The Carbon Market

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Abstract

The carbon market is a matter of growing interest both globally and in Argentina. It cannot be assessed by taking into account solely the transactions made, offered and announced. This article seeks to contribute to the clarification of the relationship between the carbon market and the environmental objective that led to its creation, as well as of the differences between the various types of credits and of the conditions in which these credits can be generated. It also examines the flaws in the criteria used in the creation process of the carbon market, from the standpoint of environmental integrity. Finally, the possible levels of credit supply and demand are explored, by looking at official information and taking into account the experience of the European Union between 2005 and 2007. Conclusions are left open to be complemented as better and more accurate data becomes available.

1. Introduction

The objective of the Kyoto Protocol (KP)[2] is to reduce and limit greenhouse gas emissions in order to stabilize their atmospheric concentration, as agreed in the United Nations Framework Convention on Climate Change[3]; the objective is not the creation of a carbon market. With the sole aim of facilitating the fulfilment of obligations by those Parties to the KP that have quantified commitments to reduce or limit emissions, the Protocol establishes flexibility mechanisms that allow commercial trading of "carbon credits".

In its first session, the Meeting of the Parties to the Protocol established that the use of these mechanisms would be additional to the mitigation measures that countries may adopt internally, and stated that these national measures must constitute a large part of the efforts made by each Party to fulfil its quantitative commitments to limit and reduce emissions[4]. This "additionality" was not quantified in the Meeting, however, because no agreement was reached on this issue just as none was reached at any point in the negotiations that had been taking place since 1995. Consequently, each country must establish its own *quantum*[5]. The European Union has fixed, for each of its 27 member states, a percentage limit for the use of the Joint Implementation and Clean Development Mechanisms with countries that are outside the Union, as shown below[6].

If all the Parties to the KP that have quantified commitments to reduce or limit emissions could fulfil them exclusively with carbon credits acquired through the flexibility mechanisms, the objective of the KP would not be met. The carbon market alone is not sufficient to mitigate climate change because, in many cases,

[1] The author is especially grateful for the collaboration of Agricultural Engineer and Master of Science Mr. Daniel Ginzo, and in particular for his help with the compilation and analysis of the statistics used in this article.

[2] Kyoto Protocol to the United Nations Framework Convention on Climate Change, adopted in 1997, entered into force in 2005, with 177 Parties in December 2007.

[3] 3 Art.2 of the 1992 United Nations Framework Convention on Climate Change states: "The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

[4] Decision 2/CMP.1

[5] In January 2008, Norway announced that by 2030 it would have no net carbon emissions (becoming *carbon neutral*), which was truly impressive given that Norway is a great oil exporter and that its gross greenhouse gas emissions grew by 8.8% between 1990 and 1995 (FCCC/SBI/2007/30). The New York Times of March 23rd 2008 reports that, the details of that plan having come to light, it has become clear that this objective is to be achieved by acquiring carbon credits. If this were the case, the Norwegian interpretation of additionality seems to be extremely broad.

[6] European Commission Press communication of October 26th 2007. Percentages range from 0% for Estonia to 15% for Italy and Slovenia, with Germany being a special case.

the emissions traded are ones that would never actually be produced, and in other cases some of the emissions counted would have been additional to those that are actually reduced, as shall be seen below. The carbon market was created as a means to facilitate the fulfilment of quantified commitments. The controls imposed on this market aim to ensure that its use contributes as much as possible to reaching the objective of the Protocol.

However, the market has itself created interests, especially for those who use it, and its participants are therefore often wary of the controls and favour "more flexible" or "less bureaucratic" formulas. Furthermore, during public discussions about how the carbon market will continue once the first commitment period ends in 2012, it is often argued that it must be maintained, as if its existence were an end rather than a means (Lusford *et al*., 2007).

The statistical information included in this article indicates that the emission reduction required of Parties to the Kyoto Protocol for the 2008/2012 period will be significantly lower than the availability of credits. The availability of these credits during the first commitment period, with its resulting impact on the market, will depend on the decisions of the few countries that have a credit surplus. Many commercial and financial prospects could be compromised despite the frequent international conferences and seminars about the carbon market, which are a business in themselves.

This market began developing before the first commitment period which started on January 1st 2008. To raise the interest of developing countries, the KP establishes that credits generated by the Clean Development Mechanism (CDM) from the year 2000 onwards can be used. By April 30th 2008, the CDM Executive Board had issued credits for a total of 140.7 million tonnes of carbon dioxide (CO_2) equivalent. So these credits are currently on the market. This figure may sound large, but it is really quite a small amount in the global context of the problem, as will be seen below. It is not an easy task to regulate internally a country or group of countries, as is the case of the European Union, to comply with the obligations of the KP, and governments have for this reason been encouraging the development of the carbon market in the last few years.

In fact, the European Union (EU) established its own emissions trading scheme between 2005 and 2007. This turned out to be an interesting experience and is discussed below. Furthermore, the United Kingdom established a domestic emissions trading scheme which is linked to the EU one. Norway intends to link its own domestic emissions trading scheme to that of the European Union. Up until the beginning of March 2008, however, the European Union had still not managed to align its carbon operations registries with the conditions of the International Transaction Log established by the KP, and EU members were therefore unable to complete transactions until that date, even those members which were eligible to do so from the point of view of the International Transaction Log[7]. Australia and New Zealand have also established in advance the basis for domestic emissions trading schemes which will begin to operate at the end of the first commitment period.

[7] On March 8th, the following were eligible for the Internacional Transaction Log: The Czech Republic, Hungary, Japan, New Zealand, Slovakia and Switzerland. Greece had a compliance question pending, while Luxembourg had not yet made its initial presentation. Most of the other states, however, should be eligible by April 2008.

In the USA, despite the refusal by the central administration between 2001[8] and 2007 to even accept the existence of a problem called climate change[9], public concern about global warming has generated state, municipal and private initiatives that put forward various mitigation measures, with the setting of voluntary emission targets and the creation of carbon markets. Northeastern USA, at the proposal of New York State, saw the creation of the Regional Greenhouse Gas Initiative, in which Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, Rhode Island and Vermont also participate. On the West Coast, the Western Climate Change Initiative was created with the participation of Arizona, California, New Mexico, Oregon and Washington. Illinois has the Chicago Climate Exchange[10], in which private companies, cities and intermediaries participate. It must be pointed out that both democratic presidential pre-candidates for the November 2008 elections, Barack Obama and Hillary Clinton, supported in their respective websites the bill originally presented by the republican candidate, John Mc Cain, which is known as the "*Climate Stewardship Act*".

These potential markets, as well as the one planned in Taiwan, are generally known as voluntary markets. The potential volume of operations in each of them is a matter of great speculation.

Emission trading, which is growing constantly, promotes intense activity amongst consultants and intermediaries and generates plenty of interest in the world of business and in the general public. Mounting international interest has led to some confusion and it seems to have at times been forgotten that these market mechanisms are merely accessories to the greater environmental objective described above. Criticism of the international regulations provoked an eloquent clarification by the Executive Secretary of the Convention and Protocol, Yvo de Boer, who is an enthusiastic campaigner for these market mechanisms and who reiterated his enthusiasm following the meetings which took place in Bangkok in April 2008[11]. In May 2007, in response to growing media interest during the annual Carbo Expo meeting in London, de Boer felt compelled to say that "some confusion is to be expected – after all, the mechanism is breaking new ground and catalysing new action on climate change, but some analysis of the CDM has dangerously missed the mark, especially in not distinguishing between the certified emission reductions (CER) produced under the CDM, and the emission offsets being sold by the growing number of unregulated or self-regulated enterprises."[12]

This article sets out which gases can give rise to carbon credits and how they can counted as common units, and explains the uncertainties surrounding emission inventories, the eligibility criteria for Parties to use carbon credits, the various flexibility mechanisms and the main characteristics of the European market. It also gives well-founded projections about the dimension the carbon market will take in the five years from 2008 to 2012. The annex includes the abbreviations most used in this article.

2. Greenhouse Gases and Sources that give rise to Carbon Credits

[8] Letter by President Bush to Senators Hagel, Helms, Craig, and Roberts, March 13th 2001.

[9] On April 16th 2008, in a press conference in the White House, President Bush announced a program for capping greenhouse gas emissions in the USA by 2025.

[10] www.chicagoclimateexchange.com

[11] See press communication at www.unfccc.int

[12] Press communication by Convention Secretariat, May 2nd 2007.

The Kyoto Protocol regulates only 6 greenhouse gases (GHG). Three of these are naturally occurring but can also be produced by economic activity, and it is this anthropogenic part which the KP is aimed at. The three remaining gases are generated by industrial processes.

The greenhouse effect is a natural phenomenon produced when the atmosphere sends back to the Earth´s surface part of the solar energy that the planet reflects into space. It is estimated that without this natural effect, the average global temperature would be 33° C lower than what it actually is: this would make it -18ºC instead of the 15° C which has been the average up until now although it is beginning to rise. This phenomenon is caused chiefly by the presence in the atmosphere of water vapour, carbon dioxide, methane and ozone. International concern has been mounting due to the increase in the concentration of certain gases as a result of human activity and of the appearance of other industrial gases that have high "positive radiative forcing", a formula used to refer to the characteristics which make those gases send back to the Earth´s surface the solar radiation reflected by it.

The emissions regulated by the Protocol are laid down in its Annex A, in a list of gases and the sources from which they arise. Only when both gas and source exist together can the emission be registered in an inventory and its reduction generate a credit.

