Carbon markets: the simple facts

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CARING FOR CLIMATE SERIES

THE GLOBAL COMPACT

Caisse des Dépôts

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The Mission Climat is the research centre on the economics of climate change at the Caisse des Dépôts, a French public financial institution. Hosted within the CDC Climat Department, it brings together a team of economists and engineers specialized in the economics of three main research areas: emissions trading schemes, emission reduction projects and the adaptation of territories to climate change. The Mission Climat of Caisse des Dépôts provides information and expertise to the public, businesses, experts and policy makers through its free publications. Visit: www.caissedesdepots.fr/missionclimat

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Foreword

Caring for Climate (C4C) was introduced by United Nations Secretary-General Ban Ki-moon in July 2007. The Secretary-General challenged Global Compact participants to exercise leadership on climate issues by:

- making climate change a leadership issue for strategy and operations;
- setting emission reduction targets and exploring low-carbon technologies;
- supporting public policy efforts aimed at achieving low carbon economies;
- sharing experiences and publicly disclosing progress made on an annual basis.

Less than two years on, Caring for Climate has emerged as the world's largest and most diversified business engagement platform on climate, with more than 350 corporate signatories in over 60 countries.

Less than seven months before the crucial UN Climate Change Conference in Copenhagen, we are releasing several new research studies and reports, the Caring for Climate Series, to offer a range of perspectives on the role of business and investors in tackling climate change. It is our hope that the findings of the C4C Series will inspire more businesses to make climate change a priority issue, so that policy makers will feel more confident that business is ready to be part of the solution.

The good news is that businesses from all regions and sectors have already started their journey towards energy efficiency, innovation and GHG emission reductions. Indeed, in many instances businesses have embraced climate action as an opportunity to drive efficiency and to gain competitive advantages, even where Governments have not yet taken action.

Caring for Climate participants recognize that climate change is not only an environmental issue. Around the world, businesses are beginning to feel the economic impacts as well. Consequently, some have made the connection between mitigation and adaptation, putting in place long-term measures to address not only emissions, but also food and water concerns and related natural resource issues. In fact, this drive towards energy efficiency and carbon reductions, combined with a proactive management of systemic climate risks, is defining a new level of environmental stewardship. Long-term investors, asset managers and analysts are also beginning to integrate these considerations into investment analysis and decision-making.

The bad news is that, despite encouraging and inspiring leadership, the number of businesses that are actively addressing climate change is far too small. Too many are still sitting on the fence waiting for others to act first.

What is needed now is Government leadership to produce a clear incentive structure that favors good performance and a global deal on climate change that creates certainty. Governments should be confident that change is possible. If Caring for Climate is any indication, business and investors certainly have the capacity and understand the compelling case for taking action. We therefore hope that the C4C Series will give policy makers and negotiators the confidence and inspiration to bring the Copenhagen Climate Conference to a successful conclusion.

Georg Kell
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Executive Summary

To limit climate change and its impacts, we need to reduce our emissions drastically. This requires strong incentives that take the form of a combination of standards, taxes and carbon markets. In order to meet the envisaged goals, these instruments will have to be put in place at both national and international levels. Economists can help in finding the optimal combination that would provide the required emissions reductions at the lowest cost.

In theory, carbon taxes or permit markets can achieve identical results: each ton of GHG emitted, no matter where it comes from, is responsible for inducing further climate change. The cost of this additional emission should be borne by the global community who will face collectively the consequences of more intense climate change. Until now, private emitters have had no interest in reducing their emissions and the marginal damages they bring about. In attributing a price to carbon emissions, taxes and permit markets transfer the social cost of future climate change damage to the emissions sources.

In practice, in the case of greenhouse gas emissions, permit markets have been much easier to implement than taxes. In such markets, the quantity of greenhouse gases emitted is directly controlled: emitters included in the system eventually have to cover their emissions by a corresponding number of permits. Participants may offset their excess emissions by acquiring permits from other sources able and willing to emit below their established cap. The carbon price reflects the scarcity of the right to emit GHGs, which depends on the stringency of environmental policy.

This report focuses on the experiences of the two major permit markets already implemented: The international market for project-based credits created by the Kyoto Protocol, and the European Union Emissions Trading Scheme covering the main industrial sources of carbon dioxide. The main lessons regarding the design of permit markets relate to four strategic issues: 1/ defining carefully and equitably the initial allocation of permits; 2/ ensuring reliable measurement and control of emissions; 3/ setting up registries that keep track of all permit transactions; 4/allowing flexibility mechanisms through the use of offset credits and appropriate rules for banking and borrowing.

Putting a price on carbon will accelerate the emergence of a low-carbon economy and should be expanded to the major emerging economies. In the framework of current international climate negotiations, the creation of a global GHG market, covering the main industrial sources, could help to bring on board countries with different levels of economic development as did the EU-ETS for the EU 27 Member States. This international market could emerge from several regional trading schemes that would be linked together. Mutual recognition of international offset credits, such as CDM or JI credits, can be the first step in the linking of different carbon markets.

Market-based instruments can also help in including agriculture and forestry in a future climate agreement. These sectors represent almost a third of worldwide GHG emissions and often a larger proportion in developing countries. Stopping deforestation is one of the first priorities. This could be achieved by crediting national or regional policies designed to protect tropical forests and increase food and agricultural output in a sustainable way. These programmes could be partially financed by credits sold on the future international GHG market.

Carbon markets can also provide public authorities with new financial resources when allowances are auctioned. In the future, part of the revenues from auctioning could be directed to financing implementation of climate change policies including both mitigation and adaptation measures. In particular, auction revenues may provide additional funds for developing countries.

Permit markets allow an efficient sharing of a global emissions constraint among emitters. If the market works well, the carbon price equalizes the costs of emissions reductions across the various actors, and enables the achievement of the desired emissions reductions at least cost. In the context of international negotiations, permit markets possess two features that may facilitate an agreement: flexibility and efficiency.

“ Permit markets allow for an efficient sharing among emitters of a global emissions’ constraint”

I. Introduction

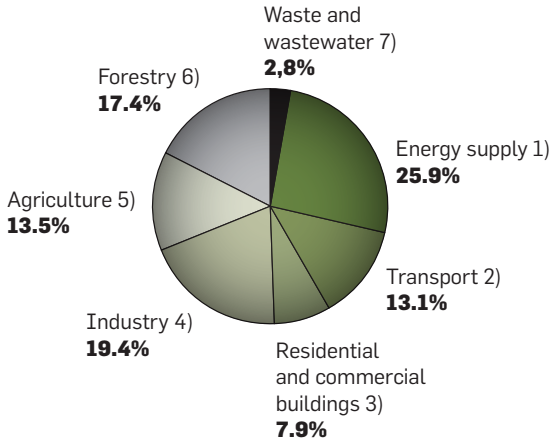
A. THE NEED TO REDUCE DRAMATICALLY ANTHROPOGENIC EMISSIONS

The leading role of human emissions in climate change has now become a consensus among the international community, particularly after the publication of the latest IPCC report: *Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level. (…) Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas (GHG) concentrations.* This statement results from a common agreement of scientists and politicians who participated in the IPCC debate, i.e. most countries in the world.

If we want to limit climate change and its impact on the environment, societies and economies, we need to reduce quickly our emissions, given that the GHG stock in the atmosphere is highly resilient. It takes a long time for the impact of emissions reductions to be noticeable since the warming potential of GHG results from their accumulation; but once introduced, GHG emissions remain in the atmosphere, resulting in a long-lasting effect. Early action is necessary in order to limit climate change to reasonable levels within the next decades. Furthermore, recent reports including the Stern Review (2007) highlight that reducing emissions now would be less costly than doing so in the future.

The breakdown of global GHG emissions in Figure 1 shows that more than 60% of emissions results from the use of fossil energy in the world and that almost a third comes from agriculture and forestry. In practice, massively reducing GHG emissions implies that we will need to completely change how we produce and use energy and how we manage agricultural and forestry resources.

Figure 1 – The world GHG emissions in 2004 by sector



Notes: 1) Excl. refineries, coke ovens etc., which are included in industry. 2) Incl. international transport (bunkers), excl. fisheries, offroad agricultural and forestry vehicles and machinery. 3) Incl. traditional biomass use. 4) Incl. refineries, coke ovens etc. 5) Incl. agricultural waste burning and savannah burning (non-CO_2). CO_2 emissions and/or removals from agricultural soils are not estimated in this database. 6) Incl. CO_2 emissions from deforestation, CO_2 emissions from decay (decomposition) of above-ground biomass that remains after logging and deforestation, and CO_2 from peat fires and decay of drained peat soils. 7) Incl. landfill CH_4, wastewater CH_4 and N_2O, and CO_2 from waste incineration (fossil carbon only).
Source: Technical report of Contribution of Working Group III to the Fourth Assessment Report of the IPCC, 2007.

That said, what should we do? Efficient and cost-effective measures to curb GHG emissions are needed. Meanwhile, however, a large part of the world population is still striving to secure basic needs — food, water and energy supply, health care, education. Fighting climate change should not threaten the world's economic development. The true challenge is therefore to decide which policy will have both the ability to effectively reduce GHG emissions and ensure we achieve it at the lowest cost. A worldwide solution must be found: as GHG emissions have the same impact wherever they are emitted, a strong regional GHG constraint would be useless if emissions elsewhere continued to grow.

