

CARBON MARKETS AND BLOCKCHAIN TECHNOLOGY

Abstract: *The present study analyses one of the mitigation measures that has been proposed first under the Kyoto Protocol and what effects has it had to enhance climate action. Furthermore, we will have a look over the mechanisms that have been developed for this measure to be implemented and what legal issues have appeared. The main question that I will try to answer is if it has indeed had a positive effect and if the greenhouse gas emissions have gone down. If not, can we implement a system that by using blockchain technology we will get the wanted results? By analyzing the legal barriers of applying such a new technology I will try to determine the opportunity of such a measure and the legal frame that should exist for this to function.*

Key words: *blockchain technology, carbon markets, climate action, greenhouse gas emissions, international treaties, mitigation measures.*

1. Climate change

1.1. Notion

The Industrial Revolution marked a major turning point in Earth's ecology and humans' relationship with their environment. It dramatically changed every aspect of human life and lifestyles. From human development, health and life longevity, to social improvements and the impact on natural resources, public health, energy usage and sanitation, the effects were profound. It wasn't that the Industrial Revolution became a stalwart juggernaut overnight. It started in the mid-1700s in Great Britain when machinery began to replace manual labor. Fossil fuels replaced wind, water and wood, used primarily for the manufacture of textiles and the development of iron making processes.

Unfortunately, in our search of strong economic development and technology improvement we have mistreated a very important element of our life, the environment. More than 200 years of fast-forward movement, where we have witnessed huge changes in the society's structures and lifestyle of the peoples has also caused an increase in the concentration of greenhouse gases in the atmosphere which slowly lead the climate to change.

Climate change is a complex problem, which, although environmental in nature, has consequences for all spheres of existence on our planet. It either impacts on – or is impacted by – global issues, including poverty, economic development, population growth, sustainable development and resource management.

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In the present moment, there is a conceptual error being made when economic growth is equated with environmental degradation, or at the very least, with the increasing consumption of the Earth's resources. Despite their close connection in the past, it is theoretically possible to have limitless economic growth on a finite planet.

I believe, these years to come are crucial decision-making years and any mechanisms we will use will either help us enhance climate action or will determine even worse climate change consequences that we have not experienced till now. The biggest "enemy" is the growing level of greenhouse gas emissions. In March 2019 the level of CO₂ emissions reached the highest point after the Industrial Revolution, 411.66 ppm. This is a sign, that with all the discussions, treaties and partially applied measures we still did not manage to peak the emissions level.

Without serious policy changes, scientists expect devastating consequences in many regions: inundation of coastal cities; greater risks to food production and, hence, malnutrition; unprecedented heat waves; greater risk of high-intensity cyclones; many climate refugees; and irreversible loss of biodiversity. Some international relations scholars expect increased risk of violent conflicts over scarce resources due to state breakdown.²

The sensitivity of such a topic is highlighted in one of my favorite scientific books called "The Medea Hypothesis: Is Life on Earth Ultimately Self-destructive?" by Peter Ward. The main theory debated in the book is the Gaia hypothesis which states that biological processes should tightly regulate the composition of the atmosphere and therefore keep it relatively stable (not see appreciable changes in oxygen or carbon dioxide levels over time). The author conducted numerous researches in the ice caps of the planet and found out that this is not quite the case. On the contrary, it showed that has been a 35% increase in the atmospheric CO₂ since preindustrial times but rates of carbon uptake into the biosphere have accelerated by only about 2%. This tell us that even if the planet has carbon sinks and can indeed keep a balance, it is only till a crucial point, when the emissions go over a certain level, different natural processes of destruction start. Horror cases of mass extinctions are being presented in the book as an effect of the high levels of greenhouse gases.

1.2. International treaties

After the Second World War, the rising levels of greenhouse gases have triggered big debates on the international stage. Because of the reports and the concerns of the scientists, in 1961 the United Nations General Assembly called on the World Meteorological Organization (WMO) and the non-governmental

² Andrei Marcu (2017). Governance of Article 6 of the Paris Agreement and Lessons Learned from the Kyoto Protocol. p. VII. Center for International Governance Innovation. Fixing Climate Governance Series. Paper no.4.

International Council for Science (ICSU) to collaborate in developing the new scientific and technological opportunities for monitoring, predicting and eventually controlling, weather and climate and triggered the twin birth of the WMO World Weather Watch and the WMO/ICSU Global Atmospheric Research Program (GARP).

