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Approximated EU GHG inventory: proxy GHG estimates for 2012

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Contact persons

Ricardo Fernandez
European Environment Agency (EEA)
Ricardo.fernandez@eea.europa.eu

Anke Herold
Oeko Institut — EEA's European Topic Centre
on Air Pollution and Climate Change Mitigation
(ETC/ACM)
a.herold@oeko.de

European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark
Tel.: +45 33 36 71 00
Fax: +45 33 36 71 99
Web: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

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The full report and annexes are available at:

http://www.eea.europa.eu/publications/approximated-EU-ghg-inventory-2012

Note to the reader:

Estonia corrected its energy statistics in September and emissions in non-ETS sectors appear to be overestimated in the current report as a result. The EEA has not been able to incorporate Estonia's late data revision in the Proxy GHG estimates.

Executive summary

Objective of the report

This report provides approximated estimates of greenhouse gas (GHG) emissions in the EU-15 and EU-28 for the year 2012. They are also referred to as 'proxy' estimates in this report, and they are based on incomplete activity and/or emissions data at country level. The EU proxy estimates include Croatia for the first time. The official submission of 2012 data to the United Nations Framework Convention on Climate Change (UNFCCC) will occur in 2014.

In recent years, the EEA and its European Topic Centre on Air Pollution and Climate Change Mitigation have developed a methodology to estimate GHG emissions using a 'bottom-up' approach. This 'bottom-up' approach is used in this report. It uses data (or estimates) for individual countries, sectors and gases to derive EU GHG estimates for the preceding year (also known as 't-minus-1'). For transparency, this report shows the country-level GHG estimates from which the EU estimates have been derived. The 2012 estimates are based on the latest activity data available at country level, and these estimates assume no change in emission factors or methodologies as compared to the official 2013 submissions to UNFCCC (which relate to emissions in 2011).

The data and estimates used in this report have mostly been compiled by the EEA's European Topic Centre on Air Pollution and Climate Change Mitigation and are shown in Annex II of the full report. However, some EU Member States also estimate and publish their own proxy estimates of GHG emissions for the preceding year. Where such estimates exist they are clearly referenced in this report in order to ensure complete transparency regarding the different GHG estimates available. EU Member States' own proxy estimates were also used for quality assurance and quality control of the EEA's GHG proxy estimates for 2012.

Finally, the EEA has also used the proxy estimates of 2012 GHG emissions produced by EEA member countries to assess progress towards the Kyoto targets in its annual trends and projections report (due to be published alongside the present report). In that report, the EEA's own proxy estimates for 2012 were only used for countries that lack their own estimates to track progress towards national and EU targets.

Rationale for proxy GHG emission estimates

The European Union (EU), as a Party to the UNFCCC, reports annually on GHG inventories within the area covered by its Member States (i.e. emissions occurring within its territory). National GHG inventories for EU Member States are only available with a delay of one and a half years. Inventories submitted on 15 April of the year t therefore include data up to the year t-minus-2. For example, the data submitted on 15 April 2013 included data covering all of 2011, but not 2012.

The latest official EU data available (1990–2011) covering all countries, sectors and gases were released on 30 May 2013 (EEA, 2013a) in connection with the annual submission of the EU GHG inventory to the UNFCCC (EEA, 2013b). The inventory data include GHG emissions not controlled by the Montreal Protocol — both from sectors covered by the EU Emission Trading Scheme (ETS) and from non-trading sectors. However, whereas UNFCCC emissions run on a year t-minus-2 timeline, Kyoto registries and EU ETS information are available on a year t-minus-1 timeline. Verified EU ETS emissions are therefore already available for 2012 (EEA, 2013b).

There are clear advantages in generating proxy GHG estimates for all sectors. Under the Kyoto Protocol, the EU-15 took on a common commitment to reduce emissions by 8 % between 2008 and 2012 compared to emissions in the base year. Total emissions from sectors included in the EU ETS are capped for the period 2008–2012, meaning that EU compliance with the Kyoto targets will be largely determined by the performance of non-ETS sectors, i.e. those sectors for which data are only available on a t-minus-2

timeline. A proxy estimate of the previous year's emissions can therefore improve tracking and analysis of progress towards Kyoto targets, as is done in the annual EEA report on greenhouse gas emission trends and projections in Europe. Member States seeking to determine whether they need to use Kyoto's flexible mechanisms to achieve their targets also benefit from access to proxy data.

In addition, the EU's 2009 Climate and Energy Package encourages both the trading and non-trading sectors to run on similar timelines. The Package is the EU's first step in its commitment to limit the global average temperature increase to no more than 2 °C above pre-industrial levels. In order to achieve this commitment, Member States agreed to reduce total EU GHG emissions in 2020 by 20 % compared to 1990 (and to achieve a reduction of 21 % for ETS sectors by 2005, as well as a reduction of 10 %, with country-specific targets, for non-ETS sectors compared to 2005). As with Kyoto, meeting the 2020 national targets will largely be determined by how countries reduce emissions in the non-trading sectors. Proxy GHG estimates can therefore help track progress towards the EU and national targets for 2020.

Publishing a proxy GHG emissions report also fulfils the goals of the 'Beyond GDP' process (EU, 2011), which encourages authorities to produce data on the environment with the same frequency and timeliness as they produce data on the economy.