B. THE ECONOMISTS' TOOLBOX: HOW TO COMBINE STANDARDS, TAXES AND PERMITS MARKETS?

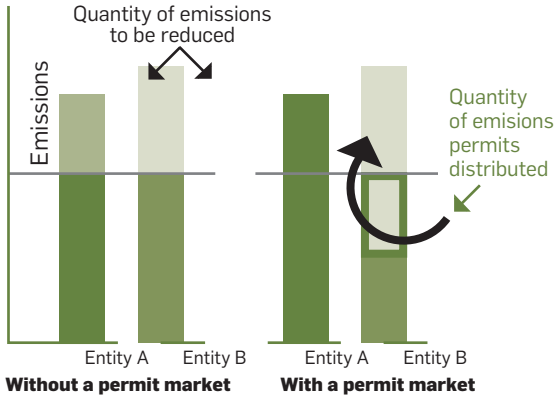
Each ton of GHG emitted, no matter where it is produced, is responsible for inducing further climate change. The cost of this additional emission should be assumed by the global community who will face — as a whole — the consequences of more intense climate change. Until now, individual emitters have had no incentives to reduce their emissions and the marginal damages they bring about. In order to integrate the indirect cost of emissions for society in the decisions of private actors, several instruments can be used. They can be volume-based instruments such as standards and permit markets or price-based instruments such as taxes. A combination of each of these instruments will have to be mobilized, at the national and the international level, to cope with the challenge of climate change.

One option is to define **emissions standards** for GHG emissions, for example per unit of output. Standards are a widespread solution for environmental goods' regulation. Control and compliance procedures need to be sufficient to prevent infringements which typically result in a fine for non-compliers. The first difficulty of implementing GHG emissions standards is to define their levels for a wide range of emissions sources. Furthermore, the cost of reducing GHG emissions varies significantly within countries and sectors. This heterogeneity means that setting the same level of emissions standards may lead to excess costs and thus economic-inefficiency. Finally, standards do not assure a targeted environmental result which will in fact depend upon production volumes. Moreover no incentive is given to reduce emissions beyond the standard level, giving limited incentive for the development of innovative emissions reduction options.

A second option would be to implement a **tax policy**. As with standards, this price-targeted policy implies that the level of emissions is not known in advance, since it ultimately depends on the tax level and the distribution of emissions reductions costs among emitters: emitters tend to reduce emissions insofar as their marginal abatement cost[1] remains below the level of the tax. This may lead to incremental tax adjustments by the regulator to reach the targeted limit for the total emissions, thus introducing more uncertainty for investors in the long run and less incentives for innovation. Many economists think that a harmonized international carbon tax could be an efficient way of reducing GHG emissions. However the implementation of this option seems very difficult in practice, if not impossible, at the international level. That is why the main economic instrument chosen to cope with climate change has been **cap and trade mechanisms** better known as "carbon markets".

This last option directly controls the quantity of greenhouse gases emitted. Emission permits - corresponding to a cap fixed by the regulator - are initially distributed among the participants to the system, and emitters included in the system eventually have to cover their emissions by a sufficient number of permits. Participants may offset their excess emissions by acquiring permits from other sources able and willing to emit below their established cap. Each incremental emission has a price fixed by the permit market. Inversely, emitters willing to emit below their cap can directly benefit from the carbon price by selling unused permits.

Figure 2 – The principle of emissions trading



Consider two economic entities (countries, companies or installations) emitting GHGs. To achieve a given level of emissions (the purple line), each entity may decrease its own emissions (on the left) or use the flexibility given by a permit market (on the right). In the latter case the use of the market mechanism involves more emissions reductions in the entity whose emissions reductions costs are lower.
Source: Mission Climat of Caisse des Dépôts.

[1] The marginal abatement cost is defined as the increase in total cost induced by producing one additional unit. See glossary.

In this last approach, the role of the regulator is limited to the definition of the overall cap i.e. the environmental objective, and to the verification of the compliance of each participant to the scheme. The environmental efficiency is obtained simultaneously to economic efficiency: a single piece of information — the carbon price — is integrated in the investment and management decisions. Thus emitters are enabled to decide on the cheapest option with great flexibility, depending on their individual situations.

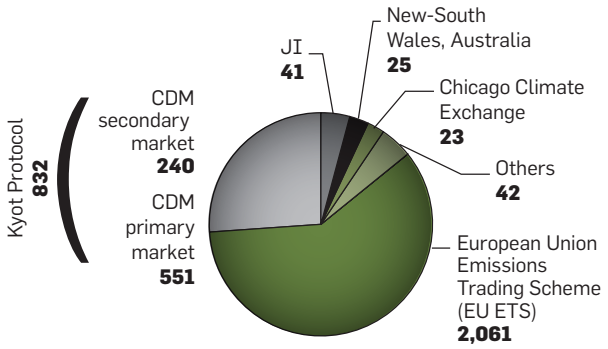
Due to cost heterogeneity, permit markets have proved to be more acceptable than taxes or standards for emitters as they let private actors decide on the means they want to use for compliance. Until now two major permit markets have been implemented, the permit market of the Kyoto Protocol and the European Union Emissions Trading Scheme (EU ETS), both after the failure of tax proposals. On top of their operational characteristic they have proved to be economically and environmentally efficient even if there is a significant room for improvement. This report aims at presenting those GHG markets and explaining how their expansion may be a good way to address climate change issues in a political context characterized by the need to find a consensus on the commitments of many sovereign States. Nevertheless, carbon markets represent only a technical tool that can help governments to achieve their commitments to reducing GHG emissions.

II. The emergence of carbon markets

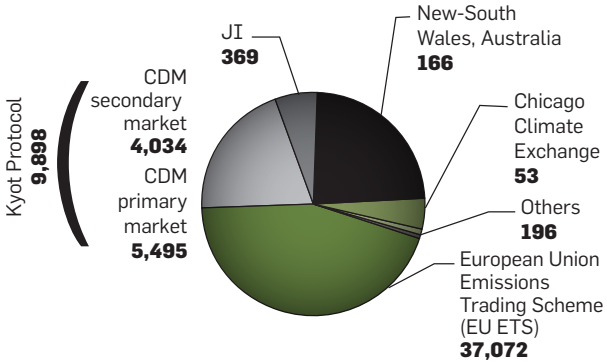
The first environmental permit markets were implemented during the 90s in the US to combat acid rain from SO_2 emissions. They were subsequently applied to GHG emissions in the Kyoto protocol framework and at different regional and multinational levels, the most developed system to date being the European Union Emissions Trading Scheme (EU ETS).
Each Emissions Trading Scheme (ETS) has its own characteristics in terms of the scope of industries and gases covered, and emissions reductions targets. Those differences in ambition explain why the price for the same commodity, a ton of CO_2 equivalent, can vary from less than 1€ to almost 20€ depending on the GHG market. Figure 3 shows the weight of the different carbon markets in the world. By far, the two main mechanisms are the European Emission Trading Scheme and the international Kyoto credit-based mechanisms..

Figure 3 – Carbon Markets in 2007

Carbon assets transactions in volume 2007 (in Mt)



Carbon assets transactions value in 2007 (in B€)



Source: World Bank, State and Trends of the Carbon Markets 2008, BlueNext, ECX.

A. THE KYOTO PROTOCOL: AT THE BEGINNING OF A GLOBAL CARBON MARKET

The commitments

The Kyoto Protocol adopted in 1997 established commitments necessary to implement the United Nations Framework Convention on Climate Change (UNFCCC).[1] The Protocol defines fixed objectives for the 38 most industrialized countries (listed in the Annex B of the Protocol) to collectively reduce by at least 5% their overall emissions of 6 greenhouse gases (CO_2, CH_4, N_2O, HFC, PFC, SF_6) in relation to 1990 levels. Non-Annex B countries do not have set objectives. These reductions must occur over the period 2008-2012. To become legally binding, the Protocol needed to be ratified by the appropriate national institutions of each signatory country.[2] The United States is the only developed country which has not ratified it.

Three flexibility mechanisms

To help Annex B countries achieve their reduction objectives, the Protocol includes three flexibility mechanisms: the creation of an international carbon market, Joint Implementation (JI) and the Clean Development Mechanism (CDM).

(1) The United Nations Framework Convention on Climate Change (UNFCCC) is the primary international treaty on global climate change. Signed in Rio de Janeiro in 1992, the Convention's objective is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." See the UNFCCC's website: www.unfccc.org

(2) The Protocol also stipulates that the reduction objectives are not legally binding until those countries having ratified the treaty represent at least 55% of global emissions in 1990. This quorum was achieved in September of 2004 following the ratification of the Protocol by Russia.

The international carbon market is based on the allocation of Assigned Amount Units (AAUs) to Annex B countries: each Annex B country received in 2008 a quantity of AAUs equal to its emissions' objective between 2008 and 2012 under the Kyoto Protocol. If a country's actual emissions are higher or lower than its target, the country can purchase or sell AAUs to other Annex B countries. The UNFCCC Secretariat oversees the functioning of the system through its registry, the International Transaction Log (ITL). Each Annex B country is obligated to develop a standardized registry connected to the ITL.

Up to now, there have been very few transactions of AAUs, on a bilateral basis(3). Three reasons for that: first, the system is new and most countries have had to develop new tools to evaluate their future emissions and define their Kyoto Protocol strategies; second, the Annex B compliance to the Kyoto Protocol should be verified only in 2015; finally, the total number of AAUs distributed is largely sufficient to cover the needs because of the US retreat from the Kyoto Protocol (the US was expected to be the major buyer of AAUs). The two precedent points explain why it is unnecessary for countries in deficit to be rushing to buy AAUs. Countries in a deficit position include EU15, Canada and Japan, and countries that have a surplus of AAUs are namely Ukraine and Russia. The excess in AAUs compared with actual emissions should be furthermore increased by the impact of the economic downturn which will lead to reduced emissions.

Two other instruments have been implemented by the Kyoto Protocol, generally called project mechanisms. The Joint Implementation (JI) and Clean Development Mechanism (CDM) projects allow countries to achieve part of their target by reducing emissions outside of their national territory. The principles and recent developments concerning these two mechanisms are explained further in the subsequent sections.

