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How the projects seeking to enhance the nature-based solution of wild grassland carbon sinks can benefit from carbon markets at present

A case of Rewilding Europe

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As an environmentalist with a business background, this research allowed me to fully dive into my passion: create business models that work with the earth instead of exploiting it. We must be creative and work with the current financial system to redirect the money for climate action until we make the transition to an alternative economic model that mirrors what we really need to thrive in partnership with the earth. Conducting this research was an incredible endeavour because environmental sciences, policy, and management, truly came together. I feel that my research led to more questions than answers, but I am fulfilled to having toiled through no-man's land for a while.

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The price for anything is the amount of life you exchange for it

- Henry David Thoreau

Abstract

This exploratory mixed-methods case study research is guided by the question of what kind of role carbon markets can currently play in crafting a business model to support nature-based solutions of wild grassland carbon sinks in Europe. By developing a carbon offset project for the nature organisation Rewilding Europe, this research engages with and connects the literature on carbon markets and Carbon Storage and Sequestration to critically reflect on their combined potential to mitigate carbon dioxide emissions. More specifically, this research emphasises on the potential business model of carbon markets as a vital source of financial investment for Carbon Storage and Sequestration projects. The main research question is**:** "How could projects seeking to enhance the nature-based solution of wild grassland carbon sinks benefit from carbon markets at present?"

Qualitative methods used were desktop research, including literature review, and the review of governmental, multilateral, corporate reports, and scholarly articles. Moreover, interviews with Rewilding Europe's employees were conducted. Quantitative methods included financial analysis of carbon-market data and geographical data on Rewilding Europe's project-location, both used to create the carbon offset business model.

Results were that, first, it should be said that by selling carbon offsets, society cannot buy itself out of climate change. However, unavoidable emissions can be offset as a final option after investing in emission-abating and low-carbon technologies. Secondly, Voluntary- and Compliance Markets differ legally, which causes Rewilding Europe to only be able to offer a carbon offsets to Voluntary Markets. This market is volatile on both price and demand level, and carbon offsets on this market have seen complications with transparency. Governments need to impose stricter rules and regulations to enhance the functioning of carbon markets. Moreover, even though carbon offsets can be sold on Voluntary Markets, Rewilding Europe is not limited to this market to generate investment. Governments can revert subsidies from agriculture to nature conservation if a viable business model shows societal co-benefits and ultimately financial independence from these funds. Also, developing a carbon offset project has the potential for becoming financially lucrative seen the overall increase in the price of carbon dioxide together with regulatory changes in current carbon markets, and expected upcoming carbon dioxide taxes.

Despite the volatility of Voluntary Markets, Rewilding Europe is recommended to pursue carbon finance by starting a pilot project. One of the existing rewilding areas- the Coa Valley in Portugal- has been suggested to serve as a case study. At a price of €50 per ton of CO_2, an income of €130.50/ha/yr. can be made, meaning a potential yearly income of €4,698,000 for all the wild grasslands in the Coa Valley in Portugal. Seen the current increasing intensity of debates around carbon dioxide issues, now is the time to start experimenting with carbon offset projects -also in other parts of Europe- to attract carbon finance as an extra source of income for Rewilding Europe's nature-based solution projects.

Key words: Carbon Markets, Carbon Storage and Sequestration, Natural Carbon Sinks, Nature-based Solutions

Executive Summary

This research addresses the need for the development of a business model that can financially facilitate nature-based solutions. Nature-based solutions are commonly defined as the sustainable management and application of natures' ingenuity to address societal challenges (Christian et al., 2018). Areas of vegetation that can sequester and store carbon dioxide (CO_2) are called natural carbon sinks (Hungate et al., 2017). Roots and vegetation take CO_2 out of the atmosphere by the natural process of photosynthesis and store it in the soil through a process called Carbon Storage and Sequestration (Erb et al., 2018). This biophysical function is the nature-based solution central to this research. Carbon Storage and Sequestration is very well known to occur in forests, but the evidence is growing that also wild grasslands -today one of the most threatened habitats worldwide- are very effective (Smith, 2014). Yet, there is still a lack of knowledge on how to create a business model that can attract financial investment to this nature-based solution. Investment is needed for the restoration of natural carbon sinks, and for protection of grasslands, which also, when not managed properly, can turn into CO_2-producing sources.

Businesses that are participating in carbon markets and need or want to offset their CO_2 emissions can pay third parties for undertaking carbon offset projects. Simply put, in carbon markets, one carbon offset is equivalent to one ton of CO_2. These projects range from renewable energy innovation to cleaner production tools for factories, but also terrestrial environmental projects such as afforestation and reforestation. Carbon finance can be the mechanism through which money can go into both the restoration and protection of wild grasslands. Namely, the idea is that the investment attracted by the sales of carbon offsets can increase the financial means of nature conservation organisations to undertake projects.

Noteworthy to say, criticism is existent on both carbon markets and carbon offsets. Carbon markets have been criticised for not achieving CO_2 reduction over time, which is the reason why these markets exist (McNish, 2012). Also, carbon offsetting has been associated with greenwashing and fraud, and ultimately not contributing to CO_2 abatement (Rogers, 2010). Carbon offsetting should only be used as tool to neutralise unavoidable emissions, only after all other emission-abatement techniques, and investment in low-carbon technology alternatives have been explored (Raymond, 2016). Moreover, governments need to act to impose improved rules and regulations for carbon markets and carbon offsetting.

Rewilding Europe, the subject of this case study-based research, is a European-based nature organisation that has a strong interest in finding business models to financially facilitate their projects, of which one objective is the restoration of wild grasslands. Therefore, in this research, a wild grassland carbon offset project was developed. The added value of using Rewilding Europe as a case lies in combining an academic discussion on the market-based policy mechanism behind carbon markets and carbon offsets, with a more practical view by developing a unique and pioneering carbon offset project case in the nature-related field.

The objective of this case-based research is gaining insight into how an organisation like Rewilding Europe could utilise current forms of carbon markets to support their activities. This was done through exemplification by building a carbon offset. Overall, this research can have a large-scale impact on both the European climate and its biodiversity. As such, this research might be interesting for other civil, governmental, and business actors that are trying to find the tools and arguments to work within the planetary boundaries.

The main question of this research: **"How could projects seeking to enhance the nature-based solution of wild grassland carbon sinks benefit from carbon markets at present?"** was divided into four sub-questions:

1. Where could Rewilding Europe start its European wild grassland carbon offset project?
2. How do carbon market structures affect the possibility of a carbon offset to be embedded?
3. What influenced other carbon offset projects on their path to the carbon market?
4. How could the business model for Rewilding Europe's carbon offset take shape?

