Estimate of historical emissions for stationary installations to reflect the current scope of the EU ETS (2013-2020)

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Verena Graichen, Johanna Cludius, Sabine Gores

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Historic emissions from a stationary installation

Author affiliation:
Verena Graichen, Johanna Cludius, Sabine Gores (Öko-Institut, DE)

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ETC/ACM Technical Paper 2017/2
European Topic Centre on Air Pollution and Climate Change Mitigation
PO Box 1
3720 BA Bilthoven
The Netherlands
Phone +31 30 2748562
Fax +31 30 2744433
Email etcacm@rivm.nl
Website http://acm.eionet.europa.eu/

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Summary

The Emission Trading System (ETS) ([1]) of the European Union (EU) was launched in 2005 and has been a milestone of EU climate policy. The two first trading periods took place between 2005 and 2007, and between 2008 and 2012. In 2013, the EU ETS entered its third trading period, covering approximately 12 000 stationary installations. The scope of the ETS in the third period is larger than in the two previous trading periods: some of the installations today covered by the ETS have not been participating in the system since 2005 and some greenhouses gases of already participating installations have not been regulated under the scheme in earlier periods. A meaningful analysis of ETS emissions over time and across trading periods needs to account for those additional emissions.

This paper presents a methodology used by the European Environment Agency (EEA) to complement the emissions data available from the European Union Transaction Log (EUTL) for the period 2005–2012 with additional emission estimates in order to reflect the current scope of the EU ETS (for the period 2013–2020). With such estimates, it is possible to build a consistent time series of emissions under the EU ETS for stationary installations. These estimates are calculated using complementary methods outlined in the paper, as well as data directly provided by Member States. The methods used have different levels of uncertainty. In the end, the full data set provides a basis for assessing emission trends in the EU ETS as a whole and at the national level ([2]). The data set also allows for the calculation of consistent time series of national emissions in the sectors covered by Decision No 406/2009/EC, the Effort Sharing Decision (ESD) ([3]), i.e. by definition outside of the EU ETS.

Based on the methodology described in the paper, verified emissions (available in the EUTL) for the entire EU ETS are adjusted upwards. These adjustments represent 15 % of total emissions in 2005, then drops to 10 % in 2007 and finally 5 % in 2012 (see Figure 0-1 and Table 0-1).

Methodology

The EU ETS started in 2005 and covered only CO_2 emissions from the EU-25 countries ([4]). In 2007, Bulgaria and Romania joined the EU and its ETS. Installations from Liechtenstein and Norway entered the scheme at the start of the second trading period in 2008. At the same time, additional installations from already participating countries started to be covered by the scheme, due to the end of opt-outs and to the clarification of the definition of combustion installations. At the start of the third trading period in 2013, stationary installations from Croatia and Iceland started to be covered by the EU ETS. At the same time, a range of new sectors and source categories were included, in particular N_2O emissions from the production of nitric and adipic acid, glyoxal and glyoxylic acid and PFC emissions from the production of aluminium.

To reflect these changes in scope, six types of estimates were calculated to be added to ETS verified emissions, in order to derive a time series starting from 2005 consistent with the scope of the third trading period (see Figure 0-2).

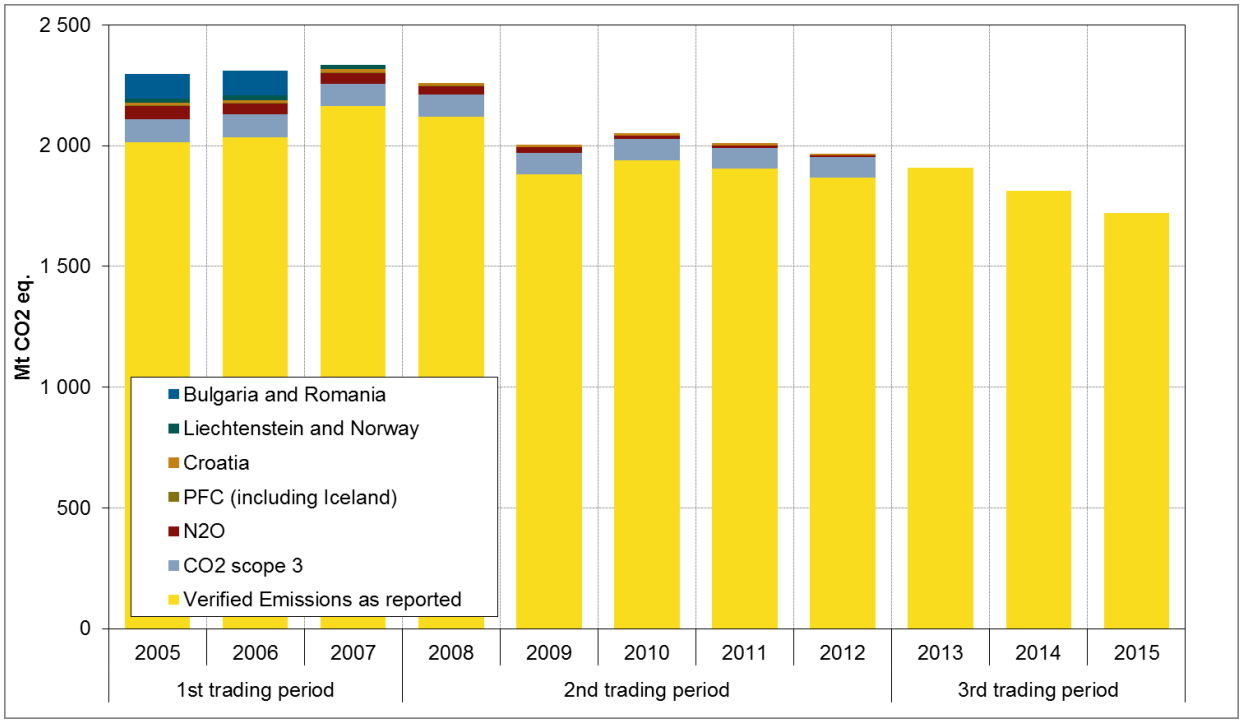
([1]) This paper uses indifferently the terms “system” and “scheme” to refer to the EU ETS.

([2]) The paper does not provide estimates at sector level as the level of uncertainty at sector level would have been significantly higher using a top-down method applicable to all Member States.

([3]) ETS and ESD emissions are directly related: the sum of stationary ETS, ESD and domestic aviation CO_2 emissions is always equal to total GHG emissions reported in national GHG inventories, excluding emissions from land use, land-use change and forestry (LULUCF).

([4]) Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

Figure 0-1 Verified emissions and estimate of emissions to reflect the scope of the third trading period (2005–2014)



Source: EUTL, 2017; EEA.

Three estimates of additional emissions to reflect the expansion of the scope in the second trading period:

- An estimate of emissions for Bulgaria and Romania before entering the EU ETS. This is relevant in 2005 and 2006 and was calculated using inventory emissions and EUTL verified emissions for these countries in 2007-2009.
- An estimate of emissions for Liechtenstein and Norway before entering the EU ETS in 2008. Their historical emissions in 2005 were taken from the respective NAP and combined with 2008 verified emissions from the EUTL.
- An estimate for the additional emissions covered as a result of changes in scope between the first and second trading period related to opt-outs and the clarification of the definition of combustion installations. The estimate of emissions was performed using information stemming from the process to determine annual allocation allowances (AEAs) under the ESD.

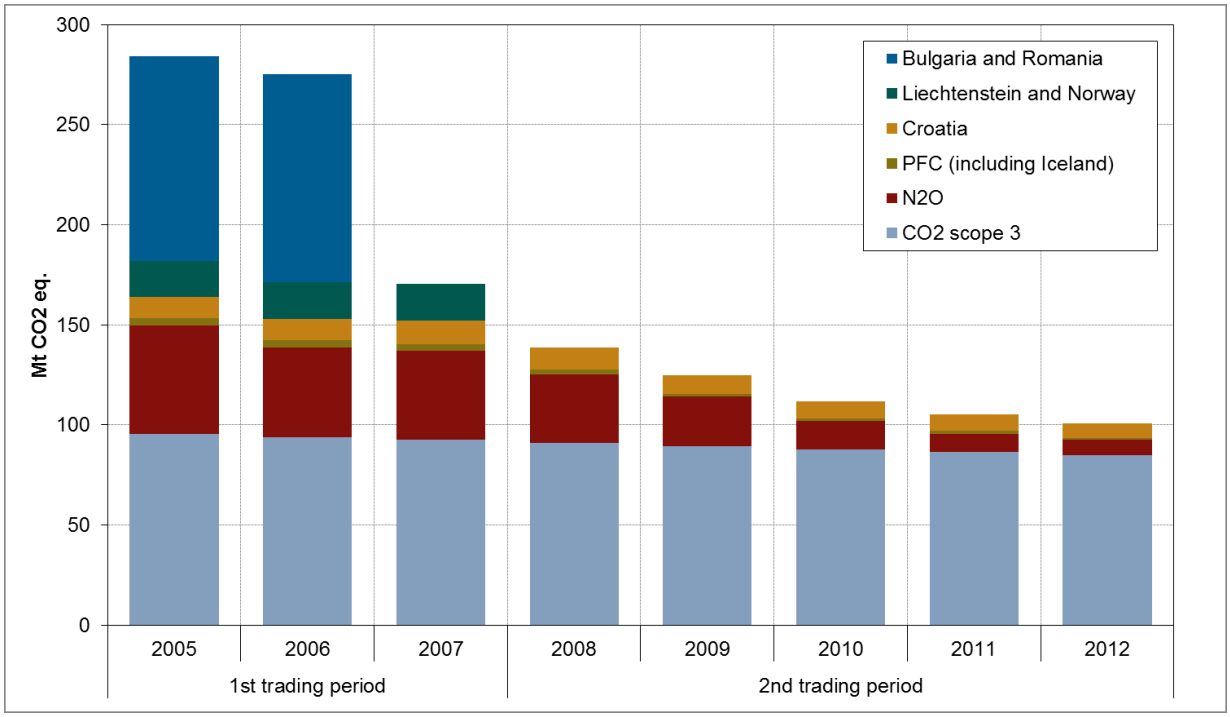
Three estimates of additional emissions to reflect the expansion of the scope in the third trading period:

- An estimate of emissions for Croatia before entering the EU ETS in 2013. Data stemming from the process to determine annual allocation allowances (AEAs) under the ESD was used to estimate Croatia's ETS emissions in 2005–2012, combined with 2013 verified emissions data and inventory emission trends for this country.

- An estimate of the additional emissions covered as a result of the non-CO_2 gases entering the scope of the EU ETS in 2013. For this purpose, historic emissions in the relevant source categories were taken from GHG inventories and converted to CO_2 equivalent units ([5]).
- An estimate of additional emissions covered for CO_2 emissions of installations from sectors that were included in the scope of the EU ETS from 2013 onwards, based on cap adjustment information from the ESD target setting process.

Two countries, Norway and Slovenia, have provided the authors with bottom-up emission estimates to reflect the scope of the third trading period. These estimates are used by the EEA and reflected in the EEA EU ETS data viewer. The paper nevertheless presents the results of the top-down approach also for Norway and Slovenia.

Figure 0-2 Summary of estimates in 2005–2012 to reflect the scope of the third trading period



Source: EEA.

Many of the estimates only apply to some Member States. For three participating countries (Cyprus, Denmark and Malta), no estimate of emissions was necessary as the scope remained constant during the whole period 2005–2012. An overview of the estimates of emissions carried out for each Member State, as well as the share of the estimated emissions in the overall emissions, are provided in Table 0-1. The detailed numbers by country can be found in Annex 3.

([5]) Conversions were done on the basis of global warming potential (GWP) values from the IPCC's Fourth Assessment Report (AR4).

Table 0-1 Estimates of emissions for changes in the scope by country and their share in total emissions (including these estimates)

	Element of scope estimate						Share of estimate in total emissions (incl. scope estimate)	
	New country	Opt-out	Definition combustion	N2O	PFC	CO2 scope 3	1st trading period	2nd trading period
Austria			☑	opt-in		☑	7.5%	6.3%
Belgium		☑	☑	☑		☑	16.0%	7.7%
Bulgaria	☑			☑		☑	66.6%	4.1%
Croatia	☑			☑		☑	100.0%	100.0%
Cyprus							0.0%	0.0%
Czech Republic				☑		☑	4.0%	3.8%
Denmark							0.0%	0.0%
Estonia			☑				1.8%	0.0%
Finland			☑	☑		☑	5.7%	2.9%
France			☑	☑	☑	☑	14.7%	10.3%
Germany			☑	☑	☑	☑	8.4%	5.6%
Greece				☑	☑	☑	3.2%	3.3%
Hungary			☑	☑	☑	☑	9.7%	0.1%
Iceland	☑				☑	☑	100.0%	100.0%
Ireland						☑	1.5%	2.0%
Italy			☑	opt-in	☑	☑	7.3%	4.0%
Latvia						☑	0.7%	0.7%
Liechtenstein	☑						100.0%	0.0%
Lithuania			☑	☑		☑	44.5%	36.7%
Luxembourg						☑	10.6%	12.1%
Malta							0.0%	0.0%
Netherlands		☑	☑	opt-in	☑	☑	11.9%	2.0%
Norway	☑			opt-in	☑	☑	100.0%	20.7%
Poland			☑	☑	☑	☑	8.0%	4.6%
Portugal			☑	☑		☑	5.5%	3.0%
Romania	☑			☑	☑	☑	69.9%	11.9%
Slovakia			☑	☑	☑	☑	13.6%	6.3%
Slovenia				☑	☑	☑	-0.1%	-1.4%
Spain			☑	☑	☑	☑	6.2%	5.9%
Sweden			☑	☑	☑	☑	16.8%	8.6%
United Kingdom		☑	☑	opt-in	☑	☑	10.4%	0.5%
EU-25		☑	☑	☑	☑	☑	8.7%	4.6%
EU-28	☑	☑	☑	☑	☑	☑	12.2%	5.4%
All countries	☑	☑	☑	☑	☑	☑	13.2%	5.6%

Source: EEA.