Table 1 – Annex B countries' commitments under the Kyoto Protocol and their position in 2006 compared to their Kyoto target

Country	Kyoto Protocol's emissions target [2008-2012] / 1990	Assigned Amount Units received over [2008-2012] (Mt CO2e)	% change in emissions from 1990 to 2006	% difference between 2006 emissions and Kyoto Protocol target
EU 15	-8.0%	19,683	-2.2%	+6.0%
Russia	0.0%	16,082	-34.2%	-34.2%
Japan	-6.0%	5,928	5.4%	+11.4%
Ukraine	0.0%	4,627	-51.9%	-51.9%
Australia	8.0%	2,990	28.8%	+20.8%
Canada	-6.0%	2,815	21.7%	+27.7%
Poland	6.0%	2,758	-28.9%	-22.9%
Romania	-8.0%	1,299	-44.4%	-36.4%
Czech Rep.	-8.0%	903	-23.7%	-15.7%
Bulgaria	-8.0%	610	-46.2%	-38.2%
Belarus	-8.0%	586	-36.4%	-28.4%
Hungary	-6.0%	578	-32.1%	-26.1%
Slovakia	-8.0%	332	-33.6%	-25.6%
New-Zealand	0.0%	309	25.7%	+25.7%
Norway	1.0%	251	7.7%	+6.7%
Switzerland	-8.0%	243	0.8%	+8.8%
Lithuania	-8.0%	221	-53.0%	-45.0%
Estonia	-1.8%	200	-54.6%	-46.6%
Croatia	-5.0%	148	-5.2%	-0.2%
Latvia	-8.0%	119	-56.1%	-48.1%
Slovenia	-8.0%	93	1.2%	+9.2%
Iceland	10.0%	18	24.2%	+14.2%
Liechtenstein	-8.0%	1	19.1%	+27.0%
Monaco	-8.0%	0	-13.1%	-5.4%
United-States*	-7.0%	–	14.4%	+21.4%

(3) AAU transactions details are usually confidential. They are often integrated into agreements called Green Investment Schemes in which the buyer country ensures that the AAU revenues have been or will be used to fund emissions reductions or other environmental measures.

The United States did not ratify the Kyoto Protocol and thus do not have the legal obligation to comply with their objective.
Source: UNFCCC, Initial reports under the Kyoto Protocol, 2008 National Inventories Submissions.

Joint Implementation (JI): achieving cheaper emissions reductions within Annex B countries

JI projects take place between two Annex B countries. They generate GHG Emission Reduction Units (ERUs) corresponding to the reduced emissions, the precise amount of which is certified by an independent verifier. JI projects must be approved by the host country and registered by the UNFCCC Secretariat. JI projects do not create credits, but rather transfer reduction units from one Annex B country to another: for every credit transferred and added to the allowance of the receiving country, an equivalent amount of allowances is cancelled in the giving country.

The vast majority of JI projects take place in Russia, Ukraine and Eastern European countries. Nevertheless, some other countries have started developing JI projects, particularly Germany and France. In Europe, because of the existing CO_2 permit market — the EU ETS — covering the major industrial installations, JI projects mainly address emissions reductions for small industrial installations or in sectors not included in the EU ETS, like transportation, agriculture or buildings.

Overall, JI projects have been mainly developed in the energy sector where the potential for emissions reductions through energy efficiency measures or fugitive emissions capture is significant. The destruction of N_2O and methane (coal mine and landfill gas) represent 44% of the credits generated.

Figure 4 – The transfer of Joint Implementation credits within two Annex B countries

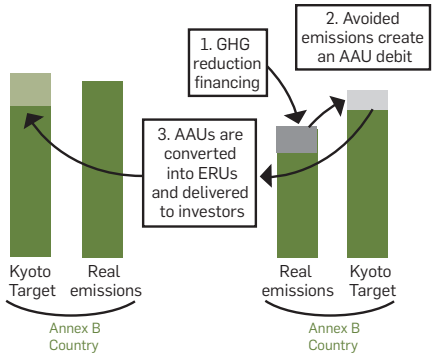
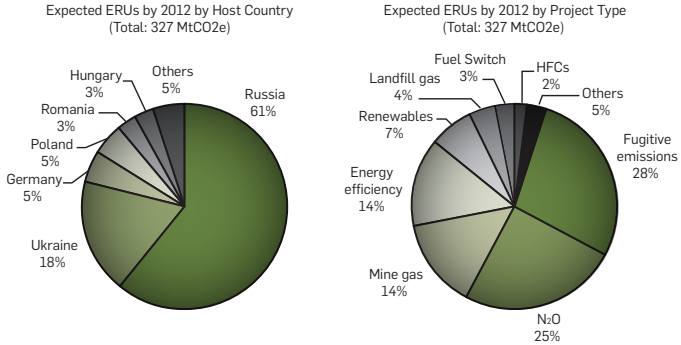


Figure 5 – Number of JI credits expected by 2012 by country and type of project as of 1st May 2008



The Clean Development Mechanism (CDM): engaging non-Annex B countries without binding targets

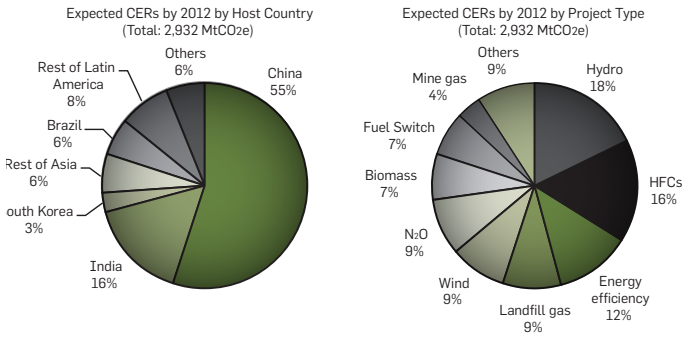
CDM projects rely on the same principle as JI projects, except they take place in non-Annex B countries. The funding should be provided by an Annex B country, or a project developer based in an Annex B country. Once the project is approved and registered by the UNFCCC Secretariat and the emissions reductions verified by an independent entity, CDM projects are credited to projects participants by an equivalent amount of Certified Emission Reductions (CERs). As non-Annex B countries do not have an AAU cap, CDM credits are created ex-nihilo.

The aim of CDM projects is to promote investments in developing countries by industrialized nations and to encourage the transfer of low-emission technologies. More than 75% of CERs that are anticipated to be generated before 2012 are concentrated in Asia. Conversely, Africa will account for only 5% of projected credits.

As for JI projects, about half of the credits generated will come from energy-related projects which are focused on renewable energies (hydro, wind and biomass). The HFC emission reduction projects, which were the first ones put in place due to their very low cost and have also been the most controversial due to the amount of credits they have generated, are seeing their importance decline due to the exhaustion in the number of sites available.

The price at which CER credits are paid to project developers is estimated to be around 10€ by the World Bank (See Capoor & Ambrosi, *State and Trends of the Carbon Market, 2007*). This means that the CDM is expected to incur the transfer of roughly 20 billions euros from developed countries to developing countries until 2012.

Figure 6 – Number of CDM credits expected by 2012 by country and type of project as of 1st May 2008



The Kyoto Protocol and carbon markets

Annex B countries will be compliant with their obligations under the first period of the Kyoto Protocol if they can present in 2015 the quantity of AAUs, CERs and ERUs corresponding to their cumulated national emissions between 2008 and 2012. From 2008 onwards, AAUs, CERs and ERUs are internationally tradable[4], including by private actors. CERs and ERUs can also be used as offset credits under other GHG reduction commitments, for example by the industries covered by the EU ETS.

Under the Kyoto Protocol, Annex B countries can carry over their unused AAUs to the second period of the Kyoto Protocol, after 2012. CERs and ERUs can both be placed in reserve in each country up to a total of 2.5% of the initial quantity of AAUs allocated. The choices made for the design of a post-2012 international climate agreement will influence the management of these carbon assets by signatories countries.

Even if the first period of the Kyoto Protocol turns out not to be overly constraining for Annex B countries (see Annex 1), it has already proved useful to put in place international mechanisms to finance emissions reductions in developing countries. These kinds of mechanisms will probably be expanded to provide adequate funds for both mitigation and adaptation actions in the coming years.

B. THE EU ETS: CAPPING INDUSTRIAL CO_2 EMISSIONS

Annex B signatories to the Kyoto Protocol have a free hand to determine the tools they decide to set up in order to achieve their emissions targets. The then 15 member States of the European Union engaged in 1997 as a whole for a -8% target, which was disentangled by country afterwards in a “burden-sharing agreement”. Because the EU was the legal entity in charge of having the Kyoto Protocol target achieved, the European Commission proposed in 2001 the creation of a European-wide instrument, the European Union Emissions Trading Scheme (EU ETS) in order to help European countries to meet their national commitments. Designed to be a central tool of the European climate policy, the EU ETS has, starting from 2005, set a ceiling on CO_2 emissions in industries with the highest GHG emission levels, in the 25 then 27 member states.

The scope

The EU ETS caps on a mandatory basis only CO_2 emissions from major industrial installations belonging to 5 industrial sectors: combustion (including electricity production, district heating, cogeneration and refineries), metal (including iron and steel), cement, glass-ceramics and paper-board productions. The regulation does not apply to the sectoral or the company level, but to individual industrial installations. The smallest industrial installations are not included, to avoid disproportionate regulation costs.

(4) Note that each Annex B country has to keep at any time on its account at least 90% of its AAUs allocated for the 2008-2012 period.

Overall, the covered installations emit approximately 2 gigatonnes of CO_2 per year, about 40% of European GHG emissions. The EU ETS sets an emissions ceiling for them in the form of an annual allocation of tradable allowances for each industrial installation, one allowance giving the right to emit one ton of CO_2.

