

ASSESSMENT AND CHALLENGES OF CARBON MARKETS

AVALIAÇÃO E DESAFIOS DOS MERCADOS DE CARBONO

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Abstract: Global warming, with its harmful effects, is one of the most crucial issues of the 21st century. States of the international community have responded to this challenge by resorting to an original instrument: tradable emissions permits for carbon and, as a direct consequence, the pollution rights markets. This article deals with the study of this hybrid instrument and is divided into three parts. The first part concerns the description and an assessment of the initial framework enshrined in the Kyoto Protocol (I). The second part provides an overview of the reactions triggered by the consecration of the approach put forward in the Protocol (II). On the basis of the various adopted measures, an outline of the alternative and feasible solutions will be drawn in the last section. In this regard, we will recommend an approach that would start from the carbon markets as they exist today but which would integrate them and coordinate the available social and institutional actors (civil society, NGOs, federated and local entities, etc.) through a mechanism of fungibility that would make the markets compatible with each other. From an operational point of view, this fungibility could occur by using new technologies such as blockchain (III).

Keywords: Global Warming, Kyoto Protocol, Paris Agreement, Carbon Markets, EU-ETS, blockchain, civil society.

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Resumo: O aquecimento global, com seus efeitos nocivos, é uma das questões mais cruciais do século XXI. Os Estados da comunidade internacional responderam a esse desafio recorrendo a um instrumento original: licenças de emissões negociáveis de carbono e, como consequência direta, os mercados de direitos de poluição. Este artigo trata do estudo deste instrumento híbrido e está dividido em três partes. A primeira parte diz respeito à descrição e avaliação do quadro inicial consagrado no Protocolo de Kyoto (I). A segunda parte fornece uma visão geral das reações desencadeadas pela consagração da abordagem proposta no Protocolo (II). Com base nas várias medidas adotadas, será delineado um esboço das soluções alternativas e viáveis na última seção. Nesse sentido, recomendaremos uma abordagem que começaria a partir dos mercados de carbono como eles existem hoje, mas que os integraria e coordenaria os atores sociais e institucionais disponíveis (sociedade civil, ONGs, entidades federadas e locais, etc.) por meio de um mecanismo de fungibilidade que tornaria os mercados compatíveis entre si. Do ponto de vista operacional, essa fungibilidade pode ocorrer usando novas tecnologias, como blockchain (III).

Palavras-chave: Aquecimento Global, Protocolo de Kyoto, Acordo de Paris, Mercados de Carbono, EU-ETS, blockchain, sociedade civil.

According to the United Nations (“the UN”), global warming has numerous dramatic environmental, social, and economic consequences. Among these, the main concerns are undoubtedly those associated with the rise in sea levels that will lead to multiple floods and the displacement of populations. This increase in temperature will also accelerate the hydrological cycle and reduce the quantity and quality of freshwater supplies. Finally, this progression will particularly affect the living conditions of the poorest amongst the Earth’s population to the extent that they will be the ones most exposed to the impacts of climate change, as they have fewer resources to allocate to the prevention and mitigation of its effects¹.

According to the Intergovernmental Panel on Climate Change (“the IPCC”)², human activities represent the main cause of global warming, and are particularly responsible for greenhouse gas emissions (“GHG”), including carbon; they are said to have caused the rise of temperatures to 1°C above pre-industrial levels. Therefore, the fight against global warming is demonstrably one of the most crucial global challenges of the 21st century in that the harmful consequences of global warming are innumerable and the solution to mitigate its effects requires a change in our production methods and lifestyles.

To date, to meet this unprecedented challenge, States of the international community and the European Union, as well as some sub-state actors, have chosen to resort to a newly devised regulatory instrument: tradable emissions permits for carbon and, as a direct consequence, the pollution rights markets. In other words, our political decision-makers have deemed this hybrid rights-market instrument, a true unidentified legal object (ULO)³, as the best method for attempting to tackle one of the great challenges of our time on which depends the survival of humanity and our planet. The study of this little-known mechanism (even though it is more than twenty years old) is the core of this article.

Although original at first glance, the system of pollution rights markets is not new. It was developed by the Canadian economist John Dales⁴, echoing the idea of Thomas Crocker (1966), who believed that “unless gross error on [his] part, markets *can be* used to implement any anti-pollution policy [one can] dream of”⁵. The Kyoto Protocol, and later the Paris Agreement—in addition to European Union law—have legally recognized this economic theory.

On the legal front, today we find ourselves in a pivotal period for the international fight against global warming: the Kyoto Protocol set targets for the initial period of 2008-2012, which was then extended until 2020, while the Paris Agreement, which entered into force in 2016, will have to take over for the post-2020 period. The Kyoto Protocol’s track record is unsatisfactory. The figures speak for themselves: according to the available data, GHG emissions covered by the Kyoto Protocol have increased by 30%⁶ to 50%⁷ since 1990. 2018 is said to have been a record year in terms of emitted CO₂ levels⁸. However, the protocol has had the merit of jump-starting a global process of carbon pricing and providing a legal framework within which to develop carbon markets. Since this instrument consists of time-bound commitments, subsequent COPs were organized to play a significant role in renewing them.

Still, these conferences have led to no substantial improvement in the carbon market; it was not until COP 21 in Paris (eighteen years later) that a new agreement was reached, whose ambition and concrete contribution to the fight against climate change extended the Kyoto system without actually bringing real innovation in this area.

In order to understand the current situation of the carbon markets and to find solutions for the future, this article will be divided into three parts. The first part concerns the description and an assessment of the initial framework enshrined in the Kyoto Protocol (I). The second part provides an overview of the reactions triggered by the consecration of the approach put forward in the protocol (II)⁹. On the basis of the various adopted measures, an outline of the alternative and feasible solutions will be drawn in the last section. In this regard, we will recommend an approach that would start from the carbon markets as they exist today but which would integrate them and coordinate the available social and institutional actors (civil society, NGOs, federated and local entities, etc.) through a mechanism of fungibility that would make the markets compatible with each other. From an operational point of view, this fungibility could occur by using new technologies such as blockchain (III).

I. The Kyoto Protocol

When the international community decided to tackle global warming as a whole, negotiations first focused on the reality of global warming, its intensity, causes, consequences, and extent. These matters, which are at the heart of the IPCC's work, are extensively discussed in the literature¹⁰ and will be only indirectly addressed in this article, which takes a look at the fight against global warming through the prism of the regulatory mechanisms proposed to remedy it.

