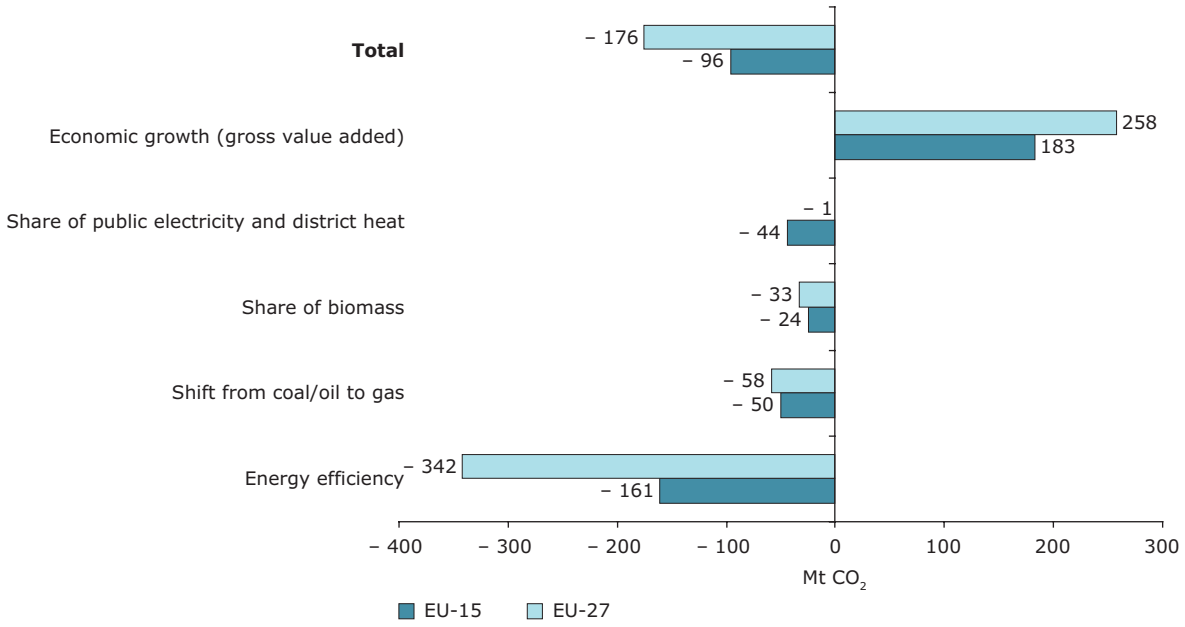
Figure 3.1 Main drivers of CO_2 emission trends from public electricity and heat production in the EU-27 and EU-15, 1990–2007



Note: The bars with positive values indicate factors that cause an increase in emissions; the bars with negative values indicate factors that have a reducing effect.
Aggregating all five effects provides the actual emission changes.
'Change in share of production in thermal plants' describes the effect resulting from changes in the share of thermal plants in the total production of electricity and heat (including production by end users such as industries and households).
'Efficiency improvements' describes the effect resulting from changes in the amount of fuel used in public power and heat plants per unit of electricity and heat produced.
'Increase in share of biomass' describes the effect resulting from increases in the share of biomass in total fuel used in public power and heat plants.
'Shift from coal/oil to gas' describes the effect resulting from the shift to less-carbon-intensive fossil fuels in public power plants.

Source: EEA 2009a, Eurostat.

Figure 3.2 Main drivers of CO_2 emission trends from manufacturing and construction industries in the EU-27 and EU-15, 1990–2007



Note: The bars with positive values indicate factors that cause an increase in emissions; the bars with negative values indicate factors that have a reducing effect.
Aggregating all five effects provides the actual emission changes.
'Economic growth' relates to the growth in manufacturing industry, measured in change of gross value added.
'Share of public electricity and district heat' describes the effect resulting from changes in the share of public electricity and district heat in total final energy consumption. Consumption of public electricity and consumption of heat by industry or households cause emissions that are accounted for by the sector public electricity and heat production.
'Share of biomass' describes the effect resulting from changes in the share of biomass used in total fuel use.
'Shift from coal/oil to gas' describes the effect resulting from the shift to less-carbon-intensive fossil fuels in public power plants.
'Energy efficiency' describes the effect resulting from changes in final energy consumption (including electricity and district heating) per unit of gross value added (EUR million).

Source: EEA, 2009a; Eurostat.

- the efficiency improved much more in the new Member States due to the economic restructuring;
- the share of public electricity and heat consumption in industry decreased in the 1990s in the EU-12 (as opposed to the EU-15), which contributed to increasing emissions in the industry sector.

3.3.2 Households (residential sector)

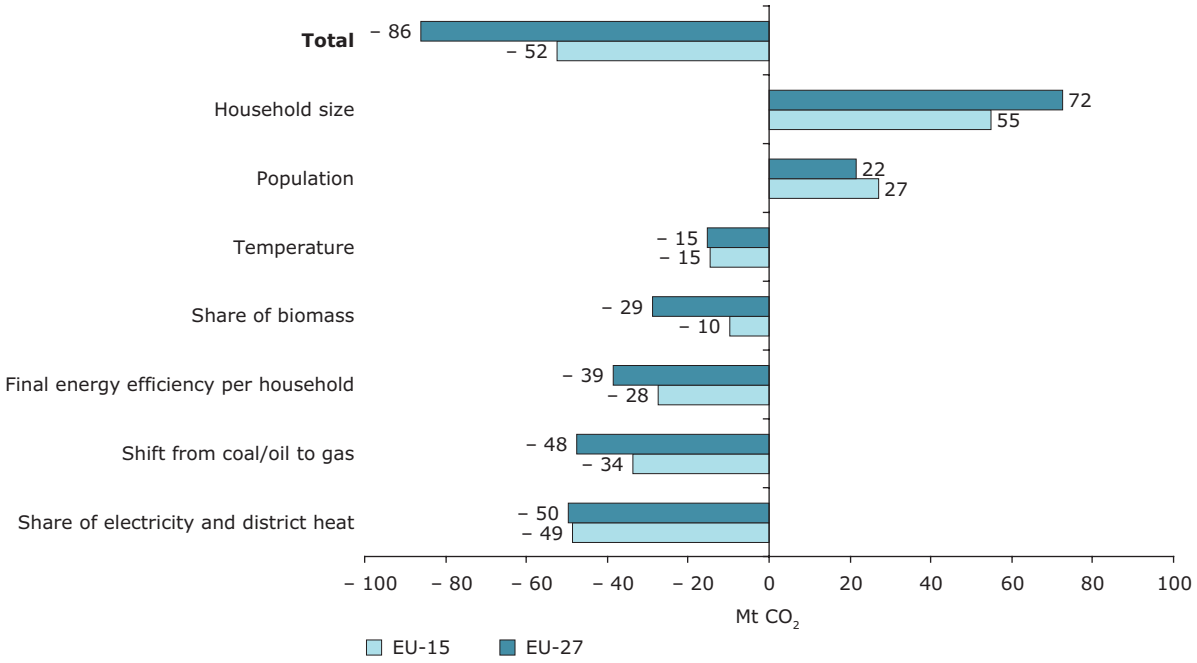
CO_2 emissions from fuel combustion in households (mainly for heating purposes) accounted for 8 % of total GHG emissions in 2007 in the EU-27. These emissions have been decreasing since 1990 in both the EU-27 and the EU-15. Households and services actually constituted the largest source of CO_2 emission reductions in the EU-27 between 1990 and 2007 (Table 2.1).

During the period 1990–2007, the increasing share of electricity and district heating in final energy consumption, the shift from coal to oil or gas and the final energy efficiency per household resulted in significant lowering of emissions (Figure 3.2). Smaller improvements resulted from increased use of biomass (wood for heating). Fuel prices can also have an influence on annual variations in these emissions.

Share of public electricity and district heating
The main factor responsible for the decrease in emissions from households (increasing share of electricity and district heating) is in fact purely methodological and does not necessarily imply an overall reduction in total GHG emissions from the total use of energy by households and services: greenhouse gases stemming from households only include emissions resulting from direct

fuel combustion. They do not include indirect emissions from electricity production and district heating (accounted for in the category 'public electricity and heat production'). GHG emissions related to the production of electricity and district heating finally used by households and services

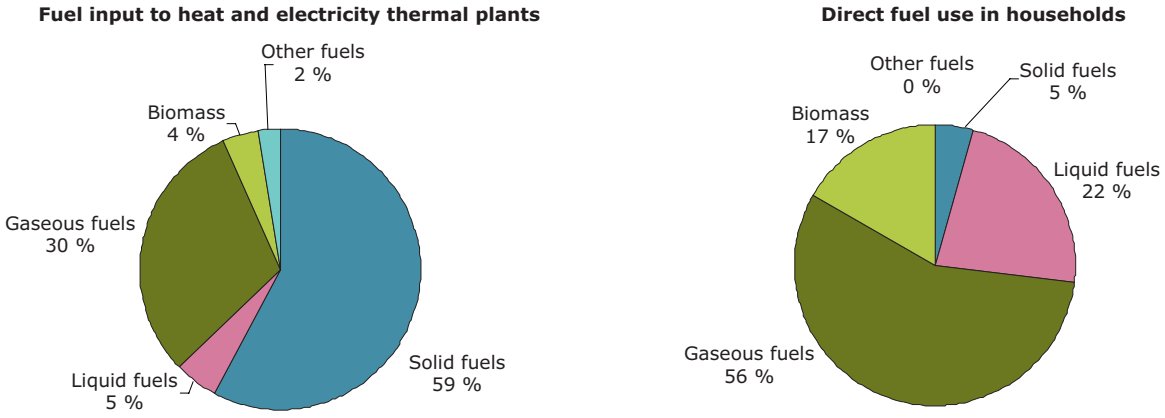
Figure 3.3 Main drivers of CO_2 emission trends from households in the EU-27 and EU-15, 1990–2007



Note: The bars with positive values indicate factors that cause an increase in emissions; the bars with negative values indicate factors that have a reducing effect. Aggregating both effects provides the actual emission changes. Final energy efficiency describes the effect resulting from changes in final energy consumption (including electricity and district heating) per household.
Share of electricity and district heat describes the effect resulting from changes in the share of electricity and district heat in total final energy consumption. Note that, depending on the energy mix, electricity and heat consumption in industry/households cause emissions in the public electricity and heat production sector.
Share of biomass describes the effect resulting from changes in the share of biomass used in total fuel use.
Shift from coal/oil to gas describes the effect resulting from the shift to less-carbon-intensive fossil fuels in households.

Source: EEA, 2009a; Eurostat.

Figure 3.4 Fuel mix in thermal power stations and for direct use in households in the EU-27, in 2007



Source: EEA, 2009a.

are attributed to the energy industry sector, not to households. As an example, the good performance of the Nordic countries and Austria can be partly explained by increased use of district heating. As (centralised) district heating replaces heating boilers in households, an increase in the share of district heating reduces direct CO_2 emissions from households but increases emissions reported under the sector 'public electricity and heat production'. Despite compensating factors such as the high efficiency of district heating plants, and combined heat and power (CHP) plants, the overall effect on GHG emissions is not necessarily positive, since coal represents almost 60 % of the average fuel input to thermal power stations in Europe, the share of biomass being much lower (Figure 3.4) while coal represents less than 5 % of the average fuel input for direct heating in households.