When building Rewilding Europe's carbon offset business model, the analytical framework was used by mirroring findings on Carbon Storage and Sequestration in grasslands, carbon markets, with the quantitative and qualitative factors that have influenced other carbon offset projects in the past. This, in turn, helped with forming an opinion on whether carbon markets are a suitable financial tool to attract investment for Rewilding Europe's projects.
An explorative mixed methods approach was used. All sub-questions involve desktop research including the review and both qualitative- and quantitative data extraction from governmental, multilateral, and corporate reports, on top of scholarly peer-reviewed articles. Both qualitative- as quantitative data were collected for sub-question one through interviews with two of RE's employees with specialised knowledge on both project-governance and knowledge on business development and finance. The desktop analysis was used for sub-question two on carbon markets, and sub-question three on carbon offset experiences. Then, in sub-question four, results from all previous sub-questions, and additional insights from the interviews with Rewilding Europe were used to craft Rewilding Europe's carbon offset business model. Using these four sub-questions will provide both academic and practical insights into the ability of carbon markets to establish a business model that can be used to financially facilitate the nature-based solution of Carbon Storage and Sequestration in natural sinks.

Regarding scope, creating this carbon offset in Europe was done for two reasons. First, this organization does not operate outside of Europe. Second, hitherto, no European nature-based carbon offset project exists, providing a pioneering position for this case-study to be executed. Moreover, this research is replicable. Namely, might a carbon offset project be developed in the future, these same environmental, market-context, and business-model factors can be applied to the case. Another scoping decision was to only look at the implications of the legal frameworks of carbon markets to gain understanding of how carbon offset projects can be embedded; and not perform an analysis of this entire legal framework and implications for matters other than carbon offsetting.
To give a comprehensive overview and enable a comparison of the types of carbon markets and their potential to finance Rewilding Europe's nature conservation project both Voluntary and Compliance Markets were considered. One of most relevance to this research is the way carbon markets legally allow carbon offset projects to be sold. Voluntary Markets operate globally, are decentralised and unregulated, whilst Compliance Markets are regulated and linked to the Kyoto Protocol to the United Nation Framework Convention on Climate Change (hereafter referred to as Kyoto Protocol) (UNFCCC, 1997) (Dumanski, 2004). Therefore, on Compliance Markets, only Kyoto-linked carbon offset programs are allowed, including the Clean Development Mechanism, Joint Implementation, and REDD (Reducing Emissions from Deforestation and Forest Degradation) (Dumanski, 2004). No private carbon offset projects -such as the undertaking of Rewilding Europe- are legally accepted as carbon offsets. Other carbon offset projects showed hardship on Voluntary Markets regarding high up-front investment, uncertain prices for carbon offsets, and varying quality of carbon offset projects that make competition unfair. Compliance Markets have shown to be much more stable in

both price and demand, so offering a high potential for carbon offset projects to flourish if only these projects would be accepted in this market. The linking of carbon markets in combination with an increasing CO_2 price, more regulatory- and consumer pressure on industries to decrease CO_2 emissions, as well as policies and regulations such as CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) -a CO_2 tax for the aviation industry- might positively improve market conditions for carbon offset projects (Air Transport Action Group, 2017)

It has been concluded that Rewilding Europe's project in the Coa Valley in Portugal could be offered to the Voluntary Market since Compliance Markets only accept Kyoto-linked carbon offsets. In wild grasslands, 2.61 ton of CO_2/ha/yr. can be stored. A price of €50 per ton of CO_2e, based on the EU ETS -the required price to make a positive impact- would generate an income of €130.50/ha/yr. or a yearly income of €4,698,000 for the Coa Valley. For €50 per ton of CO_2, equivalent to one carbon offset, Rewilding Europe would be able to break-even in a minimum of 8.8 and a maximum of 33.6 years, depending on the price of land and interest rates on the land acquisition loan. Yet, earning these revenues are dependent on Rewilding Europe finding buyers willing to pay this price for the carbon offset. The higher the price of CO_2, the earlier Rewilding Europe can earn back its up-front investment.

This case should be seen as an example of how a market-based instrument such as the carbon market can be used to support a nature-based solution like Carbon Storage and Sequestration in natural sinks. Even though undertaking this carbon offset project is a risk due to currently challenging conditions on the Voluntary Market, entering the market and experimenting with carbon offset projects can improve the market position of Rewilding Europe as a project developer. Starting a pilot project such as the one designed in this research could have a widespread impact because of three reasons. Firstly, offering a high-quality, transparent, and nature-based carbon offset can influence carbon offset buyers to choose for a carbon offset that contributes both to the decrease of atmospheric CO_2 levels, and the development of biodiverse European landscapes with many associated socio-environmental co-benefits. Despite the relatively high price Rewilding Europe can use the EU ETS as a guiding price for carbon of its carbon offset. Willingness to pay is expected to increase to the more socio-environmental and political debate around the issue of CO_2. Secondly, Rewilding Europe can, through successfully implemented pilot-projects, show the potential of carbon markets, which enhances the business-viability of sustainable land-use models. This, in turn, has the potential to influence European agricultural policy and subsidy-schemes if these land-use models show to lead to more public goods than the ones derived from conventional models. Also, other market-based investment flows can result from developing marketable nature-development projects, able to suit the demand expected to result from regulatory- and policy changes such as taxes and fees on CO_2. Third, Rewilding Europe can, through its pilot project, contribute to the establishment of scientific consensus by monitoring the rates of Carbon Storage and Sequestration in natural sinks over time. This might increase the popularity- and sense of urgency to take conserve and protect and develop this critically important, and currently most threatened biome in the world. Seen reasons above, it was recommended to Rewilding Europe to start a pilot project in the Coa Valley of Portugal designed according to Voluntary Market guidelines but keep in mind future potential for lucrative carbon offsetting when market conditions change.

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Abbreviations

ATN - Associação Transumância e Natureza
CORSIA - Carbon Offsetting and Reduction Scheme for International Aviation
CO_2 - Carbon Dioxide
CSS -Carbon Storage and Sequestration
CER - Certified Emission Reductions
EU - European Union
EU ETS - European Trading System
EUA - European Union Allowance
ERU - Emission Reduction Unit
FAO - Food and Agriculture Organisation
MBI - Market-based Instrument
NGO - Non-Governmental Organisation
Ha - Hectare, one ha is 10.000 m2
Ppm - Parts per million
REDD - Reducing Emissions from Deforestation and Forest Degradation
SDGs - Sustainable Development Goals
tCo2/ha/yr. - tons of carbon dioxide per hectare per year
tCo2e - tons of carbon dioxide equivalent
UNEP -United Nations Environmental Program
UNFCCC -United Nations Framework Convention on Climate Change
VER - Voluntary Emission Reduction

1 Introduction

Society needs to half its carbon emissions by 2030. Multiple, simultaneously implemented, large-scale projects are necessary to achieve this reduction and keep global warming below the 1.5 °C limit (Hsiang and Kopp, 2018). One major challenge is to implement projects that both limit the negative anthropogenic impacts on the environment and work on climate adaptation that address issues of global warming (Goers, 2010). This requires an integrative approach of governments, Non-Governmental Organisations (hereafter: NGOs), civil society, and businesses (UNFCC, 2015). Lacking financial investment has been an impediment to the realisation of large-scale projects. It must be understood, however, that steering investment into such projects will result in returns in the future that are far greater than the present up-front investment costs (Auffhammer, 2018). Major collaborative projects are necessary to both decrease CO_2 emissions through reduction and the development of low-carbon technologies (Cherp et al., 2017). However, the topic that this research focuses on is decreasing atmospheric CO_2 through Carbon Storage and Sequestration in natural carbon sinks. by finding financial investment through carbon markets.

