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Policy Options to Support the Carbon Price within the European Emissions Trading System: Framework for a Comparative Analysis

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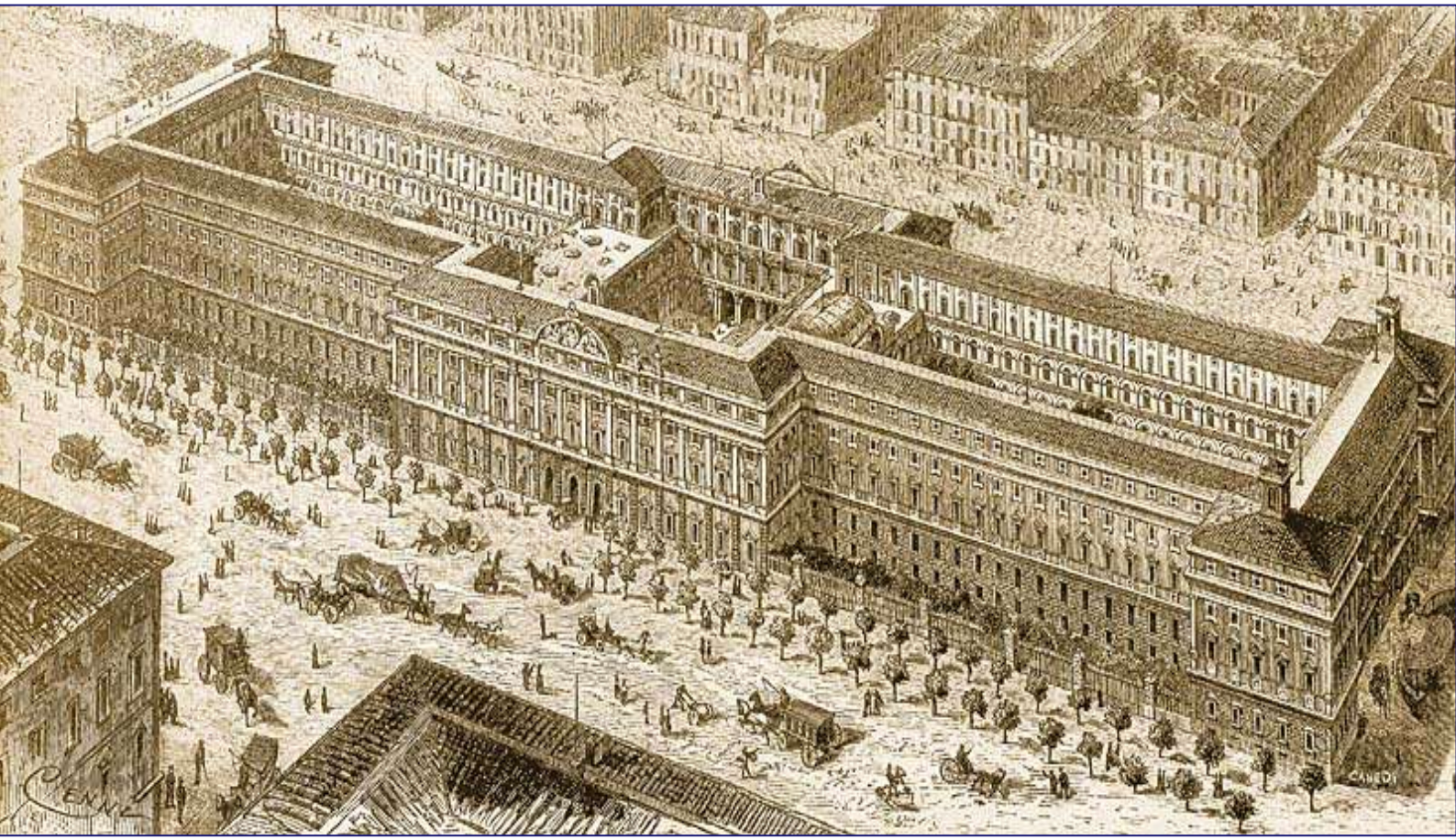

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Susan Battles*, Stefano Clò** and Pietro Zoppoli***

Abstract

This paper develops a methodology aimed at assisting policymakers in selecting the optimal policy option to support the carbon price within the ETS. We consider different policy proposals that can support the carbon price either by intervening on the ETS cap (-30%, set-aside, carbon central bank, long-term reduction targets) or directly on the carbon price (national and EU price floor). In detail, each proposal is examined according to six criteria that allow us to capture and compare their economic, regulatory and procedural implications, so as to determine which options would not only be feasible but also most effective. We conclude that the introduction of a price stabilization mechanism allowing for a reversible adjustment of the ETS cap according to clear, pre-defined rules by an independent authority such as a carbon central bank would be the most effective option to reduce not only the current shortcomings of the ETS but also reinforce the mechanism to avoid similar problems in the future. The establishment of a EU-wide price floor would represent a second-best solution. The worst options appear to be those involving an overall increase in target reduction to 30% and a price floor in its national version, as currently implemented in UK. Finally, we conclude that the setting of post-2020 targets is not a mutually exclusive option, and could be adopted in any case to increase the regulatory certainty of the system.

JEL Classification: K32, Q5.

Keywords: Multi-Criteria Analysis, ETS, Carbon Central Bank, Set-aside, Price Floor.

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1 INTRODUCTION

By ratifying the Kyoto Protocol and by approving the 20-20-20 energy and climate package[1] in 2008, the European Union (EU) and its Member States committed themselves to ambitious emission reduction targets to be reached by 2020[2]. In the context of European climate policy, the main challenge facing Member States is that of reaching the 2020 target and setting a path for effective decarbonisation of the EU economy in a way such as to enhance, not hamper, growth potential and prospects, particularly in the medium to long run. Given this prerogative, it is indeed essential that the EU induce emissions abatement by stimulating technological innovation and the adoption of low-carbon technologies (EC 2011). It was in this spirit that the EU launched the so called European Emissions Trading Scheme (ETS) in 2005. The Directive creating the System (Directive 87/2003/EC) foresees that emissions produced by the European energy and industrial sectors are capped and priced[3]. Within the ETS the regulator fixes ex-ante a limit to the amount of emissions that the ETS sectors can produce (the ETS cap), and then allocates among the ETS installations a corresponding amount of freely tradable allowances. Firms need an allowance for every ton of emissions they produce and can comply with the regulation either by acquiring at the market price allowances within the ETS or by reducing emissions internally, for instance by adopting a low-carbon technology.

This decision depends heavily on the current and expected level of the carbon price. An adequate carbon price is thus required to induce an abatement of emissions and to foster investments in low carbon technologies, which otherwise would fail to penetrate spontaneously the market. However, since the launching of the ETS in 2005, the actual carbon price has, on several occasions, dipped beneath the level required to promote abatement of emissions (ECa 2010, Helm 2008).

At the time the Climate Package was approved and the ETS cap was fixed for the third trading period, a 30€/ton carbon price was expected. However, the economic recession in 2009 caused an unexpected reduction in ETS emissions and, consequently, a structural decrease in the ETS carbon price. Indeed, a particular characteristic of this market-based instrument is that the supply of allowances is fixed, while demand varies continuously depending on economic

[1] Specifically, by 2020 the EU is committed to: i) reduce emissions by 20 percent with respect to 1990; ii) reduce energy consumption by 20 percent and iii) increase the quota of renewable energy sources in total energy consumed to 20 percent. The package is composed of four Directives (Emission Trading System - ETS; Renewable Energy; Carbon Capture and Storage/CCS and Biocarburants), one Decision (Effort Sharing,for sectors not included in the ETS) and one Regulation (vehicule emissions).

[2] This overall target is split into two separate European emission reduction goals: one for the ETS sectors that are directly liable in case of non-compliance, and one for the non-ETS sectors. The European non-ETS target has been shared among Member States (MS), with Governments being directly responsible for compliance. During the first two phases of the ETS Directive, 2005-2007 and 2008-2012, emission allowances have been assigned basically without charge, on the basis of National Allocation Plans. In the third phase allowances will be allocated at European level instead. For 2013 the cap has been fixed at 2.04 billion allowances; the cap should be reduced by 1.74 percent each year thereafter. The revised ETS Directive introduces new sectors and gases into the scheme. Furthermore, from 2013 on, the thermal electric sector will have to buy 100% of its allowances. Allowances will auctioned by Member States on a regular basis; as a consequence, Member States' governments will benefit from a new source of revenue, according to their relative share of allowances. A good share of the manufacturing sector will continue to receive free emission allowances, while the remaining part will participate gradually in ETS auctions, increasing from 20 percent (of their total share of allowances) in 2013 to 70 percent in 2020, reaching 100 percent in 2027.

[3] The ETS covers CO2 emissions from installations such as power stations and other combustion plants, oil refineries, coke ovens, iron and steel plants and factories making cement, glass, lime, bricks, ceramics, pulp, paper, board petrochemicals, ammonia and aluminium. Nitrous oxide emissions from certain processes are also covered. As such, the ETS installations cover about 50% of overall emissions of CO2 in the and 40% of its total greenhouse gas emissions. Airlines have joined the scheme in 2012; it will be further expanded at the beginning of the third period (2013-2020) to petrochemicals, ammonia and aluminum industries and to additional gases. A proposal to include international maritime emissions should be forthcoming.

and financial trends, causing price fluctuations and adjustments. Since the ETS cap does not result stringent anymore due to the current surplus of allowances that will be transferred to the third trading period 2013-2020, the future carbon price will be, by all accounts, significantly lower than the expected one. The future carbon price currently expected is low, most likely too low and unstable to incentivize low carbon investments (ECa 2010).

By all accounts, investment in low carbon technologies is essential if Europe is to reach its goal of decarbonisation by 2050[4]. However, without a clear carbon price signal, market operators do not know whether investing in low-carbon technology will be a profitable strategy. This uncertainty, that can be amplified by the lack of a clear and certain ETS regulation, risks leading them to postpone low-carbon investments, at a time when a considerable part of the capital stock in the energy sector needs to be replaced[5]. A low carbon price thus risks locking Europe into high carbon investments, significantly increasing mitigation costs after 2020[6].

Given these shortcomings several options to support the ETS carbon price by intervening either on the ETS cap or directly on the carbon price (price floor) have been proposed and are currently under discussion. These different policy proposals are likely to affect in different ways the carbon price and the performance of the ETS. They have different juridical implications too, in terms of adjustments to the ETS normative framework and implementation procedures.

This paper develops a comparative analysis of different normative proposals aimed at supporting the ETS carbon price by focusing on their different legal and economic implications. In particular, this paper considers five different policy options: a) increase in the European emission reduction target (-30%; b) ex-post cap adjustment (set-aside); c) price stabilization mechanism (carbon central bank - CCB); d) a carbon price floor set either at a national and at an European level; e) establishment of binding reduction targets into the future.

In order to develop a comparative analysis, this paper builds a qualitative framework that combines different criteria regarding both the economic and legal effects of each proposal. Each proposal is examined in detail, according to six criteria: i) support to carbon price, ii) long-term price signalling, iii) impact on public finance, iv) timing of implementation, v) regulatory certainty and vi) European harmonization. By attaching a qualitative value to each of the six criteria (positive (+), neutral (0), a negative impact (-) or ambiguous) we rank the five different policy proposals. The intention of this methodology is to assist policymakers in selecting the optimal policy proposal aimed at supporting the carbon price.

