Mercator Research Institute on
Global Commons and Climate Change
(MCC) gemeinnützige GmbH

After Monetary Policy, Climate Policy: Is Delegation the Key to EU ETS Reform?

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MCC Working paper 1/2014
April 2014

MCC was founded jointly by Stiftung Mercator and the Potsdam Institute for Climate Impact Research.

Abstract

Since the crash of carbon prices in phase II of the EU ETS, many have argued that the low price mirrors structural failures requiring intervention. A wide range of reform options have been suggested, including delegating the governance of the carbon market to an independent authority. This paper analyses the debate by reconstructing the various arguments for or against reform. Three possible drivers of the price decline are investigated: (i) exogenous shocks; (ii) insufficient credibility; and (iii) market imperfections. It is argued that the extent to which a low price is problematic and warrants reform depends on the specific objectives associated with the EU ETS and the perception on the functioning of the market. A two-dimensional EU ETS Reform Space, comprising the degree of price certainty within the EU ETS and the level of delegation, is devised. Within the Reform Space, EU ETS reform options currently discussed are mapped. This descriptive structure offers a framework to clarify whether delegation responds to various concerns with respect to the EU ETS. Delegation might enhance flexibility under unforeseen circumstances, decrease policy uncertainty, and increase the credibility of long-term policy commitments. At the same time, delegation faces challenges regarding democratic legitimacy and political feasibility.

Keywords

EU ETS, delegation, carbon authority, carbon central bank,
market stability reserve, reform, carbon price.

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Section 1: Introduction

Whether the European Union Emissions Trading System (EU ETS) needs to be reformed – and if so how – is one of the most discussed questions of current European climate policy. The debate was mainly triggered by the marked and persistent drop of the EU allowance (EUA) spot price, which went from 30 Euros in January 2008 to below 5 Euros in January 2013 and has since remained around this level until the time of writing this paper (January 2014). The EUA future prices closely followed the trend and in 2013 ranged from 6 to 7 Euros for a year 2020 allowance (ICE, 2014). In the academic debate, the price deterioration has been attributed to several factors. These include: the economic and financial crisis; the overlap with other policies such as 'renewable support schemes'; the large import of offsets at the end of phase II; and the policy uncertainty as well as lack of long-term credibility with regard to future emission targets and time inconsistent[1] climate policies within the European Union (see e.g. Aldy and Stavins, 2012; Egenhofer, Marcu and Georgiev, 2012; European Commission, 2014a; Koch, Fuss, Grosjean and Edenhofer 2014; Neuhoff, Schopp, Boyd, Stelmakh and Vasa, 2012; Van den Bergh, Delarue, D'haeseleer, 2013).

There appears to be much less consensus on whether the current low price is per se a problem that warrants regulatory reform. This paper argues that the divergence on this question originates partially from different fundamental objectives (usually implicitly) associated with the EU ETS, as well as on the perception of the functioning of EU ETS. This diversity of opinions was reflected in interviews with experts from academia, industry as well as policymakers that were undertaken to inform this paper. [2] For instance, while some observers consider the EU ETS a pure quantity-based mechanism to implement emissions targets at least cost within a trading period, others expect the scheme to convey a credible long-term price signal to induce the technological innovation and investments required to reduce emissions costs effectively over time. Moreover, even if the case for EU ETS reform is accepted, the ranking of reform options might differ.

To address the perceived problems of the EU ETS, in 2012 the European Commission (2012a) proposed six reform options broadly falling into three groups: (i) a one-off reduction of the

surplus of allowances; (ii) a change in the scope of the EU ETS (sectorally or geographically); and (iii) price management. Based on industry consultation and limited modelling, in January 2014 the European Commission announced it favoured a Market Stability Reserve (MSR) to introduce added flexibility and improve the functioning of the EU ETS. While there is a range of policy instruments available to implement these and other reform options, a distinct question is what type of institution should have the control over the respective policy levers. Theoretically, control could remain with the European Union - i.e. the current arrangement of legislating and implementing policy between the European Commission, European Council, and European Parliament. However, the idea of delegating some aspects of carbon market governance to an independent regulatory body such as a carbon central bank has also been discussed. For instance, the German Council of Economic Experts (2013) has suggested the creation of a 'certificate central bank' to stabilise carbon prices. In this context, delegation is understood as transferring some degree of decisional power to an independent body managing the permit supply. Such an agency might base its interventions on a pre-determined rule (set by others or itself), its own discretion, or both, and could remain accountable to the legislator.

Delegation has been discussed extensively in the literature, usually as a mechanism to strengthen regulatory commitment in a context of potential time inconsistency (Barro and Gordon, 1983; Kydland and Prescott, 1977; Rogoff, 1985) as well as to increase policy flexibility (Newell, Pizer and Raimi, 2013). Time inconsistency problems of policies arise where policymakers have an ex post incentive to renege on commitments that may have been optimal ex ante, and where anticipation of this effect by regulated agents is not adequately considered in policy design. Monetary policy provides the classic example where the short-run trade-off between inflation and unemployment decreases the credibility of anti-inflationary commitments by governments with short-term objectives. In other sectors requiring large and irreversible investments such as infrastructure, a rational regulator has the incentive to focus on broader goals such as increasing consumer welfare once sunk investments have been made (Trillas, 2010). Investors anticipating such behaviour therefore either hold off or underinvest in new infrastructure, relative to what would be socially

optimal. An often suggested remedy to time inconsistent policies is either setting rules that tie the hands of the politician, or delegating to an independent and credible regulator that is able to deliver its commitments (Barro and Gordon, 1983; Levine, Stern and Trillas, 2005, Stern and Trillas, 2003;).

In addition to time inconsistency, it has been argued that delegation can enhance regulatory flexibility in complex decision making under uncertainty (Majone, 2001), to address principal-agent problems (Bendor, Glazer and Hammond, 2001; Eggertson and Le Borgne, 2003), and to shield negotiations between politicians and interest groups from regulatory capture (Miller, 1998). Again, these functions of delegation can either be achieved through policy rules or the establishment of an independent body that operates with some level of discretion (also called constrained discretion in monetary policy). Those that favour delegation via rules argue that rules reduce human induced policy mistakes, increase transparency for market participants, and reduce the risk of regulatory capture (Van Lear, 2000). Proponents of discretion argue that rules are too inflexible and thus unable to adjust in case of (expectable) mistakes made in the policy design (Barro, 1986; Bernanke, 2003).

In the context of carbon pricing policy, delegation was first considered in view of potential time inconsistency problems (Helm, Hepburn and Mash, 2003). More recently, it has also been discussed as a response option to specific perceived failures of the EU ETS. For example, delegation has been proposed to manage the EUA permit market by either targeting prices (Clò, Battles, Zoppoli, 2013; Taschini, Kollenberg, and Duffy, 2013) or quantities (de Perthuis 2011; de Perthuis and Trotignon, 2013; European Commission, 2014b; IETA, 2013). It is expected to introduce a transparent and predictable intervention framework capable of aligning short-term prices with long-term objectives (see de Perthuis, 2011; de Perthuis and Trotignon, 2013). It has also been suggested as a mechanism to provide market supervision and undertake policy coordination (de Perthuis, 2011; Edenhofer, Flachsland and Marschinski, 2007). Similar proposals were made for the United States (Whitesell, 2007; Whitesell, 2011), Australia (Garnaut, 2012) and globally (Edenhofer, Knopf and Luderer, 2010; Klingenfeld, 2012). In a nutshell, two key features are usually

foreseen from an independent institution in a carbon market context such as the EU ETS. First, it is intended to manage the short-term permit supply in order to implicitly or explicitly achieve a more stable price signal. Second, by locating the decision-making process outside the policy sphere, it is expected to deliver a higher degree of flexibility and greater speed in adjusting the emissions cap while insulating the institution from regulatory capture (Newell, Pizer and Raimi, 2012). Both features are intended to reduce policy uncertainty.

Much of the recent debate on EU ETS reform has so far focused on comparing and contrasting a carbon authority against instrumental reform options such as a price floor or price corridor. In our view, this is misleading, as the degree of delegation and the type of instrument used - for instance introducing more price certainty – are different dimensions of policy design that cannot be directly compared. In that context, our paper aims at clarifying two important aspects of the current discussion. First, it intends to bring insight to the debate on the need for reform by grounding in economic theory the diverging perspectives on the low allowance price. This will support assessing to what extent and under which assumptions a low price could be perceived as reflecting a fundamental flaw in the current design of the carbon market necessitating policy reform.

Second, our paper proposes an EU ETS Reform Space, which offers a descriptive framework to map EU ETS reform proposals along the two dimensions of price certainty and degree of delegation. The merits and demerits of several options discussed in the academic literature and suggested by the European Commission to respond to a specific diagnosed problem are then discussed. It is concluded that delegation is not justified for all EU ETS problem diagnoses. However, it may enhance regulatory flexibility for responding to unforeseen shocks and increase long-term credibility, similar to its application in monetary policy. That said, delegation, either through a rule-based mechanism or the transfer of discretionary powers to some regulatory agent will likely face strong political and institutional barriers. Also, it should not be seen as a 'silver bullet' eliminating all challenges arising from structural uncertainty and policy credibility. External factors such as the outcome of international climate policy negotiations will continue to impact the long-term credibility of the EU ETS. In

addition, there are some limitations to delegation that depend on the precise mandate the independent body is given. For example, delegation may not solve the commitment problem but rather relocate it (McCallum, 1995); it may not be possible to find an agent with appropriate preferences (Trillas, 2010); and there may be a risk of industry capture (Che, 1995). Finally, independent agencies may also lack accountability and hence democratic legitimacy (Aziz, 2005; Ergas, 2010).