1.1 Carbon Storage and Sequestration in wild grasslands

Nature absorbs CO_2 through oceans, peatlands, forests, and grasslands, so-called natural carbon sinks (Jones and Donnely, 2004). Carbon sinks are natural areas of vegetation that – through the biophysical process of photosynthesis – take up CO_2 from the atmosphere, and transfer and store it into compact bundles in root systems (Abberton et al., 2010). Carbon Storage and Sequestration is a typical nature-based solution, meaning a solution to a societal problem offered by nature (Christian at al., 2018). Especially wild grasslands have shown to be effective in storing and absorbing CO_2. While to many this may sound surprising, soils hold two times as much CO_2 than can be found in the atmosphere (Ghosh and Mahanta, 2014).

To clarify, *wild grasslands* are biodiverse grazing mosaics. They are not vast areas of monotone grass but include multiple species, different varieties of grasses, bushes, and occasional trees. They are not domesticated, have deeper root systems, are better at holding water, and are typically a habitat for a wider array for species compared to domesticated or artificial grasses (Preece et al., 2018).

Many of today's natural carbon sinks are in danger due to the consequences of unsustainable land management practices (Schmitz, 2017). The need for nature conservation and the adaptation of sustainable land management practices needed to enhance and protect natural carbon sinks. Nature conservation aimed at restoring grasslands involves protecting degraded landscapes that have been depleted due to human conduct -of overexploitation of soils, water bodies- and their associated detrimental effects on biodiversity (Molin et al., 2018 and Pohjola et al., 2018). One of the most urgent actions to conserve their ecological functioning is through sustainable land management practices. These practices are often embedded in nature conservation (Christian et al., 2018). Minasny et al. (2017) argue that nature conservation projects should ideally be implemented and supported through partnerships with landowners such as farmers and the government (Bauer, 2011). Moreover, next to the enhancement and protection of natural carbon sinks, multiple co-benefits are created, which makes the need for more financial investment to facilitate this sector more prominent (Molin et al., 2018). First, the cost of in-action involving climate adaptation projects is far greater than bearing the costs when nature turns against society when it is exploited (Auffhammer, 2018). Secondly, when landscapes are restored, people who earn their livelihood with the land might find new employment through the creation of new jobs. This is contributing to local development and sustainable development

at large (Hungate et al., 2017), pointing to socio-environmental benefits from biodiverse and healthy lands. Namely, economies can be revived by giving a new purpose to the land, (Jaeger 2005). One could think of eco-tourism, responsible farming, or the sales of regional specialties such as cheese, wild meat, or honey from flowering meadows (Schumacher, 1973). Summing up, sustainable land management practices are necessary to protect and restore wild grasslands serving as natural carbon sinks, but also to stimulate the many co-benefits that increase the number of public goods available to society. This provides a strong economic argument for nature conservation (Constanza et al., 2014).

Yet, even though the benefits of nature conservation -including ecosystem restoration, human health and well-being, and reviving economies as listed above- are evident to most climate scientists, financial investment is needed to accelerate this sector (Jackson, 2009). Lobbying of industries that benefit from the exploitation of nature can attract large sums of subsidies that maintain the financial health economic activities and sectors that are otherwise not self-sufficient (Jaeger, 2005). These subsidies, mainly allocated to agriculture, are a direct competition to nature conservation projects. Next to competing with governmental subsidies of this sort, two major aspects generally withhold private investors from transitioning from conventional- to sustainable land management practices that support nature-based solutions. First, nature-based projects are typically a long-term investment as project development often takes multiple years. This is problematic as often little return in the short term is preferred over significant returns over time by stakeholders, putting a pressure on corporations to prioritize what profits remain at the bottom line (Jackson, 2009 and Bakan, 2003). Second, sustainable land management might not always result in direct financial benefits, but in the prevention of societal disasters that would cost more if it were to be dealt with afterward, rather than up-front through taking preventative measures. This type of large, long-term, and often not financially tangible investment is seen as a big risk for the investor (Hungate et al., 2017).

Rewilding Europe is a nature organisation, focusing on giving nature the space to develop itself through a process called rewilding, of which an artist impression is shown in Figure 1-1. Rewilding is a new approach to nature conservation and has the purpose of bringing back the biophysical nature of a landscape to its uncultivated state, by letting nature return to its original state before human interference using its own natural power. (Fraser, 2009). Rewilding Europe's projects revolve around finding modes of sustainable land management, investigating possibilities for more ecologically varied and natural landscapes (Rewilding Europe, 2018). Its projects contribute to several climate adaptation challenges including mitigating wildfires (in grazed forests) and decreasing flood risk via river- and wetland restoration. Another main objective is to restore and support ecosystems by bringing back predators such as wolves and large herbivores like bison into the European wilderness. A map of Rewilding Europe's projects is shown in Figure 1-2. Rewilding Europe now has 67 members in 27 European countries. The red dots represent European Rewilding Network areas, and the purple dots are the main rewilding areas, where current projects actively take place.

Figure 1-1 'An artist impression of rewilding'.

Source: 'Rewilding Europe 2017', https://rewildingeurope.com/areas/western-iberia/. *Reprinted with permission.*

Through the stimulation of biodiversity, new nature-based economies can take shape in the form of new branches such as eco-tourism and production of organic regional produce. One of its aims is to find grazing models that offer solutions to a range of socio, environmental, and economic issues in the rural areas of Europe, which is the project that aligns with this research. Rewilding Europe has an interest in creating nature-based business models that can connect its projects with the market economy. In this way, a more varied portfolio of financing options can help to expand Rewilding Europe's projects and contribute to its mission to 'make Europe a wilder place' (Rewilding Europe, 2018). Also, it is essential to gain insight into how new business models for nature creation can open the discussion of how the current range of subsidies in the EU (hereafter: European Union) are currently arranged. Showing alternative modes of land management and suitable forms of investment to facilitate this transition might change policies of land management and financial flows accordingly. Finding creative business-based solutions to help bridge the gap in finance for nature conservation would benefit the planet and society. The next section will explore a novel idea on how this could be realised through carbo markets.