It was not until the international community became aware of the gravity of the situation in the early 1990s, when the Earth Summit was held in Rio de Janeiro (1992), for a new dynamic to take hold. From amongst the adopted texts, two deserve special attention in the context of the fight against global warming. Firstly, the Rio Declaration, which advanced the concept of States' rights and responsibilities in the areas of environment and development by establishing the principle of “common but differentiated responsibilities”¹¹ (Principle 7). Secondly, the Framework Convention signed in Rio, which laid the foundation for international cooperation in the face of climate change and established an institutional framework with a very specific

type of governance: the Conferences of the Parties (“COP”). However, the only accepted coordination measure was the setting of quantified targets which did not make it a clear obligation for industrialized countries to stabilize, and even more so reduce, their GHG emissions, but merely established a legal and institutional framework for the gradual development of a more operational international system.¹²

1. An agreement on quantified targets but with flexibility to meet them

On the basis of the achievements of the Framework Convention¹³ and inspired by the principle of “common but differentiated responsibilities”, the International Conference held in Kyoto in 1997 put forward the specific objectives to be attained: industrialized countries (the United States, Canada, Japan, Member States of the European Union and countries of the former Eastern Bloc – referred to as “Annex I Parties”) committed themselves to reducing their GHG emissions by an average of 5.2% compared with 1990 reference levels¹⁴. Reaching this agreement, which was originally scheduled to end in 2012, but was extended until 2020, was only made possible through the establishment of three flexibility mechanisms¹⁵. Concurrently with the internal policy measures to reduce GHG emissions, these allow States subject to the obligations of the protocol to execute in another State the requirements imposed on it.

Firstly, the *Emission Trading Scheme* (Article 17 of the Kyoto Protocol), where each committed State is allocated, according to its emission reduction target, a certain amount of international emission allowances. Countries that do not use all their rights will be able to sell them. In this way, some countries will be able to buy the allowances they lack from other countries that have less difficulty meeting their emission reduction targets. This exchange mechanism is in the hands of the States and leads to the creation of a carbon market and the setting of a carbon price.

Secondly, the *Joint Implementation Mechanism* (Article 6 of the Kyoto Protocol) allows an industrialized country that has ratified the Kyoto Protocol to acquire emission credits from another State by financing reduction of GHG emissions projects not on its national territory, but on the territory of other industrialized countries which are also Parties to the Kyoto Protocol where reduction costs are lower.

Thirdly, the *Clean Development Mechanism* (Article 12 of the Kyoto Protocol) is a mechanism regulated and overseen by the United Nations that is greatly different from the Joint Implementation Mechanism. First of all, the investments are made by countries that have ratified the Kyoto Protocol on the territory of developing countries that are not subject to any mandatory reduction of GHG emissions. Furthermore, these investments create new rights that can be added to the emission allowances of the “financing” country and thus increase its emission rights. The operation of allocation of emission rights “is not a zero-sum game because in this case there is no exchange between the countries concerned, but only the creation of new emission credits the ‘financing’ country benefits from without a subtraction of credits from the financed country”¹⁶. In other words, this mechanism thus generates a “net inflation”, that is to say, beyond the “cap” on the number of emission credits. The 2016 Paris Agreement provides a new one intended to replace it, but since the discussions on this subject held in Poland last winter were unsuccessful, the matter was postponed to the next COP in 2019¹⁷ (see below).

The Kyoto Protocol thus creates a cap-and-trade system, by limiting the quantities of authorized emissions, with emissions allowance trading¹⁸. It should also be noted that with this market-oriented approach, it is mainly the American vision that is retained. This vision is strongly influenced by the business communities, which are not in favor of taxes and rely on the previous experience (since the 1990s) of the introduction of sulfur dioxide (SO₂) and nitric oxide (NO) emission allowances by the US energy sector in order to reduce acid rain. This situation is paradoxical as the United States has gone from being a leader in this field and a repository of conclusive experience to being a country that refused to ratify the Kyoto Protocol¹⁹.

2. A mixed record: an inefficient system and minimal political progress

In the words of a specialist on the subject, Christian de Perthuis: “in hindsight, it is clear that the [Kyoto] protocol has not delivered the expected results. [...] The emission trading scheme did not work [...]”²⁰

Commentators agree on the two main causes of this less than thrilling record: the lack of incentives for developing or non-Kyoto protocol countries to reduce their emissions and the lack of a long-term project²¹. The lack of incentives for non-Annex I countries is the result of the application of the principle of common but differentiated responsibility, which leads to the

exemption of developing countries from any obligation concerning the reduction of emissions. This situation is particularly problematic in the case of China, especially as it is now the second-largest country in the world by its nominal gross domestic product (GDP), possessing a very high growth rate (almost 7% in 2017) and it is the most important generator of CO₂. However, China is not subject to any obligation under the Protocol, it has benefited greatly from the clean development mechanism by receiving nearly 60% of flows²² and was the scene of numerous cases of fraud²³. It should be noted however that the situation has changed recently. Since 2017, the country has developed the largest carbon market covering more than three billion tons of GHG emissions²⁴.

The second cause, the lack of a long-term vision, pushed the actors into permanent negotiations—oftentimes hurried—which undermined the process because the negotiators lost sight of the most important and vital matter (global warming) and instead argued over the ancillary (such as financial transfers) during their numerous marathon meetings (COPs). It also pushed away the civil society that was not involved in these labyrinths of negotiations and texts with an unclear status (only at the UN level there were, in early 2015, more than 7,700 documents, a figure that has only grown after the Paris Agreement). This feeling is reflected in the United Nations' major global consultation, called *My World*, which aims to identify priorities for a better world. About 10 million people have completed the survey and it is striking to see that the fight against global warming is only 16th on the list of priorities²⁵.

Since the Protocol consists of time-bound commitments, it was necessary to renew and amplify the ones made in Kyoto. Let us briefly revisit the achievements and failures of the COPs that followed the ratification of the Kyoto Protocol.

The COP 15 in Copenhagen (2009), which was intended to find a solution for the post-Kyoto period, was negotiated under a cloud of confusion and led to the establishment of a system of “à la carte” commitments. The only positive outcome was that rich countries agreed to annually (from 2020 to 2100) devote US\$100 billion to developing countries. At COP 16 in Cancun²⁶ in 2010, an agreement was adopted but its only purpose was to give the Kyoto Protocol an extension²⁷ as soon as possible, without setting deadlines or deciding on its binding nature. The COP 17 in Durban the following year only allowed for an agreement on the commitment periods (2013-2020), while leaving the details to be determined, including the Parties' reduction objectives²⁸. The Doha Conference in December 2012 (COP 18) decided on

an extension of the Kyoto Protocol until 2020. However, three G8 countries (Japan, Russia, and Canada) refused to continue their reduction efforts within a framework that did not apply to China and the United States²⁹. The COP 19 in Warsaw and COP 20 in Lima mainly prepared the ground for COP 21 in Paris (see below).

II. Reactions to the Kyoto Protocol

The Kyoto Protocol's GHG reduction targets were ambitious; therefore, it was necessary to rely on other actors than States to even have a chance of achieving them. At the regional level, the European Union took the lead in establishing an emissions trading scheme through which European companies could exchange emission allowances (1). At the local level, numerous initiatives put forward by federated entities and cities have attempted to counterbalance the inaction of certain States (2). All this eventually influenced the States in the negotiations leading up to the Paris Agreement, the successor to the Kyoto Protocol (3).

1. The European Union, its directives and its trading scheme

Although initially opposed to the pollution rights market system, the European Union, eager to reach an agreement by any means necessary but divided and unable to propose a serious political alternative to the American position, resigned itself and adopted the approach by fixing quantities (cap-and-trade) to the detriment of the tax in order to put a price on carbon emissions³⁰. The initial American proposal became that of the Europeans, whereas it was abandoned on the other side of the Atlantic. Therefore, the European Commission had to devise and put in place the “Kyoto without the United States” plan³¹ in order to meet international commitments to reduce GHG emissions.