The paper is organized as follows. In Section 2, the possible explanations for the low permit price are attributed to three potential drivers, which are then linked to the different objectives associated with the EU ETS and a case for (or against) reform derived. In Section 3, options for reform in terms of both policy tools and institutional reform that have been suggested in the policy debate are discussed. In Section 4, these options are mapped onto an EU ETS Reform Space and the possibility to address the various perceived fundamental problems of the EU ETS through delegation is discussed. The final section provides a brief discussion of caveats and conclusions.

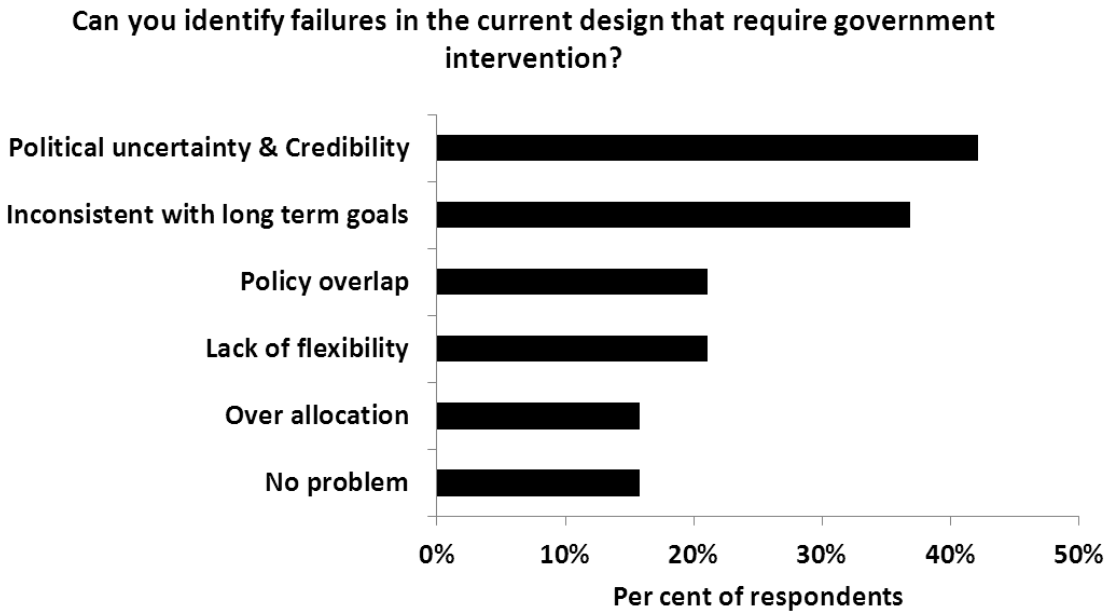
Section 2: Drivers of the low permit price and rationales for intervention

As the EU ETS entered its third phase in 2013, the EUA price decreased and remained at around 5 Euros. Moreover, the annual schedule for releasing new permits into the market remained unchanged despite the existing annual surplus.[3] As a consequence, it is estimated that an oversupply of allowances will persist throughout phase three until the year 2020, with the EUA price remaining accordingly low (European Commission, 2014c; Morris, 2012; Neuhoff et al., 2012). Currently, many analysts do not expect the EUA price to exceed 20 Euros before 2020 (European Commission, 2013a; Point Carbon, 2013a) or even 2030 (Egenhofer et al., 2012), although it was previously expected to reach 20-39 Euros/tCO_2-e over that period.[4]

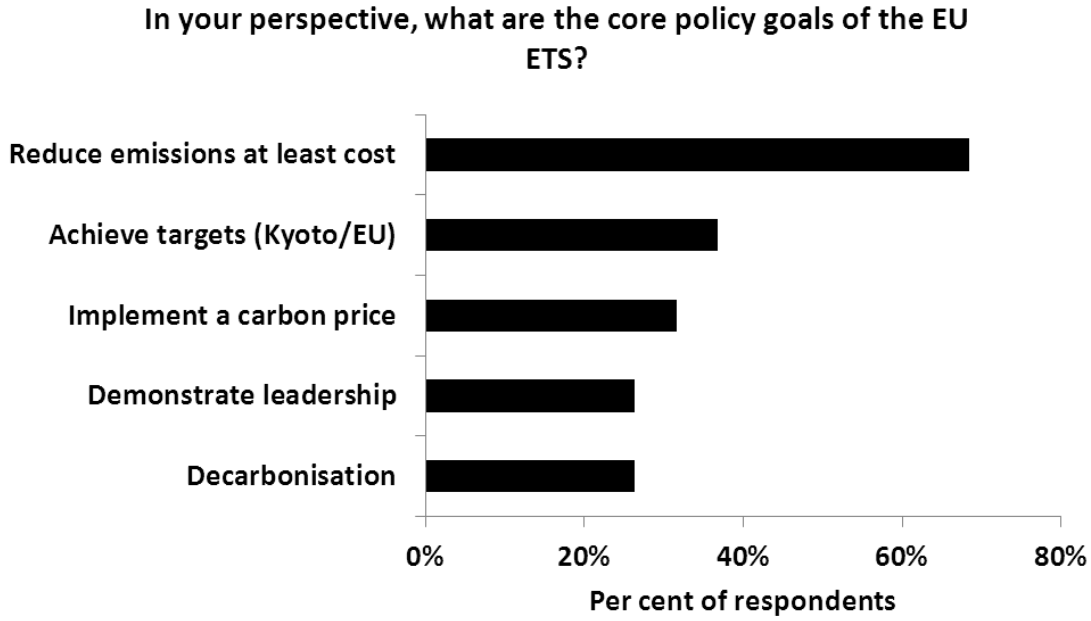
But does the low permit price point to a structural problem of the EU ETS? And if so, what exactly is the problem with a low EUA price, and what should be done about it? These were two of the questions asked to 23 EU ETS experts.[5] The answers to the first question were

almost evenly divided between ‘low price does not indicate a problem’, ‘low price indicates a problem’ and ‘cannot say’, thus revealing a strong divergence in the assessment of EUA prices. When asked about structural problems built into the EU ETS, most experts agreed that political uncertainty and a lack of credibility were key concerns, followed by inconsistency with long term-goals, overlap of climate policies, lack of flexibility, and over-allocation (see Figure 1a). Fifteen percent did not perceive any failures in the current EU ETS design that would mandate government intervention.

In addition, Figure 1b shows that no clear consensus exists as to what constitutes the primary objective of the EU ETS. This strongly suggests that the positions interviewees adopted on reform need to be explained both in terms of their assessment of current design problems and their understanding of the main objectives of the EU ETS.



a)



b)

Figure 1a, b: Results from the expert interviews

Note: Results are based on ex post assessment and categorisation of responses. Hence, responses have not been coded and categories were established after the interviews. Respondents could give multiple responses.
Source: Interview Results

In sum, the picture that emerges from the expert interviews is puzzlingly heterogeneous. In view of this, this section sets out to disentangle whether (and which) reform of the EU ETS is warranted based on different views on: (i) the most relevant drivers of the permit price, and (ii) the perceived objective(s) of the EU ETS. The aim of this paper is to understand the various aspects of the debate, rather than argue for or against a specific position. Against this background, each of the following subsections discusses one of the main possible drivers of the price level, including: exogenous shocks (2.1), lack of credibility (2.2), and market imperfections (2.3).