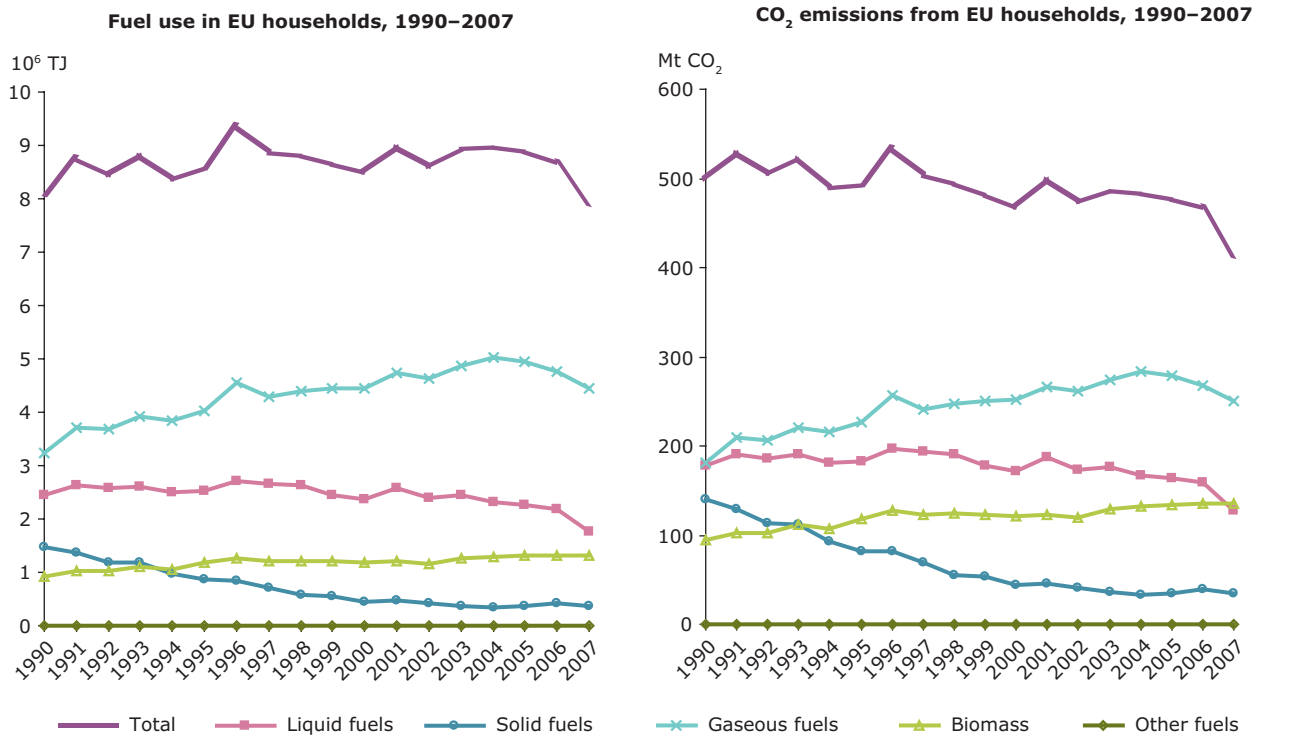
Fuel mix for direct fuel use

Gas is the most widely used fuel in European households, representing more than half of all the fuel input in 2007, followed by oil and biomass. However, the use of both gas and oil has been strongly declining in the past years, particularly in 2007, while the use of biomass has been slightly but steadily increasing (Figure 3.5).

Gas emits less CO_2 than coal and liquid fuels for the same unit of energy produced ([17]). CO_2 emissions from the burning of biomass with energy recovery (e.g. for heat) are considered carbon neutral in the reporting under the IPCC/UNFCCC ([18]) and therefore are not included in national greenhouse gas emission totals.

In 2007, consumption of liquid fuels and coal together decreased more than consumption of gas. In parallel, the use of biomass has remained constant. The share of fuels emitting more CO_2 was therefore reduced in the total energy use by households, which led to reduced CO_2 emissions

Figure 3.5 Energy use, by fuel, for direct heating and related CO_2 emissions in households



Source: EEA, 2009.

([17]) In 2007, average implied emission factors for coal, liquid fuels and gas were, respectively: 96 t CO_2/TJ, 72 t CO_2/TJ and 56 t CO_2/TJ.

([18]) An unsustainable use of biomass — i.e. harvesting outpacing annual re-growth — would be reflected in the LULUCF sector as a loss of biomass stock.

from that source. The steady increase in biomass for heating in European households has *de-facto* reduced CO_2 emissions by an amount proportional to the fossil fuel input substituted.

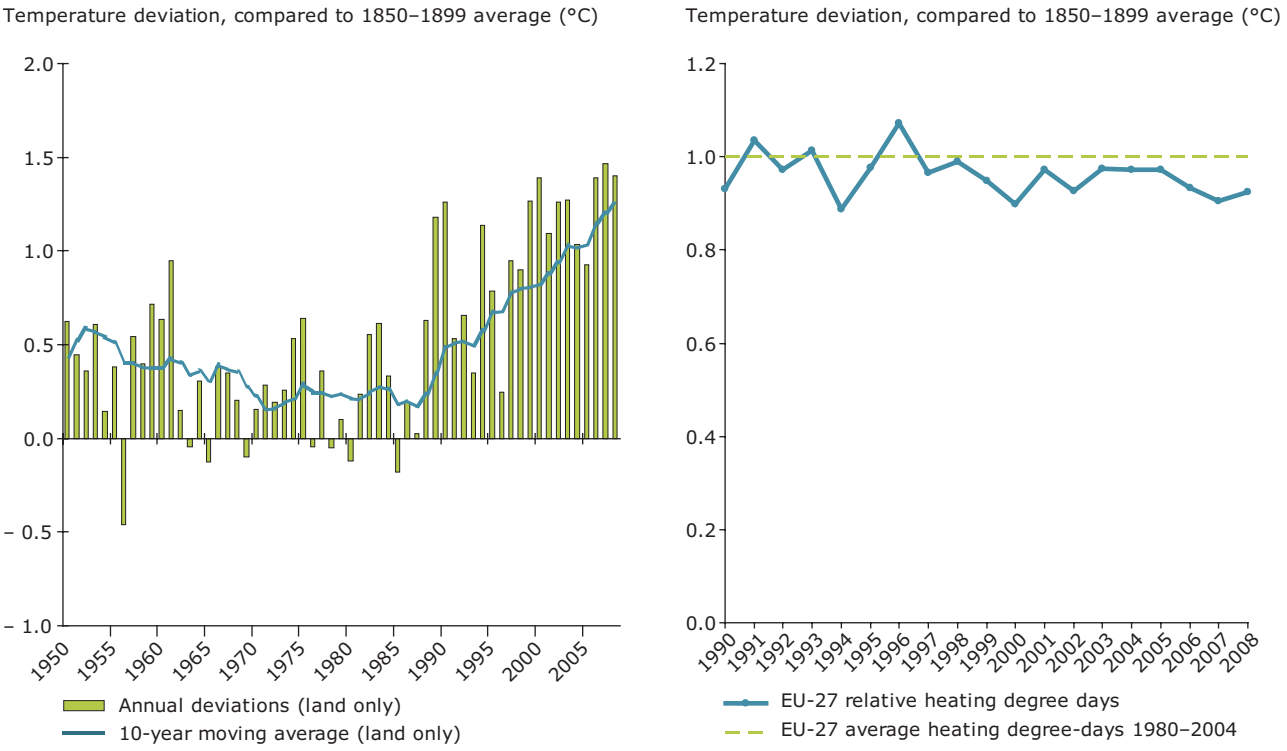
This change in the fuel mix, pooled with an overall decrease in energy use by households, has resulted in an even larger decrease in CO_2 emissions from households.

Climatic conditions

In general, CO_2 emission from households shows considerable annual fluctuations, due to the variations in climatic conditions, in particular annual temperature fluctuations. For example, 2007 was a warmer year in Europe than 2006, which was already between 1 and 1.5 degrees warmer than pre-industrial mean temperatures (Figure 3.6). Mean land surface temperature is increasing globally, including in Europe, and has done so particularly in the last 30–40 years. In addition to this phenomenon, winter temperatures in Europe have been increasing at a faster pace than summer temperatures. Current heat demand in Europe is below the long-term average heat demand (Figure 3.6). The number of heating degree days, an indication of heat demand based on outdoor temperatures, has been decreasing since 2004 in all EU Member States.

Between 2006 and 2007, the reduction in heating demand in Germany was one of the largest in the EU: this had a substantial impact on total heat demand in Europe. This heating demand reduction could be explained by high energy prices (affected by an increase in value added tax) and energy efficiency measures in this country. The decrease in Germany's emissions significantly influenced the overall EU-15 and EU-27 trends in GHG emissions from households and, consequently, total emissions.

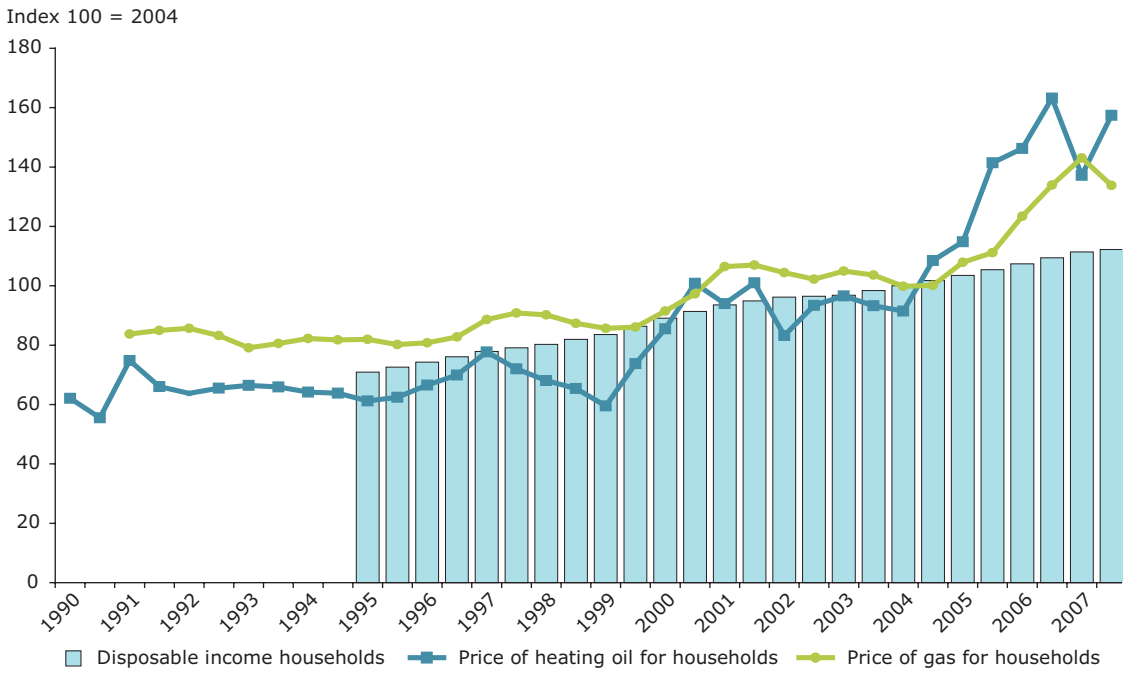
Figure 3.6 Average temperatures in Europe and relative heating degree days in EU-27



Note: Average temperatures: the source of the original data is the Climatic Research Unit of the University of East Anglia. The annual deviations of the European mean annual temperature shown in the chart have been adjusted from the initial data to be relative to the period 1850–1899, to better monitor the EU objective not to exceed 2 °C above pre-industrial values. Over Europe, average annual temperatures during the real pre-industrial period (1750–1799) were very similar to those during 1850–1899. Europe is defined as 35° to 70° north, – 25° to 30° east, plus Turkey (35° to 40° north, 30° to 45° east). The resulting temperature anomalies were obtained using KNMI's climate explorer.