The institutional framework

The allocation method is elaborated at the national level in each National Allocation Plan (NAP). These NAPs are developed by member countries and then checked and amended by the European Commission.

The compliance of each installation to the EU ETS regulation is verified yearly before the 30th of April: at this date the covered installations must provide the European Commission with enough credits to cover their emissions during the previous year (See Figure 8).

A company needing more credits can purchase them on the market. Conversely, a company that has a surplus of credits can sell the excess. Emissions reductions will therefore be implemented where they are the least costly. Trades between buyers and sellers occur either face to face, through professional brokers, or through marketplaces, electronic portals which release publicly the price and amounts exchanged.

To track allowance exchanges, each Member State has to set up a national registry. All national registries are connected to a central European registry maintained by the European Commission: the Community Independent Transaction Log (CITL). The CITL gathers in one place all the information from Member States' national registries, and is continually updated due to the constant dialogue between national registries and the CITL. National registries and the CITL are then connected to the International Transaction Log (ITL) set up by the UNFCCC for the first commitment period of the Kyoto Protocol. The EU ETS has been established over two periods: 2005-2007 which can be seen as a test phase, and 2008-2012 corresponding to the Kyoto engagement period. The adoption of the European Climate-Energy Package in December 2008 set ambitious reduction objectives for Europe as far as 2020 and confirmed the central role of the EU ETS to achieve them in its third period (2013-2020[5]. It also brought about major changes in the EU ETS design, in particular by imposing a high share of auctions for allowances' allocation and limiting the use of flexibility mechanisms like the CDM.

Figure 7 – Allowances distributed to industrial installations covered by the EU ETS in phase I (2005-2007) by sector (in Mt and as a % of total allocation)

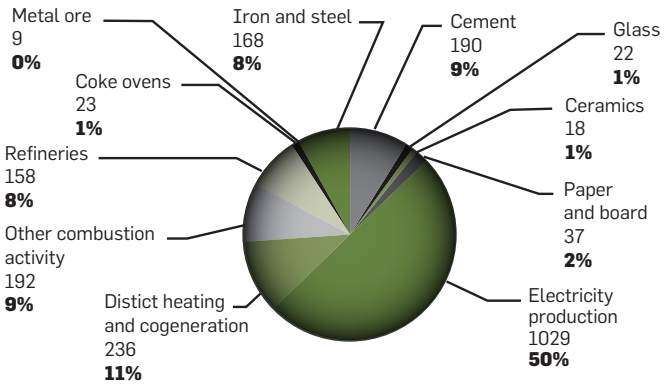
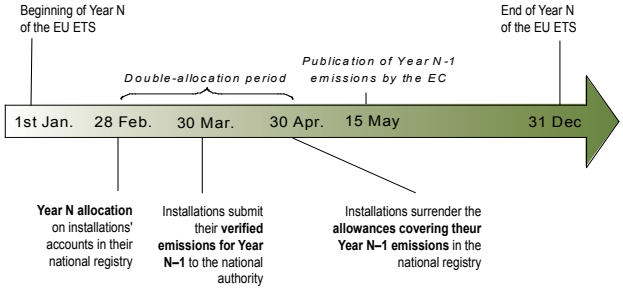


Figure 8 – Institutional timeline for industrial installations covered by the EU ETS



Source: Mission Climat of Caisse des Dépôts.

The European carbon market in action

The first phase of the EU ETS ended in 2007. Six main conclusions can be drawn from the first three years of its operation[6].

First, this pilot phase was useful. It presented a number of problems, but its aim was to make the system function. Further, this was done within a very short timeframe, with the launch of the scheme in 2005, only two years after the initial proposal in 2003. Some lessons from the pilot phase are already being incorporated, as is confirmed by several allocation choices in the second phase: more harmonized allocation rules, stricter caps set in National Allocation Plans, etc. An important insight from the pilot phase is that not all elements have to be in place when an emissions trading scheme is launched.

“ The EU ETS is likely to contribute to the shape of a future global system, and is already instructive for emerging national and regional schemes”

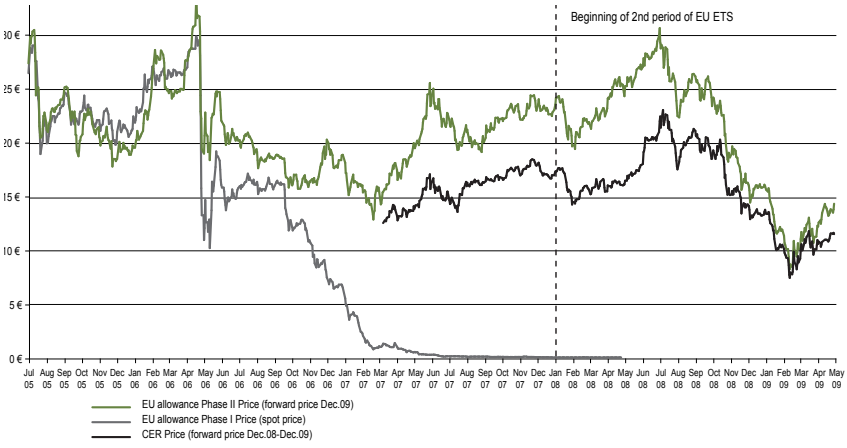
Second, carbon now has a real price. From 2005 to 2007, the European market developed strongly in terms of traded volumes and market infrastructure (see Figure 9). An effective carbon price has emerged on this market reflecting the balance between supply and demand. The market proved to be economically rational: the allowance surplus for the first period led to a price close to zero in 2007 and steadier prices for the second period reflect the scarcity anticipated by market players from political decisions. The entrance of the European industry in the world recession has also triggered a sharp fall of carbon prices at the end of 2008. But the banking provisions between the second and the third period have helped the market find a new equilibrium at prices over 13 euros per ton at the end of April 2009. All major industry and finance players now no longer consider carbon to be free in Europe and that it will continue to be costly in the future. This is a major achievement.

Third, the carbon price induced some emissions abatement. Despite over-allocation, which clearly existed in some Member States and sectors, the emergence of a carbon price induced some emissions abatement. While switching from coal to natural gas did not occur in the magnitudes expected, other unanticipated emission reduction strategies were employed, including intra-fuel substitution (brown to hard coal) in Germany and improved CO_2 efficiency in the UK. Emissions reductions have been estimated to reach approximately 50 Mt/y (Buchner and Ellerman, 2007).

Forth, the EU ETS's link with the international Kyoto credit market has driven the development of Clean Development Mechanism (CDM) projects in developing countries and has led to additional emissions reductions through Joint Implementation (JI) projects. The development of the European carbon market has provided the first empirical experience with linking different carbon markets and valuable lessons on how linking may be incorporated into future climate regimes. Fifth, to date, the carbon price has had a limited impact on industrial competitiveness. In the non-power sectors, including cement, refining, steel and aluminum, international competition makes it difficult, if not impossible, to pass carbon prices on to consumers. Equally, there is no empirical evidence of any market share loss in these sectors due to carbon pricing. However, future stronger carbon constraints may affect their long-term competitiveness.

Finally, the lessons learned from the first trading period of the EU ETS may be applied to future climate negotiations. The EU ETS is a true multi-national system. The European Union is home to 500 million people, living in 27 countries, embracing 23 languages, with per capita GDP ranging from $42,000 (Ireland) to $9,000 (Romania and Bulgaria). Through the EU ETS, nations of widely varying circumstances and commitments to climate policy have agreed to a common constraint. Europe's choice of emissions trading has created a 'fact on the ground' that will be difficult to ignore in future global climate negotiations. The EU ETS is likely to contribute to the shape of a future global system, and is already instructive for emerging national and regional schemes.

Figure 9 – Price and volume evolution since the beginning of the EU ETS



The first period of the EU ETS was marked by a dramatic drop in phase I carbon prices in April 2006, when the first data on 2005 emissions showed there were more allowances distributed than emissions. Given the impossibility of using phase I allowances in phase II (no bankability), the overall excess in allowances led to a decrease in their price which finally dropped to zero.
Source: ECX, BlueNext, Reuters.

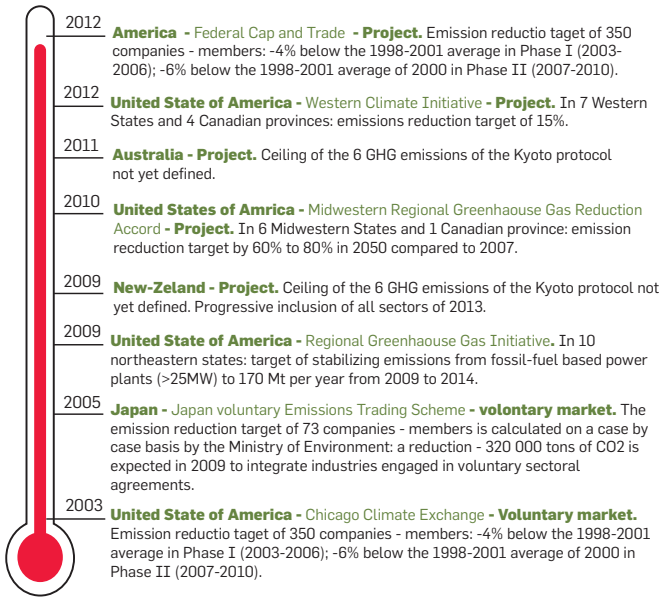
(5) The review of the EU ETS Directive also stated that the market will continue after 2020.
(6) See Convery F., Ellerman D and De Perthuis C., March 2008.