More years and more conferences after, a text for the UN Framework on Climate Change Convention was drafted and got signed by 155 countries at the Rio Earth Summit in June 1992. The signing of this convention marked an important step in bringing even more awareness of the consequences of greenhouse gas emissions. Several guiding measures were developed to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects but it seemed to be more of a recommendation than an actual obligation.

Unfortunately, by the year 1997 it was clear that things are moving at a very slow pace, with not much impact to be felt. On the contrary, the levels of greenhouse gases kept on rising. A stronger effect was needed, so at the 3rd Conference of Parties in December 1997 which took place at Kyoto, Japan a new protocol was shaped, the Kyoto Protocol.

The Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits its Parties by setting internationally binding emission reduction targets³. Owing to a complex ratification process, it entered into force on 16 February 2005.

One important new element needs to be highlighted and that is the establishment of flexible market mechanisms, which are based on the trade of emissions permits. Kyoto Protocol Parties bound to targets are required to meet them largely through domestic action – that is, by reducing their emissions at home. But they can meet part of their targets through three market-based mechanisms that ideally encourage greenhouse gases abatement to start where it is most cost-effective, for example, in the developing world. It does not matter where emissions are reduced, if they are removed from the atmosphere.

The three economically viable, flexible supplementary mechanisms established “to reduce the emission of certain harmful anthropogenic gases” are: the emissions trading system (ETS), the clean development mechanism, (CDM) and joint implementation (JI).

Even if a more complex solution plan was developed, years after the entering into force of the Kyoto Protocol (2005), the international governing bodies and scientists were getting information about the impact and raising level of greenhouse gas emissions. In the frame of all these acknowledgments, the Paris Agreement was being negotiated by representatives of 196 state parties at the 21st Conference of the Parties of the UNFCCC in Le Bourget, near Paris, France, and was adopted by consensus on 12 December 2015.

³ What is the Kyoto Protocol? retrieved from <https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/what-is-the-kyoto-protocol>

As of July 2018, 195 UNFCCC members have signed the agreement, and 180 have become party to it. The Paris Agreement's long-term goal is to keep the increase in global average temperature to well below 2°C above pre-industrial levels; and to limit the increase to 1.5°C, since this would substantially reduce the risks and effects of climate change. “Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production while making finance flows consistent with a pathway towards low greenhouse gas emissions and climate resilient development are the other 2 goals set up in order to fight climate change⁴”.

As emissions reduction is accepted as a mechanism for abating global warming to internationally accepted levels, the UNFCCC Conference of the Parties held in December 2015 (“COP 21”) heralded the shift in focus, scope and solutions to address the ultimate impact of increasing GHG emissions to respond to the potentially physically, economically and socially catastrophic consequences of climate change. Even more, the Paris Agreement is further reaching than the Kyoto Protocol, aiming to strengthen the ability of countries to deal with the impacts of climate change through ‘appropriate financial flows, a new technology framework and an enhanced capacity building framework’ to support action by developing countries and the most vulnerable countries ‘in line with their own national objectives’. Under the Paris Agreement, each participating country is required to establish a nationally determined contribution (“NDCs”), which outlines its objectives to combat climate change. Importantly, and in contrast to the Kyoto Protocol, NDCs are a ‘best efforts’ commitment and not legally-binding.⁵

2. Emissions trading system (Carbon markets)

2.1. Notion

Under the Kyoto Protocol, countries' actual emissions must be monitored, and precise records must be kept of the trades carried out. Registry systems track and record transactions by Parties under the mechanisms. The UN Climate Change Secretariat, based in Bonn, Germany, keeps an international transaction log to verify that transactions are consistent with the rules of the Protocol. Reporting is done by Parties by submitting annual emission inventories and national reports under the Protocol at regular intervals.⁶

As we saw in the previous chapter, the parties with commitments under the Kyoto Protocol have accepted targets for limiting or reducing emissions. These

⁴ Art. 2 of the Paris Agreement;

⁵ Tallat Hussain, Ingrid York and James Read. (2016). What is the future of emissions trading? White&Case. Environment&Climate Change Report.

⁶ What is the Kyoto Protocol? retrieved from <https://unfccc.int/process-and-meetings/the-kyoto-protocol/what-is-the-kyoto-protocol/what-is-the-kyoto-protocol>.

targets are expressed as levels of allowed emissions, or “assigned amounts”, over the 2008–2012 commitment period. The allowed emissions are divided into “assigned amount units” (AAUs). The mechanism thought allows countries which have spare emission units (carbon credits) to sell them to other countries that are over their target.

As an effect of the Kyoto protocol, a new commodity has been established in the form of emissions removals. Because the main greenhouse gas traded is carbon dioxide, the mechanism received the name of carbon market.