Previous proxy GHG emission estimates for 2008, 2009, 2010 and 2011

At the end of August 2009, the EEA published its first proxy estimates of total greenhouse gas emissions in 2008 (EEA, 2009). The actual reduction in greenhouse gas emissions in 2008, as officially reported to the UNFCCC in 2010, was within the 'confidence interval' of the EEA's mean proxy estimates for the EU-15 and the EU-27, indicating that our proxy estimates were relatively accurate.

In 2010, 2011, and 2012, the EEA continued to publish its proxy emission estimates for 2009, 2010 and 2011 respectively (EEA, 2010, 2011 and 2012). Just as was the case with our first proxy estimates, the EEA's proxy estimates for the EU-15 and the EU-27 were accurate for 2009 and 2010, with subsequent official UNFCCC emissions falling within the expected range of uncertainty. For the proxy inventory for the year 2011, the EEA underestimated the emissions decline at EU level compared to the official data submitted to UNFCCCC in 2013. One of the key reasons for this underestimate was that we compiled our estimates without a complete energy balance by final uses, a problem that mainly affected our knowledge of the consumption of heat in the residential and commercial sectors. This has been taken into account in the uncertainty estimates of this year's prediction.

The main factors explaining the change in emissions in 2011 compared to 2010 were further analysed in the 2013 EU GHG inventory submitted to the UNFCCC and in the underpinning analysis paper 'Why did greenhouse gas emissions decrease in the EU in 2011?' (EEA, 2013b).

Methodology for proxy GHG emission estimates

The present report sets out the estimated GHG emissions for 2012 for the EU Member States, the EU-15 and the EU-28 based on data sources that were published by mid-July of 2013. The estimates cover total GHG emissions as reported under the Kyoto Protocol and the UNFCCC excluding the land use, land-use change and forestry (LULUCF) sector.

Estimates are made for all major source categories in all sectors. For the most important source categories, data sources with updated activity or emissions data for the year t-minus-1 were identified and used to calculate emissions. For source categories for which no international datasets with updated activity data exist or which are too complex for such an approach, emissions were extrapolated from past trends (linear extrapolation), or emissions from the previous year were kept constant if historic data did not show a clear trend. On this basis, a detailed bottom-up approach was developed covering the full scope of emissions included in a GHG inventory submission.

The EEA estimates are based on publicly available datasets at the national, European and international levels. These datasets are disaggregated by major source categories in all sectors reported under the UNFCCC and the Kyoto Protocol. Some countries provided and/or published their own proxy greenhouse gas estimates (Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Poland, Spain, Slovenia, Sweden, the United Kingdom, Norway and Switzerland). Where

relevant, the EEA also used these estimates to assess current progress in relation to greenhouse gas emission targets and to verify its own calculations.

Proxy GHG emission estimates for 2012 at EU level

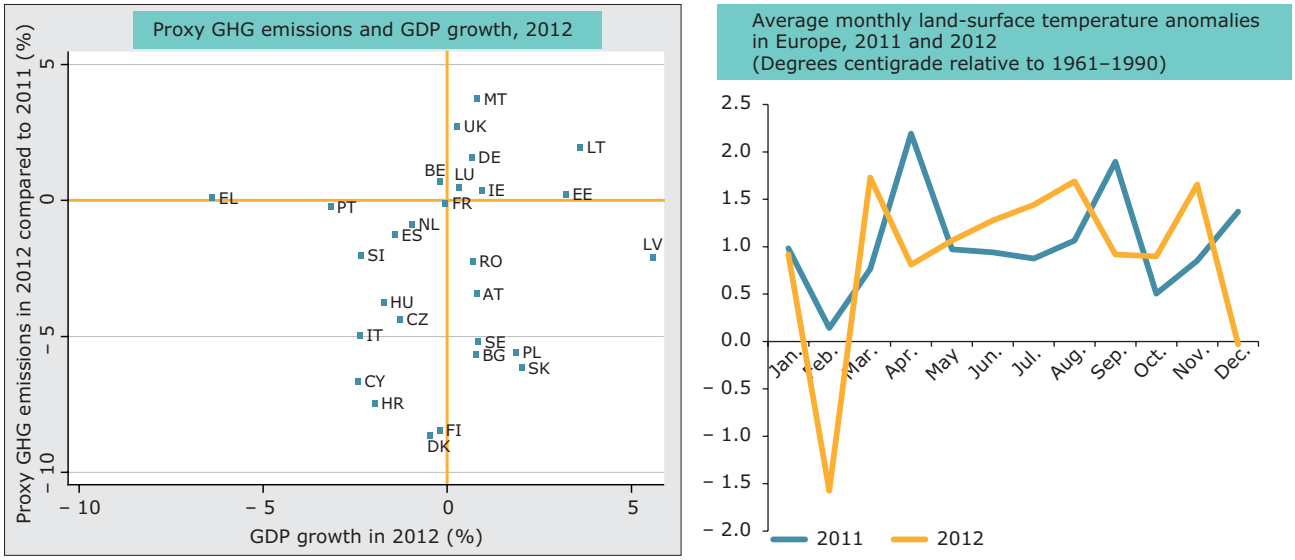
The 2012 EEA estimates indicate that EU greenhouse gas emissions continued to decrease slightly between 2011 and 2012, although by less than the decrease in emissions between 2010 and 2011. Compared to the 2011 official emissions published earlier this year, the fall in total greenhouse gas emissions (without LULUCF) between 2011 and 2012 is estimated to be – 9.2 Mt CO_2-equivalent or a decline of 0.3 % (uncertainty +/– 1.7 %) for the EU-15. For the EU-28, the decline (also without LULUCF) is estimated at 42.6 Mt CO_2-equivalent or 0.9 % (uncertainty +/– 2.3 %). The greenhouse gas emissions for the new EU Member States in 2012 (EU-13) decreased by – 3.8 % compared to the previous year. Based on these proxy estimates, total EU-15 emissions in 2012 would be 14.9 % below the 1990 level and 15.1 % below base-year level. For the EU-28, total GHG emissions in 2012 are estimated to be 19 % below 1990 emissions.