1 Introduction

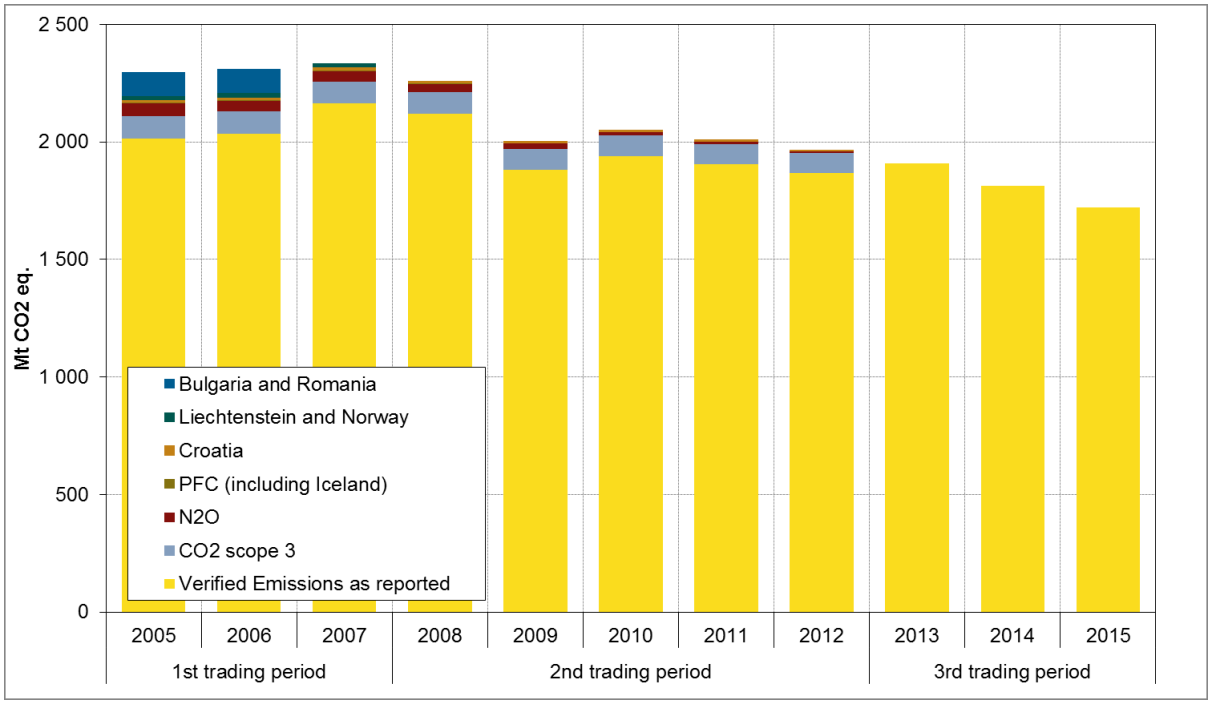
Since the start of the EU ETS in 2005, the number of installations and gases covered has steadily increased due, for example, to the inclusion of new countries or sectors. This paper describes the process of estimating a consistent time series of emissions that reflects successive changes in the scope of the ETS Directive for stationary installations, i.e. participation of new countries and decisions with regards to new sectors. Building such time series is only possible by estimating what the equivalent emissions would be for previous years at the current scope, in order to account for these changes in the scope of the ETS.

The emissions at the current ETS scope are estimated for each year and for each participating country.

The paper does not address changes related to the inclusion or exclusion of individual installations within trading periods (e.g. new entrants and closures). Although aviation has been part of the EU ETS since 2012, no estimate of emissions is applied to aviation emissions at this stage. Throughout this paper, all numbers shown refer to stationary installations.

This estimate of emissions to reflect the current scope has many possible uses. It allows a meaningful comparison of verified emissions under the EU ETS across years. Without such an estimate, comparing the absolute numbers for emissions over time could lead to the impression that emissions have been reduced by only 15 % between 2005 and 2014. With the addition of the estimated emissions to reflect the current ETS scope the comparison shows that the actual reduction in emissions included under the ETS in the same period can be estimated to be around 28 %.

Figure 1-1 Verified emissions and estimated emissions in historical years to reflect the scope of the third trading period (2005–2014)



Source: EUTL, 2017; EEA.

The results can also be used to estimate scope-consistent time series of emissions under the ESD, which are derived from ETS emissions ([6]). The availability of fully consistent time series for ETS and ESD emissions between 2005 and 2014 can be expected to be of interest to a whole range of stakeholders including policy makers, regulators, researchers and the interested public. These emissions can for example be used to calibrate models (to 2005 levels) which aim at producing projections of ETS and ESD emissions consistent with the current scope of the ETS, when no official data corresponding to this current scope exists for the year 2005.

A simple methodology to provide consistent time series has been used in the EEA's EU ETS data viewer since 2013. A first version of the described improved methodology and its results have been tested in the EEA EU ETS data viewer between May 2015 and March 2016 and been consulted with Member State experts during 2015.

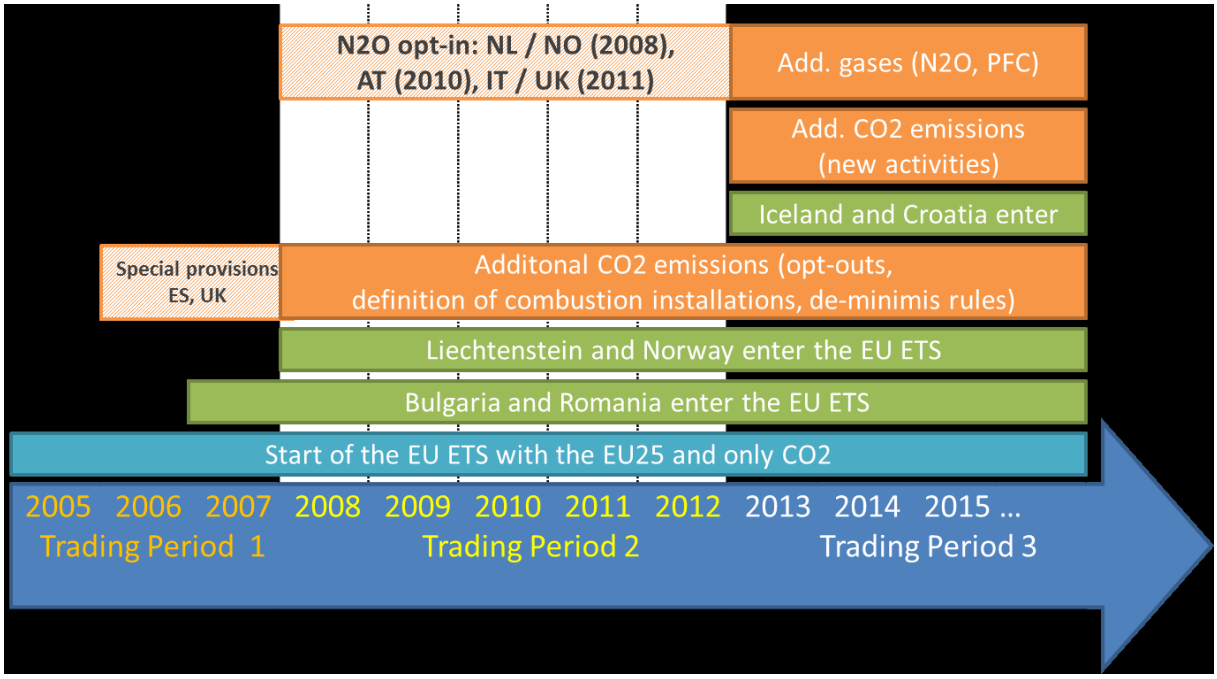
([6]) According to the definition provided in its Article 2(1), the ESD covers the total GHG emissions reported in GHG inventories, without LULUCF and CO_2 emissions from domestic aviation, as determined pursuant to the Monitoring Mechanism Regulation, excluding stationary emissions covered under the ETS Directive.

2 Overall approach

The scope of the EU ETS has been modified several times since its start (see Figure 2-1):

- The EU ETS started in 2005 covering only CO_2 emissions from large point sources in EU-25 countries[7].
- In 2007, Bulgaria and Romania joined the EU and its ETS.
- Installations from Liechtenstein and Norway entered the scheme at the start of the second trading period in 2008. At the same time, additional installations and emissions from already participating countries started to be covered by the scheme, due to the end of opt-outs and to the clarification of the definition of combustion installations.
- At the start of the third trading period in 2013, installations from Croatia and Iceland started to be covered by the EU ETS. At the same time, a range of new sectors and source categories were included, in particular N_2O and PFC emissions.

Figure 2-1 Changes in the scope of covered stationary installations under the EU ETS since 2005



Source: EEA.

For each of these changes in scope, different options exist regarding the method for estimating historical emissions at the current scope of the EU ETS. The choice of the best option depends on data and resource availability and the expected magnitude of the activities and sectors for which an estimate needs to be made compared to total emissions covered.

(7) Austria, Belgium, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden and United Kingdom.

The most important data to underpin estimates of emissions is available data on historical emissions. In general, four approaches depending on the availability and quality of these data can be distinguished:

1. Data on yearly historical emissions that reflect the current scope are available at installation level, for each installation that entered the EU ETS since 2005 (ideal case).

2. Data on historical emissions are available at sector level. A possible source for this are the national GHG inventories officially submitted under the UNFCCC. These data are subject to an external review process. However, the categories used in the GHG inventories (based on the UNFCCC's common reporting format (CRF)) are not strictly comparable with the activity types reported by individual installations and one ETS installation may cause emissions that are reported in several inventory categories. Thus a fully consistent mapping of ETS sectors to CRF categories is not possible without additional knowledge on installation level. In this case, ETS emissions can be estimated as inventory emissions multiplied with the share of ETS in inventory emissions in other years. However, it should be kept in mind that inventory figures are revised retro actively whenever the underlying methodologies related to the data are changed, therefore emission estimates for the past might be subject to change.

3. Data considered for legislation, e.g. data used in the ESD target setting process or data contained in the National Allocation Plans (NAPs). This kind of data may be good, since it directly identifies relevant installations and / or sectors. However, some of the data may not be accessible, information may not be available for the whole time series and the data may include also other factors than historical emissions data alone. Information for missing years can be linearly interpolated.

4. If no historic emissions data is available, assumptions have to be made that allow back-casting of more recent (available) emissions data. Inventory data and ETS shares may again be used for this back-casting exercise.

For the first approach, the database from the European Pollutant Release and Transfer Register (E-PRTR) was explored as a data source. This database has, however, a number of shortcomings that make its use not feasible for the present exercise: 1) E-PRTR data is only available from 2007 onwards, making the 2005-2012 time series incomplete; 2) not all (new) ETS installations can be consistently identified in this database; and 3) data quality is uncertain, because (contrary to ETS emissions), the data entered are not verified.

Therefore, the estimates of emissions to reflect current ETS scope that are made in this study mainly rely on a mix of approaches 2 and 3. In some cases, inventory emissions were used to back-cast recent emissions data (approach 4). The process of constructing an overall estimate of emissions based on current ETS scope for the whole period from 2005 to 2012 takes place in two main steps. A first estimate of emissions is built to reflect the scope of the second trading period (Chapter 3). An additional estimate of emissions is then calculated to reflect emissions to the scope of the third trading period (Chapter 1). Background information as well as total and detailed estimates of emissions at current ETS scope by country can be found in the Annexes.

Two countries, Norway and Slovenia, provided the authors with estimated emissions at current ETS scope, based on bottom-up calculations (Chapter 1). The paper presents the results of the top-down approach for Norway and Slovenia in chapters 3 and 1 and in the Annexes, although the EEA uses the estimates provided by Norway and Slovenia as these can be considered more accurate than the results based on a top-down approach.

3 Estimates of emissions to reflect the scope of the second trading period

3.1 *Additional countries entering the EU ETS*

The estimate of emissions at current ETS scope has to take into account that four countries joined the EU ETS between 2005 and 2012, namely Bulgaria and Romania (2007), Norway and Liechtenstein (2008).

3.1.1 Bulgaria and Romania

For **Bulgaria and Romania**, verified emissions are available from the EUTL for the years from 2007 onwards. To estimate 2005 and 2006 ETS emissions, inventory emissions and the share of ETS emissions in CO_2 emissions in relevant inventory categories in subsequent years is used (approach 2) as no installation specific data could be found.

The main CRF categories in which ETS emissions occur are identified based on ETS shares given in Annex V under Article 10 of the Implementing Regulation EU (2014). These are:

- 1.A.1 (fuel combustion by energy industries),
- 1.A.2 (fuel combustion by manufacturing and construction industries),
- 2.A (industrial processes for mineral production)
- 2.B (industrial processes by chemical production) and
- 2.C (industrial processes for metal production) ([8]).