The gases controlled by the KP are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (NO_2), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). The first three – as mentioned above – are naturally occurring, but their concentrations increase as a result of human activities such as the use of fossil fuels, agriculture and land clearance. The other three gases are produced by certain industrial processes, such as the production of refrigerants, smoke agents, insulation materials, etc. HFCs are to date unwanted subproducts resulting from the production of hydrochlorofluorocarbons (HCFCs), which were themselves invented as a substitute for chlorofluorocarbons (CFCs) which deplete the ozone layer[13]. PFCs are used in refrigeration and in fire extinguishers. SF_6 is a very effective insulator which is used in industry and in electrical installations.

The sources of GHG considered by the KP are, in essence: the energy generated by fossil fuel combustion, fugitive emissions from oil and gas pipelines and coal mines, certain industrial processes, the production and use of certain solvents, various aspects of agriculture, forestry and land-use change, landfills and the management of waste incineration.

The fact that emissions, to be entered in an inventory, must be of a gas listed in the KP and must also have been produced by one of the sources listed in the Protocol, can lead to some confusion. For example: the burning of biofuels produces CO_2 which is released into the atmosphere, but as neither ethanol of vegetable origin nor biodiesel are included in the KP list, this CO_2 cannot be recorded in the emissions inventory of the country where it is emitted and can therefore play no part in any commitment to limit or reduce emissions. Consequently, it is frequently said that biofuels do not produce greenhouse gases, which is incorrect. What actually happens is that, in accordance with the methodologies adopted, this CO_2 cannot be added to the inventory because the carbon released by the biofuel was already in the biosphere. On the other hand, the carbon released by fossil fuels is deliberately extracted from a geological deposit through mining, in order to be burned. Its combustion releases into the atmosphere carbon that was trapped in the bowels of the earth and was not "circulating" in the biosphere.

[13] It has recently been reported that the chemical industry is working on the production of new HFCs to replace HCFCs which, according to the 1987 Montreal Protocol on substances that deplete the ozone layer, must no longer be used by industrialised countries by 2020 and by developing countries by 2030.

In addition, there are other GHGs created by industry but expressly excluded from the KP: these are gases which also deplete the ozone layer and are therefore regulated by the Montreal Protocol[14]. The most significant of these are chlorofluorocarbons (CFCs), employed in refrigeration and in many industrial sectors and whose use is being abandoned, and hydrochlorofluorocarbons (HCFCs), which are replacing CFCs. As HCFCs are powerful greenhouse gases, industrialised countries must stop using them by 2020 and developing countries by 2030. As neither CFCs nor HCFCs are regulated by the Kyoto Protocol, their elimination does not give rise to carbon credits. In fact, the replacement of CFCs by HCFCs imposed by the Montreal Protocol has brought good business opportunities to the transnational chemical industry. In industrialised countries, the substitution has largely occurred in the same way as all cases of obsolescence. In developing countries, on the other hand, this substitution was financed with donations from the Multilateral Fund for the Implementation of the Montreal Protocol, financed in turn with donations from industrialised countries.

3. Global Warming Potential of Greenhouse Gases

Another question to be considered when analysing the nature of carbon credits is the method used to estimate the different contributions made to global warming by greenhouse gases with different radiative properties. The index used is called "Global Warming Potential" (GWP). This is the measure of how much global warming is caused by a given mass of greenhouse gas compared to the same mass of carbon dioxide. The unit used is a tonne of CO_2 and, in accordance with Art. 5.3 of the Protocol, the values for the remaining gases were assigned by the third Conference of the Parties to the Convention (Kyoto 1997). Article 5.3 states that, to this end, the values taken into account shall be those accepted by the Intergovernmental Panel on Climate Change (IPCC). In its decision 2/CP3, the Conference of the Parties adopted the values contained in the Second Assessment Report of the IPCC which was published in 1995 for a 100-year scenario[15].

TABLE 1

Global Warming Potential, with reference to that caused by a tonne of CO2

	Second IPCC Report 1995 (a)			Fourth IPCC Report 2007 (b)		
Gas	20 years	100 years	500 years	20 years	100 years	500 years
CO_2	1	1	1	1	1	1
Methane	56	21	6.5	72	25	7,6
Nitrous oxide	280	310	170	289	298	153
HFC-23	9100	11700	9800	12000	14800	12200
Sulphur hexafluoride	16300	23900	34900	16300	22800	32600
Perfluoromethane	4400	6500	10000	5210	7390	11200
Perfluoroethane	6200	9200	14000	8630	12200	18200
Perfluoropropane	4800	7000	10100	6310	8830	12500
Perfluorobutane	4800	7000	10100	6330	8860	12500

Sources: (a) IPCC (1996); (b) IPCC (2007)

This was a political decision with relatively little scientific basis, which weighs heavily on the value assigned to carbon credits. The scenario chosen determines the relative importance of each gas with regard to its half life. As can be seen in Table 1, the values change significantly depending on the scenario chosen, but in addition

[14] Montreal Protocol on substances that deplete the ozone layer, 1997.

[15] When this decision was discussed in informal meetings in Kyoto, I asked, as president of the Plenary Committee, whether it was a good idea to establish 1995 criteria for inventories that would be compiled 13 years later; the answer of industrialised countries was that they preferred the certainty provided by pre-established guidelines to the uncertainty of having to wait for new scientific studies.

successive IPCC studies have changed global warming potential estimates. Table 1 shows the values that appeared in the 1995 Report, which were those taken into account for the Kyoto Protocol, as well as those presented in 2007. In the case of methane, the equivalence that is currently taken into account is 21 tonnes of carbon dioxide per tonne of methane, as this is the value attributed by the 1995 report for a 100-year scenario. If, for the second commitment period which should start in 2013, the 20-year scenario values from the 2007 report were chosen, the equivalence would be 72 tonnes of CO_2 per tonne of methane, which would increase by 3.45 times the significance of methane in inventories. This would mean a significant increase in the inventories of countries with large livestock and agriculture sectors, as is the case of Argentina, and would also increase the significance of fugitive methane emissions in natural gas production and coal mining, in landfills and in distribution networks.

The very concept of GWP has been a matter of debate. When evaluating each gas, the IPCC refers to its radiative forcing, which when positive warms the Earth´s surface, and when negative moderates global warming. Radiative forcing can also be either direct or indirect depending on its relationship with other substances present in the atmosphere or with the processes occurring within it. It is clearly a complex issue which cannot be solved by multiplying figures by a fixed factor, although this is precisely what is done as far as the carbon market is concerned.

4. Uncertainties

Moreover, while measurements of atmospheric gas concentrations are quite accurate, there is a considerable margin of uncertainty regarding GHG emission inventories. The greatest certainty concerns CO_2 emissions, but there is no such accuracy with regard to methane or nitrous oxide emissions. At the beginning of the Kyoto Protocol negotiations, the Alliance of Small Island States (AOSIS) fought for mitigation efforts to be concerned exclusively with CO_2 and that position was very well received by the Group of 77. The initiative did not prosper, however, because several industrialised countries insisted that acting over a wider range of gases would facilitate the fulfilment of their obligations.

This uncertainty is reflected in the reports of independent groups of experts who analyse in depth the inventories of industrialised countries. These reports are public and are available on the Convention´s website[16]. For example, the latest report on Belgium´s inventory indicates that the uncertainty for nitrous oxide emissions could be 100 per cent[17]. The most recent report on Finland´s inventory indicates that the uncertainty for methane emissions ranges from -20 to +30 per cent and that for nitrous oxide emissions the range is -60 to +170 per cent[18]. This situation is not exclusive to Belgium and Finland and can be found in other reports that use less explicit language, as is indicated by the affirmation that the uncertainties contained in Finland´s inventory, especially regarding emission factors (EF), are in line with those contained in the reports of other countries.

[16] www.unfccc.int

[17] Document FCCC/IRR/2007/BEL paragraph 43 says: "Belgium has reported level uncertainties for 2003 and the trend uncertainty for 1990-2003. In earlier submissions Belgium reported an uncertainty analysis for 2001; however, the F-gases were excluded from this analysis. The overall uncertainty has reduced between the analyses from 8.1 to 7.5 per cent and the trend uncertainty from 3.8 to 2.7 per cent, respectively. The uncertainty for CO2 has reduced from 3.6 to 1.9 per cent, while the uncertainty for CH4 is the same (24 per cent) and the uncertainty for N2O has increased from 91 to 100 per cent. The increase in N2O uncertainty was dominated by agricultural soils. The uncertainty of F-gases was estimated in 2003 at 27 per cent."

[18] Document FCCC/IRR/2007/FIN paragraph 64 says: "Uncertainties have been estimated using the Monte Carlo simulation method for all the key categories. The lowest levels of uncertainty were for CH4 from enteric fermentation of domestic livestock (–20 to +30 per cent) and the highest for N2O emissions from agriculture soils (–60 to +170 per cent). The agriculture sector has some of the highest uncertainties in the inventory especially for EFs. This is in line with other reporting Parties."

5. Eligibility Criteria

The obligation to reduce or limit emissions established in the Protocol is regulated by decisions of the Meeting of the Parties, and the eligibility of developed countries to participate in emissions trading is subject to a series of criteria[19]. These criteria are essential elements of the initial report that must be presented by the Parties and they must be maintained in subsequent annual reports, as they are fundamental for the transparency of the system and for the attainment of the Protocol´s objective.

The first of these criteria is the presentation of the base year emissions inventory. In the case of countries that were market economies after the Second World War, the base year is 1990 for carbon dioxide, methane and nitrous oxide. "Transition economies", which are countries that were centrally planned economies, have a limited possibility to choose a year prior to 1990, in consideration of the economic processes they experienced. The inventory must also contain information about hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride, but as the industrial production of these gases is more recent, the base year for them is 1995.

The second requirement is the presentation of the most recent inventory available, which is usually two calendar years old – in other words, the inventory presented in 2007 is that which corresponds to 2005.