“More than actual emissions units can be traded and sold under the Kyoto Protocol’s emissions trading scheme. The other units which may be transferred under the scheme, each equal to one ton of CO₂, may be in the form of: a removal unit (RMU) based on land use, land-use change and forestry (LULUCF) activities such as reforestation; an emission reduction unit (ERU) generated by a joint implementation project; a certified emission reduction (CER) generated from a clean development mechanism project activity;⁷”

All transfers and acquisitions of these units are tracked and recorded through the registry systems under the Kyoto Protocol.

2.2. Effects

None of the treaties or measures had a significant impact; on the contrary they offered a lot of opportunities for the countries to escape their obligations.

One big issue is first the lack of an enforcement mechanism that would make countries comply with their duties. Again, a big change in greenhouse gas emissions has not happened and the measures offered were misused. In my opinion they were never meant to actual solve the problem and with a lack of control, strict procedures and serious checkups they have created harm to the environment.

Related to carbon trading, for the countries that set up the cap and where the obligations of the companies were set up a question remains, if those companies went over the carbon credit allowances, were there any serious consequences? And what was to be done to reach that cap of the market that was set. Even if some countries applied some administrative penalties which resulted in certain amounts of money, were they used to develop other projects that enhanced climate action? A clear answer has not been found.

The trading emission scheme has been conceived as a market. The actual developers of the idea are said to be big players of the Wall Street stock market like Goldman Sachs and the big energy trading company Enron. By the way it is constructed may be so. While I am not totally against it, I only see the use for just a transition period till complete clean energy system is adopted if we respect that maximum cap and do not create mechanism to get extra “pollution permits”.

Some argue that applying this mechanism it will be easier to buy credits than to reduce emissions and then it will just be a license to pollute. This was partially

⁷ International emissions trading retrieved from <https://unfccc.int/international-emissions-trading>.

my concern too and unfortunately after 14 years we can see that it was for sure not effective. And this is not the only problem.

The cap and trade system is a financial bubble; the creators get big commissions on the transactions from the carbon stock market. Governments are distributed certain permits to pollute every year, which will be less and less as we progress. The idea was it does not matter who pollutes if we keep our cap. In this context some companies would innovate while others that would not and would go over the permitted carbon emissions would need to buy extra carbon credits (this is where the trading comes in and the creators get their commission). In this way the company that innovates is rewarded why the one that pollutes is “sanctioned”. But not everything worked so smoothly.

Even the creator of this stated it is not a solution for climate change; biggest problems lay in the details of the proposal: vast polluters got these permits for free to assure the continuous development of the economy. The cap and giveaway system in Europe made the value of the permits jump like crazy, the energy prices went up for consumers and more emissions were created. And the polluters made millions of dollars in profit. This is for sure not a solution and those permits should have been sold and the money be used to develop projects that would have influenced the reduction of greenhouse gas emissions.

Another carbon trading market mechanism that was used is offsetting. A company which reduces or removes carbon will get an offset carbon permit which can again be sold. The problem was how to guarantee that the actual company reduced that carbon because the procedures of assessment were loose, and it was very difficult to verify. These permits were still given and sold. This led to the creation of false offsets and companies started to cheat. E.g.: In Indonesia massive corporations cut down indigenous forests causing massive ecological and cultural destructions (a lot of species are almost extinct) and on the waste land created they planted palm oil trees for which they can get carbon offsets permits. It is useless to point out how this mechanism double rewarded some of the big destructors of these planets, the corporations.

2.3. Carbon markets 2.0 – the Paris Agreement

Carbon markets are now moving into a 2.0 phase. The fact that serious issues exist is evident in current symptoms: a freeze in international activity and virtual disappearance of the international component of the carbon market. In a “normal and clear world,” both sovereign states (Parties to the Paris Agreement) and private companies would have already started to work on hedging their carbon risk, using contributions that could be counted toward the NDCs. The lack of interest in international transactions is partly due to the lack of demand to meet obligations under the second commitment period of the Kyoto Protocol and the Cancun commitments. However, another and more important cause is the lack of clarity on

the governance of markets for the Paris Agreement, including how it will interact with domestic markets⁸.

Art. 6 “(1) 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. (2) 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. (3) The use of internationally transferred mitigation outcomes (another word for carbon credits) to achieve nationally determined contributions under this Agreement shall be voluntary and authorized by participating Parties (...).”

The new framework for cooperative approaches and mechanisms under Article 6 of the Paris Agreement charts a path for the resurgence of carbon markets. However, the modalities, rules, and guidance are yet to be fully elaborated by the Parties to the Paris Agreement.