For the sum of these categories, the share of ETS emissions (available from the EUTL from 2007 onwards) in those inventory emissions is calculated. It can be seen that the share of ETS emissions in the relevant inventory emissions is relatively stable over the years.

Table 3-1 Estimated emissions for Bulgaria and Romania to reflect the scope of the second trading period

Bulgaria	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 07-09
	Mt CO_2e									
Inventory emissions (1.A.1, 1.A.2, 2.A, 2.B, 2.C)	40.675	41.174	45.322	43.422	35.832	38.168	43.076	37.987	33.651	41.525
ETS verified emissions			39.182	38.303	32.015	33.525	39.998	35.050	32.696	36.500
Share ETS in relevant inventory emissions (%)			86%	88%	89%	88%	93%	92%	97%	88%
Estimate based on average 07-09 share	**35.796**	**36.234**								

Romania	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 07-09
	Mt CO_2e									
Inventory emissions (1.A.1, 1.A.2, 2.A, 2.B, 2.C)	75.695	77.393	76.858	73.036	57.375	54.806	59.555	56.597	47.710	69.090
ETS verified emissions			69.612	63.817	49.062	47.344	51.239	47.857	42.415	60.830
Share ETS in relevant inventory emissions (%)			91%	87%	86%	86%	86%	85%	89%	88%
Estimate based on average 07-09 share	**66.476**	**67.966**								

Source: EUTL, 2017; GHG inventory emissions categories 1.A.1, 1.A.2, 2.A, 2.B, 2.C (2015 Submission)

([8]) Other source categories are also mentioned in this Annex but these are minor with regard to ETS emissions from stationary installations.

The average share of three years (2007, 2008 and 2009) is then multiplied with the relevant 2005 and 2006 inventory emissions. The choice of an average share for 2007–2009 is preferred here to the share in 2007 only, in order to avoid the potential impact of special circumstances in that year (e.g. weather conditions).

Table 3-1 provides an overview of the data used, as well as the estimated CO2 emissions from ETS sectors for Romania and Bulgaria for the missing years 2005 and 2006. In order to check the validity of this approach, Annex 1 displays average ETS shares in 2007-2009 with 2005 and 2006 for the EU-25 Member States. It is however important to note that because the data used to derive the estimate is based on data from before 2007; these pre-date the inclusion of Bulgaria and Romania as part of the EU ETS, unlike the figures for emissions from ETS installations from 2007 onwards. This means that the emissions data were not subject to the same framework of rules for monitoring, reporting and independent verification as was in place for those Member States which were already part of the EU ETS in those years, and thus these estimated figures do not have a comparable basis in terms of overall data quality and robustness.

3.1.2 Norway and Liechtenstein

For **Norway and Liechtenstein**, verified emissions are available from the EUTL for the years from 2008 onwards. In addition, information on actual 2005 emissions of ETS installations is available from the respective national allocation plans (NAPs) (Liechtenstein, 2008; Norway, 2008). Assuming that the NAP information for 2005 depicts the situation of ETS installations in that year better than an estimate based on inventory shares, this data was used (approach 3). 2006 and 2007 CO_2 emissions are calculated by linear interpolation between 2005 and 2008 emissions.

Table 3-2 Estimated emissions for Liechtenstein and Norway to reflect the scope of the 2nd trading period

Norway	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
ETS verified emissions				19.342	19.216	19.274	19.083	18.550
N2O emissions in ETS based on inventory (2.B.2, 2.B.3)				0.449	0.443	0.342	0.278	0.269
Emissions data from NAP process	17.820							
ETS emissions without N2O				18.893	18.773	18.932	18.805	18.281
Resulting estimate based on interpolation	**17.820**	**18.178**	**18.536**					

Liechtenstein	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
ETS verified emissions				0.020	0.013	0.002	0.002	0.001
Emissions data from NAP process	0.018							
Resulting estimate based on interpolation	**0.018**	**0.019**	**0.019**					

Sources: Liechtenstein, 2008; Norway, 2008; EUTL, 2015, 2015 GHG inventory submission.

Since Norway opted-in N_2O-emitting installations in July 2008, 2008 verified emissions from the EUTL combine CO_2 for the whole year and N_2O emissions for the second half of 2008. 2008 CO_2 emissions are therefore estimated by deducting 50% of 2008 N_2O emissions reported in the national GHG inventory (for source categories 2.B.2. Nitric acid production and 2.B.3. Adipic acid production) from 2008 EUTL emissions ([9]). The following years are shown for information purpose only – in these years 100% of N_2O emissions are deducted as installations reported N_2O emissions for the full year. The estimate for N_2O emissions (related to the change between second and third trading period) is carried out in a separate step (cf. 4.1.3).

([9]) Norway reports in the GHG inventory (2015) that emissions from glyoxal and glyoxylic acid are not occurring.

As outlined in the overall approach; it is preferable to use bottom up installation specific data where available. The Norwegian Environment Agency provided the authors with national figures which are used in the further EEA work when an estimate of historical emissions at current ETS scope is required (see chapter 1). Nevertheless the top-down method is showed below.

3.2 *Opt in, opt outs and clarified definition of combustion installations*

The scope of participating installations changed between the first and second trading periods of the EU ETS in a number of participating countries for two main reasons: opt outs and clarified definition of combustion installations. Other – in terms of emissions less important - reasons for changes included the creation of de-minimis rules (i.e. rules for exclusion of small installations) and the exclusion of temporary opt-ins.

Opt outs in 2007-2009

The previous version of article 27 of the ETS Directive allowed Member States to temporarily exclude certain installations of the ETS during the first trading period. Opt-out was allowed only if the concerned installations were subject to emission reductions, monitoring and reporting rules and penalties similar to those under the EU ETS.

In the United Kingdom, some installations participating in the UK emissions trading scheme entered the EU ETS in 2007. They were opted-out of the EU ETS in 2005 and 2006 (DECC, 2009). In Belgium and the Netherlands, some installations were opted out during the first trading period and entered the EU ETS in 2008.

Definition of combustion installations

For the second trading period, the European Commission clarified the definition of combustion installations to be covered by the EU ETS (European Commission, 2005) ([10]). This clarification was released to increase harmonisation of included combustion installations across the EU ([11]). In particular, the following activities were to be included as combustion installations by all participating countries from the second trading period onwards.

- Flaring activities including those at offshore installations;
- Combustion processes involving crackers at petrochemical installations;
- Combustion processes for the production of carbon black;
- Furnaces including rock wool production furnaces;
- Integrated steelworks including rolling mills, re-heaters, annealing furnaces and pickling;
- Installations for the production of ethylene and propylene with production capacity of > 50,000 tons per year.

([10]) Also for installations in the ceramics sector a clarification regarding the thresholds that warranted inclusion in the scheme were made. Ceramics installations were included based on capacity or production thresholds during the first trading period. From 2008 onwards, the definition was clarified so that ceramic installations had to exceed both thresholds.

([11]) Point 36 of COM(2005)703 final, as clarified by the "co-ordinated definitions of additional combustion installations " contained in the minutes of the Climate Change Committee of 31 May 2006.

From 2005 to 2007, some Member States applied a 'narrow' definition of combustion installations and did not include all or some of the types of installations listed above, while other Member States used a 'broad' definition and included these emissions in their reporting of verified emissions under the EU ETS. The following 16 Member States extended the scope of ETS installations due to this clarification: Austria, Belgium, Germany, Estonia, Finland, France, Hungary, Italy, Lithuania, the Netherlands, Poland, Portugal, Sweden, Slovakia, Spain and the United Kingdom. In Spain, the broader definition of covered installation was applied already from 2006 onwards (Real Decreto Ley 5/2005, 2005), while for all other listed Member States, the broader definition was used from 2008 onwards.

De-minimis rules or temporary opt-ins

The introduction of de-minimis rules (defining a minimum size of installations for their inclusion in the EU ETS) and the temporary inclusion in the ETS of certain installations during the first trading period resulted in the exclusion of these installations from the ETS in the second trading period, e.g. in the UK.

Table 3-3 Estimated emissions to reflect the scope of the 2nd trading period for EU-25 countries

	2005	2006	2007
	Mt CO_2e		
Austria	0.350	0.350	0.350
Belgium	5.189	5.189	5.189
Cyprus			
Czech Republic			
Denmark			
Estonia	0.247	0.247	0.247
Finland	0.400	0.400	0.400
France	4.710	4.710	4.710
Germany	11.000	11.000	11.000
Greece			
Hungary	1.432	1.432	1.432
Ireland	-0.041	-0.041	-0.041
Italy	5.920	5.920	5.920
Latvia			
Lithuania	0.057	0.057	0.057
Luxembourg			
Malta			
Netherlands	3.923	3.923	3.923
Poland	4.952	4.952	4.952
Portugal	0.770	0.770	0.770
Slovakia	1.794	1.794	1.794
Slovenia			
Spain	6.223		
Sweden	1.671	1.671	1.671
United Kingdom	29.149	29.149	20.549
EU-25	77.747	71.524	62.924

Sources: Communication between Commission and Member States to determine annual emission allocations under the Effort Sharing Decision; DECC, 2009; Real Decreto Ley 5/2005, 2005.

Data source

Emission data for the installations concerned by the changes in ETS scope described above were provided by Member States for the purpose of determining AEAs under the ESD (EU, 2013;

European Union, 2009). In particular, information on 2005 emissions data was made available for all those installations that entered the ETS due to the termination of opt-outs and the clarification of the definition of combustion installations.

The estimated emissions to reflect the scope of the 2nd trading period for the years 2006 and 2007 is assumed to be equal to the 2005 estimate ([12]) for all countries except Spain and the United Kingdom (UK). For Spain, the new definition of combustion installations was applied from 2006 onwards; therefore no estimate of emissions is necessary for 2006 and 2007. For the United Kingdom, the opt-out of installations covered by the UK ETS ended at the end of 2006, therefore no estimate of emissions for the opt-out of installations is necessary for 2007. The resulting estimates of emissions to reflect the scope of the 2nd trading period are presented in Table 3-3 for all EU-25 Member States as estimates for those countries which entered as a later point of time have been catered for separately (cf. 3.1 and 4.2).

([12]) This assumption was taken as for the majority of ETS countries emissions remained quite stable within the first trading period with variation below 5% of the trading period's average.

4 Estimates to reflect the scope of the third trading period

4.1 *Additional activities and gases in the third trading period*

4.1.1 Main changes in the scope of the EU ETS

The revised ETS Directive modified the scope of the EU ETS after the second trading period. From 2013 onwards, the following additional sources of greenhouse gases have been included in the EU ETS:

- CO_2 emissions from the production or processing of ferrous metals including ferroalloys;
- CO_2 emissions from the production and processing of non-ferrous metals
- CO_2 from calcination of gypsum (> 20 MW);
- PFC and CO_2 emission from primary aluminium production
- CO_2 emission from the production of secondary aluminium
- CO_2 and N_2O emissions from adipic acid and nitric acid production
- CO_2 and N_2O emissions from bulk organic chemicals, in particular glyoxal and glyoxylic acid
- CO_2 emissions from ammonia production
- CO_2 emissions from production of hydrogen
- CO_2 emissions from soda ash and sodium bicarbonate production
- CO_2 emissions from capture of GHGs, transport and geological storage.

The definition of combustion was further broadened and now captures all fuel combustion activities. The revised ETS Directive states that “combustion" means any oxidation of fuels, regardless of the way in which the heat, electrical or mechanical energy produced by this process is used, and any other directly associated activities, including waste gas scrubbing.

On the other hand, the revised ETS Directive provides for new possibilities to exclude installations from the scope of the ETS:

- The exclusion of installations using exclusively biomass (fossil fuels may be used for start-up and shut-down).
- Subject to government consultation, equivalent measures and approval by the European Commission, the exclusion of small emitters (installations where emissions of CO2 are less than 25,000 tonnes per year and with a rated thermal input of below 35MW) and hospitals.

4.1.2 Data sources

A range of potential data sources is available to reflect this change in scope as illustrated below:

1. **ESD cap adjustments made by the Commission**: In 2013, annual emission allocations (AEAs) for the period 2013–2020 were adjusted by the European Commission, under Article 10 of the ESD, to reflect the change in scope of the ETS between the second and the third trading

period ([13]): the ETS cap was raised and Member States' AEAs reduced if installations/emissions were included to the ETS in 2013, while the ETS cap was reduced and Member States' AEAs increased if installations/emissions were excluded from the ETS (Art.27 of the ETS Directive). The cap adjustments are available, per country and per year between 2013 and 2020, in the Implementing Decision related to the ESD (EU, 2013). These adjustments were calculated by the Commission based on Member State submissions on historic emissions of concerned installations (Article 9a(2) of the ETS Directive). Data on cap adjustments in 2013-2020 is publicly available, while Member State information of the underlying historic data are not. Based on the published cap adjustment data, it is possible to estimate the average historic data on which they were calculated, by applying retroactively the linear reduction factor (1.74 % of normalised 2010 emissions). It is important to note that the Member States submitted data for the period 2005-2009 only, while the estimate of historical emissions at current ETS scope for the third trading period needs to be applied to the period 2005-2012. As outlined in detail below, data on ETS/ESD cap adjustments are inappropriate to estimate the historical emissions at current ETS scope for the third trading period, where trends for 2005-2009 and those for 2005-2012 are significantly different from each other. Moreover, Member States could also notify lower non-CO_2 emissions according to Art. 9(a)2 of the ETS Directive (in order to take into account the emission reduction potential of those installations), so that in some cases these figures were not the same as historic emissions of installations in question (ESD Article 10 adjustments were about ETS allowances and AEAs, not emissions). The cap adjustment data may therefore not be a good source for an estimate of historical emissions related to non-CO_2 gases. For these gases, data from GHG inventories were used instead (see below). In the end, **cap adjustment figures were used to estimate historic CO_2 emissions relating to the scope changes between 2008-2012 and 2013-2020** (see further details below).