Moreover, Parties must report if they operate under Art.4 of the Protocol, which enables regional economic integration organizations to spread the obligation to reduce or limit emissions amongst their members. In fact, during the first commitment period (2008/2012) this applies only to the 15 countries that were members of the European Union in 1997. No other regional organization has invoked this clause which is undoubtedly attractive for certain Asian countries which together could invoke it in a future commitment period.

To enter the sequestration of greenhouse gases in their inventories, countries must define the "forests" which shall be taken into account within a framework of three parameters: minimum forest area, tree crown cover percentage and average tree height[20]. Further flexibility granted by the system with respect to carbon dioxide sinks is in the choice of activities regarding land use, land use change and forestry (LULUCF) that will be taken into account (Art.3.4). Every country that has emission targets must include afforestation, deforestation and reforestation in its annual inventories, but countries are in addition given the option of counting grazing land management, cropland management and forest management as sinks; if they choose to do so, they must report it explicitly.

Parties must also calculate satisfactorily the levels of emissions assigned to them by the Protocol for a particular commitment period and the reserve they must keep for that period, in other words the portion of their assigned amount that cannot be transferred to another Party by means of emissions trading.

Finally, Parties are required to have established a national system for the estimation of anthropogenic emissions of greenhouse gases as imposed by Art.5.1 of the Protocol and a national registry to track and record carbon credit transactions which complies with the requirements established by the decisions of the Meeting of the Parties, including the requirement that the registry must be compatible with the International Transaction Log kept by the Protocol Secretariat.

All these eligibility criteria are analysed by Expert Review Teams (ERT) which examine national reports and, if they deem it necessary, suggest adjustments and modifications. In the case of discrepancies, as happened recently with Greece, the report is sent to the Compliance Committee.

[19] 2/CMP 1, 3/CMP.1, 9/CMP.1 and 11/CMP.1
[20] 16/CMP.1

6. Joint implementation

Having outlined general aspects in the paragraphs above, more specific considerations can now be formulated for each of the three flexibility mechanisms which can generate carbon credits in the KP system: joint implementation, the clean development mechanism and carbon trading.

Joint implementation is a concept that existed prior to the Protocol and that originates from the 1992 Convention. In its Art.4.2, that Convention established, for industrialised countries, a common target of returning by the year 2000 to the emission levels of 1990, and indicated that this could be achieved either individually or jointly. Since the coming into force of the Convention in 1994 and the adoption of the Protocol in 1997, various attempts have been made to orchestrate this requirement. Some developed countries strived to be allowed to fulfil this aim in conjunction with developing countries, but this approach did not prosper because the latter insisted that the obligation to reach the year-2000 target was specific to industrialised countries. It its place, a very lax procedure of "activities implemented jointly" was agreed upon, but it did not prove to be very significant.

When, during the negotiation process of the Protocol, it was agreed that the method to be used to contribute to the mitigation of climate change would be a cap-and-trade system, joint implementation naturally emerged as a form of cooperation between two developed countries with quantified targets of emission reduction or limitation. Art. 6 of the KP reflects the idea that, in the territory of a given country, any project to be implemented should be one that actually reduces emissions, and the result of that reduction should be distributed between participating countries in a manner agreed between them.

This mechanism produces a real reduction in the emissions of the countries in Annex B of the Protocol because participants have limitations and controls. If the country where the project is implemented fulfils the eligibility criteria, its own national registry grants an Emission Reduction Unit (ERU) if it is derived from an emission reduction, or a Removal Unit (RMU) if the unit came from the removal of carbon from the atmosphere into vegetation through human-induced activities such as afforestation, reforestation or one of the other land uses covered by Art.3.4 of the KP, such as forest management, grazing land management or cropland management. If the developed country where the project is implemented does not have an established national accounting system, as was determined by the Compliance Committee with respect to Greece in April 2008, the project must be verified by an *ad hoc* body created by the Protocol. While ERUs can be passed from one commitment period to another, RMUs cannot be transferred to another period, due to the time limitation peculiar to the removal of carbon into forests. In countries that have emission targets and consequently measure their carbon sequestration, the matter is resolved more easily than in the case of carbon sequestration in developing countries, as shall be seen when this issue is considered with respect to the Clean Development Mechanism.

If the Party interested should encounter a difficulty in satisfying the eligibility criteria, it must resort to a body authorised to perform a verification and must submit to a control by the Joint Implementation Supervisory Committee, and the corresponding carbon credit cannot be used until all the eligibility criteria described above have been met. The report presented in the third Meeting of the Parties to the Kyoto Protocol in December 2007 in Bali[21] indicates that, up until that date, 102 project outlines had been published but only 2 projects had gone ahead.

[21] Document FCCC/KP/CMP/2007/4 (Parts I y II).

The transaction costs of the projects of this mechanism shall be considerably reduced by the use of the experience developed in the Clean Development Mechanism in terms of methodologies and designation of Operational Entities.

7. Clean Development Mechanism

The Clean Development Mechanism enables, in the territory of a developing country, the implementation of a project aimed at reducing emissions and enables the benefit of that reduction to be used by a developed country to comply with its own reduction or limitation commitment. The types of projects involved and their cycles are complex, due to the need to control how they contribute to environmental integrity, and they are changing constantly. Analysing them would require an article as long as this one.

The credit generated by the Clean Development Mechanism is called a Certified Emission Reduction Unit (CER,). If the unit originates in the sequestration of carbon by forests, it has an expiry date at the end of which the original credit must be replaced or the corresponding volume of CO_2 will be added to the inventory of the country that used the unit. These units with expiry dates are called tCER or lCER. tCERs expire at the end of the commitment period following the one in which they were issued[22]. lCERs expire at the end of the crediting period for the afforestation or reforestation CDM project for which they were issued. In both cases, the credits must have expiry dates and cannot be used in a commitment period subsequent to the one during which they were issued. Technical difficulties and the variations in carbon sinks located in the territory of a Party that has no quantified emission commitments make it necessary to regulate tCERs and lCERs meticulously in order to guarantee the environmental integrity of the mechanism[23] and this inevitably weighs heavily on the prices of these credits.

Before the CDM was adopted, Brazil presented in May 1997 a proposal[24] whose approach was completely different to that which was being negotiated and was finally adopted. That proposal included the creation of a Clean Development Fund financed by a "fine" per tonne of carbon dioxide or equivalent that would be paid by countries emitting GHG above their assigned amounts. In the Brazilian project, the financial resources generated by the fund were to be paid to the largest developing countries, as these countries were considered to generate the most emissions among those that did not have quantified commitments. So the distribution was to be carried out following a scale of percentages that began as follows: China 32 %, India 9,4 %, Venezuela 5%, Mexico 4,9%, Kazakhstan 4,7%, Brazil 3,4%. Uzbekistan 3,2%, Argentina 3%, Iran 2,6%, Korea 2,3%, Democratic Republic of Korea 2,2%, Indonesia 2%, Saudi Arabia 1,9%, Azerbaijan 1,4%, Egypt 2%, and Colombia and Nigeria 1%.

During informal consultations held in Tokyo in September 1997 with the participation of a group of governments invited by Japan, the head of the USA delegation at the time, Thimoty Wirth, indicated very clearly that it was unthinkable that a government, and in particular his own, should be made to pay a penalty because one or more companies operating in his country had exceeded its GHG emissions. He suggested instead that a formula should be created to enable companies in developed countries to pay in advance for emissions that they anticipate will exceed the assigned amount.

This proposal was accepted by the Brazilian and Indian delegations, among others. Fresh conversations took place and when the third Conference of the Parties began in Kyoto, I entrusted, as President of the Plenary Committee, my friend Professor Gilvao Meira Filho, member of the Brazilian delegation, with the task of

[22] It was mentioned at the beginning of this article that negotiations have only just begun on a second commitment period, so strictly speaking this "subsequent period" does not yet exist.
[23] Decision 5/CMP.1
[24] FCCC/AGBM/1997/MISC.1/Add.3

conducting negotiations to concretize the CDM. He did this successfully and the formula took shape in the form of Art.12 of the Protocol, which has been the subject of careful regulation.

The CDM has the peculiarity of having begun to operate before the Protocol came into force in 2005. This occurred because paragraph 10 of the aforementioned Art.12 establishes that the CDM shall take into account carbon credits produced from the year 2000 onwards. This is perfectly compatible with the law of treaties and it is common for international instruments to have clauses that apply before they have come into force, such as those regarding signature, ratification, reservations, etc. Consequently, when the Seventh Conference, which took place in Marrakech towards the end of 2001, produced the basic regulations of the CDM, the CDM Executive Board was immediately created, with Sir John W. Ashe from Antigua and Barbuda as its president, and the mechanism began to operate.

In the case of the Joint Implementation Mechanism, both parties have the same objective, namely to satisfy their quantified emission reduction or limitation commitment. In the CDM, the developed country, or the company that resides in a developed country, uses this mechanism to help it reach its quantified target. On the other hand, the developing country´s intention is to improve its sustainable development performance, which can give rise to very different interpretations. It was initially thought that important economic growth opportunities would be created, but this turned out to be just false hope.[25]

Moreover, CDM projects do not always contribute to reducing global emissions, as developing countries that do not have emission targets can keep adding to their economies an endless stream of projects that are inefficient from the point of view of carbon use, without any limitations. Finally, these projects can constitute a negative incentive for some developing countries to prefer being paid to use the cheapest mitigation options, instead of using those same options to reduce their emissions. A typical example of this is the burning of methane in landfills with no significant transfer of technology or generation of energy.