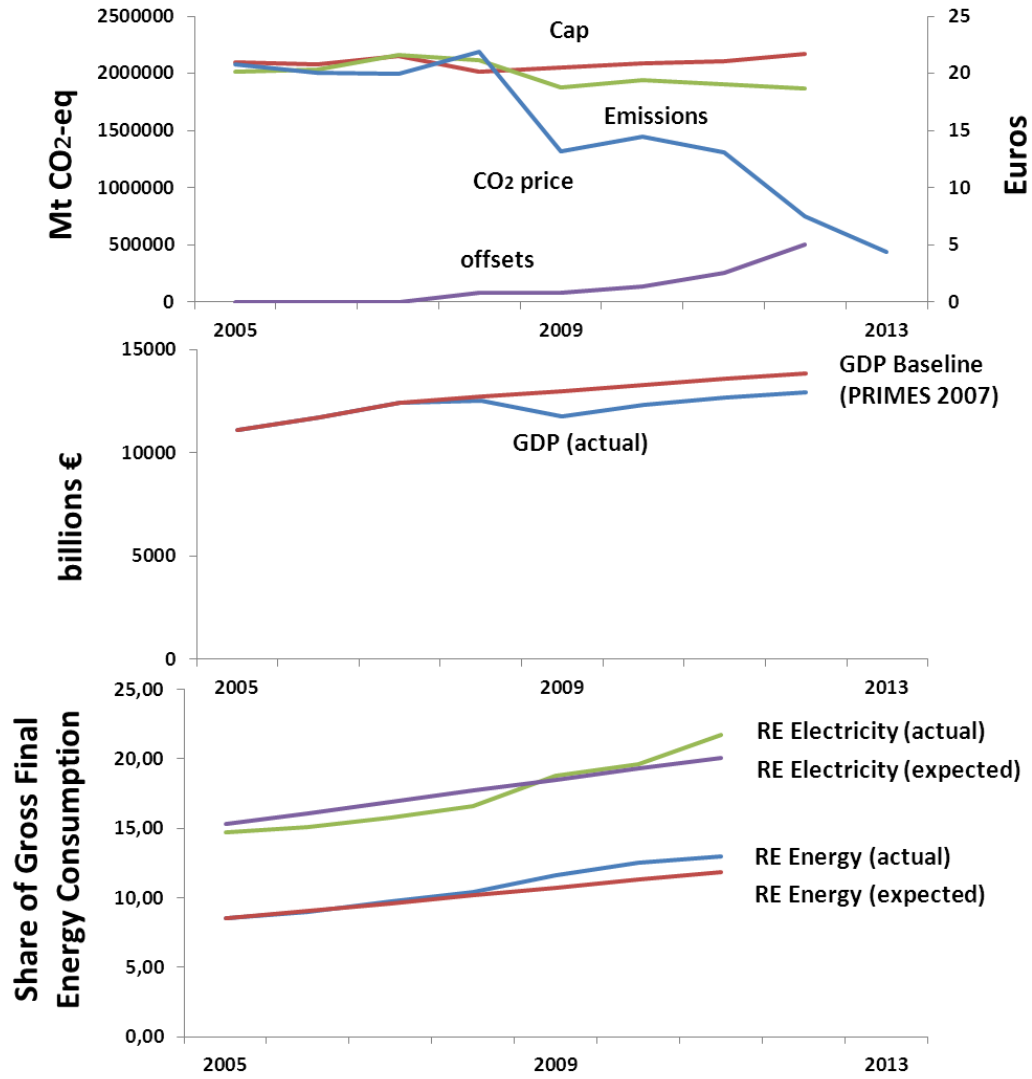
2.1 Exogenous shocks

Perhaps the simplest explanation of the low EUA price is a market response to a series of exogenous shocks reducing demand in presence of a fixed supply schedule. Those exogenous shocks included: (i) the economic recession following the financial crisis; (ii) overlapping policies like national 'renewable support schemes' for renewable energy sources; and (iii) the large influx of CERs/ERUs at the end of phase II.

Regarding the first point, as illustrated in Figure 2, it is evident that the economic crisis has played an important role in the oversupply of allowances (Curien and Lewis, 2012; de Perthuis, 2011). The crisis has hit Europe for several years, depressing output and therefore demand for emission permits. The actual Gross Domestic Product (GDP) growth of the European Union turned out to be much lower than previously anticipated in the modelling exercises (PRIMES 2007) that informed the design of phase II (see Figure 2b) (European Commission, 2007). In addition, some of the sectors covered by the EU ETS experienced even more dramatic drops in output than the overall economy. For instance, production in the steel industry declined by 28 per cent from 2008 to 2009 (Eurostat, 2013a) and did not recover in the following years. The total verified emissions of the facilities covered by the EU ETS decreased by 12 per cent between 2008 and 2012 (European Environment Agency, 2013) and remained persistently well below the cap (Figure 2a) from 2009 onwards.

Second, the EU ETS is currently interacting with a host of broader climate and energy policies that are administered both at the member state and European level. For example, a range of member states including Sweden, Norway, Denmark, the United Kingdom and Ireland have implemented carbon taxes in addition to the EU ETS (Böhringer and Rosendahl, 2011; Fankhauser, Hepburn and Park, 2010). Countries such as Germany or Spain have introduced 'renewable supporting schemes' to promote the development of renewable technologies in order to reach domestic energy policy objectives and the EU 20/20/20 targets (European Commission, 2012b). The current evidence indicates that the total renewables deployment was indeed slightly higher than anticipated for the European Union in 2011 (see Figure 2c).[6] Nonetheless, the European Commission expects that the European Union might fall short of its energy efficiency as well as its renewable targets for the year 2020 without further actions from Member States (European Commission, 2013b). Looking at past and expected deployment suggests that an excess of renewables may not necessarily have been the decisive factor impacting the EUA price.

Third, when market participants use CERs for compliance, this automatically reduces the demand for permits in the EU ETS. As long as the price of CERs remains lower than that of EUAs, companies have an incentive to use international offsets until they reach the legislated (per company) quota on maximum CERs use. In 2012, firms had already surrendered more than 60 per cent of the maximum amount of offsets permissible for the entire period 2008-2020 (Point Carbon, 2013b). This development was driven by two factors. First, a change in the EU ETS regulation preventing the use of some offset types in Phase III (e.g. credits originating from HFC and adipic acid N_2O projects, World Bank, 2012). Second, the collapse in credit prices due to the non-ratification of the Kyoto protocol by major emitters that led to a low international demand for credits. This triggered an unexpectedly large use of offsets for compliance in the EU ETS in 2011 and 2012 (see Figure 2a), which further increased the size of the surplus of allowances at the end of phase II (European Commission, 2014c; Neuhoff et al., 2012).



Figures 2 a, b, c: drivers of the low price

The upper Figure (a) shows the EU ETS annual cap (Cap), annual verified emissions from sources covered by the EU ETS (Emissions), annual offsets surrendered for compliance (Offsets) and average annual future rolling prices (CO_2 price),
The middle Figure (b) shows the actual annual GDP (EU27) compared to the 2007 GDP baseline in PRIMES (2007).
The lower Figure (c) shows the deployment of total renewable energy (RE Energy (actual) and RE Energy (expected)) as well as the deployment of renewable electricity (RE Electricity (actual) and RE Electricity (expected)).
Note that aviation was added to the trading scheme in 2012 (European Commission, 2014d) (it was limited to domestic aviation in 2013) and that the linear reduction factor of the cap was only implemented from 2013 onwards.
Sources: Own compilation based on Beurskens and Hekkenberg (2011); EEA (2013); European Commission (2007); Eurostat (2013a); ICE (2014); and Point Carbon (2013a).

Depending on the objectives associated with the EU ETS, explaining the current low price as the result of exogenous shocks actually allows for two opposing conclusions regarding the case for or against an EU ETS reform. If the focus is on cost-effective attainment of the short-term cap as the only objective of the EU ETS, there is clearly no reason for intervention. In this line of reasoning, changing the market rules now by, for example, revising the planned number of new permits, could even be counterproductive. If fact, it could damage the European Union's credibility to adhere to announced emission targets (Egenhofer et al., 2012).

However, various authors have adopted a broader, multiple objectives perspective beyond short-term cost-effectiveness resulting in a preference for a higher and more stable permit price as a means to meet these objectives. The first two objectives are (i) inducing the development of low-carbon technologies in a dynamically efficient manner (Clò et al., 2013; European Commission, 2014c) and (ii) promoting Europe's goal of being a symbolic leader-by-example (Grubb, 2012; UK Government, 2013). Given the first objective, current (and forward) carbon prices would need to be sufficiently high to achieve the desired level of low-carbon technology development (the optimal level of which seems methodically difficult to determine). From the perspective of the second objective, the implementation of the EU ETS is intended to show leadership to bring other major emitters on board for a global climate agreement. Early and ambitious action in mitigation might be used to signal high benefits from emissions reduction to other players (Jakob and Lessmann, 2012). It could also create technological learning spillovers reducing the costs of the energy transformation for the rest for the world (Golombek and Hoel, 2004). This might be regarded as strengthening the European Union's leadership role in fighting climate change, which may be regarded as a desirable policy objective.

Third, there have also been concerns that an excessively low price will not reflect the marginal social costs of carbon and thereby fails to internalize the negative global externality associated with carbon emissions (Nordhaus, 2011). As is well known (e.g. Baumol and Oates, 1988, or Stern, 2007), pricing externalities is one of the cardinal lessons distilled from

environmental economics. While the adherence to emission targets under the EU ETS is guaranteed, it cannot be relied upon to generate a price consistent with the social cost of carbon. Against this background, it might be justified to intervene in the market if there is a pretence to establish such a correspondence (if only roughly).

From each of these multiple objectives perspectives a (sufficiently high) carbon tax may appear the appropriate instrument in the first place. However, its implementation was not politically feasible in the European Union due to the requirement of unanimity voting required to implement a tax at the EU level (Convery, 2009). Turning the EU ETS into a hybrid instrument featuring a price corridor would thus introduce the benefits of a taxation instrument into the EU ETS quantity system (Pizer, 2002). If the EUA price turns out to be lower ex post than anticipated ex ante (e.g. based on modelling studies) measures stabilising the price in the presence of exogenous shocks would be justified in this multiple objectives perspective.