2. **Inventory emissions**: As noted above, CRF categories from the inventories have to be mapped to ETS activities in order to be able to use them for the purposes of estimating historical emissions at the current ETS scope. In 2015 Member States reported for the first time the share of ETS emissions in inventory emissions in certain inventory categories for 2013 in Annex V under Article 10 of the Implementing Regulation EU (2014). As the share of emissions in the relevant inventory categories varies across years and the numbers are partly calculated with different methodologies and therefore either not comparable or not easily to be allocated to CRF categories, this information is of limited use for the period of interest (2005-12). For non-CO_2-gases matching with inventory categories is easier than for CO_2; the coverage of the relevant inventory categories can be assumed to be about 100 %. Therefore, **inventory emissions were used only for non-CO_2 gases**.
3. Another option would be to use **2013 verified emissions of N_2O- and PFC-emitting installations** and back-casting them using a trajectory calculated based on inventory data. However, such emissions are not directly available, because 2013 ETS emissions are only expressed as one aggregated number in CO_2 equivalent, with no detail by GHG being available.

[13] These adjustments were made in accordance with the quantity of allowances to be issued in respect of installations only included in the EU ETS from 2013 onwards, allowances issued pursuant to Commission Decisions approving the unilateral inclusion of additional activities and gases in the ETS under Article 24(1) of the ETS Directive in between 2008 and 2012 and, allowances corresponding to installations excluded from the EU ETS pursuant to Article 27 of the ETS Directive as of 2013 for the time they are excluded.

Furthermore, installations emitting non-CO_2 gases are not necessarily reported under the relevant main activity codes ([14]).

4. Installation-level emission data from other databases. The E-PRTR database contains emissions for different gases on an installation basis. However, information is only available from 2007 onwards. Furthermore, time series are not complete or inconsistent for some installations and thus N_2O emissions in the E-PRTR appear to be lower than in the inventory. In other cases N_2O emissions in the E-PRTR database are higher than in the inventory e.g. in the case of the Netherlands. The Dutch inventory records N_2O emissions in the chemical sector related to the production of nitric acid and of caprolactam, the latter which is not covered by the EU ETS causing 76% of N2O emissions from chemicals in 2012; in E-PRTR the two categories cannot be distinguished and basing the assessment on E-PRTR data would lead to an overestimation of N_2O emissions included in the EU ETS. Therefore, these data were only used for cross-checks.

Summing up the following differentiated approach was used, depending on source considered:

- For non-CO_2 gases, inventory data were used.
- For CO_2, information based on cap adjustments carried out for the new activities was used. The emissions were estimated by subtracting from the overall ETS cap adjustment, covering all gases, the cap adjustment related to N_2O and PFC emissions.

4.1.3 N_2O emissions

Data from ETS/ESD cap adjustments are an inadequate source for determining an estimate of emissions for N_2O for the third trading period. As mentioned above and outlined in detail below, the reason is that the trend for N_2O emissions for the period 2005-2009 (which is the base period for the ETS/ESD cap adjustment) is significantly different from the trend for 2005-2012.

The EU ETS covers N_2O emissions from the production of nitric and adipic acid as well as glyoxal and glyoxylic acid. The following inventory categories are added to estimate N_2O emissions covered by the EU ETS in years 2005-2012:

- 2.B.2. Nitric acid production,
- 2.B.3. Adipic acid production,
- 2.B.4.b Glyoxal and
- 2.B.4.c Glyoxilic acid

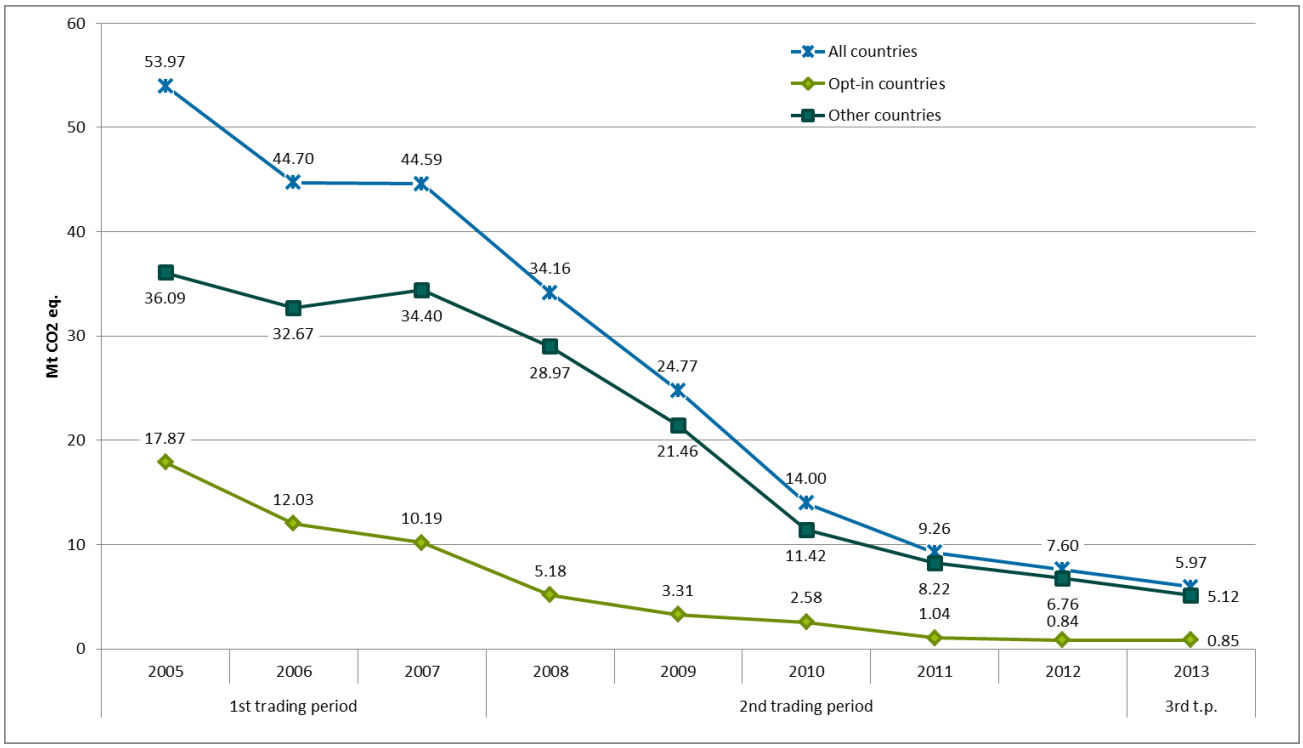
Global warming potential values from the IPCC's AR4 are used to convert N_2O emissions to CO_2 equivalents.

Using emissions from the inventories, Figure 4-1 shows the magnitude of this reduction for N_2O emissions. In 2005, N_2O emissions from adipic acid, nitric acid, glyoxal and glyoxylic acid production for the EU ETS countries were equal to 54 Mt CO_2-eq. In 2013, these emissions had decreased by 89 %, down to 6 Mt CO_2-eq. Reductions in N_2O emissions were even steeper in those countries which opted in these activities during the second trading period (i.e. Austria, Italy,

([14]) One example is that some countries that opted-in N_2O-emitting installations do not report any installations under those activity codes. Reasons include that their main activity is another one or that they remain in the category "combustion installation" even after the introduction of new and more specific activity codes.

Netherlands, Norway, and the United Kingdom), with an average 95 % decrease between the average 2005 levels and 2013. This steep decline in emissions was due to the implementation of relatively cheap abatement options; the trend is mostly driven by emissions from nitric acid production. For nitric acid production many catalysts were installed at the end of the year 2008 or in 2009 – amongst others, through JI projects. For adipic acid production, a first decline in emissions already started earlier (around 1997), but emissions have declined further since (ETC/ACC, 2010).

Figure 4-1 Inventory emissions related to the production of adipic and nitric acid, glyoxal and glyoxylic acid



Note: GHG emissions for the source categories 2.B.2. Nitric acid production, 2.B.3. Adipic acid production, 2.B.4.b Glyoxal and 2.B.4.c Glyoxilic acid are expressed in CO_2 equivalents based on global warming potential values from the IPCC's Fourth Assessment Report (AR4).

Source: 2015 GHG inventory submissions of EU-28, IS, LI and NO.

The estimate of historical emissions at current ETS scope for N_2O emissions is in all countries without opt-in equal to the N_2O emissions reported in the above mentioned inventory categories (2.B.2., 2.B.3., 2.B.4.b und 2.B.4.c – see Table 4-1). For countries which have opted-in N_2O emissions already in the second trading period, inventory emissions are taken for an estimate of emissions for the years prior to the opt in. This is relevant for Austria (before 2010), Italy (before 2011), the Netherlands (before 2008), Norway (before 2008) and the United Kingdom (before 2011) ([15]).

For the years following the opt-in, estimates were made to reflect if N_2O emissions were not covered for the whole first year but e.g. in April (Italy, UK) or July (Norway) and the change of the GWP values applied to convert N_2O emissions in CO_2 equivalents.

([15]) The Commission decisions on applications to include additional gases and installations are available at http://ec.europa.eu/clima/policies/ets/pre2013/nap/documentation_en.htm.

When the opt-in occurred during the year, then for the months before entering the scheme an estimate was made assuming that emissions were distributed evenly throughout the year (so if three out of 12 months were not covered, 25% of inventory emissions were added to correct the emissions).

In the years 2008-2012 the GWP consistent with the IPCC's Second Assessment Report (SAR) was used to convert N_2O emissions to CO_2 equivalents. From 2013 onwards both in the inventories and in the ETS the GWP of the forth assessment report (AR4) are used. The difference is small (310 vs. 298). For those years with opt-in prior to 2013 this difference is multiplied with reported inventory emissions leading to negative values in the estimate of emissions.

Table 4-1 Estimate of historical emissions at current ETS scope for N_2O

	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Austria	0.26	0.27	0.26	0.31	0.16	0.00	0.00	0.00
Belgium	2.95	2.00	1.31	1.36	1.41	1.79	0.60	0.65
Bulgaria	0.88	0.47	0.58	0.56	0.26	0.26	0.23	0.13
Croatia	0.64	0.63	0.69	0.71	0.59	0.76	0.75	0.65
Cyprus								
Czech Republic	0.89	0.79	0.65	0.60	0.45	0.33	0.37	0.38
Denmark								
Estonia								
Finland	1.56	1.38	1.42	1.52	0.76	0.16	0.13	0.16
France	5.90	5.30	4.98	4.24	3.50	1.75	1.08	0.80
Germany	8.00	7.82	10.37	9.08	9.47	1.38	1.00	0.76
Greece	0.52	0.43	0.42	0.41	0.35	0.41	0.46	0.30
Hungary	1.67	1.37	0.87	0.00	0.01	0.01	0.02	0.02
Iceland								
Ireland								
Italy	7.46	2.54	1.82	1.02	1.09	0.62	0.06	-0.01
Latvia								
Liechtenstein								
Lithuania	2.32	2.33	2.99	2.79	0.63	0.56	0.85	0.57
Luxembourg								
Malta								
Netherlands	5.44	5.38	4.14	-0.02	-0.02	-0.01	-0.01	-0.01
Norway	1.88	1.56	1.32	0.41	-0.02	-0.01	-0.01	-0.01
Poland	4.20	4.18	4.35	3.65	0.84	0.89	0.79	0.78
Portugal	0.54	0.53	0.55	0.50	0.28	0.28	0.07	0.06
Romania	2.98	2.37	2.66	1.08	0.68	1.19	1.18	1.00
Slovakia	1.23	1.52	1.36	1.26	1.05	0.87	0.40	0.29
Slovenia								
Spain	1.39	1.12	0.96	0.95	0.86	0.48	0.25	0.15
Sweden	0.42	0.44	0.23	0.26	0.29	0.30	0.04	0.06
United Kingdom	2.83	2.27	2.65	2.41	1.15	1.27	0.04	0.00
EU-25	47.59	39.67	39.32	30.35	22.30	11.08	6.15	4.97
EU-28	52.09	43.14	43.26	32.70	23.83	13.29	8.31	6.74
All countries	53.97	44.70	44.59	33.12	23.82	13.28	8.30	6.73

