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Abstract

The author provides an overview of carbon markets and explains how emissions trading can be important in encouraging the reduction of CO2 emissions in an efficient manner. He describes the key steps in establishing a cap-and-trade system, and reviews the European experiences with emissions trading. He highlights the lessons learned from the EU Emissions Trading System on how to design a market that operates efficiently and effectively. By learning from the experience of other countries, Canada can avoid the uncertainty and volatility witnessed in carbon markets abroad while benefiting from an efficient trading mechanism that contributes to the welfare of all Canadians.

JEL classification: D4, N50, Q21
Bank classification: International topics; Market structure and pricing

Résumé

L’auteur donne un aperçu des marchés du carbone et explique comment les échanges de droits d’émission peuvent contribuer de manière efficiente à la réduction des émissions de CO2. Il décrit les principales étapes de l’établissement d’un système de plafonnement et d’échange de droits d’émission et passe en revue les expériences menées à cet égard en Europe. Il met en lumière les enseignements tirés, au point de vue de l’efficacité et de l’efficience, de la mise sur pied du système d’échange de quotas d’émission de l’Union européenne. En s’inspirant de l’expérience d’autres pays, le Canada peut éviter l’incertitude et la volatilité qui ont caractérisé les marchés du carbone ailleurs dans le monde et profiter d’un mécanisme efficace d’échange de droits d’émission qui contribuera au bien-être de tous les Canadiens.

Classification JEL : D4, N50, Q21
Classification de la Banque : Questions internationales; Structure de marché et fixation des prix

1 Introduction

Following the signing of the 1997 Kyoto Protocol, a new global market for trading allowances to emit carbon dioxide (CO2), known as the 'carbon market,' has emerged. These allowances have been created by varying national 'cap-and-trade' schemes, where governments set emissions targets designed to reduce a country's CO2 emissions over time. Individual firms then decide how best to meet their individual targets – either by improving their production processes or by purchasing allowances from other firms (known as emissions trading).

The Canadian government has proposed to include emissions trading as part of its environmental agenda announced under the "Regulatory Framework for Air Emissions" earlier this year. If this proposal passes into legislation, Canada would see the emergence of a new dimension to its financial system that would have important effects on the behaviour of firms. In particular, firms would need to pay attention to this market when making investment decisions. By learning from the experience of other countries, Canada can avoid the uncertainty and volatility witnessed in carbon markets abroad, while benefiting from an efficient trading mechanism that contributes to its economic welfare.

Section 2 of this paper gives an overview of carbon markets and explains how emissions trading can be important for encouraging the reduction of emissions in an efficient manner. Section 3 describes the key steps in establishing a cap-and-trade system. Section 4 describes the European experiences with emissions trading. Section 5 highlights the key lessons learned from the European Union experience to ensure that the market operates efficiently and effectively. Section 6 describes Canada's regulatory framework for air emissions. Section 7 summarizes the key findings of the paper.

2 What Is the Carbon Market?

From a market value of US$10.9 billion in 2005, Table 1 shows that the annual value of global trading in carbon markets nearly tripled to US$30.1 billion in 2006. This market consists of two types of assets: project-based emissions credits (or offsets), and emissions allowances from national cap-and-trade schemes.

Project-based emissions credits (or offsets) are created through two mechanisms set up under the Kyoto Protocol, namely Joint Implementation (JI) projects and Clean Development Mechanism

(CDM) projects.[1] In essence, firms receive credits for investing in projects that reduce CO2 emissions in foreign countries. Table 1 shows that trading in project-based emissions credits represented 18 per cent of the carbon market by value traded in 2006.