The paper is organized in the following manner. Section 2 summarizes the performance of the ETS, highlighting the inefficiencies that characterize its performance to date, as evidenced by the current excess of allowances and very low carbon price. Section 3 recalls the widely recognized arguments in favour of a clear and stable long-term carbon price. Then, section 4 introduces the various policy options to be analysed as well as the methodology and criteria to be applied in the comparative analysis . In the following sections 5 to 8 the methodology and criteria are applied to the defined policy options. Section 9 provides a summary of the main findings and the final ranking of the policy options, as well as a few final considerations.

[4] The revised ETS Directive foresees a reduction of emissions by at least 50% below their 1990 levels by 2050. The European Council has endorsed the more ambitious target of an emissions reduction of at least 80% by 2050 in its Council Conclusions of 29/30 October 2009.

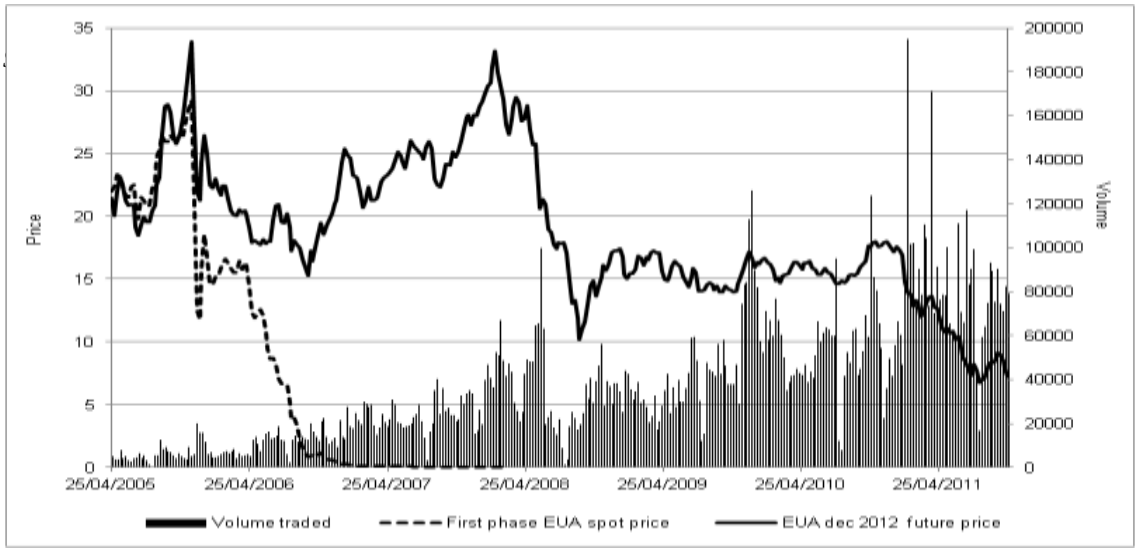
[5] IEA, 2007, Climate Policy Uncertainty and Investment Risk.

[6] The resulting increase in costs has been estimated using the Primes and Gains models in the Impact Assessment of the European Commission accompanying the Communication of a Roadmap for moving to a competitive low carbon economy in 2050. According to these estimates, delaying action now would lead to greater investment expenditure of around €100 billion per year for the period from 2030 to 2050, without comparably decreasing investment needs before 2030.

2 STATE OF AFFAIRS OF THE ETS: PROBLEMS OF PRICE IGNALLING AND REGULATORY UNCERTAINTY

The ETS was designed as a cost-effective and economically efficient tool to promote the reduction of greenhouse gas emissions, delivering gradual and predictable reductions of emissions over time and encouraging the use of more energy-efficient and clean technologies. As such, it represents a milestone within European and international climate policy. For the first time in Europe, carbon emissions have been priced, and this represents the first essential step for reducing emissions and moving toward a low-carbon economy. However, the ETS has had some important setbacks, perhaps inevitable in the beginning stages. In particular, during the first trading period 2005-2007, the over-allocation of non-bankable[7] allowances caused a collapse of the carbon price toward zero (Clò 2009, Kettner et al. 2007). At the time when the Climate Package was approved and the ETS cap was fixed for the third trading period (2013-2020), a 30€/ton carbon price was expected[8] (EC 2008), as the European economy was in an upswing, ETS emissions were expected to increase and the ETS cap for the second phase had been reduced by the European Commission[9]. However, economic recession in 2009 caused a drop in the EU-27 GDP (-4.3%), European industrial production (-13.7%) and primary energy gross inland consumption (-5.8%)[10]. This caused an unexpected reduction in ETS emissions, generating, for the second time, a huge surplus of allowances and, consequently, a structural decrease in the ETS carbon price, down from 27€/ton in September 2008 to 7/€/ton at the beginning of 2012, as shown in figure 1.

Fig. 1 Trend of carbon prices during the first and second phase of the EU ETS and traded volumes



Source: Thompson Reuters Datastream Pointcarbon.

[7] Allowances could not be banked and transferred from the first to the second trading period 2008-2012. Differently, firms will have the possibility to transfer from the second to the third trading period 2013-2020 any surplus of allowances not delivered.

[8] In particular, the 30€/ton carbon price was used in the impact assessment accompanying the revised ETS Directive.

[9] To ensure the scarcity of allowances, the European Commission had previously cut by 10% the amount of allowances Member States had intended to allocate to the ETS sectors.

[10] Source: Eurostat.

A substantial surplus of allowances flooded the market and in a few months the carbon price lost almost 70% of its previous value (-40% from 2008 to 2009). Nevertheless, the price did not collapse to zero as in the previous phase, mainly for two reasons: banking and room for bargaining.

Thanks to banking, the demand for allowances has been sustained by power companies' hedging activities[11], allowing the ETS sectors to manage the over-supply of allowances without the carbon price falling to zero. Moreover, despite the market for ETS allowances being overall long over this period, the market was divided between buyers and sellers, with the thermoelectric sector accumulating a deficit of 270 million allowances and manufacturing industry a surplus of 605 million allowances. Most of this surplus was surely sold, as shown by the sharp increase in volumes traded during the ETS second trading period: manufacturing installations have increased financial liquidity while electricity installations have covered their hedging positions.

Tab. 1 Market positions of the power and industrial sectors for the period 2009-2011

	2009			2010			2011			2009-2011		
	Allocation	Verified Emissions	Surplus/ deficit	Allocation	Verified Emissions	Surplus/ deficit	Allocation	Verified Emissions	Surplus/ deficit	Allocation	Verified Emissions	Surplus/ deficit
Power	1.264	1.365	-102	1.284	1.398	-114	1.286	1.340	-54	3.834	4.104	-270
Industry	702	495	208	706	521	185	707	494	212	2.116	1.510	605
Total	1.966	1.860	106	1.990	1.919	71	1.993	1.835	158	5.949	5.614	335

Source: own elaboration on EEA, CITL (on April 2012).

Since the ETS cap does not result stringent anymore due to the surplus of allowances that has resulted, the future carbon price will be, by all accounts, significantly lower than the expected one. As a consequence, the carbon price is expected to be too low and unstable to incentivize low carbon investments (EC 2011, Martin et al 2011)[12]; some market analysts have even concluded that without any intervention in the near run, the ETS will stop functioning all together.

3 CARBON PRICE VOLATILITY AND REGULATORY UNCERTAINTY

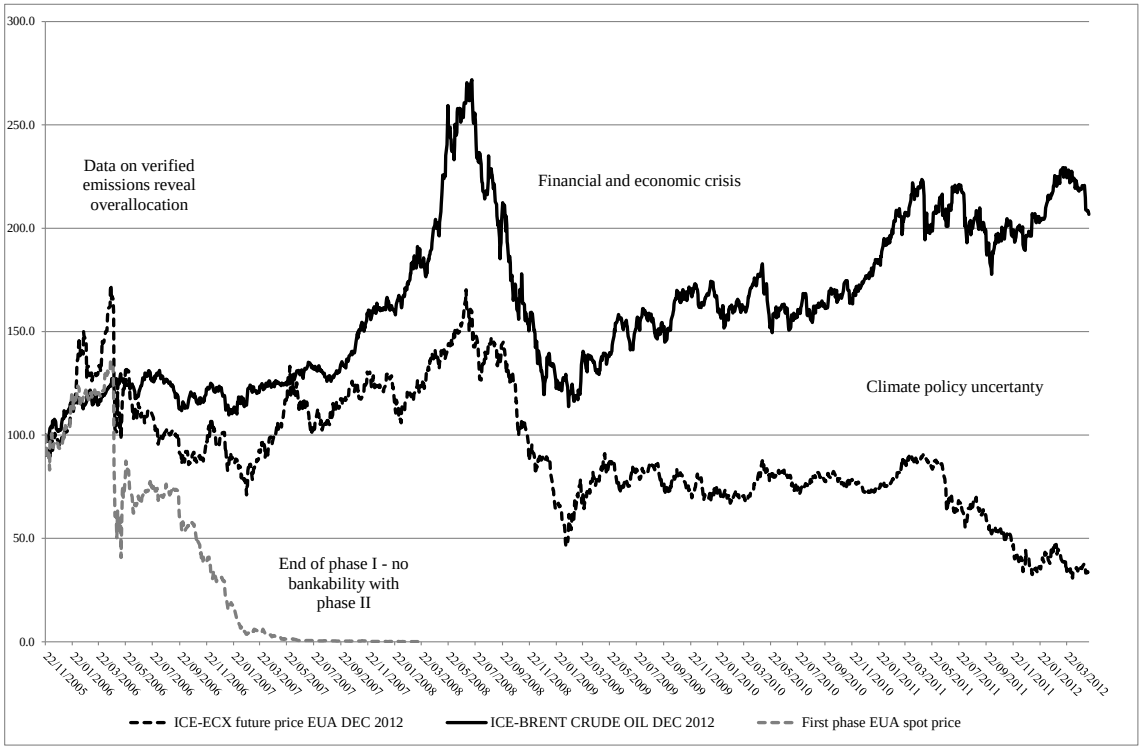
The ETS is defined as a quantity-based mechanism because the aggregate level of emissions that the ETS sectors can produce is fixed and known, while the carbon price is not. Given this structural rigidity on the supply side, the carbon market clearing price varies daily according to firms' demand of allowances, which varies with uncertainty depending on, among other factors, weather conditions and temperature (Mansanet-Bataller et al. 2007),

[11] The power sector tends to sell electricity up to three years in advance. When stipulating these forward contracts, power companies find it to be to their advantage to buy in advance the amount of fuels and emission allowances required to cover their production (hedging).

[12] In particular, Martin et al (2011), in a regression analysis of the effect of climate policy on innovation at firms' level, find a significant and robust positive association between expectations that firms hold about the future stringency of their cap and clean innovation.

macroeconomic and financial markets (Chevalier 2011a), industrial production (Alberola et al. 2008b), and on the uncertain trend of energy markets' fundamentals. In particular, it has been shown that the carbon price trend is correlated to the price of energy commodities such as gas and oil (Chevalier 2011b) and both prices show a high degree of dispersion.