As was mentioned above, up to 30th April 2008 the CDM had generated CERs equivalent to 140.6 million tonnes of carbon. The exact value of those CERs cannot be determined with certainty. Prices cannot be known because the market is not transparent, except in the case of the market that operated in the European Union from 2005 to 2007, as shall be described below. Certain commercial information sources provide price information to their subscribers, but it is hard to know exactly quite how reliable they are because they essentially refer to *over the counter* operations. While it may seem like a large amount, it is not so much when compared with the emissions of developed countries which in 2005, without accounting for land-use, afforestation and deforestation, reached 7.241 million tonnes in the USA, 4.192 in the European Union, 2.132 in Russia, 1.359 in Japan, 746 in Canada and 525 in Australia,[26] to mention only those with the greatest emissions. To these must be added the emissions of large developing countries, amongst which China has announced that in 2008 its emissions will be greater than those of the USA.

The cycle of CDM projects is complex and, as had been said above, its study deserves a thorough analysis which exceeds the boundaries of this article. The Executive Board has approved individual methodologies followed by consolidated methodologies, whose use can now make the process simpler and cheaper. In any case, in the CDM, the different motivations of parties and the need to preserve the Protocol´s objective produce situations where participants must take on high transaction costs, in other words situations where the profits of consultants and intermediaries are high.[27] The experience gained from the methodologies approved

[25] The Netherlands has ordered a study to determine what impact the CDM projects it has been involved in have had on development. Initial indications are not encouraging. See articles published in *Joint Implementation Quarterly* 13 (3), of October 2007.
[26] Document FCCC/SBI/2007/30.
[27] See Schwed (1940).

and the designation of CDM Operational Entities, processes which have been expensive, can now be used for the Joint Implementation Mechanism, which also helps to reduce the transaction costs of these projects.

The CDM was originally conceived as a system in which a more technologically advanced and financially stronger participant could join up with a participant lacking these conditions. But shortly after it began to operate, unilateral projects appeared, where the developing country takes the initiative and puts CERs on the market once the project has been generated. The initial resistance to this approach was gradually overcome, but then it became harder to show the "additionality" of every project.

The question surrounding a unilateral project is that, if a developing country has the right conditions – basically the right technology, financial resources and institutional framework – to implement the project, where is the additional element incorporated by the CDM to justify that a company from a developed country may acquire the credits generated in this way to deduce them from its greenhouse gas emissions? The answer most frequently given is "financial additionality" because, goes the argument, without the price received for the CERs, the project would never have been able to happen. In order to analyse the additionality required by the Protocol, which is an element invoked by participants that must be evaluated by the CDM Executive Board, a "tool kit" has been developed and is now available on the Convention´s website.[28]

Just as was suggested by the aforementioned Clean Development Fund initiative presented by Brazil, the large developing countries have been receiving most of the projects while the smaller ones have obtained fewer. This generates reiterated political declarations about the need for a fair geographical distribution of projects which is very difficult to reflect in reality. There are various ways of comparing the distribution of projects per country and some of these are presented quite graphically in the Convention´s website.[29] The number of projects per country can be considered, or the performance estimated over the entire operational lifetime of the projects (which may exceed the first commitment period), but the best and most easily comparable indicator is the estimated annual performance of all the project activities in each country.

Although until December 31st 2007CERs had been issued for only 102.5 tonnes of CO_2 equivalent, as was pointed out above, the Convention Secretariat estimated, on that same date, that the average annual performance expected for countries registered at that date would be of 188 million tonnes. Almost half of that, 91 million tonnes, corresponds to China, and 15%, or 28 million tonnes, to India. Next on the list comes Brazil with 17 million, South Korea with 14 million, Mexico with 7 million, Chile with 3.9 million, Argentina with 3.8 million and Malaysia and Indonesia with just over 2 million.

However, the most desirable or advanced technologies are not always used. On 31st December 2007, it was estimated that the 17 projects relating to the thermal destruction of hydrofluorocarbon 23 (HFC 23) would produce 73 million tonnes of CO_2 equivalent annually, because given its global warming potential, a tonne of HFC is equivalent to 14,310 tonnes of CO_2 (OMM-PNUMA, 2005: 7).

HFC 23 is an unwanted sub-product of the production of hydrochlorofluorocarbons (HCFC). The global warming potential of HCFCs per tonne is equivalent to 2,000 tonnes of CO_2 (OMM-PNUMA, 2005: 7); they were invented by the chemical industry to replace chlorofluorocarbons (CFC) whose use is being abandoned because they deplete the ozone layer. Neither HCFCs nor HFC23 deplete the ozone layer but they both have very high global warming potentials as has been described.

[28] See http://cdm.unfccc.int/Reference

[29] www.unfccc.int/cdm/statistics

The global warming potential of HCFCs produced in a developed country that is a Party to the KP, and that therefore has an emissions target, is added to the concentration of GHGs in the atmosphere, but it is not taken into account in the Kyoto Protocol inventory because, as explained at the beginning of this article, HCFCs are not regulated by it but rather by the Montreal Protocol. On the other hand, HFC 23, an unwanted sub-product generated in a developed country, is regulated by the KP and must consequently be included in developed countries´ inventories with the resulting impact on the satisfaction of their obligations. This distinction has no scientific basis, and it was created only as a result of the urgent need to protect the ozone layer.

On the other hand, if HCFCs are produced in developing countries – where the KP imposes no emission caps – these gases and the undesirable HFC 23 will accumulate in the atmosphere without being included in any inventory. The destruction of HFC 23 generated in a developing country must be encouraged. But the problem is that if a CDM project is used to do this, a carbon credit is created and the developed country that acquires it can increase its CO_2 emissions in real terms. What is worse, at current prices, a HCFC production plant set up in a developing country makes more economic profit by selling HFC 23 carbon credits than by selling HCFCs – object of the industry – themselves. In short, it makes good economic sense to build a HCFC plant in a developing country, set up the additional process of HFC 23 destruction to generate carbon credits, and then sell them to a developed country.

It can be said that in all CDM projects, the developed country uses the carbon credits it acquires to increase its own emissions, but in the case of HFC 23, this gas has the peculiarity of being an unwanted industrial sub-product, practically a residue. To deal adequately with the problems of climate change, a suitable international environmental policy of cooperation would be to order the destruction of HFC 23 in every country and in the same plant in which it is produced as a precondition for the authorization of HCFC production. A requirement of this kind could be incorporated as a mandatory policy in the Convention or in the KP. From the point of view of respective national legislations, it would operate in the same way as the regulations requiring toxic gases to be filtered or liquid residues generated by industry to be processed.

In Argentina, a company which is planning to produce HCFCs has a registered CDM project to destroy HFC 23. It is estimated that this will generate an annual 1.4 million tonnes-worth of carbon credits out of a total of 3.7 million for all Argentine CDM projects. In April 2007, our country announced the creation of an Argentine Carbon Fund, financed by the World Bank, for the promotion of CDM projects. On December 31st 2007, Argentina had ten CDM projects registered, according to the website of the Secretaría de Ambiente y Desarrollo Sustentable.[30] All these projects were elaborated before the creation of the Fund. They have life spans of 7 to 21 years, and it is estimated that they will produce 3,703,364 tonnes of CO_2 equivalent per year during the years in which all the projects would be operating simultaneously, as would be the case

[30] www.ambiente.gov.ar

during the 2008-2012 period. Out of this total, 2,213,470 tonnes correspond to the combustion of landfill and 1,434,196 to the combustion of HFC 23, two project categories that have not proved to contribute greatly to sustainable development. That leaves only 56,000 tonnes generated annually by projects that may be of more interest, such as the generation of wind power and the replacement of fossil fuels.

The joint project of the Risoe National Laboratory for Sustainable Energy - Technical University of Denmark (Risoe DTU) and the United Nations Environment Program (UNEP) keeps an up-to-date analysis of CDM projects – available on its website – which shows the trends surrounding this mechanism.[31]

8. Emission trading

Emission trading (ET) is in fact the specific name given to the flexibility mechanism created by the KP that operates only between countries that have limitation or reduction commitments established in Annex B of the Protocol. It enables them to transfer some of their assigned amount units (AAU). At the same time, it is the means which enables the secondary carbon market to operate. But emission trading is also the name that has been used generically to refer to all the operations that take place in the carbon market, as it provides that parties with quantified emission reduction or limitation commitments have the right to transfer and acquire carbon credits.[32]

The inclusion of this mechanism in the Kyoto Protocol was proposed by the USA, which took as a model its own domestic system of sulphur dioxide emission trading. Washington imposed the acceptance of this mechanism in the KP negotiations as a pre-condition to the USA accompanying the unanimity with which the text was adopted in December 1997, and this was presented as a success before the USA Senate Foreign Relations Committee[33] by the head of the US delegation in Kyoto, Stuart Eizenstat, at that time Subsecretary of State.

The mechanism contains a basic question of fairness which has not yet been resolved. Every country was assigned an amount of emissions with respect to its historical emissions and the base year chosen was 1990, without taking account of the tremendous disparity of emissions *per capita*. This standard of assignment is called “grandfathering” and it generated a certain amount of resistance in developing countries but was finally adopted by them. Taking this approach further by granting the right to sell some of these emissions to another developed country raised once again the question of the legitimacy of the right to emit those amounts, and this almost caused the negotiations to fail. The first reflection to arise out of this is that if a developed country has emissions below their assigned amount, such a situation must be praised. But to give them the possibility to make a business out of it cannot be accepted so readily.

The issue is complicated further by the fact that countries that used to be centrally planned economies were granted emission amounts far above the emission levels they actually had when the Protocol was adopted in 1997. The most noteworthy cases are those of the Russian Federation, which was authorised to emit close to 3,000 million tonnes when its emissions that year were closer to 2,000 million, and the Ukraine which was assigned a surplus of 500 million tonnes. These surpluses are called “hot air” or “paper tonnes”.