Table 1
Overview of the Carbon Markets in 2006

Category	Volume (MtCO2e)	Value (US$m)	% of value
Project-Based			
Clean Development Mechanism	475	5,257	17%
Joint Implementation	16	141	1%
Other	17	79	0%
Emissions Trading			
European Union	1,101	24,357	81%
New South Wales + ACT	20	225	1%
Chicago Climate Exchange	10	38	0%
Total	1,639	30,097	100%
World emissions in 2003	27,500		

Note: MtCO2e = millions of tonnes of carbon dioxide equivalent
Source: World Bank, United Nations Statistics Division

An emissions allowance represents a permit to emit one tonne of CO2 or its metric tonne equivalent in other greenhouse gases. Emissions allowances are created under national cap-and-trade systems, where the supply of carbon allowances for a given period is set by a national regulator to achieve a targeted reduction in overall emissions over a given time horizon. These allowances are allocated to a group of firms covered by a mandatory or voluntary firm-level cap. Table 1 shows that trading of emissions allowances represented 82 per cent of the carbon market by value traded in 2006, with almost all the volume in the European Union.

Cap-and-trade schemes are seen as a cost-effective and flexible way to reduce carbon emissions. By creating an allowance that can be traded, a cap-and-trade scheme transforms a constraint (the obligation to cut emissions) into an asset (a new commodity to be traded alongside other commodities such as oil, natural gas, and electricity). This approach provides flexibility for firms that can choose the most cost-effective strategy to meet their individual emissions targets. Firms

1. JI projects are projects that reduce emissions within the other industrialized countries that are listed in Annex 1 of the Kyoto Protocol, while CDM projects reduce emissions in other countries, predominantly emerging markets.

with low-cost opportunities to reduce emissions can invest to reduce their emissions and finance part of this investment by selling their surplus allowances to firms that have uneconomic abatement opportunities. An important benefit of cap-and-trade schemes is that emissions trading becomes a source of information for firms on the costs involved in reducing CO2 emissions, and for policy-makers on the appropriate level and the pace to achieve national targets. A high price for allowances suggests that firms are finding it difficult and expensive to reduce emissions, while a low price suggests that there are relatively inexpensive opportunities to reduce emissions.

3 Establishing a Cap-and-Trade Market

The most active cap-and-trade market for carbon is the European Union Emissions Trading System (EU-ETS), launched in 2005. Table 1 shows that the allowances created under the EU-ETS represented 73 per cent of the global carbon market by volume traded in 2006 and 81 per cent by value traded. Emissions trading in CO2 under the EU-ETS has followed the practices pioneered by the United States Acid Rain Program, where a cap-and-trade system in emissions of sulphur dioxide (SOx) and nitrogen oxides (NOx) developed following the passage of the 1990 U.S. Clean Air Act. The U.S. and European experiences suggest five steps in the creation of a cap-and-trade scheme.

3.1 Capping emissions sets a clear goal

The first step is to pass regulation that sets mandatory limits (or caps) on CO2 emissions over a specific time period. The national cap determines the supply of allowances over a given period, which will affect the price signal. The cap is set to achieve a reduction in emissions to a desired level over the target horizon. Typically, this cap is broken down into targets for different subperiods, providing interim goals for emissions reductions along a path towards the long-term target.

3.2 Allocating allowances assigns responsibility

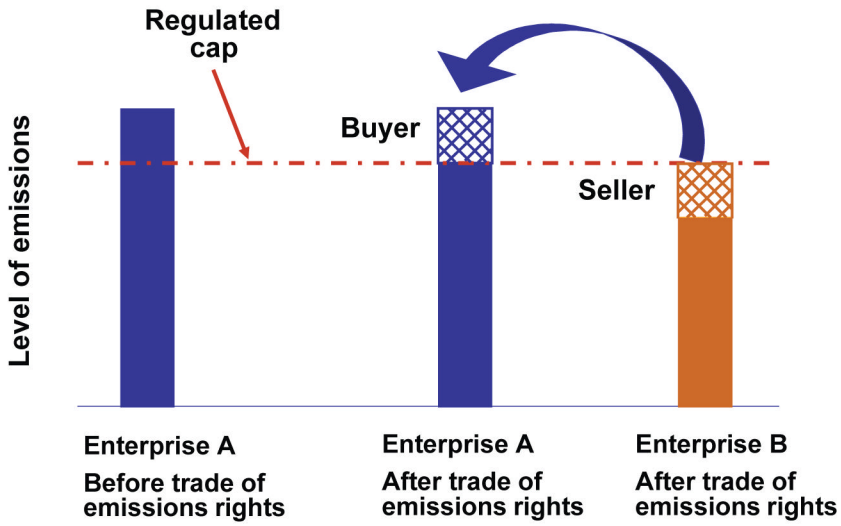
National regulations specify which individual firms are covered by the cap – whether private companies, public sector installations, or both. Each firm is given its own cap consistent with an aggregate reduction in CO2 emissions. The firms are then allocated the appropriate number of carbon allowances. At the end of the period covered by the regulations, each firm must either reduce its CO2 emissions to a level at or below its individual cap, or deliver allowances equal to the excess amount of emissions. Firms that fail to meet their targets are fined.

