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MASTER
ENVIRONMENTAL ECONOMICS AND MANAGEMENT

How to comply with Nationally Determined Contributions both in the Developed and the Less-Developed World

An internship report at AENERGIA, S.A. – SUCURSAL DE PORTUGAL

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Internship report

Master in Environmental Economics and Management

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Professor Cristina Chaves

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Acknowledgments

Writing this internship report has been fascinating and extremely rewarding. Thus, I would like to thank several people who have contributed to this effort in distinct ways.

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Abstract

This report aims at evaluating and comparing certain techniques on how to comply with Nationally Determined Contributions both in the developed and the less-developed world. More emphasis is given to the great potential of climate finance sources for developing and emerging economies.
This requires verifying the presumption that Developed Countries prevail to undertake carbon pricing systems mainly domestically, from an economical viewpoint, while Less-Developed Countries prevail to appeal climate finance mechanisms internationally, from a financial viewpoint. On the base of this presumption, main emphasis is given to climate finance sources by identifying their effectiveness to help keeping global warming within the 1.5°C Paris Agreement goal. More specifically, such secondary market mechanisms are analyzed in depth as the use of green bonds beyond a relevant contribution of the company of Aenergy, which is reviewing the case of a green bond issuance as a private project in Angola and Ghana.
A complementary methodology from a market-based research project is used to provide an additional significant contribution by counseling Aenergy within its choice as of financed environmental areas, but this data is not to consider absolute to answer leftover report findings. Nevertheless, this contribution mainly aims at analyzing which environmental areas have been mostly financed by which issuers, in the case of Multilateral Development Banks.
According to the main results, if comparing Europe and Ghana the mentioned presumption is confirmed by the fact that respective Nationally Determined Contributions, advocate at least 40% domestic reduction (only) in emissions by 2030 for Europe, while 15% both domestic and 30% international reduction in emission by 2030 for Ghana. Europe intends to achieve its target mainly through its carbon pricing system, while Ghana considers finance highly indispensable. In fact, USD 1.6 to 3.8 trillion of energy system investments are required to keep global warming within the 1.5°C Paris Agreement goal. At least, climate finance has been steadily increasing with the major share for private finance with Less-Developed Countries being the dominant destination of climate investments. In this respect, an explosive growing trend of green bonds is represented by USD 167.6 billion issues in 2018, but more and more climate finance sources are needed. Results from the market-based research project suggests that Aenergy is following the right path by investing in Renewable Energy and Energy Efficiency. In fact, results envisaged that both variables were main targeted environmental areas from Multilateral Development Banks as well.

Keywords: Nationally Determined Contributions; Developed Countries; Less-Developed Countries; Paris Agreement; Multilateral Development Banks; Climate Finance; Green Bonds.

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Afreximbank – African Export-Import Bank.

APA – Ad Hoc Working Group on the Paris Agreement.

BAU – Business-as-usual.

BMCE – Bank al-Maghrib Central Bank of Morocco.

CMA – Conference of the Parties serving as the meeting of the Parties to the Paris Agreement.

COP – Conference of the Parties.

COP 24 – 24th edition of the Conference of the Parties.

CPI – Climate Policy Initiative.

DCs – Developed Countries.

EBRD – European Bank for Reconstruction and Development.

EEA – European Economic Area.

ESR – Effort Sharing Regulation.

ETSs – Emission Trading Schemes.

EU – European Union.

EU ETS – European Union Emission Trading Scheme.

EViews – Econometric Views.

FEP – Faculty of Economics of Porto.

FMCP – Facilitative, Multilateral Consideration of Progress.

GBPs – Green Bonds Principles.

GDP – Gross Domestic Product.

GHG – Greenhouse gas.

I4CE – Institute of Climate Economics.

IADB – Inter-American Development Bank.

IBRD – International Bank for Reconstruction and Development.

IDFC – International Development Finance Club.

IFC – International Finance Corporation.

IPCC – Intergovernmental Panel on Climate Change.

ITMOs – Internationally transferred mitigation outcomes.

LDCs – Less-Developed Countries.

LHS – Left-Hand Side.

LULUCF – Land use, land-use change, and forestry.

MASEN – Moroccan Agency for Solar Energy.

MDBs – Multilateral Development Banks.

MDFIs – Multilateral development finance institutions.

MoU – Memorandum of Understanding

NA – No available.

NDCs – Nationally Determined Contributions.

NDFIs – National development finance institutions.

NGO – Non-profit organization.

PA – Paris Agreement.

PCA – principal component analysis.

R&D – Research & Development.

REDD – Reducing Emissions from Deforestation and Forest Degradation.

RHS – Right-Hand Side.

SDGs – Sustainable Development Goals.

SPSS – Statistical Package for Social Science.

TER – Technical Expert Review.

UNFCCC – United Nations Framework Convention on Climate Change.

UNSG – Secretary-General of the United Nations.

1. Introduction

In a time where climate change becomes a huge problem for the society, it is challenging to find solutions to overcome the excessive greenhouse gas (GHG) emissions. This might be attained through environmental policy, using economic and financial tools to limit the rate of harvested resources and pollution emissions. Taking into consideration that carbon dioxide is the main GHG, carbon pricing systems as well as climate financial mechanisms become of extreme importance to control environmental damage.

In this context, this study motivation is to evaluate and compare certain techniques on how to comply with Nationally Determined Contributions (NDCs) both in the Developed and the Less-Developed World. In fact, this report aims at verifying the presumption that Developed Countries (DCs) prevail to undertake carbon pricing systems mainly domestically, from an economical point of view, while Less-Developed Countries (LDCs) prevail to appeal climate finance mechanisms internationally, from a financial point of view. A weaker institutional stability of LDCs is taken for granted, which prevent LDCs to act by themselves without any external support to reach their own emission targets (as of their NDCs).

This being said, this research starts connecting a comparatively economical topic, which is represented by the international carbon pricing with a strictly financial topic, which is supported by the international experience of the company of Aenergy (AENERGIA, S.A. - SUCURSAL DE PORTUGAL) in the African market. Therefore, on the base of the afore mentioned presumption, particular emphasis is given then to climate finance sources by identifying their effectiveness to help keeping global warming within the 1.5°C goal settled by the Paris Agreement (PA). More specifically, such secondary market mechanisms are analyzed in depth as green bond uses.

This analysis is considered relevant as to understand how green bonds and their global market work. In fact, they represent an explosive growing trend, which is especially driven by partnering Multilateral Development Banks (MDBs) to help finance LDCs. Also, this study is expected to incentivize further green bond issues in the context of Africa, in which these instruments offer a great investment opportunity. In fact, a relevant contribution is expected to come from Aenergy, which is reviewing the case of a green bond issuance as a private project in Angola and Ghana. Moreover, this opportunity leaded by the company own purpose to comply with its own Environmental Responsibility, is investigated from another point of view constituting another potential, such as the directly linked opportunity to help LDCs (globally) meet their own NDCs.

The complementary methodology from a market-based research project (related to an internship research activity), is mainly expected to justify the choice of Aenergy for its green bond issuance with main targeted environmental areas from MDBs. In fact, this research project aims at analyzing which environmental areas have been mostly financed by which issuers (in the case of MDBs), in which year, in which money amount and in which number of issues. However, the used data is not to consider absolute to answer these report findings, instead, it should only provide an additional significant contribution by counseling Aenergy within its current business. This contribution is enabled by investigating the interest of bigger supranational speculations in the case of MDBs, which already do possess the right experience (partnering LDCs) for the issuance of green bonds.

This report is structured as follows. Section 2 exposes NDCs as a whole. Section 2.1 broadly explains how NDCs arise, followed by one selective case of Europe and Ghana. Section 2.2 aims at analyzing DCs attitudes towards their NDCs from an economical point of view, while section 2.3 aims at analyzing LDCs attitudes towards their NDCs from a financial point of view. This is described by introducing the concept of climate finance firstly and the sub-related broad concept of green bonds (section 3) secondly. Section 4 envisages the effort of Aenergy as of main internship activities approached. Subsequently, section 5 gives emphasis to the used data within its methodology (section 5.1), results (section 5.2) and discussion (section 5.3). Section 6 exposes the conclusion. Along with the literature contribution, most used reports were consulted within the internship course as stated in the signed curricular internship protocol.

2. Nationally Determined Contributions (NDCs)

2.1 The arise of NDCs due to the Paris Agreement (PA)

As a matter of common knowledge, the most important environmental regulatory instrument that has been established on the planet so far is the PA, which entered into force on November 4, 2016. According to World Bank (2019), after two years, an important turning point has been reached during the 24th edition of the Conference of the Parties (COP 24) in Katowice, Poland. In fact, leaders of many governments gave green light to the Katowice Climate Package that outlines the implementation guidelines for the PA. This Package contains operational guidance on the relevant information that governments require for setting out their NDCs, as well as respective rules for the function of the transparency framework. The goal of the framework is in fact to set up trust and confidence ensuring that all countries are committing a fair share to the global attempt to tackle climate change. A proper NDC Guidance has been thus carried out, in which its essence it is mainly represented by two annexes, as respectively revealed in this internship report, Annex I (as of section 2.1.1) and Annex II (as of section 2.1.3).

In this context, as of April 1 (2019), 195 Parties have already signed the Agreement, of which 185 (that were responsible for 87% of global GHG emissions) have already placed their instruments of ratification, as displayed in Figure 1. Moreover, Parties that have already submitted at least a first NDC, account for 180. However, this number is continually updating, as in fact, according to the UNFCCC (2019), the NDC Registry already accounts for 184 Parties (information retrieved on 22/06/2019). Nevertheless, according to World Bank (2019), there is still a huge share of Parties mentioning carbon pricing in their NDC, which accounts for 96 Parties announcing whether they plan or consider the use of various climate markets and/or domestic carbon pricing to meet their NDCs.

In conclusion, even if the PA is not such an explicit economical or financial tool in itself, it still lays the ground for the development of such one. Thus, pertaining to NDCs, Article 6 constitutes the main section, which envisages that the Agreement requires all ratifying Parties to communicate their NDCs as to be operative.

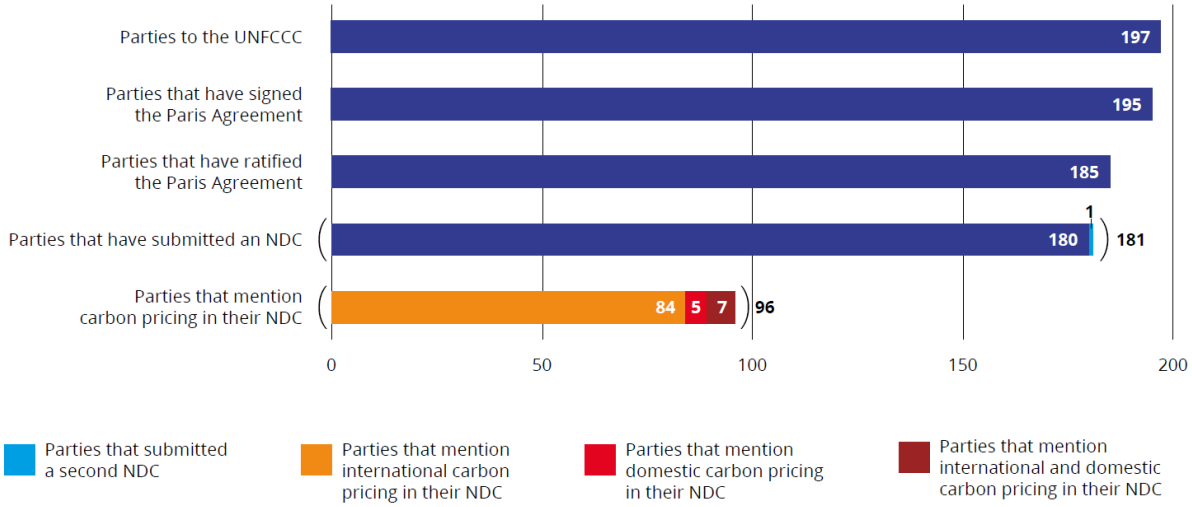


Figure 1 – Status of NDC submissions as of April 1 (2019) – Source: World Bank (2019)

In its essence, Article 6 of the PA encourages for voluntary collaboration among countries for the application of NDCs to support each other for higher climate aspiration, advocate sustainable development, and boost environmental integrity, as stated in the PA provided by the UNFCCC (2015). In this sense, Article 6 mainly covers Article 6.2 and 6.4. On the one hand, Article 6.2 permits Parties to opt to comply with their own NDCs by using internationally transferred mitigation outcomes (ITMOs) covering cooperative approaches. On the other hand, Article 6.4 permits Parties to use GHG emission reductions to comply with NDCs of a host country or another country incentivizing both public and private contributions. Thus, according to World Bank (2019), the main demand for emission reductions from international mechanisms does typically come from three leading categories: the compliance markets, the voluntary markets, and more indirectly, through climate finance.

In conclusion, NDCs play a critical role in the engineering of the PA. Parties are required in fact to prepare and communicate their NDCs and to undertake challenging domestic efforts to meet their mitigation commitments, which are facilitated by support and finance from others for the most part.

In this regard, Doelle (2019) provides an accurate interpretation on the respective rules contained in the PA, as well as, on most recent updates of the last COP 24 in Katowice. According to these rules, for the first time in the history, Parties are required to report their efforts and their progress toward their commitments (their NDCs) to the international community every 5 years, starting the official registration from 2020. Following *Technical Expert Review* (TER) teams reviewing these national efforts against the content of NDCs, countries discuss their efforts in a multilateral process (the *Facilitative, Multilateral Consideration of Progress*, or FMCP). The final step in the five-year review cycle is given by the multi-year *Global Stocktake*, that shifts the focus from individual NDCs toward collective goals set out in the PA. Once this step is concluded, the next five-year cycle starts with the filing of enhanced NDCs again (from 2025 and so on). Moreover, every five years the Global Stocktake concludes with a decision of the *Conference of the Parties serving as the meeting of the Parties to the Paris Agreement* (CMA), which is followed by a special event, under the auspices of the UN Secretary-General, to stimulate increased ambition through revised NDCs. Therefore, all States that are Parties to the PA are represented at the CMA, while States that are not Parties participate as observers. Also, the CMA oversees the implementation of the PA and takes decisions to promote its effective implementation.

The focus of this internship report is on components of the five-year cycle, especially the rules negotiated by the *Ad Hoc Working Group on the Paris Agreement* (APA) which make up the fraction of the PA on the communication of NDCs (section 2.1.1), the interim NDC Registry (section 2.1.2) and the accounting of NDCs for their implementation (section 2.1.3). However, this classification considers that further negotiations on Article 6 have still to be concluded (and could still be modified) provisionally until the end of 2019, though the prospect for a conclusive agreement is unclear, as no agreement is reached yet.

2.1.1 Communication of NDCs

The substance of what's expected to be enclosed in an NDC is basically contained in Annex I to the NDC Guidance following the interpretation of Doelle (2019). The complexness in ascertaining what the NDC Guidance needs, arises for the most part from the flexibleness that parties face within the nature of their mitigation commitments. The principles take care of this flexibility initially by determining common components notwithstanding of the self-determined nature of the commitment, and secondly by attempting to clarify what methodologies and metrics are acceptable for various kinds of mitigation commitments. Thus, the aim of the NDC Guidance, Annex I, on communication is to guarantee adequate information from every party to perceive the nature of mitigation commitments established and to track their implementation.

While DCs have committed to economy-wide absolute targets, alternative parties have, at the beginning, extensive flexibility in the way to frame their mitigation commitments as Doelle (2019) claims. Methodologies and metrics for absolute targets are well established from past involvements with the Kyoto Protocol. This is often not the case for alternative forms of mitigation commitments provided within the PA. This implies that whereas the essential components, like *reference year*, *target*, and *timeframes* need to be provided by all countries, there's extensive flexibility that flows from the self-determined nature of mitigation commitments, particularly for developing ones. In fact, the essential components may be compulsory, however the self-determined nature of mitigation commitments creates extensive flexibility within the information that has to be provided concerning those components.

In overall terms, parties have to announce whether or not they expect to count on cooperative approaches (Article 6) to fulfill their mitigation commitments as Doelle (2019) states. Obviously, the principles for Article 6 were not finalized at COP 24 yet, leaving their role in permitting parties to fulfill their mitigation commitments unknown. However, within the PA there are still regular rules in place, as the COP 21 Decision, and the NDC Guidance on double counting, environmental integrity, and ambition associated with emissions trading, which should enable parties to trade emission reductions even while Article 6 is not finalized yet. The main enigma is whether or not TER teams will allow the clue provided by parties on trades that would be close.

Nevertheless, according to Doelle (2019) what will not happen yet, is the creation of a replacement mechanism to certify emission reductions almost like those certified under the Kyoto Protocol's Clean Development Mechanism. A disputable issue throughout the course of the negotiations (at COP 24) was whether or not the Annex I of the NDC Guidance would apply solely to mitigation components of NDCs or additionally to alternative components, like adaptation. The NDC Guidance seems to deal solely with mitigation commitments, however this could not exclude the likelihood that some components of the guidance might (within the future) be relevant to the voluntary inclusion of adaptation, finance, loss-and-damage commitments, capacity-building, education, and technology.

In addition, Doelle (2019) claims that parties were asked to choose on the application form of the developed guidance (at COP 24) to their initial NDCs (as several parties had already submitted them), and to new NDC submissions after December 2018. The choice encourages parties to consider the rules to initial and new NDCs but demands their application solely from the second NDC onward. However, what will constitute a party's second NDC is still unknown. In the meanwhile, the UNFCCC (United Nations Framework Convention on Climate Change) established an interim NDC Registry following the adoption of the PA. During COP 24, parties defined key style components of the permanent register and a methodology for finalizing and approving it. Therefore, the UNFCCC was asked to frame a register in line with the guidance provided and approving it at COP 25 as the interim Registry will continue to be active for NDCs.

2.1.2 The interim NDC Registry

More specifically, the NDC Registry is currently available on the official website of the UNFCCC (2019). In fact, if consulting the site, it is clearly to see that 184 Parties have already submitted their first NDC, while only 1 country has submitted its second NDC (according to the information retrieved on 22/06/2019).

Actually, the latter is the case of The Republic of the Marshall Islands, which submitted as a first country a second NDC on 22 November 2018 and according to the rules of section 2.1.1 this country should be already eligible for the previously mentioned 5-year cycle on a permanent registry basis starting by 2020.

Having said that, all other countries are also supposed to submit their second NDC at the latest by 2020. Nevertheless, this internship report mainly focuses on the example of the European Union (EU) for Developed Countries and the example of Ghana for Less-Developed countries. Indeed, the fact that both parties already submitted their first NDC enables for a better analysis if comparing the Developed with the Less-Developed World. Also, the example of the EU makes this analysis even more confident than the example of other countries, as for the EU being a well-known and a pretty transparent example. The choice of Ghana is driven by the fact that the internship linked to this report has been mostly related to this country, particularly regarding the use of given climate finance mechanisms to help this country to reach its own NDC.

