A preliminary assessment of CO_2 emissions abatement resulting from the implementation of the EU ETS in Italy

Domenico Gaudioso
ISPRA – Institute for Environmental Protection and Research, Italy
domenico.gaudioso@apat.it

Antonio Caputo
ISPRA – Institute for Environmental Protection and Research, Italy
antonio.caputo@apat.it

Chiara Arcarese
ISPRA – Institute for Environmental Protection and Research, Italy
chiara.arcarese@apat.it

Keywords
European Union emissions trading system, CO_2 abatement, 1st phase EU ETS.

Abstract
The environmental effectiveness of the EU ETS, i.e. its ability to provide real CO_2 emissions reductions, has often been questioned by researchers and environmental organisations. Preliminary estimates performed by Ellerman and Buchner (2006), based on installation-level data for verified emissions in the first trading year, 2005, and a range of indicators of economic activity as well as trends in energy and carbon intensity, suggest that CO_2 emissions abatement in the European Union as a whole, measured by the difference between emissions and the counterfactual, or what CO_2 emissions would have been in the absence of the EU ETS, could have been slightly over 3%. This indicates that in the absence of the EU ETS CO_2 emissions in the EU would have been 3% higher than they actually were. The objective of this paper is to provide estimates of the abatement that has taken place in Italy in the first implementation period (2005-2007) of the EU ETS. This analysis is carried out on the basis of the approach proposed by Ellerman and Buchner, with a view to understanding CO_2 emission trends at sectoral level, and to discovering possible changes in production and consumption patterns, using suitable indicators. Finally, the insights and implications that emerge from this tentative assessment are also discussed, with particular reference to the 2nd phase of implementation (2008-2012) of the system.

Introduction
The first implementation period (2005-2007) of the European Union Emission Trading Scheme (EU ETS) has been designed with the objective to verify the operation of the scheme and to develop the institutional structures needed for its full operation in the second implementation period (2008-2012). This period has ended with the surrender of allowances for the year 2007 by the operators of the industrial facilities subject to the scheme, due by 30 April 2008, and the release by the European Commission, on 23 May 2008, of installation-level data for verified emissions for the year 2007.

A preliminary assessment of the operation of the scheme is therefore possible, on the basis of verified emission data for 2005, 2006 and 2007. The efficiency of the scheme, its equity and its environmental effectiveness have been identified as key criteria for this evaluation (Betz and Sato, 2006). The volume of allowance allocation influences scarcity levels and thus the efficiency of the scheme, which is measured by the volume of traded allowances and the respective market prices. The various provisions in the allocation plans (i.e. how to split allocation at national, sectoral and installation level, auctioning or free allocation, etc.) determine its equity. Methodological choices related to allocation are guided by the criteria established by Article 10 and Annex III of the directive, as well as by additional guidance documents issued by the European Commission; see for instance Commission's Communications COM(2003) 830 final and COM(2005) 703 final, which refer respectively to the first and to the second implementation period (Commission of the European Communities, 2004 and 2005). According to Article 9 of the directive, the Commission is furthermore responsible for final approval of national allocation plans. The environmental effectiveness of the scheme, i.e. its ability to provide real greenhouse gas emissions reductions, is based on allocation decisions, but also on other technical issues concerning the operation of the scheme, such as monitoring, reporting and verification procedures.

Ellerman and Buchner (2006) have developed a set of methodologies for this evaluation, with particular reference to the extent of over- or under-allocation (which influences the efficiency of the scheme) and to the extent of CO_2 emissions abatement resulting from the implementation of the scheme. They have based their analysis on installation-level data for verified emissions in the first trading year 2005. The study shows that over-allocation occurred, and that its magnitude may have been as much as 100 million European Union Allowances, hereafter EUAs, corresponding to 100 million tons CO_2 (to be compared with an overall allocation of 2087.9 million EUAs, and total reported emissions equal to 2006.6 million EUAs) but, despite that, CO_2 emissions abatement in the European Union as a whole, measured by the difference between emissions and the counterfactual, or what CO_2 emissions would have been in the absence of the EU ETS, could have been slightly over 3%.

An evaluation of the implementation of the EU ETS in Italy

According to the approach developed by Ellerman and Buchner, we have analyzed the implementation of the EU ETS in Italy, on the basis of the verified emissions data for the installations included in the EU ETS for the years 2005, 2006 and 2007. The relevant figures are communicated by the operators of these installations directly to our Institute, which is responsible for the maintenance and the operation of the ETS registry in Italy; they can be downloaded from the *web* page of the Community Independent Transaction Log (CITL, 2009).

OVER- AND UNDER-ALLOCATION BY SECTORS

In order to define over- or under-allocation, we may refer alternatively:

- to the level that emissions would have reached without the trading system, which can be called the counterfactual, and is termed BAU (Business as Usual) emissions in modelling exercises;
- to the level that emissions should reach in order to comply with a desired environmental cap, which is constraining and which is less than the counterfactual.