As part of its international obligations under the Kyoto Protocol³², the European Community (at that time) adopted a directive³³ in 2003 to set up an emissions trading scheme (“EU-ETS”). A new directive was passed in 2009³⁴ with the aim of improving and extending it. Recently, another directive – Directive 2018/410³⁵ – was adopted after lengthy negotiations with the Council and the European Parliament and came to modify the “original” 2003 directive. The adoption of this European system in March of last year is a testament to the Commission's ever-growing ambition, while also reminding States that they should keep increasing their efforts in order to reach their international goals regarding climate change.

Overall, the Union's system is based on two specific features. Firstly, since the Kyoto Protocol comprises objectives that vary depending on the socio-economic situation of each of the Member States³⁶, during the Marrakech Accords (COP 7 in 2001) the Union succeeded in obtaining the establishment of a “European bubble” that fits directly into the internal market-oriented approach. Indeed, with this “bubble”, the Union’s Member States pool their own obligations and set themselves a common objective (-8% compared to 1990)³⁷. Secondly, the EU-ETS introduced by the Directive mainly creates a market for emission allowances *between economic operators* and no longer between States³⁸. So, we move from a public international law approach to a market-oriented one. It is no longer a case of confining the matter to interstate relations but of transposing, as if by translation, the States’ international obligations directly to the issuing companies. More particularly, European legislation limits the emissions of more than 11.000 energy-intensive plants (power plants and the most polluting industries such as oil refineries or steel but also some aircraft operators) thus covering about 40% of GHG emissions³⁹.

Driven by a desire to make its market as fungible as possible, the Union adopted the Linking Directive (2004)⁴⁰ in order to join the mechanisms of the Kyoto Protocol with the Community scheme. In addition, since 2009, the scheme has been ultimately and primarily a system of auctioning allowances⁴¹ by the public authority⁴², a change from the initial free allocation. The revenues resulting from auctions must, in part, go towards meeting the objectives of the fight against global warming⁴³.

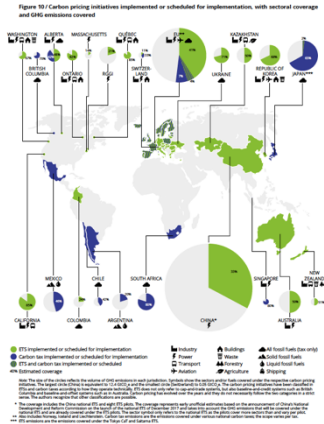
The 2018 directive finally set a target to reduce GHG emissions by at least 40% by 2030 compared to 1990 levels and enhanced the Union's ambitions for renewable energy sources and energy efficiency. This scheme also reinforced the market stability reserve created by the Council and the European Parliament in 2015 by inputting around 265 million allowances for the January to August 2019 period, which corresponds to a reduction of approximately 40% in the supply of allowances compared to the same period in 2018⁴⁴, thereby increasing the price.

These measures clearly signal the ambition and political will of the Commission in terms of global leadership⁴⁵ and the conquest of larger markets⁴⁶. Nevertheless, their concrete implementation still suffers from some imperfections. The European system has mainly been disseminated on the basis of the emission allowances exchange model, but neither the Kyoto protocol nor the European directives set a specific legal framework for the emissions trading

scheme (for example, sales by mutual agreement, through a broker, a bank, the creation of a financial center, etc.). This lack of direction has allowed market actors to control this policy through exchanges and the complexity of the mechanisms laid down in the directives has led buyers of carbon assets to turn to these exchanges in order to make the purchases and sales of allowances⁴⁷. This demonstrates a real financialization of the fight against global warming system. Within these exchanges, the price of the carbon allowance has fallen from €26 to less than €5 during the first phases of implementation of the EU-ETS.

Faced with this fall in prices and the negative consequences it has on the fight against global warming (facilitating the purchase of allowances and lack of economic incentives to resell them), the European institutions took action. They decided to reform the EU ETS and to create and strengthen the market stability reserve where unallocated or surplus allowances can be frozen. These measures seem to have succeeded—for now—in countering the weakness identified above. Since the adoption of the 2018 directive, carbon prices have indeed increased steeply, reaching around €20 in March 2019⁴⁸. Despite this, the carbon price has still not yet reached a high-enough level that would help effectively reduce the GHG emission rate. In fact, the High-Level Commission on Carbon Prices estimates that only a price between US\$40 and US\$80 per ton of CO₂ emitted would be likely—if reached in 2020—to have the required impact on the different economic actors to maintain the rise of temperatures below 2°C compared to pre-industrial levels⁴⁹.

2. Local initiatives



Faced with the inaction of certain States’ governments, multiple “bottom-up” initiatives have emerged throughout the years. In its 2018 report, the World Bank lists 25 trading schemes implemented or planned at the sub-state level⁵⁰.

Among the several initiatives, there is significant activity from federated entities consisting of federal States. Certain American, Canadian or Australian federated entities have decided to carry out their own actions to help the fight against global warming, given the apathy of their respective constituent states⁵¹. For the United States alone, a total of 28 states have developed climate plans and set targets for reducing their carbon emissions.

It is in this context that the pioneering *Regional Greenhouse Gas Initiative*⁵² (“RGGI”) was born in the 2000s. This mandatory program for power plants in nine states in the Northeast of the United States created an emissions market with the aim to reduce CO₂ emissions. Since 2008, allowances have been auctioned off and profits have been reinvested in energy efficiency projects and the development of renewable energies. A reform of the system⁵³ and a timetable for reducing quantities by 2.5% per year until 2020 have been undertaken to revitalize this project⁵⁴. In 2017, a new reform raised the RGGI’s level of ambition in two respects. On the one hand, it planned for a linear annual decrease in capped quantities⁵⁵. On the other hand, it established an “*Emissions Containment Reserve*” that should start operating from 2021, which is reminiscent of the European market stability reserve. However, the US mechanism is based on a trigger price system and therefore demands for allowances to be withdrawn from circulation in the event of the carbon price falling below US\$6 by 2021 (amount that will gradually increase after that)⁵⁶. New Jersey decided to join the initiative in 2018 and Virginia seems to be in the process of doing so, while Massachusetts, already a member of this program, has concurrently developed and implemented its own system of allowances exchange⁵⁷.

Resting upon regional carbon market initiatives, a transnational allowance system in this case, the *Western Climate Initiative* intended to bring together California, British Columbia, and Quebec, as well as a few other American states and Canadian provinces as observers. This market is aimed primarily at companies in the industrial and electricity sectors, as well as those operating in the fuel and fossil fuels sector. After experiencing some difficulties⁵⁸, the cap-and-trade system was established and the auctioning finally started in 2013, but only for Quebec⁵⁹ and California⁶⁰, with British Columbia preferring to play the carbon tax card to reduce its emissions. Finally, in May 2018, Nova Scotia joined California, Quebec, and Ontario in this initiative⁶¹, albeit the latter decided to withdraw in July⁶², after elections. This event still demonstrates the weakness of regional trading systems: their dependence on entities that agree to link their markets (and thus on the political figures that govern them) increases the risk of price volatility in the common market. A quick comparison raises the question of the impact of the United Kingdom’s exit from the Union on the EU-ETS and on the price of the emission allowance.