In this regard, if opening the registry of any of those 28 Member States, the NDC remains the same for the EU in total, as it constitutes a unique document submitted by the Latvian Presidency of the Council of the EU (2015), being Latvia, the country holding the Presidency of the EU from 1 January till 30, 2015. This document states that the EU and its 28 Member States considered themselves fully committed to the UNFCCC negotiating process. Also, they emphasized to follow a view to adopt a global legally binding agreement applicable to all Parties at the Paris Conference in December 2015 in line with the below 2°C ambition. In particular, in line with the call for climate action the EU considered itself committed to a **binding target of an at least 40% domestic reduction in GHG emissions by 2030 compared to 1990**, which seemed to mainly address mitigation targets. This was communicated by the EU in the first quarter of 2015 in a manner that facilitated the clarity, transparency and understanding of its NDC.

Different looks the registry for Ghana according to the Presidency of the Republic of Ghana (2015). Ghana saw finance as an essential part of the whole NDC process. The scope of finance from developed countries must address mitigation, adaptation, technology transfer and development in developing countries. It should not be solely focused on mitigation as it seemed to be the case for the above-mentioned EU's binding target. Ghana, like the EU, was also pleased to communicate its NDC to facilitate the clarity, transparency, and understanding of their contribution. To help achieve its target, Ghana defined 31 specific action programs in total, 20 on mitigation and 11 on adaptation both in 7 priority economic sectors, which were proposed for the 10-year period (2020-2030). During this period, it was estimated that Ghana would need USD 22.6 billion in investments from both domestic and international sources (public and private). Only USD 6.3 billion was expected to be mobilized from domestic sources, whereas USD 16.3 billion from international support. According to its mitigation target, if compared with the EU, Ghana stated to unconditionally lower its **GHG emissions by 15% relative to a business-as-usual (BAU) emission scenario of 73.95MtCO2e by 2030.** As a result, they claimed that an additional 30% emission reduction is attainable on the possibility that external support is made available to Ghana to cover the full cost of implementing the mitigation action (finance, technology transfer, capacity building). By mean of this external support, a total emission reduction of 45% below the BAU emission scenario could be achieved by 2030.

2.1.3 Accounting of NDCs

According to the interpretation of Doelle (2019), underneath the PA and also the COP 21 Decision, parties are lawfully required to account for the implementation of their NDCs. Nevertheless, neither the Agreement nor the Decision hand over clear orientation on when or how many times parties are to account for the implementation of their NDCs. In any case, the PA expects parties to report as a matter of usual practice on progress. Also, the COP 21 Decision suggests that many of the parties will be required to furnish this information on a biennial basis. The procedure to the legal nature of the obligations is essentially contained in Annex II of the NDC Guidance, that is analogous to that for Annex I discussed within section 2.1.1 of this report.

The basic principles of the guidance on accounting of NDCs for their implementation are unequivocal, as Doelle (2019) states. They contain prerequisites for consistency with the procedures accustomed for communicating NDCs, consistency with relevant provisions of the PA, and, as appropriate as possible to the circumstances, consistency with the principle of following procedures used underneath the UNFCCC and assessed by the IPCC (Intergovernmental Panel on Climate Change), as adopted by the CMA. In addition, there's legal obligation of the PA to advocates environmental integrity, transparency, accuracy, completeness, correspondence, and to guarantee the abstention of double counting. Nevertheless, like Annex I, Annex II identifies the specified components to be contained, however it doesn't indicate specific methodologies/metrics to be approached for these components. The only mentioned preference is for parties to account for emissions and removals approaching methodologies/metrics assessed by the IPCC and adopted by the CMA. It seems that, methodologies/metrics aren't supposed to be developed by the IPCC, however they will rather be developed elsewhere and assessed by the IPCC to inform the choice of the CMA on whether or not to adopt them. So, the guidance doesn't clearly indicate who should develop methodologies or metrics leaving it open.

2.2 Developed Countries (DCs) as for their NDCs

2.2.1 National and Subnational Contributions in the context of Carbon Pricing

As to understand the current global panorama of carbon pricing systems of DCs, Postic & Métivier (2019) provide an updated database on the carbon price situation worldwide. This database was furnished by ongoing researches from I4CE (Institute of Climate Economics). I4CE is based in Paris and is a think tank that equips public and private decision-makers with knowledge on economic and financial issues about both the energy and the ecological transition. Their last database on the landscape of carbon pricing was published in May 2019, as displayed by Postic & Métivier (2019), and it exhibits a great panoramic position of the most recent key tendencies about the implementation of carbon pricing systems at both the national and subnational level globally. In particular, they exhibit a world map, which provides comprehensive information on those systems that are either already established or scheduled for implementation, the type of carbon pricing system chosen and pricing levels. As a matter of fact, one of the key areas of I4CE's expertise is international carbon pricing.

Thereby, Figure 2 helps to figure out that as of May 1 (2019), nearly 51 carbon pricing systems are already established or scheduled for implementation as stated in the database. This consists of 26 Emission Trading Schemes (ETSs), mostly subnationals (provinces or cities), and 25 carbon taxes mostly nationals. As a positive trend, the experience gained through the evolution of current carbon pricing systems could help further systems to emerge and the operationalization of the PA to grow in order to comply with NDCs. Moreover, Figure 2 serves to display prices given in USD/tCo2e. Portugal for example faces a distinct price for carbon taxes (14) and for ETSs (17), as it also makes part of the EU facing the same price (17) as for all other countries under the same scheme. Despite this picture is not relaying a very detailed price list, it is of clear evidence that there is a positive tendency for many DCs for applying either one or the other carbon system, which has been already established or at least scheduled for implementation. Differently looks the scenario for LDCs that shows a negative tendency for applying any of both mentioned carbon systems.

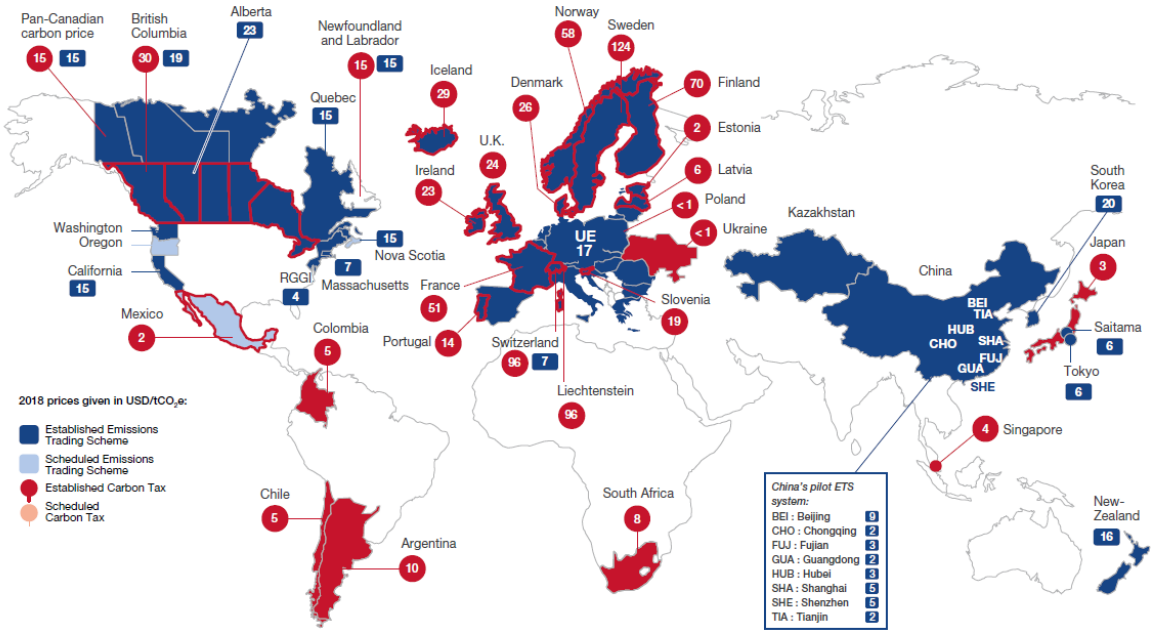


Figure 2 – Map of explicit carbon prices around the world in 2018 – Source: Postic & Métivier (2019)

2.2.2 Emission Trading Schemes (ETSs) are mainly Subnational Contributions

In this regard, this section aims at further research those 26 (already established or scheduled for implementation) ETSs, which are mostly located in subnational jurisdictions (provinces or cities) comparing them with most recent trends and analyses in emissions trading drawing on certain practical experiences.

More specifically, according to the International Carbon Action Partnership (2019), there are currently 20 (already established) ETSs covering 27 jurisdictions from locals to supranationals (7 cities, 15 provinces/states, 4 countries and 1 supranational). Moreover, 6 further jurisdictions (scheduled for implementation) are setting in place their ETSs which could be operational in the next few years, while more 12 jurisdictions (under consideration) are examining the role an ETS could play in their own climate change policy mix.

This consists of systems that are spreading around the world and new entries have more than doubled the share of global GHG emissions covered by emissions trading since the launch of the EU ETS (European Union Emission Trading Scheme) in 2005. Moreover, with more systems expected to emerge in the next few years, it is expected that the number of global GHG emissions under ETSs could increase by almost 70% in 2020 compared to the last registered values, according to the International Carbon Action Partnership (2019). This being said, the EU ETS alone makes up 5% of covered global GHG emissions and is by now the oldest ETS with the largest share of covered global GHG emissions under leftover (already established) ETSs. In this subject matter, the just mentioned potential is what makes it so ponderous for the most.

2.2.3 European Union Emission Trading Scheme (EU ETS)

According to the International Carbon Action Partnership (2019), the EU ETS represents the central pillar of the EU climate change policy. As claimed in the upper paragraph the system has been introduced in 2005 and is still facing its trading phase number 3 (2013-2020) of 4 foreseen phases in total (respectively 2005-2007 for phase 1 and 2008-2012 for phase 2). In fact, the EU ETS has gone through several reforms and will change again with the start of the next trading phase number 4 (2021-2030) in January 2021. This being said, the system covers emissions from power, industrial, and aviation sectors, with the aviation being limited to flights within the European Economic Area (EEA). Moreover, as of 2017 the EU and Switzerland signed an agreement linking the Swiss ETS to the EU ETS. In this regard, steps will be taken during 2019 to ratify this agreement, which could see both markets linked from 1 January 2020, as a first ever agreement for the EU.

According to Marcu et al. (2019a), there are many options that the EU could consider for reaching its own GHG reduction target of at least 40% by 2030 below 1990 GHG levels, as previously mentioned (section 2.1.2). Also, the EU seems willing to achieve this target through domestic efforts, as the contribution from international credits (outside of the EU) is not allowed. So, coming to the point, how is the EU going to afford it? This target was divided into two sub targets, which were initially not communicated through the respective European NDC submitted. According to the first sub target, 43% emissions reductions must be achieved by the EU ETS and 30% by the Effort Sharing Regulation (ESR) from 2005 levels.

The ESR is a policy framework from the EU, which covers emissions from most sectors not included in the EU ETS (that is why it is also called non-ETS), such as transport, buildings, agriculture and waste. According to the second sub target, the remaining 27% emissions reductions must be achieved both by the increasing share of renewable energy in the EU energy production (by at least 27%) and the improvement of energy efficiency (by at least 27%). That's basically all in regard to recent developments in the EU legislation and that is why the EU ETS is so important for the EU to reach its 2030 target (its NDC), as the EU ETS constitutes the largest share of emission reductions if compared with the other mentioned frameworks (43% emissions reductions compared with 30% and 27%).

According to Marcu et al. (2019b), the EU ETS is in fact also important through its role as it constitutes the foundation of the EU climate change policy being an archetype and a pioneer to follow as a shining example for other carbon markets as well. Concerning the EU long-term climate strategy, another crucial development about some progressing discussions for an update on domestic commitments that might affect the EU ETS is going on. In fact, Marcu et al. (2019b) envisages the strategic long-term vision (called *A clean planet for all*) published by the European Commission, which could lay the ground for a climate neutral EU economy by 2050 compared to 2005 emission levels for ETS sectors. Nevertheless, this vision is being examined and debated by more governments and parliaments for the moment, thus both at the European and the subnational level.

Also, looking ahead to the international climate change policy driven by the PA, the course of 2019 could see the international community rethink own NDC ambitions. In fact, the Secretary-General of the United Nations (UNSG) has called for a climate summit taking place in New York on the 23rd of September 2019, encouraging countries to hand over objective and reasonable plans to increase their NDCs by 2020 in consonance with reducing GHG emissions by 45% over the next ten years, as well as to reach net zero emissions by 2050. A categorical success of the summit in question could see motivated countries review their own NDCs, which in the case of the EU could be due to increasing efforts to cut emissions both by ETS and non-ETS sectors.

Coming to the point, is the EU ETS, on the right trajectory, expected to environmentally deliver against the agreed target for the next trading period (of at least 40% by 2030 below 1990 GHG levels)? Verified emissions have always been under the target path since the beginning of phase 2 (2008-2012) and are comprehensively expected to follow this trend during phase 4 (2021-2030). Marcu et al. (2019b) also provides some statistical models (extrapolated up to 2030) exhibiting the dynamics between GHG emissions and GDP (Gross Domestic Product), which reveal that resulted emissions are not even expected to meet the predicted target path (facing even more emission reductions than the agreed target) before 2030. However, only under a high GDP growth (of nearly 2% per year) resulted emissions would meet the predicted target path (corresponding to the agreed target) by the end of phase 4.

So, in consonance with previous experiences, the EU ETS is expected to environmentally deliver adequately against its predicted target, but as it is already doing well the EU is likely to raise its NDC ambition. However, for the PA to affect the EU ETS, its targets require to be converted into domestic policies. In fact, after COP 21 there has not been any direct adjustment of EU ETS goals so far, and thus, no explicit market signals to respond to. Just if domestic policies are in consonance with international developments, the carbon market will respond (react) and be consequently affected. Having said that, it is of extreme relevance to notice that the EU ETS is not the only operational ETS, as its efficient environmental delivery could be compared to others affecting too much competition and carbon leakage issues. Estimates advocate an increase by almost 70% in global emissions covered under ETSs by 2020 compared to 2019, especially with the predicted start of the Chinese ETS.

2.3 Less-Developed Countries (LDCs) as for their NDCs

2.3.1 Definition of Climate Finance as for its Global Architecture in the context of financing LDCs

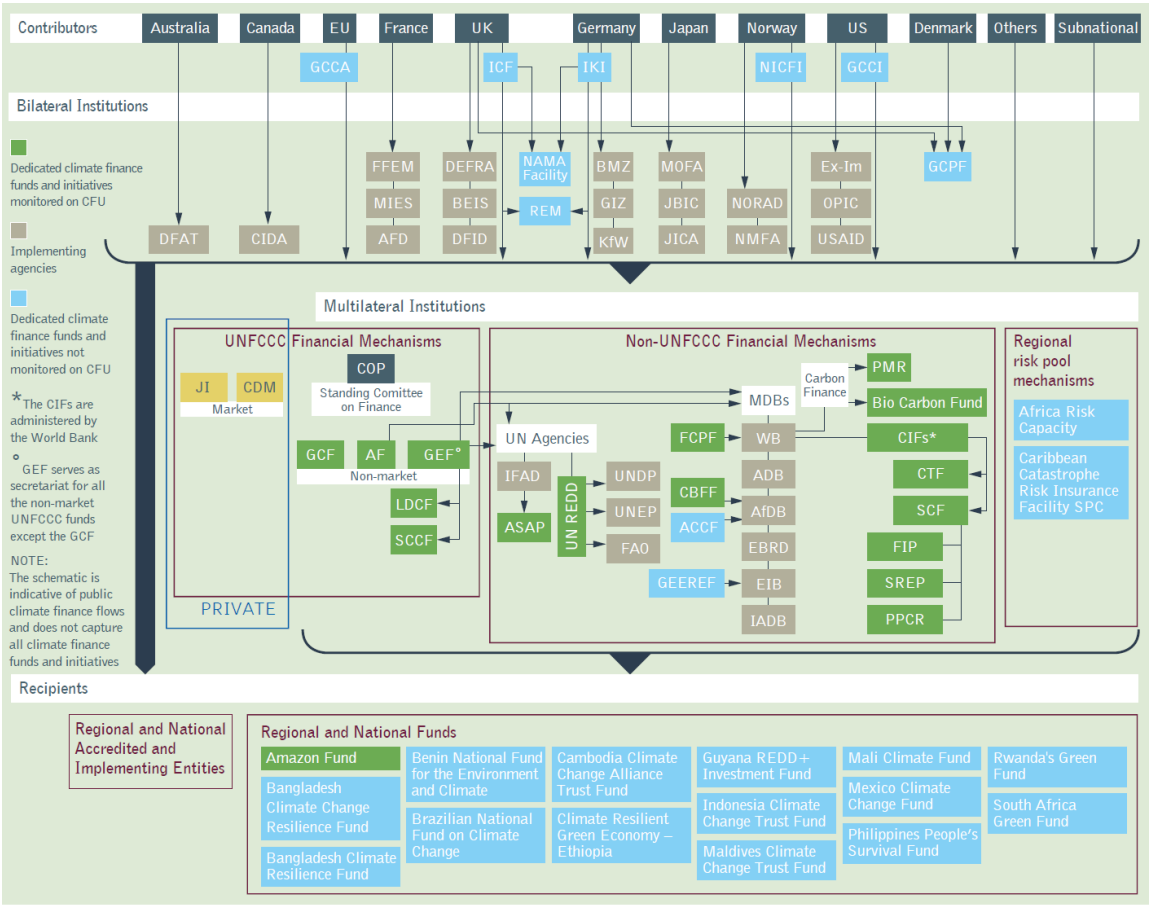
Before entering into the details of the global landscape of climate finance in overall terms as Buchner et al. (2017) and subsequently Oliver et al. (2018) state, this section aims at giving a clean definition of climate finance (and some related concepts). This turns easier to understand if analyzing the global climate finance architecture according to Watson & Schalatek (2019). In fact, the climate finance concept constitutes a fundamental background being related to the entire section 3 (as for the main part of this internship report). A first comprehensive diagram of several channels through which climate finance flows is enabled by Figure 3.

Also, the purpose is to highlight climate finance needs, especially for developing and emerging economies, thus, by identifying which areas are mostly benefiting from climate finance flows, according to the seventh edition of the Joint Report on Multilateral Development Banks' Climate Finance by The European Bank for Reconstruction and Development (2017). This is represented by an exhaustive collaborative effort of public climate finance on the viewpoint of main Multilateral Development Banks under the general family of Multilateral Development Financial Institutions (section 2.3.2).