For each installation, the difference between emissions and allocations has been calculated. A positive difference identifies a "short" position, while a negative difference identifies a "long" position. Installations with short position have emissions greater than EUAs allocation. On the contrary, long position revealed facilities with EUAs for sale, although it doesn't mean that they were made available to the market or transferred to another facility. As stated by Ellerman and Buchner (2006) "a long position is not per se evidence of over-allocation". Following the methodological approach by Ellerman and Buchner (2006), for every sector we have calculated the sum of the differences for all the installations having long and short positions, respectively reported as "gross long" and "gross short". The difference between the "gross long" and "gross short" data points for each sector establishes the "net long" or "net short" position for that sector, depending upon the sign of the result. A sector with net long position has emitted less CO_2 than quotas it has been assigned, while a sector with net short position need to buy quotas of CO_2 to compensate for emissions.

Furthermore, installations, or any aggregation of installations, such as a sector, member state, or the entire system, can be long or short for a number of reasons such as general, national or sectoral economic and energy trends, as well as the extent they react to the incentive that motivates trading, i.e. differences in the marginal cost of abatement. The appearance of long and short positions is therefore implicit in any trading scheme, which simply would not function, in case all allocations were over- or under-allocated to the same extent.

With these considerations in mind, it is useful to look at the comparisons between emissions and allocations at the installation level, split by economic sector, for the years 2005, 2006 and 2007, as shown in Figures 1, 2 and 3 in terms of absolute values, and in Figures 4, 5 and 6 in percentage terms. As already mentioned, verified emissions are reported to the Italian national registry, managed by ISPRA, and are available through the *web* page of the Community Independent Transaction Log (CITL, 2009); allocations of allowances for the years 2005, 2006 and 2007 have been drawn from the allocation decision issued in 2006 by the Italian Ministry for Environment and Territory (Ministero dell'Ambiente e della Tutela del Territorio, 2006). In these figures, the data are portrayed as the sum of the differences for all the installations having long and short positions, respectively as "gross long" and "gross short." Each aggregate then has either a "net long" or a "net short" position equal to the difference between the "gross long" and "gross short" data points for that aggregate.

Figures 1, 2 and 3 show that the power & heat sector represents the main source of demand and, at the same time, of potential supply of EUAs in the market. Under-allocation is evident for both the power & heat and the cement sectors. The power & heat sector is considerably short both in 2005, 2006 and 2007; under-allocation, expressed in percentage terms, increases from 2005 to 2006, but decreases between 2006 and 2007. Refineries are long throughout all the period; over-allocation (in percentage terms) increases from 2005 to 2006, but decreases between 2006 and 2007. For ceramics, bricks and tiles, other combustion installations and iron, steel and coke, over-allocation (in percentage terms) increases from 2005 to 2006, and then from 2006 to 2007.

As a measure of the likelihood of over-allocation, Ellerman and Buchner have introduced the following indicator:

$$Net\ Ratio = \frac{Net\ Long\ or\ Short}{Gross\ Long\ or\ Short}$$

which can be applied to any aggregate of installation data (member state, economic sector…).

If a member state has a negative net ratio, no obvious over-allocation has taken place, and over-allocation to certain sectors is compensated by under-allocation to other sectors. A positive net ratio indicates that sectors and installations may be over-allocated, with the extent of over-allocation depending on the value of the net ratio (the number of over-allocated sectors and installations increases with the value of the net ratio).

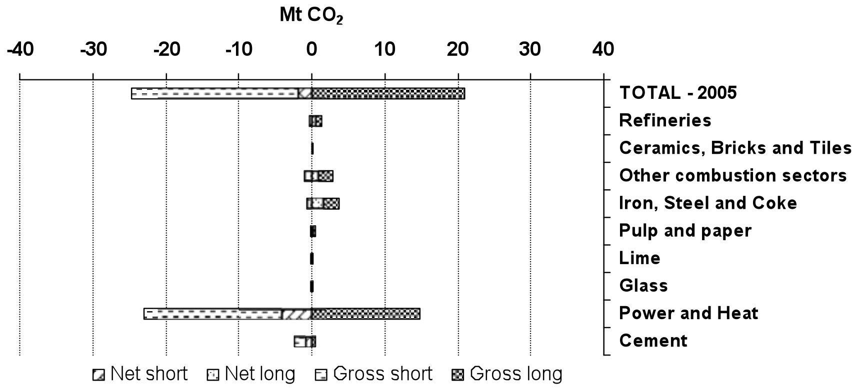

Figure 1. Short and long positions by sectors in Italy for the year 2005 (in absolute terms)

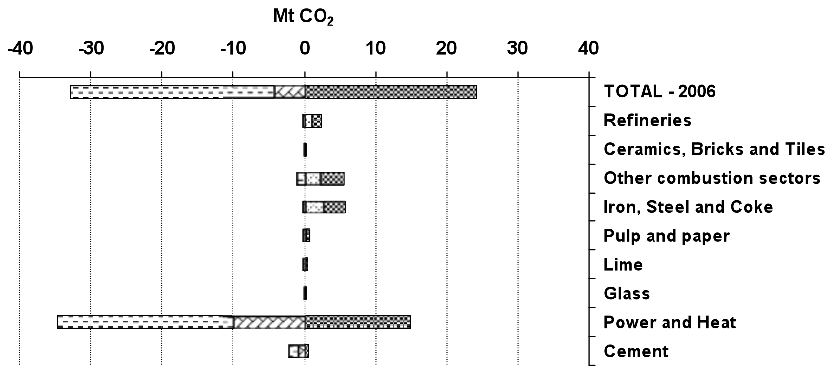

Figure 2. Short and long positions by sectors in Italy for the year 2006 (in absolute terms)