As a precaution, it was established that Parties would have a reserve amount that cannot be transferred. In accordance with the regulations agreed by the seventh Conference of the Parties to the Convention in Marrakech in 2001 and finally adopted by the first Meeting of the Parties to the Kyoto Protocol in Montreal in 2005, the amount that each Party must hold in its national registry as a reserve for the entire commitment period must be at least equal to 90% of the total amount assigned for the 2008-2012 period, or to five times

[31] www.CDMpipeline.org
[32] Decision 11/CMP.1
[33] 105 Senate Hearings (S. Hrg. 105-457) February 11th 1998.

the amount corresponding to its most recently reviewed inventory, whichever is lower. The amounts assigned to each country and the reserves established are being determined by technical expert teams in the evaluations they are presenting to the Compliance Committee about the initial reports of Parties.

Emission trading could have started at the beginning of the first commitment period on January 1st 2008, but the process has been delayed by the slowness of countries in presenting the information required to ensure the controls established through the Compliance Committee. Inventories, national registries and transfers and acquisitions shall be the responsibility of the interested parties. Any Party that authorises companies or private entities to make transfers or acquisitions is still responsible for satisfying its obligations and must ensure that those transactions comply with the regulations laid down in the Meeting of the Parties to the Protocol.

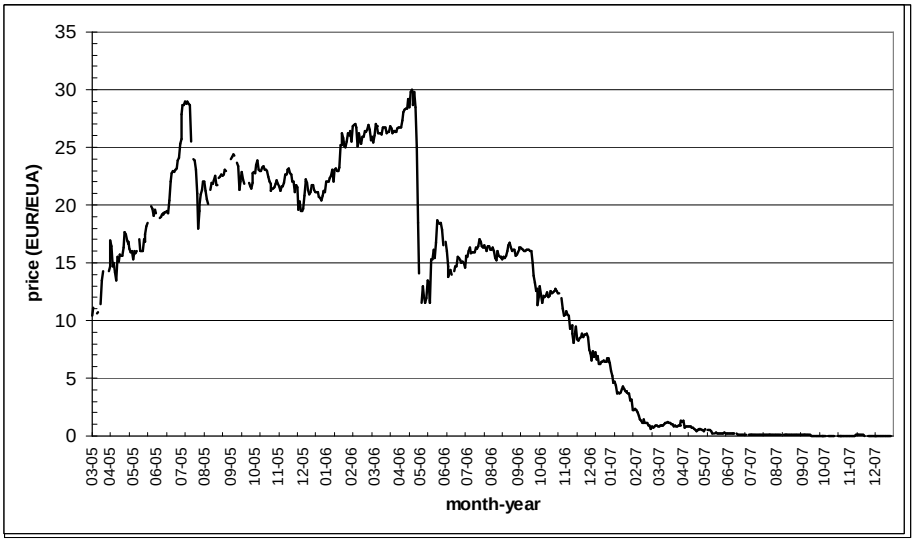
9. European Union Emission Trading Scheme

From 2005 to 2007, the European Union established and implemented an emission trading scheme[34] exclusively for carbon dioxide produced form various GHG generating sectors, but not all those governed by the KP. The system was organised around national plans for assigning emission allowances, and these plans were submitted to EU bodies. The transaction of EU-specific credits called European Union Allowances (EUA) was authorised. Surprisingly, intermediaries complained that these allowances could not be transferred to the commitment period that started on January 1st 2008, unaware that this did not depend on provisions of EU bodies but rather on those of the KP.

The first stage was without a doubt very useful from many points of view, particularly with regard to the standardisation of criteria for implementation by the various national authorities, but its most noteworthy characteristic was an excessive assigning of emission allowances. In addition, CO_2 emissions decreased due to heavy rain in the Scandinavian countries, which facilitated the generation of hydroelectric energy, and to a slight reduction in steel production. These factors caused the prices of carbon credits, which had begun at 20 euros per tonne and increased to 30, to fall steeply down to 15 euro cents per tonne. As shall be developed below, analysts estimate that in the 2008-2012 commitment period the supply of carbon credits will exceed the needs of EU countries.[35] Graph 1, elaborated with data from the European Union website which gives information about its emission trading scheme, clearly shows that change in the 2005-2007 period. Graph 2, from the same source, shows the assigned units traded.

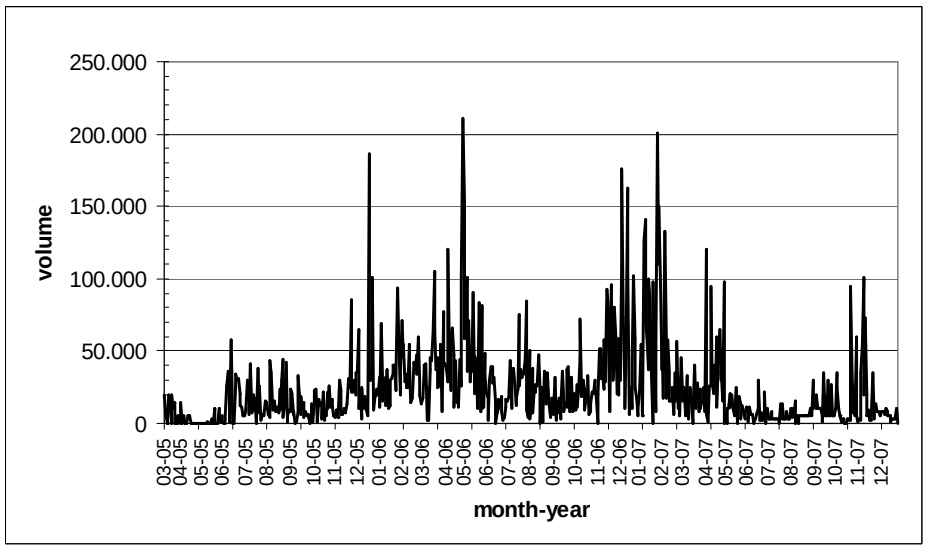
The second stage of this emission trading scheme corresponds to the first commitment period of the KP. It also began with a process in which the EU assigned emission allowances to each Member State. The regional European system must adjust to the KP commitments and regulations. With certain restrictions, the system allows transactions using Clean Development Mechanism CERs, which have existed since the year 2000, and ERUs generated in Joint Implementation projects. This second stage includes the six gases and all the sources considered in the Protocol.

[34] Directive 2004/101/CE of the European Parliament and Council of Europe, of October 27th 2004.
[35] Sam Fankhauser, Managing Director (Strategic Advice), IDEAcarbon, e-mail: sfankhauser@ideacarbon.com



Graph 1. Variation in the unit price of EUA from the first trade in 2005 to the last trade in 2007. Data from

On October 26th 2007, the European Commission concluded its internal process of assigning emission allowances when it decided on those for Bulgaria. On the following day, it published a document summarizing its decisions. For the purposes of illustration, Table 2 shows the allowances decided upon by the Commission. These cannot be compared directly to the assigned amounts included in Table 5 elaborated from data from the Kyoto Protocol, because the assigned amounts in the European Commission document refer to the European Union Emission Trading Scheme (EU ETS).



Graph 2. Variation in the volume of trades (including OTC) from the first trade in 2005 to the last trade in 2007. Data from

As a party to the KP, the EU decided to report on the 15 states that were members of the Union in 1997 and operate within the bubble provided for by Art.4 of the Protocol. This proposal was accepted by the first Meeting of the Parties and is now in operation. This naturally does not prevent the group of 15 members from acquiring AAUs from the 12 new members, which used to be centrally planned economies. As can be seen in Table 5,

this group of countries has been assigned by the KP emission levels that exceed their current needs. Up to April 30th 2008, no transactions had been reported in this scheme.

TABLE 2

Summary information for 26 EU ETS allocation plans[A]

Member State	1st period cap	2005 verified emissions	Proposed cap 2008-2012	Cap allowed 2008-2012 (in relation to proposed)	Additional emissions in 2008-2012[1]	JI/CDM limit 2008-2012[2]
	Mt CO_2eq[B]	Mt CO_2eq	Mt CO_2eq	Mt CO_2eq	Mt CO_2eq	%
Austria	33.0	33.4	32.8	30.7 (93.6%)	0.35	10
Belgium	62.1	55.58[3]	63.3	58.5 (92.4%)	5.0	8.4
Cyprus	5.7	5.1	7.12	5.48 (77%)	n.a.	10
Czech Rep.	97.6	82.5	101.9	86.8 (85.2%)	n.a.	10
Denmark	33.5	26.5	24.5	24.5 (100%)	0	17.01
Estonia	19	12.62	24.38	12.72 (52.2%)	0.31	0
Finland	45.5	33.1	39.6	37.6 (94.8%)	0.4	10
France	156.5	131.3	132.8	132.8 (100%)	5.1	13.5
Germany	499	474	482	453.1 (94%)	11.0	20[4]
Greece	74.4	71.3	75.5	69.1 (91.5%)	n.a.	9
Hungary	31.3	26.0	30.7	26.9 (87.6%)	1.43	10
Ireland	22.3	22.4	22.6	22.3 (98.6%)	n.a.	10
Italy	223.1	225.5	209	195.8 (93.7%)	n.k. [5]	14.99
Latvia	4.6	2.9	7.7	3.43 (44.5%)	n.a.	10
Lithuania	12.3	6.6	16.6	8.8 (53%)	0.05	20
Luxembourg	3.4	2.6	3.95	2.5 (63%)	n.a.	10
Malta	2.9	1.98	2.96	2.1 (71%)	n.a.	Tbd
Netherlands	95.3	80.35	90.4	85.8 (94.9%)	4.0	10
Poland	239.1	203.1	284.6	208.5 (73.3%)	6.3	10
Portugal	38.9	36.4	35.9	34.8 (96.9%)	0.77	10
Romania	74.8	70.8[6]	95.7	75.9 (79.3%)	n.a	10
Slovakia	30.5	25.2	41.3	30.9 (74.8%)	1.7	7
Slovenia	8.8	8.7	8.3	8.3 (100%)	n.a.	15.76
Spain	174.4	182.9	152.7	152.3 (99.7%)	6.7[7]	ca. 20
Sweden	22.9	19.3	25.2	22.8 (90.5%)	2.0	10
UK	245.3	242.4[8]	246.2	246.2 (100%)	9.5	8
SUM	**2256.2**	**2081.56**[9]	**2257.74**	**2038.63 (90.3%)**	**54.61**	**-**

[A] Slightly modified from *'Emissions trading: Commission approves Romania's national allocation plans for 2007 and 2008-2012'. Ref IP/07/1612. 26/10/2007.*
http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/1612&format=HTML&aged=1&language=EN&guiLanguage=en

[B] Million tonnes of CO2 equivalent.