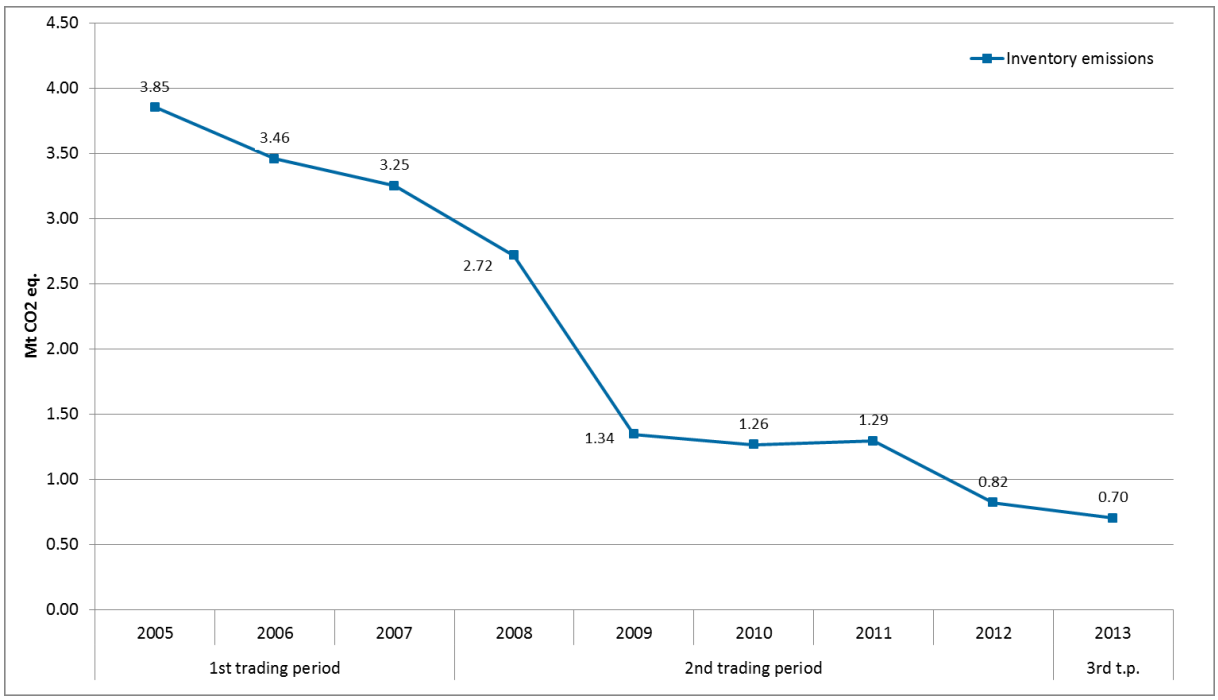
Note: For Austria, Italy, the Netherlands, Norway and the United Kingdom the years with opt-in of N_2O emissions are marked in grey.

Source: 2015 GHG inventory submissions.

4.1.4 PFC emissions

For PFC emissions from the production of aluminium, a similar trajectory as for N_2O emissions can be observed in GHG inventories (Figure 4-2). 2013 emissions were 82 % lower than in 2005. One reason is that PFC emissions can be reduced by process optimisation. Consequently, data from ETS/ESD cap adjustments are not a good source for determining an estimate of historical emissions for PFC for the third trading period, either. Similarly to N_2O emissions, the estimate of historical emissions for PFC is carried out using information from the inventory in the source category 2.C.3. (Aluminium production). Since opt-in of PFC emissions was not applied in the second trading period, no differentiation between Member States is necessary here.

Figure 4-2 Reduction in PFC emissions related to the production of aluminium



Note: GHG emissions for the source category 2.C.3. (Aluminium production) are expressed in CO_2 equivalents based on global warming potential values from the IPCC's AR4.

Source: 2015 GHG inventory submissions.

Table 4-2 Estimate of historical emissions for PFC from aluminium

	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Austria								
Belgium								
Bulgaria								
Croatia								
Cyprus								
Czech Republic								
Denmark								
Estonia								
Finland								
France	0.83	0.70	0.51	0.10	0.03	0.05	0.10	0.13
Germany	0.39	0.22	0.22	0.29	0.21	0.16	0.09	0.09
Greece	0.05	0.05	0.04	0.06	0.03	0.04	0.05	0.06
Hungary	0.28							
Iceland	0.03	0.39	0.33	0.41	0.18	0.17	0.07	0.09
Ireland								
Italy	0.21	0.18	0.23	0.13	0.17	0.10	0.09	0.04
Latvia								
Liechtenstein								
Lithuania								
Luxembourg								
Malta								
Netherlands	0.10	0.07	0.11	0.08	0.05	0.07	0.10	0.02
Norway	0.96	0.86	0.95	0.90	0.44	0.24	0.26	0.20
Poland	0.17	0.17	0.16	0.14				
Portugal								
Romania	0.10	0.06	0.03	0.02	0.01	0.01	0.01	0.01
Slovakia	0.02	0.04	0.03	0.04	0.02	0.03	0.02	0.03
Slovenia	0.14	0.13	0.10	0.01	0.01	0.01	0.02	0.02
Spain	0.17	0.15	0.14	0.14	0.09	0.08	0.07	0.04
Sweden	0.29	0.28	0.28	0.26	0.04	0.18	0.21	0.08
United Kingdom	0.12	0.15	0.10	0.14	0.07	0.13	0.19	0.02
EU-25	2.77	2.14	1.94	1.39	0.72	0.85	0.94	0.52
EU-28	2.87	2.21	1.97	1.41	0.73	0.85	0.95	0.52
All countries	3.85	3.46	3.25	2.72	1.34	1.26	1.29	0.82

Note: GHG emissions for the source category 2.C.3. Aluminium production are expressed in CO_2 equivalents based on global warming potential values from the IPCC's AR4.

Source: 2015 GHG inventory submissions.

4.1.5 CO_2 emissions

From 2013 onwards, the scope of the EU ETS was not only enlarged by the inclusion of new gases, but also by additional CO_2 emissions. The estimate of historical emissions for CO_2 emissions relies on the overall ETS cap adjustment determined by the Commission (covering all gases), related to the change from the second to the third trading period (EU, 2013). The adjustment is reported for the sum of all three gases N_2O, PFC and CO_2 only, once using the global warming potentials from the second assessment report by IPCC (EU, 2013, Annex I) and once using GWP from the fourth assessment report (Annex II). In order to avoid correcting twice for N_2O and PFC, we aim to deduct the estimated historical emissions for N_2O and PFC from the overall amount to single out the estimate for CO_2 emissions. For the EFTA countries the AEA adjustment figures are based on the decisions of the EEA Joint Committee (2012a).

There are four groups of countries:

1. Countries without an estimate of historical emissions for N_2O or PFC: The amounts given in the implementing decision are assumed to relate to CO_2 emissions only. This applies to Ireland, Latvia and Luxembourg. For Norway adjustments are separated by gas (EEA Joint Committee (2012a)) and can be used without further adjustment.

2. Countries with estimate of historical emissions for N_2O but not for PFC: The N_2O emissions included in the implementing decision are deduced using the difference between the tables in Annex I and Annex II as they use distinct GWPs (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Finland, Hungary[16], Lithuania and Portugal).

3. Countries with estimate of historical emissions both for PFC and eventually N_2O: In this case both the contribution of N_2O and PFC in the amounts of the implementing decision has to be estimated based on inventory emissions (for more details see below). This applies to France, Germany, Greece, Iceland, Italy, Netherlands, Norway, Poland, Romania, Slovakia, Slovenia[17], Spain, Sweden and United Kingdom.

4. Furthermore there are five countries without any cap adjustment for scope 3. These are Cyprus, Denmark, Estonia, Liechtenstein and Malta.

In a first step the CO_2 only cap adjustment in 2013 is estimated. For countries without estimate of historical emissions for non-CO_2 gases (group 1) the values can be used straight away. Calculations for the groups two and three are described below. In a further step CO_2 only cap adjustment in 2013 is extrapolated to 2005.

Countries with AEA adjustment for CO_2 and N_2O

For those countries with CO_2 and N_2O emissions only, the share of N_2O emissions included in the adjustment to annual emissions allocation can be deduced when comparing the two tables in the Annex of the implementing decision. The GWP for N_2O according to the second assessment report (SAR) is 310 whereas the GWP according to the fourth assessment report (AR4) is 298. The CO_2 emissions in the sums given can be expressed as follows:

$$CO2\ emissions\ (t) = total\ AEA\ adjustment\ (t\ CO2e) - N2O\ emissions\ (t) * GWP\ (\frac{t\ CO2e}{t\ N2O})$$

When this equation is filled twice; with the values in Annex I and Annex II of the implementing decision and the corresponding GWPs the two equations can be combined and simplified as follows:

$$N2O\ emissions\ (t) = \frac{AEA\ adjustment\ Annex\ I\ - AEA\ adjustment\ Annex\ II}{GWP\ SAR\ (310) - GWP\ AR4\ (298)}$$

The resulting N_2O emissions (in t N_2O) can then be converted to CO_2 eq. and deducted from the total AEA adjustment. The resulting emissions can then be considered to represent the scope change due to inclusion of additional CO_2 emissions. The result for the countries Austria, Belgium, Bulgaria, Croatia, Czech Republic, Finland, Hungary, Lithuania and Portugal can be found in Table 4-3.

([16]) Hungary did report PFC emissions in 2005 but in the following years PFC emissions were zero. It is therefore assumed that the emitting installation either closed or stopped producing primary aluminium and thus no allocation and no cap adjustment for PFC from aluminium was carried out for Hungary.
([17]) In the case of Slovenia additional information on CO_2 emissions was provided.

Table 4-3 Calculation of CO_2 emissions in AEA adjustment for countries with estimate of historical emissions for N_2O and CO_2

	Adjustment to annual emissions allocation (2013, t CO2 eq.)		N2O emissions in AEA adjustment (2013, t N2O)	N2O emissions (t CO2 eq.)	CO2 emissions in AEA adjustment (2013, t CO2)
	SAR	AR4		AR4	
	A	B	C = (A-B) / (310-298)	D = C * 298	E = B - D
Austria	2 026 990	2 018 185	734	218 658	1 799 528
Belgium	4 048 929	3 996 502	4 369	1 301 937	2 694 565
Bulgaria	1 750 024	1 728 601	1 785	532 005	1 196 597
Croatia	1 605 875	1 582 200	1 973	587 929	994 271
Czech Republic	3 000 270	2 978 152	1 843	549 264	2 428 888
Finland	1 769 997	1 720 524	4 123	1 228 580	491 945
Hungary	413 285	397 287	1 333	397 284	3
Lithuania	4 297 664	4 217 333	6 694	1 994 887	2 222 447
Portugal	563 543	563 543	0	0	563 543

Source: EU, 2013; own calculations

Countries with AEA adjustment for CO_2, PFC and N_2O

As above the estimate of historical emissions is based on the AEA adjustment published in the implementing decision (EU, 2013) and the decision of the EEA joint committee (EEA Joint Committee (2012a)). In order to avoid double counting as part of the estimated emissions for the non-CO_2 gases N_2O and PFC, we aim to estimate the CO_2 only share of the total AEA adjustments for 2013.

The approach used for countries with N_2O and CO_2 emissions only does not work in this case as there are too many unknowns in the equation – also for F-Gases the GWP have changed and furthermore PFC emissions from the production of primary aluminium consist of several gases.

Therefore we estimate the share of N_2O and PFC emissions as part of the total estimate of historical emissions at current ETS scope based on inventory data und subtract it from the total AEA adjustments to estimate the share of CO_2 in the total AEA adjustment.

Step 1: Understanding the methodology applied by the Commission for the AEA adjustments

To calculate the overall 2013 AEA adjustment, the Commission adjusted the data as submitted by the Member States[18] with the 1.74 % linear factor. To our understanding the adjustment was carried out applying the linear reduction factor to "normalised 2010 emissions" and thus derive the AEA adjustment in 2013([19]).

([18]) "Data as submitted by the Member States pursuant to Article 9a(2) of Directive 2003/87/EC and as contained in Commission Decisions C(2011)3798, C(2008)7867, C(2009)3032, C(2009)9849 and C(2012)497 to accept the unilateral inclusion of additional greenhouse gases and activities by Italy, the Netherlands, Austria, Latvia and the United Kingdom pursuant to Article 24 of Directive 2003/87/EC, as well as taking in consideration the exclusion of installations with low emissions from the EU ETS by Germany, the United Kingdom, France, Spain, Croatia, Slovenia and Italy pursuant to Article 27 of Directive 2003/87/EC and adjusted by the Commission with the 1,74 % linear factor, were used in the calculation of the adjustment to each Member State's annual emission allocation, as relevant." (EU, 2013)

([19]) The linear reduction factor is applied by estimating an amount to be reduced each year, corresponding to 1.74% emissions in the base year / base period.

- Adjustment to 2013 AEA = (Normalised 2010 emissions) - 3*1.74 %*(Normalised 2010 emissions)
  = (Normalised 2010 emissions) * (1-3*1.74 %)

Normalised 2010 emissions were themselves estimated from average 2005–2009 emissions, following the same annual linear decrease between the midpoint of this period (2007) and the year 2010, this annual decrease being the one previously defined:

- Normalised 2010 emissions = (Average 2005–09 emissions) – 3*1.74 %*(Normalised 2010 emissions)
  = (Average 2005–09 emissions) / (1+3*1.74 %)

And therefore:

- Adjustment to 2013 AEA = (Average 2005–09 emissions) * (1-3*1.74 %) / (1+3*1.74 %)
  = (Average 2005–09 emissions)*90.08 %

Step 2: Calculation of N_2O and PFC scope adjustment

The data submitted by Member States to the Commission is not publicly available. As a proxy we use inventory data for 2005-09. N_2O emissions are based on inventory data reported under CRF categories 2.B.2. Nitric acid production, 2.B.3. Adipic acid production, 2.B.4.b Glyoxal and 2.B.4.c Glyoxilic acid. PFC emissions are based on inventory data reported under CRF category 2.C.3. Aluminium production. The linear reduction factor is applied as explained in step 1 by multiplying the average 2005-09 emissions with 90.08 %.