Fig. 2 Trend of carbon, oil prices (Indexed values)[13]



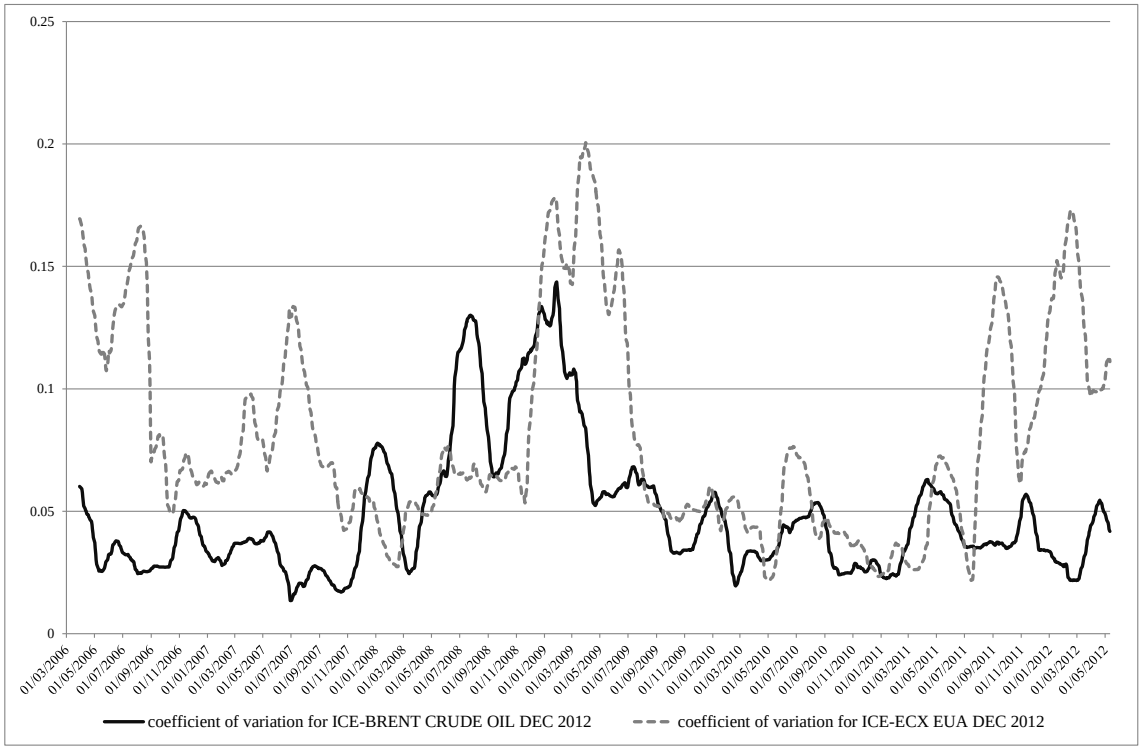
Sources: own elaboration on Thomson Reuters data.

Since the economic literature points to fossil fuel prices as one of the main elements influencing the price trend of permits (Chevalier 2011b), and given the high variability of fossil fuel prices on the market in recent years, we use oil prices as the benchmark to illustrate the degree of carbon price variability in the allowances market. In order to capture price volatility (dispersion) in the EU ETS market, we use the simple but clear measure of the Coefficient of Variation (CV) . This coefficient describes the dispersion of the variable in relation to the mean, such that variability is independent of the unit of measurement used for the of variable itself. The CV is usually used to compare the relative dispersion among different variables. The variable with the higher CV has the greater degree of dispersion. Figure 3 shows the different paths for the CVs for both future crude oil and future EUAs with settlement price given at December 2012 traded in same market (ICE-ECX). In certain periods the CV is higher in the crude oil market than in the permits market, in others the contrary is true. This rough analysis shows that from November 2007 to August 2008 the CV of oil prices was inferior to that of the CV of EUA

[13] In order to show the different trend of oil and carbon price in the same figure, their value at April 2005 has been normalized to 100. Therefore this picture catches the trend of these prices but not their absolute value expressed in their related unit of measure.

prices. Instead, in the first phase of ETS, the variability of EUA prices was significantly higher than that of oil prices; in this same period the ETS was suffering from an oversupply of permits. Over the last seven months depicted in the graph (end 2011- mid 2012), a situation similar to that of the first phase of ETS has arisen, with a significant increase in the dispersion of permit prices compared to that of oil prices.

Fig. 3 Coefficient of Variation for carbon and oil prices



Sources: own elaboration on Thomson Reuters data..

As briefly shown in figure 3, carbon price volatility is an intrinsic feature of the ETS. However, to the extent that it is highly, though not exclusively, related to price fluctuations in energy-related commodities' markets, volatility does not necessarily constitute a problem *per se,* as companies have developed several instruments to hedge against this type of uncertainty (market uncertainty).

However, differently from energy markets, the ETS is an artificial market where firms trade an intangible good - emission unit allowances- generated by the regulator. The ETS' performance thus depends on political decisions that shape its institutional framework. Consequently, uncertainty affecting the carbon price is also regulatory driven (regulatory uncertainty). Regulatory uncertainty concerning the ETS has arisen in a number of instances (Alberola et al. 2008, Chevalier et al. (2009), Alberola and Chevalier 2009), impacting negatively on firms' confidence in this mechanism[14].

[14] We recall that the over-allocation of allowances combined with the impossibility to bank and transfer them into the second phase caused a collapse of the carbon price at the end of the first phase. In addition, at the time of the ETS launching in 2005, many National Allocation Plans had not yet been finally approved and many ETS installations had to operate within the ETS without knowing the exact amount of allowances they initially owned. More recently, uncertainty

It is widely recognized that an adequate and stable long-term carbon price is required to foster investments in low carbon technologies, which otherwise would fail to penetrate spontaneously the market (IEA, 2011; Martin et al 2011). Most recently, however, the unexpected carbon price slump caused mainly- though not exclusively- by the 2009 financial and economic crisis, the permanence of regulatory uncertainty and the lack of a clear long-term price signal, are negatively affecting ETS installations' confidence in the ETS and their propensity to adopt long-term investment strategies in low-carbon technology. The risk is that of increasing the cost of reaching the European goal of decarbonisation by 2050, since a considerable amount of the capital stock in the energy sector needs to be replaced within the current decade[15]. The next section describes the different policy proposals aimed at improving the functioning of the ETS and introduces the methodology we have adopted to compare and rank these policy options.

4 MEASURES FOR CARBON PRICE STABILIZATION AND CRITERIA FOR COMPARATIVE ANALYSIS

Given the shortcomings previously discussed, several policy proposals to correct the present carbon trend and support the ETS carbon price have emerged within (as well as outside) the European political climate debate. This paper considers the following policy options:

a. **An increase in the European emission reduction target**: in an official communication "*Analysis of options to move beyond 20% GHG emission reductions and assessing the risk of carbon leakage*[16]" the European Commission analyses the possibility to increase the EU emissions target from 20% to 30% by 2020. The effects of this option, which would affect both ETS sectors and non-ETS sectors, have been assessed for each member State in a Commission Staff Working Paper "*Analysis of options beyond 20% GHG emission reductions: Member State results*[17]".

b. **Ex-post cap adjustment**: this option consists in imposing an ex-post adjustment of the ETS cap without affecting the non-ETS emissions reduction target. This proposal could be realized by cancelling part of the amount allowances to be sold by public auction (one shot permanent set-aside, option b.1), by initially withdrawing a certain amount of allowances to be subsequently reintroduced (temporary set-aside option b.2) or by deepening the rate at which the CO2 cap is cut over the next nine years (progressive

has been created by the change in the future availability of certified emissions reductions generated by CDM projects. In particular, and differently from the previous and current trading period, it has been decided that only a subset of CERs generated by a particular typology of projects (i.e. HFC projects are banned) developed in certain countries will be tradable within the ETS in the next trading period. Furthermore, final decisions on some NAPs (2008-2012) have been revised. In particular, Poland and Estonia have opposed the European Commission's imposition of limits on how many carbon permits they can hand out for free. Estonia appealed before the European Court of Justice the EC's decision to cut its national cap and won a 2009 ruling from the European Court of First Instance that annulled the EC-imposed quota reduction. On December 2011 the EC agreed to a revised emissions plan for Estonia for the 2008-2012 period, by entitling the country to hand out almost 3 million extra CO2 permits.

[15] According to IEA estimates, the EU power sector will need to invest 694 billion dollars in the current decade and 1080 billion dollars in the period 2021-2035 (MANCA FONTE).

[16] COM(2010) 265 final.

[17] SWD(2012) 5 final.

and permanent set-aside, option b.3). A general proposal along these lines was included in the legislative report of the Industry, Research and Energy Committee of the European Parliament with reference to the proposed energy efficiency directive, subsequent to its deliberations on 28/02/2012. MEPs have asked the Commission to consider taking measures, in particular "*before the start of the third phase, the Commission shall, if appropriate, amend the regulation referred to in article 10 (4) of Directive 2003/87/EC in order to implement appropriate measures which may include withholding of the necessary amount of allowances*"[18].

c. **A price stabilization mechanism - a Carbon Central Bank**: this option foresees the creation of an independent central authority entrusted with the possibility to correct the supply of allowances by acting like a central bank to maintain the carbon price within a pre-determined fluctuation band. This option has not been officially proposed, but it has been introduced and discussed in the political and academic debate (De Perthius 2011).

d. **A carbon price floor**: instead of intervening on the ETS cap, a floor to the carbon price could be introduced. This option could be implemented in many ways: a regulatory authority could be entrusted to buy back allowances at the given price floor (Helburn 2006), a reserve price could be set for public auctions (Neuhoff and Grubb 2006) or the payment of a fee equal to the difference between the real carbon price and the price floor could be envisaged. (Wood and Jotzo 2009).

e. **Establishing targets into the future**: This option would involve setting future targets now for the post 2020 period. A long-term policy signal would be given so as to boost investment in low-carbon technology, given its long-term nature in terms of commitment.

We compare these options in terms of both the economic and procedural implications of their implementation, so as to identify options that could be not only feasible but also effective in overcoming present shortcomings. More specifically, we build up a framework that allows us to evaluate, compare and classify the identified policy options, according to the following economic and institutional criteria:

i. **Support to carbon price**: a too low carbon price does not reflect the social cost of carbon and it fails to increase the attractiveness of low-carbon technologies compared to traditional ones. We thus assess whether the policy options reviewed manage to support the carbon price by increasing its average value in the short-run.

ii. **Long-term price signalling**: In the past, price trends have been corrected by shortening the ETS cap and the supply of allowances on a national level. Regulation has also been significantly modified, but problems related to price level and stability have persisted. The generated regulatory uncertainty highlights the need for corrective action that takes into account a longer time horizon, in order to provide a stable set of rules. Therefore each policy option is analysed by considering its capacity to send a clear and long-term carbon price signal.