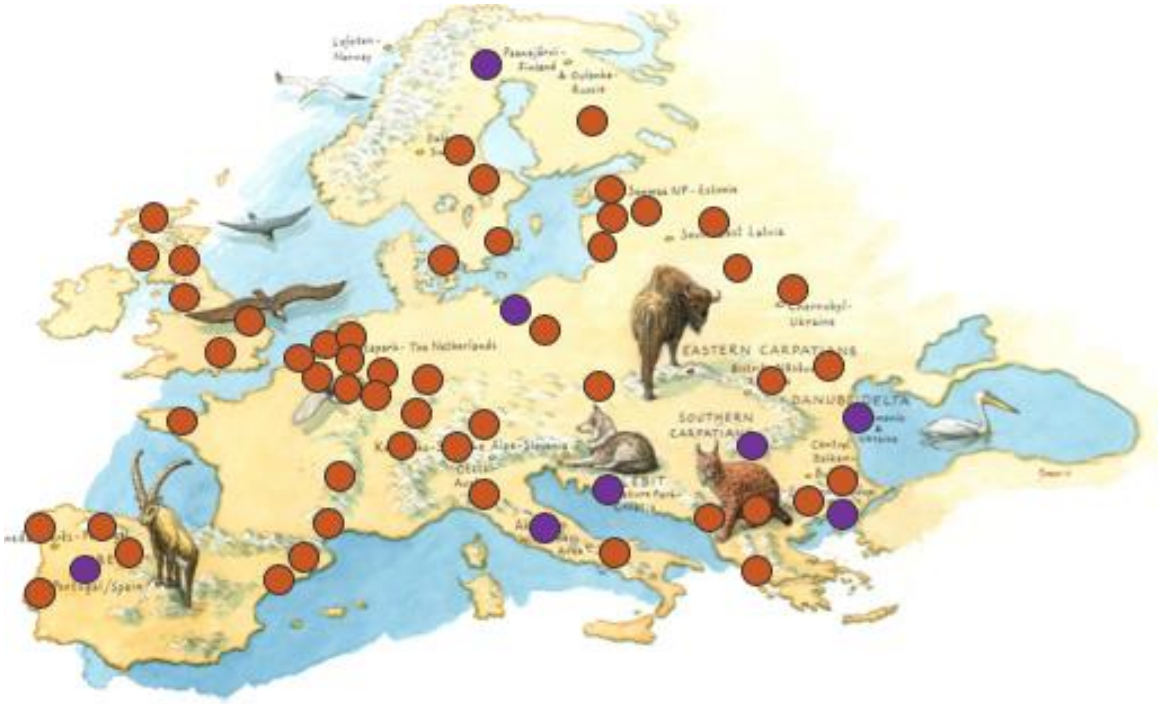


Figure 1-2 Project areas of Rewilding Europe.

Source: W. Helmer, 2019, https://rewildingeurope.com/european-rewilding-network/. *Reprinted with permission.*

1.2 Environmental Policy and Carbon Emissions Trading

Environmental Policy entails the measures that national governments, businesses, and other organisations take to control anthropogenic effects on the environment (Rosenzweig, 2016). In order to prevent the destruction of ecosystems due to human conduct, environmental policy is necessary because the environment is often an inferior decision factor as opposed to economic ones, leading to negative externalities such as pollution (Hsiang and Kopp., 2018).

Rosenzweig (2016) explains the four major realms to environmental policy, which include regulation, which for the issue of air pollution could mean a limit on total allowable levels of atmospheric CO_2. Secondly, there are financial incentives such as subsidies on renewable energy (incentivising low-carbon alternatives instead of fossil fuel energy-sources) or taxes, such as a carbon tax per ton of emitted CO_2. Third, there is reporting and ecolabeling, which aids decision makers in opting for more environmentally-friendly options by gaining insight into environmental impacts of human activities or gaining insight into the carbon footprint of an organisation by eco-labeling and certification and standardisation of products and services. Lastly, there are global policy agreements that result in the establishment of protocols and laws that address the most pressing environmental issues society faces. The protocol central to this research is the Kyoto Protocol (UNFCCC, 1997), which is hard law with required CO_2 reduction targets for nation states and global regions. The use of the market economy has been recognised as an essential mechanism to direct money to the necessary sectors (Jaeger, 2005). When linking the market-economy to environmental policy mechanisms, market-based mechanisms are called to life and can contribute to facilitating the implantation of environmentally oriented projects (Goers, 2010).

Out of the Kyoto protocol, carbon markets were created, both taking form in Compliance Markets, and Voluntary Markets (UNFCCC, 1997), each having different legal structures. Both markets will be elaborated on in section 5.2 in this research.

The importance of amending our societal carbon overshoot, and the subsequent land management practices that are needed to conserve and protect carbon sinks were shown in the previous paragraph. An idea that is currently upcoming is to increase the Carbon Storage and Sequestration potential in wild grasslands, and financially facilitate the projects responsible for this through the sales of carbon offsets to carbon markets (Bambus, 2011). Namely, carbon offsets can be bought to neutralise CO_2 emissions, and one way in which these carbon offsets can take shape is through the Carbon Storage and Sequestration of CO_2 in natural carbon sinks. Currently, European wild grassland carbon offsets are not present, creating a business-opportunity for project developers that aim at increasing the natural function of wild grasslands (Barbier & Markandya, 2013).

1.3 Problem definition

The overall problem is the need for a business model that financially facilitates nature-based solutions that nature-conservation organisations work with; wild grasslands in this case. Research is available on both the potential of wild grasslands for Carbon Storage and Sequestration (Ghosh and Mahanta, 2014; Hungate et al., 2017; Robotyagov, 2010) and on how revenue can be generated by offering a carbon offset project to carbon markets (Hungate et al., 2013; Jaeger, 2005; Smith, 2014). However, there are no empirical cases for academic discussion that show how to link these two bodies of knowledge by offering a European wild-grassland carbon offset project. This research wants to explore, in the current situation, how an organisation like Rewilding Europe utilise current forms of carbon markets to support their activities.

This research has wide practical and academic use. Practically, this research can contribute to developing a business model supporting a nature-based solution, which, if successful, will contribute to two major socio-environmental issues. First, finding ways to act on societies' carbon overshoot, and second, restoring (CO_2-storing) ecosystems. Moreover, this research can also provide a financial motive to prefer sustainable land use models and the partnerships required between landowners, farmers, rural communities, or other nature conservation organisations that help implement these models. Academically, this research can contribute to the combined academic and theoretical body on both Carbon Storage and Sequestration in natural sinks, and the development of nature-based business models that are together helpful for practitioners in this pioneering field. By crafting a business model, this research does not only speak about theoretical implications but also shows the practical implications of this idea. Developing a business model for this organisation required it to be placed at the heart of this research.

1.4 Research questions

The main question of this research is: **"How could projects seeking to enhance the nature-based solution of wild grassland carbon sinks benefit from carbon markets at present?"**

Sub-question one will go into ecological and project-based technicalities of Rewilding Europe's carbon offset project development. Sub-question two will evaluate the administrative and legal design of carbon markets. Sub-question three will review the steps that have to be undertaken to create a carbon offset, and what has influenced other carbon offsets on their way to the carbon market. Then, in sub-question four, research findings from all previous sub-questions will be used when crafting a business model for Rewilding Europe's very own carbon offset that will show the potential of carbon markets.

1. Where could Rewilding Europe start its European wild grassland carbon offset project?
2. How do carbon market structures affect the possibility of a carbon offset to be embedded?
3. What influenced other carbon offset projects on their path to the carbon market?
4. How could the business model for Rewilding Europe's carbon offset take shape?