At the local level, let us highlight the *Mayors in action*⁶³ program, which brings together thousands of municipalities representing hundreds of millions of people. In May 2014, these cities signed an agreement (*Covenant of Mayors*)⁶⁴ through which they commit themselves to

developing and promoting renewable energy at their level of power. By February 2017, no less than 7200 municipalities representing more than 228 million inhabitants had signed this agreement. This program is not solely focused on this political ambition. It also offers a platform for best practices sharing, as well as technical and scientific assistance for the municipalities that request it.

Far from drawing up an exhaustive list, this section aims to demonstrate the extent of the actions undertaken by sub-state actors. It is proof of the scope of their influence.

3. The 2016 Paris Agreement

Given the world's major polluting powers' lack of enthusiasm and the European Union's inability to play a leadership role in international negotiations, the COP 21 in Paris was intended to be their last chance to reach an agreement on the issue. The text of the agreement thus reached⁶⁵ is, in our opinion, not as ambitious as what the organizers declared triumphantly. Let us return to its most prominent features.

The *objective* of this agreement, which will lead the fight against global warming for the post-2020 period, is now to limit the increase in the global average temperature to “*well below 2°C above pre-industrial levels*” and “*to pursue efforts to limit the temperature increase to 1.5°C*”, which would “*significantly reduce the risks and impacts of climate change*”.

The agreement calls for the establishment of national commitments to combat global warming (“nationally determined contributions”, Article 4). These commitments will be reviewed every five years, so for the first time in 2025. Their verification and sanction of non-compliance is based primarily on a transparency and reputation mechanism⁶⁶. In concrete terms, a committee of experts will have to check the information provided by the countries in terms of monitoring their emissions and publish the results. Peer and civil society pressure should encourage states to keep their promises⁶⁷. The Paris Agreement therefore lacks any other mechanism of control and sanction than that of “naming and shaming”.

With regard to carbon markets, Article 6 provides a basis for international cooperation to achieve the objective set by the Parties. This cooperation can take various forms, *including* that of a carbon market. Indeed, Article 6 can be divided into four parts, the last three

corresponding to as many possible methods of cooperation. The importance of this “new climate architecture”⁶⁸ makes it necessary to dwell on Article 6 and the mechanisms it identifies and establishes in order to better understand the impact of the Paris Agreement on carbon markets.

The first paragraph sets out the scope of Article 6 as a whole. It states that: “Parties recognize that some Parties choose to pursue voluntary cooperation in the implementation of their nationally determined contributions to allow for higher ambition in their mitigation and adaptation actions and to promote sustainable development and environmental integrity”⁶⁹. There are two points that we should look at here. First, the bottom-up approach characteristic of the Paris Agreement is clearly asserted in this paragraph: international cooperation is recognized (and not approved) and it operates on a voluntary (and non-binding) basis. Then, the procedures and mechanisms to which the article is referring target both the already existing cases of cooperation (such as the EU-ETS) and those that may emerge in the future. Article 6 of the Paris Agreement therefore does not focus exclusively on market mechanisms and provides a broader basis for action by States parties wishing to revise their rising climate ambitions.

The second and third paragraphs deal with Internationally Transferrable Mitigation Outcomes (ITMOs). They state: “Parties shall, where engaging on a voluntary basis in cooperative approaches that involve the use of internationally transferred mitigation outcomes towards nationally determined contributions, promote sustainable development and ensure environmental integrity and transparency, including in governance, and shall apply robust accounting to ensure, inter alia, the avoidance of double counting, consistent with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement [...] The use of internationally transferred mitigation outcomes to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties”⁷⁰.

Once again, the Parties emphasized the purely voluntary nature of the potential cooperation between them. In addition, several clarifications are necessary, but we will pay particular attention to the following three. First, these provisions do not create a carbon market or carbon pricing as such, but provide the opportunity for Parties to create such an international market if they so wish⁷¹. It should thus be noted that States are required to promote sustainable

development, guarantee environmental integrity and transparency in accordance with the CMA transparency guidelines and establish an accounting system to avoid double counting. In this respect, following the adoption of the agreement, Andrei Marcu already judiciously raised the question of “*whether the CMA, or a designated body, is foreseen as playing an active (regulatory?) role in [...] the transfer of mitigation outcomes*”⁷². Finally, it is important to highlight the lack of any indication as to how cooperation at the regional or sub-national levels should be integrated, even though this type of cooperation was explicitly featured in the Preamble of the Paris Agreement⁷³. Once again according to Andrei Marcu, who participated in the negotiations of Article 6 of the agreement, there is no reason to conclude that the latter does not allow such cooperation “*as long as they are coordinated/synchronized with the respective Party in accounting towards its NDC*”. In concrete terms, these paragraphs provide a framework for the accounting of transfers of mitigation results between Parties that are free to make such transfers if and as they wish to. Only in this context would they help with the establishment of a carbon market.

Paragraph 4 of Article 6 creates a “new flexibility mechanism”⁷⁴ often referred to as the successor of the Kyoto Protocol’s Clean Development Mechanism: the Mechanism for Sustainable Development which aims to “*contribute to the mitigation of greenhouse gas emissions and support sustainable development*”⁷⁵. Several more specific aspects are expanded on in paragraphs 5 and 6.

The *seventh paragraph* states that “*the Conference of the Parties serving as the meeting of the Parties to this Agreement shall adopt rules, modalities and procedures for the mechanism referred to in paragraph 4 of this Article at its first session*” (i.e. at COP 22). According to the Institute for Climate Economics, this mechanism “could allow for the emergence of a compensation mechanism that offers Parties the flexibility to use emission reductions achieved outside their jurisdiction, which could lead to the extension of this carbon price signal to other sectors and countries”⁷⁶.

Finally, *the last two paragraphs of Article 6* provide a framework for Parties wishing to cooperate on the basis of non-market approaches, in contrast to the 1997 Protocol which relied exclusively on market mechanisms to meet the needs for cooperation⁷⁷.

In conclusion, even though it does not in itself establish a carbon market, the Paris Agreement, and more specifically Article 6 (detailed above), is likely to play a facilitating and catalytic role in “the emergence of transnational approaches that directly or indirectly put a price on carbon”⁷⁸. In this respect, it follows the market-oriented approach that was legally recognized in 1997, while making certain changes that we should briefly highlight.

What most distinguishes the Kyoto Protocol from the Paris Agreement⁷⁹ also partially explains why the latter could be adopted at COP 21 and entered into force just as quickly⁸⁰. It is the fact that the agreement was elaborated using a bottom-up and more decentralized approach, while the Protocol operated on the basis of a top-down system and in a more centralized manner⁸¹. Therefore, the main issue at COP 21 was to find a way to ensure the long-term pursuit of GHG emission reduction targets. As a result, the Paris Agreement marks a major change from previous texts adopted by the Parties. It focuses more on developing methods and tools that can be mobilized to act in the long term. In other words, the Paris Agreement provides a structure in and through which stakeholders can develop their climate policy and action in order to achieve the common goal of limiting the increase of temperatures. This overlaps with the flexibility of the agreement. It should be noted, however, that although it does not explicitly mention sanctions, this instrument remains a treaty of international law (more specifically an additional protocol to the United Nations Framework Convention on Climate Change) to be executed in good faith by the Parties⁸².