[18] http://www.europarl.europa.eu/document/activities/cont/201203/20120315ATT40997/20120315ATT40997EN.pdf

iii. **Impact on public finance**: Each policy option is analysed by considering its impact on public finance. In particular we consider how public revenues from auctioning are likely to vary under each of the proposed measures. The size and direction of variation of public revenues resulting from a reduction in the quantity of allowances sold will depend on the slope of the demand curve. Generally speaking, when the slope of the demand curve is relatively flat (high elasticity) the quantity effect will be greater than the price effect, causing a reduction of public revenues. Vice-versa, when the slope of the demand curve is relatively steep (low elasticity), then the price effect is greater than the quantity effect, increasing public revenues. According to the EC, by reducing the ETS cap, "carbon prices are expected to increase by more than the reduction of allowances auctioned" (p.6 EC 2010). We take this assumption as a benchmark to assess the impact of each policy option on public finances. Given current public budget constraints, we attach a negative value (-) to those measures which have a negative impact on public finances.

iv. **Timing of implementation**: The time element is crucial when considering the feasibility of introducing each policy option in the ETS legal framework. Therefore, we consider the legislative procedure and the amount of time roughly required to implement the different measures.

v. **Regulatory certainty**: In order to reduce politically related uncertainty, it is crucial that any measure adopted to correct the carbon price is framed within an open and clearly understood process, guided by equally transparent and predictable rules. If, instead, market operators perceive the chosen price correcting measure as an arbitrary political intervention that only interferes with the market functioning mechanism, their confidence would be jeopardized, with possible detrimental effects in terms of long-term investment. Given that any intervention on the rules governing the ETS may have a disruptive impact upon current operations in the market for permits, as operators have set their portfolio strategies on existing rules, any intervention would need to minimise possible negative impacts on the market and, as such, should be built on clear, predictable rules, announced in advance and introduced gradually, so as to allow a transition period. In our view, this would allow operators to adjust their expectations, avoiding excessive discontinuities in the market.

vi. **European harmonization**: The ETS has been identified and agreed upon as that market mechanism which will deliver emission reductions at lowest cost to Member States; as such, it should be supported, as its perceived failure will lead to further fragmentation of EU and national policies. EU harmonization may be intended not only as harmonization of ETS policies between different Member States but also as harmonization between the ETS price and the carbon price imposed on non-ETS sectors within the EU context. Such a harmonization would be particularly important in the case of future provisions in a revised EU Directive on energy taxation regarding carbon taxation of non ETS sectors.

By attaching a positive impact (+), neutral (0), a negative impact (-) or ambiguous to each of the six criteria we can rank the five different policy proposals. In this way, the adopted methodology can assist policymakers in selecting the optimal policy proposal aimed at supporting the carbon price.

The following sections analyse each of the above mentioned policy proposals according to these criteria.

5 A FURTHER REDUCTION IN OVERALL EUROPEAN EMISSIONS: TOWARDS A -30% REDUCTION TARGET

In October 2010 the European Council invited the Commission to further analyse options for moving from 20% to 30% and the consequences at Member State levels, starting from its previously Communication "A*nalysis of options to move beyond 20% GHG emission reductions and assessing the risk of carbon leakage*". In February 2012 the Commission provided a Staff Working Paper " *Analysis of options beyond 20% GHG emission reductions: Member State results*". An increase in the EU's overall emission reduction target produces effects on ETS sectors and non-ETS sectors. Indeed, the overall EU target, -20% by 2020, was split into two separate European emission reduction goals: one for the ETS sectors, who are directly liable in case of non-compliance, and one for the non-ETS sectors. The European non-ETS target has been shared among Member States (MS)[19], who are directly liable for compliance. In order to achieve their non-ETS goals and avoid penalties, MS have to provide incentives and implement corrective measures aimed at reducing non-ETS emissions, perhaps by mobilizing financial resources from the public budget. On the EU ETS side, the European Commission's working paper argues that an increase in the ETS emission reduction target would be associated with significant benefits in terms of financial stability, environmental quality and extra government revenues per year.

The Commission Staff Working Paper, in order to achieve a -30% reduction in European GHG emissions by 2020, assumes a 25% GHG reduction through domestic measures, with the remaining 5% reduction met through the use of international emission reduction credits. This reduction would be effectively implemented through two instruments, as it would affect both the ETS and non-ETS sectors: the ETS cap would become 34% rather than the current 21% below 2005 emissions, and the overall target for sectors not covered by the ETS would become 16% instead of the current 10% below 2005 emissions.[20] Moreover, to ensure an equitable distribution of efforts between Member States, the Commission supposes that these two measures should be supported by offsetting mechanisms[21] based on income level (low income

[19] *Decision No. 406/2009/EC of the European Parliament and of the Council of 23 April 2009 on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020.*

[20] See Communication from the Commission of May 2010, *Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage.*

[21] The document states that "*moving to a 30% target has an impact on the distribution of efforts between Member States, and would require decisions on mechanisms to ensure an equitable distribution of efforts between Member States*" (p. 8).

countries and high income countries)[22]. Firstly, lowering the ETS cap by reducing the number of allowances auctioned in the ETS. As an offsetting measure, the Commission proposes to strengthen the existing distribution key for auctioned allowances in the ETS Directive[23].

To specifically address the distributional impacts, in the Commission Staff Working Paper it is assumed that the reduction only affects the quantity of allowances that higher income MS can auction. As a result, the Commission projections show that the net effect will be positive (the price-increase effect is greater than the quantity-decrease effect) both for high income MS (with an increase in auctioning revenues of 13% from 14.640 € millions in 2020 to 16.511 € millions - 2008 price - in 2020) and for low income MS (with an increase in revenues of 82%, from 6.563 € millions to 12.012 € millions - 2008 price – in 2020). Secondly, lowering the non-ETS target and increasing emission reduction efforts in the non-ETS sectors. The offsetting measure is related to existing flexibility rules in the *Effort Sharing Decision*: if a country exceeds their emission reduction target it can sell the resulting surplus to another MS in exchange for a financial transfer. In this way, those MS "*which are required to make less effort to achieve their goal, often lower income MS, have an additional incentive to implement carbon reducing policies*"[24]. For example, a country that still has far to go to reach its emission reduction target in non – ETS sectors could decide to buy, through the public budget, emission surpluses from other MS instead of implementing additional measures to reduce carbon emissions domestically in non ETS sectors.

We evaluate this option according to the pre-defined criteria:

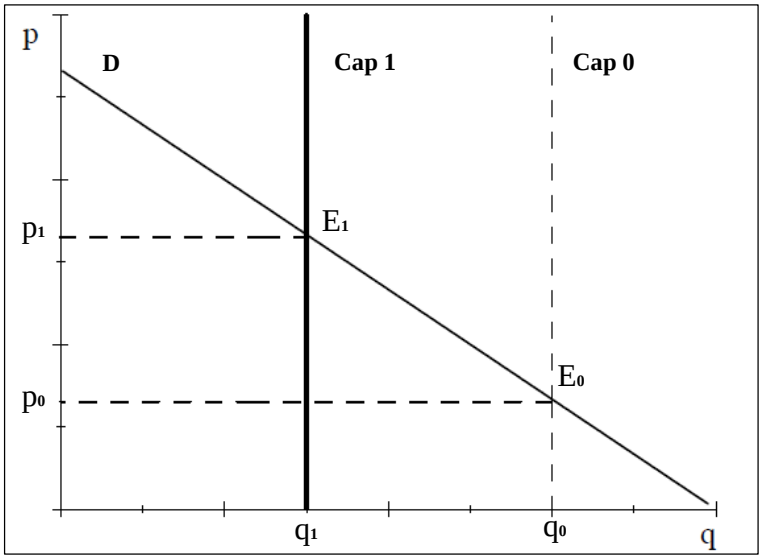
i. **Support to carbon price**: This option is expected to support the ETS carbon price, as the reduction of the number of allowances auctioned in the ETS would decrease, thus increasing the average equilibrium price. This effect is illustrated by figure 4, which describes the equilibrium market within the ETS, given by the balancing between a fixed supply function (ETS cap) and a negatively sloped demand function. The figure shows that in the short term, when the demand of allowances does not vary, the shift to the left of the supply function (from Cap 0 to Cap 1) set by the regulator through a reduction of the ETS cap increases the price level and reduces the optimal quantity at equilibrium (from equilibrium E0 to E1). Emission reductions in non-ETS sectors should not have any impact on the ETS carbon price, instead.

[22] The document states that "*as the impact assessment for the Package pointed out, a cost effective achievement of these targets EU-wide can result in a distribution of the efforts among Member States with proportionally higher direct costs for Member States with lower GDP per capita, and hence the smallest capacity to invest in GHG mitigation and renewable energy. The Climate Change and Energy Package, following the European Council in March 2007, explicitly recognised this and included a number of redistribution mechanisms through the targets per Member State it defined and the amount of allowances to auction in the ETS it foresaw per Member State*". (p. 14).

[23] Currently a total of 88% of allowances to be auctioned by each Member State is distributed on the basis of the Member State's share of historic emissions under the EU ETS. For purposes of solidarity and growth, 12% of the total quantity is distributed in a way that takes into account GDP per capita and achievements under the Kyoto-Protocol.

[24] The carbon deficit projected for high income countries would be equal to 137 Million tonnes CO2 eq, (more than double the current deficit), while the carbon surplus for lower income countries would be equal to 55 Million tonnes CO2 eq. (compared to 65 Million tonnes CO2 eq. under current burden-sharing arrangement).

Fig. 4 Short term price increase induced by ETS cap reduction

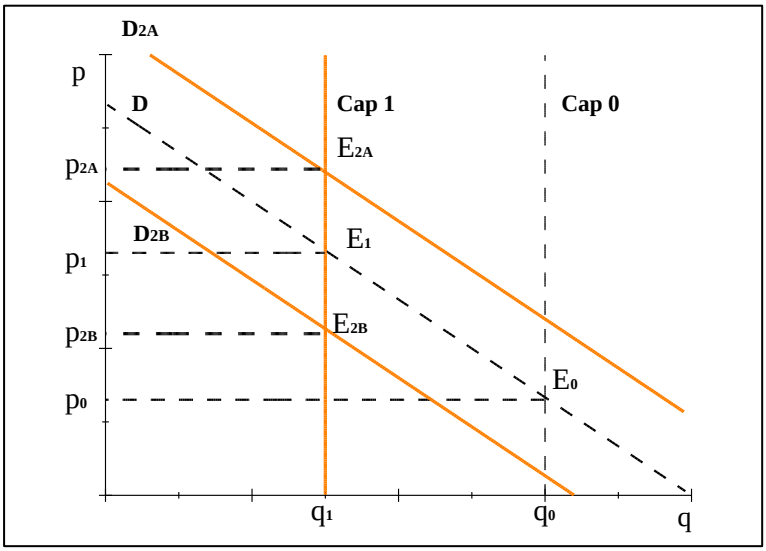


Sources: own elaboration

ii. Long-term price signalling: By reducing the ETS cap, the degree of market flexibility would remain unchanged compared to the current legislation. Therefore this measure would not ensure price stability, as the carbon price is expected to continue to vary, depending on the uncertain variation of the demand of allowances, due to the unpredictable evolution of economic, financial and energy markets. This effect is shown in figure 5: in the long term, given the lower and fixed supply (from cap 0 to cap 1), the uncertain and continuous variation of demand, within the range D2A and D2B, causes a variation of the equilibrium price between P2A and P2B.

Given the possibility that the price could unexpectedly decrease or increase following the implementation of this option, it is unlikely to send a clear long-term price signal.