So, what is climate finance? According to Watson & Schalatek (2019), climate finance refers to financial resources mobilized to fund actions that mitigate (*mitigation actions*) and adapt (*adaptation actions*) to the impacts of climate change. Mitigation actions aim at reducing emissions and enhancing sinks of GHGs, while adaptation actions aim at reducing the vulnerability of human and ecological systems to negative climate change impacts, as well as maintaining and increasing their resilience. Having said that, climate finance can be obtained from a variety of sources, each with its own unique documentation needs, approval procedures and eligibility criteria, although a full definition of the term "climate finance" is yet to be agreed internationally.

To better understand the climate finance definition as for its global architecture, Figure 3 provides a comprehensive overview of several channels through which climate finance flows. Therefore, it should be mainly distinguished between *public* and *private sources*. Public sources can be *domestic* (e.g., internal national budgets of the country), *bilateral* (e.g., existing development aid/financing, dedicated bilateral funds for adaptation) or *multilateral* (e.g., see LDCF, SCCF, PPCR on Figure 3 as of multilateral funds and initiatives), while private sources can be either *domestic* (e.g., local banks and businesses, private citizens) or *international* (e.g., international private banks, foreign direct investments, pension funds, non-profit organizations).

Figure 3 seems to be quite intricated, however it really helps to present an overall overview of the global climate finance architecture, focusing particularly on public climate financing mechanisms. In fact, it is clearly to see that Figure 3 distinguishes between specific channels through which climate finance flows, beginning with their *contributors*, as for main involved Developed Countries, followed by *bilateral*, *multilateral* institutions and *recipients*, mainly designed for Less-Developed Countries seeking to receive climate finance through regional and national funds. While according to the instruments of climate finance available, it can mainly be differentiated between grants, concessional loans, guarantees and private equities.



Implementing Agencies and Institutions	
AfDB	African Development Bank
AFD	French Development Agency
ADB	Asian Development Bank
BEIS	Department for Business, Energy & Industrial Strategy
BMZ	Federal Ministry of Economic Cooperation and Development
CIDA	Canadian International Development Agency
DEFRA	Department for Environment, Food and Rural Affairs
DFAT	Department of Foreign Affairs and Trade (Australia)
DFID	Department for International Development
EBRD	European Bank for Reconstruction and Development
EIB	European Investment Bank
Ex-Im	Export-Import Bank of the United States
FAO	Food and Agriculture Organisation
FFEM	French Global Environment Facility
GIZ	German Technical Cooperation
IADB	Inter American Development Bank
IFAD	International Fund for Agricultural Development
JBIC	Japan Bank of International Cooperation
JICA	Japan International Cooperation Agency
KfW	German Development Bank
MIES	Inter-ministerial Taskforce on Climate Change
MOFA	Ministry of Foreign Affairs
NMFA	Norwegian Ministry of Foreign Affairs
NORAD	Norwegian Agency for Development Cooperation
OPIC	Overseas Private Investment Corporation
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	US Agency for International Development
WB	World Bank

Multilateral Funds and Initiatives	
AF	Adaptation Fund (GEF acts as secretariat and WB as trustee)
ACCF	Africa Climate Change Fund
ASAP	Adaptation for Smallholder Agriculture Programme
CBFF	Congo Basin Forest Fund (hosted by AfDB)
CDM	Clean Development Mechanism (implemented under the Kyoto Protocol)
CIF	Climate Investment Funds (implemented through WB, ADB, AfDB, EBRD, and IADB)
CTF	Clean Technology Fund (implemented through WB, ADB, AfDB, EBRD, and IADB)
FCPF	Forest Carbon Partnership Facility
FIP	Forest Investment Program (implemented through WB, ADB, AfDB, EBRD, and IADB)
GCCA	Global Climate Change Alliance
GCF	Green Climate Fund
GEF	Global Environment Facility
GEEREF	Global Energy Efficiency and Renewable Energy Fund (hosted by EIB)
JI	Joint Implementation (implemented under the Kyoto Protocol)
LDCF	Least Developed Countries Fund (hosted by the GEF)
PMR	Partnership for Market Readiness
PPCR	Pilot Program on Climate Resilience (implemented through World Bank, ADB, AfDB, EBRD, and IADB)
SCCF	Special Climate Change Fund (hosted by the GEF)
SCF	Strategic Climate Fund (implemented through WB, ADB, AfDB, EBRD, and IADB)
SREP	Scaling Up Renewable Energy Program (implemented through WB, ADB, AfDB, EBRD, and IADB)
UNREDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation

Bilateral Funds and Initiatives	
GCCI	Global Climate Change Initiative (US)
GCPF	Global Climate Partnership Fund (Germany, UK and Denmark)
ICF	International Climate Fund (UK)
IKI	International Climate Initiative (Germany)
NAMA facility	Nationally Appropriate Mitigation Action facility (UK and Germany)
NICFI	International Climate Forest Initiative (Norway)
REM	REDD Early Movers (Germany and UK)

Figure 3 – Global climate finance architecture – Source: Watson & Schlatek (2019)

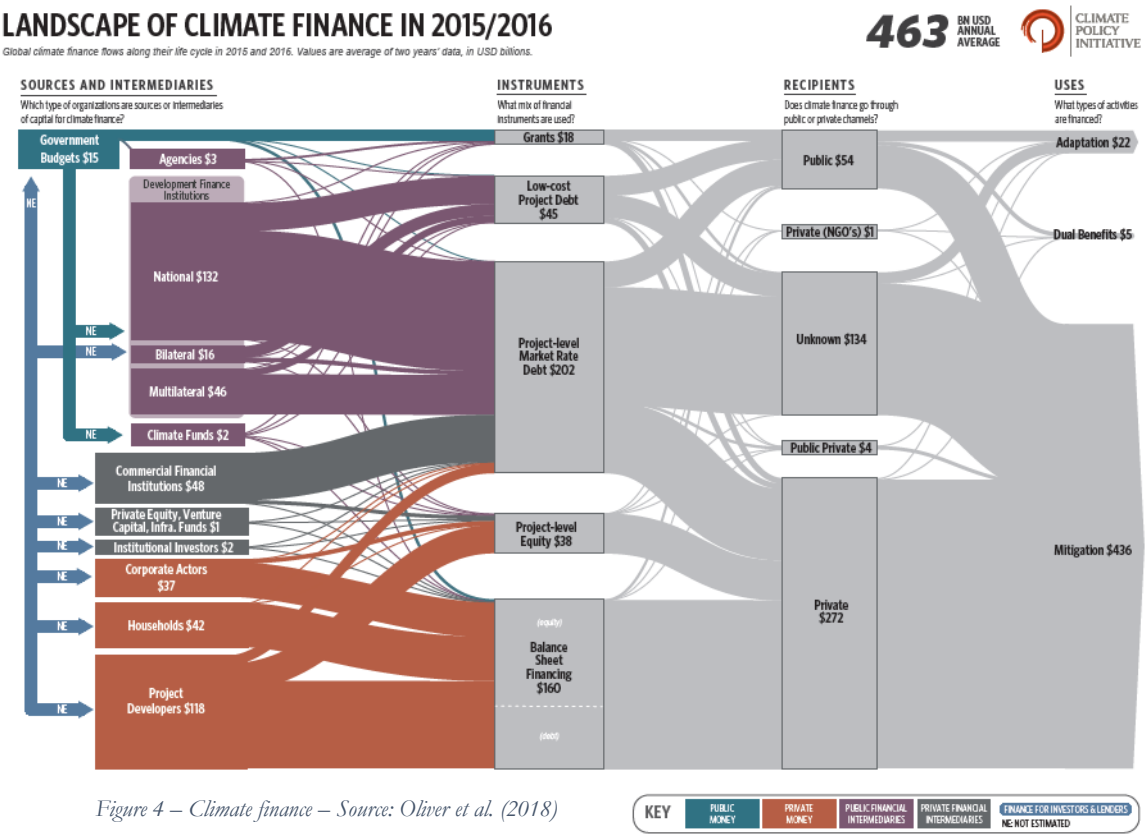


Figure 4 – Climate finance – Source: Oliver et al. (2018)

This being said, climate finance continues to remain a central issue. How should the global community get along with climate finance in order to contribute with the implementation of the PA? According to Oliver et al. (2018), this issue is essential in the context of the last data from the IPCC of 2018, which shows USD 1.6 to 3.8 trillion of energy system investments required to keep global warming within the 1.5-degree Celsius' Paris Agreement goal, in order to avoid the most harmful effects of climate change. Oliver et al. (2018) provide an updated report on actualized data *(Global Climate Finance: An Updated View 2018)*, which provides a more recent understanding of the previous report *(Global Landscape of Climate Finance 2017)* according to Buchner et al. (2017). Nevertheless, all these authors are working for the same institution, the Climate Policy Initiative (CPI), which has sought to comprehensively track domestic and international investment from both the public and private sectors for actions that address and respond to climate change (i.e., mitigation and adaptation) acting as a non-profit organization (NGO) over the years since 2012.

More specifically, CPI based his research on the third biennial assessment and overview of climate finance flows from the UNFCCC of November 2018. In this regard, CPI reviewed estimates on climate finance flows for the years 2015 and 2016 and incorporated new data, to provide the latest and best information available as to scale up investments for climate change actions. According to new key findings, global climate finance flows for 2015 account for USD 472 billion and for 2016 account for USD 455 billion. The annual average over the 2015-2016 period is thus USD 463 billion, as this one value appears on top of Figure 4. In comparison with previous findings, Oliver et al. (2018) identifies an additional USD 53 billion in the annual average of global climate finance flows over the same period, which is mainly driven by new data on national development finance institutions and the integration of electric vehicle sales into the dataset.

Looking at the distribution of climate finance sources, Figure 4 helps to perceive some specific key findings of Oliver et al. (2018) synthesized here: climate finance has been steadily increasing (USD 463 billion versus USD 360 billion in 2012) but more is needed; private investment continues to account for the major share of climate investments, as of the highest value shown under "recipients" of Figure 4 (USD 272 billion); renewable energy investment slightly fell by 16% from 2015 to 2016 as of falling renewable energy technology costs; investments in sustainable transport are growing fast; adaptation finance is estimated at remaining roughly just USD 22 billion as shown under "uses" of Figure 4; domestic investments continue to account for the vast majority of climate investments (mainly provided by the private sector); flows from Developed to LDCs increased by 9% from 2013/2014 values; LDCs continue to be the dominant destination of climate investment both for domestic and international investments.

It is important to notice that these specific calculations don't include financial mechanisms of secondary market transactions including green bonds due to the potential for double-counting against project investment costs. However, there is a greater potential for Article 2.1 of the PA to make these financial mechanisms consistent with the 2°C pathway. As for example, improved reporting practices on green bond investments among many other similar mechanisms are already being important first steps even though standardization of reporting is limited. So, why mentioning green bonds and what are they? Section 3 provides a clear explanation and describes why they are so essential to help tackling climate change along with NDCs.

2.3.2 Particular efforts of Multilateral Development Banks (MDBs) in financing developing and emerging economies

In regard to Figure 4, there is clear evidence that national development finance institutions (NDFIs) play an essential rule on the global distribution of climate finance sources (values by USD 132 billion under "sources and intermediaries" of Figure 4), but which rule do multilateral development finance institutions (MDFIs) play? MDFIs represent still the second largest share of climate finance values if considering all public finance sources and intermediaries (values by USD 46 billion under "sources and intermediaries" of Figure 4), but who are the respective recipients, which are mostly benefiting from this significant share?

The seventh edition of the Joint Report on Multilateral Development Banks' Climate Finance provided by The European Bank for Reconstruction and Development (2017) reviews the contribution of seven of the main MDFIs in total, as it the case of the following MDBs: the European Bank for Reconstruction and Development, the African Development Bank, the Asian Development Bank, the European Investment Bank, the Inter-American Development Bank Group, the Islamic Development Bank and the World Bank Group. Along with the last announcements, these MDBs together with the International Development Finance Club (IDFC) agreed on a set of common principles to mitigate climate change (mitigation actions) and to support adaptation to climate change (adaptation actions) starting from 2015.

Thus, according to The European Bank for Reconstruction and Development (2017), the MDBs collectively committed USD 35.219 million in financing developing and emerging economies. Respectively of this total, 79% for mitigation actions and 81% through concessional loans, which was mainly allocated to Latin America/Caribbean and Sub-Sahara Africa with the largest shares. These institutions are therefore expected to promote and further develop common principles as to discuss all differences transparently. In fact, the Paris Agreement's vision of making financial flows consistent with low GHG emissions and climate-resilient developments (as reported on Article 2.1 of the Paris Agreement) will be particularly important in this ongoing common approach to improve tracking and reporting climate finance, especially by including further reporting practices, such as the ones of the secondary market.

3. Green Bonds. A turning point for further financial mechanisms in the context of financing LDCs

For the development of this section four goals in total have been considered, which are accurately explained as followed. The first goal is to understand what green bonds in fact are as they represent an explosive growth of capital markets attracting attention from many investors according to the International Bank for Reconstruction and Development (2015). To ease the comprehension of the green bond concept, it is firstly distinguished between bonds and other traditional financial mechanisms and secondly between bonds in general and green bonds. Then a wider green bond definition is emphasized as well as to provide a voluntary process guideline for the green bond issuance approach, which is enabled by the illustration of the green bond principles according to the International Capital Market Association (2018). The second goal is to open a further insight on the global state of the green bond market according to most recent reviews of Filkova et al. (2019) and Climate Bonds Initiative (2019). The third goal is to clarify the current market situation focusing on Africa according to the London Stock Exchange Group (2018) as well as to provide some up-to-date information on last African green bond issues according to Environmental Finance (2019). The fourth goal is to emphasize the potential of green bonds regarding the fulfillment of already submitted NDCs according to the UNFCCC (2019) as well as to hand out NDC sectors that are best-suited for green bond uses according to Goodman (2017).

From this point on, it should be kept in mind that the entire internship report (with main emphasis on section 3) is advising key bond terms, according to Table 1, and key bond parties, according to Table 2, which both face relevant finance terms regarding bonds in general enabling for a better comprehension of the green bond concept. That means, both tables should only support the understanding of green bonds, as contained definitions can be read independently from the text progress afterwards.

Term	Definition
Security	A tradable financial instrument or asset. Generally, they can be classified into equities, debt (i.e. a bond), or derivatives (e.g. options, futures, swaps, etc.).
Maturity	The period when the final payment will be made by the issuer to the investor. The tenor/term of a bond is the time remaining until maturity.
Coupon	The promised payments to investors made at agreed-upon periods. A coupon rate is the interest level from which the coupons are determined.
Face value	The principal of the bond. It is typically the final payment made to investors, along with final coupon.
Proceeds	The funds received by the issuer from investors when the bond is initially sold, which can be directed toward productive activities to support an enterprise.
Yield	The return an investor receives for holding a bond. The yield to maturity is the present value of all promised future payments.
Credit quality	The perceived likelihood that all promised payments will be made at the promised time. Lower credit quality entails a higher yield for investors. This information is often communicated by a credit rating, assigned by a rating agency.

Table 1 – Key bond terms – Source: Goodman (2017)

Party	Description of role
Issuer	An entity, public or private, which sells securities in order to finance operations. In the case of a bond issuance, the issuer is the borrower.
Investor	An entity, public of private, which purchases securities from issuers (or from other investors). In the case of a bond issuance, the investor is the lender.
Underwriter	An entity that facilitates the issuance of securities. Typically they work with issuers to price securities, purchase them, and then sell them to investors, for which they receive a fee.

Table 2 – Key bond parties – Source: Own elaboration based on Goodman (2017)

3.1 What is a bond? Green Bond Definition and Principles

Bonds are thought to relate to further reporting practices to comply with NDCs in the future, as further financial mechanisms that could contribute for a low-carbon and climate resilient economy, if under the family of those called *green bonds*. In this respect, it is necessary to distinguish bonds in general from traditional financial mechanisms first. According to the International Bank for Reconstruction and Development (2015), bonds constitute a form of debt security, keeping in mind that a debt security is basically a legal contract for owed money, which can be bought and sold between parties. This being said, entities in general, who seek to achieve finance to raise funds, can mainly choose between *stocks,* as for equities, or *bonds*. Stocks constitute a form of ownership, while bonds a form of debt. So, what is the main difference between investors in bonds and investors in stocks? One the one hand, investors in bonds are creditors of the bond issuing entity. These investors are paid with a fixed interest (coupon rate) and they are returned with their initial investment (principal) upon this investment related maturity. Thus, because bonds typically rise fixed interests over the related maturity period, they are often attributed to fixed-income securities. Also, once bonds are already being issued and therefore purchased from the bond issuing entity (that mainly happens through financial institutions acting as dealers, such as investment banks called lead managers or underwriters), bonds can continue to be traded in the securities market. On the other hand, investors in stocks are buyers of an entire portion of the stock issuing firm, which means that the returns of their investment fluctuate in accordance with dividends paid by the stock issuing firm and its respective value. Like bonds do, stocks are also traded in the securities market.

So, what is a green bond and how does it differ from a bond in general? According to the International Bank for Reconstruction and Development (2015), a green bond also constitutes a debt security, but is mainly issued to raise capital to support environmental or climate-related projects. Therefore, it aims at raising the environmental awareness, especially by reaching new investors (through the announcement of respective environmental projects that the bond intends to support) besides at evaluating the regular financial benefits and characteristics, such as the maturity, the coupon rate, the price and the credit quality of the issuer (credit rating).

GREEN BOND DEFINITION:
Any type of bond instrument where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible Green Projects and which are aligned with the four core components of the Green Bond Principles

Figure 5 – Green bond definition – Source: Own elaboration based on International Capital Market Association (2018)

According to the International Capital Market Association (2018), green bonds aim at enabling and developing the key role that debt securities markets can play in properly funding environmental projects. In this context, they provide a wider green bonds definition as shown in Figure 5, which introduces in turn another broad concept, in the case of the Green Bonds Principles (GBPs). GBPs constitute a voluntary process guideline that guarantees transparency and disclosure by clarifying the issuance approach of any green bond. GBPs are also intended to service multiple market players, such as bond issuers (in launching credible green bonds), bond investors (with the necessary information to evaluate environmental impacts of their green bonds investments) and bond underwriters (enabling adequate market disclosures to facilitate transactions). For this reason, GBPs have currently developed four core components in total as exposed on the left column of Figure 6.