1.5 Outline

In chapter two, the reader will be introduced to scholarly insights required to understand the current knowledge available on the topic of this study. Chapter three will present the analytical framework. This framework will function as a tool to analyse the case of Rewilding Europe. Then, the research methods will be provided in chapter four, followed by results of the data collection in chapter five. In chapter six, analysis follows, where the analytical framework, literature review findings, and findings to sub-questions discussed and analysed. Chapter seven involves conclusions and chapter eight recommendations and suggestions for further research.

2 Literature review

This literature review gives an overview of the body of knowledge about Carbon Storage and Sequestration in wild grassland carbon sinks, and its challenges. Then, carbon markets, carbon offsetting, and criticism on these two systems are presented. Lastly, the relationship between these different sections is visualized using a visual causal model revealing the research gap.

2.1 Carbon Storage and Sequestration in wild grasslands

Roots and vegetation take CO_2 out of the atmosphere by the natural process of photosynthesis and store it in the soil through a process called Carbon Storage and Sequestration (Erb et al., 2018). This mechanism is very well known from forests and peatlands, but the evidence is growing that also wild grasslands -today one of the most threatened habitats worldwide- are very effective in storing carbon (Smith, 2014). The large surface (25% of terrestrial earth meaning approximately 3.4 billion ha) that grasslands cover contributes to large Carbon Storage and Sequestration potential in these lands, and already holds 12 % of current terrestrial carbon stocks (Adams et al., 1990). McNish (2012) explains that soil is most effective in long term Carbon Storage and Sequestration, containing 3.1 times as much CO_2 as can be found in the atmosphere. Grasslands are more effective since most of CO_2 is stored in the root systems, and grassroots systems contain more biomass per ha than trees (Ghosh and Mahanta, 2014). Namely, in root systems of wild grasslands, layer over layer of organic matter, and CO_2 can be stored and sequestered for thousands of years (Adams, 1990). Roots of wild grasslands often reach meters into the soil, which is where most CO_2 is effectively sequestered and stored. Trumpeter et al. (2008) state that Carbon Storage and Sequestration in wild grasslands is seen as perhaps one of the most effective methods to take away CO_2 from the atmosphere in the short term.

There is an increase in carbon offset projects in the forestry area Veldman et al. state (2015), and critically mention that planting trees instead of enhancing grasslands as carbon sinks can even damage biodiversity. Namely, some wild grasslands are even converted into monoculture-typed forest plantations, damaging large ecosystems and undermining the Carbon Storage and Sequestration potential of wild and biodiverse ecosystems. Moreover, for economic reasons, timber is in some cases being resold as biomass for charcoal production, meaning CO_2 is not stored and sequestered indefinitely by these plantations (Bland et al., 2018, Pohjola et al. 2018, and Gelfand et al., 2011).
Mengistu and Mekuriaw (2014) list a range of benefits from grasslands other than serving as carbon sinks; benefits that turn into threats when not managed properly. Healthy grassland ecosystems contribute to water quality and hold more water, prevent soil erosion, and create a habitat for wildlife. That said, harmful land management practices not only jeopardize grasslands as ecosystems on which humans and nature rely but the whole pursuit of climate change mitigation (Bland et al., 2018). Soil erosion and the destruction of grasslands results in 20% of the world's greenhouse gas emissions (Levy et al., 2007 and Woodard et al., 2018). Minasny et al. (2017) state that maintaining proper ecological functioning of carbon sinks is essential to run in parallel with societies' development towards a low-carbon society. In this respect, it is crucial to understand how carbon sinks are key in balancing the global carbon budget, and how mismanagement can have detrimental effects.

2.1.1 Carbon Storage and Sequestration rates in wild grasslands

Lal (2009) and Minasny et al. (2017) argue that the global potential of the restoration of wild grasslands is around 2.5-3 gigatons of CO_2 per year if land management practices are changed from artificial to natural. This is an equivalent of reducing CO_2 by 50 ppm (parts per million) in a course of 50 years, which will be able to offset 30% of the globes' CO_2 emissions. Janowiak et

al. (2017) calculated that in the Colorado steppes, eight kilograms of CO_2 per ha is stored daily. On a yearly basis, this means 2.610 kg (2.61 ton)/ha/yr. of CO_2 for wild grasslands. Research from Lesschen et al. (2012) and Burke et al. (2008) argue a similar amount for wild grasslands. What can be done by nature conservation organisations for grasslands will now be explained.

2.1.2 Ways to improve the health of wild grasslands

Jones and Donnely (2004) suggest that adjustments in regular agricultural practices to sustainable land management practices substantially affects Carbon Storage and Sequestration rates in grassland and soils. These changes would entail the decrease or elimination of the use of fertilisers, the increase of irrigation, crop rotation, and crop variety, and introduce grazers that continuously move around. Ghosh and Mahanta (2014) add to these methods, by pointing to not only existent grasslands but also the re-integration of grasses on arable and deserted lands. In this way, new carbon sinks can be created. Also, Jones and Donnely (2004) specify that 98% of CO_2 can be found in root systems, which grow longer and deeper in rich natural soils, supplicating their protection. Hungate et al. (2017) also note the variety of species to influence the Carbon Storage and Sequestration potential of grasslands, which corresponds to the arguments of the researchers stated above in pleading for more varied crop production if agriculture on grasslands was to be practised at all.
Controversially, looking at the balance of the overall CO_2 that is stored into vegetation, and new CO_2 being released into the atmosphere, it has been argued that some agricultural lands that have also claimed to be carbon sinks are actually net-carbon sinks (emitters) (meaning no CO_2 is removed) due to the Nitrogen Monoxide emissions from soils that are turned into artificially-managed agricultural soils, and Methane from livestock for meat and dairy production (Levy et al., 2007). This pleads for the preference of wild carbon sinks over artificially managed lands.

Provided the arguments above, nature conservation could directly focus on grazing and increasing soil organic matter, leading to a doubling in Carbon Storage and Sequestration rates between 10 to 20 years from implementing projects (Simone et al., 2017). Mengistu and Mekuriaw (2014) discuss the challenges that wild grasslands currently face. These include the lack of policy to conserve and protect grasslands, harmful large-scale agricultural practices, deforestation and soil degradation, lack of institutions including land-tenure issues, and governance challenges.
The first challenge involves policy. Hungate et al. (2017) argue that readily available data on the Carbon Storage and Sequestration potential of wild grasslands has not yet been translated into policy-decisions aimed at protecting grasslands. Robotyagov (2010) mentions that even though policymakers are aware of these issues, they can only make policy-changes if they have more certainty on the actual CO_2 offset rates in soils. He argues that monitoring these rates and regulating whether projects really store and sequester as much as they claim is time-consuming and costly due to the many different terrestrial carbon offset projects undertaken globally (once again, mostly forestry).
Secondly, over the last five decades, farmers globally have experienced increasing difficulty. With decreasing crop productivity on the best soils, abandonment of marginal areas, and more people moving to the city leading to less labour to manage the land, this industry is currently under pressure, and thus heavily subsided. Demographic changes show urbanisation leading to large-scale land-abandonment (Rabbinge and van Diepen 2000). Verdú et al. (2018) argue that pesticides with antiparasitic compounds in agricultural soils have a substantial effect on soil health affecting the general health of ecosystems on terrestrial lands and in turn Carbon Storage and Sequestration rates. Trumpeter refers to the economic and social opportunities of wild grasslands, but a large threat to well-being when mismanagement happens since drylands are home to over two billion people and many depend on them for their livelihoods (Trumper et al., 2008). However, linked to the challenge number of the lack of institutional capacity, Erb et