Source: EEA, based on CRU HadCRU3 and CRUTEM3 datasets; Eurostat.

Figure 3.7 Household income and heating fuel prices in EU-27, 1990–2007



Note: The EU trend is based on available country data.

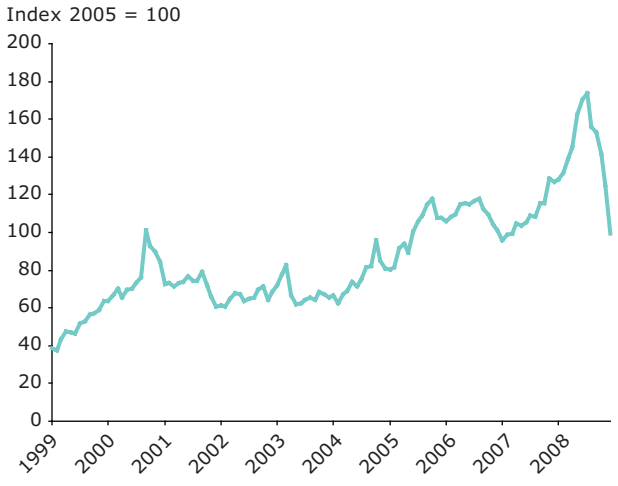
Source: Eurostat.

Fuel sales, fuel prices and fuel taxation

Fuel prices and purchase decisions by consumers may play an important role, since CO_2 emissions from direct combustion in households (as reported in national greenhouse gas inventories) are calculated based on fuel sales, not on actual consumption, although the two are obviously related. CO_2 emissions from households fell sharply in 2007 as a direct consequence of lower sales of fossil fuels, particularly oil and gas. The reduction in the sales of oil and gas for heating purposes in households in 2007 was primarily due to:

- favourable climatic conditions in 2007 (warmer winter), leading to a reduced heating demand;
- significant increases in fuel prices in 2007; important fuel stocks at the end of 2006 limited need for fuel purchases, in particular in Germany.

Figure 3.8 Consumer price index of (light) heating oil in Germany



Source: Statistische Bundesamt Deutschland, Wiesbaden, 2009.

Between 2004 and 2007, fuel prices increased very rapidly. This increase significantly outpaced the growth in gross disposable household incomes — most remarkably for oil (Figure 3.7). Large increases in fuel prices were observed in all Member States, particularly in Germany.

In the second half of 2006, prices for heating oil (Figure 3.8) were falling and the German government announced its decision to raise VAT from 16 % to 19 % starting in January 2007. This prompted consumers to stock up with heating oil at the end of 2006. Consequently, with a mild winter in 2007 and unusually high gas and oil prices at the end of 2007, consumers did not restock as much as they had in previous years. Thus, the consumer response to fuel prices variations and fiscal policy (VAT increase) in Germany resulted in much lower sales of heating oil

in 2007 compared to 2006, and consequently, to lower reported CO_2 emissions in the residential sector.

3.4 Transport

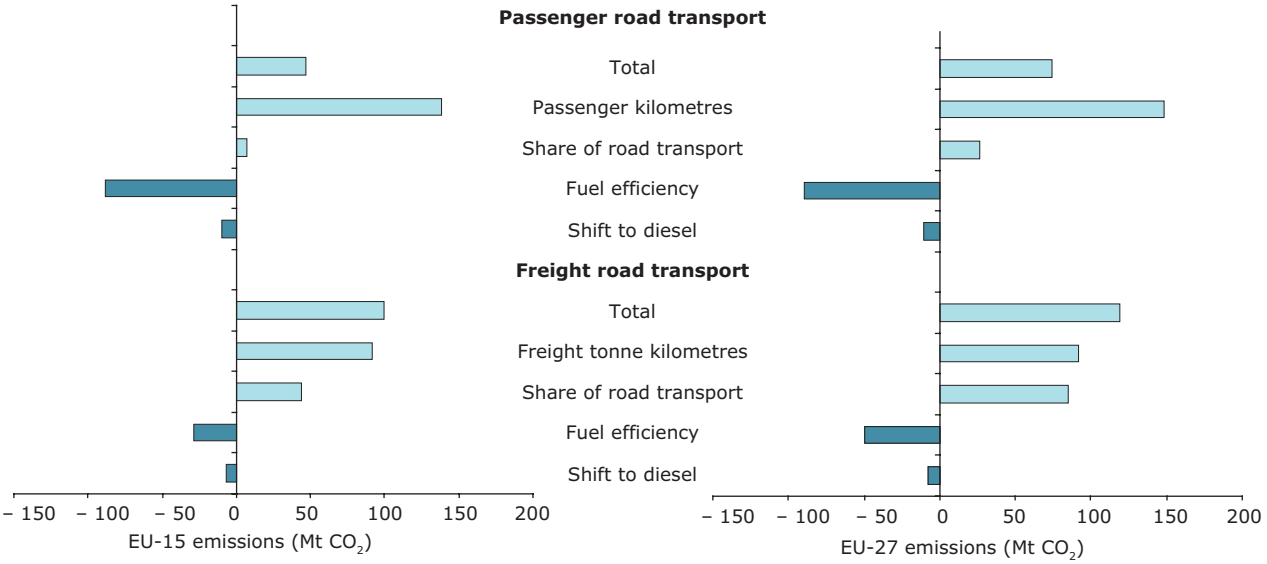
Transport is the sector in which the negative emission drivers (transport demand and increasing share of road transport) most outgrew the positive emission drivers (fuel efficiency and fuel shift).

Between 1990 and 2007, CO_2 emissions from transport rose by 29 % in the EU-27. This increase was observed for both passenger transport and freight transport. These increases were mainly due to growing transport demand, characterised by large increases in passenger kilometres and tonne kilometres (freight) (Figure 3.9). For passenger road transport, a relative decrease in the use of public transport is also noteworthy. Efficiency improvements in passenger cars have not been sufficient to counteract this trend. For freight road transport, an increased share of road freight transport as opposed to other transport modes supplemented the increased transport demand for goods. Modal shift is therefore taking place in the wrong direction, especially in the EU-12.

Bulgaria, Estonia, Germany and Lithuania are the only Member States that have managed to reduce their transport GHG emissions since 1990, with Germany showing by far the largest absolute reduction (– 11 Mt CO_2-equivalent). In Germany, this reduction was due to an increased share of diesel-powered cars, increasing fuel prices (including effects of the eco-tax) and the purchase of fuel outside Germany. Policies have been decided at EU level to tackle ever-increasing transport emissions. Such policies aim for example to promote use of biofuels (Directive 2003/30/EC), promote modal shift to rail (Directive 2001/12/EC) and an integrated European railway area (Commission Communication COM(2002)18 final), and provide better consumer information on cars.

The performance of the transport vis-à-vis environmental performance, including its impacts on climate change, is analysed in detail in the EEA annual report on transport and environment. The latest report ([19]) concludes that different policy initiatives hold plenty of options for synergies but some measures also risk of counteracting each other.

Figure 3.9 Main drivers of CO_2 emission trends from road transport (passenger and freight) in the EU-27 and EU-15, 1990–2007



Note: The bars with positive values indicate factors that cause an increase in emissions; the bars with negative values indicate factors that have a reducing effect. Aggregating both effects provides the actual emission changes.
Fuel shift describes the effect resulting from the shift to less carbon-intensive fossil fuels in transport including the shift towards biofuels.

Source: EEA, 2009a; Eurostat; European Commission, 2008.

([19]) EEA, 2009b.

4 Emission savings from policies and measures

- Based on the information provided by 26 Member States, over 56 % of policies implemented at national level were introduced in response to EU-level policies and 24 % more have been reinforced by them. The EU Emission Trading Scheme (EU ETS), the promotion of biofuels and the provision of consumer information (energy labelling) have been most influential to push adoption of new measures at national level. Overall, EU policies will be responsible for most of the policy-driven emission savings in Member States in 2010 and in 2020.
- Quantitative estimates from Member States lack consistency and completeness to allow an accurate quantification of savings at the EU level.

2010

- Member States anticipate that the EU ETS, Kyoto flexible mechanisms, the promotion of renewable energy sources, energy performance of buildings and internal energy market policies will contribute most to them meet their Kyoto targets. In relative terms, significant emission savings are expected in 2010, due to better waste management practices. The use of Kyoto mechanisms will remain supplemental to domestic action at EU-15 level.
- Further implementation of the RES-e Directive and the Directive on energy end-use efficiency and energy services might provide additional savings by 2010. A number of Member States expect relatively high emission reductions from the implementation of additional policies, which should be considered prudently given the short time lapse from now until 2010.
- Expected emission savings from domestic policies will be insufficient to offset the projected growth of emissions due to energy consumption between 2007 and 2010. Transport demand and share of road transport will also greatly counter the effects of measures addressing transport emissions over the period.

2020

- The largest emission reductions in 2020 are projected to occur in the transport and energy sectors. These savings will come from sector-specific responses (e.g. new RES directive, recast directive on energy performance of buildings) as well as cross-cutting measures, such as the revised EU ETS and the IPPC Directive.
- Successful implementation of additional measures in the energy use and transport sectors will be decisive in reversing projections of emissions growth between 2007 and 2020 under the existing measures.
- In the agriculture sector, very little emission reductions are projected from both existing and additional measures for 2010 and 2020. Agriculture is the sector where the least absolute and relative reductions are expected, despite a contribution to 9 % of the EU-27 total emissions in 2007.
- Most Member States have not quantified expected savings from certain recent policies and measures, which the European Commission estimates will bring important emission reductions in 2020 such as: eco-efficiency requirements of energy using products, inclusion of aviation in EU ETS, strategy for car CO_2 and Fuel Quality Directive. Only eleven Member States have so far taken into consideration elements of the new climate change and energy package adopted in 2009.
- Under the EU Effort Sharing Decision, the sectors not covered by the EU ETS across the EU-27 are required to reduce emissions by 10 % by 2020 compared to 2005 levels. Further implementation of measures will be required to achieve emission savings in sectors such as transport, heating in buildings, services and agriculture.