2.2 Lack of credibility

Although specific EU ETS targets have been legislated only until 2020, the cap is scheduled to be reduced linearly by a factor of 1.74 per cent even beyond this date unless changed otherwise by policy reform. In addition, European Union leaders officially re-acknowledged in February 2011 the objective of reducing Europe's emissions to 80–95 per cent below 1990 levels by 2050 (European Commission, 2011), but it is worth noting that this is not a legally enshrined goal. [7] In response to longer term targets and a constant year-on-year reduction of the cap, firms should be expected to exploit the current low price by moving forward abatement and accumulating permits for later trading periods with inevitably higher permit prices, which would drive the current price up. However, if the European Union's announcement of stringent emission targets in the trading periods leading up to 2050 lacks credibility[8] vis-à-vis market participants the permit price will not correctly reflect scarcity implied by future targets (Koch et al., 2014). [9]

Doubts that the European Union will stick to its plans are evidently fuelled by the uncertainty about the future of international climate policy, including the prospects over the substance of the climate agreement envisaged for 2015 under the UNFCCC and beyond that date. In fact, it seems questionable whether the European Union will implement aggressive emission reductions if the rest of the world does not participate in this effort in some meaningful way (Sartor, 2012; Schiller, 2011). It would, however, be premature to accept the uncertainty about the global policy context as the only source of low credibility. In particular, policy uncertainty and the inherent credibility problems of any long-term commitment by government need to be distinguished. By deciding upon specific 2030 and 2040 ETS emission targets along with associated levels of technology support and energy efficiency targets, politicians could mitigate to some degree the impact of the former (Blyth and Bunn, 2011). But even in the absence of uncertainty regarding future targets, it would be questionable whether such commitments can indeed be credible, if the envisaged policy program suffers from time inconsistency (Helm et al., 2003; Laffont and Tirole, 1996). According to Helm et al. (2003) this is likely to occur due to several inherent features of climate policies, including: (i) the multiple and conflicting objectives (abatement, public finance, low energy prices) faced by governments when designing such policies; (ii) the irreversibility of large scale energy investments; as well as (iii) the possibility to ex post renege on ex ante regulatory pledges regarding emissions caps or carbon taxes. This is also likely to be influenced by the level of support for climate policy within the European Union.

Both the uncertainty of future targets and the credibility of long-term commitment may undermine the EU's announcement, and might therefore push the short-term permit price below the efficient level vis-à-vis the planned emission trajectory. As a result, the long-term reduction target of the EU ETS might no longer be achieved cost-effectively, e.g. as indicated by long-term modelling of the EU ETS sector (European Commission, 2007). Hence, if the low price of the EU ETS was only or in significant parts driven by insufficient credibility, a regulatory intervention promising to alleviate this problem would clearly be warranted. A policy reform will not reduce all uncertainty over future policies. Adjustments might still be required, e.g. in view of learning over climate impacts, mitigation costs, or international

climate policy developments. However, there may be institutional options for enhancing procedures for preparing and implementing such adjustments that better balance the trade-off between flexibility and credibility than the current setup, enabling the EU ETS to operate more efficiently.

2.3 Market imperfections

Finally, the permit price might also be driven by excessive discount rates and asymmetric information and the resulting strategic behaviour of firms, market power, or other market distortions. First, disproportionately high discounting due to an excessive short-term focus by some market participants combined with insufficient regard for long-term strategy could have undermined the long-term price signal (Taschini et al., 2013). In addition, Neuhoff et al. (2012) argue that the current surplus in the EU ETS is larger than the demand from market participants to hedge the carbon costs of future power and industrial production. They conclude that remaining investors in the market are speculators, which typically require higher returns than those participants that bank permits for future compliance. Second, asymmetric information can result in a 'ratchet effect', where firms exaggerate current compliance costs or lock-in to emission intensive technologies in order to negotiate more lenient regulation (Brunner, Flachsland and Marschinski, 2012; Harstad and Eskeland, 2010). The case for regulatory intervention would be compelling from an economic theory perspective if market imperfections could be confirmed to distort the permit market. The type of intervention or policy instrument would depend on the specific market imperfection as well as on its magnitude. Generally, it seems that further empirical or theoretical evidence than is currently available would be required to arrive at this conclusion (for a review of potential market imperfections and distortions in a climate policy context, see Staub-Kaminski, Zimmer, Jakob and Marschinski, in press).

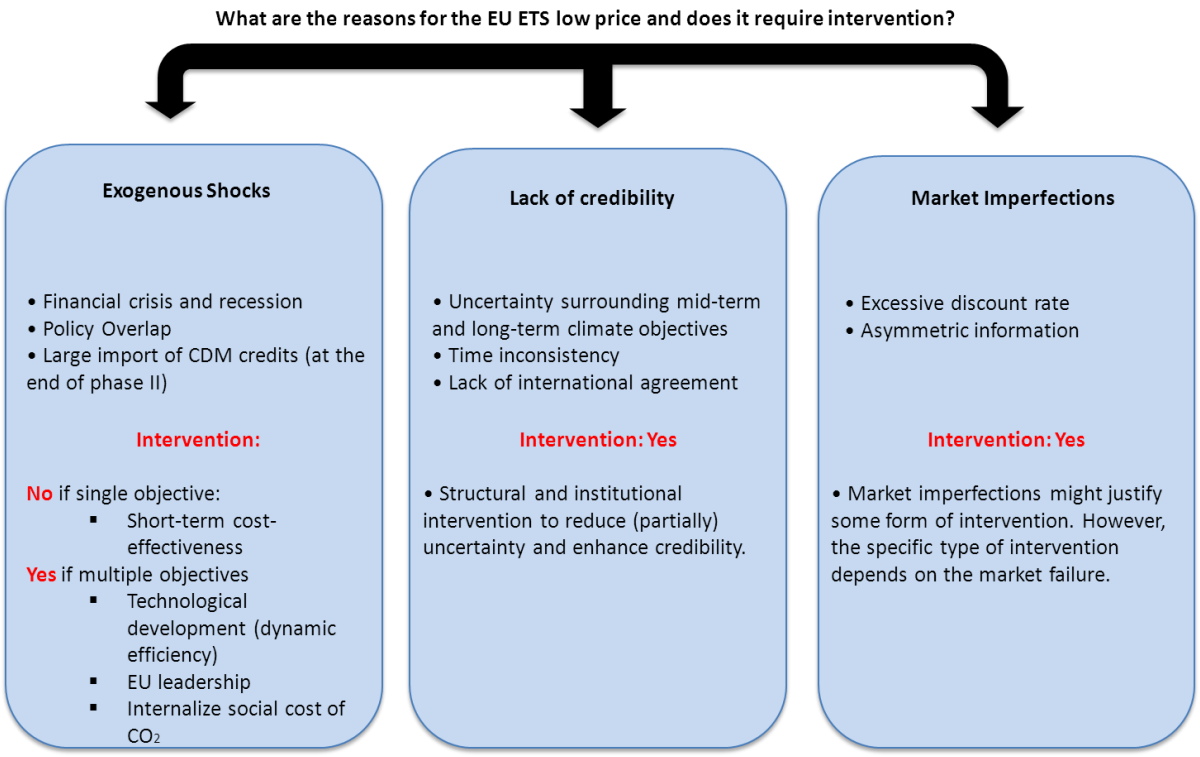


Figure 3: Three possible drivers of the low price in the EU ETS

Figure 3 summarizes the discussion of the three possible price drivers in the EU ETS and the implications for regulatory reform. On aggregate, some mix of these effects led to the annual cap being higher than the verified emissions in the years 2009 onwards and a cumulated current permit surplus of almost 2 billion tonnes (European Commission, 2013a). An empirical analysis of the drivers of the carbon price from the European Commission provides evidence that both depressed economic activity and renewable energy penetration have had a statistically significant and negative impact on the carbon price over the period 2008-2012 (European Commission, 2014a). However, Koch et al. (2014) find preliminary evidence suggesting that policy-events such as the back-loading votes might affect price fluctuations to a greater extent than other market fundamentals such as confidence in economic developments or renewable energy supply. Therefore, the policy uncertainty on post 2020 targets as well as the lack of credibility of long-term commitment might have prevented investors from buying permits. This situation is likely to have reduced the inter-temporal price smoothing that should have occurred given the expected medium to long-term scarcity

of carbon permits.[10] However, even if a case for reform can be made, the question remains on the specific kind of reform required. The following section discusses EU ETS reform options in line with the different perspectives.

Section 3: Reforming the EU ETS: instruments versus institutions

In this section, instrumental and institutional reform options are discussed before a conceptual framework to compare and contrast different reform proposals is introduced.

3.1 Instruments

In November 2012, the European Commission released a report outlining a number of options for reform based on the public and academic debate. These options can be categorized into three sets (see Table 1). Set I includes mechanisms to impose a one-off reduction of the surplus of allowances.

Table 1: Reform options proposed by the European Commission

EU Set I: Reduce permit surplus	EU Set II: Adjust scope	EU Set III: Reduce Price Uncertainty
• Increase the EU reduction target to 30 per cent by 2020 • Retire a number of allowances in phase three • Early revision of the linear reduction factor	• Expand the EU ETS to other sectors • Restrict the number of usable offsets	• Price floor • Soft price collar (allowance reserve) • Hard price collar

Source: European Commission, 2012a.