The inventory emissions may differ from the data submitted by Member States for several reasons.

1. Some Member States made use of the possibility to notify for non-CO_2 gases a lower amount of emissions according to the reduction potential of those installations (Art 9a(2) of the ETS directive).
2. The AEA adjustment refers to ETS allowances that will be issued. ETS allowances can only be issued to operational installations; if part of the N_2O or PFC emissions were emitted by installations that closed since; these amounts will not be allocated.
3. Not all Member States submitted information for all years.

We assumed that the following Member States submitted only 20% of their actual 2005-09 N_2O emissions (after application of the annual linear reduction) to the Commission: Germany, Netherlands, Spain and Sweden. For UK we assume that no N_2O emissions were notified ([20]).

For EFTA states the AEA adjustments were reported separately according to Article 9 (phase two scope), Article 9a(1) (opt-in installations) and Article 9a(2) (phase three scope) in the EU ETS directive. For Norway solely the adjustment according to Article 9a(2) was used. This does not include the N_2O emissions (which are reported under 9a(1)); therefore no deduction of N_2O emissions is necessary. In the case of Iceland no stationary installation participated prior to 2013; therefore the AEA adjustment used is the sum of figures pursuant to Article 9 and Article 9a(2).

The default applied to all other countries for N_2O and to all countries for PFC is 100% (after application of the linear reduction factor).

([20]) For the UK, the Annex I AEA adjustment (using SAR GWP) is slightly lower than the Annex II adjustment (using AR4 GWP). If N_2O emissions were taken into account, the Annex I figures would be higher as the SAR GWP is higher than the AR4 GWP.

Step 3: Calculation of the resulting CO_2 scope adjustment

The calculated adjustments for N_2O and PFC are then deducted from the total AEA adjustment in 2013.

Table 4-4 Calculation of N_2O and PFC components in 2013 AEA adjustment and resulting adjustments for CO_2

	N2O				PFC				All gases	CO2
	Average inventory emissions **2005-09**	Appli-cation of LRF	Share notified to COM	Reduction of 2013 AEA adjustment	Average inventory emissions **2005-09**	Appli-cation of LRF	Share notified to COM	Reduction of 2013 AEA adjustment	Total AEA adjustment 2013	AEA adjustment for CO2 (total - reductions)
	Mt CO2 eq.		%	Mt CO2 eq.	Mt CO2 eq.		%	Mt CO2 eq.	Mt CO2 eq.	Mt CO2 eq.
France	4.78	4.31	100%	4.31	0.43	0.39	100%	0.39	14.69	9.99
Germany	8.95	8.06	20%	1.61	0.27	0.24	100%	0.24	23.20	21.35
Greece	0.43	0.38	100%	0.38	0.04	0.04	100%	0.04	2.05	1.62
Iceland	0.00	0.00	100%	0.00	0.27	0.24	100%	0.24	1.76	1.51
Italy	2.79	2.51	100%	2.51	0.18	0.17	100%	0.17	9.61	6.93
Netherlands	3.19	2.88	20%	0.58	0.08	0.08	100%	0.08	2.14	1.49
Poland	3.44	3.10	100%	3.10	0.13	0.12	100%	0.12	10.94	7.72
Romania	1.96	1.76	100%	1.76	0.04	0.04	100%	0.04	7.45	5.65
Slovakia	1.29	1.16	100%	1.16	0.03	0.03	100%	0.03	1.85	0.67
Slovenia	0.00	0.00	100%	0.00	0.08	0.07	100%	0.07	-0.05	-0.12
Spain	1.06	0.95	20%	0.19	0.14	0.12	100%	0.12	7.99	7.67
Sweden	0.33	0.30	20%	0.06	0.23	0.21	100%	0.21	1.70	1.43
United Kingdom	2.26	2.04	0%	0.00	0.11	0.10	100%	0.10	0.24	0.14

Source: EU, 2013; EEA Joint Committee, (2012b); 2015 GHG inventory submissions; own calculations

Estimate of historical CO_2 emissions to reflect the scope of the third trading period

With the adjustment of AEAs in 2013 based on CO_2 only, the estimate of historical emissions to reflect the scope of the third trading period for CO_2 emissions is calculated. The 2013 figures are used as a basis to calculate normalised 2010 emissions (by dividing the figures for 2013 by (1-3*1.74 %)). The annual cap adjustment equals 1.74 % of normalised 2010 emissions. This amount is added to previous years leading to a linear extrapolation up to 2005.

Table 4-5 Estimate of historical emissions at the scope of the third trading period (CO_2)

	Correction for the scope of the 3rd trading period (CO2 only)								AEA adjustment for CO2
	1st trading period			2nd trading period					
	2005	2006	2007	2008	2009	2010	2011	2012	2013
	Mt CO_2e								
Austria	2.06	2.03	2.00	1.96	1.93	1.90	1.87	1.83	1.80
Belgium	3.09	3.04	2.99	2.94	2.89	2.84	2.79	2.74	2.69
Bulgaria	1.37	1.35	1.33	1.31	1.28	1.26	1.24	1.22	1.20
Croatia	1.14	1.12	1.10	1.09	1.07	1.05	1.03	1.01	0.99
Cyprus									
Czech Republic	2.79	2.74	2.70	2.65	2.61	2.56	2.52	2.47	2.43
Denmark									
Estonia									
Finland	0.56	0.56	0.55	0.54	0.53	0.52	0.51	0.50	0.49
France	11.45	11.27	11.09	10.90	10.72	10.54	10.35	10.17	9.99
Germany	24.48	24.09	23.70	23.31	22.91	22.52	22.13	21.74	21.35
Greece	1.86	1.83	1.80	1.77	1.74	1.71	1.68	1.65	1.62
Hungary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iceland	1.74	1.71	1.68	1.65	1.62	1.60	1.57	1.54	1.51
Ireland	0.38	0.38	0.37	0.37	0.36	0.35	0.35	0.34	0.33
Italy	7.95	7.82	7.69	7.57	7.44	7.31	7.19	7.06	6.93
Latvia	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Liechtenstein									
Lithuania	2.55	2.51	2.47	2.43	2.39	2.34	2.30	2.26	2.22
Luxembourg	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28	0.28
Malta									
Netherlands	1.71	1.68	1.65	1.62	1.60	1.57	1.54	1.52	1.49
Norway	4.88	4.80	4.72	4.65	4.57	4.49	4.41	4.33	4.26
Poland	8.85	8.71	8.57	8.43	8.29	8.14	8.00	7.86	7.72
Portugal	0.65	0.64	0.63	0.62	0.60	0.59	0.58	0.57	0.56
Romania	6.48	6.38	6.27	6.17	6.07	5.96	5.86	5.75	5.65
Slovakia	0.76	0.75	0.74	0.73	0.72	0.70	0.69	0.68	0.67
Slovenia	-0.13	-0.13	-0.13	-0.13	-0.13	-0.12	-0.12	-0.12	-0.12
Spain	8.80	8.66	8.52	8.38	8.24	8.10	7.95	7.81	7.67
Sweden	1.65	1.62	1.59	1.57	1.54	1.51	1.49	1.46	1.43
United Kingdom	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14
EU-25	79.96	78.68	77.40	76.12	74.84	73.56	72.28	71.00	69.72
EU-28	88.95	87.53	86.10	84.68	83.26	81.83	80.41	78.98	77.56
All countries	95.57	94.04	92.51	90.98	89.45	87.92	86.39	84.86	83.33

Note: In the case of Norway and Slovenia national data is used (see chapter 5)

Source: EU, 2013; EEA Joint Committee, (2012b); Table 4-3, Table 4-4

4.2 *Additional countries entering the EU ETS*

4.2.1 Iceland (2013)

The vast majority of Iceland's ETS emissions (99 %; EEA Joint Committee (2012a)) are PFCs and CO_2 from the production of aluminium. This sector was included in the EU ETS (for all countries) in the third trading period. Therefore, the estimate of historical emissions for Iceland is covered by the overall estimate of historical emissions related to the change of ETS scope between the second and the third trading period, for which the method is described in section 4.1 above.

4.2.2 Croatia (2013)

Croatia entered the EU ETS in 2013. Verified emissions from 2013 onwards are available in the EUTL. In the context of setting targets under the ESD, emissions of installations to be covered in the EU ETS, consistent with the scope of the second trading period, were made available for the years 2005, 2008, 2009 and 2010. To complete the time series between 2005 and 2012, missing values for 2006, 2007, 2011 and 2012 are calculated using the share of ETS emissions in inventory emissions of the next neighbouring year available (the 2005 share is used for 2006, 2008 share for 2007 and 2010 share for 2011 and 2012) (see Table 4-6).

It is however important to note that because the data used to derive the estimate is based on data from before 2013; these pre-date the inclusion of Croatia as part of the EU ETS, unlike the figures for emissions from 2013 onwards. This means that the emissions data were not subject to the same framework of rules for monitoring, reporting and independent verification as was in place for those Member States which were part of the EU ETS in those years, and thus these estimated figures do not have a comparable basis in terms of overall data quality and robustness.

Table 4-6 Estimate of historical emissions to reflect the current ETS scope for Croatia (second trading period scope)

Croatia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
ETS scope 2 emissions from ESD target setting	10.65			10.87	9.48	8.71		
Sum of relevant inventory categories (CO2)	13.04	13.12	14.32	13.22	11.56	10.98	10.75	9.58
Share of ETS in inventory	82%			82%	82%	79%		
Resulting estimate	**10.65**	**10.72**	**11.77**	**10.87**	**9.48**	**8.71**	**8.53**	**7.60**

Sources: Communication between Commission and Member States to determine annual emission allocation under the Effort Sharing Decision; EUTL, 2015, 2015 GHG inventory (CRF categories 1.A.1, 1.A.2, 2.A, 2.B, 2.C.)

5 Estimate of historical emissions based on national data

5.1 *Norway*

The Norwegian Environment Agency has made an estimation of Norway's 2005-2012 emissions based on the scope of the third trading phase. The methodology is a bottom-up approach using detailed actual emission data at installation level and adjustment according to methodology used in the Norwegian GHG inventory. Furthermore changes compared to the NAP could be taken into account. These are:

- For some installations the official emission figure for the period 2005-2012 has been retroactively corrected. This was reflected in the GHG inventory, but not in the NAP.
- Emissions from mobile rigs were included from 2011 without being included in the NAP.
- After co-incineration was included in phase three scope additional source streams were added for some installations. This is taken into account in the estimate below but was not part of the NAP.
- Furthermore some small emissions from CCS installations are included.

National figures thus give more accurate estimate of Norway's 2005-2012 emissions based on a phase three scope. The estimate of historical emissions at current ETS scope for Norway is calculated as difference between the Norwegian emission figures for scope three and the emissions recorded in the EUTL (see Table 5-1).

Table 5-1 Estimate of historical emissions to reflect the current ETS scope for Norway

Norway	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
ETS emissions scope 3 (stationary)	**26.79**	**26.22**	**27.51**	**26.73**	**24.33**	**25.48**	**25.06**	**24.60**
CO2	23.95	23.80	25.23	24.94	23.45	24.90	24.52	24.13
N2O	1.88	1.56	1.32	0.90	0.44	0.34	0.28	0.27
PFC	0.96	0.86	0.95	0.90	0.44	0.24	0.26	0.20
ETS emissions EUTL (stationary)	0.00	0.00	0.00	19.34	19.22	19.27	19.08	18.55
Estimate to reflect the current scope	**26.79**	**26.22**	**27.51**	**7.39**	**5.12**	**6.20**	**5.98**	**6.05**

Sources: Norwegian Environment Agency by Email; EUTL, 2017.

5.2 *Slovenia*

The Jozef Stefan Institute - Energy Efficiency Centre in Slovenia has provided an estimation of Slovenian ETS emissions reflecting the scope of the third trading period based on bottom up data.

Certain small installations were excluded from the ETS from 2013 onwards provided that they undertake equivalent measures to reduce GHG emissions. Those installations were marked and excluded when 2005-2012 current scope emissions were calculated based on the Slovenian ETS registry. PFC emissions related to the production of primary aluminium were added (based on inventory information).

National figures concerning CO_2 emissions from excluded installations are more accurate than the estimation approach presented in this paper; national data as presented in Table 5-1 is therefore used in further Topic Center work.

Table 5-2 Estimate of historical emissions to reflect the current ETS scope for Slovenia

Slovenia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
ETS emissions scope 3 (stationary)	**8.75**	**8.85**	**9.05**	**8.75**	**7.93**	**8.00**	**7.94**	**7.58**
CO2	8.61	8.72	8.95	8.74	7.93	7.99	7.92	7.56
N2O	0.00							
PFC	0.14	0.13	0.10	0.01	0.01	0.01	0.02	0.02
ETS emissions EUTL (stationary)	8.72	8.84	9.05	8.86	8.07	8.13	7.99	7.61
Estimate to reflect current scope	**0.03**	**0.01**	**0.00**	**-0.11**	**-0.13**	**-0.13**	**-0.06**	**-0.03**

Sources: Jozef Stefan Institute by Email; EUTL, 2017.