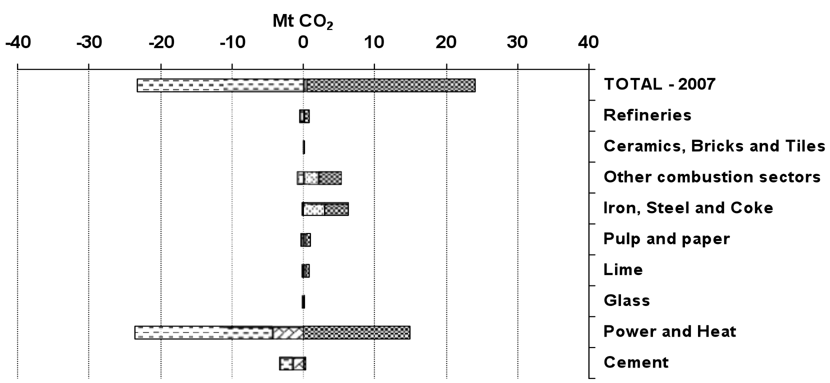

Figure 3. Short and long positions by sectors in Italy for the year 2007 (in absolute terms)

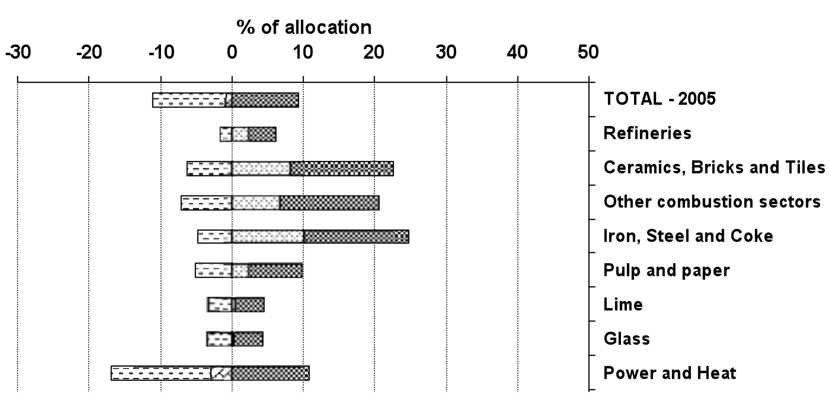

Figure 4. Short and long positions by sectors in Italy for the year 2005 (in percentage terms)

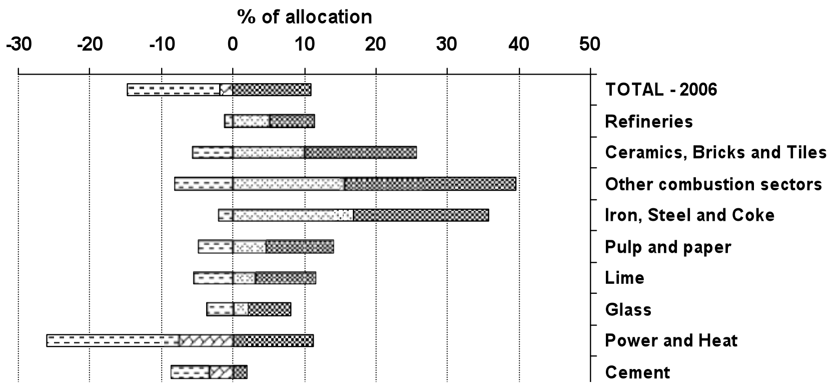

Figure 5. Short and long positions by sectors in Italy for the year 2006 (in percentage terms)

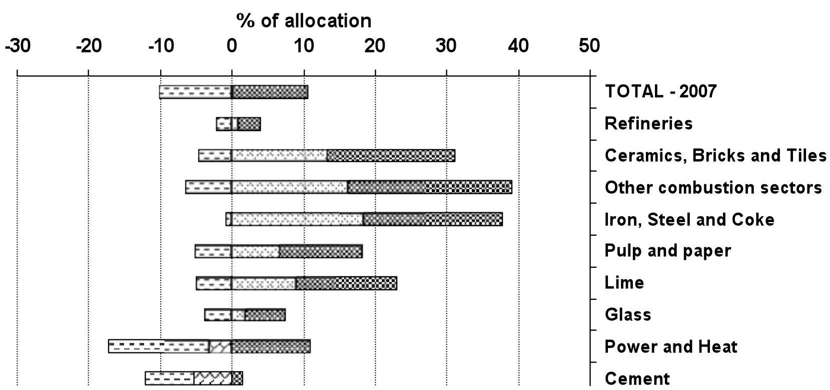

Figure 6. Short and long positions by sectors in Italy for the year 2007 (in percentage terms)