Set II aims at changing the scope of the EU ETS either by extending it to other sectors or by reducing the supply of international credits. Set III introduces the possibility of some form of price management in the trading scheme (European Commission, 2012a).

The final option therefore converts the EU ETS from a pure quantity-based instrument to a hybrid scheme in order to reduce the uncertainty of permit prices. There is a range of mechanisms that have been discussed in the literature which would introduce greater price certainty including: (i) price floors (Helm 2008; Wood and Jotzo, 2011); (ii) price caps (Jacoby and Ellerman, 2004; Pizer 2002); and (iii) soft (with allowance reserves) and hard price corridors (Burtraw, Palmer and Kahn, 2009; Fell, Burtraw, Morgenstern, Palmer and Preonas, 2010; Hepburn, 2006; Murray et al., 2008). Allowance reserves allow for inter-temporal adjustment of the permit supply, but do not affect the long-term cap or necessarily prescribe any specific minimum (or maximum) price. A soft price collar normally includes a minimum price but is limited in its ability to control price hikes by the allocation reserve, whereas a hard price collar allows for unlimited quantity adjustments to achieve fixed price levels (see Fell et al., 2010, for a comparison). Conceptually, the more control that is exerted on the price, the closer the hybrid scheme resembles a carbon tax.

Following stakeholders' consultation on the proposed options, the European Commission published in January 2014 a legislative proposal for the European Carbon market. This legislative proposal encompasses two key pillars: (i) drawing on set I, a possible increase in the linear reduction factor from 1.74% to 2.2% from 2021 onwards; and (ii) the creation of a 'Market Stability Reserve' (MSR), also from 2021. The latter had not been included in the previously proposed reform options.

3.2 Institutions

While most proposed reform options have been instrumental in nature, some authors have also argued in favour of institutional innovation by delegating some elements of ETS regulation to an adjustment rule or an independent agency (see introduction). However, it is not clear what form of delegation would be best suited to address the perceived problems of the EU ETS. As evident from monetary policy and the regulation of other industries, various forms of delegation are possible.

For EU ETS governance there is a continuum of delegation options in which the European Union (i.e. the current interplay of European Commission, Council, and Parliament)[11] would surrender decisional power over the governance of the EU ETS at increasing degrees. The status quo represents a situation where the European Union retains full decisional power and continues to directly implement reforms. Moving further on the continuum, adjustment rules are introduced. These rules could either be legislated by the European Union, or by an independent agency operating within a pre-defined mandate and they would define the way intervention takes place in the EU ETS. Towards the end of the continuum, the European Union could relinquish most (if not all) decisional powers to an independent body that would manage the EU ETS, potentially including full control over the cap and/or price. In this context, the independent institution would have a mandate legislated by the EU specifying its objectives, such as achieving a certain emission target at least costs. In this low end of the continuum, this institution would be entitled to choose its instruments for interference. Such approaches to delegation most closely resemble the case of independent central banks having significant discretion over money supply, while being guided by some core objectives such as price stability, which were politically set at their inception.[12]

3.3 EU ETS Reform Space

Various degrees of instrumental and institutional change embodied in reform proposals can be mapped in a two-dimensional EU ETS Reform Space (Figure 4). The horizontal dimension relates to the extent to which an option leads towards more price certainty (right hand side) as compared to the status quo of quantity certainty (left hand side).

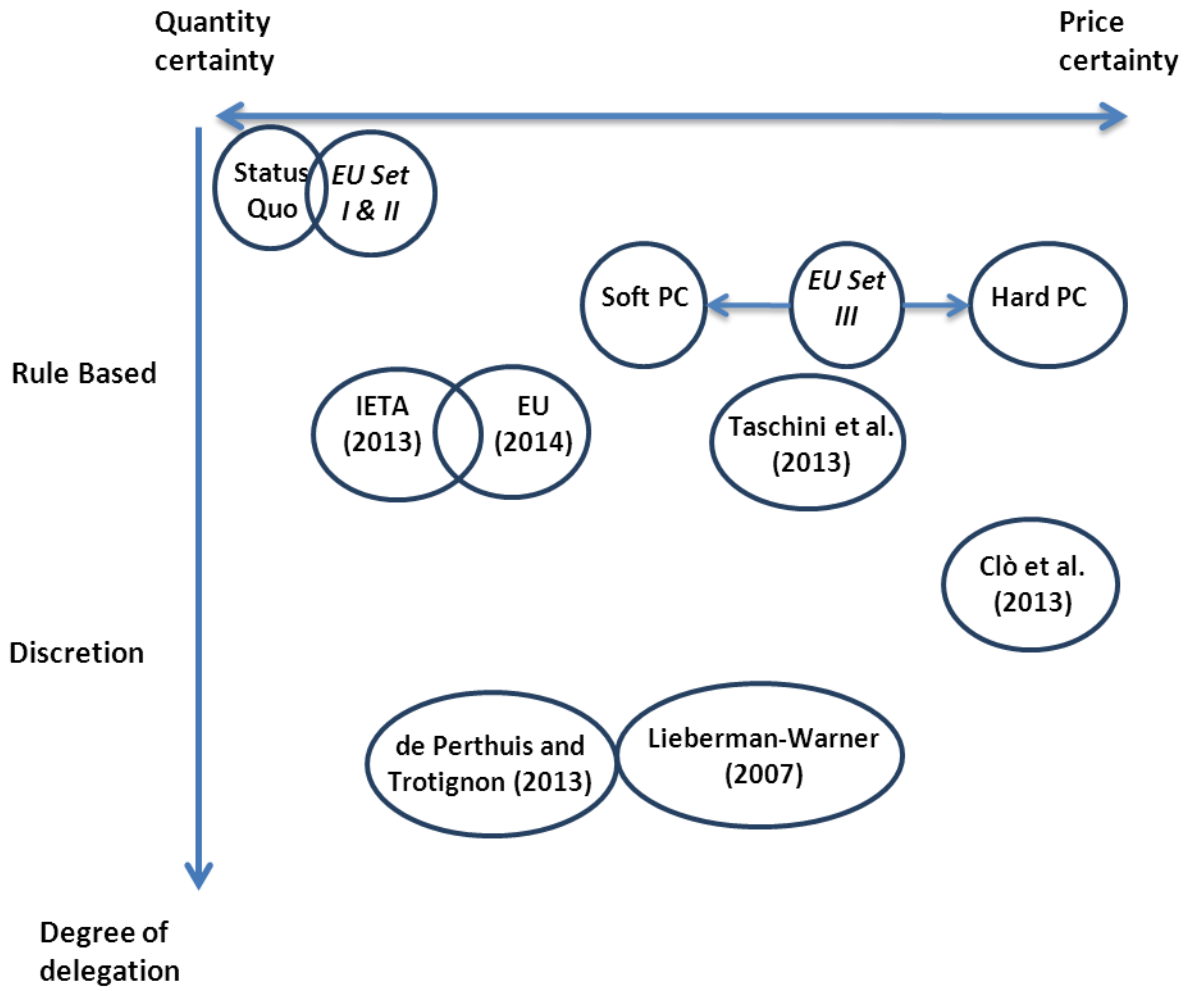


Figure 4: EU ETS Reform Space
Soft PC: soft price corridor; Hard PC: hard price corridor.

On either end of the price vs. quantity certainty spectrum lie a pure cap-and-trade mechanism (left) and a carbon tax (right).[13] In between these two extremes are a range of hybrid schemes such as hard and soft price collars. The vertical dimension pertains to the continuous delegation of decisional power over the governance of the EU ETS away from the European Union.

Within this basic framework, many of the options that have been put forward to reform the EU ETS can be compared. For example, if the European Union remains the main entity in charge of managing the market, various options exist. The status quo, where the EU ETS

remains a pure quantity mechanism, is the first possibility. Set I, with reform options such as a revision of the linear reduction factor as suggested by the European Commission (2014e), is located in the top left area of the EU ETS Reform Space. This is due to the limited changes in terms of delegation and explicit price certainty. Set II is located with set I as adding another sector such as transport to the EU ETS, where short-term demand for permit is likely to be more inelastic, could have a smoothing effect on price development but remains uncertain.[14] Set III represents the set of options available to exert greater control over the emission price. Within this set of options, the soft price collar entails more price certainty than the status quo due to the minimum auction price and the allowance reserve. At the same time, it also implies more quantity certainty than a hard price corridor. In fact, with a soft price collar, no more emissions than the cap plus the allowance reserve would be released. When implemented by the European Union, this option lies in the upper middle area of the EU ETS Reform Space. The hard price collar, on the other hand, is placed in the upper right corner as it offers stronger price certainty by implementing a strict price floor and ceiling. However, it entails less quantity certainty as an unlimited number of permits could be added to (or removed from) the market. Both options lie below the status quo in terms of level of delegation, as the price collar would need to be defined in legislated rules in addition to the existing framework.