4.1 EU-level policies and measures addressing greenhouse gas emissions

In June 2000, the European Commission launched the first European Climate Change Programme (ECCP I), in which it identified a number of EU-wide common and coordinated policies and measures (CCPMs) to implement the Kyoto Protocol. These CCPMs have been adopted or are at an advanced stage of preparation. Most of these CCPMs take the form of directives, which must be transposed by Member States into national legislation, and Regulations, which are directly applicable in all Member States. Voluntary agreements between the European Commission and stakeholders are also used in specific areas.

The second ECCP (ECCP II), launched in October 2005, focused on reviewing the first ECCP I and exploring new policy areas. Specific areas for which additional emission reduction measures for 2008–2012 have been developed, include aviation and CO_2 and cars. Other policy areas addressed in ECCP II include adaptation and carbon capture and storage (CCS).

Following an agreement between the European Parliament and the European Council on a climate and energy package in December 2008, a set of legislative measures was adopted in June 2009, including a strengthened and expanded EU Emission Trading Scheme (EU ETS), national 2020 targets for emissions not covered by the EU ETS (Effort Sharing) and national 2020 targets for renewable energy.

Most CCPMs target the energy and transport sectors where absolute GHG reduction potentials are greatest. Table 4.1 provides a description of key common and coordinated policies and measures.

Table 4.1 Key common coordinated policies and measures

Sector	Issue	Description
Cross-cutting	Effort sharing	**Effort Sharing Decision**: Decision No 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020
	EU Emission Trading Scheme (EU ETS)	Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (**EU ETS Directive**: Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC)
	Carbon capture and storage (CCS)	**CCS Directive**: Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide and amending Council Directive 85/337/EEC, European Parliament and Council Directives 2000/60/EC, 2001/80/EC, 2004/35/EC, 2006/12/EC, 2008/1/EC and Regulation (EC) No 1013/2006
	Kyoto Protocol project mechanisms	**Linking Directive**: Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms
	Integrated pollution prevention and control (IPPC)	**IPPC Directive**: Directive 2008/1/EC EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control (recast of Council Directive 96/61/EC of 24 September 1996 concerning integrated pollution prevention and control)

Sector	Issue	Description
	Green public procurement	Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts
Energy supply and use	Energy from renewable sources	**RES Directive**: Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (**RES-e Directive**: Directive 2001/77/EC of the European Parliament and of the Council of 27 September 2001 on the promotion of electricity produced from renewable energy sources in the internal electricity market, Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport)
	Energy end-use efficiency and energy services	Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC
	Use of biomass, renewable heat	**Biomass Action Plan**: Communication from the Commission on a Biomass Action Plan, COM(2005) 628 final (adopted in December 2005)
	Ecodesign of energy-using products	**Ecodesign Directive**: Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005 establishing a framework for the setting of ecodesign requirements for energy-using products and amending Council Directive 92/42/EEC and Directives 96/57/EC and 2000/55/EC of the European Parliament and of the Council
	Cogeneration (combined heat and power)	**Cogeneration Directive**: Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC
	Energy taxation	**Energy Taxation Directive**: Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity
	Trans-european energy networks (TEN-e) and internal energy markets	Decision No 1229/2003/EC of the European Parliament and of the Council of 26 June 2003 laying down a series of guidelines for trans-european energy networks and repealing Decision No 1254/96/EC Directive 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas and repealing Directive 98/30/EC Directive 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity and repealing Directive 96/92/EC Regulation (EC) 807/2004, Regulation (EC) 1228/2003
	Energy labelling	Commission Directive 2003/66/EC of 3 July 2003 amending Directive 94/2/EC implementing Council Directive 92/75/EEC with regard to energy labelling of household electric refrigerators, freezers and their combinations **Energy Labelling Directive**: Council Directive 92/75/EEC of 22 September 1992 on the indication by labelling and standard product information of the consumption of energy and other resources by household appliances
	Motor-driven systems	**Motor Challenge Programme**: European Commission voluntary programme launched in February 2003 to aid industrial companies in improving the energy efficiency of their electric motor-driven systems, focusing on compressed air, fan and pump systems
	Energy performance of buildings	**Energy Performance of Buildings Directive**: Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings
Sector	**Issue**	**Description**

	Large combustion plants	**LCP Directive**: Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (recast of Council Directive 88/609/EEC of 24 November 1988 on the limitation of emissions of certain pollutants into the air from large combustion plants)
Transport	Emission performance of passenger cars	**Strategy for car CO_2**: Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles **Voluntary agreements with car manufacturers**: Commission Recommendations of 5 February 1999 and 13 April 2000 on the reduction of CO_2 emissions from passenger cars (voluntary agreement with car manufacturers from EU, Japan and Korea to reduce fleet average CO_2 emissions to 140 g/km by 2008/2009)
	Energy efficiency	Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles
	Transport fuels	**Fuel Quality Directive**: Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 98/70/EC as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions and amending Council Directive 1999/32/EC as regards the specification of fuel used by inland waterway vessels and repealing Directive 93/12/EEC
	Aviation	Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC so as to include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community
	HFC motor vehicle air conditioning	**MAC Directive**: Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC
	Biofuels	**Biofuels Directive**: Directive 2003/30/EC of the European Parliament and of the Council of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport
	Modal shift towards rail	**Rail Directives**: Directive 2007/58/EC of the European Parliament and of the Council of 23 October 2007 amending Council Directive 91/440/EEC on the development of the Community's railways and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure Railway Safety Directive: Directive 2004/49/EC of the European Parliament and of the Council of 29 April 2004 on safety on the Community's railways and amending Council Directive 95/18/EC on the licensing of railway undertakings and Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification Directive 2004/50/EC of the European Parliament and of the Council of 29 April 2004 amending Council Directive 96/48/EC on the interoperability of the trans-european high-speed rail system and Directive 2001/16/EC of the European Parliament and of the Council on the interoperability of the trans-european conventional rail system
Industry	Fluorinated gases	F-gas regulation: Regulation (EC) No. 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases
Sector	**Issue**	**Description**

Agriculture	Decoupling of support from production	**CAP reform — transition to single farm payment (SFP)**: Council Regulation (EC) No 1782/2003 of 29 September 2003 establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers and amending Regulations (EEC) No 2019/93, (EC) No 1452/2001, (EC) No 1453/2001, (EC) No 1454/2001, (EC) No 1868/94, (EC) No 1251/1999, (EC) No 1254/1999, (EC) No 1673/2000, (EEC) No 2358/71 and (EC) No 2529/2001
Waste management	Landfill	**Landfill Directive**: Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste
	Waste Framework Directive	**Waste Framework Directive**: Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives
Forestry	Sustainable forest management	**EU Forest Action Plan**: Communication from the Commission to the Council and the European Parliament on an EU Forest Action Plan, COM(2006) 302 final (adopted on 15 June 2006)

Source: European Commission ECCP (2003), EC impact assessments.

4.2 Contribution of EU policies to greenhouse gas emission savings

CCPMs demonstrate the collective determination of the EU-27 to take action on climate change and they help to deal with competitiveness concerns of Member States. National policies and measures (PAMs) and EU CCPMs are closely linked, as European Directives require Member States to enact legislation to implement them (which European regulations and voluntary agreements do not). National PAMs in place in Member States can therefore result from the implementation of EU CCPMs, but can also be driven by specific national policy objectives that are not necessarily related to the EU-wide CCPMs. It is often difficult for Member States to attribute clearly expected savings from their PAMs to either national objectives or to EU CCPMs due to this close interaction.

Based the information provided by 26 Member States on the consequences of the implementation of CCPMs at national level ([20]), over 56 % of PAMs implemented at national level were introduced in response to the adoption of CCPMs and 24 % more have been reinforced by them (Table 4.2). Not all Member States reported on their implementation of CCPMs. The role of CCPMs in prompting the implementation of PAMs at a national level has been particularly strong in the EU-12, although the average number of PAMs implemented by Member State is higher in the EU-15. EU policies that have been most influential in terms of adoption of new PAMs at national level are the EU ETS, the promotion of biofuels and the provision of consumer information (energy labelling of appliances, labelling of cars, energy labelling for office equipment). CCPMs on energy using appliances (efficiency fluorescent lighting

Table 4.2 Contribution of CCPMs to the implementation of PAMs

	New national PAMs due to CCPMs	National PAMs reinforced by CCPMs	National PAMs already existing before CCPMs
EU-15	54 %	29 %	17 %
EU-12	63 %	13 %	24 %
EU-27	56 %	24 %	19 %

Source: EEA, 2009.

([20]) All EU-15 Member States and eleven EU-12 Member States (all apart from Malta) have provided information on linkages between national PAMs and CCPMs. Good quality information was provided.

and eco-design requirements for energy-using products) have been implemented in several EU-15 Member States but only in one Member State in the EU-12 so far. Further details on the linkages between CCPMS and national PAMs are provided in Annex 2.

In addition, the vast majority of policy-derived emission reductions projected by Member States are expected to come from PAMs associated with CCPMs (Table 4.3). In 2010, however, the further reductions Member States expect to achieve are primarily linked to additional PAMs that are not directly connected to CCPMs.

4.3 Quantified expected effects of policies and measures

4.3.1 Data source and methods used

Quantified expected effects of policies and measures are available from the European Commission and from Member States. The European Commission estimates correspond to total emission reduction potentials at EU-15 level for a limited number of CCPMs. Many estimates for 2010 savings date back to 2003. More up to date estimates for 2020 savings are available from the impact assessments prepared by the Commission for its recent legislative proposals. Most estimates from Member States were reported in 2009, but in general they lack consistency and completeness to allow a precise quantification of savings at EU level. Two methods are used to assemble Member State estimates of GHG savings from policies and measures:

- The impact of existing policies and measures at EU level is estimated using a bottom-up approach, which aggregates Member State estimates of the impact of individual policies and measures. The lack of completeness of quantified savings from existing policies and measures across Member States is likely to result in underestimated total savings at EU level.
- The impact of additional policies and measures at EU level is estimated using a top-down approach, which calculates the difference between emission projections under the two scenarios 'with existing measures' and 'with additional measures'. This method is more comprehensive than the bottom-up approach for additional measures, because several Member States do not quantify the expected impact of all additional measures. However, it cannot yet be applied to estimate the impacts of existing measures at EU level, because too few Member States provide emission projections under a counterfactual scenario 'without measures'.

The approaches must therefore be combined to provide the best available estimates of the expected impact of existing and additional policies and measures according to Member States. These approaches do not operate any distinction between savings due to the implementation of EU CCPMs and savings resulting from strictly national policies. More methodological information is available in Annex A.2. An analysis of the total emission savings from policies and measures for each Member State is presented in Annex A.2.

4.3.2 Quantified expected effects of policies and measures in 2010

The projected savings from individual PAMs estimated and reported by Member States indicate that, among all EU policies, the EU ETS, the promotion of renewable energy sources and the use of Kyoto mechanisms will contribute most to help Member States meet their Kyoto targets (Figure 4.1). These findings are roughly in line with earlier (2003) and more recent estimates from the European Commission, although significant differences can be observed in the magnitude of total savings. In addition, the Commission expects the IPPC Directive to deliver large GHG emission savings while Member States rather expect significant savings from policies aimed at developing the internal energy market.