Fig. 5 Long term price variation induced by ETS cap reduction



Sources: own elaboration.

iii. **Impact on public finance**: On the one hand, the reduction of the ETS cap increases revenues from allowances auctioned compared to the current situation when the price-increase effect is greater than the quantity effect, as is likely to be the case as stated by the European Commission. Indeed, according to the EC Impact assessment of the -30% option, by reducing the ETS cap "the total amount of auctioned allowances would reduce. Nevertheless, the carbon price increases from €16 in the reference case to €30, allowing total revenues from auctioning in 2020 to increase from €21 billion in reference to €29 billion with the auctioning set-aside." (p. 47 EC 2010b). For high income MS, the actual realization of the projected revenue increase is likely to depend on which kind of offsetting option would be chosen. Furthermore, unless measures were introduced on the non-ETS sectors to raise new funds, like a carbon tax, for example, the greater emission reductions required in non-ETS sectors could pose an extra burden on public budgets. The net effect of the two measures is difficult to estimate in the current situation, particularly given that the impact on public finances is not homogeneous among MS.

iv. **Timing of implementation**: Timing is a critical issue since not only the ETS Directive, but also the non-ETS Decision No 406/2009/EC would need to be amended through a European Council and Parliament procedure. This would require negotiation that would take a significant amount of time before an agreement could be reached between all parties concerned.

v. **Regulatory certainty**: This option does not bear on the rules governing the ETS mechanism and could be introduced gradually, reducing progressively the number of allowances auctioned. However, it must be taken into consideration that this would signify that the EU takes a unilateral step to further reduce emissions when it had announced that it would do so only in the case of a binding international agreement for emission reductions signed by all, or nearly all, major emitting countries. Given that a significant international accord was not concluded over the last two years of negotiations (though at Durban countries agreed to turn to do so by 2015) this measure would likely encounter internal political resistance on the part of some Member States.

vi. **European harmonisation**: This proposal is European-based but would affect European Member States differently, having different distributional effects among MS, particularly in terms of impact on public finances.

6 EX-POST CAP ADJUSTMENT

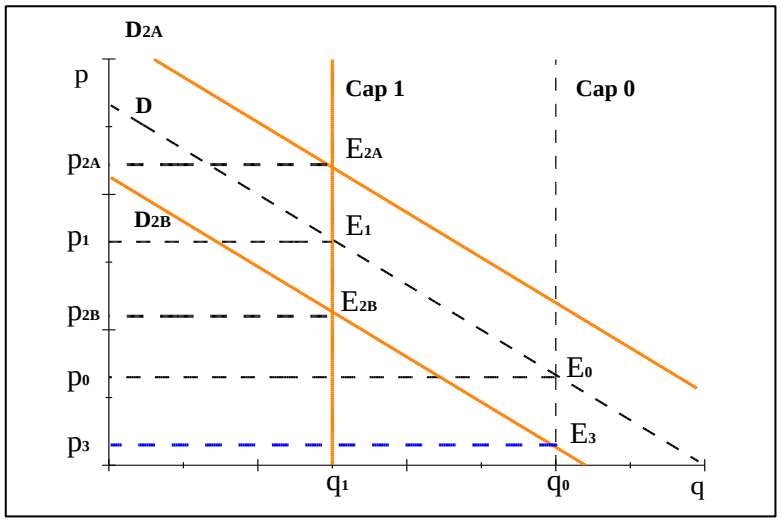
Instead of imposing a reduction target of -30% for all European emissions that would signify new, more ambitious targets for both ETS and non-ETS sectors, a second option considers the possibility to intervene exclusively on the ETS target by imposing an ex-post adjustment of the ETS cap. Such a cap adjustment can be realised by withdrawing part of the amount of allowances to be sold by public auction. We can distinguish between a one shot permanent set-aside (option b.1), where the withdrawn allowances are definitively cancelled, and a temporary set-aside (option b.2), where the allowances that had been initially withdrawn can be reintroduced over the reference period in case of a shortage in allowances These options look relevant as the European Parliament is currently discussing the possibility to reduce the supply of allowances through a set-aside measure, proposed as an amendment of the Energy Efficiency Directive. In order to minimise the potential disruptive impact of the one-shot reduction of the supply of allowances on the carbon price trend and variability, allowances could also be withdrawn from the market progressively at a constant rate, implying a progressive and linear reduction of the ETS cap (option b.3). This option could be realized by deepening the rate at which the scheme's CO2 cap is cut over the next nine years from 1.74 per cent to a lower percentage (for instance to an annual 2.25 per cent, as proposed in the document circulating between Members of the European Parliament).

We evaluate these options according to the pre-defined criteria:

i. **Support to carbon price**: Both options b.1 and b.2 are expected to increase the ETS carbon price (compared to the current trend) via a reduction of the allowances auctioned in the ETS, thus increasing the average equilibrium price. The short term effect of these options on the equilibrium price is illustrated by figure 4. Moreover, ensuring a progressive reduction of the cap (option b.3) would ensure a gradual transition of the carbon price from P0 to P1 (figure 4), reducing the shock that could affect the price if a huge amount of allowances had to be withdrawn in one-shot (options b.1 and b.2).

ii. **Long-term price signalling**: By opting for a permanent set-aside (option b.1), the degree of ETS flexibility would remain unchanged compared to the current legislation. Therefore this option would impact positively on the carbon price level in the short-run, while its long-term effects remain unclear. Indeed, depending on the fluctuation of the demand of allowances, the long-term clearing market price could be higher or lower (P_{2A} and P_{2B}) than the desired one (see figure 5). Option b.2, which foresees the possibility to reintroduce allowances in the market, could even increase the range in which the carbon price could vary. As shown in figure 6, in case the entire amount of withdrawn allowances had to be reintroduced in the market before the end of the trading period (from cap1 to cap0), the carbon price could decrease significantly, to the point P_3.

Fig. 6 Long-term price variation induced by a reintroduction of allowances



Sources: own elaboration.

In order to avoid such a wide price fluctuation that could decrease the market's capacity to send a clear price signal, the regulator could set clear criteria for reintroducing the amount of withdrawn allowances based on the evolution of demand. For instance, the range within which the price can vary can be reduced by imposing a rule by which allowances would be reintroduced only if demand exceeds the level D (while the withdrawn allowances would be cancelled if demand falls below D).

Finally, while reducing the risk of disruptive price variations induced by a one-shot intervention on the cap, option b.3 would not be any more successful in sending clear, long-term price signals, as the risk of a future surplus or deficit of allowances would persist.

iii. **Impact on public finance**: Since the non-ETS target would not be strengthened option b would not imply any negative impact on public finances in this regard. On the other hand, the permanent reduction of the ETS cap (options b.1 and b.3) would increase revenues from allowances auctioned compared to the current situation as long as the price-increase effect is greater than the quantity effect, as discussed in option a. The positive impact on public finances would be higher than the previous option a. The effect of the sub option b.2 on public finances is ambiguous as far as the subsequent reintroduction of allowances is not defined according to clear rules.

iv. **Timing of implementation**: The time required for implementation of the three sub options considered might differ among them. In particular, option b.2 could be adopted without having to modify the ETS Directive, for instance by rescheduling the auctioning of allowances, as stated in the Auctioning Regulation. Conversely, options b.1 and options b.3 would most likely require an adjustment of the relevant legislation, meaning the revision of the EU ETS Directive itself. Without such a revision before 2020, according to Article 10 of the ETS Directive, any allowances that have been set aside may have to be put back on the market, falling within option b.2 (House of the Commons 2012). We conclude that option b.2 would require less time for

implementation than options b.1 and b.3. We observe that the option b in general would require the EU Member States to modify only the ETS and not the non-ETS provisions. Therefore we could expect that less time would be necessary to implement such a change of the ETS cap with respect to the previous option a. As a consequence, this option could likely be implemented in the short-run. Nevertheless, we should take into consideration that none of these options can exclude the risk of further, necessary interventions on the ETS cap in the future If this were indeed to be the case, then the overall amount of time necessary for this type of corrective measure might actually be greater over the long run.

v. **Regulatory certainty**: An ex-post adjustment of the ETS cap will not affect firms' confidence in the ETS if they perceive this measure as a single and foreseeable event. Concerning options b.1 and b.3, in both cases a one-off intervention might not be perceived as an isolated measure. Indeed, this measure cannot exclude the possibility that in the future the ETS will once again face a surplus of allowances, depressing the carbon price below the expected one, inducing the regulator to adopt another one-off intervention on the ETS cap through ex-post legislative amendments. This political uncertainty might deter firms from undertaking long-term investment strategies. By establishing a precedent of rapid political interference in the market this option risks impacting more heavily than other measures on firms' confidence in the ETS, creating further uncertainty and price volatility. Option b.2 also risks increasing regulatory uncertainty unless the decision about the timing, frequency and the amount of allowances to be reintroduced is taken according to clear and pre-determined rules. In the opposite case where such a decision is perceived to be arbitrary and subjected to political sentiments, this option could have a distortive impact on the market and on firms' behaviour. Even the British House of the Commons has recognized that this type of intervention risks to undermine operators' confidence in the functioning of the market. According to the report drafted by the House of the Commons, "Short-term measures that interfered with an already agreed emissions cap could heighten perceptions of political risk, undermine confidence and damage long-term investment" leading to the conclusion that "in order to avoid creating uncertainty, any set aside of allowances would need to be carried out under transparent rules, based on an objective assessment of over-supply and reduction in demand caused by the recession" (House of the Commons 2012, pp.14-15).

vi. **European harmonisation**: this proposal is European-based and would impact on the ETS in a uniform way. As such, it would not have any distributional consequences on the European Member States, whose non-ETS sectors would not be affected.

7 A PRICE STABILIZATION MECHANISM: A CARBON CENTRAL BANK

The current carbon price slump and its predictably high volatility in the future are both due to the combination of uncertain demand and rigidity of supply, as the ETS cap is fixed ex-ante and cannot be modified or corrected rapidly. Because of this rigidity, when the demand of allowances varies significantly, unexpected variations of the carbon price can result. Under current rules, it is not possible to adapt the supply of allowances in order to ensure stability of CO2 prices.

In the future, other exogenous factors may affect negatively the carbon price trend. Indeed, national policies to support renewable energy sources and energy efficiency risk to overlap with the European ETS. The lack of an appropriate coordination mechanism among energy and climate instruments designed both at a national and European level risks creating systemic inefficiencies which can negatively affect their functioning and capacity to promote a cost-effective achievement of the energy and environmental targets. (IEA 2011, Oikonomou and Jepma (2008)). For example, some studies have found that national Tradable Green Certificates affect negatively the EU ETS by reducing the price of allowances and making the instrument less relevant, increasing thereby the social costs of reducing emissions (Abrell and Weigt 2008;Unger and Ahlgren 2005). Böhringer and Rosendahl (2010) have demonstrated that when a cap and trade system is in place, policies supporting renewable energy sources have an indirect depressing impact on carbon price, favoring the dirtiest fossil fuel technologies. Sorrell et al (2009) show that when the ETS is in place, a tradable white certificate (TWC) scheme does not lead to any further reduction of ETS emissions, while it has a negative impact on carbon prices and on investment in RES generating capacity, compared to a scenario where only the ETS is in place.

The European Commission working staff impact assessment of the Energy Efficiency Directive has estimated that a full implementation of energy efficiency measures could bring the carbon price down from 25€ to 14€/ton or even to 0€ by 2020 if no adjustment were to be made to counteract the drop in demand caused by the implementation of extra energy efficiency measures.