C. Other existing or planned carbon markets

The development of several permit markets is currently under study. The most advanced projects take place in the USA — where the Regional Greenhouse Gas Initiative (RGGI) program entered into force in January 2009 — New-Zealand, Australia, and Japan. Interestingly, if the first initiatives started with voluntary agreements, the most recent projects imply mandatory emissions caps.

Over the last few years, an increasing number of carbon markets projects have been developed on a mandatory basis at the multinational, federal or infra-national levels. This impressive development results in part from the growing awareness of the danger of climate change which has strongly risen since the signing of the Kyoto Protocol. If the Kyoto Protocol has not succeeded in creating an effective carbon markets for countries, it has nevertheless implemented the conditions for civil society involvement in emissions reductions through its two project-based mechanisms. The issue is now to study how those different regional markets can join to form a global carbon market. The way they can be linked strongly depends on the characteristics of the existing markets. The next section presents the main stakes of carbon markets design.

Figure 10 – Permit market in development in the world apart from the European Trading Scheme



Source: Mission Climat of Caisse des Dépôts

“ Carbon markets represent only a technical tool that can help governments to achieve their commitments to reducing GHG emissions.”

III. Carbon markets in practice: the four pilars

The primary aim of carbon markets is the achievement of an environmental objective at the lowest cost possible for participants. Political choices are thus important in regards to the scope of the market, the definition of the effort required and the allocation methodology. These choices can be made by different regulators: at the international level in the context of international negotiations between countries (e.g. the Kyoto protocol); at a multinational level to achieve a common objective (e.g. the EU ETS in Europe); or at a national or local level to achieve domestic emissions reductions (e.g. RGGI, Norway's ETS from 2005 to 2007).
In all of these cases, the design of carbon markets has to take into account **four parameters:** 1/ defining the permit volumes through initial allocation; 2/ ensuring a reliable measure and control of emissions; 3/ setting up a registry that keeps track of all permit exchanges; and, 4/ allowing flexibility both over time, through budgeting, banking and borrowing, and over space through offset mechanisms.

A. THE ALLOCATION PROCESS

Which GHG emissions from which emitters?

The first question that is raised when designing a carbon market is its scope in terms of greenhouse gases and participants.

Six GHGs detailed in the Kyoto Protocol signed in 1997 are usually considered: CO_2 is the primary gas, accounting for approximately 75% of all human activities emissions; the remainder is composed primarily of methane (CH4), nitrous oxide (N20), and three fluorinated gases (PFCs, HFCs and SF6). The cap in the framework of a carbon market can be set for all six GHGs or just a part, for example CO2. The first option was chosen in the Kyoto Protocol; the second in the European CO2 allowances markets or in the RGGI in the North-East of the United States.

After defining the GHGs covered, it remains to be seen whether all **emitters** of these GHGs should be integrated in the permit market. Choosing not to include some of them may be considered if inclusion costs incurred are too high regarding the emissions reduction achieved[7]. While the Kyoto Protocol includes all the emissions of the six main GHG emitted by human activities and the changes in carbon storage in soils and forests, regulators of the European market for CO_2 allowances chose to regulate only the CO_2 emissions of a limited number of industrial installations that were both above a given size limit - from 2005 to 2012, 20 MW capacity for combustion installations — and belonging to five major sectors: combustion; steel and iron production; cement production; glass and ceramics production; and pulp and paper production. The inclusion of more sectors is under consideration, with aviation slated for inclusion in 2012. However, each new inclusion must be justified by an economic analysis proving the ETS compliance costs would be proportionate to the environmental benefits.

No existing permit market is all-inclusive: the most comprehensive market, created by the Kyoto Protocol, concerns only developed countries; the EU ETS does not cover all CO_2 emissions, in particular from transportation. There are various reasons for this limitation of scope: firstly, the difficulty of integrating in a single system participants with very different backgrounds (developed and developing countries in the case of the Kyoto Protocol); secondly, some emissions are difficult to manage - small, mobile sources (shipping,

[7] In particular the cost of measuring and controlling the emission of medium and small entities can rapidly be very high compared to their GHG emissions, not to mention the case of agriculture and forestry in which the calculation of precise emission levels is a real nightmare.

transport fleets, aviation, private sources like cars) and cross-national emissions — and this explains why transportation-related emissions were not included in early phases of the EU ETS.

Another issue for deciding who will be capped is the question of the "upstream" or "downstream" approaches, depending on the regulation point. In the "upstream" approach, the regulation applies to the beginning of the supply chain which is held responsible for the emissions incurred by the final product and its production process. This approach is mainly used to cap emissions from fuels by including oil providers in the permits market. In this case the number of regulated actors is far smaller than in "downstream" approaches where the regulation would apply to all direct emitters, such as car drivers or households using fuel to heat their house. The downstream approach has been chosen in existing carbon markets such as European or RGGI carbon markets.

Setting a cap for emitters

Once it is decided who will have to cap their emissions, the issue of the allocation of permits arises.

Objectives may be set either in absolute or in relative terms (relative terms may be for example a maximal emission quantity per unit of production). In the latter case, the environmental target is not known in advance. This is the case in the Kyoto project based mechanisms or in the frst Canadian ETS project where the target is to improve the emissions intensities of industrial production by 18 % in 2020 compared to 2006, that is, the emissions per unit of output. As we do not know the final quantity of goods produced, we are not able to determine in advance what will be the real level of emissions. As policies such as coping with climate change have specific environmental objectives, absolute objectives are usually used.

Once the target is chosen, two architectures can be used: a baseline-and-credit system or a cap-and-trade one. The first aims at distributing permits to emitters that do better than a reference emissions scenario, named the baseline. Those who exceed the baseline have to buy permits. The same kind of approach is used for the Kyoto project-based mechanisms (CDM and JI, see below) which are aimed at rewarding projects reducing emissions against a business as usual baseline by carbon credits.

The second option involves fixing the GHG emissions levels in advance for a given period of time, using an absolute cap: for example, the Kyoto Protocol requires that developed countries reduce their emissions between 2008 and 2012 by 5% compared to 1990 levels. The emissions cap is then converted into carbon permits (generally 1 ton of GHG converted into CO_2 equivalent [8] = 1 permit) that can be distributed.

Distributing the cap among emitters

Allocation is generally calculated from emissions expectations to fix the overall cap and ensure it is reachable without disproportionate costs. The global cap is then split among emitters that are covered by the permit market. There are three main ways in allocating emission permits: grandfathering the permits, using benchmarks, or selling permits through auctions.

The **grandfathering** method is the method most used. Permits are freely distributed depending on the share of each emitter in the emissions of a given reference period. For example the Kyoto protocol set 1990 as the reference year for the vast majority of countries. This method implies that emitters are granted allowances proportionately to their historical emissions. Thus any emitter having undertaken emissions reductions efforts prior to 1990 will have fewer permits than another one who did not invest in emissions reductions. Early action is not compensated in general. Also, this method assumes availability of accurate and reliable data for the reference year emissions, which is often not the case. This method remains the most accepted for already existing heavy industries that take part in the negotiation. It cannot apply to new installations.

A second option for free allocation would be to use **benchmarks**. Permits are granted on an output basis for each sector or sub-sector, following a given factor. This factor can correspond to the best available technology (BAT) or the average of real emissions factors. In both cases, early action is compensated by giving a direct advantage to low-carbon productions. To provide favourable economic incentives, the benchmark should not be differentiated by technology but by final product. This approach can also be dynamic: the benchmark factor may be re-calculated periodically to evolve in accordance with changes in both the quantitative limit set by

the emissions cap and production.

Allocations can also be **sold** by the authority. Even if negligible for the moment, having emitters pay for their allocation, in particular through **auctions**, is particularly favoured by economists. Selling permits obliges emitters to factor in the entire cost of carbon, and prevents them from benefiting from undue profits incurred by the pass-through of the carbon costs to final consumers even if they received their allowances for free. Moreover they have to reveal their abatement costs in an auctioning process. Finally revenues from auctions may be re-used by the regulator to fund climate change actions or to effect other kinds of economic measures such as tax reductions on the labour market - which in most cases fosters the economic growth — leading to both environmental and economic benefits, the so-called “double-dividend”.

(8) Noted as tCO_2e in the rest of the document. See the glossary for more information on the CO_2 equivalence.

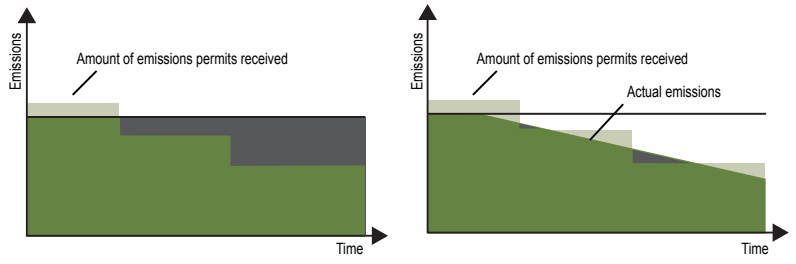
B. A RELIABLE MEASURE AND CONTROL OF EMISSIONS: AT THE BASIS OF THE COMPLIANCE PROCESS

Achieving compliance

The state of compliance is achieved when the installation or the company covered by the permit market surrenders as many GHG permits as its actual emissions for a given period of time. If not, a fine must generally be paid which can correspond in some cases to a ceiling price for emissions. This ensures a correct incentive to comply with the scheme.
In the short-term, installations or companies covered by a permit market have different compliance strategies:
• they can adjust their emissions to their carbon allowances through a production adjustment in volume, the improvement of their energy or emissions intensity (the quantity of energy consumed or the emissions per unit of production) for example by switching to lower carbon emitting fuels, or the investment in low carbon technologies ;
• if they have enough allowances to cover emissions for the current period they can sell the excess on the market or keep them for future compliance periods if, for example they predict a rise in allowance prices due to higher carbon constraints;
• they can buy allowances or credits on the market to cover emissions exceeding their initial allowance allocation ; this solution is economically justified if reducing their emissions is more expensive than the price for carbon allowances.