One of the biggest problems of the Paris Agreement in general and which still continues to exist after the Conference of parties (COP) number 24 meeting at Katowice is the fact that while the countries managed to put together a skeleton of an agreement in Paris they haven't decided back then how to implement the provisions. Many have described this meeting as the most important UN talks since Paris – “the moment,” as David Waskow, director of the Climate Initiative at the World Resources Institutes, puts it “to bring life into all of the dimensions of the Paris Agreement”.

Unfortunately, after the meeting, negotiators were unable to reach an agreement on guidelines implementing Article 6 of the Agreement, which allows for “internationally transferred mitigation outcomes,” thereby opening the door to linking of carbon markets through voluntary market mechanisms. In theory, these market-based mechanisms would provide more creative and flexible pathways to deeper reductions in global carbon emissions by linking emissions trading systems around the world (e.g., carbon trading) and by instituting emission credit systems like the Clean Development Mechanism (CDM) under the Kyoto Protocol. Although much progress has been made since implementation of the CDM, implementation of Article 6 has been fraught with contention, in part due to concerns that developed nations will continue to emit and rely upon reductions achieved by developing nations to satisfy their own NDCs⁹. The implementation of

⁸ Andrei Marcu (2017). Governance of Article 6 of the Paris Agreement and Lessons Learned from the Kyoto Protocol. p. 2. Center for International Governance Innovation. Fixing Climate Governance Series. Paper no. 4.

⁹ Mary Yang (2018). COP 24 Round-Up Part One: The Paris Rulebook. Covington & Burling LLP.

art. 6 has been postponed for the COP 25 meeting in Chile. This is a pretty bad decision considering all the previous effects under Kyoto Protocol which continue to exist today.

2.4. European Union Emissions Trading System (EU ETS)

In the frame of the adoption of the Kyoto Protocol the European Union has set up the EU ETS. It is a cornerstone of the EU's policy to combat climate change and it is a key tool in the fight against climate change. It was the first major carbon market (set up in 2005) and till the present moment remains the biggest one.

The principle that is the base of this market is the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. The cap is reduced over time so that total emissions fall.¹⁰

In the European Union System, within the cap set up, companies receive or buy emissions allowances to pollute. These emissions can either be used by the company or traded with another one as needed. The companies can also buy limited amounts of international credits from projects that can be qualified as emissions-saving. The problem with this system is that it has been imposed as a mandatory system to big power stations, industrial plants and air lines. Unfortunately, this system for now does not cover very 2 important sectors which are transportation and livestock farming. The explanation of such a decision can be traced back to the lifestyle of the modern European. Unfortunately, we are living in a society where in our diets it is a consistency to consume animal products (especially beef) and a lot of us own a personal car which we use every day. Although the education on climate change effects and consequences of the European citizen is set up as a high desideratum very few programs have been developed and not a huge impact has been felt among the behavior of most of them. I believe this is one of the biggest problems in succeeding with any measure that we intend to take. If there is a request from the population to consume certain services and goods, there will always be a provider. The easiest way to decrease the greenhouse gas emissions is by far informing the people, setting up an example by the leaders and creating alternative environmentally friendly options that would naturally create an impact.

That doesn't mean that the system of carbon emissions trading hasn't had an impact. From the year 2005 till now it shows an overall decrease of 21%. From the year 2021, phase 4 of the market will be implemented and it is expected by the year 2030 a total of 43% decrease in greenhouse gas emissions compared to the starting year 2005.

Analyzing the future measures to be taken, one is very easy to be noticed; the EU will still be allowing the free allocation of allowances as a safeguard for the international competitiveness of industrial sectors at risk of carbon leakage, further

¹⁰ EU Emissions Trading System (EU ETS) retrieved from https://ec.europa.eu/clima/policies/ets_en.

stating that it will be taken into the technological progress of each industry and possibilities of switching to more environmentally friendly procedures. This means that the free allowances will be offered from the year 2021 to the companies that cannot shift their operating mode because of lack of technological development.

For us to understand why, an example may be needed. Let's look at the power plants that burn coal to produce the electricity that is later transmitted through lines to our households and offices for us to consume and use in all the needed activities. We are the ones paying for the electricity in the end. From the moment the mandatory emissions certificates have been imposed, the companies had to also pay money to gain the number of certificates needed to cover their emissions (they did not only get free ones, only in some conditions). In most of the European countries these companies are not state owned anymore, maybe partially but not totally. Their main goal remains making profit. Any additional cost will be reflected in the final cost of not only the electricity but also goods and other services depending on the usage of it.