The small emission decrease for the EU-28 came along with economic recession across the EU between 2011 and 2012. Gross Domestic Product (GDP) decreased by – 0.3 % for the EU-28 in this period. Total GHG emissions are expected to decrease by 0.9 % in 2012 in EU-28. Notwithstanding economic developments in specific sectors and countries, there was no apparent correlation between GDP and GHG emissions in the EU in 2012, although emissions did not increase significantly in any MS where GDP was negative (see Figure ES.0).

The winter in Europe was generally colder in 2012 than it was in 2011 (see Figure ES.0). This led to higher heating demand and higher emissions from the residential and commercial sectors. However, higher residential emissions did not offset much lower emissions in other combustion sectors, and as a result, total fossil fuel emissions decreased for the EU as a whole.

Between 2011 and 2012 emission reductions in the EU-15 were greater for the installations covered by the European Emissions Trading System (a decline in emissions of 0.9 %) (see Figure ES.4 at the end of this summary) than they were in the non-ETS sectors (where emissions remained at a relatively stable level, growing by 0.1 %). In the EU-28, the ETS sectors showed larger reductions in the same period (falling 1.9 %) compared to the non-ETS sectors (which also saw little change, with emissions falling 0.2 %). For the new Member States (EU-13), the

Figure ES.0 GHG emissions, GDP growth and monthly European temperatures, changes 2011–2012



Note: GDP from DG ECFIN's Ameco database, European Commission. Average monthly land-surface temperatures from the United Kingdom's Met Office Hadley Centre, HadCRUT3 dataset.

Source: EEA.

decrease in the ETS sectors between 2011 and 2012 was also greater (falling 5.3 %) than the non-ETS sectors (where emissions fell by 1.9 %).

On a sectoral basis, the greatest absolute reduction in emissions in the EU occurred in the energy sector (a broad definition that covers all fuel combustion activities including transport, domestic heating, and electricity production from combustible fuels such as coal, oil and gas), and this reduction was largely made in the new Member States. GHG emissions from the energy sector fell by – 34.4 Mt CO_2-equivalent (a decline of 0.9 %) across the EU-28 between 2011 and 2012. The decrease for the energy sector in the EU-15 was only – 3.1 Mt CO_2-equivalent (a decline of 0.1 %). This decrease in emissions in the energy sector reflects the decline of gross inland energy consumption in the EU-28 in 2012. Within the energy sector, emissions decreased mostly in manufacturing industries, construction and transportation. However, emissions from the residential and commercial parts of the energy sector increased significantly because of larger heat consumption.

Based on BP data (BP, 2013), total fuel consumption in the EU fell by 2 % between 2011 and 2012 (falling by 2 % in the EU-15, and by 4 % in the new Member States), with different trends for the different fossil fuel types: natural gas consumption fell by 2 % and liquid fuel consumption fell by 4 %, but consumption of coal increased by 4 % ([1]). The decrease in oil consumption is likely to be an effect of oil prices remaining at the high levels they reached in 2011.

Electricity production from renewable sources increased by about 11 % between 2011 and 2012 in the EU, according to BP data (BP, 2013) ([2]). Energy production from wind and solar continued to increase strongly in 2012. The use of renewables continues to play an important role in GHG mitigation efforts by the EU and its Member States. Nuclear electricity production across the EU-27 decreased by 3 % in 2012 compared to 2011 according to BP data.

Greenhouse gas emissions from industrial processes decreased in 2012 compared to 2011, falling by 1.4 % in the EU-15 and by 1.6 % in the EU-28. Emissions from mineral products fell by 6.2 % in the EU-15 in 2012 compared to 2011, and by 5.5 % in the EU-28 in the same period. This is consistent with the decrease in emissions from cement and lime production under the EU-ETS in the same period, which was 6.9 % for the EU-15 and 7.0 % for the EU-27. Emissions released by metal production decreased in the EU-15 by 2.9 % and in the EU-28 by 1.4 % between 2011 and 2012. Emissions from chemical production remained relatively stable in the EU-15 (rising by only 0.6 % between 2011 and 2012) while decreasing (down 1.6 %) in the EU-28.

Figure ES.1 shows the emission trend for total GHG emissions without LULUCF in EU-15 and EU-28 in the period 1990–2012 ([3]).