3.3 Trading facilitates cost-effective reductions

Once allowances are allocated, the stage is set for trading to begin. Each firm must determine the most cost-effective means to reduce (or abate) its carbon emissions. The firm may invest to improve its production processes. Or it may judge that it is cheaper to buy allowances in the carbon market sufficient to cover its excess emissions.

Chart 1 provides an example of how this trading process works. Enterprise A has a level of CO2 emissions that are above its regulated cap, and has limited or uneconomic abatement opportunities. Enterprise B has a low-cost opportunity to reduce CO2 emissions and can therefore sell its excess allowances to Enterprise A. At the end of this transaction, both parties are within their caps.

Chart 1
Overview of Emissions Trading



Physical trading in carbon instruments takes place either on an organized exchange or over the counter, similar to other commodities. A number of carbon exchanges have emerged in Europe and North America that trade spot, forward, and option contracts in carbon. In Canada, for example, the Montreal Exchange launched the Montreal Climate Exchange in 2006 to provide a location for Canadian firms to trade in CO2 allowances. The Toronto Stock Exchange and the Winnipeg Commodity Exchange have also expressed interest in this new market.

3.4 Monitoring and reporting ensure accountability

As with any market, a cap-and-trade market may not develop efficiently without the necessary infrastructure. Experience suggests that a successful cap-and-trade system relies on the following elements:

- registration of the ultimate owner of allowances or credits
- independent monitoring of emissions from a facility
- reporting of emissions to a central authority over a given period
- verification of the level of emissions and confirmation of reductions

These components are critical for promoting both public and business confidence in the system, allowing the market to function properly, and minimizing uncertainty. While some of these functions may be provided by financial intermediaries, a central authority may have responsibility for some or all of the functions.

3.5 Reconciliation ensures compliance

At the end of the period covered by the scheme, regulators must reconcile a firm's emissions against its holdings of allowances to ensure compliance. The firm must either deliver the equivalent number of allowances for its excess emissions, or pay some predetermined fine if they are short. This fine effectively sets an upper limit on prices for emissions. Under the EU-ETS, for example, the penalty is EUR 40 per missing allowance under Phase I (2005–07), and EUR 100 under Phase II (2008–12). Without effective compliance and enforcement, the incentives will not be in place to ensure an aggregate reduction in emissions.

In the case of the U.S. Acid Rain Program, compliance has been very high, with over 99 per cent of firms meeting their targets, thanks to rigorous monitoring, reporting requirements, and stringent penalties. By 2007, the Environmental Protection Agency reported that sulphur dioxide emissions were 41 per cent below their 1980 levels, while emissions of nitrogen oxides were 57 per cent below their 2000 levels.