A credible signalling of the ETS carbon price, could be achieved by increasing the flexibility of the ETS by way of a rules-based mechanism. Predictability and certainty are two necessary conditions of any such mechanism to improve effectively the functioning of the ETS and to increase the ETS installations' confidence in this system.

These requirements could be satisfied by the introduction within the ETS of a mechanism for a reversible and continuous adjustment of the ETS that would allow for an adjustment of the ETS cap according to transparent and pre-determined rules whenever the carbon price were to vary significantly from a desired range, compatible with EU emission reduction targets. While the previous option of set-aside would impose a reduction of the ETS cap without affecting the ETS framework and its rigidity, this option would increase the flexibility of the ETS, allowing for a more continuous support of the carbon price and a stable long-term price signal over the long-run.

According to this option, a central authority would be legally entrusted to correct the supply of allowances in the case of unexpected variations in demand that cause the carbon price to

deviate significantly from its expected trend. These interventions would be based on clear and objective criteria that would operate much along the same lines as those of a central bank, working to stabilize inflation by controlling the money supply: the hypothesized CCB would in fact control the supply of allowances in order to maintain the carbon price within a desired range. This would imply reducing the supply of allowances when the carbon price were to fall below the lower limit of the fluctuation range and increasing the supply of allowances when the carbon price were to exceed the upper limit of the range. In turn, while the other policy options have been proposed to solve the current problem of surplus of allowances within the ETS, the CCB is the only option that could potentially deal both with the current problem of surplus of allowances and with the opposite risk of a deficit of allowances and a too high carbon price. In practice, the CCB would introduce a safety valve within the ETS, avoiding the risk of price peaks that has been experienced in other cap and trade experiences such as the American SO2 emissions trading program (Schmalensee et al. 1998). Moreover, this proposal would strengthen the rule foreseen in the ETS Directive 2009/29/EC which entails the possibility to increase the supply of allowances in the case the "allowance price is more than three times the average price of allowances during the two preceding years on the European carbon market" (art. 29a). Indeed, while under art. 29a increases in the supply of allowances cannot exceed an amount equivalent to 25% of allowances stored in the New Entrants Reserve, the CCB would be able to increase the ETS cap even beyond the limit imposed by the ETS Directive through open market operations. As argued by De Perthuis (2011) the are several similarities between money and carbon markets, since emission allowances can be interpreted as a currency emitted by a public authority which allows holders to buy the right to emit one ton of carbon emissions. As an over -supply of money generates inflation, reducing the currency value and weakening the economy, an over-supply of allowances reduces the value of emissions and lowers the incentive to reduce emissions.

In the same way the European Central Bank can create and supply money, a CCB would have the possibility to generate and supply allowances to primary auction markets. Differently from the previous options a and b, according to which the ETS cap could be reduced only once by cancelling part of the emission allowances, this option is reversible, since the CCB could increase the amount of auctioned allowances whenever the clearing price is above the desired range and withdraw allowances from the auction (rather than cancelling them) with the further possibility of re-introducing them into the market in the case of a bearish market and a too low carbon price, the last resort possibility being to retire allowances from the secondary market.

Moreover, in the same way central banks apply a pre-defined rule to determine the extent to which the nominal interest rate should be modified in response to exogenous economic changes (GDP, potential output, rate of inflation), an European CCB could apply a kind of "Taylor rule" to clearly define how the quantity of allowances should be modified whenever the real carbon price were to diverge from the carbon price stabilization target. Consistent with the "Taylor rule", the supply of allowances could be linked to relevant, observable economic variables, such as primary energy demand, the price of fossil fuel sources and GDP; supply would then be adjusted according to the deviation of these variables from their expected trend. For instance, as an increase in fossil fuel prices compared to their target trend makes pollution more costly, resulting in lower emissions and lower demand for allowances and thus downward

pressure on the carbon price, the rule could allow for the supply of allowances to be reduced whenever the real oil price were to exceed the expected level (and vice-versa). Along the same lines, as an increase in energy consumption tends to increase the amount of produced emissions (increasing the demand for allowances and the carbon price), the supply of allowances could be increased whenever primary energy consumption were to exceed its expected level. By linking the variation of the ETS supply of allowances to the trend of clearly observable variables, such a rule would reduce the uncertainty of regulation, and should thereby improve ETS operators' confidence toward this mechanism.

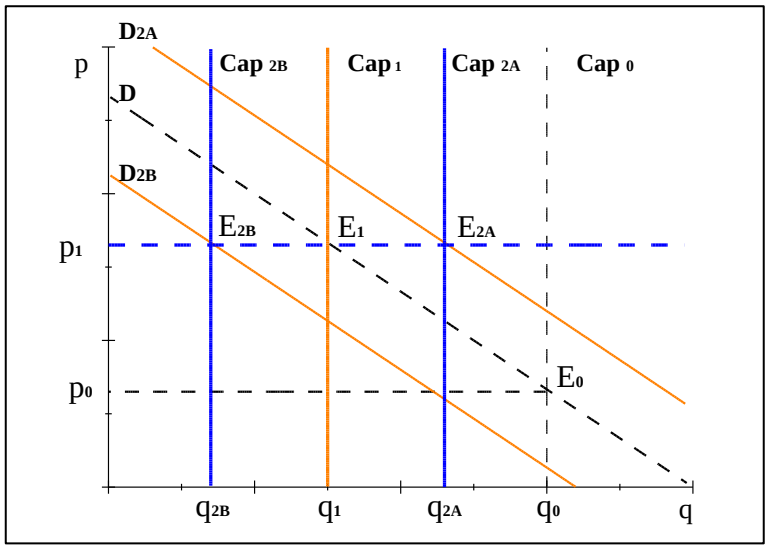
The credibility of this measure requires the institution of an independent authority with the power of intervening in the ETS in a transparent way, by adjusting the supply of allowances according to objective and public available criteria and indexes in order to make the future trend of carbon prices predictable. The designated authority should thus be insulated from short-term political concerns.

We evaluate this option according to the pre-defined criteria:

i. **Support to carbon price**: This option is expected to support the ETS carbon price via an initial reduction of the allowances auctioned in the ETS, thus increasing the average equilibrium price.

ii. **Long-term price signalling**: A carbon central bank able to maintain the ETS cap within a pre-determined level of stringency would stabilize the ETS carbon price against the risk of unexpected economic shocks, as well as limiting the indirect impact of national energy policies on the carbon price. It could also modify supply on a permanent base in the case new international agreements were signed. As such, it would send a certain price signal in the long-term thanks to the possibility to modify in a flexible, yet predictable way the ETS cap in order to keep the price within a desired range.
Figure 7 depicts a particular case where the CCB adjusts simultaneously the ETS cap to maintain the carbon price at a pre-determined fixed level (from p0 to p1).

Figure 7 – Long-term price stability through a CCB intervention



Sources: own elaboration.

In this case, as the demand of allowances diverges from its initial value D and varies with uncertainty (D2A and D2B), the CCB adjusts the supply of allowances accordingly (Cap2A and Cap2B) to grant price stability. Though the price is fixed (p1), the variation of demand causes a variation of the quantity of emissions produced at equilibrium (q2A and q2B). The impact on emissions is thus similar to that of a carbon tax.

While the graphic analysis considers the extreme case of a fixed-price, it is more likely that the CCB bank would be committed to allowing the carbon price to vary within the constraints of a pre-determined corridor.

iii. **Impact on public finance:** This option would not imply any strengthening of the non-ETS target, thus it is not expected to result in an increase in public expenditure required to ensure compliance with the non-ETS target compared to the current situation. Moreover, as far as the carbon price can be stabilized just by reducing the amount of allowances to be sold via public auction, then this option is likely to impact positively on public revenues as far as the price effect is greater than the quantity effect[25]. In the case the reduction of allowances to be sold in the auction were not sufficient to support the carbon price at the desired level, then the stabilization of the carbon price would require the CCB to buy back allowances from the secondary market. If it were the case, as a certain amount of allowances will have originally been allocated for free, this option could give rise to undesirable redistributive effects or not be feasible given current budgetary constraints. Therefore, though it is generally asserted that by reducing the current amount of allowances public revenues are expected to increase[26], we could prudently conclude that the establishment of a CCB would have an ambiguous impact on public finances over the period 2013-2020. Finally, we note that the CCB is expected to stabilize public revenue from auctions, increasing the effectiveness of recycling of revenues to be used for further emission reduction policies and/or other purposes.

iv. **Timing of implementation**: This option would require the EU Member States to deeply modify the ETS framework to introduce greater flexibility. As the establishment of the auctioning platform required an impact assessment, a public consultation, a proper regulation and a public procurement process, we would expect that similar steps be undertaken to set up an independent authority like a CCB to ensure a maximum degree of operational transparency.. This would initially require a longer implementation period with respect to options a and b. On the other hand, further modifications of the relevant

[25] This is likely to be the case as the quantitative analysis performed by Capros et al. (2011) in the impact assessment of the -30% target proposal concludes that by reducing the ETS cap, public revenues from auctioning are likely to rise, meaning that the increase in public revenues induced by a higher carbon price (price effect) is likely to exceed the reduction in public revenues caused by a decrease in the total amount of allowances sold via public auction (quantity effect): *the carbon price increases from €16 in the reference case to €30, allowing total revenues from auctioning in 2020 to increase from €21 billion in reference to €29 billion with the auctioning set-aside*" (p. 47 EC 2010a).

[26] "*Under a 20% scenario, the current allocation methods will generate public sector revenues in Phase III of the EU ETS in the order of €150-190bn. (…) Should the EU move to a 30% commitment, this rises to €200-310bn*" (p. 22 Cooper and Grubb 2011).

legislation would not be required, since according to this option the designated central authority would be allowed to adjust the ETS cap without having to further renegotiate the ETS Directive.

v. **Regulatory certainty**: A reversible intervention on the ETS cap aimed at stabilizing the price of emission permits within a range should increase the degree of market predictability. By guaranteeing that the carbon price will not be subject to excessive and unpredictable fluctuations, this measure should impact positively on firms' confidence in the ETS, fostering long-term strategies. However, at least two conditions are necessary to preserve firms' confidence: i) a long-term commitment to the price range and ii) clear, well-defined and predictable criteria, communicated in advance, upon which all interventions would be based, including that of periodically revising the carbon price target.

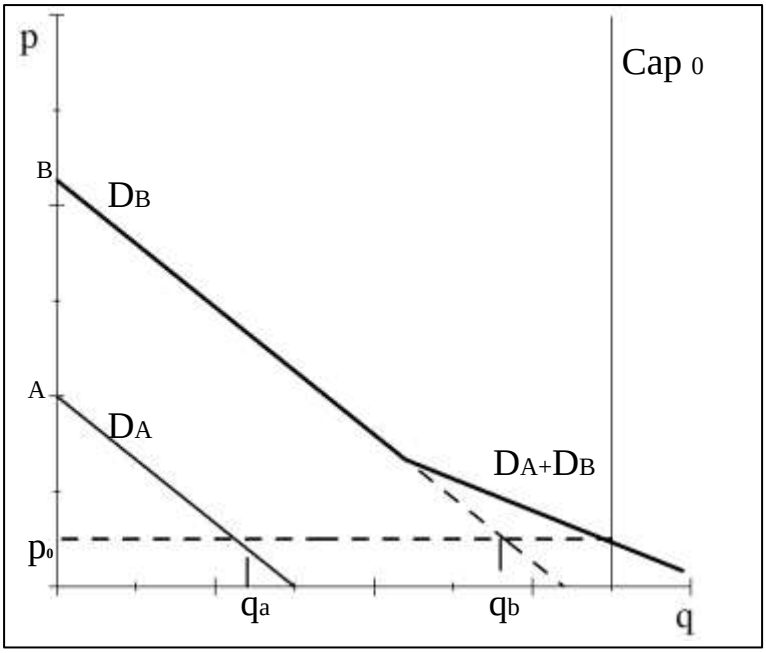
vi. **European harmonization**: This proposal is European-based and would impact on the ETS in a uniform way, not having any distributional consequences on European Member States, whose non-ETS sectors would not be affected. Furthermore, by keeping price oscillations circumscribed within a pre-defined range over a defined period of time, subject to variations based uniquely on transparent and clearly communicated criteria, the CCB mechanism would allow for a greater degree of harmonization with carbon tax provisions on non ETS sectors in a future revised EU directive on energy taxation.