Next, institutional reform proposals are discussed.[15] These proposals combine various degrees of delegation with different levels of controls over quantity or price. IETA (2013) proposes a type of rule-based approach to revise the quantity of permits in the market. However, the authors argue in favour of keeping the long-term carbon budget neutral.[16] A rule to temporarily remove or add allocation from the market could be based on a mathematical formula or pre-defined triggers. This mechanism is likely to adjust to relevant and observable economic variables, such as primary energy demand, diffusion of renewable energy, estimated abatement costs, technology switching prices, size of the permit surplus, or GDP. Supply would then be adjusted in a predictable way according to the deviation of these variables from their expected trend. This would implicitly lead towards a more carbon-

intensity based cap-and-trade system (with intensity based on the respective mix of indicators), but not to a direct price control mechanism.

The European Commission's January 2014 proposal can also be characterised as a rule-based approach, which targets the quantity of allowances. The proposed MSR is designed to adjust the supply of allowances in the market based on pre-defined rules surrounding the level of permit surplus.[17] To facilitate price discovery between trading periods, the reserve can be carried over multiple periods.

Alternatively, Taschini et al. (2013) propose a quantity adjustment rule, which would respond to a price-indexed trigger mechanism. This proposal draws on Article 29a of the European Union Emissions Trading Directive (European Union, 2009), which aims at avoiding large temporary price hikes.[18] Here the quantity adjustment would be triggered when the price deviates from its long-term trend for a certain period but would apply to both price hikes and price drops. The authors argue that such a mechanism would make intervention necessary only under exceptional circumstances. In fact, the expectations of a possible intervention would (at least partially) already correct the price. If intervention is necessary based on the triggers, its magnitude would be decided by the European Commission based on projected emissions, the time remaining until the end of the period and the number of allowances still to be auctioned.

The European Commission (2014b), IETA (2013) and Taschini et al. (2013), propose that interventions are made by the European Union and are governed by legislated rules. By contrast, Clò et al., (2013) suggest (i) the creation of a new institution that would (ii) govern the permit market via a price-based rule such as a price corridor. The introduction of a new body with the ability to set rules for the carbon market reflects less decisional power for the current European Union governance arrangement, locating their proposal further down the delegation spectrum (see Whitesell, 2007 for similar proposal for the United States).

Finally, two proposals for delegation entailing significant levels of discretion have been put forward. First, de Perthuis and Trotignon (2013) propose the creation of an Independent Carbon Market Authority (ICMA). The mandate of this institution would be to maintain the credibility and political ambition of climate policy over time by managing allowance supply. In the short-term, this requires adjustment of auctions to ensure 'proper functioning' and 'liquidity' in the trading market. Over the medium to long-term, this could also entail the adjustment of the allowance cap. Interventions would focus on discretionary quantity adjustment and hence the authors see no need for price management mechanisms. The role of the ICMA would be to ensure the compatibility of the EU ETS with other energy and climate policies as well as to monitor the interactions with international markets. In the current policy context, according to the authors, the revision of the cap would be downward if its objective is to avoid, for instance, an unexpected decrease in the demand for permits due to policy overlap and the import of offsets. To motivate its actions and allow for clear expectations, the ICMA would implement a transparent monitoring framework and report to the Council and the European Parliament. This option is located in the lower-left corner of the EU ETS Reform Space, as it entails no explicit price management.

Second, a Carbon Market Efficiency Board was suggested in the United States Congress Lieberman-Warner legislative proposal (S. 2191).[19] The proposed mandate was to achieve some price level that balanced emission reductions and economic growth (Manson, 2009).[20] Consideration of short-term price certainty and its impact on industry competitiveness therefore appears to be at least equally important as short-term quantity concerns, locating this option at the bottom middle area of the EU ETS Reform Space. [21]

Most proposals entailing higher degree of delegation, discussed here, are rather general in terms of the exact mandate of the carbon authority. In particular, they lack precision regarding the conceptualisation and operationalization of the policy tool that is to be applied and the specific set of objectives and mandate that are to be achieved.

Section 4: Is delegation key to the EU ETS reform?

Would delegation 'fix' the EU ETS by solving the problems identified in Section 2? This section addresses this question drawing on the EU ETS Reform Space. For each potential driver of the low price, and taking into account potential EU ETS objectives, an appropriate policy space is identified (see Figure 5) before the strengths and weaknesses of different reform options are discussed. This analysis is more descriptive than analytical. It aims at providing a structure to the on-going debate as well as a framework to better understand in which case and to what extent delegation of climate policy might be useful. Consequently, this paper does not aim to identify the optimal reform. Rather the preferable reform option (including the option not to reform) depends on: (i) the weight attached to the drivers of the current price level (i.e. exogenous shocks, lack of credibility or market imperfections); and (ii) the relative importance of objectives assigned to the EU ETS (single short-term least cost objective versus multiple objectives).

4.1 Responding to exogenous shocks

As discussed in section 2, two perspectives on reform can be taken if an exogenous shock is considered to be the cause of the low EUA price: a single short-term cost-effectiveness objective and a broader, multiple objectives perspective. The reform space for those that subscribe to the single objective perspective is the status quo. No regulatory change is required.

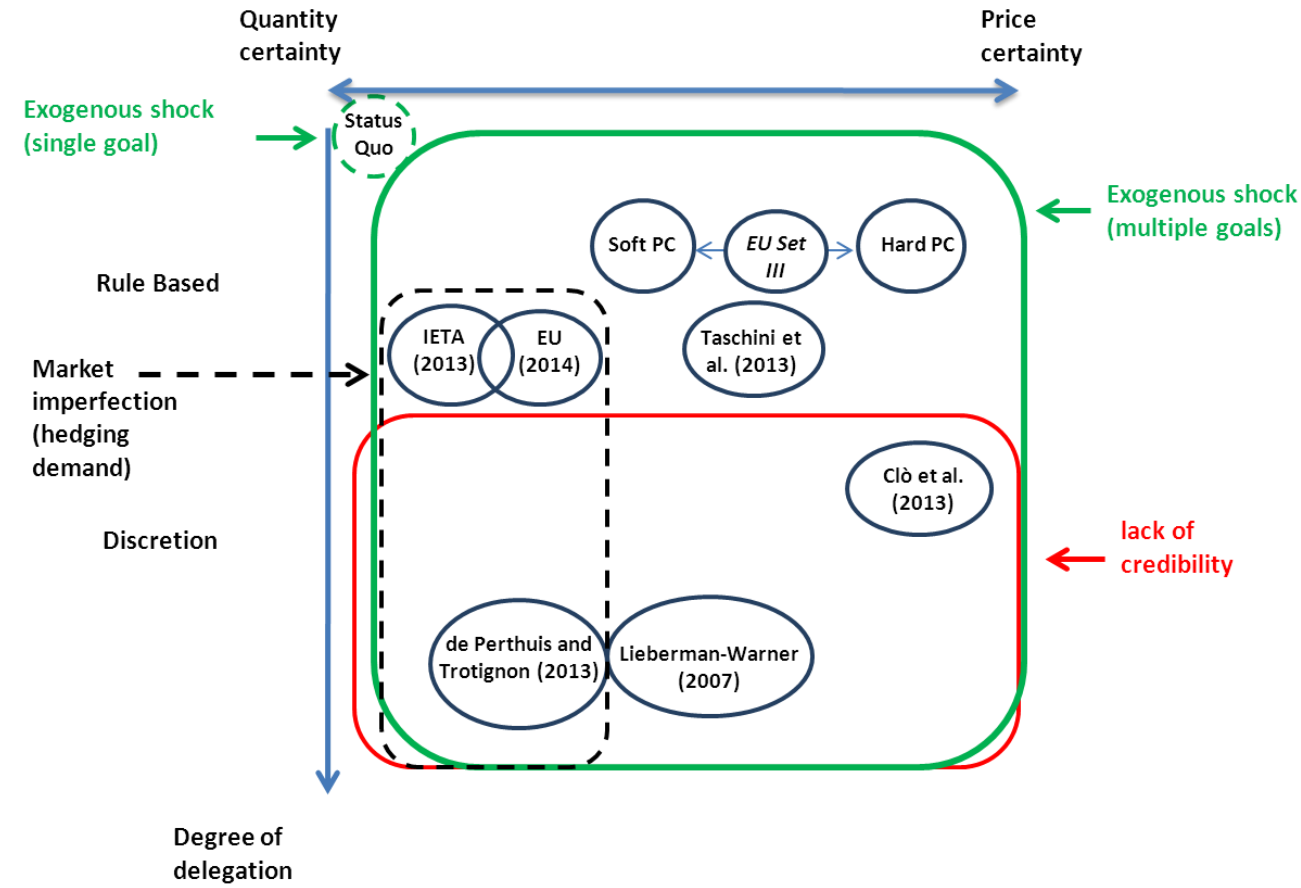


Figure 5: Perspectives on EU ETS reform
Soft PC: soft price corridor; Hard PC: hard price corridor
EU Set I and Set II are not discussed in this graph as the analysis focuses on options entailing some minimum degree of delegation.