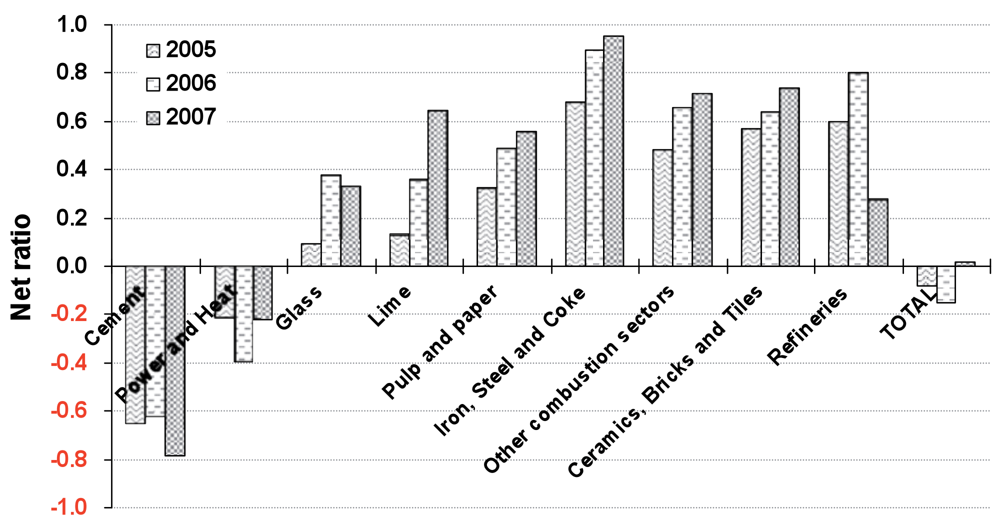

Figure 7. Net ratios for the various sectors, and Italy as a whole, for the years 2005, 2006 and 2007

As concerns Italy, although at national level there is no evidence of over-allocation, several sectors show high positive net ratios, while cement and power & heat sectors show negative ratios. For most sectors with positive net ratios (glass, lime, pulp and paper, iron, steel and coke, other combustion installations, ceramics, bricks and tiles), net ratios increase from 2005 to 2007. This trend seems to indicate a trend towards a reduction of emissions for these sectors.

Figure 7 shows the evolution of the net ratios for the various economic sectors, and for Italy as a whole, in the first implementation period of the EU ETS.

CO_2 EMISSIONS ABATEMENT RESULTING FROM THE IMPLEMENTATION OF THE EU ETS

Any estimation of the CO_2 emissions abatement resulting from the implementation of the EU ETS requires a comparison between verified emission data and the counterfactual, or what

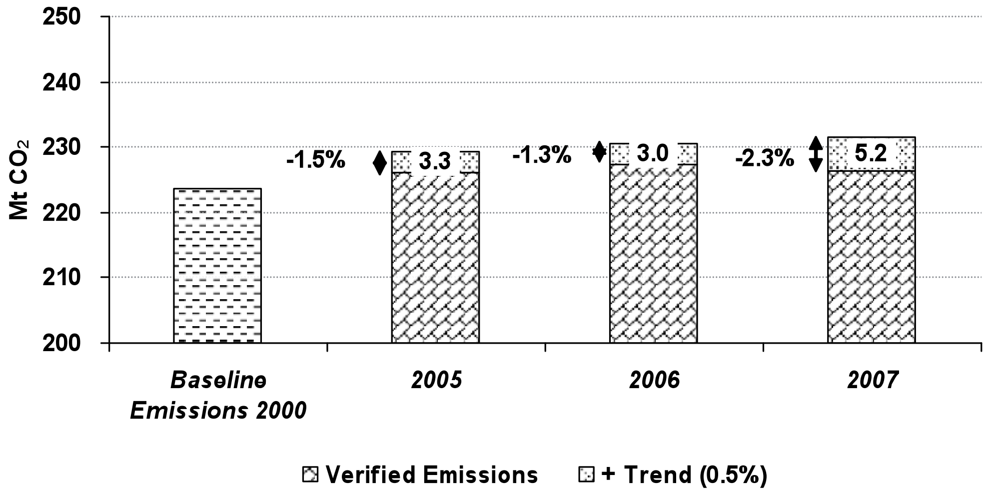

Figure 8. Verified CO_2 emissions for the first period compared to baseline emissions and scenario emissions with 0.5% for annual rate of increase of CO_2. Scenario emissions are reported as percentage and absolute figures.

CO_2 emissions would have been in the absence of the scheme. This second quantity is not observed, and can only be estimated *ex ante*, through the establishment of a baseline, or *ex post*, on the basis of the information concerning the levels of economic activity, weather, energy prices and other factors affecting the demand for allowances.

In the case of the EU ETS, the determination of a baseline is complicated by the poor quality of the information concerning emissions from the installations included in the scheme for the years before the establishment of the scheme. In most member states, this information was collected for the first time for the development of the first set of National Allocation Plans in 2004, and is generally affected by potential bias (given the interest of industries to inflate allocations) and imperfect comparability (due to the different approach chosen by member states).

In our study, verified emissions for the years 2005, 2006 and 2007 at national and sectoral level have been compared with those extrapolated using as a basis emission figures for the year 2000 reported by Italy's National Allocation Plan for 2005-2007 (Italian Competent Authority for the EU ETS, 2004), which were based on data submitted by the operators of the installations included in the ETS. Data for the year 2000 were then projected for 2005, 2006 and 2007 using different growth rates: 0.5%, 1.0%, 1.5%.