[1] The figures indicated in this column comprise emissions in installations that come under the coverage of the scheme in 2008 to 2012 due to an extended scope applied by the Member State and do not include new installations entering the scheme in sectors already covered in the first trading period.

[2] The JI/CDM limit is expressed as a percentage of the member state's cap and indicates the maximum extent to which companies may surrender JI or CDM credits instead of EU ETS allowances to cover their emissions. These credits are generated by emission-saving projects carried out in third countries under the Kyoto Protocol's project-based flexible mechanisms, known as Joint Implementation (JI) and the Clean Development Mechanism (CDM).

[3] Including installations which Belgium opted to exclude temporarily from the scheme in 2005

[4] The German national allocation law contains a figure of 22 %, which relates to the allowances allocated free of charge, rather than the total cap.
[5] Italy has to include further installations. The amount of additional emissions is not known at this stage.
[6] Due to Romania's recent accession to the EU, this figure is not independently verified.
[7] Additional installations and emissions of over 6 million tonnes are already included as of 2006.
[8] Verified emissions for 2005 do not include installations which the UK opted to exclude temporarily from the scheme in 2005 but which will be covered in 2008 to 2012 and are estimated to amount to some 30 Mt.
[9] The sum of verified emissions for 2005 does not include installations which the UK opted to exclude temporarily from the scheme in 2005 but which will be covered in 2008 to 2012 and are estimated to amount to some 30 Mt. Furthermore, the emissions figures for Romania are not independently verified.

10. Demand, Supply and Prices of Carbon Credits in 2008/2012

The most important questions being asked today about the carbon market refer to the scale that the demand, supply and prices of carbon credits could reasonably be expected to reach. The purpose of adopting an emission "cap and trade" system was to stimulate reductions whose cost would be lower than the value of the credits available on the market and to facilitate, through the trading of these credits, the meeting of reduction and limitation commitments.[36] The marginal cost of equilibrium of reduction would be defined by the price of the carbon credit. However, this balance may be set at a point that is commercially convenient but environmentally undesirable. A very low price offer may encourage only minor reductions.

Emission trading has always been considered a complement to national effort and this is what led to the concept of additionality explained above. It is clear that, in view of the need to stabilize the concentration of greenhouse gases in the atmosphere – which is the objective of the KP – it would be undesirable to have a situation of abundant supply which pushes down carbon market prices. The objective is not to bring down costs but rather, it must be repeated, to stabilize the concentration of greenhouse gases in the atmosphere. The presence of "hot air" or "paper tonnes" mentioned above has increased the importance of the concept of additionality, which comes from a school of thought whose preferred environmental policy tool is regulation and control.

Estimates surrounding the future of this market vary according to the perspective or the type of interest with which analysts examine the issue, and differences are not minor. Furthermore, several unknown factors have yet to be clarified.

The first concerns emission projections. In the field of the United Nations Convention on Climate Change, there are no standards that would enable the elaboration of comparable national projects, so the tables available and applied are of limited use.[37] On the other hand, the Intergovernmental Panel on Climate Change looks at a number of possible global scenarios, but these scenarios are not forecasts and the probability of all of them actually materializing depends on national or regional circumstances. Trying to predict the accumulated emissions of different countries with different national conditions on the basis of global scenarios may lead to mistakes being made about the future behaviour of states considered individually.

Another unknown concerns what system will be in place after 2012, when the first commitment period of the Kyoto Protocol comes to an end. It was explained above that the Protocol has provisions that have triggered the start of the negotiations which are taking place and, in this context, there is a tendency to want to keep the

[36] In the "cap and trade" system, a company that emits more than its assigned amount shall reduce its emissions if the marginal abatement cost is lower than the price the carbon credit could reach.
[37] The proposal formulated by Argentina on this matter during informal negotiations in COP 9 (Milan 2003) was rejected rather than welcomed by developed countries.

carbon market. Even lCERs and tCERs are designed to last beyond 2012. But this does not solve the question. From the point of view of the supply of carbon credits, it is important to know whether countries that have emission units to spare, mainly countries that used to be centrally planned economies, will put most of this surplus on the market, or rather reserve a large part to be applied to their own obligations or sold in future commitment periods, which can have a huge effect on prices.

Moreover, prices are not uniform. The price of credits for carbon sequestration CDM projects (tCERs and lCERs) will be lower because they have expiry dates. The rest of the credits which originated in the CDM and were bought before being issued by the Executive Board have a reduced price due to the risk associated with their final acceptance. In the same way, credits generated by joint implementation projects that are traded before being confirmed can have lower prices because they involve a risk that the emission reduction may not actually occur or be approved by the CDM Executive Board. On the other hand, credits that have completed their verification cycle and have been approved by the CDM Executive Board do not carry that risk or uncertainty, and neither do credits corresponding to part of the amount assigned to a given country.

Finally, the aforementioned "voluntary markets" may require certain credits from the Clean Development or Joint implementation Mechanisms, but it is generally calculated that they should make up no more than 10 per cent of the central demand generated by the Kyoto Protocol.

Both the World Bank and the International Energy Agency have published annual reports on these subjects, which it is important to take into account when passing judgement.

In the Meeting of the Parties to the Kyoto Protocol which took place in Bali in December 2007, the Japanese Ministry of Economy, Trade and Industry (METI) presented very broad estimates of carbon credit supply and demand for the Protocol´s first commitment period (see Table 3), to which has been added the estimated demand for Australia, which was ratified by the Protocol just a few days before the Japanese presentation. For that estimate, the data was taken from Australia´s national communication. The table shows a potential surplus of supply, but as was explained above, it is possible that part of this surplus in assigned amounts will not actually be put on the market but rather reserved for future commitment periods. Similarly, the estimate for the possible reductions produced by CDM projects is a bit high considering the realities about the mechanism described in the paragraphs above.

TABLE 3

Potential carbon credit supply and demand estimated by Japan (1) for the first commitment period (2008-2012)

In millions of tonnes of CO2 equivalent.

Supply		Demand	
Surplus assigned amount for the Russian Federation	4400	Demand for 15 EU members	1600
Surplus assigned amount for the Ukraine	2400	Demand for Switzerland, New Zealand, Norway and others	57/200
Surplus in the amount assigned to 12 new EU members	1500	Bought by Japanese government and companies	260
UNEP projection for CDM credits	2300	Demand for Australia (2)	34

(1) Data presented by the Japanese delegation in the Meeting of the Parties to the KP, December 2007
(2) The figure for Australia was not included in the Japanese estimates; it was taken from Australia's national communication.
Source: Japanese Ministry of Economy, Trade and Industry.

The paper on the carbon market produced by the World Bank in March 2007 (World Bank, 2007), whose results are reproduced in Table 4, was a precedent to these estimates. All the notes at the foot of the table as well as the description of the sources illustrate the limited accuracy of these estimates.

TABLE 4

Potential carbon credit supply and demand estimated by the World Bank for the first commitment period (2008-2012) (A)

<table>
<tr><th colspan="5">Potential demand
2008-2012</th><th colspan="2">Potential supply
2008-2012</th></tr>
<tr><td rowspan="2">Country or Entity</td><td rowspan="2">Distance to target
($MtCO_2e$)</td><td rowspan="2">KMs demand
($MtCO_2e$)</td><td rowspan="2">CDM&JI contracted
($MtCO_2e$)</td><td rowspan="2">Residual demand for KMs
($MtCO_2e$)</td><td colspan="2">Potential surplus of AAU
($MtCO_2e$)</td></tr>
<tr><td>Russian Federation</td><td>3,200</td></tr>
<tr><td>EU-15 govts</td><td>1,300 (1)</td><td>450</td><td>143</td><td>307</td><td>Ukraine</td><td>2,200</td></tr>
<tr><td rowspan="2">EU ETS</td><td rowspan="2">1,250
(900-1,500)</td><td rowspan="2">1,140
(900-1,400)</td><td rowspan="2">506</td><td rowspan="2">634</td><td>EU-8+2</td><td>700-1,500</td></tr>
<tr><td>Other EIT</td><td>200</td></tr>
<tr><td>Japan (govt & cies)</td><td>500 (1)</td><td>350
(100-500)</td><td>266</td><td>84</td><td>TOTAL</td><td>6,300-7,100</td></tr>
<tr><td>Ro Europe & N. Zealand</td><td>200</td><td>60</td><td>2</td><td>58</td><td colspan="2"></td></tr>
<tr><td>TOTAL</td><td>2,000</td><td>917</td><td>1,083</td><td></td><td colspan="2">CDM& JI Potential
($MtCO_2e$)</td></tr>
<tr><td rowspan="2">Canada</td><td rowspan="2">1,300</td><td rowspan="2">??</td><td rowspan="2">0</td><td rowspan="2">??</td><td>CDM</td><td>1,500 (2)</td></tr>
<tr><td>JI</td><td>200 (3)</td></tr>
<tr><td colspan="5" rowspan="2"></td><td>TOTAL</td><td>1,700</td></tr>
<tr><td>GRAND TOTAL</td><td>8,000 – 8,800</td></tr>
</table>

(A) Redrawn from Table 4 in World Bank 2007. The 'Grand Total' was added by the current author.