Those that subscribe to a multiple objectives perspective, beyond short-term cost-effectiveness, argue that the price is 'too low' to induce the desired innovation, or to signal European Union leadership on climate policy. Other authors also point out that a low price may no longer reflect the social cost of carbon (Nordhaus, 2011). In these perspectives, the extent of enhanced price certainty introduced by specific reform options is particularly relevant. In this framework, the MSR as a quantity-based adjustment rule reform does not provide a clear price signal because the choice of the adjustment rule is not tied to price formation. In addition, revision of the rule is announced for 2026, and it is difficult to assess what the result of this review will be. While perhaps having an upwards effect on short-term prices by reducing near-term permit availability, it is unclear how the MSR will shape the

price expectations of market participants. In fact, the Impact Assessment indicates that such a cap neutral adjustment may increase short-term but depress mid-term prices (European Commission, 2014c), which will have an uncertain overall impact on investment and innovation.[22] If multiple objectives considerations result in a preference for enhanced stability over prices, a price floor or a price corridor would deliver a clearer signal to market participants (Wood and Jotzo, 2011).

In a pure exogenous shock perspective and adopting a multiple objective approach, it is not obvious why independence of the ETS regulator should be necessary. Indeed, the European Union could implement a price management strategy that would alleviate the perceived concerns associated with unforeseen change in demand. Nonetheless, although institutional change with a higher degree of delegation is not necessarily required in a multiple objectives perspective, enhanced flexibility to adjust to sizeable shocks and new information might be valuable in order to decrease the transaction costs of a regulatory change (Newell et al., 2013; Trotignon, Gonand, and de Perthuis, 2014).

Based on these considerations, the reform space for dealing with exogenous shocks under a multiple objectives perspective comprises the entire plane right of the vertical axis (Figure 5). However, a decision to go towards the right hand side of the EU ETS Reform Space will be based on the weight assigned to a stable and predictable carbon price. Moving downwards (i.e. increasing the level of delegation) will reflect the willingness to increase the responsiveness and flexibility to adjust to exogenous shocks (in particular unexpected ones).

4.2 Responding to lack of credibility

Whether one takes a single objective or a multiple objectives perspective is largely irrelevant if lack of credibility is seen as the main driver of the low price since, in an acute form, it distorts the functioning of the EU ETS. A lack of credibility can have two sources: uncertainty over regulation, e.g. announced stringency of the cap or permanence of the overall system, and the time inconsistency related to long-term climate policies. Both problems are intertwined but not identical. Even in the presence of clearly defined caps and reduced

political uncertainty (e.g. due to a strong global and EU consensus on the desired level of climate policy ambition and instruments), delegation may be warranted given the time inconsistency of climate policy. In fact, the main 'raison d'être' of an independent body in other policy contexts is precisely to deal with problems of credibility of long-term commitment and of time inconsistent policies. The independence of the agency: (i) shields it from short-term political pressures that are considered detrimental to welfare (thus, implying a broad consensus on what welfare would imply, e.g. in terms of climate policy ambition); and (ii) enables it to build a reputation for announcing and enacting its policy on the basis of a clear and transparent framework (Brunner et al., 2012).

The Reform Space from the credibility perspective (in Figure 5) suggested here includes three options promoting delegation, one based on rules (Clò et al., 2013) and two on discretion (de Perthuis and Trotignon, 2013 and Lieberman-Warner, 2007). They all represent delegation to an independent carbon authority. In fact, the key choice here is between a rule-based and discretion-based institution.

To operate effectively, rules must be based on a sound theoretical model of how the carbon market should be adjusted in response to new economic conditions and other external shocks. Also, in defining such a rule, the objective function embodied must be linked clearly and explicitly to the political objectives of the EU ETS. However, given the complexity of the carbon market and the potential for further unforeseen exogenous shocks, it is not clear which theoretical framework should be applied to set such a policy rule or if indeed an adequate rule can be designed.

In that context, some analysts regard discretionary power as a potential solution to overcome the trade-off between credibility and flexibility (for a discussion of this trade-off, see Brunner et al., 2012 and Jakob and Brunner, in press). Drawing on lessons from past experience, the possibility of unforeseen events or 'unknown unknowns' which require a quick response beyond applying a pre-defined rule to ensure the efficiency of the ETS, makes the case for delegation to a carbon authority more appealing. While this constitutes an argument in favour of discretion to enhance efficiency in presence of economic shocks (as argued in the previous section) it does not justify discretion as an adequate response to credibility problems. This justification usually rests on the argument that the separation of politics from regulation of the EU ETS can potentially mitigate problems of time inconsistency and enhance investor confidence that the independent regulator will ensure long-term targets are achieved.

The type of instruments applied by an independent authority to stabilise expectations and induce long-term cost effectiveness will also be important. In selecting and managing these tools, such a body must balance concerns regarding environmental effectiveness and long-term economic efficiency. Fell and Morgenstern (2009) demonstrate empirically that a price collar may achieve this balance in the most cost effective way. In this line of reasoning, reform options located in the low-right area of the EU ETS Reform Space might be best placed to respond to both concerns associated with exogenous shocks and credibility.

Nonetheless, delegation to an independent body is unlikely to be a 'silver bullet'. In fact, the ability of such a new institution to establish credibility among market participants will take time and is likely to depend on several factors such as its mandate, the profile of the head of the agency, and its historical record. It also requires political agreement on the objectives of the EU ETS as well as on the degree of ambition of EU climate policy, which is perhaps the major challenge this design option is facing.

4.3 Responding to market imperfections

Market imperfections distort the functioning of the permit market and hence from both a single and multiple objective perspectives are undesirable. However, the case for delegation depends specifically on the nature of the market imperfection and its impact, in terms of direction and magnitude on the permit price. As discussed above, both theoretical and empirical evidence for EU ETS permit market imperfections is somewhat lacking and should be considered an area for further research. Therefore we focus here on the argument put forward by Neuhoff et al. (2012), for which some analysis is available and which could offer a rationale for the MSR (European Commission, 2014c). According to Neuhoff et al. (2012), when the permit surplus exceeds the hedging demand of covered entities, there is a jump in the discount rate applied to the expected future carbon prices as speculators dominate the market. Under such conditions, the EU ETS would no longer serve its intended purpose to incentivize abatement in a dynamically cost effective manner, and a case for reform could be made.

The permit surplus currently exceeds 2 billion permits while the hedging demand is estimated to be somewhere between 1.1 and 1.6 billion permits (Schopp and Neuhoff, 2013). If the hypothesis put forward by Schopp and Neuhoff (2013) holds, the appropriate reform could be a quantity-based intervention that maintains the permit surplus within the hedging corridor, such as the MSR proposal by the European Commission. This reform option is represented in Figure 5. Again, there is a choice in designing the reform: the rule could be either fixed and be subject to modification through the legislative process only, or discretionary flexibility to respond to changes in hedging demand could be enabled, e.g. via a body such as the ICMA proposed by de Perthuis and Trotignon (2013).[23] In this context it is worth noting that according to the MSR Impact Assessment (see European Commission 2014c), the Commission's proposal would not have avoided the accumulation of permit surplus in 2011 and 2012 and would have taken several years before reaching the intended surplus level (European Commission, 2014). More generally, Trotignon et al. (2014) argue that such a 'robot-type' adjustment lacking discretionary flexibility by some regulatory agent can in principle not comprehensively anticipate all market participants' reaction to changes

in their complex economic environment, and may thus fail to manage permits in a way that is in line with the intended outcomes.

Section 5: Summary and discussion

There is a lively debate on the drivers of the low price in the EU ETS and whether it results from a structural deficiency requiring a reform. In theory, the low price might be driven by three factors: (i) exogenous shocks; (ii) political uncertainty and lack of long-term credibility; and (iii) market imperfections. These are not, however, mutually exclusive. Depending on the view taken on the relative explanatory power of these effects and the objectives associated with the EU ETS, an intervention may or may not be warranted.

In this context, the European Commission proposed in 2012 six reform alternatives that can be categorized as three sets: (i) a one-off reduction of the surplus of allowances; (ii) adjusting the scope of the EU ETS; and (iii) price management. In addition, it has suggested a 'Market Stability Reserve' mechanism in its EU ETS reform proposal in January 2014. While the literature has so far focused mainly on the reform options suggested by the Commission in 2012, delegation to an independent carbon authority has also been considered. However, there has been a tendency in the literature to compare instrumental reform options such as a price cap or corridor with institutional innovation such as a carbon central bank. In our view, this is misleading as the degree of delegation and the type of instrument used - for instance introducing more price or quantity certainty – are different dimensions that cannot be directly compared. In recognition of this, the concept of an EU ETS Reform Space is suggested, which incorporates aspects of both instrumental and institutional reform.

An exogenous shock leading to lower permit prices need not per se motivate intervention if the EU ETS is considered solely as an instrument to achieve a given short-term emission target at least cost. Introducing some form of price management might, however, be justified to foster the development and deployment of low carbon technologies, to signal European Union climate policy leadership, or to reflect the social cost of emissions. This does

not necessarily require delegation as other (simpler) reform options, such as a price floor, might be sufficient to deal with such concerns.

Delegation offers, nonetheless, a higher degree of flexibility in adjusting policies under new circumstances. On the one hand, rule-based delegation delivers a clear and transparent framework for market participants to forge their expectations on potential adjustments. On the other hand, delegation with discretion is best suited when one expects unforeseen shocks to occur again in the future and puts a high value on the flexibility to react quickly to 'unknown unknowns'.