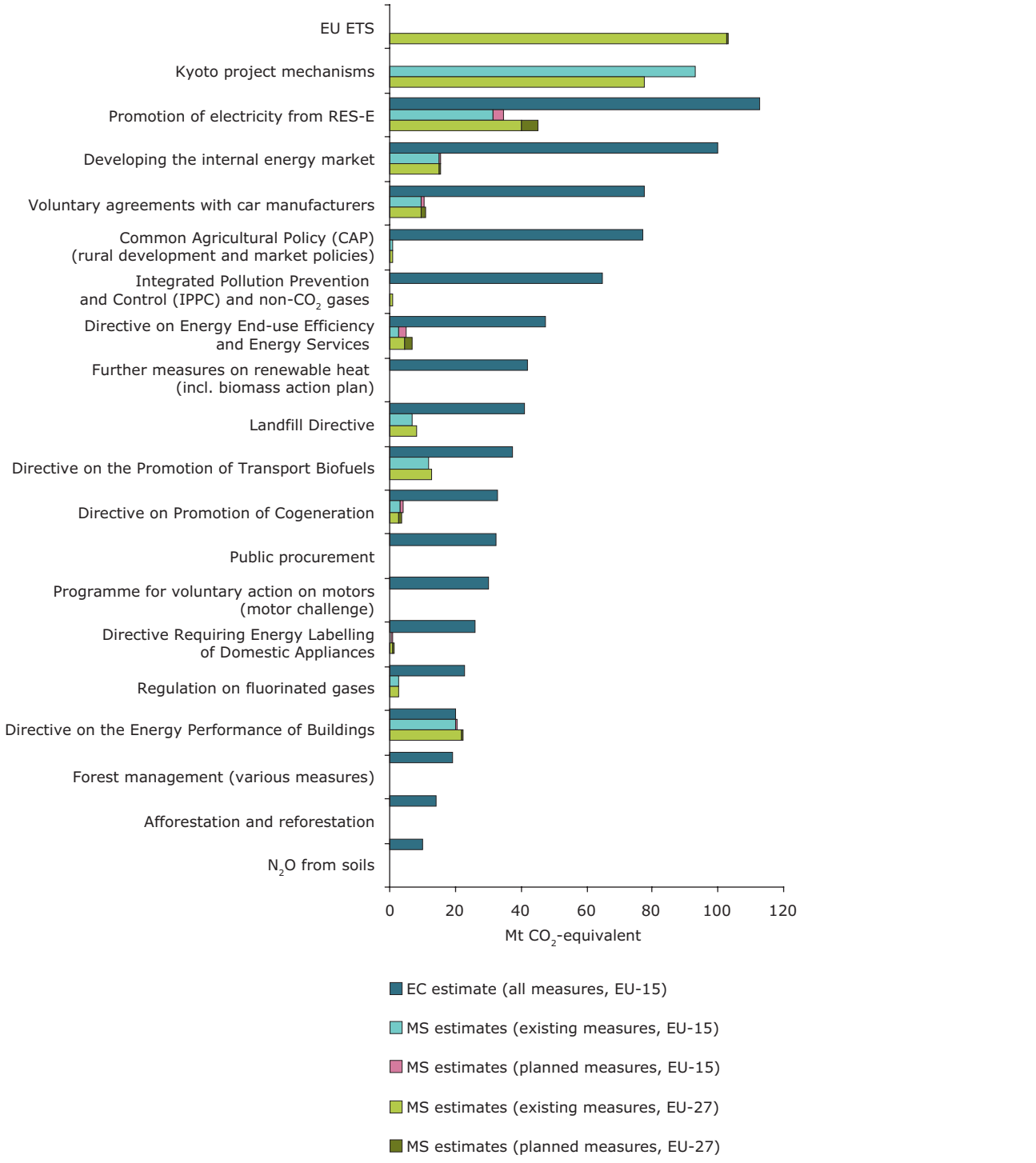
While most savings in 2010 are expected from policies and measures already implemented, significant savings are still expected from the further implementation of additional PAMs (Figure 4.2), in particular in the energy and transport sectors, such as the RES-e Directive and the Directive on Energy End-use Efficiency and Energy Services (Figure 4.1).

Table 4.3 Contribution of CCPMs to policy-driven emission savings in the EU-27

Year	WEM	WAM
2010	82 %	36 %
2020	76 %	66 %

Source: Data is derived using the bottom-up approach (see Annex A.2); EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam).

Figure 4.1 EC and Member States estimates of emission reduction potential for main EU CCPMs in 2010 in EU-15 and EU-27



Note: All data are estimates of annual reduction, not cumulative savings. This figure does not reflect the planned release of assigned amount units into the market via international emissions trading by Hungary, to the value 16.5 Mt per annum (cf. Annex A.4).

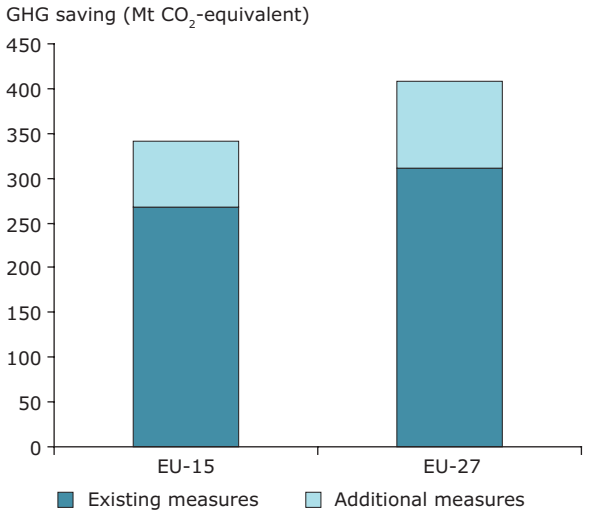
Source: European Commission ECCP, 2003; EC impact assessments, Member States' estimates (www.eea.europa.eu/themes/climate/pam), 2009 Member States' questionnaires on the use of flexible mechanisms.

Overall, measures targeting the energy supply sector are expected to deliver much larger savings than measures targeting energy consumption by households and industry in 2010, although absolute savings in both sectors are expected to be substantial (Figure 4.3). In relative terms, the contribution of energy measures targeting end-use sectors is not expected to be as strong as in the energy supply, waste and even transport sectors (Figure 4.4). Furthermore, despite policy-induced savings, emissions from energy use are still projected to grow by at least 2 % between 2007 and 2010 (Figure 4.5). However, only seven Member States managed to take the economic crisis into account in their projections, which means that emissions could be overall overestimated (cf. Section 7.6.1).

In addition to the energy and cross-cutting sectors, important reductions are also expected by Member States in the transport sector (Figure 4.3). CCPMs expected to reduce transport emissions include the voluntary agreements with car manufacturers and the directive on the promotion of transport biofuels. While policies in the transport sector are expected to contribute saving about 7 % of total emissions in 2010 (Figure 4.4), emissions in the transport sector are still projected to increase by 1 % from 2007 to 2010 in the EU-27 (Figure 4.5). This suggests that much of the reduction expected to occur by 2010 will actually compensate the otherwise rapidly increasing emissions in the transport sector, driven by rising transport demand and the increase share of road transport compared to other modes.

In relative terms, important emission reductions are also projected in the waste sector (Figure 4.4), although these are limited in absolute terms. These reductions will come from better waste management practices ([21]), in particular the Landfill Directive.

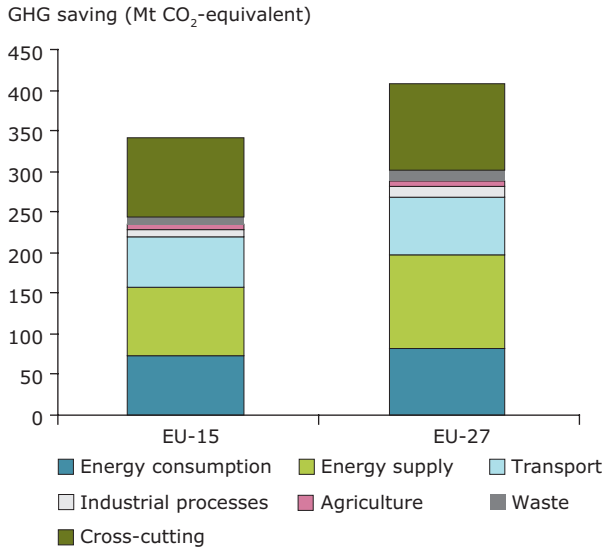
Figure 4.2 Absolute savings from existing and additional policies in 2010



Note: Absolute savings: total projected effect of existing (implemented or adopted) and additional (planned) policies and measures in 2010, compared to a counterfactual scenario where none of these measures would have been implemented.
All national policies and measures included, whether related or not to EU policies.
The lack of completeness of quantified savings from existing policies and measures across Member States is likely to result in underestimated total savings at EU level.

Source: Existing measures savings (bottom-up): EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam); additional measures savings (top-down): 2009 Member States total emission projections; EEA 2008a for Hungary and Poland.

Figure 4.3 Sectoral savings from policies in 2010

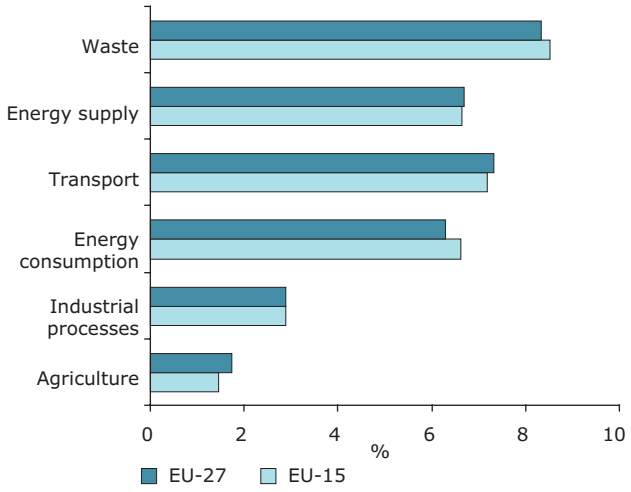


Note: Sectoral savings: projected effect of existing (implemented or adopted) and additional (planned) policies and measures in 2010 classified by sector, compared to a counterfactual scenario where none of these measures would have been implemented.
All national policies and measures included, whether related or not to EU policies.
The lack of completeness of quantified savings from existing policies and measures across Member States is likely to result in underestimated total savings at EU level.

Source: Existing measures savings (bottom-up): EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam); additional measures savings (top-down): 2009 Member States total emission projections; EEA 2008a for Hungary and Poland.

([21]) EEA, 2008c.

Figure 4.4 Expected savings from implemented and planned policies in 2010 as a proportion of 2007 emissions, by sector



Note: All policies and measures included, whether or not related to EU policies.