Change in GHG emissions in the period 1990–2012

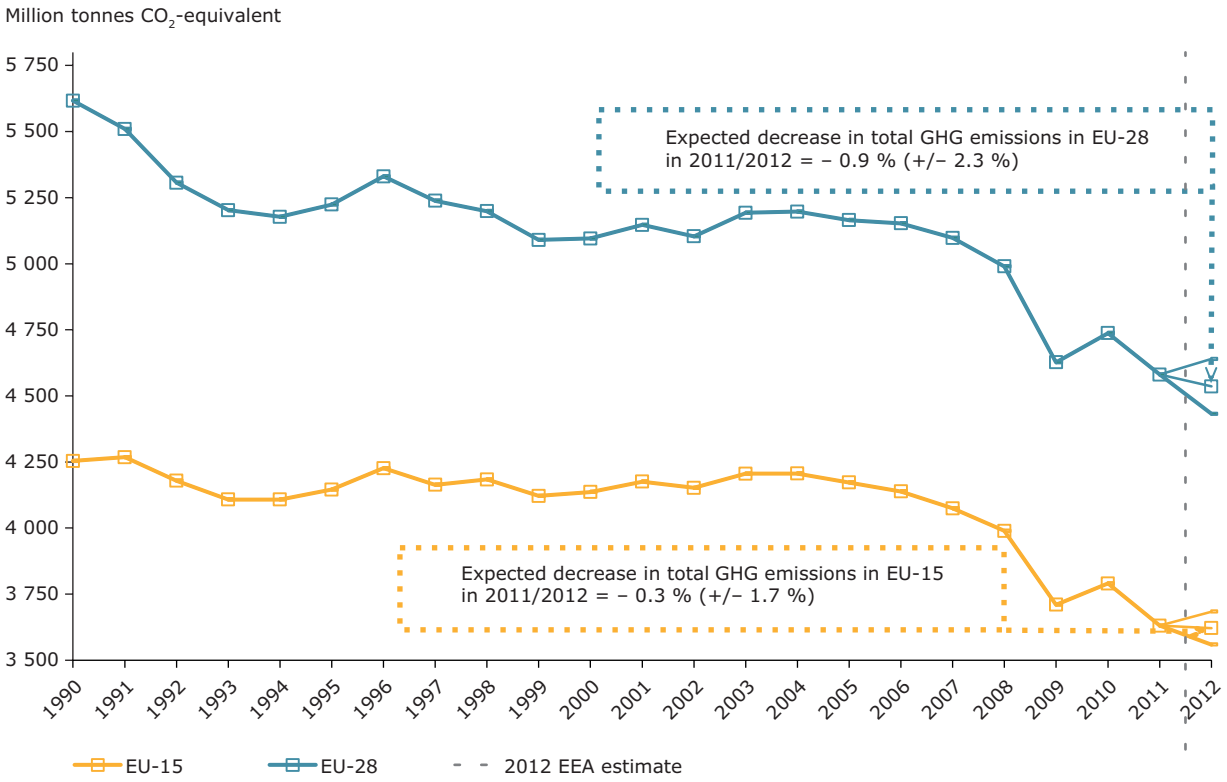
Figure ES.2 presents the estimated change in GHG emissions for each Member State between 1990 and 2012 ([4]).

Based on these 2012 estimates, total EU-15 GHG emissions in 2012 were 14.9 % below the 1990 level and 15.1 % below base year level. For the EU-28, total GHG emissions in 2012 are estimated to be 19.1 % below 1990 levels.

A wide range of factors and policies (climate-related and nonclimate-related) have contributed to the long-term decline in GHG emissions in the EU, particularly for CO_2. These include improvements in energy efficiency, the shift to less carbon-intensive fossil fuels, and the strong increase in renewable energy use. Implementation of the EU's Climate and Energy Package should lead to further reductions in emissions. The direct effects of the Montreal Protocol in reducing emissions of ozone-depleting substances have also indirectly contributed to very significant reductions in emissions of some potent

([1]) Whereas fuel consumption trends based on Eurostat monthly data show relatively similar trends for liquid and solid fuels than BP data, Eurostat data indicate a higher reduction in natural gas consumption in the EU (of – 4 %) than BP data.
([2]) Eurostat data were also analysed here, however these data were incomplete with regard to biomass consumption and solar consumption for some EU Member States and were therefore not used for the assessment of trends.
([3]) This is not equivalent to the difference to base year emissions because of accounting rules such as the selection of the base year (which varies from country to country) for F-gases and the continuing recalculations of GHG inventories.
([4]) The percentage change cannot be directly compared to the emission reduction obligations under the Kyoto Protocol and the Effort Sharing Decision because Member State net balances under the EU Emission Trading Scheme (ETS) need to be taken into account and the fixed base-year emissions are not identical to the latest recalculation of 1990 emissions. Furthermore, Member State use of flexible mechanisms and LULUCF activities also contribute to compliance with the Kyoto targets.

Figure ES.1 Trends in total greenhouse gas emissions excluding LULUCF in the EU-15 and the EU-27



Source: EEA European Topic Centre for Air Pollution and Climate Change Mitigation (ETC/ACM), based on the 2013 EU greenhouse gas inventory submitted to the UNFCCC for the years 1990-2011 and proxy estimates for 2012.