8 CARBON PRICE FLOOR

In addition to intervening on the quantity of allowances to be supplied within the ETS (the ETS cap) the carbon price could also be supported by introducing a carbon price floor. For example, the UK will introduce a price floor from 1 April 2013. The price floor will have the following characteristics: it will apply to the power sector and the floor will start at around £16 per tonne of carbon dioxide (tCO2) and follow a linear path to target £30/tCO2 in 2020 (both in 2009 prices). The British national price floor does not intervene on the ETS cap, which remains unchanged. This measure consists in an ex-post price adjustment which can be considered a carbon tax. Indeed, anytime the carbon price falls below the determined floor, the British power installations will have to pay to the British national government a carbon tax equal to the difference between the carbon price floor and the real carbon price. In this way, firms will end up paying at least the carbon price floor, even if the real carbon price falls beneath it. The price floor will provide certainty and support for low-carbon investment and reduce revenue uncertainty, while the amount of time required for its adoption is limited. However, the setting of a national carbon price floor risks causing a negative impact on the EU ETS. First, whenever the British price floor is higher than the carbon price, the cost of emissions will increase only in the UK, causing a further reduction of British emissions, but a symmetrical increase of emissions in the rest of Europe, as the total ETS cap remains unchanged (i.e. it becomes a zero-sum game). This intra-EU carbon leakage of emissions from the UK to the rest of the EU risks to distort the European carbon price signal, given the significant weight of UK emissions with respect to the

EU total. Since lower emission reductions would be required on the continent, the ETS carbon price would consequently be weakened. Thus, a carbon price floor in the UK (or any other major emitter within the EU) risks to lower the ETS carbon price, without delivering any additional emission reductions across the EU as a whole. A national carbon price, in this case, risks to distort the ETS, limiting the integration of the internal market and impeding greater harmonization among Member States. These effects are illustrated in the figures 8 and 9 below. First, figure 8 describes a market where the overall demand is given by the horizontal aggregation of two separate demands -D_A and D_B- coming from two separate countries A and B (UK and rest of Europe). The aggregate demand is a broken line: from (price) A to (price) B, D_A is zero and the aggregate demand equals D_B, from (price) 0 to (price) A the aggregate demand is given by the sum of D_A and D_B.

Fig. 8 ETS market Equilibrium with aggregated demand (countries A and B)

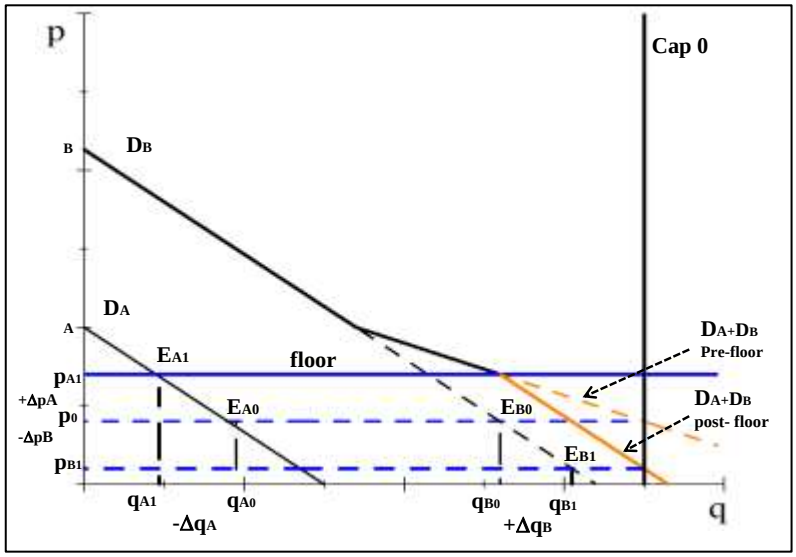


Sources: own elaboration.

As shown in figure 9, when a national carbon price floor is imposed on country A at a higher level than the previous carbon price at equilibrium (P_0), then two different equilibria emerge for countries A and B (E_{A1} and E_{B1}). In country A, the higher carbon price causes a reduction in produced emissions (Δq_A), determining a new equilibrium E_{A1} (q_{A1},p_{A1}). As a consequence, the aggregate demand is broken in two points. As in the previous case, from A to B, D_A is zero and the aggregate demand equals D_B. From the price floor (p_{A1}) to A, both D_A and D_B are positive and the aggregate demand function is given by the sum of the two national demand functions. From 0 to the price floor (P_{A1}), the aggregate demand function is given again only by demand in country B, as that part of country A demand that has a willingness to pay below the carbon price floor cannot be satisfied anymore. As a consequence, below the price floor level, the aggregate demand rotates from D_A+D_B pre-floor to D_A+D_B post-floor. Figure 9 shows that the introduction of a national carbon price floor causes a reduction in the ETS

carbon price at equilibrium (from P_0 to P_{B1}) and an increase in emissions produced by country B (Δq_B). Being the cap unchanged, the emissions reduction Δq_B equals in absolute values the reduction of emissions Δq_A, determining a leakage of emissions from country A to country B.

Fig. 9 Two countries' market equilibria with a national carbon price floor



Sources: own elaboration.

For these reasons, we conclude that a carbon price floor should not be imposed at a national level. To be effective and avoid distortions to the ETS, a carbon price floor should be implemented at an European level: an EU-wide ETS carbon floor price.

There are several modalities for implementing a carbon price floor. First, the regulatory authority may commit to buy back allowances at the floor price, thus reducing the amount of allowances in the market (Hepburn 2006). This option allows for implementation of the price floor through the adoption of just one instrument, since it ensures that the market price never goes below the floor price, whose administration remains within the ETS. However, this option requires governments to buy back allowances that have been originally allocated for free, giving rise to possible undesirable redistributive effects. It may furthermore result unfeasible given current budgetary constraints.

A second way to introduce a price floor is to establish a reserve price equal to the price floor in public auctions (Grubb and Neuhoff, 2006). This option does not require the regulator to reduce directly the supply of allowances through a set-aside intervention, since all the auction bids at a price lower than the reserve price are automatically rejected. The reserve price ensures that any quantity of allowances demanded at a carbon price lower than the reserve price will not enter the market, ensuring an indirect rationing of supply within the ETS. We observe, however, that this mechanism could be used to control the supply of allowances and grant certainty to revenues from public auctions only if all allowances were auctioned (single auctioning rule) and surpluses of unused allowances could not be freely traded on the secondary market. Instead, within the ETS a part of allowances will continue to be allocated for free in the third trading period 2013-2020 and part of the current surplus of unused allowances

will be transferred from the second to the third trading period. Given the presence of allowances that can be freely traded on the secondary market, firms may find it more convenient to first acquire allowances on the secondary market, acquiring allowances through auctions in the primary market only once the current surplus of allowances has been eliminated. The feasibility of translating a reserve price into a market floor price thus depends on the share of allowances that will be auctioned. Since a large proportion of allowances would be available on the secondary market at a lower price (with respect to the reserve price), it could very well occur that a sub-optimal amount of allowances would be sold through auctions at the reserve price. The presence of a surplus of allowances in the secondary market risks, in other terms, to reduce the amount of allowances sold by auction, and thus to reduce public revenues from auctioning. To overcome this problem, an additional price correcting mechanism on the secondary market would be necessary. Following the British example, price could be corrected in the secondary market by requiring ETS installations to pay an extra fee at the time of surrendering permits acquired on the secondary market. In this way, Governments would earn revenues both from the primary market at the time of auctioning allowances and from the secondary market at the time firms surrender their allowances. If the fee equals the difference between the floor price and the secondary market clearing price, then both prices in the primary and secondary market will converge to the floor price, ensuring certain revenues to the public authorities.

A central price floor within the EU ETS would be equivalent to setting a minimum carbon tax on top of the ETS carbon price. This would have the effect of reducing the variance of the price of permits and would grant higher price stability than *options a and b.* This proposal has been welcomed by the EEA as being able to encourage additional investment in low-carbon power generation by providing certainty to the carbon price[27].

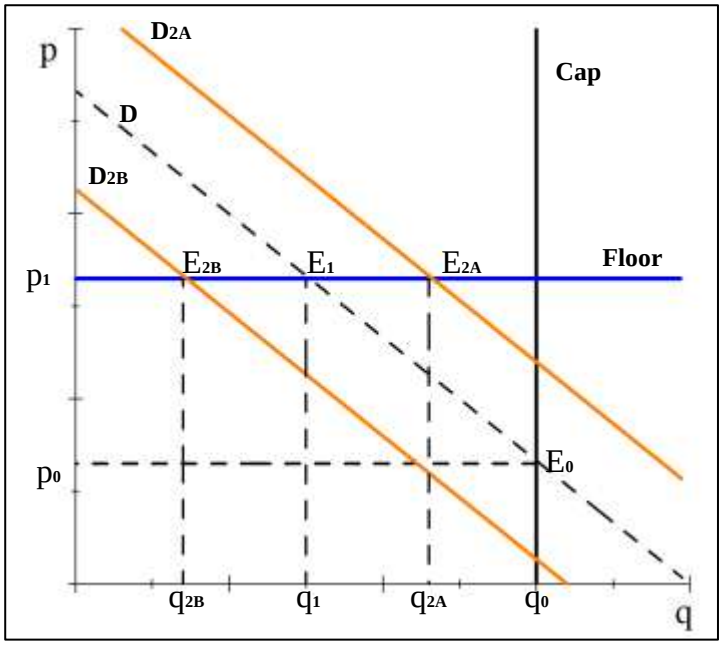
We evaluate this option according to the pre-defined criteria:

i. **Support to carbon price**: Applied at the European level, this option is expected to support the ETS carbon price through an ex-post taxation system that increases the average equilibrium price. A national carbon price is not likely to support the carbon price in those countries where it is not applied; on the contrary, it could help decrease the overall EU carbon price due to resulting lower overall demand.

ii. **Long-term price signalling**: When imposed at an European level, a price floor can ensure price stability if it is set over the unconstrained equilibrium price. In this case, as shown in figure 10, when the price floor is set at a sufficiently high level, a variation of demand within a certain range (D_{2A}, D_{2B}) causes a variation of the emissions produced at equilibrium (q_{2A}, q_{2B}), while price does not vary. Being the cap unchanged, part of the auctioned allowances remains unsold, and the size of surplus of allowances varies according to demand variation. Though the setting of a EU price floor eliminates down-side risks, this option would not ensure price stability in the case the floor were set at a low level and there were a high degree of variance of demand (as illustrated in figure 10).