These CO_2 increase rates have been chosen considering the observed annual GDP increase of 2002-2005 and the annual rate of carbon intensity change of 2000-2004 in Italy, respectively +0.4% and +0.5% (Ellerman and Buchner, 2006). This information has been used as a basis for the estimation of BAU (Business As Usual) CO_2 emissions for Italy beyond 2004; the resulting CO_2 increase rate is around 0.9%. In order to investigate the possible impact of the ETS in Italy under different assumptions for the evolution of CO_2 emissions, an average CO_2 increase rate equal to 1.0% with a range of ±0.5% has therefore been assumed.

Figures 8, 9 and 10 show that, for both 2005, 2006 and 2007, verified emissions from all the installations included in the ETS are lower than emission projected using the 2000 baseline, and the above mentioned growth rates, thus suggesting a possible impact of the scheme on the overall emission trend. The +Trend in the figures represents the difference between emissions that would have occurred in 2005, 2006 and 2007 with 2000 baseline emissions with annual CO_2 increase rate of 0.5%, 1.0%, and 1.5% and verified emissions. The most likely estimate of the CO_2 abatement resulting from the implementation of the EU ETS in Italy is thus around 9.1 million tons in 2005, 10.0 million tons in 2006 and 13.4 million tons in 2007.

In the Table 1, verified CO_2 emissions for the first period are compared with baseline emissions and scenario emissions for each sector. The difference in sectoral trends is evident. For the biggest sectors, in term of CO_2 emissions (power & heat and cement), verified emissions have been generally higher than scenario emissions; only in 2007 verified emissions from the power & heat sector have been lower than scenario emissions.

In order to draw more robust conclusions, verified emissions should be analyzed taking into account the actual development of other important factors that can influence emission trends, thus modifying the counterfactual compared to the baseline. These factors include general economic and energy developments, as well as sectoral data.

Firstly, we have analyzed CO_2 intensity trends in the period 2005-2007. Decoupling is said to occur when CO_2 emissions grow at a (possibly negative) lower rate than the rate of growth of the economy, usually measured by gross domestic product (GDP) at real prices. Decoupling can therefore be analysed by looking at the elasticity of CO_2 emissions with respect to income ($\Delta\%CO_2$ / $\Delta\%GDP$). Three types of interrelations between CO_2 emissions and economic growth can be identified (D'Orazio and Poletti, 2008):

1. **No decoupling or close coupling.** The elasticity is positive and greater than or equal to 1. In this situation CO_2 emissions are directly coupled with income growth.

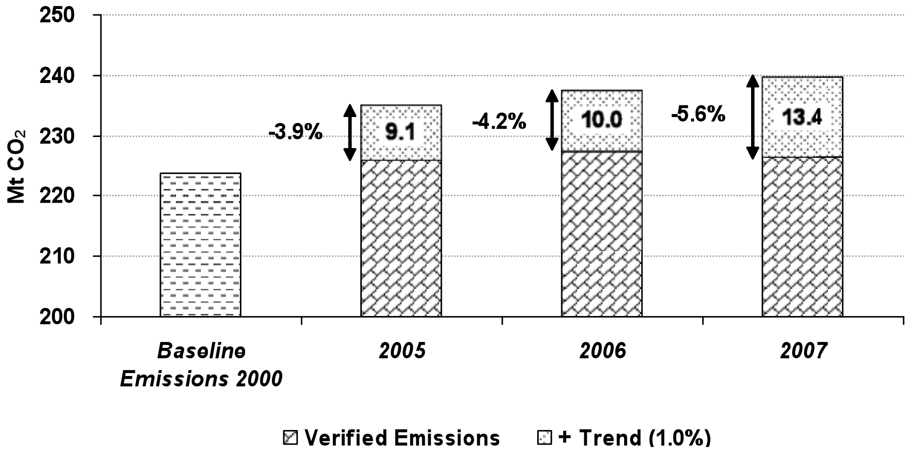

Figure 9. Verified CO_2 emissions for the first period compared to baseline emissions and scenario emissions with 1.0% for annual rate of increase of CO_2. Scenario emissions are reported as percentage and absolute figures.

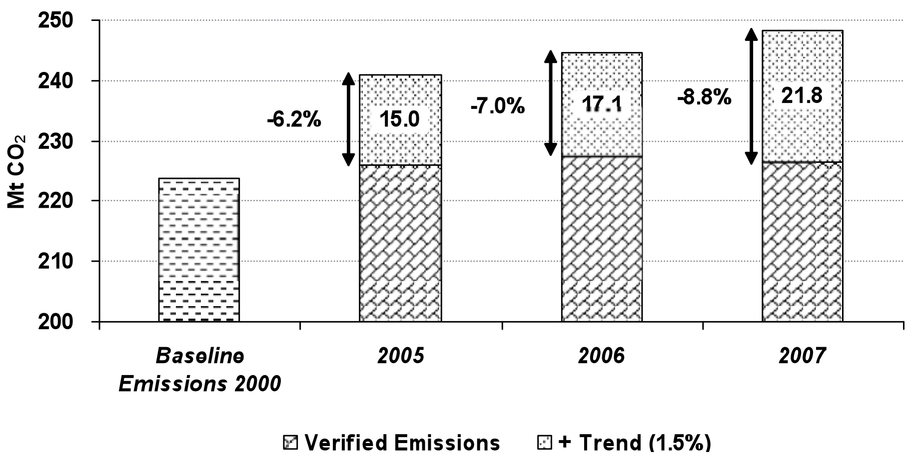

Figure 10. Verified CO_2 emissions for the first period compared to baseline emissions and scenario emissions with 1.5% for annual rate of increase of CO_2. Scenario emissions are reported as percentage and absolute figures.