In addition to this, while the Protocol provides that only industrialized countries are required to pursue a quantified GHG emission target, the Agreement requires all Contracting Parties to determine at the national level their contribution to the common goal of reducing GHG emissions. In the same vein, the two instruments display a desire for flexibility in the mechanisms put in place to enable the Parties to fulfill their obligations to the best of their ability, but it appears that the latter responds to this requirement more by offering the possibility to cooperate to all States Parties, regardless of their degree of development.

One thing is certain, as noted by the Institute for Climate Economics: “*On the whole, this new approach moves away from the binding framework advocated by the Kyoto Protocol and has the advantage of having promoted a number of commitments without precedent by state and non-state actors*”⁸³. Let us not forget, however, that this cooperative approach alone is not sufficient to achieve the objective of limiting the temperature increase to the 2°C set in the Paris

Agreement. It will be necessary to pay a great deal of attention to the concrete actions undertaken by the different actors involved in order to evaluate the effectiveness of the process—more acknowledged rather than actually implemented—of Article 6.

Before concluding this section, we should take note of the outcome of the last COP in Poland that took place at the end of 2018: the technical complexity and lack of political consensus on the issue of carbon markets and, more specifically, regarding the transferable emissions accounting system created to ensure the avoidance of double counting, led States to defer this delicate matter until the next COP⁸⁴.

In conclusion, on a global scale, the Protocol never truly worked because very few States were ready to *truly* play the game. The industrialized countries did not want to risk weakening their national economies and the less industrialized ones did not have sufficient incentives to pursue a less carbon-intensive development. The repeated major international negotiations made it possible to achieve a handful of limited agreements but above all demonstrated the inability of States to commit to quantified objectives whose violation would be accompanied by real punitive measures. By sanctioning the bottom-up regulatory process, the Paris Agreement marks a further step in the direction of the legally non-binding. Not all is doom and gloom, however, as evidenced by the evolution of the world situation in recent years. It is very obvious that it is increasingly difficult for leaders to explain to the civil society their opposition to a serious plan to fight global warming. The Kyoto Protocol, although it has not kept its promises, has the merit of existing, of setting in motion a dynamic and making it possible to set a price for carbon. As evidence, the Paris Agreement, its successor for the post-2020 period, attests to the relevance and preservation of this dynamic as it explicitly recognizes the existence and possibility of developing “cooperative approaches” that involve the use of transferred “mitigation outcomes”.

III. Active cooperation for better fungibility by means of new technologies

The Kyoto Protocol and its direct result, the carbon markets, have not kept their promises. Currently the vast majority of carbon at the global level is not tariffed (only 20% of global GHGs priced in 2018)⁸⁵ or is underpriced. The fight against global warming concerns everyone and therefore requires a joint effort. We believe that the only truly possible solution lies in the close collaboration between actors from different levels of government, the civil

society, and the business community. Without this cooperation, the fight against rising temperatures is doomed to fail or make very little progress. Social actors exist and the challenge is now to channel them to act as a real force for change. The aim of this last part is not to re-examine the fight against global warming using an idealistic and utopian approach, but to identify the beginnings of existing and promising solutions in order to correct current international and European systems by making them more efficient.

Better market fungibility is a necessary and indispensable step towards the improvement of the existing system. In other words, it is imperative to improve the interchangeability between this ensemble of carbon markets by ensuring the full preservation and inseparability of the benefits and obligations of emission rights as such or certificates covering them. This is a principle that ultimately posits the total legal equivalence of emission rights within a range of GHG emission trading systems⁸⁶. This idea is gaining further and further ground⁸⁷. It is based on the axiom of economic theory where the larger the market the more attractive it is. Finally, the various carbon markets should form a single global carbon market. For companies, linking would allow them to use allowances from other systems in order to achieve compliance. Once linked, prices in these different systems will converge until they are identical.

This increased fungibility will only be possible if an actor has the political will to coordinate the proliferation of existing initiatives by linking the markets. It takes a great deal of time to negotiate agreements between systems, as well as money to create the necessary market infrastructures, alongside a solid dose of diplomacy to convince the various stakeholders. The UN is the most natural actor, although the different COPs since the Kyoto Protocol, the lack of enthusiasm for the carbon markets issue in the Paris Agreement, and what could be described as procrastination of the States Parties in this regard at the last COPs, have raised concerns regarding the lack of efficiency and effectiveness of the current inter-state system. If the UN is not up to the task, then hopefully the European Union, which certainly has the means as well as the ambition, is able to impose itself on the international scene to play this role.

Whatever the resource actor, this coordination would in any case take the form of a progressive linkage between the carbon markets which could happen via the use of new technologies such as *distributed ledgers* (“distributed registers”), of which the most known type is that of the blockchain, used in particular for the creation of the *Bitcoin* cryptocurrency. The

blockchain is indeed an interesting tool whose mobilization seems necessary for the implementation of the political and legal framework of the fight against global warming.

The blockchain can be defined as “an information storage and transmission technology that is transparent, secure, and operates without a central control body. [This chain of blocks] constitutes a database that contains the history of all the exchanges made between its users since its creation. This database is secure and distributed: it is shared by its users, without intermediaries, which allows everyone to verify the validity of the chain”⁸⁸. Its distributed nature sets it apart from the “traditional” Internet that has developed around platforms and third-party control. Instead of having to go through an intermediary, contributors involved in creating a shared registry between different computers interact directly via the blockchain. The verification of the transferred content no longer takes place via a central actor but through a peer-to-peer network.

It should be noted that this characteristic of the *blockchain* is also what makes it a tool of choice for the implementation of the Paris Agreement. The Louis Bachelier Institute (“LBI”) in France thus promotes the use of blockchain and distributed ledger technology (DLT) to facilitate the implementation of the reporting framework provided by the Paris Agreement (based on the use of monitoring, reporting and verification tools). This project aims to facilitate the development of a strong framework for Nationally Determined Contributions and a two-degree pathway alignment strategy for non-state actors. According to *The Climate Chain* website, the use of this technology “*will build capital market confidence and help reach the Paris Accord target at both local and global levels through consensus methods and technical interoperability*”⁸⁹. Although still in the research phase, this reflection has the merit of highlighting the ability of the blockchain to serve as an infrastructure in which the various mechanisms involved in the fight against climate change, such as but not solely carbon markets, could develop.

It is also particularly interesting to see that this idea has also made its way into the field of climate governance, thanks to the leadership of the UNFCCC Secretariat. The latter has actually encouraged and facilitated the creation of the *Climate Chain Coalition*, which currently includes more than one hundred member organizations⁹⁰. This is an open global initiative that was launched during the 2017 One Planet Summit and which resulted in the adoption of a

Charter comprised of nine principles, including one on technological neutrality and one on the harmonization of the actions of the coalition with the long-term goals of the Paris Agreement⁹¹.