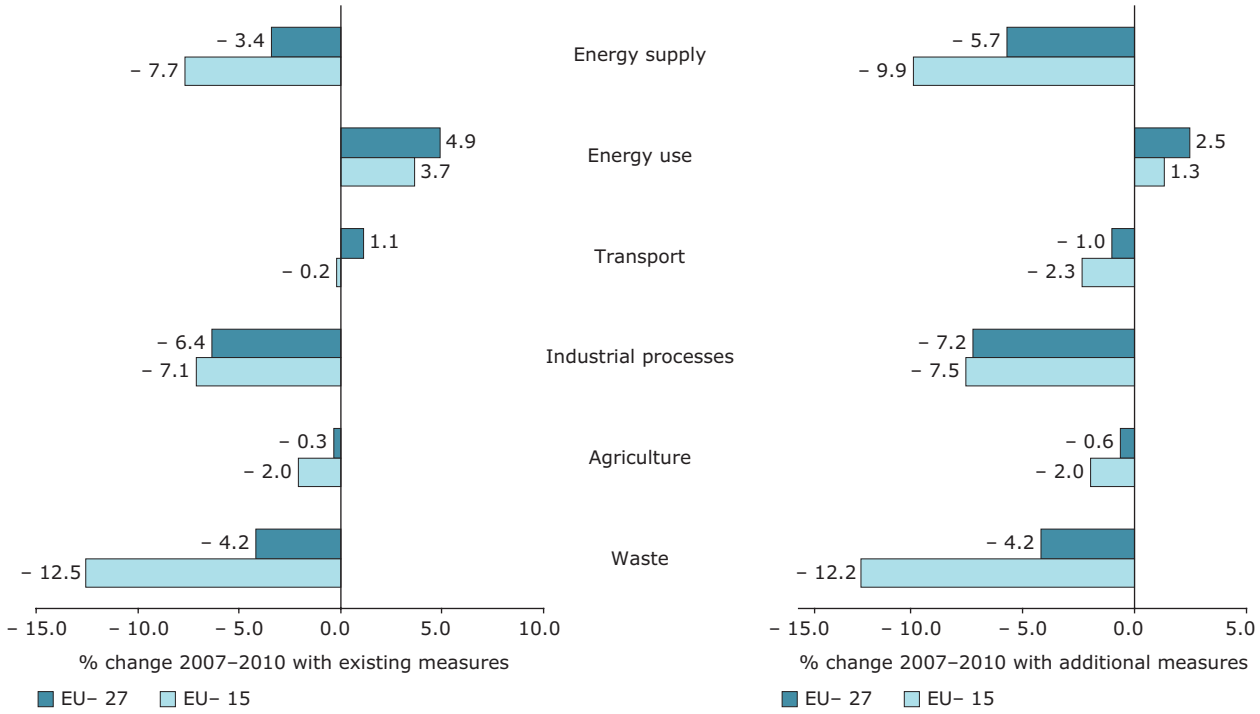
Source: Existing measures savings (bottom-up): EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam); additional measures savings (top-down): 2009 Member States total emission projections; EEA 2008a for Hungary and Poland.

In contrast, emission reductions from agriculture are limited for 2010. Member States report almost no quantified GHG reductions expected from the Common Agricultural Policy and other policies to reduce N_2O emissions from soils, in contrast with Commission estimates.

The contribution of the industrial process sector also appears to be low compared to emissions from the sector. However, some savings allocated to cross-sectoral policies such as the EU ETS and the IPPC Directive, are not properly reflected in these sector-specific quantified emission reductions, while emission reductions between 2007 and 2010 are projected in this sector. The IPPC Directive and the regulation on F-gases are expected to deliver most emission savings in this sector.

Finally, Member States expect a large overall contribution of the Kyoto flexible mechanisms to meet their Kyoto targets (Figure 4.1, cf. Section 7.3.2). The emission savings expected to be generated by such mechanisms are still lower than the cumulated savings from the other domestic PAMs. Hence, the use of Kyoto mechanisms will remain supplemental to domestic action at EU-15 level.

Figure 4.5 Projected greenhouse gas emissions on a sectoral level in 2010 relative to 2007 emissions for EU-15 and EU-27



Note: In case a Member State did not provide sectoral projections, these were estimated based on total projections and the share of each sector in 2007 total emissions. Projections of emissions from international bunkers are not presented here due to the high number of Member States that did not provide projected data for this emission source.

Source: EEA, 2009.

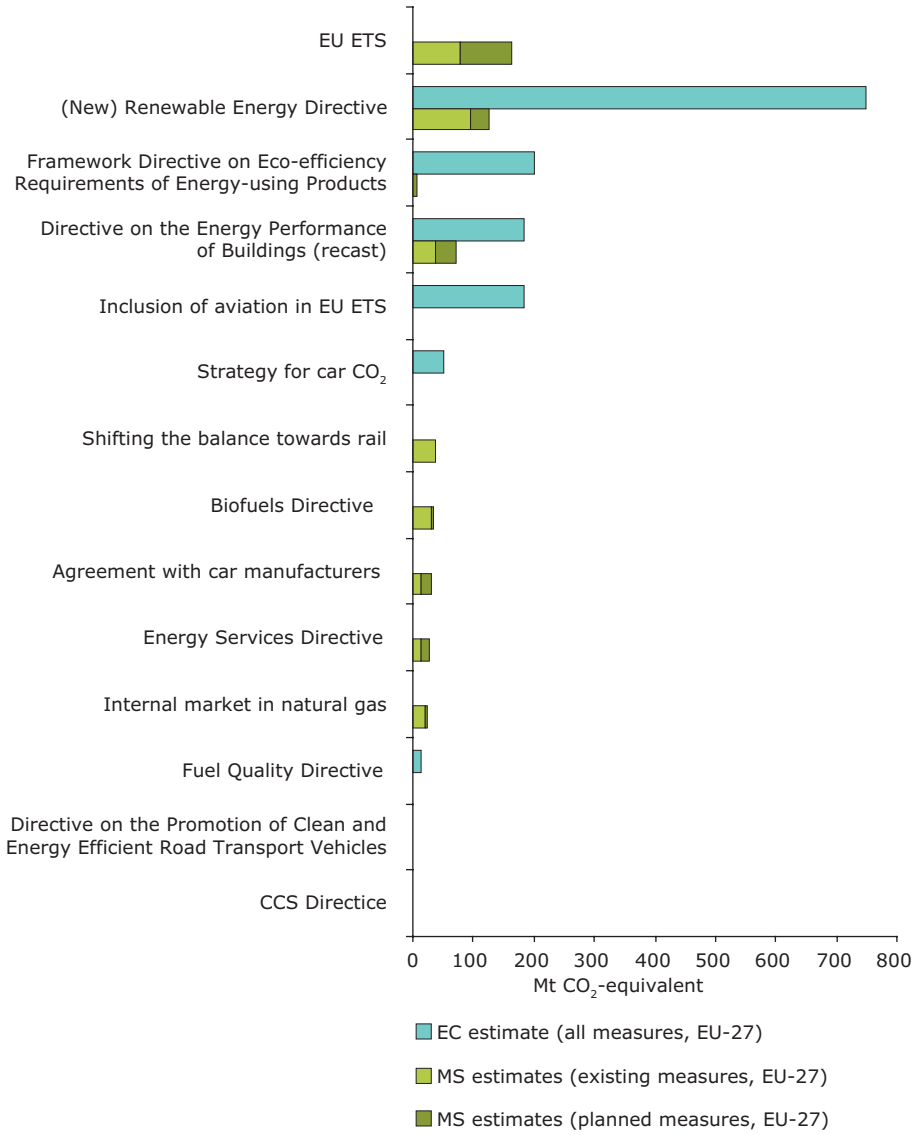
4.3.3 *Quantified expected effects of policies and measures in 2020*

Measures resulting from the implementation of EU policies in Member States are expected to contribute to most projected emissions savings from domestic policies and measures by 2020 (Table 4.3).

According to Member States projections, the RES-e Directive, the EU ETS Directive, the Energy Performance of Buildings Directive, the Rail Directives and the Biofuels Directive are the CCPMs already implemented which are expected to contribute most to total emission savings in 2020 (Figure 4.6). Germany, Greece, Italy, the United Kingdom and the Czech Republic expect considerable emission reductions in the energy supply sector due to the RES-e Directive until 2020.

Additional measures are expected to contribute a significant share towards the total projected savings from domestic policies and measures (Figure 4.7).

Figure 4.6 EC and Member States estimates of emission reduction potential for main EU CCPMs in 2020 in EU-27



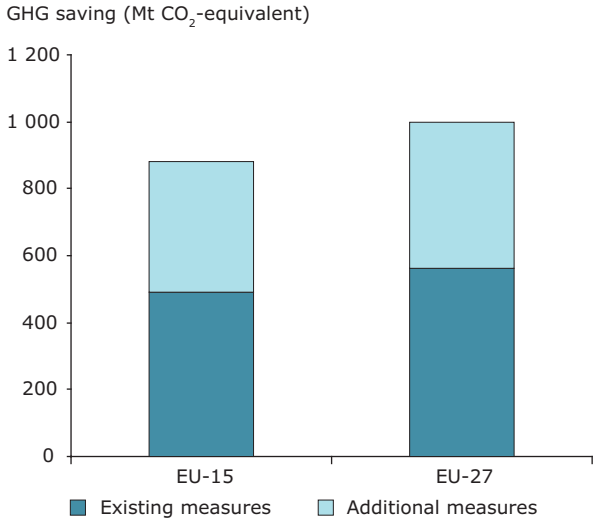
Note: All data are estimates of annual reduction, not cumulative savings. For policies where only cumulative figures are available, they have been divided by the number of years between when the policy effect starts and 2020. This has been the method used for the CCS Directive and Strategy for Car CO_2.

Source: European Commission ECCP (2003), EC impact assessments, Member States' estimates (www.eea.europa.eu/themes/climate/pam).

Revised legislation on renewable energy, buildings and the EU ETS is expected to deliver the majority of additional savings so far quantified for 2020. However, only eleven Member States have so far taken new EU policies, in particular elements of the new climate change and energy package adopted in 2009, into consideration. In addition to these policies, the European Commission expects the Framework Directive on eco-efficiency requirements of end-using products, the inclusion of aviation in the EU ETS and the Strategy for reduction of CO_2 from cars to have significant effects in 2020.

Emission reductions in the energy supply sector will have the greatest impact on total GHG emissions in the EU-15 and EU-27. Policies acting on emissions from the energy supply, energy use and transport sectors are expected to contribute most to total emission savings, both in absolute

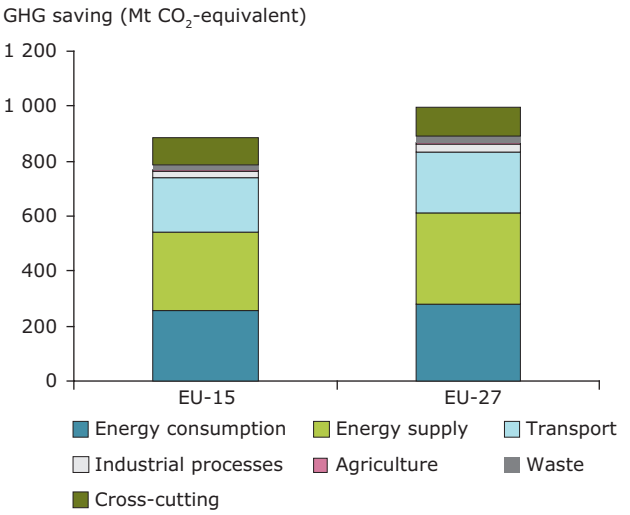
Figure 4.7 Savings from existing and additional policies in 2020



Note: Absolute savings: total projected effect of existing (implemented or adopted) and additional (planned) policies and measures in 2010, compared to a counterfactual scenario where none of these measures would have been implemented.
All national policies and measures included, whether related or not to EU policies.
The lack of completeness of quantified savings from existing policies and measures across Member States is likely to result in underestimated total savings at EU level.