Table 1. CO_2 emissions by sector for baseline year and 2005-2007 period. Scenario emissions and percentage of reduction/increase as compared to verified emissions are also shown.

Sectors	2000	2005			2006			2007		
	B.E.	S.E.	V.E.	%	S.E.	V.E.	%	S.E.	V.E.	%
Other combustion installations	14.41	15.15	12.75	*-15.8%*	15.30	11.86	*-22.5%*	15.45	11.21	*-27.4%*
Iron, steel and coke	15.93	16.74	13.59	*-18.8%*	16.91	13.39	*-20.8%*	17.08	13.53	*-20.8%*
Lime	2.96	3.11	3.00	*-3.4%*	3.14	3.13	*-0.3%*	3.17	3.13	*-1.4%*
Pulp and paper	4.68	4.92	4.89	*-0.5%*	4.97	4.89	*-1.5%*	5.02	4.89	*-2.6%*
Cement	25.87	27.19	27.63	*1.6%*	27.46	27.86	*1.5%*	27.74	28.63	*3.2%*
Ceramics, bricks and tiles	0.78	0.82	0.69	*-16.4%*	0.83	0.67	*-18.8%*	0.84	0.55	*-34.1%*
Glass	2.9	3.05	2.96	*-3.0%*	3.08	2.91	*-5.3%*	3.11	2.94	*-5.3%*
Refineries	23.29	24.48	20.47	*-16.4%*	24.72	19.91	*-19.5%*	24.97	20.61	*-17.5%*
Power & heat	132.87	139.65	140.00	*0.3%*	141.04	142.82	*1.3%*	142.45	140.93	*-1.1%*
Total	223.69	235.10	225.99	*-3.9%*	237.45	227.45	*-4.2%*	239.83	226.42	*-5.6%*

B.E. Baseline emissions. Source: Italy's National Allocation Plan for 2005-2007 (Italian Competent Authority for the EU ETS, 2004).

S.E. Scenario emissions. Projection of baseline emissions with 1.0% annual CO_2 increase rate.

V.E. Verified emissions. Source: Community Independent Transaction Log (CITL, 2009).

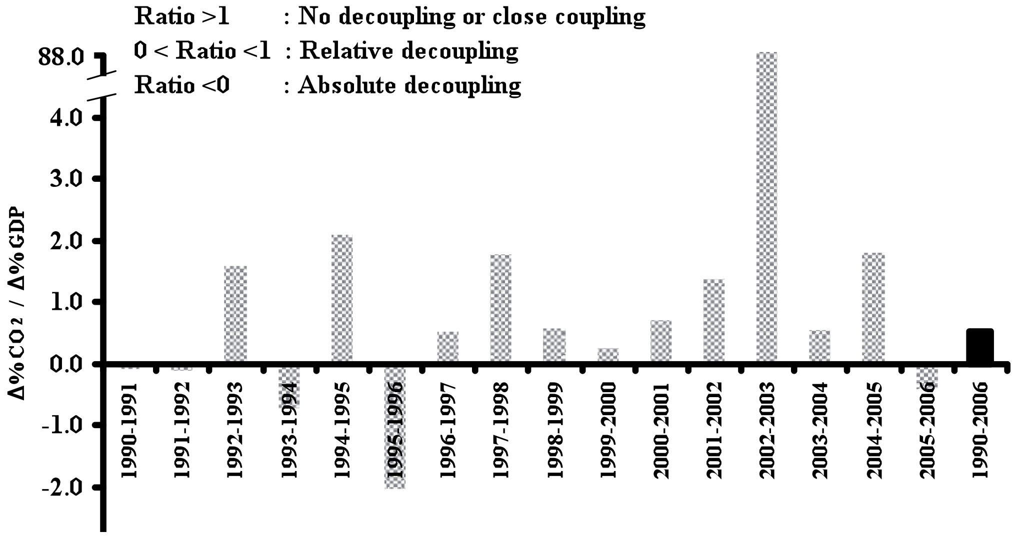

Figure 11. Elasticity of CO_2 emissions with respect to gross domestic product, for the period 1990 - 2006

2. **Relative decoupling.** The elasticity is positive and less than 1. With relative decoupling CO_2 emissions grow at a slower rate than economy.

3. **Absolute decoupling.** The elasticity is zero or negative. As income grows, CO_2 emissions can either stay at the same level or even decline. In the second case (negative elasticity) we have a close decoupling and only in this case CO_2 emissions decrease whilst the economy grows.