Given uncertainty surrounding mid- and long-term climate objectives, the lack of stability in international climate policy and the potential time inconsistency of climate policies, European Union climate policy may suffer from a lack of credibility. Delegation is unlikely to solve all uncertainty problems, for example the impact of unexpected international climate policy developments. However, it might contribute to reducing European Union political uncertainty and increasing long-term credibility either through rule-based mechanisms or discretionary powers of an independent regulator able to build up a credible reputation. Analogical considerations have been applied in monetary policy and other industries.

While delegation might cure some of the perceived deficiencies of the EU ETS, it is important to note that major political barriers stand in the way of its implementation. First, setting up an independent body with discretionary power requires a modification of the European Union treaties, which might be difficult in the current political context. Second, an independent institution in charge of solving intra- and intergenerational distributional conflicts, as it is the case in climate policy, might suffer from a democratic legitimacy deficit (Brunner et al., 2012). For example, Ergas (2010) argues that the choice of emissions trajectory should remain in the hand of policymakers. According to the author, this is necessary due to the high level of uncertainty surrounding climate policy with respect to science, economics as well as global politics, and the significant stakes involved in climate policy decisions. Third, the long time frames in carbon policy and the inertia in the energy

system (e.g. compared to monetary policy) might also allow governments to abolish a carbon authority's independence without immediately feeling the effects of higher emissions or other induced negative effects, hence undermining its credibility (Brunner et al., 2012).

The academic debate on the potential benefits and drawbacks of delegating elements of EU ETS governance is still at a very early stage. The debate would benefit from a better understanding of the empirical weight that should be attached to the various drivers of the low price. In addition, a clearer understanding and political definition of the long-term objectives of the EU ETS is necessary. Finally, the configuration of institutions and instruments best suited to a complex system characterized by significant uncertainty is also an interesting area for further research.

Acknowledgements
The authors would like to thank all interviewees for their insights as well as Michael Pahle and Brigitte Knopf for their helpful comments on this manuscript. The research leading to these results has received funding from the European Union's Seventh Framework Programme [FP7/2007-2013] under grant agreement n°308481 (ENTR'ACTE). The ideas expressed here remain those of the authors who remain solely responsible for errors and omissions.

Notes

1. Time inconsistency refers to a setting where policymakers have an ex post incentive to renege on a policy that may have been optimal ex ante (Kydland and Prescott, 1977).
2. For a list of the 23 interviewees, see the Appendix.
3. A surplus occurs when there are more permits than needed, i.e. when the number of annually available allowances exceeds the annual emission level. An alternative metric is to compare cumulated available allowances with cumulated expected emissions over a fixed future time period extending beyond one year. It is less clear that the EU ETS is over-allocated e.g. in a time perspective until 2050 (European Commission, 2013a). Starting from 2013, the annual cap (based on the average annual cap of phase II (2008-2012)) is scheduled to decline by 1.74 per cent per year. This translates in an annual reduction of 37.4 Mt (Sandbag, 2013).
4. Range of carbon price reported in the Climate and Energy Package Impact assessment for the 'cost efficient scenario' between 2020 and 2030 (European Commission, 2008).
5. In total, 19 interviews with 23 experts were conducted between January 15th and March 5th 2013. Interview candidates included experts from academia (11), industry (6), as well as carbon traders (4) and senior policymakers (2). Four interviews were conducted face-to-face, and 15 over the phone. Interview participants were selected from a range of jurisdictions including: Australia, Belgium, France, Germany, Italy, the United Kingdom and the United States. See Annex I for a list of the interviewed individuals.
6. See Beurskens and Hekkenberg (2011) for expected deployment and Eurostat (2013b) for actual data.
7. According to the European Commission (2014e), the linear reduction factor should be between 2.1 and 2.4 per cent between 2020 and 2050 to be consistent with the 80-95 per cent emissions reduction goal.
8. As defined by Brunner et al., (p. 256, 2012), '*individuals, or a set thereof, have credibility if others believe that they will do what they commit to*'. In the case at hand, the credibility pertains to the European Union leaders and their commitment to achieve a decarbonisation of the economy (80-95 per cent emissions reduction compared to 1990 levels) and specifically of EU ETS sectors by 2050.
9. Point Carbon (2013c) found that between 2011 and 2013, the percentage of market participants believing the EU ETS would still exist after 2020 dropped from 77 per cent to 69 per cent.
10. In theory, new information on abatement could have been another driver of this apparent discrepancy between long-term expected price and current price level. However, it seems unlikely that there was indeed such new information on abatement costs.
11. The European Union is conceptualized as the current arrangement of legislating and implementing policy between the European Commission, European Council, and European Parliament.

12. This may also be achieved by endowing the commission (specifically DG Climate) with more independent governance powers, i.e. DG Climate may be endowed with carbon central bank functions. Note, however, that DG Climate could not be completely independent, as it is engaged in various other interactions with council and parliament as well as other DGs, opening various channels for influence (and power) by these other bodies.
13. The duality of prices and quantities is observed in textbook micro-economic frameworks. This relationship however becomes complicated in a system that allows both unlimited banking and the potential for permit backloading. In fact, although the cumulative cap remains constant, there is uncertainty surrounding annual permit releases. For a discussion on the effects of banking and backloading on price discovery, see Chaton, Créti and Peluchon (2013).
14. If sectoral expansion is seen as an option to deal with the current surplus of the EU ETS, this makes only sense if the increase in cap derived from a sectoral expansion is less than proportional to the need of the sector (see Flachsland et al., 2011).
15. Although there have been many references in the literature to a carbon authority, few clearly state the specific mandate this independent authority should have. Consequently, the most complete suggestions in terms of the information provided on the scope of the mandate were chosen to be mapped in the Reform Space.
16. The degree of quantity certainty is complex in this context. It depends on whether quantity certainty is understood as inter-period or intra-period certainty. In addition, if a reserve builds up over time by removing allowances from the market and is never called upon it will have to be dealt with at some point in the future, potentially with a cancellation of these allowances, thus effectively reducing the cap.
17. In the proposed mechanism, allowances can be put into a reserve if 12% of the surplus of allowances in circulation in the trading scheme in a given year is equal or greater than 100 million allowances. In that case, the same amount of allowances (12% of the surplus) will be deducted from the cap of the following year and placed into the reserve. Allowances can be released from the reserve under two circumstances: (i) if the surplus in a given year is below 400 million allowances, 100 million allowances are released from the reserve and (ii) If the conditions of article 29a of the Directive apply, then 100 million allowances will be released from the reserve. The remaining allowances will be released if less than 100 million allowances are available in the reserve (European Commission, 2014b). In effect, the MSR can be interpreted as a dynamic back- and frontloading rule indexed to the allowance surplus.
18. Article 29a of the European Emissions Trading Scheme Directive allows for an injection of EUAs if for more than 'Six consecutive months, the allowance price is more than three times the average price of allowances during the preceding two years' (European Union, p. 82, 2009).
19. See Senate of the United States (2008), for details of this proposal.
20. Similar to the Federal Reserve Bank that is mandated to balance the objectives of 'maximum employment, stable prices, and moderate long-term interest rates' (Federal Reserve, 2013).

21. The action of the Carbon Market Efficiency Board under the Lieberman-Warner bill (2007) was designed to be cap neutral by borrowing. However, temporary increase of offsets and foreign allowances were allowed when necessary to contain potential harm on the US economy. Therefore, it is located in the middle in terms of intra-period quantity certainty.
22. More generally, assuming perfectly efficient markets with perfect foresight, shifting the temporal allowance release schedule without changing the cap should not or hardly change present prices (Newell, Pizer and Zhang, 2005). However, assumption of an additional credibility problem or market failure would lead to a change in current EUA prices from shifting EUA releases through time as foreseen in the MSR.
23. de Perthuis and Trotignon (2013) do not consider an MSR approach for ICMA, but this is a theoretical possibility.

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Appendix 1: List of interviewees, by institution

Experts	Institutions
Steffen Brunner	Potsdam Institute for Climate Impact Research
Christian de Perthuis	Climate Economics Chair – Paris Dauphine University
Raphael Trotignon	Climate Economics Chair – Paris Dauphine University
Karsten Neuhoff	Deutsches Institut für Wirtschaftsforschung
Frank Jotzo	Australian National University
Robert Stavins	Harvard University
Denny Ellerman	Massachusetts Institute of Technology
Daniel Klingenfeld	Potsdam Institute for Climate Impact Research
Sam Fankhauser	London School of Economics / United Kingdom Climate Change Committee
Luca Taschini	London School of Economics
Cameron Hepburn	University of Oxford / London School of Economics
Alessandro Vitelli	Bloomberg
Martin Berg	European Investment Bank
Tobias Haumer	European Investment Bank
Hans-Bernd Menzel	EEX, former CEO
Jesse Scott	EURELECTRIC
Stefan Ulreich	Eon
Jürgen Rosenow	Eon
Volker Holtfrerich	BDEW
David Valenti	EUROFER
Sarah Deblock	International Emissions Trading Association
Roger Beale	PwC, Former Secretary for Ministry of Environment, Australia
Alex Kazaglis	United Kingdom Climate Change Committee