The more stringent the carbon constraint, the higher the price on the market. The sustainability of this high level depends on the long-term signal given by the regulator to industries. Thus installations have less incentive to rely only on carbon permit purchase to assure their compliance. A long-term price signal given by a reliable market will encourage earlier emissions abatement and low-carbon investments.

Figure 11 – The emitters' strategies within a permit market: arbitrating between permits purchase and emissions reduction



In this example, the GHG cap is initially higher than actual emissions. On the left we assume the abatement costs are higher than the market price: the emitter does not have an incentive to reduce its emissions and prefers to buy permits on the market (quantity in red). On the right, the abatement cost is lower so the emitter prefers to reduce its actual emissions in the short-run: he thus becomes a net seller of allowances on the market over the time period considered. The quantities that can be sold are represented by the sum of the green areas minus the red areas.
Source : Mission Climat of Caisse des Dépôts.

Emissions monitoring, reporting and verification (MRV)

The regulatory authority is in charge of verifying that the level of emissions over a given period corresponds to the number of surrendered permits for that period. To help this reconciliation, it usually sets up compulsory and harmonized monitoring, reporting and verification procedures to ensure that installations: 1/ adopt a correct and harmonized way of measuring or estimating their emissions; 2/ explain in their reporting their methodology of measure and give the results; and 3/ have the whole procedure verified by a third independent entity on the same model as the financial accounts certification for any company.

The confidence of market participants in these MRV procedures is fundamental to ensure each allowance is really worth a ton of CO_2 equivalent. If not, it would mean market participants could buy false money with less value. The independence of the verification entity is thus a major point. The second factor is the centralization of the reported emissions at the level of the regulatory authority who certifies compliance through the system by comparing allowances surrendered to actual emissions.

This need for trustworthy MRV procedures should not let one forget about the uncertainty of measures in some sectors, for example in agriculture or in forestry. In any case, the complexity, and thus the costs, of emissions MRV should always be balanced with the environmental benefit to maintain the economic efficiency of carbon markets.

C. REGISTRIES AND MARKET TRANSPARENCY

In a cap-and-trade system or an emissions trading scheme (ETS), a regulatory institution caps the total emissions that may be released by a group of economic players (installations, firms, etc.) over a specified time period. The capped entities then each receive an annual share of the total amount in the form of tradable permits. The underlying principle of cap-and-trade systems is that the actors who can reduce emissions at least cost will do so, and will sell their surplus allowances to actors with higher abatement costs. This requires an infrastructure that guarantees the integrity of the transactions and provides market participants with reliable information: the registry.

The fundamental role of registries

The expectations regarding the evolution of the supply-demand equilibrium are reflected in the carbon price. Supply is the result of the allocation process, whether in cap-and-trade systems or in credit-based mechanisms. Controlled by a regulatory authority, it is generally well assessed by the market. Demand is more fluctuating and depends on the evolution of emissions drivers, including economic growth, relative energy prices and climatic conditions.

This calculation of the basic supply and demand equilibrium needs to be corrected by other factors like the ability to hold on to unused allowances (banking provision) or the market accessibility for small emitters which may decide not to sell unused allowances if high transaction costs make this action more costly than doing nothing. These choices may increase the scarcity in the system and lead to higher prices than predicted in theory.

To keep track of allowances, issuance is recorded in a registry which also keeps track of all physical transfers of allowances — both sales and purchases. A registry thus serves as an accounting book: at any given date it tracks the details of allocated allowances, verified emissions and surrendered allowances for each installation.

All market participants are obliged to have an account on the regulatory body's registry. It is used to register all transactions (over the counter and on the market place), and to prove the compliance when needed.

The role of financial players in the market

The access to carbon markets is generally not restricted to covered installations. The reason for this stems from the valid need for liquidity in the market: the more participants, the lower the probability for a single player to have a sufficient market power to manipulate the price of carbon allowances. Furthermore financial intermediaries can play the role of catalyst for a number of small emitters who are not familiar with markets and would prefer delegating their allowance management to a third party.

Financial trades can be organized both on a bilateral basis, for example through brokers, or on market places. Because the liquidity and transparency are higher on market places, they play an important role in publishing prices.

D. INTRODUCING FLEXIBILITY

Banking permits

The bankability of emissions permits is the ability to use them in periods subsequent to the one in which they were allocated. It means that any incumbent envisaging to emit less GHGs than the number of permits he owns has the possibility to store them instead of selling them directly on the market. This saving can be motivated by expectations of production growth or of an increase in the carbon constraint that may bring about an increase in the price of emissions permits in the near future. Banking allowances is a good incentive to achieve early emissions reduction so as to be able to bank a maximum of allowances before the constraint increases. This anticipation may also smooth the price evolution over the long term.

Figure 12 – Banking favours early investors

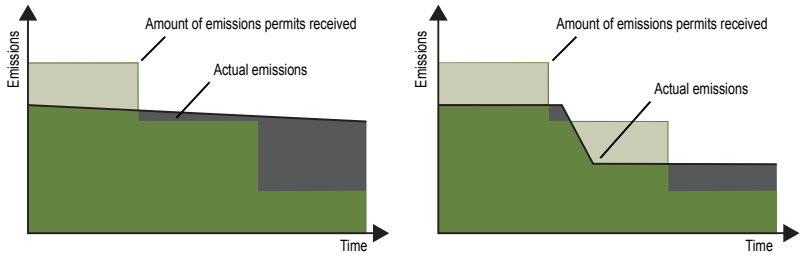


Figure 12 depicts how banking can be a strong incentive for early emissions reductions when industries know the constraint will increase over time. On the left, no investment is made; the decrease in emissions results from improvement of the production process. Even if the installation has more allowances at the very beginning of the emissions permit markets, it soon appears to be in deficit due to the strengthening of the allocation cap. On the right, the same installation chose to invest in emissions reductions; even with some delay in the implementation of the solution the sum of saved allowances exceeds the deficit in allowances overtime. This outcome is only realistic if banking is allowed within periods (each period being marked by a drop in the allocation cap).

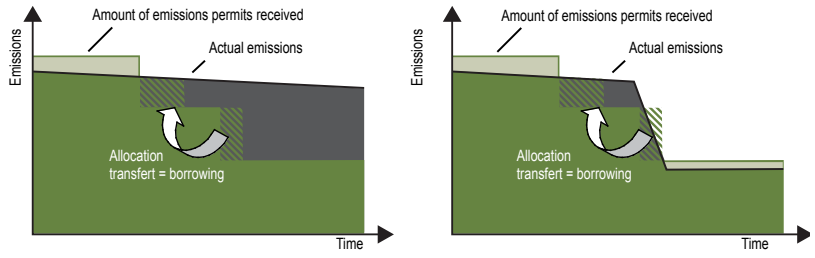
Permits' banking has been much used in the American SO2 trading system implemented in the 1990s. It explains a large part of the huge reduction achieved during the first years of the scheme.

Borrowing permits

Borrowing provisions allow regulated emitters to use part of their future allocations to cover their present emissions. Borrowing is complementary to the banking provision mechanism even though it is not as easy to implement. Whereas banking does not threaten the overall emissions ceiling fixed by the emissions trading system — at any moment, the amount of allowances used cannot exceed the number of allowances issued by the regulator — in the case of borrowing, it can happen that the number of allowances used exceeds the number of allowances actually issued. Such a system may be a good tool to control the volatility on the market if allowances reach an unbearable price for industries. Nevertheless, it can also destroy its environmental integrity if those industries do not undertake serious emissions abatements to make their future emissions catch up with their future allocation, which is now reduced by the use of borrowing. To make up for this, two solutions are possible: first, limit the ability of installations to borrow permits; second, centralize the ability to borrow in the hands of a trusted long-term regulator who can feed the permit market when the price appears too high. In the latter case, the regulator must have the mandate to loosen the carbon constraint, distributing more allowances when the price is high while at the same time ensuring that the total cap is not increased over time.

Figure 13 shows potential installation behaviour regarding the use of the borrowing provisions. On the left, the borrowing does not precede an investment in emissions reduction and just results in a delayed emissions permits purchase. In this case, the installation has economic difficulties to pay for permits at market price and could eventually shutdown without reimbursing the permits-debt incurred from the borrowing. On the right, the borrowing is used as a way to defer payment for needed extra permits and to wait until the effects of investment in lower emissions production are sensible.

Figure 13 – Borrowing needs to be controlled to limit the risk of non-environmental integrity



In this example, the GHG cap is initially higher than actual emissions. With the decrease in allocation, the emitter can use the borrowing provision to delay the purchase of allowances on the market without modifying his overall debt (on the left, in red). He can also take advantage of the time delay to implement emissions reduction measures that will decrease his overall debt (on the right).
Source: Mission Climat of Caisse des Dépôts.

Using offset credits

Offset credits are carbon assets that reward emissions reductions undertaken by installations outside of the scope of carbon markets, and hence not required to surrender permits. For example, waste management is not covered by the EU ETS; but if a European project developer invests in power and heat production from municipal waste methane instead of flaring it, it can receive offset credits corresponding to the GHG emissions savings. The delivery of offset credits is granted to project developers against the assurance that their project reduces total GHG emissions. The quantity of credits depends on the "business-as-usual" scenario which depicts what the emissions would have been without the emissions reduction project. Once verified, these emissions reductions lead to the delivery of

“ Banking can be a strong incentive for early emissions reductions.”