GREEN BOND PRINCIPLES:	
Use of Proceeds	The issuer should declare the eligible green project category it intends to support and provide a clear definition of related environmental benefits connected to the project(s) financed by the proceeds.
Process for Project Evaluation and Selection	The issuer should outline the investment decision-making process it wants to follow and communicate it to the investor.
Management of Proceeds	The issuer should credit the net proceeds to a sub-account or otherwise attest them by a formal internal process that should be disclosed.
Reporting	The issuer should report the investments made through the proceeds on an annual basis, detailing whenever possible related environmental benefits collected with qualitative/quantitative indicators.

Figure 6 – Green bond principles – Source: Own elaboration based on International Capital Market Association (2018)

The *Use of Proceeds* serves for the issuer to indicate the green project category it intends to approach. The principal green projects categories are illustrated on Figure 7. However, they are indicative, which means they illustrate just the most common project types used, in order to recapitulate the ones already pursuing the up-to-date green bond market. In fact, green projects categories could also include other related or supporting expenditures, such as the ones used for R&D (Research & Development) and many others. In this aspect, green project categories illustrated on Figure 7 are listed in no specific order and are not restrained to a limited number.

The *Process for Project Evaluation and Selection* serves for the issuer to trace the investment decision-making process by indicating environmental sustainability objectives by determining how the considered project(s) fits within eligible green projects categories and including related eligibility criteria and any exclusion criteria to avoid social risks. In addition, issuers are encouraged to divulge any *certification*, as of green standards or labels assigning respective project selections. These processes should be attributed with a so-called external review (which ranges from: *second party opinions*, *verifications*, *certifications* and *scorings/ratings methodologies*) for the project evaluation and selection. All processes should finally be communicated to the investors.

The *Management of Proceeds* serves for the issuer to shift net returns (or an equal amount) to a sub-portfolio for him to attest its lending and investment operations for respective green projects. In this regard, the issuer should periodically adjust its net returns to match allocations to eligible green projects during the entirely defined period as long as the green bond is outstanding. Like for the processes, issuers are encouraged to pursue any complemented *verification*, as of auditors or third parties' consultations validating internal tracking methods and fund allocations from net returns. Likewise, the issuer should always let the investor know about the intended temporary green bond placement, as for the investor to be aware of its unallocated net returns.

The *Reporting* serves for the issuer to report up-to-date information on investments made through the returns as to keep this information readily available to be renewed until full allocation on an annual basis. In this regard, the report should at least contain the projects list, the respective green bond allocation, the allocated amount and related environmental benefits. Environmental benefits achieved should be transparently communicated in a manner that involves the use of qualitative as well as quantitative measures (such as reduced GHG emissions, provided peoples with clean power, etc.) including the respective used methodology.

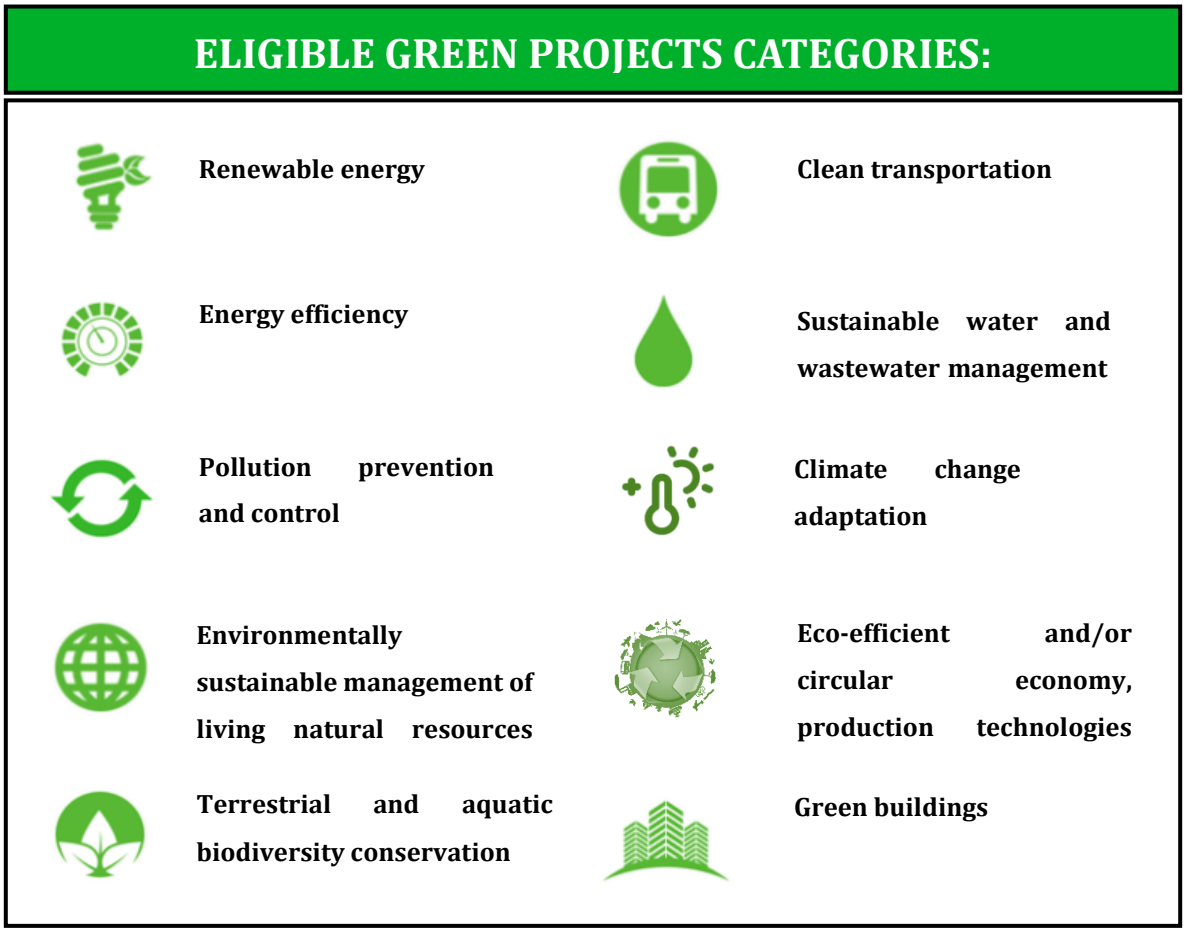


Figure 7 – Eligible Green Project Categories – Source: Own elaboration based on International Capital Market Association (2018)

3.2 The State of the Market 2018

This section aim is to provide a global overview of the 2018 green bond market in numbers. In fact, green bonds represent an explosive growth of capital markets calling attention of many investors. Also, it is estimated that an ever-growing number of countries will become active participant. According to Filkova et al. (2019), the global green bond market size corresponded to USD 167.6 billion of 2018 green bond issuances, which doubtlessly surpasses those of 2017 in the amount of USD 162.1 billion. So far, it is still unknow how much those issues will reach in 2019, however according to Climate Bonds Initiative (2019) they will grow again, in fact USD 47.9 billion were already issued on the first quarter of 2019, compared to USD 33.8 billion on the first quarter of 2018 representing a clear upward trend as of the 42% growth.

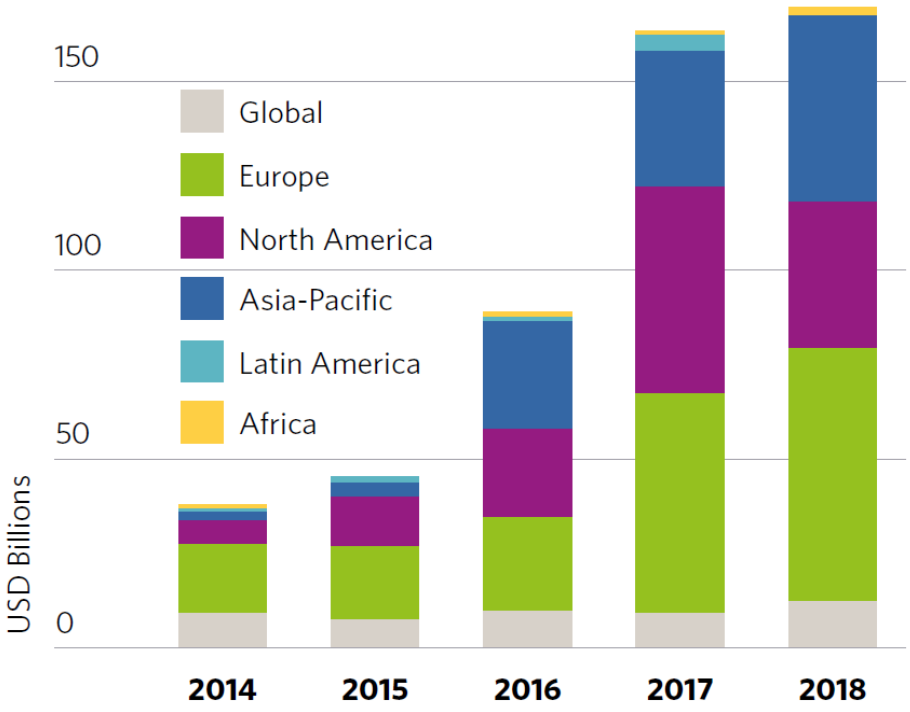


Figure 8 – The state of the market 2018 – Source: Filkova et al. (2019)

But which continents reached the higher year-on-year growth rate? To answer this question, we should observe Figure 8, which eases to figure out that Asia-Pacific achieved a considerable growth (concretely 35%, according to Filkova et al. (2019)) with the highest rate having issued the second largest 2018 volume after Europe. This is mainly due to the increasing weight of market issuers in three countries, China, Australia and Japan. On the other hand, Global issuers (which are represented by MDBs) achieved the second highest growth rate (34%) between 2017 and 2018, which is mainly due by the contribution of three banks with a strong focus on financing developing and emerging economies in the case of the European Investment Bank, the World Bank Group and the Asian Development Bank. Thus, Europe achieved the third highest year-on-year rate (15%). However, this is still enough to secure Europe on top with the largest green bond market size despite its lower growth rate. In this context, Europe is followed by Asia-Pacific, North America, Global issuers and Africa on the ranking of the largest 2018 green bond market size.

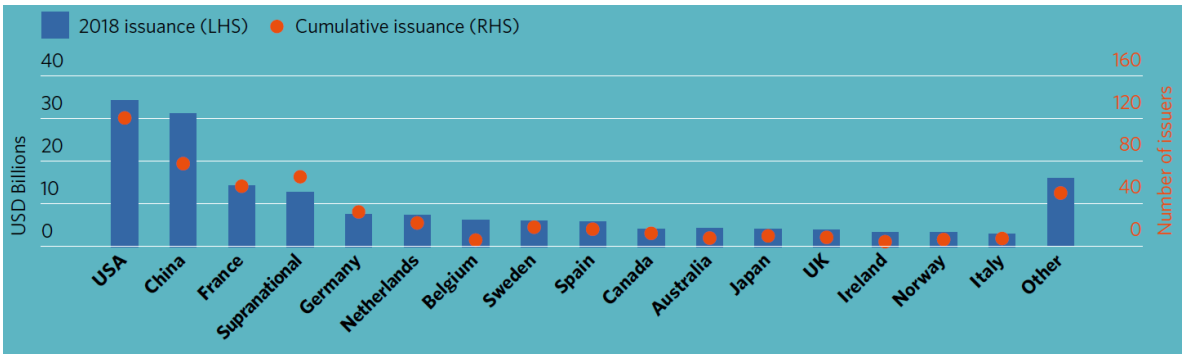


Figure 9 – The state of the market 2018 – Source: Filkova et al. (2019)

Which countries reached thus the highest green bond issuance share in 2018 and in what number of issuers? If splitting up continents (of Figure 8) and looking at them more in detail as of Figure 9, with the exclusion of Global issuers (figured as 'Supranational'), the top 5 countries can be figured out. This is the case for USA, China, France, Germany and the Netherlands. Respectively, USA with USD 34 billion and 20% market share; China with USD 31 billion and 18% market share; France with USD 14 billion and 8% market share; Germany with USD 7.6 billion and 5% market share and; Netherlands with USD 7.4 billion and 4% market share. Hence, those values correspond to those figured in blue for the Left-Hand Side (LHS) of Figure 9. Also, the cumulative issuance expressed in number of issuers can be seen in red for the Right-Hand Side (RHS).

Another important evidence is given by the fact that roughly 90% of green bonds (issued in terms of the total 2018 amount) were attributed with at least one type of external review for respective project evaluations and selections as Filkova et al. (2019) claim. In this context, *second party opinions* (confirming the alignment with the GBPs on the assessment of the issuer framework) constituted the preferred option. While, according to the leading providers of external reviews (independent parties of pre-issuance reviews), *CICERO* ranked first with 28% market share of deals by volume, followed by *Sustainalytics* with 23% and *Vigeo Eiris* with 11%.

3.3 The situation in Africa in respect of developing and emerging economies

As it can be deduced from Figure 8, Africa accounts for a small slice of the 2018 green bond market size. Nevertheless, Africa offers a great opportunity, despite the lack of a structured market. With most African countries having ratified the PA, the continent is currently struggling with an ambitious intention: Africa must intensely increase its citizens access to power services by simultaneously meeting its Agreement commitments. According to the London Stock Exchange Group (2018), to tackle environmental damage (adaptation actions) - under which the continent is suffering for the most given its limited capacity to adapt and manage its Agreement commitments (mitigation actions) - a considerable investment in infrastructure as well as a regulated transition to a low-carbon economy is needed. In fact, this achievement can only be attained through diversification of finance mechanisms and funding sources. A significant part of the required capital is expected to be performed by the private sector, as there is a prominent urgency to reestablish key parts of the financial system and apply new investment standards.

In this context, climate financing is gaining significant global eminence as a centralized financing complement to raise environmentally friendly funds. Capital raising through green bonds has been broadly conceived as the most accessible and appropriate instrument for meeting Africa's commitments among numerous climate financing instruments. On the other hand, the green bond market remains comparatively underdeveloped in Africa if looking at this market evolution in other emerging markets. Nevertheless, many African governments and domestic institutions are already beginning to recognize the relevance of climate financing and its related benefits. Therefore, green bonds were already issued in a few African countries taking a leading position in South Africa, Morocco, Nigeria and Namibia while others have already indicated their intention to undertake similar roles encouraging further issuances.

In addition, with the support of MDBs, there have already been numerous continent-wide actions to evolve the green bond market. Among these, funds aimed at investing in green assets are prevailing, with the African Development Bank leading the way. There is in fact no lack of African industries in emergency to require climate financing, especially in power generation with a desperate need to solve out its associated scarcity through renewable energy.

So, which domestic institutions already issued green bonds in Africa (excluding the African Development Bank)? Firstly, is it essential to notice that according to Environmental Finance (2019), institutions which are involved in the issuance of green bonds among countries in general are currently sub-divided in: *agencies*, *corporates*, *financial institutions*, *municipals*, *sovereigns* and *supranationals* (in the case of MDBs). In May 2019, S&P Global Market Intelligence (2019) suggests that, according to the highest green bond issuance share, South Africa is leading the way with 5 issues in total, followed by Morocco with 4, Nigeria with 3 and Namibia with 1. More specifically, South Africa issues occurred through 2 municipals (the City of Cape Town and the City of Johannesburg), 1 corporate (Growthpoint properties) and 1 financial institution (Nedbank) with 2 issues. Morocco issues occurred through 2 agencies (the Moroccan Agency for Solar Energy and the Casablanca Finance city) and 2 financial institutions (BMCE Bank and Banque Centrale Populaire). Nigeria issues occurred through 1 sovereign (the Federal Government of Nigeria), 1 corporate (North South Power Company) and 1 financial institution (Access Bank). Namibia issue occurred through 1 financial institution (Bank Windhoek).

3.4 The potential of Green Bonds for NDCs

Despite the fact that 184 countries have submitted their first NDCs (according to the information retrieved on 22/06/2019) in line with the official website of the UNFCCC (2019), they broadly vary as per national circumstances as well as in terms of quality, methodology used, ambition and details. Many of them require consistent international support, while others need additional research only (to estimate their own targets). According to Goodman (2017), almost 80% of submitted NDCs require international support and 20% underline this conditional component exhaustively. Nevertheless, NDCs constitute essential documents exhibiting essential country policy directions (as wholly explained in section 2.1). However, the ambition is quite high, as it is currently forecasted that even with the achievement of all NDCs, the average global temperature increase would be kept by 3.0 to 3.2°C by 2100 (with or without international contribution). That means, this wouldn't be enough to achieve the long-term goal of the PA to keep the average global temperature increase under 2°C above pre-industrial levels (pursuing efforts to limit it by 1.5°C).

In this respect, it shouldn't be focused on the exclusive first submission of NDCs itself, but rather on their progressive development, e.g., by gradually increasing their ambitions. For this reason, it should be looked with open eyes on additional initiatives and strategies that could close these gaps for a better alignment with the PA. To reach this goal, a great deal of financial resources, domestic and foreign, public and private is required. In this regard, the public sector should not only directly support specific projects, but also incentivize private market players to do so. It is in fact broadly recognized that private funds will have to come up for helping countries to meet their own goals. This could be empowered through a wide range of private financial instruments through different flows. Green bonds, for example, are characterized by low return expectations, low technology risks, some liquidity requirements, but large institutional sizes and typically long-term investment horizons. These characteristics alone could already be addressed to a wide range of sectors for which the accomplishment of NDCs is best suited for.

Having said that, it should also be emphasized that any project that seeks private finance, through bonds or any other instrument, is faced by its bankability (commercial viability), which is the capacity of project developers to make out an appealing business for their investors (project lenders). So which NDC sectors could be best financed through green bonds? According to Goodman (2017) there are several commonly-listed activities for which green bonds could be an appropriate mechanism. Among others, exemplary activities for this purpose are: grid-connected, utility-scale solar or wind parks, investments into low-carbon public transport, water resource management to improve its efficiency and energy efficiency upgrades in buildings. However, to encourage large finance flows into emerging markets and developing countries, which still have difficulties on raising finance domestically and appealing finance internationally, more than that is needed. This argument is further discussed in section 4.4.1.

4. Aenergy. Company insights and the effort of the Climate Finance Team in the context of main internship activities and recommended author reviews

This section serves to present and introduce the company under which the current curricular internship has been established for this report. In fact, this curricular internship protocol has been signed between the Faculty of Economics of Porto (FEP) and the company of Aenergy (AENERGIA, S.A. - SUCURSAL DE PORTUGAL) headquartered in Luanda, Angola.

The aim is to straightly explain Aenergy main commitments as well as its Sustainability Policy. Thereafter, is given emphasis to Anergy Social and Environmental Responsibility regarding main obtained reports and achieved certifications. Only at this stage, Aenergy main values, such as Credibility and Trust, Rigor and Excellence, are highlighted as well as the company corporate vision and mission according to Aenergy current business. At the end of the company profile definition, Aenergy main areas of investment are faced as well as its commitments according to some specific guidelines provided by the United Nations.