al. (2018) speak about how mostly governmental institutions face a critical trade-off. They argue that carbon sink restoration is necessary for climate mitigation but is often inferior in the trade-off with converting the land to activities with more direct economic returns, such as agriculture, mining, or construction of infrastructure. Erb et al. (2018) state, therefore, that the natural carbon sinks are in danger due to an increasing population and need for food and other economic goods.
Another challenge linked to agriculture is deforestation and soil degradation. Abbertson (2010) states that grasslands make up 30% of the worlds' surface. Given the fragility of this vegetation-type, even a small shift in the organic matter can have a tremendous effect on the CO_2 in the atmosphere (Ghosh and Mahanta, 2014). More intense artificial land use, but also increased droughts due to climate change form a threat for the soils and vegetation, since grasses suffer when receiving too little water, in turn decreasing their ability to serve as carbon sinks (Jones and Donnely, 2004). Levy et al. (2007) warn for the emission of CO_2 when wild grasslands and other carbon sinks are demolished or changed for other land uses. Namely, when vegetation dies, carbon is released into the atmosphere. So, not only do carbon sinks need to be restored to enhance their Carbon Storing and Sequestration function, they also need to be carefully treated to prevent the emission of more CO_2.
Lastly, there is a lack of institutions to administer and document land use changes and methods, leading to land tenure issues. (Jindal et al., 2008). Ghosh and Mahanta (2014) mention the protection of wild grasslands to also contribute to sustaining livelihoods of people by participating in the carbon market. However, entering the carbon markets is complicated for pastoralists because of issues with land management. Especially minorities and socially marginalised communities often suffer from a lack of tenure rights and missing ownership-administration. This is often attributable to governments allocating little resources to arrange land tenure that would enable these people to reap the benefits from tending these lands sustainably. These challenges plead for sustainable land use nature conservation a more prominent role in climate change mitigation.

The societal problem that this research at large addresses is the societal carbon overshoot. One way in which policy-makers attempt to solve this problem through the creation of carbon markets, which will be explained in the next paragraph.

2.2 Carbon Markets

There are two sorts of carbon markets, Compliance Markets, and Voluntary Markets. The Compliance Market is based on mandatory reduction schemes and was established as one of the market-based instruments resulting from the Kyoto protocol (Dumanski, 2004), which will be explained in detail in section 5.3. On Compliance Markets, businesses are obliged to decrease their CO_2 emissions under this system. There are many -mostly regional- Compliance Markets. In short, in order to pollute, emission allowances are granted or auctioned from governments to businesses. Decreasing CO_2 emission is one option, another option is to acquire allowances from other businesses within this market if this is more cost-effective than developing low-cost technologies or cutting emissions (Barkin, 2017). The allowable cap on emissions is decreased over time, forcing businesses to invest in innovative CO_2-abating technologies, but letting the market depend on who can do this at the lowest cost. A second option is to acquire carbon offsets to counteract a part of their CO_2 emissions by investing in emission reduction projects undertaken by third parties (Cullenward, 2015). When a business purchases a carbon offset, this means that they are paying to a third party (a carbon offset developer) to perform a project somewhere in the world (Hungate et al., 2017), which will later be explained in section 2.3.
Secondly, there are Voluntary Markets. In these markets, businesses, governments, and individuals can voluntarily choose to offset their CO_2 emissions. These markets are uncertain

since the price of carbon offsets is established by negotiation. Hamrick and Gallant (2018) state that the prices on Voluntary Markets are much more uncertain than those on the Compliance Markets since prices of the latter is based on the supply and demand of emission allowances, which in turn is affected by the emissions cap (Hungate et al., 2017). On Voluntary Markets, 95% of carbon offsets are acquired by large and affluent corporations such as Amazon and Aviation businesses, mostly as part of their brand- and corporate image enhancement strategy formally referred to as their Corporate Social Responsibility or Customer Relationship Strategy (Hamrick and Gallant, 2018).

The main objective of Compliance Markets is to achieve CO_2 reduction most cost-effectively. Yet, these markets have been critically acclaimed. Sovacool (2011) mentioned four arguments, which have been supported by multiple scholars. First, McNish (2012) explained that countries set their own caps based on their own estimated emission levels, based on which these countries received emission allowances ready to grant to businesses based on their excising pollution levels. So, allowances were given away for free to businesses according to these emission levels. The lenient cap and free allowances caused the price of CO_2 to drop to zero in 2006 (Ervine, 2018) and significantly reduced the incentive to reduce emissions (Gössling, 2009). Goers et al. (2010) have similar arguments where the issues of ecological effectiveness of carbon markets are highlighted. They argued that CO_2 has not decreased since carbon markets were developed, directly linked to the price of CO_2. Ahonen et al. (2017) explain why. Having too many allowances on Compliance Markets leads to market-deficiency since emission reduction is only achieved when businesses are pressured to emit less based on monetary reasons (Richstein et al., 2015). This core market-mechanism is not functioning if allowances are given away for free because a surplus of emission allowances keeps the price of CO_2 low. As an example, on EU ETS, between 2021 and 2030, allowances for 15,4 billion tonnes of CO_2 will be created on the EU ETS, of which half will be given away for free to businesses to avoid unfair competition with other industries that are not included in the EU ETS, such as the transport and agriculture sector (Eijkhout, 2019). On top of this, McNish (2012), revealed that businesses that would pollute over the allowable emissions cap often had income that reached far above the fines charged for over-polluting. Thus, it was still more economical to pollute and pay fines, than to invest in low-carbon technologies. Eijkhout (2019) states that the price of CO_2 must increase to at €50 to activate the market mechanism responsible for the innovation and emission reductions. According to Knox-Hayes (2016), carbon markets, and specifically the EU ETS, does not force emissions reductions upon parties, which automatically puts more pressure on businesses themselves to voluntarily move to low -carbon technologies in case the price of CO_2 does not function as an incentive. Because this transition to low-carbon technologies often requires substantial investment, the incentive to do so decreases. Richstein et al. (2015) therefore pledge for involuntary emission cuts.
On the positive note, currently, the action is taken to install and optimise Compliance Markets and increase the CO_2 price in order to stimulate a transition to a low-carbon society (Boyd and Salzman, 2011). Even industries have recently themselves requested a stricter cap and a more transparent carbon market because without regulation their competitive drive will most likely incline them to choose profit over emission reductions (Belfry, 2016). This can only be achieved if allowances are not given away for free, and the overall cap of allowable emissions is tightened (Raymond, 2016). Goers et al. (2010) propose a universal CO_2 tax instead of the quantity instrument that carbon trading entails. They argue that putting a price per ton of CO_2 is more efficient since regulators will have more power to manage the price of CO_2 themselves, rather than leaving this to the market as is currently happening. However, Cullenward (2015) critiques this idea because of the high expected legal and administrative costs involved to monitor each individual business, whether this is a large corporation, a small-medium enterprise, or a start-up. A hybrid model that Goers et al. (2010) introduce a CO_2 price floor, guaranteeing the price of