Finally, we should also mention the practical benefits of the blockchain for effective climate action. Massamba Thioye, who is leading UN Climate Change's work exploring blockchain, believes that this technology and DLTs could “*strengthen monitoring, reporting and verification of the impacts of climate action; improve transparency, traceability and cost-effectiveness of climate action; build trust among climate actors; make incentive mechanisms for climate action accessible to the poorest [and] support mobilization of green finance*”⁹².

Specifically, the blockchain could be used to improve carbon trading; some argue for the free use of *digital ledgers* as a platform for networking carbon markets so as to achieve the objectives of the Paris Agreement⁹³. This type of usage is not purely hypothetical: IBM and the *Energy Blockchain Lab* are collaborating on the development of an emission allowances trading platform in China. The blockchain also facilitates, as the Belgian experiment has demonstrated⁹⁴, the peer-to-peer exchange of renewable energy within a decentralized system whereby the consumer and inefficiency costs are reduced. Particularly relevant when it comes to the carbon market, blockchain technology and *smart contracts* that can be concluded by making use of it make it possible to convert the generated low-carbon energy into carbon credits and to sell them or, conversely, buy them on the market so as to offset a polluting activity. In this way, the blockchain would make possible the implementation of allowance trading and allow for better fungibility. This technology would also promote the development of *crowdfunding* and disintermediated financial transactions (peer-to-peer) in support of climate action. Finally, the use of blockchain is likely to help with the monitoring and reporting of GHG emissions and the avoidance of double counting, thereby contributing to the establishment of a strong transparency mechanism, as envisaged in the Paris Agreement⁹⁵.

Conclusion

A realistic approach is needed: a unique, fast and easy solution to counter the effects of global warming does not exist. The problem of climate change is global, and as such its solution must also be developed on a global scale.

In terms of available solutions, we believe that it would be unrealistic to suddenly break with the market-oriented approach which the international community has employed for the past twenty years. As imperfect as it may be, this system has the merit of already existing and is something that has never been done before. This sentiment is reinforced by the observation that the actors aspire to a clear and sustainable system which they can trust so that they can invest their energy in these carbon markets. In our opinion, the key to the success of this global public policy therefore rests more upon the improvement of the existing system.

We believe that it is necessary for this improvement to involve both the coordination and the linking of various existing initiatives, of which we have briefly presented the most noteworthy. Fungibility would be the legal equivalent. However, even if this solution appears to be the most realistic, a political decision is necessary to link the markets and an arbitrator must be chosen, one who will have to guarantee that the rules of the game are being followed and who will also vouch for the integrity of the allowance: the common currency. The European example of linkage with the flexibility mechanisms resulting from the Kyoto Protocol and the countries of the European Economic Area is in this respect enlightening and demonstrates the feasibility of the operation, but also illustrates the numerous difficulties encountered in its concrete implementation. Concurrently, the efforts of the civil society and the rise of new technologies such as the blockchain represent a solution, if not alternative then at least complementary, to the traditional interstate approach.

The strengthening of existing carbon markets, the development of new allowance trading systems and the combination of all these, aided by the use of new technologies and controlled by a globalized civil society whose political power can no longer be overlooked, constitute, in our view, the way forward in the fight against global warming.

¹ For more details, see <http://www.un.org/fr/climatechange/consequences.shtml>

² The IPCC is an intergovernmental body, open to all member countries of the United Nations, established in 1988 in order to provide detailed assessments of the state of scientific, technical and socio-economic knowledge of climate change, its causes, its potential impacts, and response strategies - <https://www.ipcc.ch>

³ For an analysis of the legal nature of quotas, see CHENEVIÈRE (C.), *Le système d'échange de quotas d'émission de gaz à effet de serre. Protéger le climat, préserver le marché intérieur*, Brussels, Bruylant, 2018, p. 193 to 243.

⁴ DALES (J. H.), *Pollution, Property & Prices*, Université de Toronto, 1968.

⁵ *Ibid.*, p. 100.

⁶ VIRLOUVET (G.), *Vingt ans de lutte contre le réchauffement climatique en France : bilan et perspectives des politiques publiques*, http://www.eesc.europa.eu/ceslink/resources/docs/2015_12_lutte_rechauffement_climatique1.pdf, April 2015, p. 13.

⁷ International Energy Agency.

⁸ <http://www.lefigaro.fr/sciences/2018/12/05/01008-20181205ARTFIG00331-nette-reprise-des-emissions-de-co2-en-2018.php>

⁹ These first two parts (I and II) update and complete certain sections of the article VAN WAEYENBERGE (A.) « Lutter contre le réchauffement climatique : le cas des marchés carbone », in C. Bricteux et B. Frydman (dir.), *Les grands défis du droit global*, Brussels, Bruylant, 2017, p. 115 to 147.

¹⁰ For detailed studies on these topics, see, *inter alia*, the work of the IPCC (http://www.ipcc.ch/home_languages_main_french.shtml) but also ENCINA DE MUNAGORRI (R.) (dir.), *Expertise et gouvernance du changement climatique*, Paris, LGDJ, 2009 ; MASLIN (M.), *Climate Change: a very short introduction*, Oxford, OUP, 2014, 5th edition.

¹¹ The principle of “common but differentiated responsibilities” can be defined “as a legal technique that consists of modulating the conventional obligations of States according to the level and needs of their development” and is justified “by their unequal contribution to the degradation of the environment on the one hand, and the acknowledgement that their respective economic situation must be taken into account on the other”, see BADABI (G.), *Le principe de responsabilités communes mais différenciées dans les conventions de droit international de l’environnement*, 2016, <https://www.village-justice.com/articles/principe-des-responsabilites-communes-mais-differenciees-dans-les-Conventions,23303.html>

¹² PALLEMAERTS (M.), *La Communauté européenne comme partie contractante au Protocole de Kyoto*, Am-Env., 2003, special number, p. 16 ; OUHARON (A.), *Les négociations sur le climat : un bref retour sur l’histoire*, Flux 2002/2-3, N° 48-49, p. 100.

¹³ This Convention is currently comprised of 197 Parties (including the European Union).

¹⁴ 8% for the European Union, 7% for the United States, and 6% for Japan.

¹⁵ HAUSER (J.) and MIGEOT (C.), *Les fonds d’investissement carbone ou de la commercialisation du droit de l’environnement*, ACE, November 2006, p. 22. For a detailed study, see DELAISSE (P.), SEPULCHRE (P.), WINZEN (R.), FREESTONE (D.) and STRECK (D.), *Legal aspects of implementing the Kyoto Protocol mechanisms: making Kyoto work*, New York, OUP, 2005 ; DENIS (B.), *La procédure de validation du ‘mécanisme pour un développement propre’ comme instrument de la gouvernance du climat*, ENCINA DE MUNAGORRI (R.) (dir.), *op. cit.*; from p. 131.

¹⁶ HAUSER (J.) and MIGEOT (C.), *op. cit.*, p. 22.