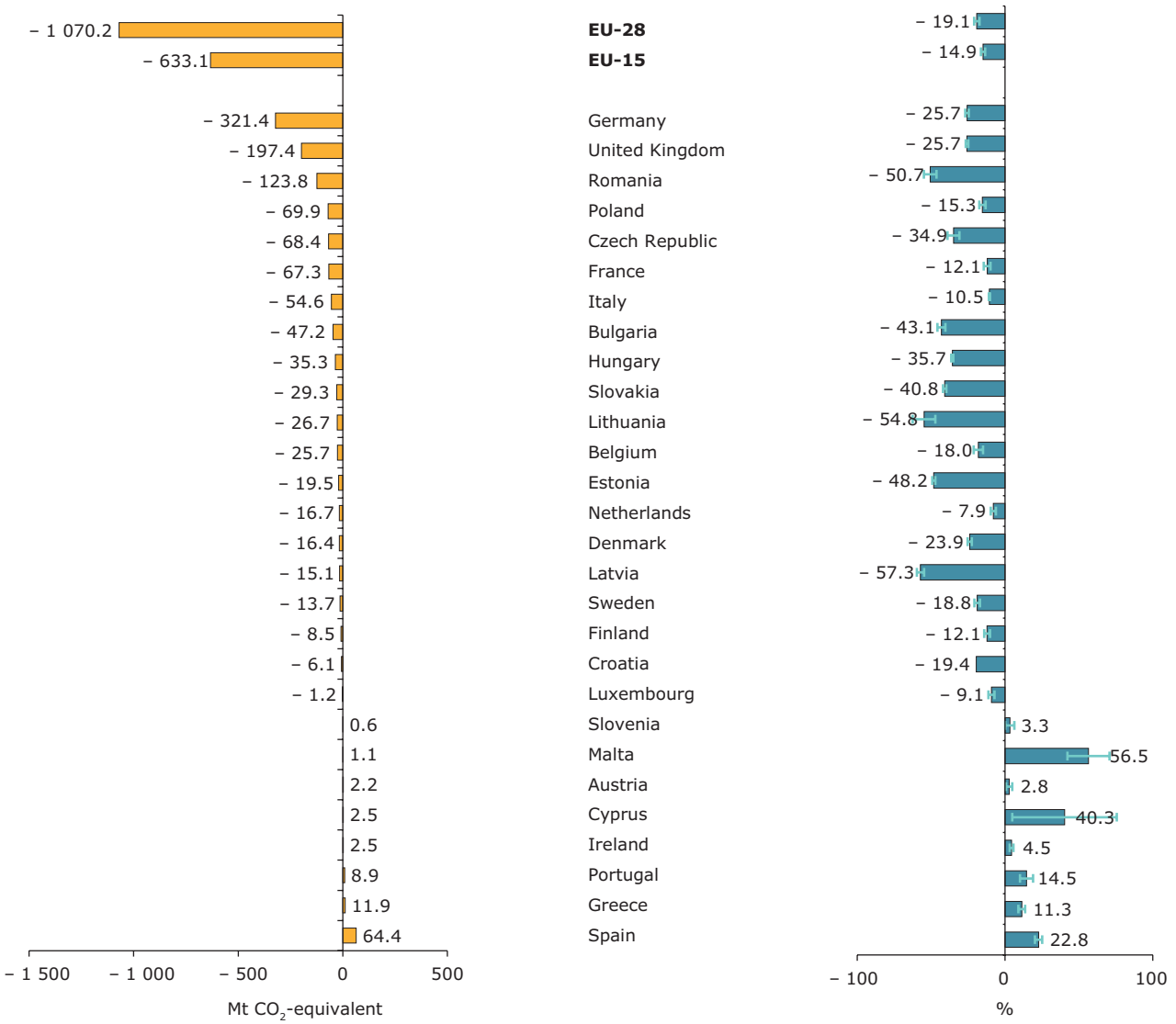
greenhouse gases such as chlorofluorocarbons. Specific polices to reduce fluorinated gases have also slowed the growth in consumption of fluorinated gases with high global warming potential. Other EU policies such as the Nitrates Directive, the Common Agriculture Policy (CAP), and the Landfill Waste Directive have also been successful in indirectly reducing greenhouse gas emissions from non-CO_2 gases such as methane and nitrous oxides.

Change in GHG emissions in the period 2011–2012 at Member State level

As Figure ES.3 illustrates, GHG emissions decreased in 19 Member States (Italy, Poland, Czech Republic, Finland, Denmark, Bulgaria, Spain, Belgium, Slovakia, Croatia, Romania, Austria, Hungary, Sweden, Cyprus, Slovenia, Luxembourg, Latvia and Portugal). The largest absolute decrease in emissions occurred in Italy (a decline of 24.4 Mt CO_2-equivalent or 5.0 % compared to 2011), followed by Poland (a decline of 12.3 Mt CO_2-equivalent or 3.1 %), the Czech Republic (a decline of 5.8 Mt CO_2-equivalent or 4.4 %), Finland (a decline of 5.1 Mt CO_2-equivalent or 7.6 %) and Denmark (a decline of 3.9 Mt CO_2-equivalent or 7.0 %). The largest relative fall in emissions compared to the previous year took place in Croatia (down 9.8 %), followed by Finland (down 7.6 %), Denmark (down 7.0 %), Cyprus (down 6.6 %) and Slovakia (down 6.2 %). The largest absolute growth in emissions occurred in the United Kingdom (up 17.4 Mt CO_2-equivalent or 3.1 %) and Germany (up 12.4 Mt CO_2-equivalent or 1.4 %). Chapter 1 of the main report includes explanations for some of the change in emissions by Member State.