Paying such taxes when producing a lot of emissions can go to millions of euros, and when the electrical company is already losing a lot of money it can endanger the economic stability of a country if the prices are to go up too fast. For example, one big Romanian electrical company called CA Oltenia had to pay in the year 2018, 296 million euros for emission allowances while it registered a loss of 233 million euros¹¹. This determined the Government in the year 2019 to think of a compensation scheme to offset part of the costs of some of the companies which had huge amounts to pay for the purchasing emissions allowances. It sounds weird to support with money from the state the companies that pollute when they are the ones that should be paying, and the money be used to develop the green energy system. Limits and guidelines are set by the European Union for such situations. Of course, we may argue that the environment should prevail, and these companies should not be protected. I fully agree with that, but can you imagine yourself without any electricity or just certain hours in a day? No, you cannot. The only true measure that can have a real impact and enhance the climate action while we keep these caps is to massively invest in renewable energy and develop at a faster pace better and less energy consuming buildings, goods and services.

2.5. Legal issues of carbon credits/ international transferred mitigation outcomes

Without having an international carbon market system to which each country is subordinated and with the allowance of multilateral agreements between different local carbon markets, one important issue has arisen. The transfer of the carbon credit/ international transferred mitigation outcomes is an actual sales contract with a determined object- the allowance to pollute more than the actual credits given.

¹¹ Vladimir Spasic (2019). Romania mulls carbon price compensation scheme. Retrieved on June 14, 2019 from <http://balkanrenewableenergynews.com/romania-mulls-carbon-price-compensation-scheme>.

For trans-border sales contract to determine the law applicable in establishing the actual moment of transfer of property is a big problem and can cause a lot of harm because it creates space for double selling of the allowance which in the end leads to even more carbon dioxide emissions than the limits proposed. Without the establishment of a real international carbon market with a clear international legal frame and application mechanism, these kinds of conflicts are bound to happen.

The possibility of a good faith acquisition is of importance for a transferee of an emissions allowance since ordinarily, a transferee cannot be sure whether the transferor's title to the allowance is free from any defects. In an international context, the question of good faith acquisition may arise in situations like the following hypothetical: An emissions allowance held in X's account in the registry of State A is stolen by Y through a "phishing attack"¹². After registration has been transferred to Y's account in the registry of State B, Y concludes a sale contract with Z, who is acting in good faith. Registration is then transferred from Y's account in the registry of State B to Z's account in the registry of State C. The laws of States A and B allow good faith acquisition of an emissions allowance upon the transfer of registration. Under the law of State C, however, a good faith acquisition is not allowed. What law is applicable to determine whether and under what conditions Z acquires good title to the allowance?¹³

Determining the nature of the allowance is crucial in determining the right legal solution to this conflict of laws. Carbon allowances/ credits are intangible goods.

These kinds of thefts have been occurring in recent years in the EU Emissions Trading Scheme. Therefore, trading was brought to a halt as Europe's registries were closed to improve security measures¹⁴.

To promote legal certainty, it is necessary to clarify the law applicable to the proprietary issues outlined in the preceding chapter. However, it is not sufficient for each constituent State to clarify individually the way in which it determines the applicable law, because if different constituent States of the same trading scheme determine the applicable law in different ways, the same allowance may be considered to be owned by different entities under the different laws which are applicable in different constituent States. To ensure the cohesive operation of a trading scheme, it is important to go one step further by unifying the determination of the applicable law among constituent States¹⁵.

¹² Phishing is the fraudulent attempt to obtain sensitive information such as usernames, passwords and credit card details by disguising as a trustworthy entity in an electronic communication. Typically carried out by email spoofing or instant messaging, it often directs users to enter personal information at a fake website, the look and feel of which are identical to the legitimate site

¹³ Koji Takahashi (2011). *Conflicts of laws in emissions trading*. P. 148. *Yearbook of Private International Law*, Volume 13, © Sellier; European law publishers & Swiss Institute of Comparative Law.

¹⁴ The national registries of Germany, the Netherlands and Belgium were closed in November 2010. In January 2011, the national registries of all constituent States of the EU trading scheme were closed. It took about three months before all registries could resume operation.

¹⁵ Koji Takahashi (2011). *Conflicts of laws in emissions trading*. P. 148. *Yearbook of Private International Law*, Volume 13, © Sellier; European law publishers & Swiss Institute of Comparative Law.