[27] See for instance Speck S. (EEA) 2011 *Economic Instruments as a Tool for Greenhouse Gas Emissions Reduction – the perspective of EU countries, International Conference on Green Growth and Official Statistics.*

Fig. 10 Market Equilibrium with a EU price floor



Sources: own elaboration.

As discussed, a national price floor risks to distort the EU carbon price signal, increasing its instability in the long-run as well.

iii. **Impact on public finance**: An European carbon price floor is likely to improve public finances, while a national floor risks to worsen public finances in all countries except those imposing it, since the European carbon price risks to be lowered as explained above.

iv. **Timing of implementation**: This option would require EU member states to modify the ETS framework to introduce an ex-post price mechanism for compensation similar to a carbon tax. As many countries may oppose this option, the time needed for implementing an European price floor risks to be very lengthy. On the contrary, a national carbon price floor could be adopted within a limited time period.

v. **Regulatory certainty**: Firms would continue to rely on the ETS only if the measure to support the carbon price were EU-based and harmonized among Member States. National measures aimed at supporting the carbon price risk to create ambiguous price signals, possibly leading to normative arbitrage among countries. A national cap floor can thus impact negatively on firms' confidence in the market, and only a price floor set within the ETS at an European level would not affect firms' confidence in this mechanism. Firms can rely on a minimum carbon price to plan their investments and evaluate their future profitability and this could have a positive impact on long-term strategies. To ensure regulatory certainty while continuing to provide price incentives for low carbon investments, a periodic price review mechanism based on transparent and efficient criteria should be envisaged to take into adequate consideration the impact of other energy and environmental policies, as well as market factors, on the ETS over time.

vi. **European harmonization**: Only an European price floor would ensure harmonization within Europe, while a national floor risks to distort the ETS. As in the case of a CCB, an European price floor, with respect to options a and b, would permit a greater degree of harmonization with carbon tax provisions on non ETS sectors in a future revised EU directive on energy taxation. This is particularly the case of a relatively high price floor as, for the reasons explained above, only in this case would price variations be kept to a minimum.

9 SETTING OF LONG-TERM EMISSION REDUCTION TARGETS

The European Union and its Member States have defined emission reduction goals for ETS sectors up to the year 2020 according to the revised ETS Directive. In the absence of further interventions, the current linear reduction factor will continue to apply up to 2025, after which a new rule should be adopted by the European Parliament and the Council. To reach the more ambitious reduction targets outlined in the European Commission's Roadmap to 2050 (total emissions reduction in the order of 80-95%), binding targets up to 2030 and beyond will be needed. The "option" of setting long-term emission reduction targets could reasonably entail resolving issues of supply for Phase IV of the ETS (2020-2030) by 2013 while declaring the firm intention to set the post 2030 cap by 2020. Taken alone or together with other actions, defining future, long-term targets could be expected to strengthen the ETS framework and provide greater certainty for long-term investments in the energy and industrial sectors. Along these lines, several energy firms have recently launched a new "climate alliance", expressed in a letter to the European Commission in which they point to "the lack of binding targets post 2020, an ETS failing to stimulate investment in renewables, and an out-dated energy infrastructure" as a severe threat to action to modernise and decarbonise the European energy sector .

We evaluate this option according to the pre-defined criteria:

i. **Support to carbon price**: While the setting of long-term emission reduction targets could add value to present allowances as investors are reassured as to long-run trajectory of EUA price trends boosted by ambitious long-term emissions reduction targets, it would not be expected that this measure alone could do much for prices in the short-term, given the significant oversupply of allowances that has been created, as well as the currently high discounting in financial markets in the present political and economic situation. It would thus seem safe to assume a neutral effect of such a measure on current prices.

ii. **Long-term price signalling**: Significant low carbon investments, especially in the energy and transport sectors, will be necessary, from the present period on, to ensure decarbonisation of the economy along the lines presented in the Roadmap to 2050. The definition of emission reduction targets in line with the Roadmap should directly support higher and more stable allowance prices in the post-2020 period, as the cap would be reduced according to a greater linear factor in a stable context of overall emissions reductions. Furthermore, greater certainty regarding reduction targets to be enforced in the post 2020 period would better anchor future price expectations and foster strategic planning around low-carbon medium and long run investments.

iii. **Impact on public finance**: In the short-run this option is not expected to have an impact on public finance, as the relative measures to obtain greater emissions reduction - both in the ETS and non ETS sectors - will take place after 2020. The net impact on public finance after 2020 will depend on the relative dimensions of : i) the positive contribution of revenue from ETS auctions post 2020 and ii) the negative contribution stemming from public spending toward reaching emission reduction goals. According to current estimates, decarbonisation of the European economy by 2050 will entail significant spending, largely by the private sector. There will continue to be a role for public funding as well, though, both at the national and EU level. In line with the scaling up of private finance, it can be expected that public finance will increase as well from its current level, in the form of preferential loans, grants that pay back part of a low-energy investment and tax rebates, for example. It is not currently possible to estimate whether public spending will be greater than projected future revenue deriving from the ETS (combined with a possible future carbon tax on non ETS sectors) for any particular Member state, or even for the EU as a whole.

iv. **Timing of implementation**: The negotiation of post 2020 binding targets is a complex issue, linked not only to the current economic juncture but also to future progress in international negotiations, in particular the 2015 deadline established at Durban. In the current economic and political context it can be expected that Member States will have difficulty in defining goals for 2030, or even a Phase IV cap, before 2015. Once there is agreement at the level of Member States, it will take additional time before such agreement is translated into legislation. For these reasons, this option cannot be expected to solve current problems with the ETS, though it should certainly be part of the general effort to reinforce the ETS going forward.

v. **Regulatory certainty**: The definition of post 2020 targets and the relative regulatory context would go a long way to increasing regulatory certainty, as mentioned above. Indeed, this option could be fundamental to ensure the long term clarity needed to promote large low-carbon energy and industrial investments, often characterized by long lifespans. This largely explains why many companies, particularly in the energy sector, are increasingly calling for binding 2030 targets on emissions reduction, and greater clarity on goals regarding renewables and energy efficiency (and with regard to possible interactions with the ETS as well).

vi. **European harmonization**: Measures to define post 2020 emission targets would be decided upon and undertaken within the EU; by definition they would be harmonized among different Member States, according to defined criteria and desired outcomes. In this way, national, policies, independent of the European context, would be avoided, as would their less than optimal consequences, as discussed above.

10 SUMMARY AND CONCLUSIONS

The ETS is a market-based instrument launched in Europe to promote the reduction of greenhouse gas emissions in a cost effective way. The ETS is defined as a quantity instrument because the environmental performance (e.g. the amount of produced emissions) is certain while the carbon price is not. Indeed, the fluctuation of carbon prices is an intrinsic feature of the ETS and does not constitute a problem per se. However, a sufficiently high carbon price is deemed necessary to achieve other, correlated goals, such as supporting the innovation and diffusion of low-carbon technologies. Presently, the EC and a majority of ETS stakeholders consider the current carbon price to be too low to support the European transition toward a low-carbon economy. Given the clear intentions to intervene upon the ETS to support the carbon price which have emerged within the European climate policy debate, the main objective of this paper has been to analyse possible options from the point of view of the most effective way to achieve this goal; the opportunity of this goal has not, as such, been subject to analysis. In detail, the present note has proposed a framework to compare different possible measures aimed at supporting the ETS carbon price in order to highlight their properties and formulate conclusions on what might be the most appropriate ones. These options have been compared in terms of their economic, regulatory and procedural implications in the case of implementation, so as to determine which options would be not only feasible but also most effective.

Tab.2 Comparison between measures to support the carbon price

	Price support	Long-term price signalling	Impact on public finance	Timing of implementation	Regulatory certainty	European harmonisation
a. Increased target reduction to -30%	+	-	Ambiguous	-	0	Ambiguous
b. ETS cap adjustment:						
b.1 one shot permanent set-aside	+	-	+	0	-	+
b.2 temporary set-aside	+	0	Ambiguous	+	-	+
b.3 Progressive and permanent set-aside	+	-	+	0	-	+
c. Price stabilization mechanism: *Carbon central Bank*	+	+	Ambiguous	-	+	+
d. Price Floor						
National level	-	-	-	+	-	-
European level	+	0	+	-	+	+
e. Long-term reduction targets	0	+	0	-	+	+

Legend: Minus (-): negative effect; zero (0): no effect; plus (+): positive effect; Ambiguous: ambiguous effect.

The results of our analysis, given in the above Table 1, clearly illustrate the major benefits deriving from option c, a price stabilization mechanism allowing for a reversible adjustment of the ETS cap according to clear, pre-defined rules by an independent authority such as a carbon central bank. This mechanism would increase flexibility of the ETS allowing the system to adjust the supply of allowances to structural or trend changes in economic conditions - represented by appropriate indicators - upon which the forecasts of GDP and baseline emissions trajectory are estimated. The risk of creating unexpected surpluses (or deficits) of

allowances would be avoided and the ETS would send credible, long-term price signals. Against these benefits, this option would require a significant intervention upon the current ETS framework that would imply a relatively long time-frame for implementation thus it is not expected to resolve in the short-term the current situation of over-supply within the ETS. Moreover, this option is likely to have an ambiguous impact on public finances as we cannot exclude that part of freely allocated allowances would have to be bought back from the secondary market in order to stabilize the carbon price at a high level. Thus we cannot exclude the risk that this option might result unfeasible given current budgetary constraints.

Furthermore, the definition of a common rule, that takes into account both countries' and carbon market peculiarities, is a complex issue. The selection of an independent authority that would intervene on the cap remains an open question, as well. Among other aspects, the launching of a CCB would require the establishment of a clear rule to guide interventions within the ETS, so as to regulate the questions of when and how the CCB should modify the ETS cap. Other issues concerning, for instance, the legal nature of the CCB or the type of financing mechanism that the CCB should adopt, need to be further clarified. The setting up of a CCB would require a determined political will to do so as well as further detailed analysis. Therefore, as many procedural, economic and juridical aspects concerning the design and the functioning of a CCB still have to be analysed, they could constitute the basis for future research.

A price floor implemented at EU level represents a second-best solution. Considering that it is likely to be difficult to implement the CCB in the short-run, and that policymakers have a preference for an effective instrument that can be adopted in the short-term, at a relatively low cost (in terms of implementation and risk of negatively impacting on public finances), the EU price floor may very well constitute the most tailored option.

Instead, the set–aside option (particularly option b.2 in the case the decision about the timing, frequency and the amount of allowances to be reintroduced is taken according to clear and pre-determined rules), is classified as third. The worst options appear to be those involving an overall increase in target reduction to 30% and, finally, a price floor in its national version, as currently implemented in UK, in order of declining benefit.

Finally, while we have examined the proposed options on the basis of their own merits, in reality the complexity of the ETS might militate for a combination of actions to address both the current situation and reinforce the overall regulatory structure, precluding future problems in the ETS. Indeed, a number of the options discussed are not mutually exclusive. In particular, the definition of long-term targets in line with long-term goals could be applied in conjunction with practically any of the options discussed and would have the benefit of supporting the current ETS as its stringency would be guaranteed into the future.

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