At this point, an important two-party cooperation deal between Aenergy and Afreximbank is emphasized, reminiscing that Afreximbank is a multilateral financial institution created for the establishment of the African Export-Import Bank. Afreximbank is the leading African trade finance multilateral institution with a mandate to facilitate and promote intra-African trade and to encourage African countries to trade internationally. Thus, this cooperation deal constitutes the base for the achievement of six main internship activities (6 outputs) and one particular strategy in finalization stage, as of the *green bond issuance* (upgrade of output 5). The sequential order of these activities is exceptionally important, as it brought the company to follow another innovative path by considering the issuance of green bonds.

At the end, this track is extended by a contribution of theoretical considerations supported by Aenergy for a well-performed green bond issuance. Firstly, it is envisaged the need of a well-functioning market infrastructure within capital markets for domestic green bond issuances to work out. Secondly, it is investigated on evident facts of first African countries experiences in green bond issues for the fulfillment of own NDCs.

4.1 Company profile, corporate path and main achievements

This being said, Aenergy is a Pan-African company based in Luanda that has a portfolio of projects of about 1.500M USD, mainly in the power, transportation and water sectors. Since the beginning, Aenergy has been characterized by innovative drive, environmental and social commitments. Its focus is always to incorporate solutions into projects for bringing improvements in the quality of life of people. The company is committed to contribute to the economic and social growth and the sustainability of Africa, by developing and enabling strategic projects offering integrated solutions, in partnership, capable of optimizing resources, including provisioning and logistics for its clients in the transport, energy and water, mining, and healthcare sectors.

Aenergy' Sustainability Policy is defined in a set of commitments that establish the matrix of its daily relationship with employees, customers, partners, suppliers and with each of the communities where Aenergy is part of. The company' sustainability objectives and goals, which are integral to the Business Plan and updated periodically, support the United Nations' 17 Sustainable Development Goals (SDGs). Aenergy have chosen to focus on seven of them where it believes to make meaningful contributions, taking into consideration its business and needs of the core markets where it operates:

1) SDG 7. Affordable and clean energy
2) SDG 8. Decent work and economic growth
3) SDG 9. Built resilient (transport, irrigation, energy, …) infrastructure
4) SDG 11. Sustainable cities and communities
5) SDG 12. Responsible consumption and production
6) SDG 13. Combat climate change and its impacts
7) SDG 17. Partnership for the goals

Aenergy often makes its contribution through actions of Social and Environmental Responsibility, with proven impact. Thus, whether in its projects or in various communities, Aenergy has made investments in access to health, education and in actions to mitigate the production of GHG. Since 2015 Aenergy has been counting its own GHG emissions and reporting them internally. In 2017 it obtained the first emissions report audited by an external entity and started with several environmental sustainability projects and policies. Pursuing innovative spirit and highest standards of conduct and ethics, Aenergy was the first African company to obtain the ISO 37001 – Anti-bribery Management System certification.

Following the company values of Credibility and Trust, Rigor and Excellence well present in its culture since the first day of operation, Aenergy has the ambition and vision of becoming a reference of offering integrated solutions in the energy and transport sectors, applying lead technology and structured financing, for the sustainable development of countries in Africa and respected for the way it conducts its business.

Aenergy mission is to support African countries sustainable development through the implementation of high-quality and efficient projects, financially accessible, with innovative and reliable technology; to provide economic benefits to local communities by way of direct and indirect employment and; to lead the way and set a good example in areas such as governance, sustainability and environmental conservation.

Aenergy implements the most efficient projects in a sustainable way, financially accessible, with innovative technology, reliable, respecting the environment, giving priority to location, technology transfer, local capacitation, qualification and the creation of competence centres. To pursuit these goals and to support countries in obtaining cheaper and more sustainable energy, Aenergy will invest more in renewable energy, energy efficiency, smart networks, efficient storage and innovative solutions for its customers which will strengthen its commitment to the United Nations SDGs. According to the United Nations (2019), the 17 SDGs constitute an urgent call for actions by the union of all countries (both DCs and LDCs) to end poverty while tackling climate change.

4.2 Internship activities

Having said that, some of the activities related to the curricular internship and one most recent strategy in finalization stage, as of the *green bond issuance*, are reviewed as followed: on the agreement between the African Export-Import Bank (Afreximbank) and Aenergy. In particular, the internship has engaged in, inter alia, a cooperation deal, the so-called "Memorandum of Understanding" (MoU) that has been established between Afreximbank (which was created under the auspices of the African Development Bank) and Aenergy. As in fact, Afreximbank and Aenergy wanted to contribute to a low carbon and sustainable economy and a climate finance strategy to support projects and national initiatives in the related sector across Africa. Thus, they established an agreement for the creation and development of the *Afreximbank' Climate Change Finance Strategy*. This strategy primarily focuses in three main areas/goals:

1. Climate finance to **Support Trade** and **Bring Low Carbon Technologies to Africa**, with main focus to the Renewable Energy and Transportation sector;
2. Establishment of a **Climate Innovation Investment Fund** (for innovative projects of reducing emissions and helping adherent countries to comply with their own NDCs);
3. Realization of a **First Multilateral Bank in Africa associated to import-export**, to issue green bonds in partnership with the Stock Exchange.

As a result, in order to achieve this agreement purpose, the constitution of six outputs in total has been carried out, for which my participation during the internship is emphasized. So, Table 3 provides a brief overview of all six outputs considered, as well as their current implementation stage. Following their progressive order, potential eligible projects and countries interested in green bond issuances were carried out (1). Then, a survey of potential climate finance sources was performed as well (2). In line with Muller et al. (2017), some other potential projects and countries have been targeted regarding the implementation phase of their nationally strategies implemented on behalf of a specific channel through which climate finance flows, the so-called REDD mechanism (Reducing Emission from Deforestation and Forest Degradation) (3). Lately, the company worked on a a project in Sao Tome and Principe for the monetization of environmental assets (4).

Area of Collaboration (OUTPUT)	OUTPUT IMPLEMENTATION STAGE
1 - Project identification	Potential Eligible projects and countries interested in Green Bonds issuance
2 - Climate Finance	Mapping of potential sources for Climate Finance fundraising
3 - REDD	Definition of Potential projects and Countries: Phase of National strategy
4 - Monetization of Environmental Assets	Sao Tome and Principe Project – Evaluation of Environmental Assets
5 – Green Bond Facility	Africa Green Bond Facility Framework completed
6 - Climate innovation Fund	Climate Innovation Fund pre operational
Final Documents	Action plan for all areas of collaboration finalized
Final Documents	Yearly budget to be finalized
Final Documents	All documentation ready for board approval

Table 3 – Output implementation stage as for six outputs in total – Source Aenergy (2019)

Only at this point, the mentioned strategy in finalization stage, as of targeting projects to be financed through a *green bond issuance* (upgrade of output 5) could be approached. Facing its finalization stage, the upgrade of output 5 constitutes in fact the most recent and treated one, as output 6, in relation to the establishment of a climate innovation fund, is only pre operational. Aenergy is in fact almost ready to issue green bonds, but this approach will be better discussed in the next section.

4.3 The green bond issuance as a private project in Angola and Ghana in the context of simultaneously help African countries meet their NDCs

This section reviews the opportunity of emitting green bonds by a strictly private project leaded by the company own purpose to comply with its own Environmental Responsibility and the directly linked opportunity to help determined recipient countries to comply with NDCs in the African landscape.

Therefore, it is firstly explained why Aenergy intended to develop the *Aenergy' green bond framework* (output 5) and to what purpose. As the framework is in accordance with the GBPs, it is illustrated how Aenergy will monitor and report the proceeds of each bond issued. Thus, a comprehensive table of Eligible Green Projects according to the company framework is provided including a related project description and those SDGs considered, which were attributed to each project. Thereafter, the initiative between Aenergy and Afreximbank is emphasized in relation to an established common framework for the functioning of any green bond issuance per projects.

This functioning as a whole, it's exposed in respect to the particular strategy on the afore discussed agreement between Afreximbank and Aenergy, which constitutes the *green bond issuance* (upgrade of output 5) as it already composes a free subject matter being its release permitted through the official consent of Aenergy. At the end, it is then given emphasis to the role of the bank on guarantying the green bond issuance in two countries on behalf of Aenergy and subsequently to the actual projects and the amount to be financed.

According to the basis for a well-performed framework, Aenergy sees the issuance of green bonds as an ideal tool to finance the low-carbon economy growth of Africa. Therefore, a green bond framework has been created to facilitate transparency, disclosure, integrity and quality of Aenergy green bond issues. This framework is in alignment with the afore mentioned GBPs (Figure 6 of section 3.1) according to the International Capital Market Association (2018).

Thus, *Aenergy' green bond framework* is based on the following 5 pillars:

1. Use of Proceeds;

2. Process for project evaluation and selection;

3. Management of proceeds;

4. Reporting;

5. External Review.

This framework may, from time to time, be updated and, will be applied to any green bond issued by Aenergy. With the objective of avoiding double counting and assuring transparency, Aenergy will monitor that the proceeds of each green bond will only finance Aenergy legal share of the project or portion of projects not already financed by third party financing (in case of joint venture agreements and co-financing).

If the total amount invested by Aenergy in a single project would be higher than the percentage of Aenergy's ownership, only the pro-rated share (as a percentage of the issuer's share of the total financing of the project) of the total results would be included in the impact reporting. In case of divestments or if an eligible project no longer meets the eligible criteria, the funds will be reallocated to another Eligible Green Project (see Table 4).

According to the Use of Proceeds of the *Aenergy' green bond framework*, the net proceeds of green bonds will be used to finance and/or refinance, in whole or in part, the development, construction, installation, maintenance of new or existing projects, assets or activities which support the sustainable economic growth of Africa, especially those that meet the eligibility requirements defined in this framework (see Table 4 for two Eligible Green Projects considered).

Eligible Green Project	Green Bond Category	Description	United Nations Sustainable and Development Goals (SDGs)
Energy Efficiency	Energy efficiency 	This includes the financing of, or investments in, projects that contribute to a reduction of energy consumption per unit of output, such as – for instance – projects that improve the outage rate and improve network resilience, heating and cooling network (which recover heat sources that would otherwise be lost), optimization of buildings or plant efficiency, systems for energy management (Smart Grids, Smart Metering), and more generally energy and facility management solutions. This smarter, more decentralized, yet more connected electricity system could increase reliability, security, environmental sustainability, asset utilization and open new opportunities for services and business. By increasing the efficiency of the overall system, optimizing capital allocation and creating new services for customers, grid edge technologies can unlock significant economic value for the industry, customers and society. It may include additional types of project to be included in future updates of the GBP' energy efficiency category. It is also an objective of these projects, introducing international best practices in relation to operational, technical, commercial, financial, staffing, labour, environmental and social and health and safety matters. Energy efficiency has a vital role in steadying and reducing greenhouse gas emissions. According to the International Energy Agency, the main factor behind Greenhouse Gas ("GHG") emissions reduction is the energy intensity decrease, driven largely by energy efficiency improvements. The Green Assets may include assets related to energy efficiency such as Improvement of infrastructure and distribution of energy. The projects should be designed to improve the operational efficiency of the electricity distribution system, increase the population's access to electricity and help transition Africa to a low-carbon economy through the reduction of greenhouse gas emissions. In fact, improvements in the operational efficiency of the distribution system are likely to reduce GHG emissions. Energy efficiency products and programs are worth pursuing because they are often the lowest cost way to meet resource needs. Avoiding a kilowatt-hour of demand is typically cheaper than supplying that demand by any other available resource.	

Eligible Green Project	Green Bond Category	Description	United Nations Sustainable and Development Goals (SDGs)
Renewable Energy	Renewable Energy	This includes the financing of, or investments in, the conception, construction and installation of renewable energy production units. It covers energy produced from renewable non-fossil sources. It includes solar (photovoltaic or concentrated solar power - CSP), wind (onshore and offshore, hydro and any other renewable sources of energy. It may include additional types of projects to be included in future updates of the Green Bond Principles' renewable energy category. The Paris Agreement on Climate Change aims to limit global temperature rise this century below 2ºC. Renewable Energies will play an instrumental role in the transition to a low-carbon economy. Investing in renewable energy production contributes to provide people with cleaner, reliable, sustainable energy and to combat climate change and its impacts.	

Table 4 – Eligible Green Project as for Energy Efficiency and Renewable Energy – Source: Aenergy (2019)

Following the *Aenergy' green bond framework*, the company traded with Afreximbank on the base of their cooperation deal to define a common framework encompassing all necessities of Anergy (the green bond issuer to invest in green projects in Africa), Afreximbank (the guarantor and bank) and related Investors (e.g., international qualified investors, sovereign funds, african qualified institutional investors, individuals investors, international companies that are in compliance to reduce emissions, African countries and family offices). The interplay of these parties follows seven steps in total and is articulated in Figure 10. Resulting from the issuance of green bonds, Figure 10 also highlights two main benefits with specific regard to African countries. In conclusion, this common framework explains how any green bond issuance per projects works.

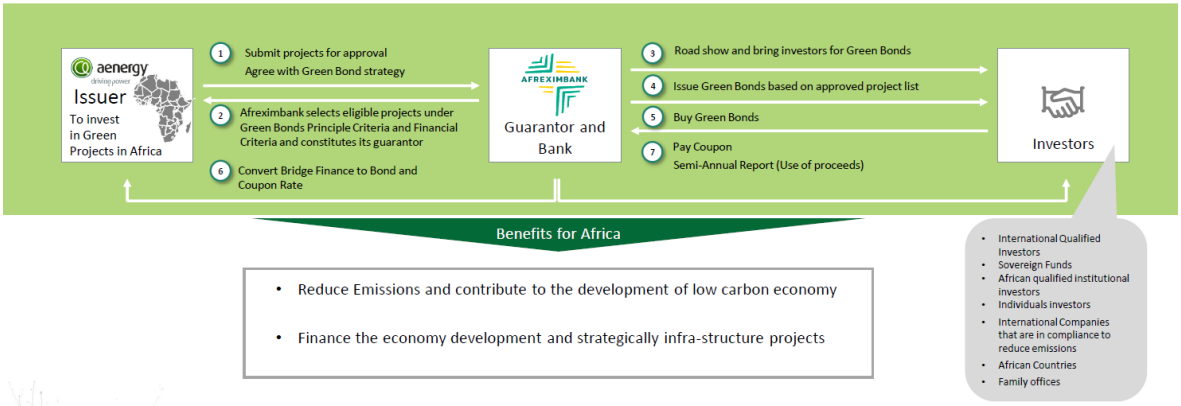


Figure 10 – Common framework & green bond issuance per project – Source: Aenergy (2019)

In practice, Aenergy submits a bunch of projects to Afreximbank for the approval. The Bank selects those eligible projects according to the GBPs (as the bank constitutes the guarantor) and conducts a road show to appeal investors to lend funds (by the purchase of green bonds from the issuer). Once investors are ready, Aenergy is ready to issue green bonds based on the approved project list provided by Afreximbank and green bonds are initially sold to them through Afreximbank. Afreximbank must then provide a bridge finance between bonds, conceiving funds for the issuer, and coupon rates, conceiving coupons for the investors. At the end, those investors are in fact payed back according to their promised coupon rates (the interest level made at a promised time). Figure 11 helps to better understand how the role of the bank works.

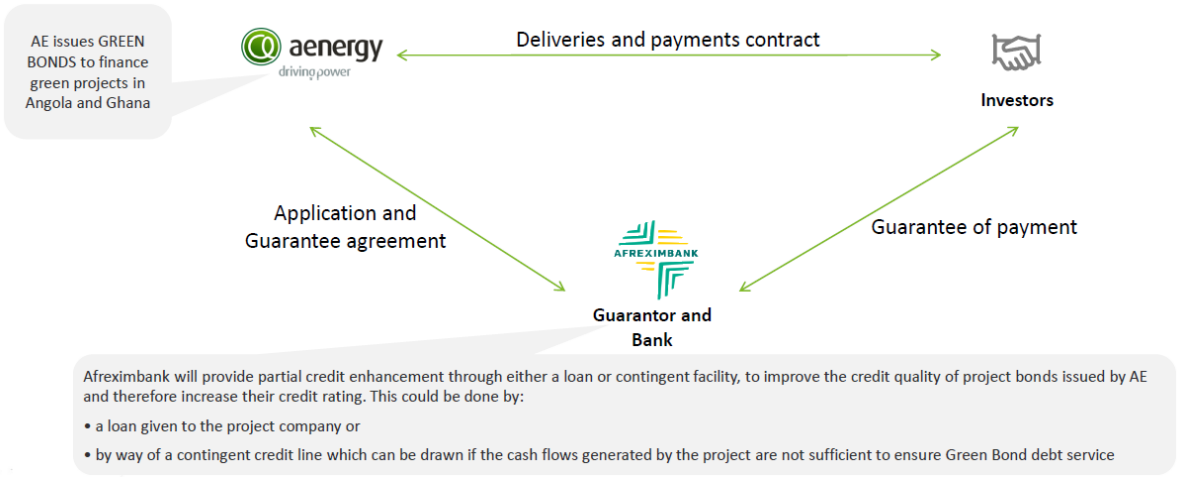


Figure 11 – The Role of the Bank (Afreximbank) – Source: Aenergy (2019)

More specifically, at this stage Aenergy determined two specific recipient countries, in the case of Angola and Ghana and is ready to issue green bonds to finance related green projects. Afreximbank will therefore provide partial credit enhancement through either a loan or contingent facility, to improve the credit quality of project bonds issued by Aenergy and therefore increase their credit rating. In fact, Afreximbank follows the considerations of Goodman (2017) claimed in the next section (4.4.1), which state that MDBs (Afreximbank in this case) can always issue green bonds on behalf of other entities (Aenergy in this case) when domestic markets lack in bond infrastructure. Also, the author well recognizes guarantees and subordinated debt instruments, among other instruments of credit enhancements. He claims in fact that, both governments and MDBs can be partnered for raising creditworthiness.

This being said, Aenergy is about to issue USD 200 million in Angola and USD 200 million in Ghana. In particular, Figure 12 provides additional information about which projects have been established to be financed through the *green bond issuance*. In this context, in the case of Angola, Aenergy would invest in solar and wind electricity production in order to improve the energy covered rate of Angola working as an Independent Power Producer (IPP). While, in the case of Ghana, Aenergy would invest through a framework contract of energy distribution with the Power Distribution Service (PDS), which serves 70% of Ghana's population. According to the Use of Proceeds, all projects in Angola will encompass Renewable Energy, while all projects in Ghana will encompass Renewable Energy, Energy Efficiency and Pollution Prevention and Control.