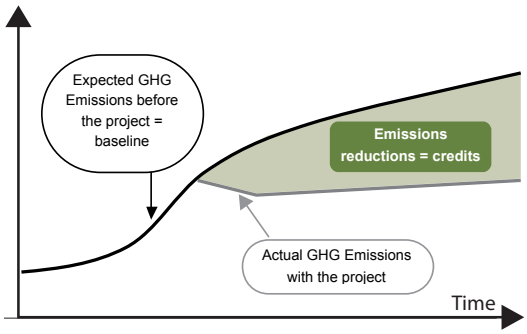
carbon offset credits that may be exchanged on secondary markets.

The main offsets credits today are provided by two project mechanisms established by the Kyoto Protocol: (1) Joint Implementation and (2) the Clean Development Mechanism, the latter the most important in terms of the number of credits generated. Only these two mechanisms benefit from United Nations approval; the offset credits they generate are accepted both on the Kyoto Protocol and the EU ETS markets. Other credits also exist for entities willing to offset part or all of their GHG emissions on a voluntary basis. The proficiency and rigour of the project developers selling such credits vary greatly, hence providing a very wide range of quality. Today, the development of private labels is underway to give buyers more assurance of the reality and reliability in some of these credits.

Allowing offset credits in permit markets increases the scope of the abatement possibilities and thus allows participants to buy emissions reductions at a lower cost. Offset credits can be sourced in the same geographical area as covered by the permit market; in this case there is an incentive to reduce emissions in sectors not addressed by the permit market. International offset credits may also be allowed, expanding indirectly the geographical scope of the market.

In both cases, and in particular in the second one, the regulator often wants to be sure that the majority of the emissions reductions are undertaken by installations directly covered by the permit market in particular when the country has committed to emissions reductions. This is why the use of offsets is often limited to a given share of the emissions target or the total number of allocated permits.

Figure 14 – Project-based mechanisms: the baseline-and-credit principle



Source: Mission Climat of Caisse des Dépôts.

IV. Towards a global successful ghg market?

Climate change is a global issue which will not be solved unless all countries take part in the process. In this context, a global carbon market can be a key tool for the upcoming global climate change agreement which will come after the Kyoto Protocol. This agreement will build on the three basic principles of the UNFCCC:

- The **precautionary principle:** lack of scientific certainty shall not be used as a reason for postponing cost-effective measures.
- **The common, but differentiated, responsibility:** each signatory country recognizes the effects of its GHG emissions on global warming. The most industrialized countries carry a greater responsibility given their earlier development and historically higher emission levels.
- The **right to development:** measures will take into consideration the right to economic development of each country.

Carbon markets can help to address these issues thanks to the flexibility they can bring into the international negotiation process. The next step of their development will be to ensure more coordinated approaches among the regional initiatives and increase the scope of their coverage to both developed and developing countries.

A. THE DESIGN OF CARBON MARKETS BY GOVERNMENTS AND THEIR USE BY PRIVATE ACTORS

One of the main lessons drawn from current carbon markets developments is that it is easier to enforce emission reduction targets towards private agents that are legally bound to national or multinational regulations. In the case of the EU ETS, for example, the European regulation on emissions is the result of a political consensus between the executive power — the EU Commission and Council, and the legislative one - the EU Parliament. Commitments are controlled at the Community level but the real constraint is put through the EU ETS to individual industrial installations through the adoption of the EU ETS Directive into national laws by Member States. The adoption of discouraging high fines increases the credibility of the constraint for private agents and gives a strong incentive to abide by the law with very few possibilities to deny the fine in case of infringement.

On the contrary, the existing international carbon market created by the Kyoto Protocol leaves more room for denials: the compliance process allows governments access to multiple delays and negotiation processes — and in the case of conviction, the punishment consists of a reduction of the allocation for forthcoming Kyoto Protocol commitment periods whose characteristics are not a given and depend on the results of international negotiations.

So up to now, international climate negotiations have involved countries that have collectively to decide what will be the emissions reduction targets they will be liable to. Being both judges and parties, the results have been widely recognized as insufficient. For the future climate agreement, the solution would be to limit participation in the global carbon market to sources with high monitoring, reporting and verification (MRV) quality. Those are basically the sources covered by present GHG markets, ie energy uses (that may include transportation) and heavy industries. Stringent, consistent and transparent compliance and enforcement mechanisms are needed to ensure market and environmental integrity.

The decentralization of the international commitments into national laws with deterrent incentives would oblige private emitters to achieve the aimed emissions reductions at the lowest cost. It would also limit the

conflict of interest for States engaged in the international negotiation. Some promising initiatives have already been evoked like the implementation of global sectoral agreements. Joining these initiatives on a compulsory basis controlled by mandatory structures would enlarge the market and allow for the emissions reductions where they are the cheapest, thus ensuring more efficiency and less costs.

B. A FIRST STEP: LINKING EXISTING OR UPCOMING REGIONAL CARBON MARKETS

The implementation of a global carbon market has long proved difficult and has lead to the development of more ambitious national or regional initiatives. A major stake in the mid-term will be therefore to ensure convergence in the design architecture of existing markets to link them and increase the economic efficiency of emissions reductions. Developing coordinated regional carbon markets will leave some time for the international negotiation to achieve an agreement. In the future, regional carbon markets can perfectly be a subpart of the international carbon markets. Their earlier implementation should help industries to take early action in finding emissions reductions solutions.

Coordinating the major regional carbon markets, including the existing —the UE ETS- or the expected in the following years — US, Japan, Australian, Canadian cap and trades- will mean first defining equivalent levels of constraints taking into account particular economic, industrial and political contexts. On more technical grounds, it also means developing common information technology protocols and language to ensure streamlined communication between registries. The linkage between regional systems may also be indirect if credits issued from project mechanisms are allowed into different markets. This is one of the major interests in developing offset mechanisms.

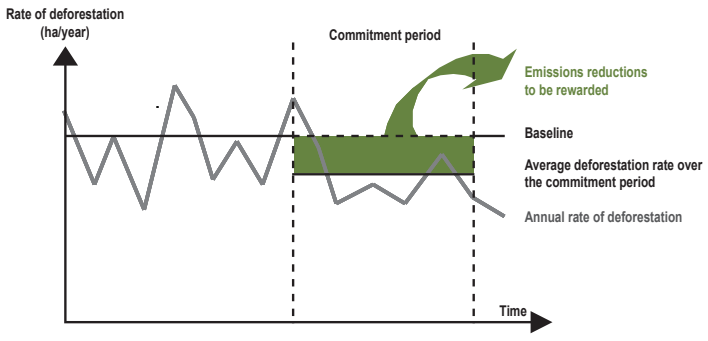
C. INCLUDING FORESTRY AND AGRICULTURE THROUGH NEW OFFSET MECHANISMS

About two thirds of global emissions come from energy uses or industrial emissions and are easily monitored. About one third comes from the forestry and agricultural sectors. Indeed modifying the use of land can lead to higher carbon sequestration in soils — through no tillage in agriculture or afforestation [9] in forestry —, or inversely free huge amounts of sequestrated carbon — through deforestation.

It is more difficult to assess the carbon fluxes between soils, forests and the atmosphere which explains why it has been quite difficult to include directly those sectors into carbon markets up to now. This is why the project-based approach and, more generally, the baseline and credit approach are more promising for these sectors.

Take the example of deforestation, responsible for around 17% of human GHG emissions. Avoiding deforestation may be among the cheapest options for reducing global GHG emissions - between 6.5 €/tCO_2e and 50 €/tCO_2e. To deliver carbon credits to governments involved in a REDD[10] mechanism, they must be able to reliably monitor and measure emissions from deforestation and consistently enforce environmental legislation, such as protected areas. Carbon-related payments can in this case rely on a baseline as shown in Figure 15: during a given commitment period, emissions reductions below the baseline are to be rewarded. In the example taken above, the baseline corresponds to the historical rate of deforestation before the commitment period. Emissions reductions are calculated thanks to a given area-based emissions factor. To make this system reliable, context-appropriate ways to monitor and control the emission reductions have to be found as mechanisms to avoid wasted spending or corruption.

Figure 15 – Example of how REDD initiatives may receive carbon permits



Source: Mission Climat of Caisse des Dépôts.

(9) The carbon stock in forests increases each year by approximately 9.5 GtCO_2e, the equivalent of 30% of the world GHG emissions.
(10) REDD stands for Reducing Emissions from Deforestation and Degradation.

"The more the participants, the lower the probability for a single player tohave sufficient market power to manipulate the price"

D. COPING WITH CARBON LEAKAGE ISSUES BY ENLARGING CARBON MARKETS

Figure 16 – Emissions and economies data from the 16 highest-emitting countries in the world

Sources: Climate Analysis Indicators Tool (CAIT) Version 5.0, World Resources Institute, 2008, International Monetary Fund, World Economic Outlook Database, April 2008, U.S. Census Bureau,International Data Base (2008).

Incomplete climate policies or GHG markets — in the sense that they would only cover a minor part of emissions and emitters — would be insufficient to address the global issue of climate change mitigation. Moreover it may cripple existing carbon markets if industrial producers delocalize to countries where no carbon constraint applies. This so-called carbon-leakage threatens both the environmental effectiveness of the market — since emissions are no longer capped - and the socio-economic status of countries that lose a part of their industrial activity. Concerns about carbon leakage are all the more important when the carbon constraint is high and the industries impacted can easily relocate.

Europe has been challenged by this issue during the discussion on the design of phase III of the EU ETS (from 2013 to 2020). Given the strengthening of the emissions constraint, the proposal to allocate the majority of allowances through auctions raised many concerns among the highest-emitting countries and sectors. Even if industries may not relocate all their existing capacities outside of Europe, their strategies regarding the construction of new facilities may change and may lead to under-investment in Europe and greater investment in the nearest non-European countries. These relocations will also depend on the cost of transportation to the final consumer: power for example is not easy to carry over long distances; glass or steel are more easily transported, given that maritime transportation costs remain low. However, the European experience shows that it is possible to set up a multi-state carbon market without triggering major shifts in the location of capped industries.