Notes: KMs = Kyoto Mechanisms. Range for the estimates indicated between parentheses.
(1) Gross shortfall once sinks are taken into account.
(2) Expected CERs deliveries in the CDM Risoe pipeline, adjusted for the observed yields (as of end of March 2007)
(3) Estimate from Point Carbon.

Sources: 4th National Communications to the UNFCCC, for distance to target as well as KMs demand for Kyoto Parties and Potential surplus under the 'with existing measures' scenario; average of (central) etimates from Fortis, Merrill Lynch, New Carbon Finance, Point Carbon, Société Générale and UBS for Distance to target and KMs demand of EU ETS.

While taking into account all the reservations with which both tables must be regarded and considering that Australia had not yet ratified the KP when the World Bank report was published, the tables do clearly show a very significant surplus in the potential supply of carbon credits for the first commitment period. This is a result of the absence of the USA in the Kyoto Protocol. The estimates that led to this instrument being adopted were calculated on the basis of that country´s participation, as the United States presented, during the negotiations, key initiatives that were accepted by the other parties, they contributed to the reaching of consensus and signed the Protocol but did not later ratify it.

11. Information generated by Governments

The gathering and systematization of information about greenhouse gas emissions, an activity that has been growing over the 14 years of the Convention Secretariat´s existence, makes an excellent source of analysis. Data is sent by the Parties in their national communications. These are often written in a tone and using a methodology intent on protecting the country´s image, but in the case of developed countries a common format has been established for all inventories. Furthermore, these communications undergo a process of review carried out by teams of independent experts, whose evaluations are produced in a standardized format to facilitate comparisons. Finally, the Secretariat publishes documents of compilation and analysis on an annual basis, and these turn out to be very useful.

The Convention and Protocol Secretariat, in response to requests by the Conference and Meeting of the Parties, has prepared a report on investment and financial flows to address Climate Change (UNFCCC, 2007 a), which contains a carbon market forecast for the 2008-2012 period, using 2010 as its reference year. This report is not an official document despite having been elaborated by the Secretariat, which is a Convention and Protocol body, at the request of other bodies created by these treaties. Its conclusion is that the supply of carbon credits for the first commitment period "will be abundant".

This forecast, which is consistent with the data compiled for the report and that is included below, is based on data contained in a report on the State and Trends of the Carbon Market prepared by the World Bank (World Bank, 2007) mentioned above, produced by two permanent employees at that financial institution which, as is well known, promotes and performs emission transactions. The report by the Convention and Protocol Secretariat also publishes the data of two private consultancy firms, Point Carbon[38] and IFC International[39],that also promote emission trading. The data from these three sources regarding estimates for the supply and demand of carbon credits in 2010 are available on the Convention´s website.[40]

In March 2008, Point Carbon produced another report for a Conference about the carbon market which took place that month in Copenhagen (Point Carbon, 2008). Part of its conclusions were based a survey of 3,703 participants which produced 1,406 answers whose reliability is of course relative and regarding a topic where interests are great. Other parts of the report contain data that is slipped in without explaining its relationship with figures officially available. For example, the report indicates that the secondary CER market grew to 300 million tonnes in 2007. However, as up until April 30th 2007the Executive Board of the CDM had issued CERs for only 140.6 million tonnes, transactions for 300 million tonnes could only have occurred if the same credit had been traded several times. This may indicate market activity, but it is totally irrelevant as far as climate change mitigation is concerned.

From 1990 to 2005, the levels of emissions in developed countries have changed in a different way. If all of those countries, including the USA, are taken into account, a drop of almost 5 per cent in total emissions is observed, but while those in "transition economies" dropped by more than 35%, those in "market economies" increased by about 10%, as shown in Graph 3.

[38] www.pointcarbon.com
[39] www.icfi.com
[40] www.unfccc.int

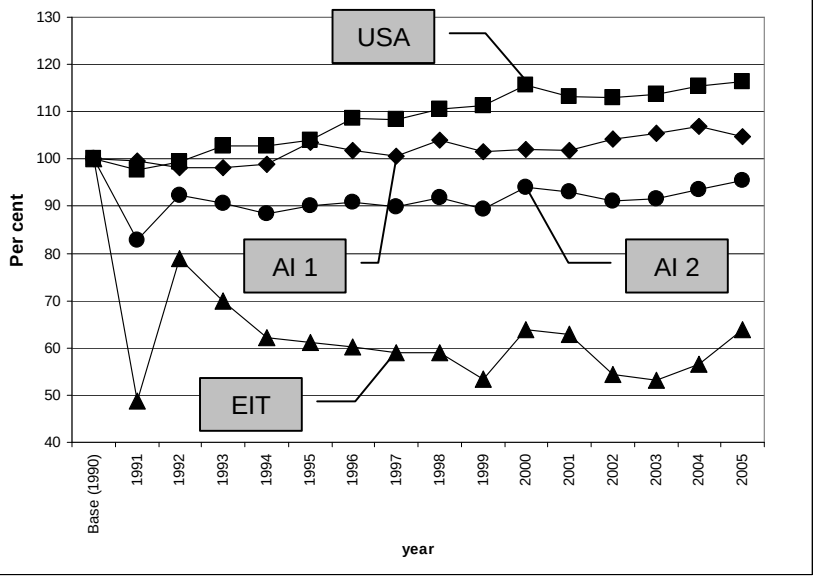


Figure 3. Changes in GHG emissions in countries considered to be industrialised by the Convention on Climate Change. Values represent per cent change with respect to the total net emissions without LULUCF in 1990. **EIT**: Economies in Transition countries; **USA**: United States of America; **AI 1**: Annex I countries excluding EIT and USA. **AI 2**: All Annex I countries. Source: UNFCCC (2007 b)

If the same change is plotted in absolute terms of emission levels with a separate curve for the USA as is shown in Graph 4, it is clear that the emissions of the United States are virtually the same as those of the rest of the group of countries with market economies and that both curves follow an almost identical path.

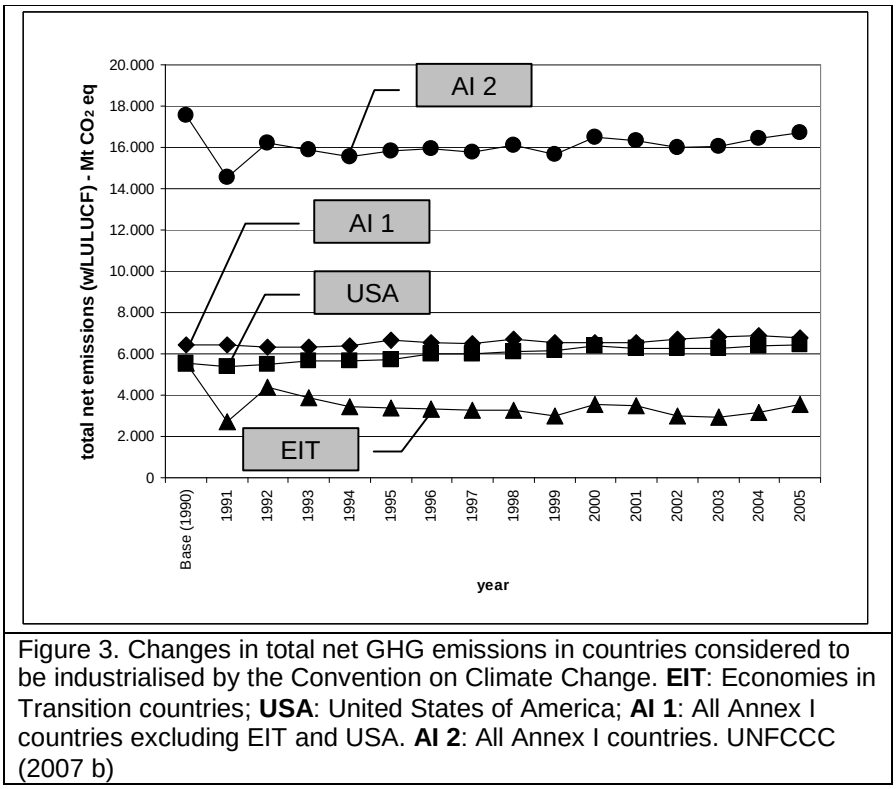


Figure 3. Changes in total net GHG emissions in countries considered to be industrialised by the Convention on Climate Change. **EIT**: Economies in Transition countries; **USA**: United States of America; **AI 1**: All Annex I countries excluding EIT and USA. **AI 2**: All Annex I countries. UNFCCC (2007 b)

Table 5 shows the information available at the end of April 2008, completed when necessary with estimates calculated as indicated in the respective notes at the bottom of the table. Countries have been listed in order of fourth column results, starting with the countries that may have the greatest deficit and ending with those that will have the greatest surplus. For illustration purposes, subtotals have been calculated for the deficit group and for the surplus group.

The first column shows the assigned amounts, that is the levels of emissions that will be available for the developed countries that have ratified the Kyoto Protocol. The sum of the values in that column shows that the total levels of emissions assigned to Parties is close to 60,000 million tonnes. As required by Art.3.1 of the Kyoto Protocol, this quantity is approximately 5% lower than the total emissions produced by those same countries in 1990: in absolute terms, about 3,000 million tonnes less. This figure is almost equivalent to the annual emission of the Russian Federation, and to less than half the emissions of the USA in 2004. Considering these absolute values, it is hard to understand the strong opposition generated by the implementation of the Kyoto Protocol.