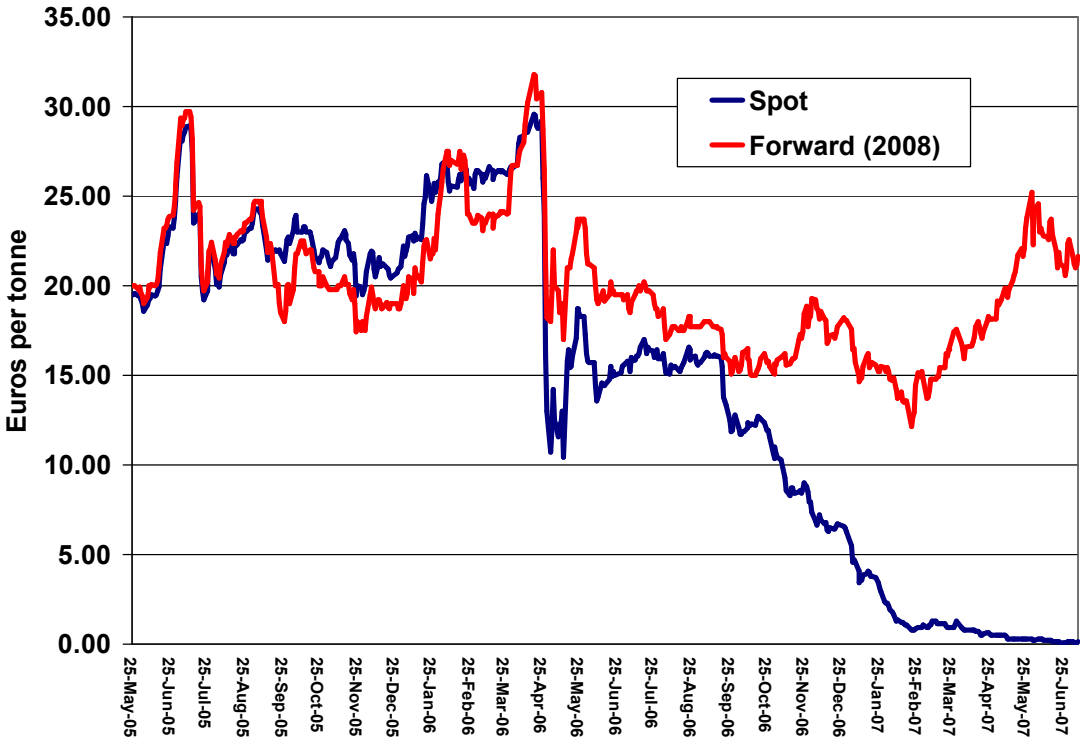
4 An Overview of the EU-ETS

Since 2002, a number of countries have experimented with voluntary cap-and-trade schemes for CO2, but only New South Wales in Australia and the European Union have passed regulations establishing legal caps on CO2 emissions. This section provides an overview of the EU scheme before discussing the key lessons learned in the next section.

The European Union Emissions Trading Scheme (EU-ETS), launched in 2005, sets mandatory caps on CO2 emissions for the 27 member countries of the European Union. Table 1 shows that the EU-ETS is by far the largest source of carbon allowances, representing 99 per cent of the volumes of allowances traded globally in 2006. The EU-ETS has consecutive trading phases, with the first phase running from 2005 to 2007 and a second phase from 2008 to 2012. A review of the third trading phase of the ETS starting in 2013 is in preparation. In Phase I, the scheme is mandatory for 11,500 energy-intensive installations across the EU that account for almost half of Europe's CO2 emissions. The number of allowances given to installations covered by the scheme is based on national emissions caps set by EU member states in their National Allocation Plans (NAPs). While the NAPs are calculated by national governments, these national plans must be approved by the European Commission. Banking of allowances across the first two phases covered by the plan is left to the discretion of individual member states, but because of the large oversupply in the first period, member states have refrained from allowing their installations to bank these emissions. Banking will become mandatory from the second phase onwards.