Source: Existing measures savings (bottom-up): EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam); additional measures savings (top-down): 2009 Member States total emission projections; EEA 2008a for Hungary and Poland.

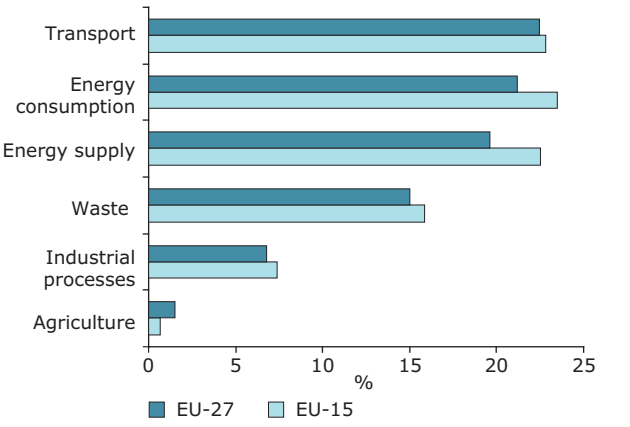
Figure 4.8 Sectoral savings from policies in 2020



Note: Sectoral savings: projected effect of existing (implemented or adopted) and additional (planned) policies and measures in 2010 classified by sector, compared to a counterfactual scenario where none of these measures would have been implemented.
All national policies and measures included, whether related or not to EU policies. The lack of completeness of quantified savings from existing policies and measures across Member States is likely to result in underestimated total savings at EU level.

Source: Existing measures savings (bottom-up): EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam); additional measures savings (top-down): 2009 Member States total emission projections; EEA 2008a for Hungary and Poland.

Figure 4.9 Expected savings from implemented and planned policies in 2020 as a proportion of 2007 emissions



Note: All policies and measures included, whether or not related to EU policies.

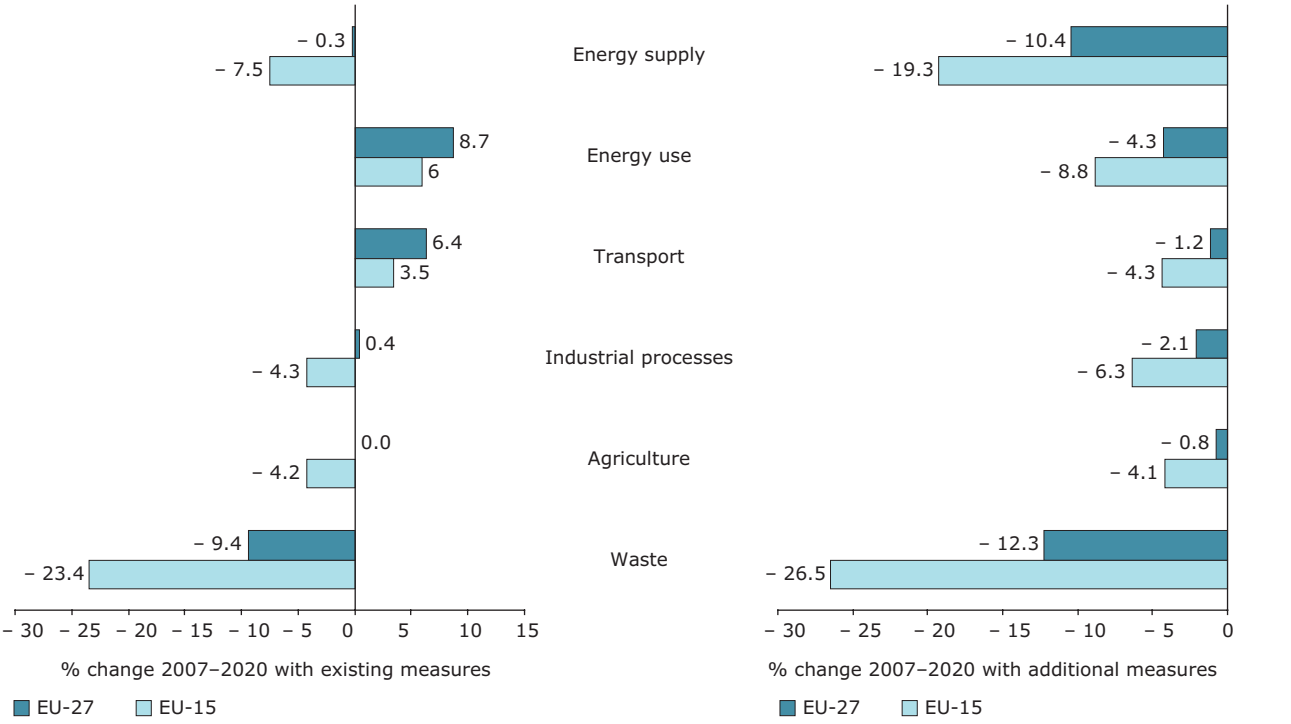
Source: Existing measures savings (bottom-up): EEA 2009, Policies and Measures database, 9 September 2009 extract (www.eea.europa.eu/themes/climate/pam); additional measures savings (top-down): 2009 Member States total emission projections; EEA 2008a for Hungary and Poland.

terms (Figure 4.8) and in comparison with these sectors' respective emissions in 2007 (Figure 4.9). However, emissions due to energy use by the residential and industry sectors and emissions from transport are expected to increase if no additional measures are implemented (Figure 4.10). Successful implementation of additional measures in these sectors will therefore be decisive to reverse these expected emission trends.

As in 2010, agriculture is the sector where the least savings are expected in 2020, both in absolute terms (Figure 4.8) and in comparison with this sector's 2007 emissions (Figure 4.9).

Under the EU Effort Sharing Decision, the sectors not covered by the EU ETS across the EU are required to reduce emissions by 10 % by 2020 compared to 2005 levels. Further new measures will be required in the non-trading sectors such as transport, heating in buildings, services and agriculture if these sectors are to contribute equally to the 2020 Effort Sharing Decision target for the EU-27 (Figure 4.10).

Figure 4.10 Projected greenhouse gas emissions on a sectoral level in 2020 relative to 2007 emissions for EU-15 and EU-27



Note: In case a Member State did not provide sectoral projections, these were estimated based on total projections and the share of each sector in 2007 total emissions. Projections of emissions from international bunkers are not presented here due to the high number of Member States that did not provide projected data for this emission source.

Source: EEA, 2009.

5 Emission trading scheme, promotion of renewable electricity and promotion of biofuels in the EU

The European Union Emission Trading Scheme (EU ETS)

- The EU ETS covers more than 40 % of total greenhouse gas emissions in the EU. Some 913 installations (corresponding to 8 % of all installations in the EU ETS) emit more than 80 % of all ETS emissions, which corresponds to a third of the total EU-27 greenhouse gas emissions.
- Through the second national allocation plans for the period 2008–2012, Member States have fixed the overall contribution that the EU ETS will provide towards reaching burden-sharing or Kyoto targets at national level.For the second trading period, the European Commission has enforced stricter caps than for the first trading period. This lead to a relative stabilization of carbon prices in the second trading period.
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- In 2008, verified emissions were 10 % higher than allocated allowances. For the first time, operators of emission trading installations surrendered substantial amount of credits from CDM and JI projects, representing approximately 30 % of the average maximum use of such credits allowed per year.
- From 2013 onwards the revised EU ETS will deliver an emission reduction of – 21 % compared to emission levels in 2005.

Promotion of electricity produced from renewable energy sources (RES)

- Since 1990 gross electricity generation from RES in Europe grew significantly in absolute terms, with an increase of about 60 % between 1990 and 2007.
- However, compared with other energy sources, the contribution from renewable energy remains limited. In 2007, only three Member States (Denmark, Germany and Hungary) had reached their indicative renewable electricity targets for 2010 and 22 Member States were less than half way towards meeting their target. It is now becoming clear that the EU will not meet its 2010 indicative target of 21 % electricity produced from renewable energy sources.
- Substantial further efforts will be required from Member States to achieve the 2020 targets. Improvements to national support schemes and the ongoing integration of the internal market should facilitate growth of renewable electricity but most Member States still need better, active policies to ensure growth occurs.
- A high carbon price would stimulate development of electricity generation from RES.

Promotion of biofuels for transport

- Energy consumption in the transport sector depends almost exclusively on imported fossil fuels (oil). The sector is forecast to grow more rapidly than any other up to 2020 and beyond.
- To meet the 2010 EU target of 5.75 % of renewable energy in the transport sector by 2010, the consumption of biofuel and other renewable fuels in EU-27 would need to more than double by 2010. Germany is the only Member State that has reached, and even exceeded, its 2010 target and is progressing well towards its 2020 target.
- To meet the 2020 EU target of 10 % renewable energy use in the total final consumption of petrol, diesel, biofuels for road and rail, and electricity for transport, the consumption of biofuel and other renewable fuels in EU-27 would need to more than quadruple by 2020.
- Biofuel production contributes to an increase in the geographical coverage and intensity of agricultural production in the EU, which can have both positive and negative environmental effects. The new RES Directive includes sustainability criteria covering minimum requirements regarding greenhouse gas savings, prevention of damage from land-use change and reporting on a wide range of environmental and social issues.

5.1 The European Union Emission Trading Scheme (EU ETS)

5.1.1 Background

The EU Emission Trading Scheme (ETS) was established by Directive 2003/87/EC (the Emission Trading Directive) and entered into force 1 January 2005. It covers CO_2 emissions from large stationary sources including power and heat generators, oil refineries and installations for the production of ferrous metals, cement, lime, glass and ceramic materials, and pulp and paper. A first trading period covered the years 2005–2007, followed by a second trading period corresponding to the Kyoto compliance period 2008–2012. Since 2008, N_2O emissions of nitric acid production may also be opted into the scheme. Until now only the Netherlands decided to include these installations, with Austria also coming in this year (formal adoption still pending due to new comitology procedures, other Member States are planning to follow. In 2007, these sectors accounted for approximately 43 % of the EU's total greenhouse gas emissions. Other sectors (e.g. residential, transport, agriculture and waste) or greenhouse gases (CH_4 and F-gases) are not covered by the current scheme but the aviation sector will be covered starting from the 1 January 2012. Under the ETS, operators receive emission allowances from their government based on national allocation rules (e.g. using benchmarks, historic emissions or projected emissions). An amount equivalent to the verified emissions has to be surrendered by the end of April each year. Operators holding more allowances than necessary to cover their verified emissions may either sell unneeded allowances to other operators in the EU who are in need of more allowances, or keep them for future years. Directive 2004/101/EC (the Linking Directive) allows operators to buy credits from joint implementation (JI) or clean development mechanism (CDM) projects (see Section 5.2.1) and to bring them, to a limited extent, into the EU ETS to fulfil their obligations.