The second column shows the levels of emissions that each country estimates it will produce in 2010 by taking some mitigation measures. Various analyses have taken 2010 as the average year for the levels of emissions that countries can be expected to produce in the five years from 2008 to 2012, and this article has used the same criterion. The KP system does not require these projections to be made, there is no obligation to do so, and the forecasts are not homogeneous because, as mentioned above, they in some cases refer to emissions that include land use, land use change and forestry, so the figures must be considered with certain reservations. Where countries have not presented forecasts, the statistical method applied was that of extrapolation of adjustments by minimum squares of total net emissions for the five-year period prior to the last year reported by a country (eg: 2001-2005 or 2002-2006). Consequently, the conservative estimates

calculated give emission levels that are greater than those that will actually be produced when counting sinks and with the adoption of mitigation policies and measures. The application of this conservative criterion increases the total levels of emissions and reduces the surplus indicated in column four.

The information presented by governments and that is available on the Internet[41] can also sometimes contain more favourable projections, in other words lower emissions, if additional mitigation measures are adopted. The nature and characteristics of those measures are described in the respective governmental presentations and are summarized in the document in question. Again following a conservative standard, those possible additional measures were not taken into account.

The third column shows the sum of those projections over the five years of the commitment period. The fourth column shows what the balance would be for each country, with a minus sign when emissions exceed the assigned amount.

It is pointed out that the key clearly rests on the emissions forecast of Russia and the Ukraine, countries which in the Kyoto Protocol negotiation process were allocated assigned amounts equal to their 1990 emissions. In accordance with the last sentence of Art.3, subsection 7, introduced on the initiative and insistence of Australia, the assigned amount for Russia includes land use, land use change and forestry because that year, as in several others, that sector produced a net emission balance. Neither Russia nor Ukraine have presented estimates for future emissions and the application of the statistical method explained above gives both countries the large figures that are shown in the table and that coincide with the most authorised literature. The assigned amount for the Russian Federation is equal to its emissions of 1990 and, as previously explained, these were 1,000 million tonnes higher than its 1995 emissions which were known in 1997, when the Protocol was adopted.

The algebraic sum of these balances indicates that there may be an overabundant supply of carbon credits within the group of industrialised countries, before even resorting to the credits that the Clean Development Mechanism can generate and which this article described above. Nevertheless, developed countries may have political reasons for wishing to continue with CDM projects, albeit considerably smaller ones. As previously explained, countries that, in the first commitment period, have a surplus of allowed emissions can reserve this surplus for future periods, which gives them a huge influence over carbon credit prices. The commercial decisions they take will probably vary according to whether or not they are members of the European Union.

Whatever the interpretation of the data above, taking those presented in the table together with those that can be updated or complemented with additional information, it is clear that countries that used to be centrally planned economies generate the most carbon credits. The way in which they decide to manage that potential commercially will have a decisive influence on the market. Naturally, their decisions are conditioned by the emission limitation and reduction commitments agreed on during the negotiations which have already begun. If obligations are demanding, it may be better to reserve AAUs to sell them in the second commitment period. In any case it does not seem reasonable to expect high prices in the carbon market for the 2008/2012 period.

At the conclusion of these considerations, the question that arises naturally is: what would the situation be if the USA had ratified the KP? This can only be answered by using the contrafactual method, which is the logical reconstruction that considers events that did not occur, but could have occurred, as having occurred. The data used for these assumptions are the 1990 emissions that could have been taken as the baseline for the United States and that, without counting LULUCF, reached the equivalent of 6,229 million tonnes of carbon

[41] Document FCCC/SBI/2007/INF.6/Add.1

dioxide.[42] Consequently, its assigned amount would have been established at five times 93 % of that level, that is 28,965 million tonnes. The USA has officially estimated that in 2010 its net emissions, that is taking account of LULUCF and with the adoption of mitigation measures, would be equivalent to 6,906 million tonnes of CO2.[43] That is the year that was taken as a reference in Table 5, and the application of the same criteria gives an estimate for the emissions of the USA in 2008-2012 equivalent to 34,530 million tonnes of CO2. The probable deficit would therefore be 5,565 million tonnes, a level which is remarkably close to the final result given by the algebraic sum of column D in Table 5, with all the implications this would have for the carbon market.

TABLE 5

Assigned Amounts, projected net emissions in 2010, projected total net emissions in 2008-2012 and balance in assigned amounts for 2008-2012 Values in Mt CO_2 equivalent

A: Likely deficit

Country	Assigned Amount(1)	Net emissions projection in 2010(2)	Net emissions projection for the entire 2008-2012 period(3)	Supply of Assigned Amounts in 2008-2012(4)
Japan	5,335.4	1,311.0	6,555.0	-1,219.6
Canada	2,814.9 †	744.3	3,721.5	-906.6
Germany	4,381.3	986.9	4,934.5	-553.2
Spain	1,666.2	136.3	2,181.5	-515.3
Italy	2,416.3	579.7	2,898.5	-482.2
Denmark	276.8	71.3 ‡	356.5	-79.7
Netherlands	1,001.3	216.1 ‡	1,080.5	-79.2
Greece	668.7	145.6 ‡	728.0	-59.3
Norway	250.6	61.8	309.0	-58.4
Portugal	381.9	88.0	440.0	-58.1
New Zealand	309.6	72.8 ‡	364.0	-54.4
Belgium	674.0	145.2 ‡	726.0	-52.0
Luxembourg	47.4	17.1	85.5	-38.1
Ireland	314.2	70.4 ‡	352.0	-37.8
Finland	355.0	78.5	392.5	-37.5
Australia	2,788.5 †,	564.5 ‡	2,822.5	-34.0
Austria	343.5	72.7	363.5	-20.0
Croatia	154.6	33.6	168.0	-13.4
Slovenia	93.6	21.2	106.0	-12.4
Iceland	18.5	4.5	22.5	-4.0
Switzerland	242.8	49.2 ‡	246.0	-3.2
Liechtenstein	1.1	0.3	1.5	-0.4
Subtotal	24,536.1			-4,318.9

B. Likely surplus

Country	Assigned amounts	2010 net emission projection	Net emission projection for entire 2008-2012 period	Assigned amounts – projection for 2008-2012
Monaco	0.5 †	0.1	0.4	0.1
Slovakia	331.4	55.3 ‡	276.5	54.9
Sweden	375.2	58.1 ‡	290.5	84.7
Latvia	119.2	5.3 ‡	26.5	92.7

[42] Document FCCC/SBI/2007/30

[43] Document FCCC/SBI/2007/INF.6/Add.1

France	2,819.6	544.8 ‡	2,724.0	95.6
Hungary	542.4	86.5 ‡	432.5	109.9
Estonia	196.1	16.5	82.5	113.6
Lithuania	227.3	18.3 ‡	91.5	135.8
Czech Republic	893.5	141.2 ‡	706.0	187.5
Belarus	585.9 †	65.3	326.5	259.4
United Kingdom	3,412.1	620.2 ‡	3,101.0	311.1
Bulgaria	610.0	59.4	297.0	313.3
Romania	1,279.8	174.7 ‡	873.5	425.8
Poland	2,648.2	394.6 ‡	1,973.0	675.2
Ukraine	4,604.2	482.4	2,412.0	2,196.2
Russian Federation	16,617.1	2,329.0	11,645.0	4,972.1
Subtotal	35,282.3			10,023.9
Total	59,818.4			5,705.0

Notes:

(1) Values obtained from countries' initial reports (Art. 7.3 KP) and confirmed by independent Expert Review Teams. † Values declared by countries but not yet verified by independent Expert Review Teams as of April 30th 2008. Country initial reports can be accessed at http://unfccc.int/national_reports/initial_reports_under_the_kyoto_protocol/items/3765.php
¤ In Australia's last national GHG inventory (see ver http://unfccc.int/national_reports/annex_i_ghg_inventories/national_inventories_submissions/items/3929.php), net emissions with LULUCF reached 516,393.73 million tonnes of CO_2 equivalent, from which the assigned amount of 2,788.5 million tonnes of CO_2 equivalent shown in the table. However, in its initial report required by the Kyoto Protocol, Australia declared that net emissions with LULUCF for 1990 were 553,773.8 million tonnes of CO_2 equivalent, from which an assigned amount of 2,990.4 million tonnes of CO_2 equivalent Is derived. The difference between the these two quantities is due to the fact that Australia recalculated the emissions from LULUCF for 1990 – which had been estimated with the Revised 1996 IPCCC Guidelines for National Greenhouse Gas Inventories –with the 2003 IPCC Good Practice Guidance for Land Use, Land-use Change and Forestry. These had been estimated. This resulted in an increase of 37,380.07 million tonnes of CO_2 equivalent for the LULUCF sector.

(2) Figures correspond to emissions without LULUCF projected "with mitigation measures" (Table 12 in *Compilation and synthesis of fourth national communications*. FCCC/SBI/2007/INF.6/Add.1), except those marked ‡, which correspond to data with LULUCF reported "with mitigation measures" (see Table 13 in *Compilation and synthesis of fourth national communications*. FCCC/SBI/2007/INF.6/Add.1). Figures for Luxembourg and Monaco were not found in any of the indicated sources. Therefore, they were obtained by extrapolation from individual regressions fitted by minimum squares to total net emissions from the five-year period prior to the last year reported by a country (2001-2005).

(3) Values are five times the value in the same row and column 'Net emissions projections in 2010'.

(4) Values are the difference between the 'Assigned Amount' and 'Net emissions projection for the entire 2008-2012 period'.

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GRAPH 1

Change in prices in the EU Carbon Market over 2005-2007 period

Prices of assigned units (AU) of the European Union Emission Trading Scheme (EU ETS), in euros

Source: European Union Emission Trading Scheme (EU ETS)