Figure 11 shows the elasticity of CO_2 emissions in Italy with respect to gross domestic product at chained prices (base 2000), for the period 1990 to 2006 (the last year for which a complete National Energy Budget has been published). The negative value of the elasticity between 2005 and 2006 suggests a close decoupling, in fact CO_2 emissions have decreased despite a growth of the economy. Since no clear trend towards a reduction in CO_2 intensity has been observed in Italy in the years before 2005, this decoupling could have been influenced by the establishment of the EU ETS. As a matter of fact, at least an important share of the decline in CO_2 emissions in 2006 is due to the reduction of energy consumption in the residential sector, which is not included in the EU ETS.

Furthermore, given this trend in the elasticity of CO_2 emissions with respect to income for the years before 2005, it is reasonable to assume that emissions have continued to increase also in the period between 2005 and 2007. The assumption of growth rates of 0.5%, 1.0% and 1.5% for CO_2 emissions from ETS sectors is therefore fully justified, and the estimation of the gap between verified emissions and the baseline should not be affected by a significant bias.

Unfortunately, the use of such an indicator cannot provide any indication concerning the possible causes of this emission trend, such as technological changes leading to a decrease in specific emissions.

For this reason, we have more closely analysed some of the main production processes included in the ETS, from the point of view of CO_2 emissions per unit of product: steel and iron production, cement production, refineries and the power & heat sector. We could not include other sectors in this analysis, mainly because each of these sectors includes different types of products, characterised by different energy and material inputs. This analysis has been carried out by our Institute using production and CO_2 emissions data reported by the operators of the facilities under the emissions trading scheme, according to the requirements of the directive (see for instance Caputo and Contaldi, 2009). This information is shown in Table 2.

Table 2 shows that CO_2 emissions per unit of product have decreased in the period from 2005 to 2007 for the steel and iron sector and for the power & heat sector, while on the other hand the cement and refineries sectors show an opposite trend. Installations included in the steel and iron sector are based on two different steel production technologies, Blast Oxygen Furnace and Electric Arc Furnace. CO_2 emissions per unit of steel produced decrease by 32.9% between 2005 and 2007, while those from the power & heat sector decrease by 0.61%. Emissions reduction in the three year period is mainly due to fuel shift, with increasing share of natural gas (Caputo and Contaldi, 2009), and an increasing trend in the production of electricity from combined cycle – gas turbine (CCGT) plants (ISPRA, 2008-2009). As concerns fuel shift, the share of natural gas as primary fuel consumption for the power & heat sector is equal to 54.1% and 60.1% in 2005 and 2007 respectively. Electricity production from CCGT increases by 14.0% from 2005 to 2007 and represents 37.5% of electricity production in 2005 and 40.7% in 2007. As concerns refineries, CO_2 emissions per crude oil refined increase by 4.31% between 2005 and 2007, this is probably due to a decrease in the quality of crude oil used as input, together with the more stringent specifications required for various products (in particular as concerns sulphur content of fuels). Emissions per unit of clinker production also increase by 1.40%. These four sectors account for about 89.6% of average verified emissions in Italy in the first ETS period. The sectors that have reduced emissions per unit of product account for 68.3% of overall emissions from installations included in the EU ETS.

Table 2. CO_2 emission indicators for the main production processes included in the EU ETS, 2005-2007

Sector	Production	Indicators	2005	2006	2007
Steel and iron	Steel	CO_2 emissions (kg) / steel production (t)	175.40	121.21	117.20
Cement	Clinker	CO_2 emissions (kg) / clinker production (t)	862.95	863.68	875.02
Refineries	Refined crude oil	CO_2 emissions (kg) / crude oil refined (t)	188.21	192.65	196.33
Power & heat	Electricity	CO_2 emissions (kg) / electricity production (MWh)	615.73	607.82	611.95

Source: Caputo and Contaldi, 2009.

Although no formal attribution of these changes can be made to the influence of the EU ETS, at least we can say that ex post evaluations based on overall and sectoral parameters do not contradict, and even seem to confirm, that an abatement of CO_2 has taken place in the sectors included in the scheme, in the period that coincides with the 1st implementation period of the directive. No comparison has been possible at sectoral level with the years before the establishment of the scheme, due to poor quality of the information available for those years.

Implications for the 2nd implementation period (2008–2012)

From an initial review of the specific elements of the 2nd implementation period of the EU ETS, it appears that the European Commission has tried hard to ensure that the 2nd period is short (unlike the 1st period). Overall, allocations proposed by Member States through their NAPs have been cut by 10.4% below the caps that were originally proposed (The World Bank, 2008).

The cap proposed by the Italian NAP has been cut by 6.3%, from 209.8 to 195.8 million tons CO_2.This allocation is lower than verified emissions for the first period, namely by 13.4% for 2005 emissions, 13.9% for 2006 emissions and 13.5% for 2007 emissions (not considering 7.1 million EUAs to be allocated to additional combustion installations included in the system for the second phase). Italy's National Allocation Plan for 2008-2012 (Italian Competent Authority for the EU ETS, 2006) has chosen to concentrate reduction of allocations in the power & heat and refineries sectors, to keep allocation for manufacturing sectors at the same levels of the 2005-2007 period and to slightly increase allocations for integrated steel works and cement factories.

Preliminary assessments of EUA trades for the first year of implementation of the EU ETS in Italy have shown that:

- the power and heat sector has been the main source of demand and, at the same time, of potential supply of EUAs in the market;
- short positions for 2005 were covered for 66% of overall traded EUAs by purchases or transfers from other installations within Italy, 18% by within-country borrowing and 16% by purchases from abroad (Point Carbon, 2006).