Eighteen Member States also calculated preliminary GHG inventories (or at least some parts of the GHG emissions) for the year 2012 and made these results available to the authors of this report. Austria, Belgium, Croatia, Denmark, Germany, Finland, Ireland, Italy, Luxembourg, Malta, the Netherlands, Poland, Slovenia, Spain and Sweden estimated complete emissions in the form of CRF summary table 2, similar to the

Figure ES.2 Change in total GHG emissions (without LULUCF) in the EU and its Member States, 1990–2012



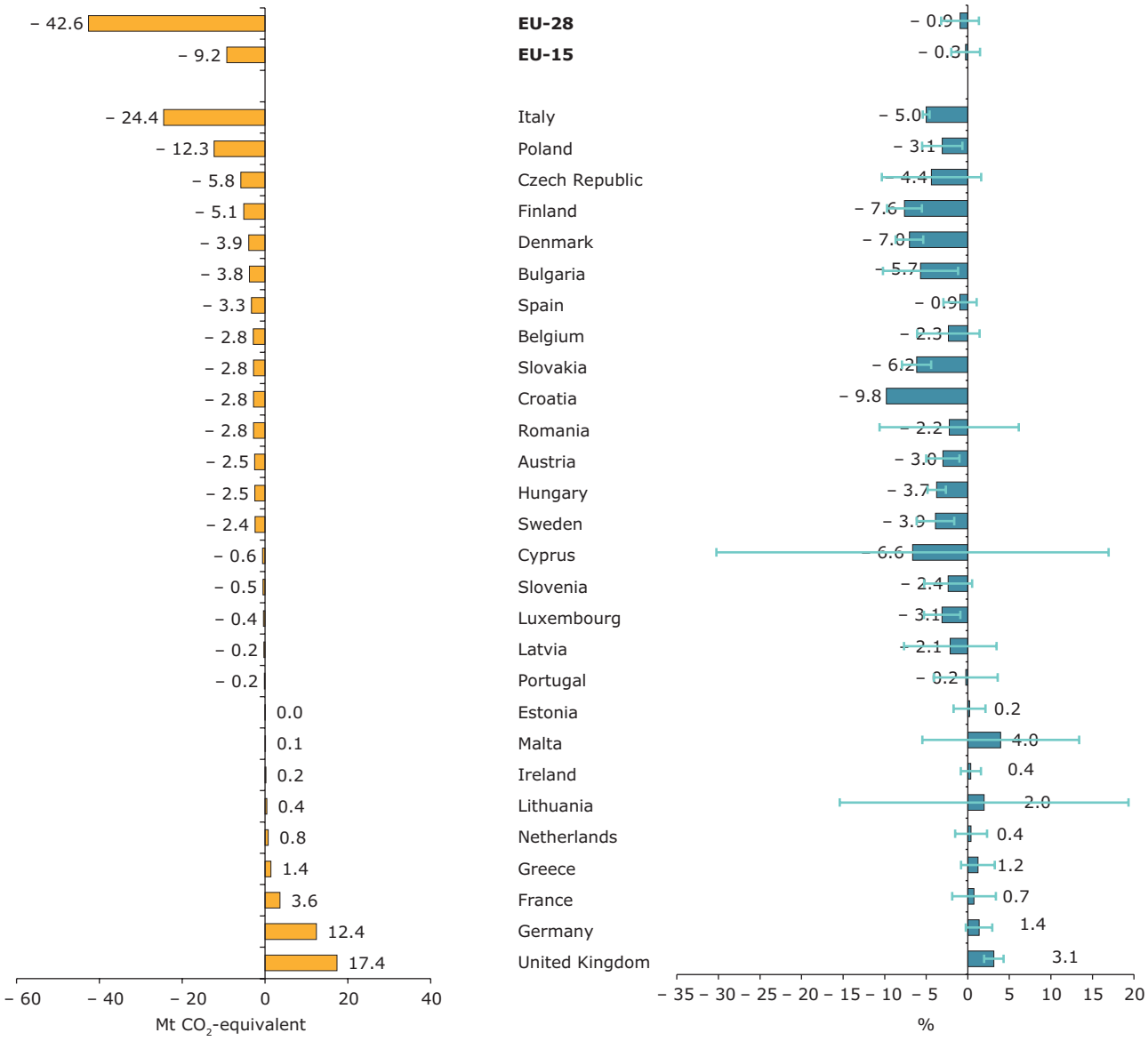
Note: For two Member States — Denmark and the United Kingdom — inventories submitted to the UNFCCC are different to the inventories submitted under the EU Monitoring Mechanism Decision due to the fact that Kyoto inventories include non-EU territories. In the case of Denmark, this means that Greenland is included in one set of data but not in the other, and in the case of the United Kingdom, emissions from Gibraltar and the Falklands are included in one set but not in the other. The comparison in this table refers to the EC GHG inventory as consistent with the inventory submitted under the EC Monitoring Mechanism Decision.
Error bars are based on the absolute difference between last year's proxy estimates for each member state and the subsequent reported emissions, weighted by sector.