CO_2 cannot drop below a certain level. The UNFCCC might in the future potentially play a role in this legal coordination as stated by Kulovesi (2012). Also, on a national level, some positive political and regulatory action is occurring nowadays. France, for example, considers putting a price floor on CO_2, and the Netherlands plans to install a carbon fee per ton of CO_2 emitted (Ahonen et al., 2017).
Next to Compliance Markets, Voluntary Markets have been criticised for not having any legal backbone that forces actors (businesses, consumers, and the government) to cut their emissions. Moreover, they have often been associated with greenwashing and merely functioning because of Corporate Social Responsibility and Customer Relationship Management strategies of large and affluent corporations (Fairhead et al., 2012).
The linking of carbon markets has also been discussed widely in the literature to decrease the current inefficiencies of carbon markets (Richstein et al., 2015). Heitzig and Kornek (2018) argue that by at least linking the prices of Compliance Markets globally, but also Compliance- and Voluntary Markets, could have benefits. They argue that in case one consistent CO_2 price floor would be established, allowances could be traded globally, as well as carbon offsets. This would make the market place for carbon offset developers more attractive. Heitzig and Kornek (2018) also state that allowing carbon offset projects outside of Kyoto-based programs to be sold to Compliance Markets, would trigger a substantial increase in the amount of carbon offset projects because of more favourable market-conditions on Compliance Markets compared to Voluntary Markets, including the more consistent CO_2 price, and more participating businesses. Linking of markets would also make these markets more liquid, meaning a larger pool of both emission allowances and carbon offsets would occur. If this is combined with a tighter cap on total allowable emissions, the chance of actually reducing CO_2 would be higher (Fedosov, 2016). According to Ahonen et al. (2017), Article six of the Paris Agreement stated the need for strengthening of the cooperation between parties is necessary to achieve emissions reduction altogether. Linking individual carbon markets into one global market could be one interpretation of this objective.
Another market development that might be of influence on carbon offset projects is CORSIA (Scheelhaase et al., 2018). This is another tax-based and compliance-reduction scheme that will be implemented in 186 countries in 2021-2027. Aviation businesses will need to reduce their emissions or offset via third parties. CORSIA can work as a triggering force for carbon offset projects globally since the demand for carbon offset projects will increase when this tax is installed. What type of carbon offsets will be accepted, however, is not known to date.
Carbon offset projects can take form as terrestrial projects that increase the Carbon Storage and Sequestration function in vegetation. Challenges for environmental carbon offsets and overall criticism for carbon offsetting is discussed in the next section.

2.3 Challenges for terrestrial carbon offset projects

Most terrestrial carbon offsets involving Carbon Storage and Sequestration occur in shape of afforestation, reforestation, and agricultural grass- and cropland production (Haim et al., 2015). The large up-front investment to start a carbon offset project is one of the largest bottlenecks (Cacho and Lipper, 2013). Prior to being able to sell a carbon offset, a large up-front investment is involved, of which the most substantial expense is land acquisition- or lease (De Pinto et al., 2010). Furthermore, the price paid for a carbon offset is paid at once, whilst the carbon offset project is fulfilled over a longer period of time. Estimating the actual cost of a carbon offset is complicated and might jeopardise the project and the executing party itself in case the carbon offset price does not cover the cost of project-implementation (Cacho and Lipper, 2013). Secondly, the volatility of carbon market conditions is another challenge (Swallow and Goddard, 2013). First, Compliance Markets are state-regulated, meaning that any sign of regulatory weakness through for example a lenient cap on emissions have a direct effect on the price of

CO_2, and hence, the price of carbon offsets. This is because one ton of CO_2 is equivalent to one carbon offset on Complementary Markets. For Voluntary Markets, demand is not predictable, nor is the willingness to pay for a carbon offset (Korthuis et al., 2019). Therefore, project developers cannot count on a consistent price for their carbon offsets, since the price is determined by negotiation between the buyer and seller. Concludingly, on both carbon markets, project developers of carbon offsets take a big risk by making a large up-front investment without knowing what they will receive in return and when.

Furthermore, environmental conditions naturally influence environmental carbon offsets. Allwardt (2011) evaluated agroforestry carbon finance in Senegal and Ethiopia. Due to varying environmental conditions that have an impact on Carbon Storage and Sequestration potential of trees, carbon offset projects are a big risk for landowners in these areas, since the carbon offset price ultimately depends on a natural process that depends on net primary production, which is typically lower at low precipitation and droughts. The income from carbon offset is worth one ton of emitted CO_2. Furthermore, Alwardt (2011) stated farmers in these regions are often not aware that carbon finance is an option, and if they do, are often unaware of how to offer a carbon offset project to carbon markets. Andonova et al. (2019) provide a similar argument, saying that a larger awareness is needed about carbon finance potential for landowners. Some farmers currently largely abandon their lands due to the lack of economic opportunity, driving prices of land down, but also adding to tremendous environmental risk of soil erosion and subsequent wild-fires (Fuijware et al., 2012 and Hungate et al., 2017). Simone et al. (2017) investigated how farmers in rural communities in Mozambique can sell carbon offsets to the carbon market. They found that revenue was earned, however, the lack of institutions to monitor the quality of these projects, and the local support and knowledge on improved land management practices added a challenge to the undertaken projects. Moss and Carlo (2014) related to this, explaining that a big barrier to implementing a carbon offset project involves the volatility exactly how much CO_2 is stored and sequestered in the land. McNish (2012) added to this, saying that sometimes not knowing enough about this process natural mechanism of CO_2 reduction leads to projects entering the market monitoring and verification, leading to no exact measurements of exactly how much CO_2 is taken out of the atmosphere (McNish, 2012). Kelly and Schmitz (2016) attributed this to one more issue, stating that Carbon Storage and Sequestration in Californian forests was such an abstract idea to commodify, that finding buyers for this type of carbon offsetting was a challenge.