Given the changes in national and sectoral allowance allocation outlined above, it is at least very unlikely that the two above conditions may occur also in the 2nd implementation period; international trading (and use of credits from the Kyoto mechanisms activities) may be expected to play a bigger role also on the Italian market.

Conclusions

Initial assessment shows a positive impact of emissions trading on CO_2 emissions abatement in Italy for most of the sectors included in the EU ETS, regardless of the degree of over- or under-allocation to the different sectors. This estimation has been carried out by comparing verified emissions for the years 2005, 2006 and 2007 with a baseline established using as reference emission figures submitted for the year 2000 by the operators of the installations included in the ETS, projected for 2005, 2006 and 2007 with different growth rates: 0.5%, 1.0%, 1.5%. The most likely estimate of the CO_2 abatement resulting from the implementation of the EU ETS in Italy is around 9.1 million tons in 2005, 10.0 million tons in 2006 and 13.4 million tons in 2007.

The analysis of the elasticity of CO_2 emissions with respect to income, for the period 1990 – 2006, has confirmed that the assumptions concerning the determination of the baseline are realistic. This assessment is confirmed both by the improvement in productive efficiency for many industrial processes and by the decline in the overall energy intensity of the country in 2005 and 2006, in relation with the start of the first phase of the EU ETS.

A more detailed analysis of sectoral trends has shown that CO_2 emissions per unit of product have decreased in the period from 2005 to 2007 for the steel and iron sector and for the power & heat sector, while on the other hand the cement and refineries sectors show an opposite trend. In particular, CO_2 emissions per unit of steel produced decrease by more than 30% between 2005 and 2007, while those from the power & heat sector decrease slightly, mainly because of fuel shift, with increasing share of natural gas, and an increasing trend in the production of electricity from combined cycle – gas turbine (CCGT) plants.

Given the changes in national and sectoral allowance allocation between the first and the second EU ETS implementation period in Italy, international trading (and use of credits from the Kyoto mechanisms activities) may be expected to play a bigger role also on the Italian market in 2008-2012.

References

Betz, R. and Sato, M. "Emissions trading: lesson learnt from the 1st phase of the EU ETS and prospects for the 2nd phase". Climate Policy 6 (2006) 351-359.

Caputo, A. and Contaldi, M. "Analisi del contenuto energetico dei combustibili utilizzati nel sistema ETS per il periodo 2005-2007 e confronto con il Bilancio Energetico Nazionale", ISPRA, Miscellanea/2009, forthcoming.

Commission of the European Communities. "Communication from the Commission on guidance to assist Member States in the implementation of the criteria listed in Annex III to Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC, and on the circumstances under which force majeure is demonstrated", COM(2003) 830 final, Brussels, 7.1.2004.

Commission of the European Communities. "Communication from the Commission on further guidance on allocation plans for the 2008 to 2012 trading period of the EU Emission Trading Scheme", COM(2005) 703 final, Brussels, 22.12.2005.

Community Independent Transaction Log (CITL): "2005-2007 CITL compiled compliance data", downloadable from http://ec.europa.eu/environment/climat/emission/citl_en.htm, 2009.

D'Orazio, A. and Poletti, C. "The Italian energy policy: changing priorities". IEFE (Istituto di Economia e Politica dell'Energia e dell'Ambiente) Working Paper no. 16, November 2008.

Ellerman, D. and Buchner, B. "Over-Allocation or Abatement? A Preliminary Analysis of the EU ETS Based on the 2005 Emissions Data". Fondazione ENI Enrico Mattei (FEEM), Nota di lavoro 139.2006, CCMP – Climate Change Modelling and Policy, November 2006.

ISPRA (formerly APAT). Environmental Data Yearbook – Key Topics. Edition 2007-Edition 2008 (forthcoming), downloadable from http://annuario.apat.it/annuario_en.php.

Italian Competent Authority for the EU ETS. "Directive 2003/87/CE – Italian National Allocation Plan", downloadable from http://www2.minambiente.it/Sito/settori_azione/pia/att/pna_c02/docs/italian_NAP.html, 2004.

Italian Competent Authority for the EU ETS. "Direttiva 2003/87/CE – Piano Nazionale d'Assegnazione per il periodo 2008-2012 elaborato ai sensi dell'articolo 8, comma 2 del D. lgs. 4 aprile 2006, n. 216", downloadable from http://ec.europa.eu/environment/climat/pdf/nap_italy_final.pdf, 2006.

Ministero dell'Ambiente e della Tutela del Territorio. "Assegnazione e rilascio delle quote di CO2 per il periodo 2005-2007 ai sensi di quanto stabilito dall'articolo 11, paragrafo 1 della direttiva 2003/87/CE del Parlamento Europeo e del Consiglio", DEC/RAS/074/2006, downloadable from http://www2.minambiente.it/Sito/settori_azione/pia/att/pna_c02/docs/dm_23_02_2006_074.pdf.

Point Carbon. "Italian companies covered 18 percent of 2005 shortage by borrowing, Point Carbon News, 30 October 2006.

The World Bank. "State and trends of the carbon market 2008", Washington, D.C., May 2008.