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Annex 1: Background information related to gap filling Bulgaria and Romania (2005 and 2006)

The methodology to gap fill 2005 and 2006 Bulgarian and Romanian emissions has been tested for all EU Member States that have participated from the on-set of the EU ETS. The share of ETS emissions recorded in the EUTL was compared to inventory CO2 emissions of the categories 1.A.1 fuel combustion by energy industries, 1.A.2 fuel combustion by manufacturing and construction industries, 2.A industrial processes for mineral production, 2.B industrial processes for chemical production and 2.C industrial processes for metal production. The results are shown in Table 0-1. It can be seen that on average the 2007-2009 ETS shares are slightly higher than 2005/2006 values by 2 percentage points. When assessing the Member States in more detail it becomes clear that in a number of Member States the scope has been broader in 2007-2009 than in the first two years of the ETS. The reasons include temporary opt-outs, the revision of the installation definition and voluntary opt-in of N_2O emitting installations in the Netherlands (for more details on these changes compare chapter 1.1).

Bulgaria and Romania have applied the same scope in 2007 as in the second trading period. When comparing the average 2007-2009 shares with 2005 and 2006 for those countries with constant scope only, it can be seen that the difference comes down to 0.02 %. Therefore the approach is considered robust and suitable to be applied to Bulgaria and Romania.

Table 0-1 Share of ETS emissions in inventory emissions for EU-25 Member States

	2005	2006	Av. 07-09	Difference	Broader	Additional comments
	Share of ETS emissions in relevant inventory emissions			av. 07-09 to av. 05/06	definition of installation	
Austria	81%	81%	80%	-1%	x	
Belgium	81%	81%	85%	4%	x	Lower 2005-2007 emissions due to opt-outs.
Cyprus	96%	97%	96%	0%		
Czech Republic	88%	90%	90%	1%		
Denmark	89%	90%	88%	-1%		
Estonia	92%	93%	93%	1%	x	
Finland	89%	92%	92%	1%	x	
France	79%	77%	79%	1%	x	
Germany	88%	88%	88%	0%	x	
Greece	92%	93%	93%	0%		
Hungary	85%	84%	87%	2%	x	
Ireland	93%	94%	92%	-2%		
Italy	85%	86%	88%	2%	x	
Latvia	84%	83%	84%	0%		
Lithuania	78%	77%	73%	-5%	x	
Luxembourg	75%	74%	72%	-3%		
Malta	97%	97%	97%	1%		
Netherlands	80%	80%	84%	4%	x	Higher 2008/2009 emission shares due to N2O opt-in from 2008 and opt-outs in the first trading period.
Poland	89%	90%	91%	1%	x	
Portugal	88%	87%	87%	0%	x	
Slovakia	88%	87%	90%	2%	x	
Slovenia	88%	87%	90%	3%		
Spain	83%	86%	86%	2%	x	Broader installation scope definition started 2006.
Sweden	72%	74%	78%	4%	x	
United Kingdom	78%	79%	87%	9%	x	Lower 2005/2006 emissions due to opt-outs (UK ETS).
EU-25	84%	84%	86%	2%		
Countries with constant scope	89%	89%	89%	-0.02%		

Source: EUTL, 2015; Inventory emissions categories 1.A.1, 1.A.2, 2.A, 2.B, 2.C (2015 Submission), EEA.

Annex 2: Total estimate of historical emissions to reflect the current ETS scope by Member State

Table 0-1 Total estimate of emissions to reflect the scope of the third trading period

	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Austria	2.68	2.65	2.61	2.28	2.09	1.90	1.86	1.83
Belgium	11.23	10.23	9.49	4.30	4.31	4.64	3.39	3.40
Bulgaria	38.05	38.06	1.91	1.86	1.55	1.52	1.47	1.34
Croatia	12.43	12.47	13.57	12.66	11.14	10.53	10.32	9.27
Cyprus								
Czech Republic	3.67	3.53	3.34	3.26	3.06	2.89	2.89	2.85
Denmark								
Estonia	0.25	0.25	0.25					
Finland	2.53	2.34	2.37	2.05	1.29	0.68	0.64	0.66
France	22.89	21.97	21.28	15.25	14.26	12.34	11.54	11.10
Germany	43.87	43.13	45.29	32.67	32.59	24.06	23.23	22.58
Greece	2.44	2.30	2.27	2.23	2.12	2.17	2.19	2.01
Hungary	3.38	2.81	2.30	0.00	0.01	0.01	0.02	0.02
Iceland	1.77	2.10	2.01	2.06	1.80	1.77	1.64	1.63
Ireland	0.34	0.34	0.33	0.37	0.36	0.35	0.35	0.34
Italy	21.54	16.47	15.66	8.72	8.70	8.03	7.34	7.09
Latvia	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Liechtenstein	0.02	0.02	0.02					
Lithuania	4.93	4.89	5.52	5.22	3.02	2.90	3.15	2.84
Luxembourg	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28
Malta								
Netherlands	11.17	11.05	9.83	1.69	1.63	1.63	1.63	1.52
Norway	25.54	25.40	25.54	5.96	4.99	4.72	4.66	4.52
Poland	18.17	18.01	18.03	12.22	9.12	9.03	8.79	8.64
Portugal	1.96	1.93	1.95	1.12	0.89	0.88	0.65	0.64
Romania	76.03	76.78	8.97	7.27	6.75	7.16	7.05	6.76
Slovakia	3.82	4.11	3.93	2.03	1.79	1.60	1.12	1.00
Slovenia	0.01	0.00	-0.03	-0.11	-0.12	-0.11	-0.10	-0.10
Spain	16.58	9.93	9.62	9.46	9.19	8.66	8.27	8.01
Sweden	4.03	4.01	3.78	2.08	1.87	2.00	1.74	1.60
United Kingdom	32.25	31.73	23.45	2.69	1.37	1.54	0.37	0.15
EU-25	208.07	192.01	181.58	107.86	97.85	85.49	79.37	76.48
EU-28	334.57	319.32	206.03	129.66	117.30	104.69	98.21	93.86
All countries	361.89	346.84	233.59	137.68	124.09	111.17	104.52	100.01
National figures								
Norway	26.79	26.22	27.51	7.39	5.12	6.20	5.98	6.05
Slovenia	0.03	0.01	0.00	-0.11	-0.13	-0.13	-0.06	-0.03

Note: For further work of the EEA the national figures for Norway and Slovenia are used.

Source: EEA.

Annex 3: Detailed figures of estimates of historical emissions to reflect current ETS scope by Member State

Table 0-1 Verified ETS emissions and estimates of current scope emissions for stationary installations in Austria

Austria	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	33.37	32.38	31.75	32.08	27.36	30.92	30.60	28.39
Total estimate to reflect current ETS scope	2.68	2.65	2.61	2.28	2.09	1.90	1.86	1.83
New country								
CO2 scope 2 (opt-out, definition comb.)	0.35	0.35	0.35					
N2O	0.26	0.27	0.26	0.31	0.16	-0.002	-0.002	-0.002
PFC								
CO2 scope 3	2.06	2.03	2.00	1.96	1.93	1.90	1.87	1.83

Source: EEA.

Table 0-2 Verified ETS emissions and estimates of current scope emissions for stationary installations in Belgium

Belgium	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	55.36	54.78	52.80	55.46	46.21	50.10	46.20	43.01
Total estimate to reflect current ETS scope	11.23	10.23	9.49	4.30	4.31	4.64	3.39	3.40
New country								
CO2 scope 2 (opt-out, definition comb.)	5.19	5.19	5.19					
N2O	2.95	2.00	1.31	1.36	1.41	1.79	0.60	0.65
PFC								
CO2 scope 3	3.09	3.04	2.99	2.94	2.89	2.84	2.79	2.74

Source: EEA.

Table 0-3 Verified ETS emissions and estimates of current scope emissions for stationary installations in Bulgaria

Bulgaria	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL			39.18	38.30	32.01	33.53	40.00	35.05
Total estimate to reflect current ETS scope	38.05	38.06	1.91	1.86	1.55	1.52	1.47	1.34
New country	35.80	36.23						
CO2 scope 2 (opt-out, definition comb.)								
N2O	0.88	0.47	0.58	0.56	0.26	0.26	0.23	0.13
PFC								
CO2 scope 3	1.37	1.35	1.33	1.31	1.28	1.26	1.24	1.22

Source: EEA.

Table 0-4 Verified ETS emissions and estimates of current scope emissions for stationary installations in Croatia

Croatia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL								
Total estimate to reflect current ETS scope	12.43	12.47	13.57	12.66	11.14	10.53	10.32	9.27
New country	10.65	10.72	11.77	10.87	9.48	8.71	8.53	7.60
CO2 scope 2 (opt-out, definition comb.)								
N2O	0.64	0.63	0.69	0.71	0.59	0.76	0.75	0.65
PFC								
CO2 scope 3	1.14	1.12	1.10	1.09	1.07	1.05	1.03	1.01

Source: EEA.

Table 0-5 Verified ETS emissions and estimates of current scope emissions for stationary installations in Cyprus

Cyprus	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	5.08	5.26	5.40	5.58	5.36	5.06	4.60	4.38
Total estimate to reflect current ETS scope								
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC								
CO2 scope 3								

Source: EEA.

Table 0-6 Verified ETS emissions and estimates of current scope emissions for stationary installations in the Czech Republic

Czech Republic	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	82.45	83.62	87.83	80.40	73.78	75.58	74.19	69.32
Total estimate to reflect current ETS scope	3.67	3.53	3.34	3.26	3.06	2.89	2.89	2.85
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O	0.89	0.79	0.65	0.60	0.45	0.33	0.37	0.38
PFC								
CO2 scope 3	2.79	2.74	2.70	2.65	2.61	2.56	2.52	2.47

Source: EEA.

Table 0-7 Verified ETS emissions and estimates of current scope emissions for stationary installations in Denmark

Denmark	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	26.48	34.20	29.41	26.55	25.46	25.27	21.47	18.19
Total estimate to reflect current ETS scope								
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC								
CO2 scope 3								

Source: EEA.

Table 0-8 Verified ETS emissions and estimates of current scope emissions for stationary installations in Estonia

Estonia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	12.62	12.10	15.33	13.54	10.38	14.51	14.81	13.54
Total estimate to reflect current ETS scope	0.25	0.25	0.25					
New country								
CO2 scope 2 (opt-out, definition comb.)	0.25	0.25	0.25					
N2O								
PFC								
CO2 scope 3								

Source: EEA.

Table 0-9 Verified ETS emissions and estimates of current scope emissions for stationary installations in Finland

Finland	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	33.10	44.62	42.54	36.16	34.35	41.30	35.08	29.50
Total estimate to reflect current ETS scope	2.53	2.34	2.37	2.05	1.29	0.68	0.64	0.66
New country								
CO2 scope 2 (opt-out, definition comb.)	0.40	0.40	0.40					
N2O	1.56	1.38	1.42	1.52	0.76	0.16	0.13	0.16
PFC								
CO2 scope 3	0.56	0.56	0.55	0.54	0.53	0.52	0.51	0.50

Source: EEA.

Table 0-10 Verified ETS emissions and estimates of current scope emissions for stationary installations in France

France	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	131.26	126.98	126.63	124.13	111.09	115.54	105.58	103.66
Total estimate to reflect current ETS scope	22.89	21.97	21.28	15.25	14.26	12.34	11.54	11.10
New country								
CO2 scope 2 (opt-out, definition comb.)	4.71	4.71	4.71					
N2O	5.90	5.30	4.98	4.24	3.50	1.75	1.08	0.80
PFC	0.83	0.70	0.51	0.10	0.03	0.05	0.10	0.13
CO2 scope 3	11.45	11.27	11.09	10.90	10.72	10.54	10.35	10.17

Source: EEA.

Table 0-11 Verified ETS emissions and estimates of current scope emissions for stationary installations in Germany

Germany	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	475.05	478.07	487.15	472.85	428.29	454.86	450.35	452.59
Total estimate to reflect current ETS scope	43.87	43.13	45.29	32.67	32.59	24.06	23.23	22.58
New country								
CO2 scope 2 (opt-out, definition comb.)	11.00	11.00	11.00					
N2O	8.00	7.82	10.37	9.08	9.47	1.38	1.00	0.76
PFC	0.39	0.22	0.22	0.29	0.21	0.16	0.09	0.09
CO2 scope 3	24.48	24.09	23.70	23.31	22.91	22.52	22.13	21.74

Source: EEA.

Table 0-12 Verified ETS emissions and estimates of current scope emissions for stationary installations in Greece

Greece	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	71.27	69.97	72.72	69.85	63.66	59.94	58.84	61.44
Total estimate to reflect current ETS scope	2.44	2.30	2.27	2.23	2.12	2.17	2.19	2.01
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O	0.52	0.43	0.42	0.41	0.35	0.41	0.46	0.30
PFC	0.05	0.05	0.04	0.06	0.03	0.04	0.05	0.06
CO2 scope 3	1.86	1.83	1.80	1.77	1.74	1.71	1.68	1.65

Source: EEA.

Table 0-13 Verified ETS emissions and estimates of current scope emissions for stationary installations in Hungary

Hungary	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	26.16	25.85	26.84	27.24	22.40	22.99	22.47	21.27
Total estimate to reflect current ETS scope	3.38	2.81	2.30	0.00	0.01	0.01	0.02	0.02
New country								
CO2 scope 2 (opt-out, definition comb.)	1.43	1.43	1.43					
N2O	1.67	1.37	0.87	0.00	0.01	0.01	0.02	0.02
PFC	0.28							
CO2 scope 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: EEA.