In the doctrine, different theories have been proposed, from applying the law of the issuing state to the one where the registration took place. A lot of authors support the last one, the law of the place where it was registered the allowance. An analogy with the proprietary issues of tangible movables seems to be preferred (*lex loci rei sitae*). Even if the carbon allowances are intangible goods, their place of registration can be considered the as a *situs* (fictional *situs*).

The rules of many countries are mostly the same. For example, if Y steals a painting and from X in State A and removes it to State B. While the painting is in State B, Y concludes a sale contract with Z, acting in good faith. Z then takes possession of the painting in State C. Whether and when Z acquires good title is determined by following the timeline. First is the moment when the sale contract is concluded. At that moment, the painting is situated in State B and, accordingly, the law of State B governs the requirements for good faith acquisition. If the law of State B requires the transferee to take possession of the painting, good faith acquisition does not occur at that moment. Second is the moment when Z takes possession of the painting. At that moment, the painting is situated in State C and, accordingly, the law of State C is applicable. If the requirements for good faith acquisition under that law are met, Z acquires good title. In this case and the one presented above with the carbon allowances the governance of the case will be established by applying the succession of the laws of state B and C. This being the case, the requirements under the law of state C are not met so Z does not acquire good title.

Is there a simple way to deal with all these successions of laws and serious complications that can appear related to the overflow of greenhouse gas emissions? Something that would make the transactions more efficient and secured from these types of attacks?

Let's take another example, company Z owns a registered emission allowance in state A and sells it to company Y in state B. Both states apply the same rule of law that the ownership of allowance is transferred at the moment of registration in the transferee's account (in our example company Y) in accordance with a valid sale contract. For state A to make amendments on the status of the allowance it is needed a notification from state B of the actual registration. But what if company Z resells the allowance before the notification arrives in state A to a third party, company X in state C and that company performs quicker the registration procedure and receives the notification of state C before state B? Who will be the owner in such a case? From the point of view of state A and state C it is clear that company X, which is acting in good faith; but for state B, company Y is the owner under the state law.

This is a complicated issue to determine and analyzing the timeframe of the events is important, but this is not the actual thing I want to highlight. These kinds of cases are existent for a long time, the problem is the lack of an international system of carbon trading; this can backfire in a very bad way and create an even bigger problem with the greenhouse gas emissions. From my point of view, this

case will take time to settle through courts and in the fight against climate change there isn't much time to wait. We need to think of an easier way to track down emissions allowances, their impact, and assure a secured way of transferring these allowances, while avoiding fishing or double selling. Is there an actual solution for this? It might be and it's named blockchain.

3. Blockchain

3.1. Notion

Blockchain is the latest development in the series of digital technologies that, due to their decentralized, horizontal, distributed and open source nature, are expected to cause fundamental and large-scale changes in how our current social, economic, political relations and institutions are organized.

Blockchain is designed to work as a trust machine.¹⁶ In order to establish the trust between parties there are 3 elements needed: identity, ownership and verification. The importance of trust is crucial considering the number of frauds, double counting and double finance of projects that have happened in the climate finance sector and institutions.

It is a technology that relies on cryptography to maintain a continuously growing database of records, protecting all the registered information from being tampered with, even by their operators. It requires software that allows computers to communicate with each other directly through a distributed network of peers, where no one has special powers over the others. Thus, these databases are periodically updated with new information comprising new transactions or registries, and consensus is automatically reached, guaranteeing that everyone connected to the network sees the same information. In other words, each peer has the exact same copy of the database, with verified new information being added to it after passing through a decentralized validation process.¹⁷

First element is an established identity, which is set up by using digital signatures through asymmetric cryptography. Each user of the blockchain is given a set of two digital codes: a "public key," similar to an account number, and a "private key", like a password.

There are different methods to establish it, ranging from no guarantees to highly reassurance procedures. In the context of climate change, personally I support the need for at least substantial assurance of the identity of the user to avoid the wrong use of the blockchain applications. This would mostly require an accreditation by the Government.

¹⁶ K.N.C. (2019). The trust machine. Retrieved from <https://www.economist.com/leaders/2015/10/31/the-trust-machine> on 18th of April 2019.

¹⁷ Leonardo Paz Neves, G.A. Prata (2018). Blockchain Contributions for the Climate Finance – Introducing a Debate report. p. 20. Published by Konrad Adenauer Stiftung.

The ownership of the database is the second very important element. Blockchain maintains a continuously growing database of records, protecting the whole transaction history of what is operating from being tampered with, even by their operators. In addition to the huge computational power that usually protects the database accounting the values each user possesses, there are also economic disincentives, making frauds financially pointless in most cases.