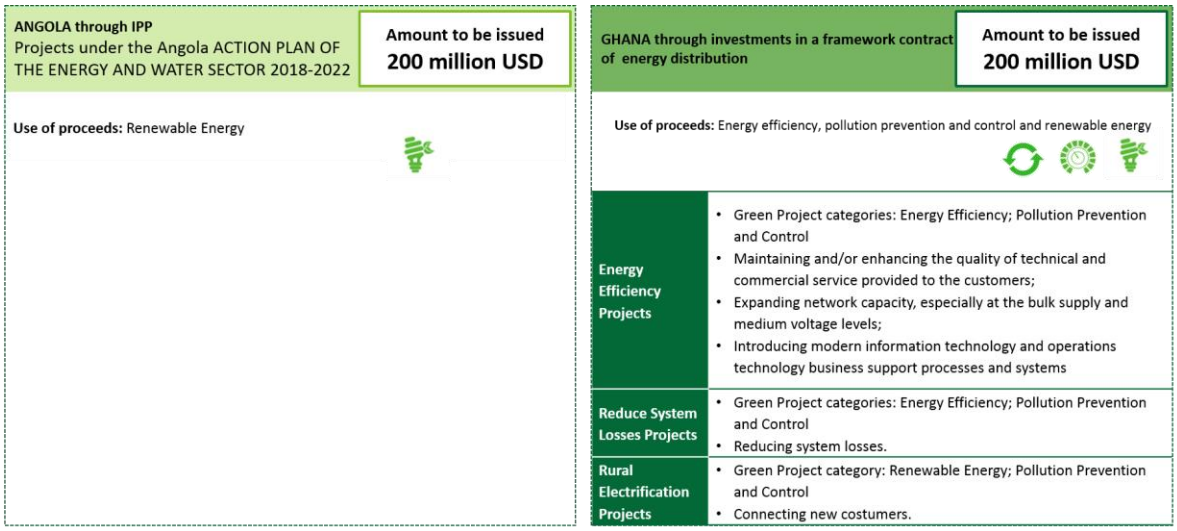


Figure 12 – Projects to be Financed through a Green Bonds Issuance – Source: Aenergy (2019)

At this stage however, Aenergy is still negotiating this strategy in finalization stage, as of reviewing targeted projects to be financed through the *green bond issuance* (upgrade of output 5). If, as is hoped, this strategy works out, it would also benefit Africa from reducing its emissions contributing for a low-carbon economy and financing the economy evolution by strategically infra-structuring projects. This chance, conducted by a strictly private project leaded by the company own purpose to comply with its own Environmental Responsibility, could in fact also be directly linked to the NDCs fulfillment of Ghana and Angola. Some African countries have de facto already faced first experiences in issuing green bonds for the fulfillment of own NDCs. Section 4.4.2 envisages thus on these countries and projects applications.

4.4 A suggested literature review arising out of the Aenergy strategy for a well-performed green bond issuance

4.4.1 The need of market infrastructure within capital markets

According to Goodman (2017) it should be considered that, possessing an NDC in the form of a strategic document exhibiting a range of initiatives, or at least indicating priority intervention sectors, is not necessarily enough for attracting finance even if these sectors would be best suitable for a green bond issuance in theory. In fact, countries would also depend upon a certain rank of financial sector development as well as their respective technical experience. Thus, a proactive local bond market involves a well-functioning government debt market from the origin, upon which corporate bond markets and others, such as secondary markets, can consequently form up. As for example, among these fundamental factors, the market infrastructure is of unique importance. For domestic issuances to work out, a regulated capital market is needed. This must be familiar with daily transactions in general as of common practice. In this respect, issuers are required to be indubitably creditworthy for being able to partner with underwriters or other financial intermediaries to promote or manage any bond business.

However, the above-mentioned characteristics are present to a greater or lesser level in many developing and emerging economies. Given the eminent premise of these requirements, it is not even surprising that most prosperous economies (exhibiting most developed capital markets) account for the preponderance of green bond issuances, while emerging markets account only for the few. For this reason, countries that lack a well-functioning government debt market to issue bonds domestically, can alternatively consider Eurobonds. A Eurobond is a bond (or a green bond) that is denominated in a foreign currency. In fact, several emerging economy governments already issued Eurobonds in foreign currencies, as in the case of Morocco, Namibia, South Africa and Zambia. On the other hand, MDBs acted on the contrary, as they also already issued Eurobonds, but these were denominated in local currencies for supporting emerging economies. By any means, it is highly relevant to notice that MDBs can always issue green bonds on behalf of other entities (e.g., Aenergy) when markets lack the capacity to do so.

In fact, another solution that has been commonly used in emerging economies, is partnerships with MDBs. MDBs issue green bonds through their usual channels, but usually through very low pricing to attract investors. Investors are in fact attracted by strong credit ratings, which are linked to high credit qualities entailing lower yields for investors. The proceeds received from investors are then channeled to projects that are launched in partnership with the bank in the local market in question. Whereas, if entities within emerging economies would like to issue green bonds, rather than receiving proceeds channeled through MDBs, they can also partner governments. For example, in cases where a potential issuer (e.g., a company) is not creditworthy in the eyes of investors, the public sector can support them as well. These instruments can make the risk (or return) profile more attractive both for the investors and the issuers. Among other instruments, classic credit enhancements include guarantees and subordinated debt instruments. In conclusion, both governments and MDBs could play important roles in the development of such bond markets.

4.4.2 First African countries experiences for the fulfillment of NDCs

NDCs are too general at this stage to assess individual projects and activities proposed by each country against best-suited green bond uses. This analysis was carried out from Goodman (2017), because only two countries directly mentioned the use of green bonds in their own NDCs, as in the case of India and Gambia. However, he provides an interesting study of some emerging economies in more details, such as Morocco, Namibia, South Africa, Tanzania, Uganda and Zambia in the case of Africa. For this comparison three factors are considered, which are designated to be crucial, as they express a country ability to use green bonds to finance its NDC. These country factors are based on the financial sector development (required market infrastructure to issue bonds), the sovereign credit rating (the ease to issue public debt) and the green bond experience (the kind of expertise of relevance for NDC financing).

Having said that, Morocco and South Africa were among first African countries to consider green bond emissions for the fulfillment of own NDCs. In fact, they constituted first visions, but also visions linked actions assessing individual project against best-suited green bond uses. In this respect, both countries' experiences have been undoubtedly highly influential as to promote the issuance of green bonds. Thus, a more accurate explanation is provided below.

Regarding Morocco, its NDC is considered strong, as it is in line with the 2°C long-term goal of the PA requiring a local commitment of USD 10 billion decreasing emissions by 13% through investments in energy, agriculture, waste, LULUCF (Land use, land-use change, and forestry) and industry. As a result, an additional 32% emission reduction is attainable through international support in the amount of USD 45 billion. By mean of this conditional component, a total emission reduction of 45% below the BAU emission scenario could be achieved. Morocco's financial sector is well-developed with a dynamic local investor base and an unrestricted foreign participation. Also, the country faces relevant experience with green bond issues as well as proceeds channeled from MDBs, such as the African Development Bank. In Particular, Morocco's first-time issue occurred in November 2016 with approximately USD 118 million issued by the Moroccan Agency for Solar Energy (MASEN) and USD 100 million purchased by Bank al-Maghrib Central Bank of Morocco (BMCE) from a World bank issue.

MASEN's green bond issues were thought to support solar power development efforts that contribute toward the achievement of the country's NDC. In fact, the proceeds were already channeled to three grid-connected, utility-scale schemes in the areas of Laâyoune, Boujdour and Ouarzazate. As a key component of the country's NDC, the total increase of solar electricity generation aims to achieve 14% of overall installed capacities from solar energy by 2020.

Regarding South Africa, its NDC is considered inadequate for the 2°C long-term goal of the PA. However, the financial resources required to implement NDC related initiatives remain highly relevant. Particularly, the country needs renewable energy expansions and mass transit and hybrid as well as electric vehicles developments which are in fact best-suited for green bonds uses. Not by chance, the country has already used these instruments according to its financing strategy. So, South Africa's financial sector is extremely well-developed, as it represents the largest on the continent with many potential issuers, both private and public. Thus, South Africa's great experience with green bonds issues is given both through domestic issuances and proceeds channeled by African Development Bank and the International Finance Corporation (IFC). In particular, South Africa's first-time issue occurred in June 2014 with approximately USD 140 million issued by the City of Johannesburg.

Issues from the City of Johannesburg were thought to be channeled to renewable energy (such as solar power generation, solar water heaters, waste-water generation and methane capture/storage) and low-carbon transport (such as hybrid-fuel buses) projects. These activities are strictly in line with the country's ambition aiming at reducing its emissions of 34% by 2020 and of 42% by 2025. As such an example, this represent a nascent case in which an emerging economy has issued green bonds to directly finance initiatives linked with its NDC.

5. A market-based research project

Facing the strategy of the green bond issuance in Angola and Ghana from Aenergy, this investment opportunity is compared to the interest of bigger supranational speculations as to further deepen this asset through an additional investigation on a global scale. This has been done looking and learning from MDBs, which are currently the most important players with the highest amount of green bonds issues in partnering emerging economies and developing countries. In fact, with the help of a research project on data analysis, the behavior of these huge banks has been further studied looking on further opportunities. These new opportunities could be followed by aiming at counseling and advising Afreximbank (having already partnered with the African Development Bank), under which Aenergy is already providing its consultancy service.

In this context, in order to give emphasis to the mentioned research project, a significative data gathering has been taken according to Environmental Finance (2018), which has been object of one under many research activities related to the curricular internship. In particular, this recently contribution is emphasized by the constitution of an output related to an investigation, for which supranational investments have been gathered in the form of green bond issues. Thus, this data has been appropriately organized in order to be exploited for the analysis. In this regard, this research project aims at analyzing which environmental areas have been mostly financed by which issuers, in which year, in which money amount and in which number of issues.

This (market-based) research project on data analysis starts with the explanation of the methodology (variables, sampling design, data collection technique and data analysis technique) followed by the results, which are based on all MDBs that presented registered money amounts invested for green bond issues by the time of the data gathering. Regarding statistical programs considered, three main different programs in total were used, as for SPSS (Statistical Package for Social Science), EViews (Econometric Views) and Excel.

5.1 Data description

5.1.1 Variables

The variables taken into consideration are twelve in total for each year and issue. Thus, the money amount invested is a singular value (variable 1: totalvalue) and the remaining eleven variables considered are concerning firstly a singular value for the number of deals (variable 2: total) and secondly ten types of green projects, in which it has been invested (Table 5). These types of green projects were taken according to those of the International Capital Market Association (2018) and then accurately labeled with adequate acronyms as to ensure a suitable use of statistical programs. In fact, the eligible green project categories are ten in total like ten (of twelve) variables considered for this research project. Table 5 provides more details to note how these variables have been labeled for each green project threated including some prototypes.

Variables:	Label:	Eligible Green Project Categories:	Included Prototypes:
3.	CCA	Climate Change Adaptation	Information support systems, such as climate observation and early warning systems
4.	EE	Energy Efficiency	New and refurbished buildings, energy storage, district heating, smart grids, appliances and products
5.	GB	Green Buildings	Regional, national or internationally recognized standards or certifications
6.	RE	Renewable Energy	Production, transmission, appliances and products
7.	SMNR	Sustainable Management of Living Natural Resources	Environmentally sustainable agriculture; Environmentally sustainable animal husbandry; Climate smart farm inputs such as biological crop protection or drip-irrigation; environmentally sustainable fishery and aquaculture; Environmentally-sustainable forestry, including afforestation or reforestation, and preservation or restoration of natural landscapes
8.	SWM	Sustainable Water Management	Sustainable infrastructure for clean and/or drinking water, wastewater treatment, sustainable urban drainage systems and river training and other forms of flooding mitigation
9.	TABC	Terrestrial and Aquatic Biodiversity Conservation	The protection of coastal, marine and watershed environments
10.	PPC	Pollution Prevention and Control	Reduction of air emissions, greenhouse gas control, soil remediation, waste prevention, waste reduction, waste recycling and energy/emission-efficient waste to energy
11.	CT	Clean Transportation	Electric, hybrid, public, rail, non-motorized, multi-modal transportation, infrastructure for clean energy vehicles and reduction of harmful emissions
12.	EPT	Eco-Efficient Products and Production Technologies and Processes	Development and introduction of environmentally sustainable products, with an eco-label or environmental certification, resource-efficient packaging and distribution

Table 5 – Labeled Variables – Source: Own elaboration based on International Capital Market Association (2018)

5.1.2 Sampling design

According to the first three steps of the sampling design, it has been differentiated between the *target population*, the *sampling frame* and the *sampling unit*. As for defining the *target population*, the sampling has been gathered based on all existing MDBs which have already issued green bonds so far. As for identifying the *sampling frame*, this research project aimed at gathering MDBs that presented registered money amounts of green bond issues on the official environmental finance bond database according to Environmental Finance (2018). If the data for the sampling frame, which has been gathered on that retrieval time, contains the real actual information, it might coincide with the target population. Having said that, the sampling frame taken into consideration is representative of the target population by any means. As for defining the *sampling unit*, those MDBs considered have been labeled "supranational issuer" in order to simplify the settlement of these units for the data analysis. They are eleven in total, but they are distributed in sixty-three statistical units in total. This is because each MDB appears so many times as for the years that it emitted green bonds again. As for example, the African Development Bank appears seven times as it emitted green bonds from 2010 to 2017 (see data in the Annex: Table I).

5.1.3 Data collection technique

The data collection, or even the so-called data gathering takes into consideration register-based sources of information, which could be thus classified as *secondary data*. As already mentioned, the data has been retrieved on the official environmental finance bond database (in line with the information retrieved on 10/11/2018) according to Environmental Finance (2018). This database is thus the most comprehensive source of information on the green, and also the social, bond markets worldwide. For achieving access and permission to view and download data, this website requires an active subscription with many required fields, such as the name of the organization involved.

As this practice has been object of one under many research activities related to the current curricular internship, it has been decided to use this gathered data to provide this up-to-date investigation both for the company's interest and to give a reasonable contribution to the internship report as well. Another reason, which gives emphasis to this data gathering is the fact that without the company's registration the data would be inaccessible. Thus, only the adequate access request from the company side has enabled to receive a time-limited access to the website. In fact, a regular unlimited access would only be enabled under very stricter conditions.

5.1.4 Data analysis technique

For the treatment and analysis of data, four analysis techniques in total have been taken into consideration. Below a brief description of the methodology used and its related benefits, as well as, a brief explanation of specific terms, concepts and techniques to better understand statistical evaluation needs.

For the first three treatments and analysis of data an *exploratory multidimensional analysis* has been taken into consideration. In fact, multivariate methods enable a simultaneous data treatment for a multiplicity of variables, regarding their description, systematization, classification and explanation of their relationships. Multivariate analysis techniques include exploratory and descriptive approaches as well as confirmatory and explanatory approaches.

As a sub-group of multivariate analysis techniques, *factor analyses* have been taken into consideration, as those are intended to represent a set of variables in a reduced basis, by creating new variables in reduced numbers, which are designated as factorial axes or factors that facilitate their interpretation. More specifically, for the first treatment and analysis of data a *principal component analysis (PCA)* has been chosen, as it is a certain technique under the family of factor analyses, which aims to analyze multidimensional quantitative data.

As for the second and the third treatment and analysis of data, *classification analyses* have been considered. In contrast to factor analyses, classification analyses aim to detect homogeneous groups of observation or variable units with respect to one or more common characteristics. Therefore, two types of classification analyses were chosen, on the one hand, the *hierarchical classification* and, on the other hand, the *non-hierarchical classification*. The hierarchical classification groups the elements in regard to a partition hierarchy with different number of clusters. Whereas, the non-hierarchical classification groups the elements in a pre-established criterion basis, in regard to a unique partition formed by a fixed number of clusters which is defined a priori.

As for the fourth treatment and analysis of data, *panel data models* have been considered as for being the most appropriate techniques under the family of the econometric models to explain this data. In fact, panel data models combine a sectional dimension and a temporal dimension to the same observation. Also, they provide simultaneous information on the dynamic behavior in a cross section as well as on the dynamic change over time. Moreover, they allow to increase the number of observations which are used in the estimation of models based on sampling plans to a single dimension (sectional or temporal).

5.2 Results

5.2.1 Principal component analysis (PCA)

For the first treatment and analysis of data it has been analyzed the content of Table 6, showed below, which provides information on the total of variance explained.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.300	60.836	60.836	7.300	60.836	60.836	6.326	52.714	52.714
2	2.269	18.907	79.743	2.269	18.907	79.743	3.241	27.005	79.719
3	1.018	8.486	88.229	1.018	8.486	88.229	1.021	8.510	88.229
4	.552	4.603	92.832						
5	.309	2.575	95.407						
6	.229	1.911	97.318						
7	.158	1.320	98.638						
8	.081	.678	99.316						
9	.045	.374	99.690						
10	.024	.201	99.891						
11	.010	.086	99.977						
12	.003	.023	100.000						

Extraction Method: Principal Component Analysis.

Table 6 – Total variance explained – Conducted by SPSS

By the automatic criterion for extracting factors, three principal components were extracted, respectively those with a higher value than 1. Thus, it is suggested to extract 3 axes in the case of the total values of 7,300, 2,269 and 1,018, which appear under the first yellow values of the column: initial eigenvalues. In order to memorize the principal components extracted, these new extracted variables were saved.

The extraction and rotation sums of squared errors columns provide information on the percentage of variance explained by the principal components (partial and accumulated). The retained principal components explain therefore 88.229% of the total variance.

In Table II (in the Annex), the communalities framework (common variation) indicates, for each variable, the proportion of variance explained by the principal components. This information is available in the extraction communalities column.

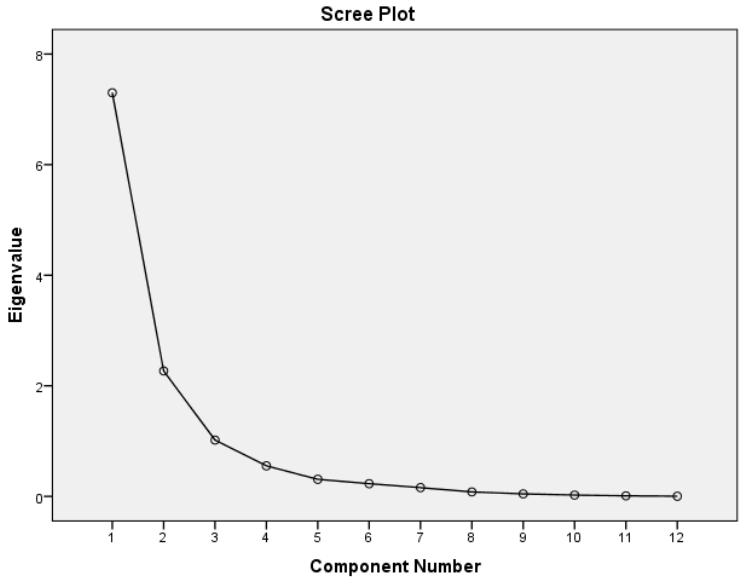


Figure 13 – Scree plot – Conducted by SPSS

In Figure 13, the scree plot chart is a useful tool to support the decision of the optimum number of principal components to retain. The behavior of the scree plot line evidences the pertinence of the solution of extracting the first 3 principal components due to its high slope.