Another lesson from the European experience is that a cap-and-trade system covering the main emitting industries can cover countries with very different backgrounds, cultures and development levels: GDP per capita gaps inside the European Union can be wider than between the poorest European countries and emerging countries like China or India. The right answer to carbon leakage would be to find the way of integrating industries from emerging economies in such cap-and-trade schemes. This could be considered with interest by governments of these countries if appropriate counterparts in terms of technologies transfers and new financial transfers toward developing countries can be reached.

The question of how permits are distributed is of paramount importance. By auctioning permits instead of giving them for free, governments would be able to capture a part of the value that has be given to the right to emit GHG and use it to fund other policies, including both mitigation and adaptation measures. Part of this funding could be directed to the least developed countries.

V. Conclusion

In capping the right to emit GHGs,, the goal of carbon markets is to put economies on track towards a low-carbon future. Thus, our present way of producing and consuming goods will have to be substantially restructured in the long-term. This revolution will lead to the substitution of old industries, based on massif fossil energy uses, by new businesses that provide technological solutions and new low-carbon services. This transition already started before the creation of carbon markets. Enlarging the scope of these markets will accelerate the trend.

Permit markets delegate the responsibility to limit greenhouse gases to the direct emitters. Cap and trade systems have three main characteristics:

- A global allocation ceiling, below which market players can trade emissions permits;
- Economic efficiency since emissions reductions are achieved at the lowest cost;
- Environmental efficiency because damages induced by climate change are independent of the location of emissions sources.

Permits markets allow for an efficient sharing among emitters of a global emissions' constraint. If the market works well, the carbon price levels the costs of emissions reductions within the different actors to obtain the desired reductions emissions at less cost. In an international negotiation, they bring about two elements that may facilitate an agreement: flexibility and efficiency.

Annex 1– The market for AAUs: estimation of the supply and demand equilibrium between 2008-2012

Figure 16 – Emissions and economies data from the 16 highest-emitting countries in the world

Country	Annual Kyoto target 2008-12	Estimated 2010 Emissions*	Estimated AAUs Deficit (-) or Surplus (+) [2008-2012]*	
	(Mt/y)	(Mt)	% of total allocation)	(Mt)
UE 15	**3 930,8**	**4 177,7**	**-6%**	**-1 234,3**
Canada	563,0	725,4	-29%	-812,0
Japan	1 185,7	1 324,9	-12%	-696,4
Spain	332,8	467,0	-40%	-671,1
Italy	485,7	577,1	-19%	-456,9
Austria	68,7	95,5	-39%	-133,8
N.-Zealand	61,9	82,7	-34%	-103,8
Denmark	55,4	74,8	-35%	-97,4
Germany	973,7	992,8	-2%	-95,4
Finland	71,1	86,2	-21%	-75,3
Ireland	63,0	70,7	-12%	-38,5
Portugal	71,1	78,2	-10%	-35,3
Luxembourg	9,1	15,8	-73%	-33,5
Switzerland	48,5	54,9	-13%	-31,7
Norway	50,3	53,6	-7%	-16,7
Slovenia	18,6	21,2	-14%	-12,9
Iceland	3,7	4,9	-31%	-5,8
Liechtenstein	0,2	0,3	-36%	-0,4
Croatia	34,2	33,6	2%	3,2
Netherlands	201,7	200,5	1%	6,2
Greece	138,8	137,0	1%	9,1
Belgium	135,9	131,0	4%	24,5
Monaco	9,9	0,1	99%	49,1
Latvia	23,8	12,7	47%	55,7
Belarus	117,2	96,5	18%	**58,6**
Sweden	75,2	61,9	18%	66,5
Slovakia	66,4	48,7	27%	**87,6**
Lithuania	44,3	26,1	41%	90,8
Estonia	40,1	20,0	50%	**94,8**
United Kingdom	682,4	655,1	4%	136,6
Czech Rep.	180,6	151,8	16%	143,9
France	563,9	534,2	5%	148,5
Hungary	115,7	80,2	31%	**158,5**
Australia	598,1	563,9	6%	170,9
Bulgaria	122,1	77,4	37%	223,5
Romania	259,9	164	37%	479,2
Poland	551,7	430,8	22%	604,5
Ukraine	925,4	488,2	47%	2 185,8
Russia	3 216,3	2 325,4	28%	4 454,5
Turkey		407,9		
United-States		7 083,7		
TOTAL (excl. Turley and the United-States)	**12 165,9**	**10 864,8**	**10%**	**5 935,4**

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GLOSSARY

• **AAU: Assigned Amount Unit:** credits received by Annex B countries to the Kyoto Protocol, corresponding to their emissions targets over the 2008-2012 period.

• **Abatement cost:** cost to achieve the reduction of one ton of GHG emissions. The average cost corresponds to the total cost divided by the output quantity. The marginal cost corresponds to the increase in total cost induced by producing one additional unit.

• **Annex I and Annex B Countries:** UNFCCC Annex I countries are the developed countries and those in transition towards a market economy. They make up the majority of the Annex B countries of the Kyoto Protocol who have accepted fixed reduction objectives. The only deviations are the following: Croatia, Lichtenstein, Monaco and Slovenia are part of the Annex B; Belarus and Turkey are not.

• **Anthropogenic greenhouse gas emissions:** greenhouse gas emissions generated by human activity as opposed to emissions produced by the natural carbon cycle. They result mainly from the use of fossil fuels, agricultural practices, deforestation and certain industrial processes.

• **Certified Emission Reduction - CER:** credit generated by the reduction of one tonne of greenhouse gas emissions by a CDM project.

• **Clean Development Mechanism – CDM:** set up by Article 12 of the Kyoto Protocol, the CDM aims to carry out emission reduction projects in developing countries (Non Annex I). The project developer obtains a CER (Certified Emissions Reduction) credit for each tonne of carbon dioxide equivalent.

• **CO2 equivalent (CO2eq.):** method of measuring greenhouse gas emissions that takes into account the global warming potential of each gas relative to that of CO_2. The measure can also be expressed as carbon equivalent (C): 1 kilogramme CO_2eq. = 0.27 kilogramme C.

• **Emission permit:** an accounting unit of the market system corresponding to one tonne of greenhouse gases. To ensure compliance with emission caps, greenhouse gas-emitting entities subject to the market must periodically surrender permits equivalent to their physical emissions to the regulatory authority.

• **Emission Reduction Unit - ERU:** credit generated by the reduction of one tonne of greenhouse gas emissions by a JI project.

• **European Union Emissions Trading Scheme - EU ETS:** the European market for trading CO_2 allowances which set an emissions cap for more than 11,000 industrial installations.

• **Forest:** according to the Kyoto Protocol, a forest is land with a minimum area of 0.5- 1 hectare, with tree crown cover of 10% to 30% and a minimum height of 2-5 metres. Each country is then free to define more specific criteria as it sees fit.

• **Greenhouse gas - GHG:** the gaseous components of the atmosphere, both natural and manmade, that absorb and emit infrared rays. The 6 manmade greenhouse gases recognised by the Kyoto Protocol are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (SF6, PFC, HFC). In addition, CFC fluorinated gases are recognised by the Montreal Protocol.

• **Gross Domestic Product - GDP:** a measure of the value produced by a country. Converting this measure into purchasing power parity (ppp) enables comparisons between countries that are not affected by sudden currency exchange rate variations.

• **Intergovernmental Panel on Climate Change - IPCC:** a research group led by the World Meteorological Organisation and the UNEP (United Nations Environment Programme), in charge of organising the synthesis of scientific work on climate change.

• **Joint Implementation - JI:** set up by Article 6 of the Kyoto Protocol, JI promotes emissions reduction projects in the developed countries (listed in Annex I) financed by another developed country (listed in Annex I). The project developer obtains an ERU (Emissions Reduction Unit) credit for each tonne of carbon dioxide equivalent.

• **Land use, land use change and forestry - LULUCF:**

• **Mitigation:** a set of actions to reduce the concentration of greenhouse gases in the atmosphere by limiting emissions and increasing underground carbon storage capacities in the biosphere or in the oceans.

• **Registry:** in greenhouse gas markets, registries monitor the issuance, the transfers and the surrender to the regulatory authority of emission allowances. They also keep count of the verified emissions of regulated emitting entities.

• **Rent:** surplus income induced by ownership of a scarce good or a particular, non-reproducible aptitude (scarcity rent) or from occupying a privileged or strategic position (guaranteed rent).

• **United Nations Framework Convention on Climate Change - UNFCCC:** the Convention on Climate Change was signed at the Earth Summit in Rio de Janeiro in 1992 by 192 countries. It officially recognises the reality of climate change, proposes to prevent all human interference and stipulates the joint but differentiated responsibility of the countries.

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The Ten Principles of the United Nations Global Compact

HUMAN RIGHTS

Principle 1 Businesses should support and respect the protection of internationally proclaimed human rights; and

Principle 2 make sure that they are not complicit in human rights abuses.

LABOUR

Principle 3 Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;

Principle 4 the elimination of all forms of forced and compulsory labour;

Principle 5 the effective abolition of child labour; and

Principle 6 the elimination of discrimination in respect of employment and occupation.

ENVIRONMENT

Principle 7 Businesses are asked to support a precautionary approach to environmental challenges;

Principle 8 undertake initiatives to promote greater environmental responsibility; and

Principle 9 encourage the development and diffusion of environmentally friendly technologies.

ANTI-CORRUPTION

Principle 10 Businesses should work against corruption in all its forms, including extortion and bribery.

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