Source: The EEA's proxy GHG emissions are based on the 2013 EU greenhouse gas inventory to UNFCCC for 1990–2011 and on proxy estimates for 2012.

approach in this report. France, Greece, and the United Kingdom provided emission estimates for 2012 as national totals but not for all disaggregated inventory subcategories and/or not disaggregated by the different greenhouse gases.

According to the country estimates, the expected change in GHG emissions in 2012 compared to 2011 is as follows: Austria (– 3.4 %), Belgium (+ 0.7 %), Croatia (– 7.5 %), Denmark (– 8.6 %), France (– 0.1 %), Germany (+ 1.6 %), Greece (+ 0.1 %), Finland (– 8.5 %), Italy (– 5.0 %), Ireland (+ 1.8 %), Luxembourg (+0.5 %), Malta (+ 3.7 %), the Netherlands (– 0.9 %), Poland (– 5.6 %), Slovenia (– 2,0 %) Spain (–1.3 %), Sweden (– 5.2 %) and the United Kingdom (+ 3.3 %).

Figure ES.3 Changes in total GHG emissions (without LULUCF) for the EU and its Member States, 2011–2012



Note: For two Member States — Denmark and the United Kingdom — inventories submitted to the UNFCCC are different to the inventories submitted under the EU Monitoring Mechanism Decision due to the fact that Kyoto inventories include non-EU territories. In the case of Denmark, this means that Greenland is included in one set of data but not in the other, and in the case of the United Kingdom, emissions from Gibraltar and the Falklands are included in one set but not in the other. The comparison in this table refers to the EC GHG inventory as consistent with the inventory submitted under the EC Monitoring Mechanism Decision.
Error bars are based on the absolute difference between last year's proxy estimates for each member state and the subsequent reported emissions, weighted by sector.

Source: The EEA's proxy GHG emissions are based on the 2013 EU greenhouse gas inventory to UNFCCC for 1990–2011 and proxy y estimates for 2012.

Using the available proxy emission estimates by Member States, EU-28 emissions are expected to decrease by 1.3 % between 2011 and 2012 (compared to 0.9 % when using EEA proxy estimates only). For the EU-15, emissions would decrease by 0.4 % using available proxy estimates by MS (compared to 0.3 % when using EEA estimates).

These preliminary data estimated by Member States were very useful for QA/QC purposes of the approximated EU inventory. In general, the preliminary estimates from both sources (i.e. both EEA-sourced proxy data and Member States' own estimates) matched well with differences smaller than ± 1–2 %, except for Belgium (where the

difference was – 3.1 %), Croatia (– 2.5), Luxembourg (– 3.7 %) and Poland (+ 2.6 %).

Some of these Member States published their own approximated greenhouse gas emissions for 2012, and the list below provides the links to these sources for individual EEA member countries:

- **Austria:** www.umweltbundesamt.at/aktuell/presse/lastnews/news2013/news_130809
- **Finland:** www.stat.fi/til/khki/2012/khki_2012_2013-05-16_tie_001_en.html
- **Germany:** www.umweltbundesamt.de/uba-info-presse/2013/pd13-009_treibhausgasausstoss_im_jahr_2012_um_1_6_prozent_gestiegen.htm
- **France:** www.citepa.org/fr/inventaires-etudes-et-formations/inventaires-des-emissions/secten
- **Spain:** www.magrama.gob.es/es/calidad-y-evaluacion-ambiental/temas/sistema-espanol-de-inventario-sei-/Avance_Emisiones_GEI_2012_tcm7-285604.pdf
- **Sweden:** www.naturvardsverket.se/Sa-mar-miljon/Klimat-och-luft/Klimat/utslapp-av-vaxthusgaser/rekordlaga-utslapp-ar-2012
- **United Kingdom:** www.gov.uk/government/publications/provisional-uk-emissions-estimates.

Uncertainty in proxy GHG emission estimates

There is always a degree of uncertainty in estimating greenhouse gas emissions. This uncertainty increases if there is a lack of up-to-date activity data for some source categories, or there are changes in implied emission factors or in the methodologies used by Member States.

The proxy 2012 estimates are based on the national methodologies and emission factors used by Member States in their 2013 official submissions to the UNFCCC. Current quality improvements in Member State inventories take effect in next year's official submissions to the UNFCCC and are therefore a source of uncertainty for the proxy inventory.