Rotated Component Matrix[a]

	Component		
	1	2	3
TotalValue	-.168	**.895**	.015
Total	.549	**.741**	.040
CCA	**.920**	.224	.015
EE	.344	**.918**	-.023
GB	-.027	-.004	**.994**
RE	.351	**.908**	-.032
SMNR	**.907**	.147	-.096
SWM	**.895**	.097	-.012
TABC	**.911**	.191	-.086
PPC	**.884**	.229	.078
CT	**.910**	.184	.059
EPT	**.919**	.137	-.053

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 4 iterations.

Table 7 – Rotated component matrix – Conducted by SPSS

Table 7 serves to interpret the principal components on the basis of the original variables for which the existing correlations are higher, given the intensity and the meaning of these correlations. Therefore, it is considered the red numeration above for the values close to 1.

Factor scores

Issuer	Year	FAC1_1	FAC2_1	FAC3_1
African Development Bank	2010	-0.34372	-0.20541	-0.24870
African Development Bank	2012	-0.32647	-0.74815	-0.32020
African Development Bank	2013	-0.18786	-0.58521	-0.33414
African Development Bank	2014	-0.18137	-0.62542	-0.26909
African Development Bank	2015	-0.26455	-0.55224	-0.33664
African Development Bank	2016	-0.00544	-0.67454	-0.31189
African Development Bank	2017	-0.02092	-0.63453	-0.31131
Asian Development Bank	2012	-0.16383	-0.55710	-0.27630
Asian Development Bank	2013	0.04482	-0.36075	-0.21291
Asian Development Bank	2015	0.00808	-0.47268	-0.24688
Asian Development Bank	2016	-0.26664	-0.37428	-0.28660
Asian Development Bank	2017	0.00826	-0.26670	-0.23446
Asian Development Bank	2018	-0.35234	0.07037	1.35508
Central American Bank for Economic Integration	2016	-0.28411	-0.64207	-0.32385
EBRD	2011	-0.32375	-0.67246	-0.30616
EBRD	2012	-0.32957	-0.78151	-0.32715
EBRD	2013	0.18177	-0.40282	-0.14131
EBRD	2014	0.56907	-0.22152	-0.11273
EBRD	2015	-0.08064	1.31421	-0.23386
EBRD	2016	0.50459	-0.07609	-0.01203
EBRD	2017	-0.21508	-0.39536	-0.33291
EBRD	2018	-0.21496	-0.62167	-0.35860
European Investment Bank	2007	-0.42834	-0.43976	-0.33543
European Investment Bank	2009	-0.42667	-0.27470	-0.33332
European Investment Bank	2010	-0.38844	-0.38129	-0.28254
European Investment Bank	2012	-0.41289	-0.22364	-0.34580
European Investment Bank	2013	-1.01049	1.87323	-0.33603
European Investment Bank	2014	-1.19166	3.91876	-0.38094
European Investment Bank	2015	-0.95355	2.32493	-0.36969
European Investment Bank	2016	-0.88000	2.30517	-0.35548
European Investment Bank	2017	-1.00442	2.58432	-0.37269
European Investment Bank	2018	-0.95742	2.12024	-0.35269
IADB	2018	-0.32986	-0.78078	-0.32714
IBRD	2008	-0.36854	-0.68087	-0.32570
IBRD	2009	-0.37385	-0.62580	-0.31843
IBRD	2010	2.26197	1.56559	0.10552
IBRD	2011	2.14700	-0.07941	-0.31899

IBRD	2012	0.82550	-0.16236	-0.24418
IBRD	2013	0.51830	-0.19554	-0.18555
IBRD	2014	1.27695	1.17699	0.17839
IBRD	2015	4.77736	1.67207	-0.31540
IBRD	2016	4.04073	-0.36789	-0.49450
IBRD	2017	0.11491	-0.36089	-0.29817
IBRD	2018	-0.24508	-0.30506	1.34258
IFC	2010	-0.36724	-0.59758	-0.33771
IFC	2011	-0.33906	-0.55020	-0.29145
IFC	2012	-0.33581	-0.72405	-0.31985
IFC	2013	-0.44774	0.48925	-0.41759
IFC	2014	-0.44382	0.28169	-0.35226
IFC	2015	-0.38311	0.29116	-0.31146
IFC	2016	-0.36002	-0.41209	-0.35855
IFC	2017	-0.16306	0.14581	4.51519
IFC	2018	-0.08320	0.04425	4.61888
New Development Bank	2016	-0.38249	-0.60166	-0.33209
Nordic Investment Bank	2010	-0.34643	-0.69662	-0.31945
Nordic Investment Bank	2012	-0.33635	-0.76401	-0.32690
Nordic Investment Bank	2013	-0.15820	-0.68524	-0.26995
Nordic Investment Bank	2014	-0.08112	-0.44340	-0.23982
Nordic Investment Bank	2015	-0.29081	-0.35406	-0.30755
Nordic Investment Bank	2016	-0.03728	-0.41730	-0.20380
Nordic Investment Bank	2017	0.27906	0.02174	3.10812
Nordic Investment Bank	2018	-0.24376	-0.54817	1.29501
North American Development Bank	2018	-0.22640	-0.65691	-0.29995

Table 8 – Factor scores – Conducted by Excel

Table 8 shows the principal components, (factor scores that were saved as new variables in the data view of the SPSS program and then extracted for Excel) which exhibit the position of MDBs on the factorial axes. In this table, the extreme cases of banks were displayed, which can be positively or negatively related to each factorial axis. Therefore, it is considered the yellow numeration, which was colored for the extreme case values from 1,50 upwards.

But let's move on to a more specific interpretation of these results by analyzing each of these three components of the rotated component matrix of Table 7. Therefore, it is considered only the red numeration of each separated component in relation to the yellow numeration of the extreme case values of Table 8.

Component 1:

Highlights MDBs that are characterized by a high weight for investments in Climate Change Adaptation, Sustainable Management of Living Natural Resources, Sustainable Water Management, Terrestrial and Aquatic Biodiversity Conservation, Pollution Prevention and Control, Clean Transportation and Eco-Efficient Products and Production Technologies and Processes. This is the case for the International Bank for Reconstruction and Development (IBRD) in 2010, 2011, 2015 and 2016.

Component 2:

Highlights MDBs that are characterized by a high weight for the total money amount invested for green projects (variable: total value), for green bond emissions (variable: total) and for investments in Energy Efficiency and Renewable Energy. This is the case for the European Investment Bank in 2013, 2014, 2015, 2016, 2017 and 2018 and the IBRD in 2010 and 2015.

Component 3:

Highlights MDBs that are characterized by a high weight for investments in Green Buildings. This is the case for the IFC bank in 2017 and 2018 and the Nordik investment bank in 2017.

5.2.2 Hierarchical classification

For the second and third treatment and analysis of data, it is analyzed the content of Table 9, which provides information on the aggregation order (agglomeration schedule), that also allows the analysis performed by the dendrogram (in the Annex: Figure I) with support of a numerical calculation for analyzing distances between clusters. Thus, the partition must be fixed to the order with the largest difference in the aggregation distance.

Agglomeration Schedule

	Cluster Combined			Stage Cluster First Appears		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next Stage
1	3	5	1.000	0	0	9
2	2	16	1.852	0	0	7
3	7	8	6.711	0	0	20
4	59	60	7.525	0	0	17
5	21	58	7.852	0	0	19
6	14	56	7.928	0	0	12
7	2	33	11.595	2	0	30
8	11	12	13.982	0	0	51
9	3	10	15.500	1	0	23
10	4	17	25.034	0	0	26
11	25	43	27.439	0	0	32
12	14	57	28.181	6	0	28
13	45	55	31.090	0	0	34
14	39	62	68.419	0	0	39
15	6	22	91.492	0	0	24
16	9	38	132.877	0	0	26
17	24	59	160.220	0	4	33
18	18	63	188.935	0	0	38
19	21	50	328.371	5	0	39
20	7	26	390.064	3	0	36
21	37	44	394.492	0	0	32
22	31	32	418.153	0	0	56
23	3	35	438.333	9	0	43
24	6	19	464.780	15	0	34

25	27	28	465.277	0	0	60
26	4	9	506.976	10	16	36
27	46	49	568.196	0	0	40
28	14	47	595.633	12	0	38
29	1	34	741.385	0	0	37
30	2	15	996.915	7	0	46
31	29	30	1028.651	0	0	56
32	25	37	1066.439	11	21	42
33	20	24	1108.801	0	17	42
34	6	45	1140.543	24	13	40
35	23	51	1588.748	0	0	48
36	4	7	1686.858	26	20	49
37	1	54	1738.348	29	0	43
38	14	18	1860.365	28	18	46
39	21	39	2731.573	19	14	50
40	6	46	3686.011	34	27	49
41	42	61	5335.795	0	0	54
42	20	25	5735.249	33	32	52
43	1	3	5983.432	37	23	50
44	41	52	6261.804	0	0	51
45	40	48	6333.014	0	0	61
46	2	14	6992.012	30	38	53
47	13	36	7654.280	0	0	58
48	23	53	9996.260	35	0	52
49	4	6	14690.117	36	40	53
50	1	21	15783.950	43	39	55
51	11	41	19680.413	8	44	54
52	20	23	23760.434	42	48	55
53	2	4	44109.743	46	49	57
54	11	42	61555.572	51	41	58
55	1	20	72700.845	50	52	57
56	29	31	146301.197	31	22	60
57	1	2	240480.212	55	53	59
58	11	13	274046.916	54	47	59
59	1	11	1157885.245	57	58	61
60	27	29	1463887.759	25	56	62

61	1	40	3923795.822	59	45	62
62	1	27	19524306.060	61	60	0

Table 9 – Agglomeration schedule – Conducted by SPSS

But let's move on to a more specific interpretation of these results analyzing the column named coefficients. Therefore, one of the most significant gaps is given by the step 58 in which its coefficient ranges from 274,046.9 to 1,157,885.245. Thus, by the step 58, 5 classes were defined, as it is suggested to consider five classes, as well as for the analysis of the non-hierarchical classification. It is therefore considered only the yellow numeration of the step 58 and 59.

As said, the dendrogram visualization (in the Annex: Figure I) allows to also identify the hierarchical grouping order of classes, the elements of each class, and the existing distances between classes and between elements to be classified. The respective elements of each class will be founded where the distance is shorter, in particular at that point of aggregation of two more associated classes. Thus, the partition should be fixed at the hierarchical level with larger distance from the next hierarchical level.

In fact, if looking at Figure I the dendrogram evidences how the partition is suitable for 5 classes in the same way as the partition fixed for the order with the largest aggregation distance between step 58 and 59.

5.2.3 Non-hierarchical classification

But let's move to a more specific interpretation of the results of the non-hierarchical classification for the third treatment and analysis of data observing Table 10.

Number of Cases in each Cluster

Cluster	1	4.000
	2	36.000
	3	2.000
	4	17.000
	5	4.000
Valid		63.000
Missing		.000

Table 10 – Number of Cases in each Cluster – Conducted by SPSS

Table 10 is the first result of this considered method (called K-means by the SPSS program), which allows for a better performance than the one provided by hierarchical classification, because in each iteration each MDB is re-evaluated for its adherence capacity to each class. Thus, this type of distribution (as of MDBs by classes) is more significant and balanced than the partition of 5 clusters alone (as of section 5.2.2), in which MDBs were grouped according to the hierarchical classification.

ANOVA

	Cluster		Error			
	Mean Square	df	Mean Square	df	F	Sig.
TotalValue	29823150.080	4	53480.284	58	557.648	.000
Total	210.304	4	30.150	58	6.975	.000
CCA	12.153	4	4.280	58	2.839	.032
EE	153.866	4	11.553	58	13.318	.000
GB	.780	4	.344	58	2.268	.073
RE	148.619	4	12.593	58	11.802	.000
SMNR	6.032	4	2.787	58	2.165	.084
SWM	11.635	4	4.067	58	2.861	.031
TABC	9.596	4	4.629	58	2.073	.096
PPC	24.359	4	5.514	58	4.417	.003
CT	21.139	4	5.153	58	4.102	.005
EPT	6.090	4	3.057	58	1.992	.108

The F tests should be used only for descriptive purposes because the clusters have been chosen to maximize the differences among cases in different clusters. The observed significance levels are not corrected for this and thus cannot be interpreted as tests of the hypothesis that the cluster means are equal.

Table 11 – ANOVA – Conducted by SPSS

Table 11 is the second result in relation to the variance analysis framework. This is not a confirmatory test, but it only shows the importance of variables in descending order. Therefore, if looking at the yellow values by the column of the F test, it is possible to observe that the importance in descending order is due to the total money amount invested for green projects (variable: total value), to investments in Energy Efficiency, to investments in Renewable Energy and to the green bond emissions (variable: total).

Final Cluster Centers

	Cluster				
	1	2	3	4	5
TotalValue	4560.19014999999900	288.48606390000000	5754.80150000000000	947.60695879999990	2135.27725000000000
Total	12	3	15	7	15
CCA	0	0	0	2	3
EE	12	2	13	4	7
GB	0	0	0	1	0
RE	12	2	13	4	7
SMNR	0	0	0	1	1
SWM	0	1	0	3	2
TABC	0	0	0	2	3
PPC	0	1	0	2	5
CT	0	1	0	3	5
EPT	0	0	0	2	1

Table 12 – Final Cluster Centers – Conducted by SPSS

Table 12 is the third result in relation to the values of the variables in the class centers. The centroids of the clusters allow to characterize each class by its determinant factors. According to Table 12, the results show some variables of extreme values (zero values in red and values above 7 in green) for which their contribution is more significant for the differentiation of classes. Therefore:

- The considerable weight for the total money amount invested for green projects (variable: totalvalue) is a common trait for all clusters 1, 2, 3, 4 and 5;
- The considerable weight for the total money amount invested for green projects (variable: totalvalue), for the green bond emissions (variable: total), for investments in Energy Efficiency, for investments in Renewable Energy is a common trait for clusters 1, 3 and 5, which differentiate them from clusters 2 and 4;
- The considerable weight for green bonds emissions (variable: total) without any evidence of other extreme values distinguishes class 4 from classes 1, 2, 3 and 5;

- The reduced weight for investments in Climate Change Adaptation, Green Buildings, Sustainable Management of Living Natural Resources, Terrestrial and Aquatic Biodiversity Conservation, Eco-Efficient Products and Production Technologies and Processes is a common trait for clusters 1, 2, 3 that differentiate them from classes 4 and 5;
- The reduced weight for investments in Sustainable Water Management, Pollution Prevention and Control and Clean Transportation is a common trait for clusters 1 and 3 that differentiate them from clusters 2, 4 and 5;
- The reduced weight for investments in Green Buildings without any evidence of other negative extreme values distinguishes class 5 from classes 1, 2, 3 and 4.

Distances between Final Cluster Centers

Cluster	1	2	3	4	5
1		4271.736	1194.615	3612.609	2424.938
2	4271.736		5466.350	659.149	1846.852
3	1194.615	5466.350		4807.221	3619.544
4	3612.609	659.149	4807.221		1187.708
5	2424.938	1846.852	3619.544	1187.708	

Table 13 – Distances between Final Cluster Centers – Conducted by SPSS

Table 13 is the fourth and final result relative to the distances between class centers. Thus, every cluster has to be summed up. For example, class 3 seems to be the farthest class from the other classes (Σ cluster 3 = 15,087.73), followed by class 2 (Σ cluster 2 = 12,243.351), class 1 (Σ cluster 1 = 11,503.898), class 4 (Σ cluster 4 = 10,266.6879), and class 5 (Σ cluster 5 = 9,079.042).

5.2.4 Panel data models

According to the estimation of the panel data model, it has been estimated an explanatory regression of the total money amount invested for green projects (variable: total value) due to the total number of projects and projects according to the respective environmental area. The explanatory panel data regression was created through the EViews program.

Dependent Variable: TOTALVALUE
Method: Panel Least Squares
Date: 12/15/18 Time: 14:51
Sample: 2007 2018
Periods included: 12
Cross-sections included: 11
Total panel (unbalanced) observations: 63

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	344.3432	167.6607	2.053809	0.0451
TOTAL	7.729930	39.11886	0.197601	0.8441
CCA	-50.63772	147.4617	-0.343396	0.7327
EE	1041.572	277.8629	3.748510	0.0005
GB	83.35352	198.2841	0.420374	0.6760
RE	-750.8622	273.5496	-2.744885	0.0083
SMNR	630.4893	316.5433	1.991795	0.0518
SWM	-164.6277	197.2355	-0.834676	0.4078
TABC	-189.2226	232.9002	-0.812462	0.4203
PPC	-107.8626	148.9625	-0.724092	0.4723
CT	64.21758	241.1949	0.266248	0.7911
EPT	-426.6828	402.1365	-1.061040	0.2937

R-squared	0.724222	Mean dependent var	1028.354
Adjusted R-squared	0.664741	S.D. dependent var	1405.028
S.E. of regression	813.5334	Akaike info criterion	16.41029
Sum squared resid	33753667	Schwarz criterion	16.81851
Log likelihood	-504.9243	Hannan-Quinn criter.	16.57085
F-statistic	12.17559	Durbin-Watson stat	2.239184
Prob(F-statistic)	0.000000		

Table 14 – Panel data regression – Conducted by EViews

In Table 14, the estimation result can be deducted from the grouped data regression model (called POLS). Thus, the algebraic representation is given by:

- TotalValue^ = 344.3432 + 7.729930total - 50.63772CCA + 1041.572EE + 83.35352GB - 750.8622RE + 630.4893SMNR - 164.6277SWM - 189.2226TABC - 107.8626PPC + 64.21758CT - 426.6828EPT

All coefficient estimates present signals according to their expectations. For example, the results show that, if keeping everything else constant, for each additional investment in the environmental area of Energy Efficiency, the total money amount invested for green projects (variable: total value) increases considerably in a value of 1041.572 USD M Dollars.

Whereas, it is estimated that, if keeping everything else constant, for each additional investment in Renewable Energy's environmental area, the total money amount invested for green projects (variable: total value) decreases considerably in a value of 750.8622 USD M Dollars.

In Addition, the coefficient of determination (R-squared) evidences a good adherence of the model to the empirical data, as it can be concluded that 72% of the total money amount invested for green projects (variable: total value) is explained by the adjustment, according to the respective average.