Uncertainty over supply and demand in the EU-ETS has led to very volatile prices for EU allowances, which is a typical feature of any new trading system where market players have insufficient oversight of key supply and demand dynamics. Figure 2 shows that, over the past two years, the average price of spot EU allowances for delivery in Phase I was EUR 14.91 per tonne of CO2, with a high of EUR 29.60 and a low of EUR 0.09. Prices dropped sharply by one-third on 27 April 2006, after the release of the EU verified emissions report that showed emissions were around 7 per cent lower than expected. Prices fell sharply again in September 2006 following the collapse of spot natural gas prices, their earlier high level being the main cause of EU allowance prices initially rising to the level of €29.60/ton. Member states did not allow installations to bank excess allowances from Phase I for use in Phase II, so by mid-2006 there was no longer any demand for Phase I allowances, since companies had purchased all the necessary allowances. As a result, the price of spot allowances fell close to zero and has remained there as the first phase approaches expiry at the end of 2007. By contrast, Chart 2 shows that the forward price of EU allowances for delivery in 2008 has averaged EUR 20.06. Forward allowances have exhibited lower volatility than spot EU allowances as market participants anticipate improvements in the allocation and design features of the EU-ETS.

Chart 2
Daily Spot and Forward Prices for EU Allowances in Euros



Source: Bloomberg

5 Lessons Learned from the EU-ETS

There are a number of lessons to be learned from the operation of Phase I of the EU-ETS. These lessons point to design features and operational issues that other countries should consider when developing their own emissions trading systems.

5.1 Setting the cap

A difficult issue in a cap-and-trade system is the level to set the overall cap at on CO2 emissions. The cap effectively sets the number of allowances that will be created under the scheme, and thereby affects the price at which they trade. If the cap is set too high, then allowances will be oversupplied and prices will be low. Firms will not have an incentive to invest in technologies or introduce operational improvements that reduce emissions, since it will be cheaper to buy allowances to meet their individual caps. If the cap is set too low and no use can be made of offsetting mechanisms from the Kyoto Protocol, prices will be too high, with potentially undesirable effects. Setting the right cap requires, foremost, reliable data about historic emissions

for each installation. The lack of reliable data is seen as the main cause of the collapse in the allowance price in the EU-ETS.

5.2 Diversity of players

To ensure that trading takes place, a cap-and-trade system must include a diversity of players with different abatement costs. If all firms covered by the scheme face similar costs to reduce emissions, there is no incentive to trade. An effective market must therefore have some players with low-cost opportunities to reduce emissions, providing an incentive for them to reduce their own emissions and supply their excess allowances to meet the demands of players with higher abatement costs. For example, the EU-ETS covers 11,500 energy-intensive installations across the European Union, over a range of sectors. From the perspective of diversity, the entry of financial actors that trade for speculative rather than compliance purposes is a welcome development in the carbon markets. Brokers, dealers, and investors such as hedge funds have the potential to increase market efficiency by providing liquidity and facilitating price discovery.

5.3 Banking allowances

Since emissions targets are set for a specific period, policy-makers need to decide whether allowances from one period may be banked for use in future years. The prohibition by member states on carrying forward unused allowances from Phase I to Phase II of the EU-ETS prevented large amounts of overallocated allowances in the first trading period from suppressing prices in the second trading period. When it was revealed that Phase I allowances were overallocated, the price of spot EU allowances dropped close to zero, since firms had effectively hedged all their needs. Under Phase II, allowances may be banked. Together with long-term EU commitments for further emissions reductions in 2020 and beyond, this has provided greater certainty and allows companies and industries to plan their future investments more effectively.

5.4 Linking with other Kyoto Protocol mechanisms

Under Phase I, European companies were able to meet their emissions targets either by buying the necessary EU allowances or by importing credits from CDM projects through a ‘linking’ mechanism. In accordance with the Kyoto Protocol, use of these mechanisms should be supplemental to domestic actions. The design flaw with this initiative is that there were insufficient limits on the number of credits that could be imported. This issue was particularly true in the second trading period, where the way “supplementarity” has been defined allows for more credits to enter the EU-ETS than actual reductions required from installations.

5.5 Simplicity

The EU (and U.S.) experience with emissions trading suggests that rules for a cap-and-trade scheme should be clear and easily enforced. Markets function better and transaction costs are lower when rules are simple and easily understood by all participants. A key complaint about Phase I has been that the allocation of national allowances was too complex and not transparent enough. Complexity makes it hard for companies and other market actors to understand national allocations and contributes to uncertainty. A lack of transparency also makes it difficult for firms to understand and form a view on investment plans. The EU has taken steps to make the national allocation of allowances under Phase II simpler and more transparent. To ensure greater transparency, for example, the EU has created standardized tables to provide consistent information across member states, and has encouraged a simplification of national rules.