¹⁷ <https://www.carbonbrief.org/cop24-key-outcomes-agreed-at-the-un-climate-talks-in-katowice> (consulted on March 16, 2019)

¹⁸ In this regard, see COUPRY (P. M.), *Réduction des pluies acides aux USA: succès du marché*, available on the website www.novethic.fr ;

¹⁹ The federal Waxman-Markey Bill (2009) opened new perspectives and brought the United States closer to the Kyoto Protocol. Although it had received a majority of favorable votes in the House of Representatives, the Senate voted against it and the Protocol was never ratified.

²⁰ DE PERTHUIS (C.) and TROTIGNON (R.), *Le climat, à quel prix? La négociation climatique*, Paris, Odile Jacob, 2015, p. 78.

²¹ *Ibid.*, p. 79.

²² *Ibid.*, p.78.

²³ See, *inter alia*, <http://www.blogueaqlpa.com/2015/12/10/mecanisme-de-developpement-propre-mdp-en-quete-dun-nouveau-modele/>

²⁴http://www.fondation-tuck.fr/upload/docs/application/pdf/2017-09/vf_panoramamondialoutilseconomiques_bat.pdf

²⁵ <http://data.myworld2015.org>

²⁶ BUCHNER (B.), *Le retour des négociations à Cancún*, Tendances Carbone, January 2011, n° 54.

²⁷ United Nations, Report on the sixth session of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, held in Cancún from November 29 to December 10, 2010, United Nations Framework Convention on Climate Change, FCCC/KP/CMP/2010/12/Add.1, Cancún, 2010.

²⁸ United Nations, Report of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its seventh session, held in Durban from November 28 to December 11, 2011; United Nations Framework Convention on Climate Change, FCCC/KP/CMP/2011/10/Add.1, Durban, 2011.

²⁹ DE PERTHUIS (C.) and TROTIGNON (R.), *op. cit.*, p. 79.

³⁰ CRIQUI (P.), FARACO (B.) and GRANDJEAN (A.), *Les Etats Carbone*, Paris, PUF, 2009, pp. 182 and 183.

³¹ BIAVA (A.), *L'Union européenne face aux défis de l'énergie et du changement climatique : bilan du Conseil européen des 8-9 mars 2007*. Revue du Marché commun et de l'Union européenne, May 2007, n° 508, p. 286 to 293 ; CRIQUI (P.), *Au cœur du futur régime climatique international: taxes ou quotas CO2*, Working paper, n°4/2009, p. 3, available on the website of the laboratory for the economics of production and international integration lepui.upmf-grenoble.fr/IMG/pdf/NT4_PC_au-coeur_2009.pdf ; KURKOWSKI (S.), *Distributing the right to pollute in the European Union: efficiency, equity, and the environment*, New York University Environmental Law Journal, 2006, from p. 701.

³² Council Decision 2002/358/EC, April 25, 2002, on the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the Joint Implementation of the ensuing commitments (OJ L 130, p. 1).

³³ Directive 2003/87/EC of the European Parliament and the Council, October 13, 2003, establishing a scheme for greenhouse gas emission allowance trading within the Community and amending the 96/61/EC Council Directive (OJ L 275, p. 32), respectively.

³⁴ Directive 2009/29/EC of the European Parliament and the Council, April 23, 2009, amending Directive 2003/87/EC to improve and extend the Community system for the trading of greenhouse gas emission allowances (OJ L 140, p. 63).

³⁵ Directive (EU) 2018/410 of the European Parliament and the Council, March 14, 2018 amending Directive 2003/87/EC in order to enhance the cost-effectiveness of emission reductions and to encourage low-carbon investments and Decision (EU) 2015/1814 (OJ L 76, p. 3).

³⁶ This way, Germany must reduce its emissions by 21% while Spain is allowed to increase them by 15%.

³⁷ See PALLEMAERTS (M.), *La Communauté européenne comme partie contractante au Protocole de Kyoto*, Am-Env., 2003, special number, from p. 16.

³⁸ The Directive also provides for the possibility for 'private persons' to participate in the European carbon market by opening an account in the registers in order to buy, sell, or cancel the allowances acquired.

³⁹ The inclusion of certain sectors of activity in the European carbon market and the exclusion of others has been the subject of political choices that were unsuccessfully challenged before the European Court of Justice: C-127/07, *Arcelor Atlantique et Lorraine e.a.*, ECLI:C:2008:728.

⁴⁰ Directive 2004/101/EC of the European Parliament and the Council, October 27, 2004, amending Directive 2003/87/EC under the Kyoto Protocol project mechanisms (OJ L 338, p. 18).

⁴¹ For an analysis of the auction process in the European context, see CRIQUI (P.), FARACO (B.) and GRANDJEAN (A.), *Les États Carbone*, Paris, PUF, 2009 *op. cit.*, p. 195 et 196 ; DE SADELEER (N.), *Environnement et marché intérieur*, Commentary by J. Mégret, Les Éditions de l'Université de Bruxelles, 2010, from p. 307. See also the numerous preparatory documents for the establishment of this auction system on the website http://ec.europa.eu/clima/policies/ets/auctioning/third/documentation_en.htm. Free allowances will however exist for sectors where there are risks of carbon leakage - 2014/746/EU: Commission Decision of October 27, 2014 establishing, in accordance with Directive 2003/87/EC of the European Parliament and the Council, the list of sectors and sub-sectors considered to be at significant risk of carbon leakage for the period 2015-2019, the validity of which has been extended until 2020 by the 2018 Directive. The current list can be consulted at: <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32014D0746>

⁴² This auctioning decision therefore leads to the disappearance of the NAPs, which will be replaced by a single Union-wide cap, which will be revised downwards according to a linear trend that will continue beyond the end of the third exchange period (2013-2020).

⁴³ Such as the creation of a Global Fund for the promotion of efficiency and renewable energies or the development of energy efficiency and insulation (article 10, paragraph 3 of the Directive 2009/29).

⁴⁴ *Report on the functioning of the European carbon market*, COM(2018), 842 final, p. 5

⁴⁵ Recital 24.

⁴⁶ Recitals 41 and 42.

⁴⁷ HAUSER (J.) and MIGEOT (C.), *op. cit.*, November 2006, p. 26.

⁴⁸ <https://www.theice.com/products/197/EUA-Futures/data?marketId=5115274&span=3> (consulted on March 16, 2019)

⁴⁹ Report of the High-Level Commission on Carbon Prices, May 2017, p. 50.

⁵⁰ *State and Trends of Carbon Pricing 2018*, a report of the World Bank, Washington DC, May 2018, p. 39.

⁵¹ NB: Canada and Australia have recently become more active and are showing political will towards carbon pricing.

⁵² <http://www.rggi.org>

⁵³ For a presentation of the reforms, see https://www.rggi.org/docs/PressReleases/PR130207_ModelRule.pdf; for an overview of the RGGI policy since 2017, see https://www.rggi.org/sites/default/files/Uploads/Design-Archive/Model-Rule/2017-Program-Review-Update/2017_Model_Rule_revised.pdf

⁵⁴ AYKUT (S.) and DAHAN (A.), *Gouverner le climat ? 20 ans de négociations internationales*, Paris, Presses de SciencesPo, 2014, p. 203 and 204.