Under the Emission Trading Directive, Member States prepared national allocation plans (NAPs) for both the first (2005–2007) and second (2008–2012) trading periods, which were submitted for approval by the Commission. The allocation plans include the total quantity of allowances that will be available during a trading period, along with the rules for allocating these allowances to operators, amongst others. By June 2005, the Commission had accepted all 25 NAPs for the first trading period and by December 2007, the Commission had finalised its assessment of the 27 NAPs for the second trading period (2008–2012). Since 2008, three countries not belonging to the EU have been participating in the scheme: Norway, Iceland and Liechtenstein. Their NAPs are assessed by the EFTA surveillance authority.

Through the second national allocation plans for the period 2008–2012, Member States have fixed the overall contribution that the EU ETS will provide towards reaching burden-sharing or Kyoto targets at national level (cf. Section 7.2.2).

The EU ETS was reviewed recently to help the EU achieve stricter emissions targets agreed by EU Heads of State in March 2007, i.e. to cut overall greenhouse gas emissions by 20 % compared to 1990 levels by 2020, with a view to increase this to 30 % in the event a satisfactory international agreement is reached in Copenhagen in December 2009. The Directive 2009/29/EC lays down the amendment to the Emission Trading Directive covering the period after 2013. The main differences to the previous two trading periods are that an EU-wide cap will replace the current 27 national caps, and that more than half of the allowances will be auctioned instead of given out for free. A linear reduction factor has been defined so that, in the 20 % reduction scenario, the EU-wide cap will decline by 1.74 % annually as of 2013, to meet the 2020 target.

5.1.2 First and second trading period (2005–2007, 2008)

While total EU-25 emissions declined by 1.5 % in the period 2005–2007, emissions in the ETS rose by 2.1 %. On average 10 559 installations participated in the first trading period. These installations, which received on average emission allowances for 2 107 Mt CO_2 per year, emitted 2 071 Mt CO_2 per year (2 % less than total allowances) ([22]). Almost two thirds of all installations are classified as combustion installations ([23]) and are responsible for 70 % of overall

([22]) At the time of writing the CITL data did not include any information for Iceland, also no 2008 data for Cyprus and Malta. For Bulgaria verified emissions data is provided, but no information on allocation is available.

([23]) The 'combustion installations' sector contains installations for the public supply of heat and electricity as well as installations in various industrial sectors. Depending on Member States and individual circumstances combustion installations belonging to the industrial sector (e.g. a heat plant in a paper mill) are either included in the sector 'combustion installations' or in the respective industrial sector (e.g. 'production of pulp and paper').

emissions. The next largest types of installation are mineral oil refineries, production units for iron and steel and for cement clinker or lime, which are each responsible for 7–9 % of total emissions. The other six sectors under the ETS contribute together the remaining 6 % of EU ETS emissions.

More than 80 % of all ETS emissions are due to only 8 % of all installations (Figure 5.1). This small group of 913 installations, each of which emits more than 500 kt CO_2 per year, represents a third of the total EU GHG emissions. On the other hand, 70 % of all installations, emitting less than 50 kt CO_2 each per year, have a 5 % share of overall emissions covered by the EU ETS.

A more detailed analysis for 2008 shows large differences amongst sectors and countries. Total verified emissions were higher than allocations in half of countries (Austria, Denmark, Estonia, Germany, Greece, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Slovenia, Spain and the United Kingdom). This is in contrast to the first trading period, where only in four countries the emissions surpassed the allocation. Overall companies in the EU ETS were short in 2008 by 221 Mt (allocated amounts vs. verified emissions). The total amount of confirmed emissions from EU ETS installations in the EU-27 ([24]) in 2008 was 2 052 Mt CO_2, 3 % lower than the 2 118 million tonnes recorded for 2007 in the same countries.

Table 5.1 Key figures of the Emission Trading Scheme for 2005 to 2007 and for 2008

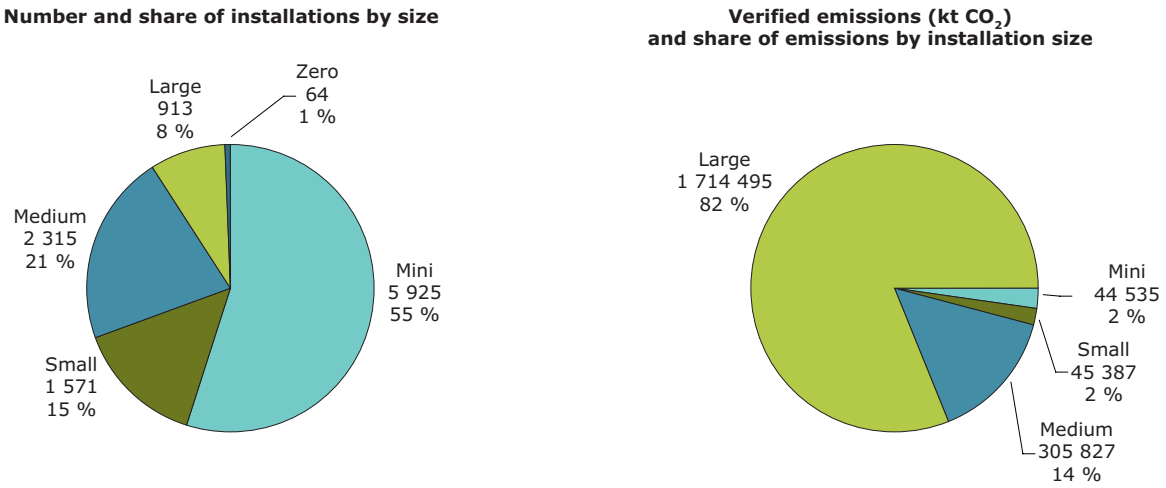
	Number of installations [a])		Allocated allowances		Verified emissions		Difference between allocated allowances and verified emissions	
	2005–2007 [b])	2008	2005–2007	2008	2005–2007	2008	2005–2007	2008
			(1 000 EUA [c]))		(kt CO_2-equivalent)			
1 Combustion installations	6 938	7 127	1 469 934	1 239 245	1 490 293	1 505 656	– 1 %	– 18 %
2 Mineral oil refineries	148	147	159 619	152 265	150 626	154 119	6 %	– 1 %
3 Coke ovens	20	21	22 789	22 527	20 857	20 989	9 %	7 %
4 Metal ore roasting or sintering	20	28	25 248	21 928	17 209	17 643	47 %	24 %
5 Pig iron or steel	229	234	155 631	184 695	131 478	132 967	18 %	39 %
6 Cement clinker or lime	531	549	193 715	206 798	186 884	188 933	4 %	9 %
7 Glass including glass fibre	412	432	22 495	23 865	20 497	22 705	10 %	5 %
8 Ceramic products by firing	1 140	1 055	18 118	18 061	14 821	13 333	22 %	35 %
9 Pulp, paper and board	798	807	37 138	37 898	29 769	31 435	25 %	21 %
99 Other activity opted-in	323	395	2 424	2 093	9 038	22 465	– 73 %	– 91 %
All installations	**10 559**	**10 795**	**2 107 111**	**1 909 376**	**2 071 472**	**2 110 245**	**2 %**	**– 10 %**

Note: [a]) A good indicator whether an installations is participating in the scheme in a given year is that it has emissions and/or allocation in that year, therefore only these installations are included in the number of installations.
[b]) All 2005–2007 values are averages over the three years. For this analysis installations have been included if allocated allowances or verified emissions have been published for each year. With this attribute the average values are not the same as in last year's report, where averages have been calculated in a different way.
[c]) European Union Allowance.

Source: Community independent transaction log (CITL), 29 April 2009/26 May 2009 ([25]).

([24]) Excluding Bulgaria, Malta and Cyprus due to registry problems or failure to notify all verified emissions.
([25]) The Community Independent Transaction Log, administered by the European Commission, is provided for the purpose of recording the issue, transfer and cancellation of allowances to and from EU member states. Data included in this report is based on the CITL released on 29 April 2009 for the years 2005 to 2007 and on 26 May 2009 for the year 2008. The data contained in the CITL is undergoing constant changes due to, e.g. installations entering or leaving the EU ETS, addition of missing information, correction of emission reports or inaccurate data in national registries and court decisions on the allocation decisions. In most cases these changes are small and will have no significant effect on the overall analysis. However, in specific cases changes may be of larger scale.

Figure 5.1 Share and number of installations and emissions by size of installation (kt CO_2), 2008



Note: Zero: emitters with verified zero emissions; mini: emitters below 25 kt CO_2/year; small: emitters of 25 to 50 kt CO_2/year; medium: emitters of 50 to 500 kt CO_2/year; large: emitters over 500 kt CO_2/year. For seven installations, the size is unknown.

Source: CITL, 29 April 2009/26 May 2009.

Norway decided to already auction a larger part of allowances in the second trading period: not being an EU Member State, it was not limited to the maximum amount of 10 % auctioning defined in the Emission Trading Directive. On the other hand, also in 2008 in four countries allocation exceeded verified emissions by more than 10 % (Lithuania, Luxembourg, Romania and the Slovak Republic). In Liechtenstein, Luxembourg and the Slovak Republic, not a single sector had to purchase allowances.

There is a clear difference between allocation to combustion installations and to industrial sectors. Many countries have decided to reduce free allocation to the power producers, as they have passed on the opportunity cost for the EUA to consumers via the electricity prices even though they had received a free allocation (so-called windfall-profits). Consequently, operators of combustion installations had to purchase additional allowances in 2008 in 19 countries. Nevertheless, in seven countries the sector could sell excess allowances (the Czech Republic, France, Latvia, Liechtenstein, Lithuania, Luxembourg and the Slovak Republic).

Overall, in 2008 the free allocation to industrial sectors exceeded their emissions in all countries except Austria and Slovenia. The sectors with the highest allocation compared to emissions are the production of pig iron and steel (39 % excess allowances) and the manufacture of ceramics (35 % excess allowances). A part of the over-allocation of the iron and steel sector can be explained by the fact that in some countries the blast furnaces also received a free allocation for CO_2 that is transferred from the iron and steel sector to combustion installations. This transfer can influence the assessment of whether the installations are long or short. But probably a large part of the over allocations in the industrial sectors can be explained by the strong economic slowdown in 2008, which hit industrial sectors proportionately stronger than the economy as a whole.

Whereas metal is roasted and sintered in eight countries, installations in only four countries had to purchase additional allowances. In contrast, pulp, paper and board is produced in most participating countries and in all of them except Denmark operators benefited from a generous allocation compared to actual emissions. In Romania and the Slovak Republic, the allocation was about three times higher than the level of emissions.

The category 'Other activities opted-in' includes all installations that are opted in under Article 24 of the Trading Directive. In practice, the activity of an installation listed in this sector is often not clear. In addition, the value for EU 27 and all countries is misleading, as for over 90 % of the emissions in the sector, allocation data was not yet published.

In many ways, the first trading period, from 1 January 2005 until 31 December 2007, can be seen as a trial phase, taking into account that the EU ETS is the first multinational emission trading scheme of this magnitude. Only limited information was available