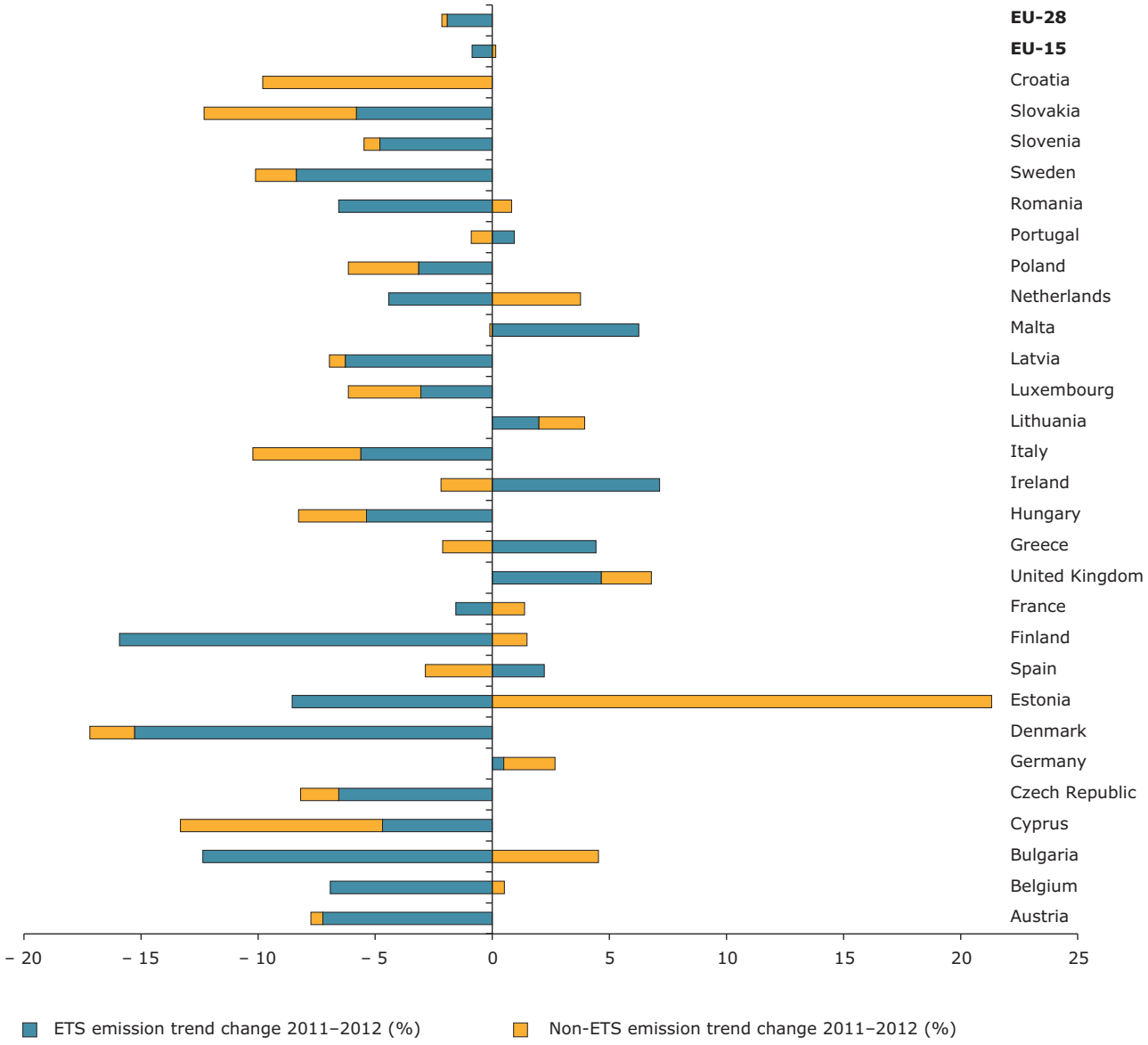
The uncertainty ranges presented for the proxy 2012 estimates are derived by comparing the official national data submitted to the UNFCCC for 2011 with the EEA proxy estimates for that year. However, by assessing the proxy greenhouse gas estimates that several Member States have produced for 2011 (Austria, Denmark, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Poland, Slovakia, Spain and the United Kingdom), the EEA was able to verify the most suitable methodology for calculating emissions, resulting in a reduced uncertainty range.

The uncertainty ranges for the approximated 2012 GHG emissions presented in this analysis are also derived by comparing the official national data submitted to the UNFCCC for 2011 with the EEA proxy estimates for that year. Each emissions source category is estimated using different methodologies, and each emission-source category makes a different contribution to Member States' total greenhouse gas emissions. For this reason, the emission deviations are assessed at sectoral level for each EU Member State ([5]) and are weighted by the sectoral emission levels. For the EU-15 and EU-27, the uncertainty for the approximated 2012 emissions is estimated as the weighted mean of these differences: weighted again by the relative contribution that each Member State makes to total EU-15 and EU-27 emissions. As Croatia only joined the EU on 1 July 2013 it is not possible to calculate an uncertainty in this way for that country. Thus, for EU-28 emission estimates, the uncertainty range calculated for the EU-27 as explained above was used.

Official 2012 greenhouse gas emissions for the EU will be available in the late May or early June 2013, when the EEA publishes the EU greenhouse gas inventory 1990–2012, and the inventory report 2014 for submission to the UNFCCC.

([5]) The deviation assessment was performed at the levels of the sectors '1: Energy', '2: Industrial processes', '3: Solvent and other Product use', '4: Agriculture' and '6: Waste'.

Figure ES.4 Change in GHG emission trends in Europe separated between ETS and non-ETS emissions between 2011 and 2012 in percentage



Note: Estonia corrected its energy statistics in September and emissions in non-ETS sectors appear to be overestimated in the current report as a result. The EEA has not been able to incorporate Estonia's late data revision in the Proxy GHG estimates.

Source: The EEA's proxy GHG emissions are based on the 2013 EU greenhouse gas inventory to UNFCCC for 1990-2011, on proxy estimates for 2012, and on verified emissions from EUTL as of August 2013.

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European Environment Agency
Kongens Nytorv 6
1050 Copenhagen K
Denmark

Tel.: +45 33 36 71 00
Fax: +45 33 36 71 99

Web: eea.europa.eu
Enquiries: eea.europa.eu/enquiries

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