⁵⁵ <http://www.c2es.org/content/regional-greenhouse-gas-initiative-rggi/> (consulted on March 16, 2019)

⁵⁶ <https://www.rggi.org/program-overview-and-design/elements> (consulted on March 16, 2019)

⁵⁷ *State and Trends of Carbon Pricing 2018*, a report of the World Bank, Washington DC, May 2018, p. 51.

⁵⁸ AYKUT (S.) and DAHAN (A.), *op. cit.*, p. 204.

⁵⁹ For a description of the evolution of the situation viewed through the lens of the Quebec authorities, see <http://www.mddelcc.gouv.qc.ca/changements/carbone/WCI.htm>

⁶⁰ The most successful domestic initiative was setup in California in 2006 through the *Global Warming Solutions Act*. This carbon market, launched in 2013, aims to meet the objective of the Kyoto Protocol, i.e. to reduce the emission levels to those of 1990 for 2020. For California, it would be a reduction of 15% from the 2006 levels. For a study of California's policies, see, MALACZINSKI (J.) and DUANE (T.), *Reducing Greenhouse Gas Emissions from Vehicle Miles Traveled: Integrating the California Environmental Quality Act with California Global Warming Solutions Act*, 36 *Ecology L.Q.*, 2009, p. 71 to 135 and AYKUT (S.) and DAHAN (A.), *op. cit.*, p. 205.

⁶¹ <https://icapcarbonaction.com/en/news-archive/552-nova-scotia-joins-the-western-climate-initiative-inc>

⁶² <https://californiacarbon.info/tag/western-climate-initiative-wci/> . For other situations in which policy changes have impacted the trading scheme, see *State and Trends of Carbon Pricing 2018*, a report of the World Bank, Washington DC, May 2018, pp. 25 and 26.

⁶³ <http://www.mayorsinaction.eu/home/> - a relatively similar action of more than 200 mayors was born in the USA and was in line with the objectives of the Kyoto protocol.

⁶⁴ For an analysis of this commitment, see RANGONE (N.), *The Nature and Role of SEAPS for Environmental Regulation in the Multilevel Planning System*, N. Rangone and J. Ziller (dir.), *Policies and Regulations for Local Sustainable Development. The Covenant of Mayors*, Editoriale Scientifica, 2013, pp. 65-82.

⁶⁵ For an excellent analysis of the stakes of COP 21, see DE PERTHUIS (C.) and TROTIGNON (R.), *op. cit.*, p. 65 to 120.

⁶⁶ On this matter, see BARNETT (M.) and DUVALL (R.) (dir.), *Power in Global Governance*, Cambridge, MA, Cambridge University Press, 2005.

⁶⁷ Find out more on http://www.lemonde.fr/cop21/article/2015/12/14/cop21-un-compromis-guide-par-la-justice-climatique_4831575_4527432.html#RpipVvSHhXDXrFq.99

⁶⁸ *Decoding article 6 of the Paris Agreement*, document of the Asian Development Bank, April 2018, <https://www.adb.org/sites/default/files/publication/418831/article6-paris-agreement.pdf> , p. vii.

⁶⁹ Paris Agreement, art. 6, §1.

⁷⁰ Paris Agreement, art. 6 §§2 and 3.

⁷¹ MARCU (A.), *Carbon Market provisions in the Paris Agreement (Article 6)*, research paper for the International Center for Climate Governance, February 2016, p. 6.

⁷² *Ibid.*, p. 8.

⁷³ Paris Agreement, recital 15: “Recognizing the importance of the engagements of all levels of government and various actors, in accordance with respective national legislations of Parties, in addressing climate change”.

⁷⁴ BULTHEEL (C.), MOREL (R.) and ALBEROLA (E.), *Gouvernance du climat & Accord de Paris : le pari audacieux de la coopération transnationale*, climate point n° 40 of the Institute for Climate Economics (I4CE), November 2016, p. 5.

⁷⁵ Paris Agreement, art. 6, §4.

⁷⁶ DAHAN (L.), VAIDYULA (M.), AFRIAT (M.) and ALBEROLA (E.), « L'Accord de Paris : un nouveau cadre international visant à faciliter l'adoption de politiques de tarification du carbone », climate point n°39 of the Institute for Climate Economics (I4CE), April 2016, p. 6.

⁷⁷ BULTHEEL (C.), MOREL (R.) and ALBEROLA (E.), *op. cit.*, p. 7

⁷⁸ DAHAN (L.), VAIDYULA (M.), AFRIAT (M.) and ALBEROLA (E.), *op. cit.*, p. 5.

⁷⁹ In this regard, see *Decoding article 6 of the Paris Agreement*, document of the Asian Development Bank, April 2018, <https://www.adb.org/sites/default/files/publication/418831/article6-paris-agreement.pdf>, pp. 5 and 6.

⁸⁰ It entered into force in November 2016 when the required double majority was reached (ratification, acceptance, approval or compliance by at least 55 countries representing at least 55% of global emissions).

⁸¹ *Decoding article 6 of the Paris Agreement*, document of the Asian Development Bank, April 2018, <https://www.adb.org/sites/default/files/publication/418831/article6-paris-agreement.pdf>, p. 6

⁸² Vienna Convention on the Law of Treaties (1969), art. 26.

⁸³ BULTHEEL (C.), MOREL (R.) and ALBEROLA (E.), *op. cit.*, p. 1.

⁸⁴ <https://www.carbonbrief.org/cop24-key-outcomes-agreed-at-the-un-climate-talks-in-katowice>

⁸⁵ *State and Trends of Carbon Pricing 2018*, a report of the World Bank, Washington DC, May 2018, p. 17.

⁸⁶ LEBLANC (B.), *Le Protocole de Kyoto et le marché du carbone : vers une fongibilité asymétrique à l'échelle internationale*, 2005, Master's thesis available at www.archipel.uqam.ca/1982/1/M9160.pdf

⁸⁷ A discussion forum promoting the search for means to link the different markets has recently been created. It brings together a group of national and international civil servants, as well as university professors – www.icapcarbonaction.com

⁸⁸ <https://blockchainfrance.net/decouvrir-la-blockchain/c-est-quoi-la-blockchain/>

⁸⁹ <http://www.theclimatechain.org>

⁹⁰ <https://www.climatechaincoalition.io/membership-list> (consulted on 29th of October 2019)

⁹¹ <https://unfccc.int/news/un-supports-blockchain-technology-for-climate-action>

⁹² Idem..

⁹³ See JACKSON, (A.), LLOYD, (A.), MACINANTE, (J.) and HUWENER (M.), *Networked Carbon Markets: Permissionless Innovation with Distributed Ledgers?*, 2017; online at: <https://ssrn.com/abstract=2997099>

⁹⁴ This is the NRGcoin concept developed by the Free University of Brussels (VUB), as part of the European Scanenergy project; see <http://nrgcoin.org/about>

⁹⁵ *How Blockchain Technology Could Boost Climate Action*, June 2017, <https://unfccc.int/news/how-blockchain-technology-could-boost-climate-action>

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