6 Canada's Regulatory Framework for Air Emissions

On 26 April 2007, the Government of Canada released a framework for regulating air emissions that outlined a proposed emissions trading system for greenhouse gas emissions and other air pollutants.[2] The proposal stated that the emissions trading system would be a baseline-and-credit system, and not a cap-and-trade system.[3] The government proposes intensity-based targets that will come into force in 2010, which should lead to absolute reductions in emissions of greenhouse gases from industry by 2012, based on current growth forecasts.[4] The government will then set national caps for 2012–15 for the emissions of various greenhouse gases relative to 2006 emissions levels for each pollutant. National caps will be broken down into sector-specific caps over the same time horizon.

In a baseline-and-credit emissions trading system, a baseline is set. In this case, the baseline would be the emissions-intensity target. Facilities that reduced emissions below their target would be allocated tradable credits that they could either bank for a future compliance obligation or sell to another facility. Facilities that emitted above their target would have to buy credits from other facilities or use their own banked credits to meet their regulatory obligation.

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2. The report can be downloaded at: http://www.ec.gc.ca/doc/media/m_124/report_eng.pdf.
3. A cap-and-trade system will be used for SOx and NOx only, similar to the mechanism in place for the United States.
4. For existing facilities, the emissions-intensity reduction target for each sector is based on an improvement of 6 per cent each year from 2007 to 2010, yielding an initial enforceable reduction of 18 per cent from 2006 emissions-intensity levels in 2010. Every year thereafter, a 2 per cent continuous emissions intensity improvement will be required, resulting in an industrial emissions-intensity reduction of 26 per cent by 2015. Targets for new facilities will be based on cleaner fuel standards.

For example, suppose the emissions-intensity target is 5.0 kilotonnes (kt) CO2e for every tonne of widgets produced. Suppose Facility A had an emissions intensity of 4.5 kt/tonne and produced 1000 tonnes of widgets during the year. It would then receive tradable credits from the government equal to the difference between the target (5.0 kt) and its actual emissions intensity (4.5 kt) times its production in that year (1000 tonnes), or (5.0-4.5) x 1000 = 500 credits received.

Suppose Facility B had an emissions intensity of 5.3 kt/tonne and produced 1200 tonnes of widgets. It would be required to remit to the government credits equal to the difference between its actual emissions intensity (5.3 kt) and the target times its production (1200 tonnes), or (5.3-5.0) x 1200 = 360 credits owed. It could buy these credits from another facility or use credits that it had banked from a previous compliance period. The government's proposal includes the possibility of importing credits from CDM projects up to 10 per cent of each firm's total target.

The emissions trading system would also include domestic offset credits. Offsets are emissions reductions that take place outside the domain of regulated activities. Offset credits, which regulated firms could use towards their regulatory obligations, would be issued for verified reductions in greenhouse gas emissions that were incremental to what would have happened without the regulatory system or other government programs.

Finally, the report suggests that linkages to North American emissions trading systems – such as the Western Regional Climate Action Initiative and the Regional Greenhouse Gas Initiative – will be actively pursued. Over time, as the international carbon market becomes more fully developed and robust, and as emissions monitoring, verification, and reporting systems evolve, the government will consider further international linkages.

7 Summary

Emissions trading is a cost-effective and flexible mechanism to reduce carbon emissions. An effective cap-and-trade scheme has these features: a regulated absolute cap to set a clear goal; an allocation of allowances that assigns responsibility to firms; a trading facility to allow cost-effective reductions; a monitoring and reporting system to ensure accountability; and a reconciliation with effective enforcement to ensure compliance. Thorny issues that need to be addressed include setting the level of the cap, allocating allowances across firms, setting rules for banking allowances, and linking with other schemes or allowing the use of project-based offsets. Whatever choices are made, simplicity and transparency will ensure the most effective outcome.