One last important element is verification. There are different blockchains created for different interests. A common interest sets up a network with a common database to which all parties can propose changes and the network itself will validate, rejecting fraudulent or wrong data from being recognized as valid and propagating only the proper information, periodically establishing consensus throughout the whole network. Everyone connected to the network sees the same information, as each peer has the exact same copy of the database, with verified new information being added to it. This public audit capability provides the system with an indisputably groundbreaking level of transparency.

“Proof of work” means that if you are a miner (a jargon for the users that connect to the network as a validating node), you need to offer a solution to a mathematical puzzle that demands a lot of computational power to be solved, in order to be able to add new information to the database that constitutes a Blockchain per se.

It is build up using cryptography which ensures another important aspect information, as well as its authenticity and authorship, is easy to verify, but it is practically impossible for a single entity or individual to elude it, as massive computational power would be needed and there are also considerable financial disincentives to do so.

The audit of the information is realized by the whole network of peers which gain immediate access to the activity that has been confirmed by the system’s code and add their own copy to the blockchain. In this manner, this information has its validity publicly audited by everyone, according to the information itself, its author and the date and the time it was created.

A database built and generated by Blockchain technology can store data of any kind, it is possible to maintain a wide range of new services, much wider than those strictly monetary, with the same qualities of Bitcoin: inviolable, irreversible, secure, independent and decentralized.

There have been thought of numerous applications for this technology and one of them is actual the carbon market. Behind this idea lays the concept of smart contracts.

3.2. Smart contracts

In our modern times, a smart contract can be defined as a computer code that, upon the occurrence of a specified condition or conditions can run automatically according to pre-specified functions. The code can be stored and processed on a

distributed ledger and would write any resulting change into the distributed ledger¹⁸.

Looking carefully to this definition the recognition that a smart contract is not necessarily a legal contract is important. As we can see, a smart contract is a program set up on an “if-then” statement condition.

When talking about smart legal contracts it is important to follow the elements needed to be qualified for now by the civil or commercial law as a contract: formation, modification and enforcement.

3.3. Legal aspects

In order to satisfy the elements of a contract, depending on the governing law of it one must verify that it meets all the conditions to form a legally binding contract. In the civil law system these are: capacity, consent, object and cause. The capacity to enter in such contracts has offered some diverged opinions because of the agents that act as representatives of companies and are in fact artificial intelligence programs. My personal view is if the legal frame of the country does not support such types of transactions the contract will be null and void for lacking one of the main elements. That doesn't mean that we need to keep it like that, on the contrary a rethinking of the capacity element extension is needed with the growing intelligent artificial market and development of new technologies.

The other elements of formation do not present much interest from the point of view of what legal impediments could the technology structure have as long as clearly the object of the agreement is the allowance of pollution, the cause is determined by the need of a company to have more carbon credits and be covered by the law for their extra emissions and the consent of each party is given in a legal manner.

The formation of the contract is very important, better said, the way the smart contract is coded will make a big difference. Extensive discussions about creating a common terminology to be implemented when coding the contract have been going on but without reaching the needed target. This can create a huge mess and offer space for bugs and hackers to tap into the contract.

The most famous incident to date was in the summer of 2016, when “THE DAO”, a smart contract virtual company running on ETHEREUM platform, imploded after an exploitable bug had been found in the smart contract code. The DAO was an example of a Distributed Autonomous Organization, and, a virtual investment fund, that allowed participants to buy a stake, which would give them proportional voting rights on which future proposals should be funded. To the surprise –and perhaps even dismay of the initiators – The DAO managed to collect nearly \$150M worth (at the time) of ether. However, shortly after the crowd-funding period, an attacker managed to gain control over a significant portion of

¹⁸ Definition given by the Smart Contract Alliance.

the value in the fund (nearly \$60M), due to a bug in the smart contract code. The resolution came in the form of a controversial, coordinated platform intervention that reverted the theft and dismantled the DAO. Some opposed this intervention, feeling it violated the “code-is-law” principle, and pushed for a fork of the platform¹⁹.

The nature of blockchain, distributed ledger, smart legal contracts, and the parties thereto will inject complex issues into judicial proceedings. Such issues will likely include: Whether the court has personal jurisdiction over the parties to the contract (assuming those parties can be identified) or, alternatively, whether the court has jurisdiction over the assets at issue; whether the court has personal jurisdiction over the smart contract platform itself; whether the court has subject matter jurisdiction over the dispute, including consideration of whether and to what extent judicial enforcement is compatible with the “immutability” of distributed ledgers and public policy²⁰.