Table 0-14 Verified ETS emissions and estimates of current scope emissions for stationary installations in Iceland

Iceland	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL								
Total estimate to reflect current ETS scope	1.77	2.10	2.01	2.06	1.80	1.77	1.64	1.63
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC	0.03	0.39	0.33	0.41	0.18	0.17	0.07	0.09
CO2 scope 3	1.74	1.71	1.68	1.65	1.62	1.60	1.57	1.54

Source: EEA.

Table 0-15 Verified ETS emissions and estimates of current scope emissions for stationary installations in Ireland

Ireland	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	22.44	21.71	21.25	20.38	17.22	17.37	15.77	16.90
Total estimate to reflect current ETS scope	0.34	0.34	0.33	0.37	0.36	0.35	0.35	0.34
New country								
CO2 scope 2 (opt-out, definition comb.)	-0.04	-0.04	-0.04					
N2O								
PFC								
CO2 scope 3	0.38	0.38	0.37	0.37	0.36	0.35	0.35	0.34

Source: EEA.

Table 0-16 Verified ETS emissions and estimates of current scope emissions for stationary installations in Italy

Italy	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	225.99	227.44	226.41	220.68	184.88	191.49	189.96	179.08
Total estimate to reflect current ETS scope	21.54	16.47	15.66	8.72	8.70	8.03	7.34	7.09
New country								
CO2 scope 2 (opt-out, definition comb.)	5.92	5.92	5.92					
N2O	7.46	2.54	1.82	1.02	1.09	0.62	0.06	-0.01
PFC	0.21	0.18	0.23	0.13	0.17	0.10	0.09	0.04
CO2 scope 3	7.95	7.82	7.69	7.57	7.44	7.31	7.19	7.06

Source: EEA.

Table 0-17 Verified ETS emissions and estimates of current scope emissions for stationary installations in Latvia

Latvia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	2.85	2.94	2.85	2.74	2.49	3.24	2.92	2.74
Total estimate to reflect current ETS scope	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC								
CO2 scope 3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Source: EEA.

Table 0-18 Verified ETS emissions and estimates of current scope emissions for stationary installations in Liechtenstein

Liechtenstein	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL				0.020	0.013	0.002	0.002	0.001
Total estimate to reflect current ETS scope	0.018	0.019	0.019					
New country	0.018	0.019	0.019					
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC								
CO2 scope 3								

Source: EEA.

Table 0-19 Verified ETS emissions and estimates of current scope emissions for stationary installations in Lithuania

Lithuania	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	6.60	6.52	6.00	6.10	5.79	6.39	5.61	5.72
Total estimate to reflect current ETS scope	4.93	4.89	5.52	5.22	3.02	2.90	3.15	2.84
New country								
CO2 scope 2 (opt-out, definition comb.)	0.06	0.06	0.06					
N2O	2.32	2.33	2.99	2.79	0.63	0.56	0.85	0.57
PFC								
CO2 scope 3	2.55	2.51	2.47	2.43	2.39	2.34	2.30	2.26

Source: EEA.

Table 0-20 Verified ETS emissions and estimates of current scope emissions for stationary installations in Luxembourg

Luxembourg	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	2.60	2.71	2.57	2.10	2.18	2.25	2.05	1.99
Total estimate to reflect current ETS scope	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC								
CO2 scope 3	0.32	0.31	0.31	0.30	0.30	0.29	0.29	0.28

Source: EEA.

Table 0-21 Verified ETS emissions and estimates of current scope emissions for stationary installations in Malta

Malta	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	1.97	1.99	2.03	2.02	1.90	1.88	1.93	2.05
Total estimate to reflect current ETS scope								
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O								
PFC								
CO2 scope 3								

Source: EEA.

Table 0-22 Verified ETS emissions and estimates of current scope emissions for stationary installations in the Netherlands

Netherlands	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	80.35	76.70	79.87	83.51	81.03	84.74	79.97	76.43
Total estimate to reflect current ETS scope	11.17	11.05	9.83	1.69	1.63	1.63	1.63	1.52
New country								
CO2 scope 2 (opt-out, definition comb.)	3.92	3.92	3.92					
N2O	5.44	5.38	4.14	-0.02	-0.02	-0.01	-0.01	-0.01
PFC	0.10	0.07	0.11	0.08	0.05	0.07	0.10	0.02
CO2 scope 3	1.71	1.68	1.65	1.62	1.60	1.57	1.54	1.52

Source: EEA.

Table 0-23 Verified ETS emissions and estimates of current scope emissions for stationary installations in Norway

Norway	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL				19.34	19.22	19.27	19.08	18.55
Total estimate to reflect current ETS scope	25.54	25.40	25.54	5.96	4.99	4.72	4.66	4.52
New country	17.82	18.18	18.54					
CO2 scope 2 (opt-out, definition comb.)								
N2O	1.88	1.56	1.32	0.41	-0.02	-0.01	-0.01	-0.01
PFC	0.96	0.86	0.95	0.90	0.44	0.24	0.26	0.20
CO2 scope 3	4.88	4.80	4.72	4.65	4.57	4.49	4.41	4.33

Note: Values for Norway are calculated by EEA. For national values please refer to chapter 5.1.
Source: EEA.

Table 0-24 Verified ETS emissions and estimates of current scope emissions for stationary installations in Poland

Poland	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	203.15	209.62	209.62	204.11	191.17	199.73	203.03	196.64
Total estimate to reflect current ETS scope	18.17	18.01	18.03	12.22	9.12	9.03	8.79	8.64
New country								
CO2 scope 2 (opt-out, definition comb.)	4.95	4.95	4.95					
N2O	4.20	4.18	4.35	3.65	0.84	0.89	0.79	0.78
PFC	0.17	0.17	0.16	0.14				
CO2 scope 3	8.85	8.71	8.57	8.43	8.29	8.14	8.00	7.86

Source: EEA.

Table 0-25 Verified ETS emissions and estimates of current scope emissions for stationary installations in Portugal

Portugal	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	36.43	33.06	31.20	29.91	28.26	24.17	25.01	25.25
Total estimate to reflect current ETS scope	1.96	1.93	1.95	1.12	0.89	0.88	0.65	0.64
New country								
CO2 scope 2 (opt-out, definition comb.)	0.77	0.77	0.77					
N2O	0.54	0.53	0.55	0.50	0.28	0.28	0.07	0.06
PFC								
CO2 scope 3	0.65	0.64	0.63	0.62	0.60	0.59	0.58	0.57

Source: EEA.

Table 0-26 Verified ETS emissions and estimates of current scope emissions for stationary installations in Romania

Romania	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL			69.61	63.82	49.06	47.34	51.24	47.86
Total estimate to reflect current ETS scope	76.03	76.78	8.97	7.27	6.75	7.16	7.05	6.76
New country	66.48	67.97						
CO2 scope 2 (opt-out, definition comb.)								
N2O	2.98	2.37	2.66	1.08	0.68	1.19	1.18	1.00
PFC	0.10	0.06	0.03	0.02	0.01	0.01	0.01	0.01
CO2 scope 3	6.48	6.38	6.27	6.17	6.07	5.96	5.86	5.75

Source: EEA.

Table 0-27 Verified ETS emissions and estimates of current scope emissions for stationary installations in Slovakia

Slovakia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	25.23	25.54	24.52	25.34	21.60	21.70	22.22	20.94
Total estimate to reflect current ETS scope	3.82	4.11	3.93	2.03	1.79	1.60	1.12	1.00
New country								
CO2 scope 2 (opt-out, definition comb.)	1.79	1.79	1.79					
N2O	1.23	1.52	1.36	1.26	1.05	0.87	0.40	0.29
PFC	0.02	0.04	0.03	0.04	0.02	0.03	0.02	0.03
CO2 scope 3	0.76	0.75	0.74	0.73	0.72	0.70	0.69	0.68

Source: EEA.

Table 0-28 Verified ETS emissions and estimates of current scope emissions for stationary installations in Slovenia

Slovenia	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	8.72	8.84	9.05	8.86	8.07	8.13	7.99	7.61
Total estimate to reflect current ETS scope	0.01	0.00	-0.03	-0.11	-0.12	-0.11	-0.10	-0.10
New country								
CO2 scope 2 (opt-out, definition comb.)								
N2O	0.00							
PFC	0.14	0.13	0.10	0.01	0.01	0.01	0.02	0.02
CO2 scope 3	-0.13	-0.13	-0.13	-0.13	-0.13	-0.12	-0.12	-0.12

Note: Values for Slovenia are calculated by EEA. For national values please refer to chapter 5.2.
Source: EEA.

Table 0-29 Verified ETS emissions and estimates of current scope emissions for stationary installations in Spain

Spain	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	183.63	179.72	186.57	163.46	136.94	121.48	132.69	135.64
Total estimate to reflect current ETS scope	16.58	9.93	9.62	9.46	9.19	8.66	8.27	8.01
New country								
CO2 scope 2 (opt-out, definition comb.)	6.22							
N2O	1.39	1.12	0.96	0.95	0.86	0.48	0.25	0.15
PFC	0.17	0.15	0.14	0.14	0.09	0.08	0.07	0.04
CO2 scope 3	8.80	8.66	8.52	8.38	8.24	8.10	7.95	7.81

Source: EEA.

Table 0-30 Verified ETS emissions and estimates of current scope emissions for stationary installations in Sweden

Sweden	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	19.38	20.00	19.04	20.08	17.49	22.66	19.85	18.17
Total estimate to reflect current ETS scope	4.03	4.01	3.78	2.08	1.87	2.00	1.74	1.60
New country								
CO2 scope 2 (opt-out, definition comb.)	1.67	1.67	1.67					
N2O	0.42	0.44	0.23	0.26	0.29	0.30	0.04	0.06
PFC	0.29	0.28	0.28	0.26	0.04	0.18	0.21	0.08
CO2 scope 3	1.65	1.62	1.59	1.57	1.54	1.51	1.49	1.46

Source: EEA.

Table 0-31 Verified ETS emissions and estimates of current scope emissions for stationary installations in the United Kingdom

United Kingdom	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	242.51	251.16	256.58	265.06	231.95	237.34	220.88	231.13
Total estimate to reflect current ETS scope	32.25	31.73	23.45	2.69	1.37	1.54	0.37	0.15
New country								
CO2 scope 2 (opt-out, definition comb.)	29.15	29.15	20.55					
N2O	2.83	2.27	2.65	2.41	1.15	1.27	0.04	0.00
PFC	0.12	0.15	0.10	0.14	0.07	0.13	0.19	0.02
CO2 scope 3	0.16	0.15	0.15	0.15	0.15	0.14	0.14	0.14

Source: EEA.

Table 0-32 Verified ETS emissions and estimates of current scope emissions for stationary installations in the EU-25

EU-25	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	2 014.08	2 035.79	2 055.94	1 998.19	1 779.31	1 838.66	1 794.07	1 765.56
Total estimate to reflect current ETS scope	208.01	191.96	181.56	107.92	97.93	85.55	79.43	76.54
New country		0.00						
CO2 scope 2 (opt-out, definition comb.)	77.75	71.52	62.92					
N2O	47.59	39.67	39.32	30.35	22.30	11.08	6.15	4.97
PFC	2.63	2.01	1.84	1.38	0.71	0.84	0.92	0.50
CO2 scope 3	80.04	78.76	77.48	76.20	74.92	73.63	72.35	71.07

Note: Values for Slovenia are calculated by EEA. For national values please refer to chapter 5.

Source: EEA.

Table 0-33 Verified ETS emissions and estimates of current scope emissions for stationary installations in the EU-28

EU-28	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	2 014.08	2 035.79	2 164.73	2 100.31	1 860.39	1 919.53	1 885.31	1 848.46
Total estimate to reflect current ETS scope	334.51	319.26	206.01	129.72	117.37	104.75	98.26	93.91
New country	112.92	114.92	11.77	10.87	9.48	8.71	8.53	7.60
CO2 scope 2 (opt-out, definition comb.)	77.75	71.52	62.92					
N2O	52.09	43.14	43.26	32.70	23.83	13.29	8.31	6.74
PFC	2.72	2.07	1.87	1.39	0.72	0.84	0.93	0.51
CO2 scope 3	89.03	87.61	86.18	84.76	83.33	81.91	80.48	79.06

Note: Values for Slovenia are calculated by EEA. For national values please refer to chapter 5.

Source: EEA.

Table 0-34 Verified ETS emissions and estimates of current scope emissions for stationary installations in all EU ETS countries

All countries	1st trading period			2nd trading period				
	2005	2006	2007	2008	2009	2010	2011	2012
	Mt CO_2e							
Verified emissions EUTL	2 014.08	2 035.79	2 164.73	2 119.67	1 879.62	1 938.80	1 904.39	1 867.01
Total estimate to reflect current ETS scope	361.83	346.78	233.57	137.74	124.16	111.24	104.57	100.07
New country	130.76	133.11	30.32	10.87	9.48	8.71	8.53	7.60
CO2 scope 2 (opt-out, definition comb.)	77.75	71.52	62.92					
N2O	53.97	44.70	44.59	33.12	23.82	13.28	8.30	6.73
PFC	3.71	3.32	3.15	2.70	1.34	1.25	1.27	0.80
CO2 scope 3	95.65	94.12	92.59	91.06	89.53	87.99	86.46	84.93

Note: Values for Norway and Slovenia are calculated by EEA. For national values please refer to chapter 5.

Source: EEA.