Having said that, the *1st random effects evaluation* is not available for this estimation method. Also, the *2nd hausman test* has not been possible to evaluate, because the random effects estimation requires a number of cross sections (number of coefficients between the estimator for the estimation of RE innovation variance). Having said that, only the *3rd fixed effects evaluation* has been possible to evaluate according to Table 16.

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	2.076470	(10,41)	0.0494
Cross-section Chi-square	25.814873	10	0.0040

Cross-section fixed effects test equation:
Dependent Variable: TOTALVALUE
Method: Panel Least Squares
Date: 12/15/18 Time: 16:42
Sample: 2007 2018
Periods included: 12
Cross-sections included: 11
Total panel (unbalanced) observations: 63

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	344.3432	167.6607	2.053809	0.0451
TOTAL	7.729930	39.11886	0.197601	0.8441
CCA	-50.63772	147.4617	-0.343396	0.7327
EE	1041.572	277.8629	3.748510	0.0005
GB	83.35352	198.2841	0.420374	0.6760
RE	-750.8622	273.5496	-2.744885	0.0083
SMNR	630.4893	316.5433	1.991795	0.0518
SWM	-164.6277	197.2355	-0.834676	0.4078
TABC	-189.2226	232.9002	-0.812462	0.4203
PPC	-107.8626	148.9625	-0.724092	0.4723
CT	64.21758	241.1949	0.266248	0.7911
EPT	-426.6828	402.1365	-1.061040	0.2937

R-squared	0.724222	Mean dependent var	1028.354
Adjusted R-squared	0.664741	S.D. dependent var	1405.028
S.E. of regression	813.5334	Akaike info criterion	16.41029
Sum squared resid	33753667	Schwarz criterion	16.81851
Log likelihood	-504.9243	Hannan-Quinn criter.	16.57085
F-statistic	12.17559	Durbin-Watson stat	2.239184

Table 15 – Fixed effects evaluation – Conducted by EViews

As in fact, by confirming that P-values were below the levels of conventional critical significance (10% or 5%), the hypothesis of the fixed effects absence has been rejected. It has been therefore considered only the yellow numeration above (4.94% and 0.40%).

However, in relation to the *4th evaluation of the cross-sectional dependence in the fixed effects model*, there were no available (NA) values to reject the hypothesis of the cross-sectional dependence absence in order to confirm that the model estimation (called OLS) was not appropriate. This is referred to Table 16 showed below. In conclusion, it hasn't been neither possible to run the *5th final estimation of the fixed effects model* (in fact, a positive or non-negative argument to function were expected from the program in computation of the group weight for the variance).

Residual Cross-Section Dependence Test
Null hypothesis: No cross-section dependence (correlation) in residuals
Equation: Untitled
Periods included: 12
Cross-sections included: 11
Total panel (unbalanced) observations: 63
Test employs centered correlations computed from pairwise samples

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	NA	55	NA
Pesaran scaled LM	NA		NA
Bias-corrected scaled LM	NA		NA
Pesaran CD	NA		NA

Table 16 – Evaluation of the cross-sectional dependence in the fixed effects model – Conducted by EViews

5.3 Discussion of project findings

According to the PCA, three principal components were extracted, respectively those with a higher value than 1. The retained principal components explain therefore 88.229% of the total variance (Table 6: total variance explained).

Also, the scree plot chart supported the decision of the optimum number of principal components to retain according to its behavior as for its high slope (Figure 13: scree plot).

These first steps served to proceed with the PCA and find relations between the rotated component matrix (Table 7) and the three new variables extracted of the factor scores (Table 8). According to the main results it was therefore founded that:

Firstly, the IBRD (during 2010, 2011, 2015 and 2016) was characterized by a high weight for investments in Climate Change Adaptation, Sustainable Management of Living Natural Resources, Sustainable Water Management, Terrestrial and Aquatic Biodiversity Conservation, Pollution Prevention and Control, Clean Transportation and Eco-Efficient Products and Production Technologies and Processes. Secondly, the European Investment Bank (during 2013, 2014, 2015, 2016, 2017 and 2018) and the IBRD (during 2010 and 2015) were characterized by a high weight for the total money amount invested for green projects (variable: total value), for green bond emissions (variable: total) and for investments in Energy Efficiency and Renewable Energy. Thirdly, the IFC bank (during 2017 and 2018) and the Nordik investment bank (during 2017) were characterized by a high weight for investments in Green Buildings.

The ANOVA (Table 11) provided the second result of a variance analysis concluding that the importance of the variables in descending order is due to the total money amount invested for green projects (variable: total value), to investments in Energy Efficiency, to investments in Renewable Energy and to the green bond emissions (variable: total).

The final cluster centers (Table 12) provided the third result. According to its main findings it could be concluded that:

1. The considerable weight for the total money amount invested for green projects (variable: totalvalue) is a common trait for all clusters 1, 2, 3, 4 and 5;
2. The considerable weight for the total money amount invested for green projects (variable: totalvalue), for the green bond emissions (variable: total), for investments in Energy Efficiency, for investments in Renewable Energy is a common trait for clusters 1, 3 and 5, which differentiate them from clusters 2 and 4.

According to the main findings of panel data models, it could be concluded that all coefficients presented signals according to their expectations and a good adherence of the model to the empirical data (as for a resulted R-squared of 72% from a scale of 0% to 100%). Also, for each additional investment in Energy Efficiency, the total money amount invested for green projects (variable: total value) increases considerably (by keeping everything else constant). Whereas, for each additional investment in Renewable Energy the total money amount invested for green projects (variable: total value) decreases considerably (by keeping everything else constant).

6. Conclusion

The cases of the EU and Ghana follow the expected patterns. As in fact, as to comply with submitted NDCs, DCs prevail to undertake carbon pricing systems (domestically) from an economical point of view, while LDCs prevail to appeal climate finance mechanisms (internationally) from a financial point of view due to their weaker institutional stability. This is confirmed by the fact that respective NDCs, submitted in the interim NDC Registry according to the UNFCCC (2019), advocate at least 40% domestic reduction (only) in GHG emissions by 2030 for Europe, while 15% both domestic and 30% international reduction in GHG emission by 2030 for Ghana. In fact, on the one hand, the EU intends to achieve its NDC by 43% within its EU ETS (with the largest share), by 30% within its non-ETS and by 27% within improvements in renewable energy and energy efficiency. On the other hand, Ghana sees finance (public and private) as an essential part of its whole NDC and it should not be solely focused in mitigation as for the EU, but also in adaptation, technology transfer, and increasing development.

According to Oliver et al. (2018), USD 1.6 to 3.8 trillion of energy system investments are required to keep global warming within the 1.5°C PA goal. Therefore, main findings suggest that climate finance (public and private) has been steadily increasing with the major share for private finance. Also, renewable energy investment slightly fell as of falling renewable energy technology costs, but investments in sustainable transport are growing fast. Moreover, adaptation finance is estimated at remaining low compared to the increasing share in mitigation finance. In conclusion, domestic investments continue to account for most climate investments (mainly provided by the private sector) but flows from DCs to LDCs also increased with LDCs being the dominant destination of climate investment both for domestic and international investments. However, more climate finance sources are needed, in fact there is a great potential for the PA to make secondary market transactions (such as the use of green bonds) consistent with the 2°C pathway. In this context, MDBs are already playing an essential role on the global distribution of climate finance sources, especially by financing LDCs.

According to Filkova et al. (2019), the state of the market 2018 corresponded to USD 167.6 billion of green bond issues, which clearly surpasses those of 2017 representing an explosive growing trend. Continents in descending order with the largest green bond market size were Europe, Asia-Pacific, North-America, Global issuers (represented by MDBs), and Africa. Also, MDBs achieved the second highest year-on-year growth rate between 2017 and 2018, which is mainly driven by the European Investment Bank, the World Bank Group and the Asian Development Bank with a strong impact on LDCs. The top 5 countries were USA, China, France, Germany and Netherlands. According to the London Stock Exchange Group (2018), despite Africa accounts for a small slice of the 2018 green bond market size, it still offers a great investment opportunity that can be only attained through diversification of finance mechanisms and funding sources (mainly performed by the private sector). Thus, capital raising through green bonds has been conceived as the most accessible instrument to meet Africa's commitments with first issues in South Africa, Morocco, Nigeria and Namibia.

According to Goodman (2017), there is a bunch of excitement over the potential that green bonds could play as a decisive role for which climate projects are financed as well as in terms of increasing initiatives toward meeting ambitious NDCs. Also, as the green bond market doesn't stop growing, there are many opportunities for development partners, especially for MDBs within LDCs with nascent capital markets. However, green bonds alone shouldn't be considered as a sort of single cure-all solution, as they won't be able to wholly close the gaps of scaling climate finance in the next coming years. Rather than that, they are thought to be well-positioned to support specific kinds of projects (grid-connected, utility-scale solar/wind parks, investments into low-carbon public transport, water resource management to improve its efficiency and energy efficiency upgrades in buildings), in specific development phases (low return expectations, low technology risks, some liquidity requirements, large institutional sizes and mainly long-term investment horizons) and under precise market conditions (the need of infrastructure within capital markets).

Results from the market-based research project suggests that Aenergy is following the right path by investing in Renewable Energy in Angola and Energy Efficiency (and Renewable Energy as well) in Ghana. In fact, results envisaged that both variables were main targeted environmental areas from MDBs as well. However, evidence from Oliver et al. (2018), suggests that Renewable Energy investments slightly fell as of falling renewable energy technology costs by time. Regarding the choice of Aenergy for investments in Pollution Prevention and Control in Ghana, MDBs seem to not really target this variable except for the IBRD (during 2010, 2011, 2015 and 2016). However, as this data considers only the behavior of MDBs, the worthiness of this environmental area, as well as its rentability, should not be excluded.

This internship report is limited to the fact that it only considers secondary market transactions (as the use of green bonds) for filling climate finance gaps of NDCs in LDCs. This is due by the motivation disposed by Aenergy for broadly studying its main private project during the internship, as of the forecasted green bond issuance. However, more and more climate finance sources are needed, especially in light of the global climate finance architecture according to Watson & Schalatek (2019). In this context, is it envisaged to conduct future research lines on improved reporting practices to make green bonds consistent with the 2°C pathway of the PA even though its standardization of reporting is currently limited. Also, it is recommended to further research climate finance sources and intermediaries coming not just from MDBs, but also from other market players.

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8. Annex

Table I: Data

Issuer	Year	TotalValue	Total	CCA	EE	GB	RE	SMNR	SWM	TABC	PPC	CT	EPT
African Development Bank	2010	421.141	13	0	0	0	1	0	0	0	0	0	0
African Development Bank	2012	5.39	2	0	0	0	0	0	0	0	0	0	0
African Development Bank	2013	500	1	0	1	0	1	0	1	1	0	1	0
African Development Bank	2014	309.894	1	0	1	0	1	0	1	0	1	1	0
African Development Bank	2015	500	1	0	1	0	1	0	0	1	0	1	0
African Development Bank	2016	176.336	2	0	1	0	1	0	1	1	1	1	1
African Development Bank	2017	331.508	2	0	1	0	1	0	1	1	1	1	1
Asian Development Bank	2012	330.2	3	1	1	0	1	0	1	0	0	1	0
Asian Development Bank	2013	284.584	7	2	2	0	2	0	2	0	0	2	0
Asian Development Bank	2015	502	2	2	2	0	2	0	2	0	0	2	0
Asian Development Bank	2016	1300	1	1	1	0	1	0	1	0	0	1	0
Asian Development Bank	2017	1298.592	3	2	2	0	2	0	3	0	0	2	0
Asian Development Bank	2018	1752.063	8	1	2	1	1	0	0	0	0	1	0
Central American Bank for Economic Integration	2016	72	1	1	1	0	1	0	0	0	0	0	0
EBRD	2011	38.368	4	0	0	0	0	0	0	0	0	0	0
EBRD	2012	6.313	1	0	0	0	0	0	0	0	0	0	0
EBRD	2013	308.877	3	0	3	0	3	0	3	0	3	3	0
EBRD	2014	116.708	5	0	5	0	5	0	4	2	4	5	0

EBRD	2015	172.029	14	1	12	0	14	0	2	0	2	2	0
EBRD	2016	711.777	5	0	5	0	5	0	5	0	5	5	0
EBRD	2017	553.668	2	0	2	0	2	0	1	1	1	0	0
EBRD	2018	166.929	2	0	1	0	1	0	1	1	0	0	0
European Investment Bank	2007	812.166	1	0	1	0	1	0	0	0	0	0	0
European Investment Bank	2009	671.9952	3	0	2	0	2	0	0	0	0	0	0
European Investment Bank	2010	776.9	7	0	0	0	0	0	0	0	0	0	0
European Investment Bank	2012	350.274	3	0	3	0	3	0	0	0	0	0	0
European Investment Bank	2013	5753.363	8	0	7	0	7	0	0	0	0	0	0
European Investment Bank	2014	5756.24	21	0	19	0	19	0	0	0	0	0	0
European Investment Bank	2015	4385.209	12	0	12	0	12	0	0	0	0	0	0
European Investment Bank	2016	4353.152	12	1	12	0	12	0	0	0	0	0	0
European Investment Bank	2017	4741.248	13	0	13	0	13	0	0	0	0	0	0
European Investment Bank	2018	4761.1516	11	0	10	0	10	0	0	0	0	0	0
IADB	2018	9.1503	1	0	0	0	0	0	0	0	0	0	0
IBRD	2008	396.72	1	0	0	0	0	0	0	0	0	0	0
IBRD	2009	480	2	0	0	0	0	0	0	0	0	0	0
IBRD	2010	1834.083	25	5	13	0	13	2	2	10	12	11	2
IBRD	2011	749.536	18	5	5	0	5	5	5	5	5	5	5
IBRD	2012	293.851	11	3	4	0	4	2	2	2	3	3	2
IBRD	2013	610.053	5	3	4	0	4	1	2	1	4	2	1
IBRD	2014	2516.014	19	6	9	0	9	1	6	1	8	6	1
IBRD	2015	1398.492	33	12	19	0	19	9	11	11	11	11	10
IBRD	2016	1096.14	10	9	8	0	9	9	9	9	8	9	9
IBRD	2017	772.724	8	1	1	0	1	1	1	1	1	1	1
IBRD	2018	740.3986	7	0	1	1	1	0	1	0	1	0	0
IFC	2010	200	1	0	1	0	1	0	0	0	0	0	0
IFC	2011	252	6	0	0	0	0	0	0	0	0	0	0
IFC	2012	98.9	2	0	0	0	0	0	0	0	0	0	0
IFC	2013	2438.949	6	0	4	0	4	2	0	0	0	0	0

IFC	2014	229.747	7	0	6	0	6	0	0	0	0	0	0
IFC	2015	570.283	9	1	5	0	5	0	0	0	0	0	0
IFC	2016	852	2	0	1	0	1	0	0	1	0	0	0
IFC	2017	1464.202	6	2	4	3	3	0	0	0	1	0	1
IFC	2018	929.7435	7	1	3	3	4	0	0	0	2	2	0
New Development Bank	2016	447.876	1	0	0	0	1	0	0	0	0	0	0
Nordic Investment Bank	2010	205.3	2	0	0	0	0	0	0	0	0	0	0
Nordic Investment Bank	2012	74.22	1	0	0	0	0	0	0	0	0	0	0
Nordic Investment Bank	2013	77.848	1	0	1	0	1	0	1	0	1	1	0
Nordic Investment Bank	2014	555.029	2	0	2	0	2	0	2	0	1	2	0
Nordic Investment Bank	2015	683.7	2	0	2	0	2	0	1	0	0	1	0
Nordic Investment Bank	2016	684.935	2	0	2	0	2	0	2	0	2	2	0
Nordic Investment Bank	2017	1166.017	7	0	4	2	4	0	4	0	3	4	0
Nordic Investment Bank	2018	611.902	1	0	1	1	1	0	1	0	0	1	0
North American Development Bank	2018	126.4	1	0	1	0	1	0	1	0	1	0	0

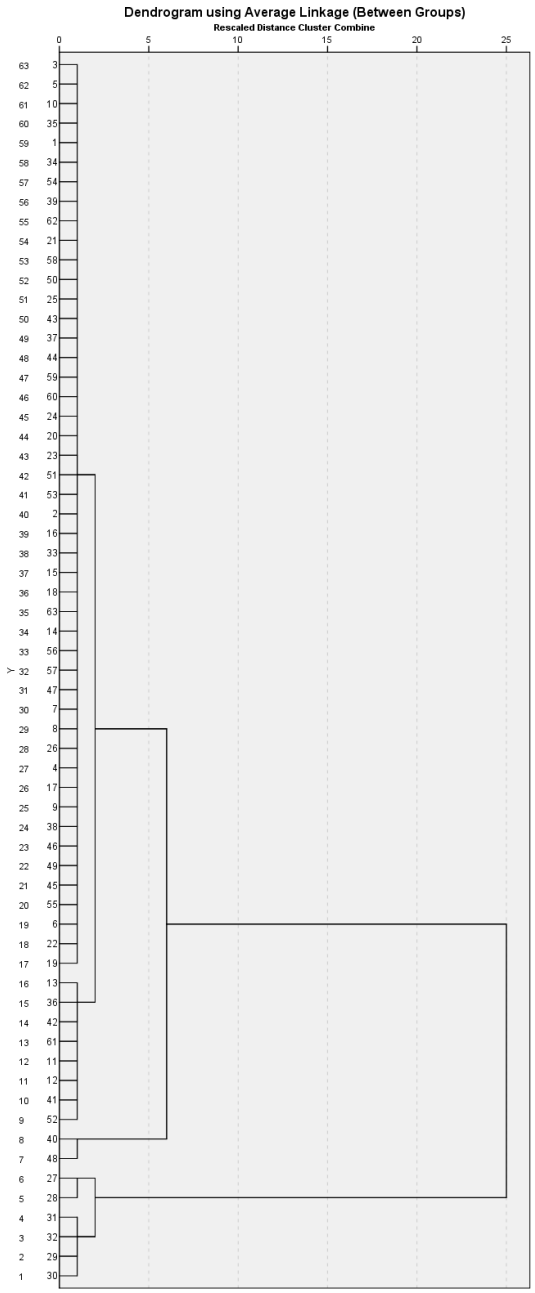
Table II: Communalities – Conducted by SPSS

Communalities

	Initial	Extraction
TotalValue	1.000	.830
Total	1.000	.853
CCA	1.000	.897
EE	1.000	.961
GB	1.000	.989
RE	1.000	.950
SMNR	1.000	.853
SWM	1.000	.810
TABC	1.000	.874
PPC	1.000	.839
CT	1.000	.865
EPT	1.000	.866

Extraction Method: Principal Component Analysis.

Figure I: Dendrogram – Conducted by SPSS



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