These are all aspects that can be fixed with the right set of laws. Most important aspect of the blockchain is that once a transaction is registered on the structure, it cannot be modified or tangled with and it even gives a stamp with the exact time of the transaction. To try to change the structure of the blockchain would require a lot of computational power and access to all the computers connected to the network. We can easily see that double counting of emissions and double selling of the emissions allowances becomes virtually impossible as long as the computer code of the smart contract is written well. Related to the issue of phishing, researchers are developing programs based on blockchain to be able to stop this phenomenon.

A company called MetaCert is trying to fight phishing emails with an extraordinarily simple method. The company has spent seven years compiling a database of web addresses known to be used by phishers, and the company and its users are constantly reporting more. Just as important, it also has a database of known “safe” addresses used by the companies, hackers like to spoof banks, payment services like PayPal, and online retailers. Meta Cert's software uses those databases to check the links in your email and place a little green shield next to known good links, a little red shield next to known phishing sites, and a gray shield next to unknown sites²¹.

Conclusion

In my opinion, carbon markets have been created primarily by people with strong connections to financial institutions be those trading or even fossil fuel companies who saw an opportunity to make extra money. That does not mean that

¹⁹ Maarten Everts, Frank Muller (2018). Will that smart contract really do what you expect it to do? P. 9. Report by TNO innovation for life.

²⁰ Prepared by Smart Contract Alliance at the initiative of the Chamber of Digital Commerce (2018). Smart contracts: Is the law ready? p. 30. Chamber of Digital Commerce.

²¹ Klint Finley (2018). This company wants to use blockchain to stop phishing. Retrieved from <https://www.wired.com/story/this-company-wants-blockchain-stop-phishing/> on 18th of April 2019.

the actual measure is completely negative. For the transition period to 100% clean energy societies it may be needed at least to set a cap for the greenhouse gas emissions. I don't believe companies should be allowed to buy as much as they can (or as many as available allowances are on the market) on the contrary; this method should stimulate more the innovation and faster passing to a sustainable development energy system. For this, it is needed a strict regulation, less cheating mechanisms as the ones from the Kyoto Protocol and a very clear protocol of how to apply these measures. Discussion has gone on about whether a local or global approach is needed in the formation of such markets and selling of such allowances.

The global carbon market is very fragmented. In the absence of a unified platform to purchase and sell carbon credits, regional markets have adopted different standards and policies. Trading costs are high because buyers and sellers rely on intermediaries to handle the often complex and cumbersome process.

I believe the best choice would be international approach and a common set of rules implemented on a blockchain. The blockchain could act simultaneously as a register and a trading platform for the carbon allowances that should be administered by the UNFCCC. In this way, the double counting, double selling and phishing could be solved if the smart contract is coded well. In our times such a desideratum is very difficult to obtain and from the way the Paris Agreement is drafted it is not considered as a first option. It is given but not enforced and the countries which fail to comply to reach their national determined contributions have no legal consequences, there are no means of a coercive mechanism, the creators of the agreement thinking that international shaming is enough to determine the countries to respect their promises.

Of course, the benefits of blockchain technology are unfortunately just theory, there isn't an actual practical case that has been implemented with carbon markets and this leaves us without effects to analyze, just possibilities. Slowly things are starting to change, and we may witness soon the results of a start up from Beijing.

In March 2019, the Beijing based company of environmental advocates named Synergy Blockchain Technology launched a carbon trading platform called VER. The company also launched its own carbon credit-backed cryptocurrency ECO_2 , which is already trading on two cryptocurrency exchanges, to enable companies and individuals interested in purchasing and trading carbon credits to engage with more efficiency and transparency. To compare, the trading platform will be like the biggest e-commerce platform of China, Taobao, which is matching consumers to sellers, while the cryptocurrency will be used as a trading tool for payments and other transactions just like Alipay.

We can only wait and see if such projects will have a good impact, if it indeed represents a solution to the problems encountered till now in the carbon trading markets. One important element needs to be set, a rigorous legal structure of the carbon market, be that at a local or international level. Without that, any technologies we decide to use will not be effective. The setting up of the capacity of the market is crucial and this can only be done by the Government of each country considering its own national determined contribution and having in mind

the importance of stimulating a renewable energy market and not offering solutions for the big companies to cut out from developing more innovative and environmental friendly procedures. For this to happen it is needed a true commitment from all the governments (especially the big polluters as China, India, USA, Brazil, Indonesia, European Union, etc.) in setting as a top responsibility the enhancement of climate action. Till the moment the governments don't make the true commitment towards prioritizing the sustainable development of the world over just the economic development there is no hope for any solution to tackle the real big threat that climate change holds.

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