A calculation of how much landscape restoration would cost to preserve natural carbon sinks could according to Robotyagov (2010) be a good first step to eventually include this in policy that would enable large-scale restoration of these natural carbon sinks. Maybe there is a need for prioritization of these carbon sink projects in the market or carbon offsets as suggested by Trumpeter (2008). In this idea, prioritization can be given to projects with the biggest impact, measured by the number of benefits they contribute to. In that case, carbon sinks in form of wild grasslands would be high in ranking since its wide range of ecological co-benefits such as wildfire prevention, protection of aquifers, and enhanced habitat for biodiversity to name a few. Kikuchi (2011) also states socio-economic co-benefits -such as the generation of a new income source for rural economies-. Lastly, Osborne and Shapiro-Garza (2018) investigated the commodification is Mexico's forests by offering carbon offsets. They found that it is essential to carefully embed social relations to the land (especially in the case of indigenous communities) when nature is commodified in order to avoid exploitation. Bambus (2011) agrees, explaining that socio-natural relations are structurally part of the commodification of any carbon offset project, whether these are terrestrial- or renewable energy-related projects. Robotyagov (2010) continues this thought process, highlighting that speculation with carbon offsets also occurs. Namely, businesses can buy carbon offsets from farmers by offering these farmers to retire the land and not produce crops anymore. Then, the business can claim a carbon offset which can

be traded on the carbon market. If revenues exceed costs, businesses could hypothetically speaking speculate with carbon offsets by outbuying farmers and selling the carbon offset that arises from this investment with a profit on the carbon market (Duffy 2010). This phenomenon has also been recognised by Fairhead et al. (2012) named 'green grabbing'. However, they explained, that this can only happen when the price of CO_2 would be high enough to make speculation financially interesting. Markowski-Lindsay et al. (2011) conclude that project developers must work together closely with land-owners and capture arrangements into transparent contracts.

2.4 Scepticism about terrestrial carbon offsets

In the range of terrestrial carbon offset projects, forestry projects are most popular. Part of forestry carbon offsetting is planting new trees, increasing the density of vegetation, using forests products as a substitute for fossil fuels (biomass), or avoiding deforestation (Searchinger, 2010). The largest program that entails all the above activities is also referred to as REDD (Reducing Emissions from Deforestation and Degradation) (Wang et al., 2018). Forestry projects bring many co-benefits to water, soil, and biodiversity (Swallow and Goddard, 2013). However, there are risks involved with carbon offset projects in forestry. First, Swallow and Goddard (2013) argue, that forests are prone to fire and insect outbreak (one could think of grasshoppers for example), in which case CO_2 is re-released into the atmosphere, making the offset unreliable. Moreover, additionality is an issue, since it cannot be determined whether afforestation and improvement from degradation would also have happened without conservation projects (Pohjola et al., 2018). The difference of human interference and the resulting increase in Carbon Storage and Sequestration requires careful monitoring, and transparent accounting of what exactly can be stored and sequestered and for how long this process continues (Adams et al., 1990 and Jindal et al., 2008). Third, and linked to the need for monitoring, leakage is also problematic for terrestrial projects, as discussed by Nur (2007) and Haim et al. (2015), since vegetation might be cut and burned after the offset has been retired, in which case there is no net decrease of CO_2.

Carbon offsetting as a whole has been critically acclaimed too. Goers et al. (2010) argue that the option given to businesses to neutralise carbon emissions by buying carbon offset credits is often used as an excuse to not change to low-carbon technologies. Furthermore, they argue, it is hard to prove whether all carbon offsets neutralise emissions to the amount they promise to (Barkin, 2017). An argument of critical importance was made by Robotyagov (2010), who argues that carbon offsets do not structurally contribute as a solution to CO_2 emissions have already happened. In the best case, carbon offsets are only used for unavoidable emissions after all other options for emission-saving and low-carbon technologies have been explored. In the worst case, it has been argued that carbon offsets can even work counterproductively purchasing a carbon offset is more cost-effective than emitting less CO_2 (Leonardi, 2017). Klein (2014) agrees and argues that carbon offsets slow down the transition to a low-carbon society.

Klein (2015) criticises that a limitless amount of carbon offset can be bought from abroad. Carbon offset projects often happen in the global South, where monitoring systems are not present, pointing to issues of transparency (Schmidt, 2009). Klein (2010) refers to carbon offset projects as corporate colonialism, as the burden of CO_2 emissions is pushed on to third parties across the world. It happens in carbon offset projects that human rights are violated (Duffy, 2010), corruption occurs (McNish, 2012), and carbon offset projects do not actually happen at all (Rogers 2010). Ethical issues arise when operations can be legitimized or *greened* by paying money for it, Monbiot (2013) argues. Ideally, all carbon offset projects should be checked, monitored, and verified by an independent third-party, and should only be used to offset unavoidable emissions after everything has been done to avoid emissions from occurring in the first place (Boyd and Salzman, 2011).

2.5 Causal relation between concepts

A causal visualisation of the literature review is shown in Figure 2-3. Natural carbon sinks store and sequester atmospheric CO_2. Conservation projects, and changes from artificial- to natural grasslands can contribute to enhanced rates of Carbon Storage and Sequestration. Project developers undertaking these projects could attract carbon finance through the selling of carbon offsets to carbon markets.

As can be noticed, the combined theoretical and practical knowledge gap that requires research is the development of a carbon offset that can financially facilitate nature conservation projects aimed at restoring and protecting natural carbon sinks, specifically wild grasslands. Namely, knowledge is growing on Carbon Storage and Sequestration in peatlands and forests, but still missing on the financial mechanism that can foster projects that conserve and enhance CO_2 uptake into large, more complex natural areas, including wild grasslands, and shrub vegetations. The gap in knowledge can be seen in figure three is captured in the arrow that says: '*Explore if nature conservation (of natural carbon sinks) can be financially facilitated by carbon finance'*. With this idea, climate adaptation can contribute to nature creation (and the other way around) and raise awareness on the possibility to find a suitable business model for the nature-based solutions that contribute to solving societal challenges.

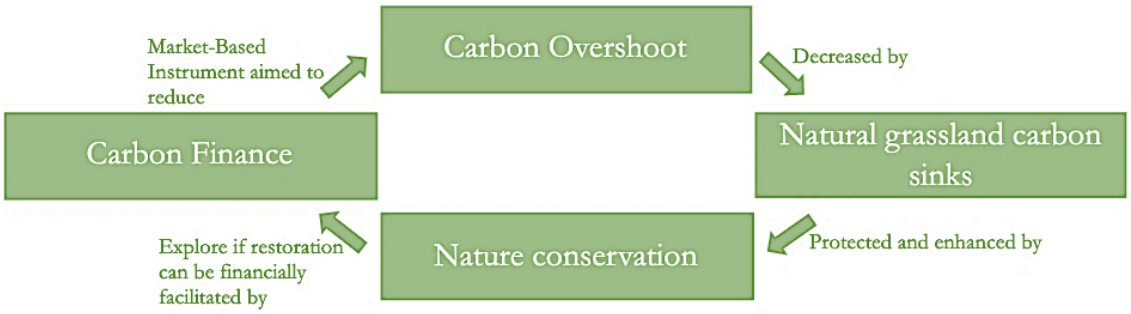


Figure 2-3 'Causal visualization of the literature review'

3 Analytical Framework

The analytical framework shown in Figure 3-4 provides a range of environmental, market-context and business-model factors that together were of influence on terrestrial carbon offsets on carbon markets. The factors below were derived from the literature review of this research. This framework can be used as an analytical roadmap for the development of the carbon offset business model of Rewilding Europe. In addition to the framework below a short explanation and academic justification per factor are provided in three tables in Appendix 1. This can be consulted in case the reader wants to know what led to the selection of each factor, and what author referred to them.

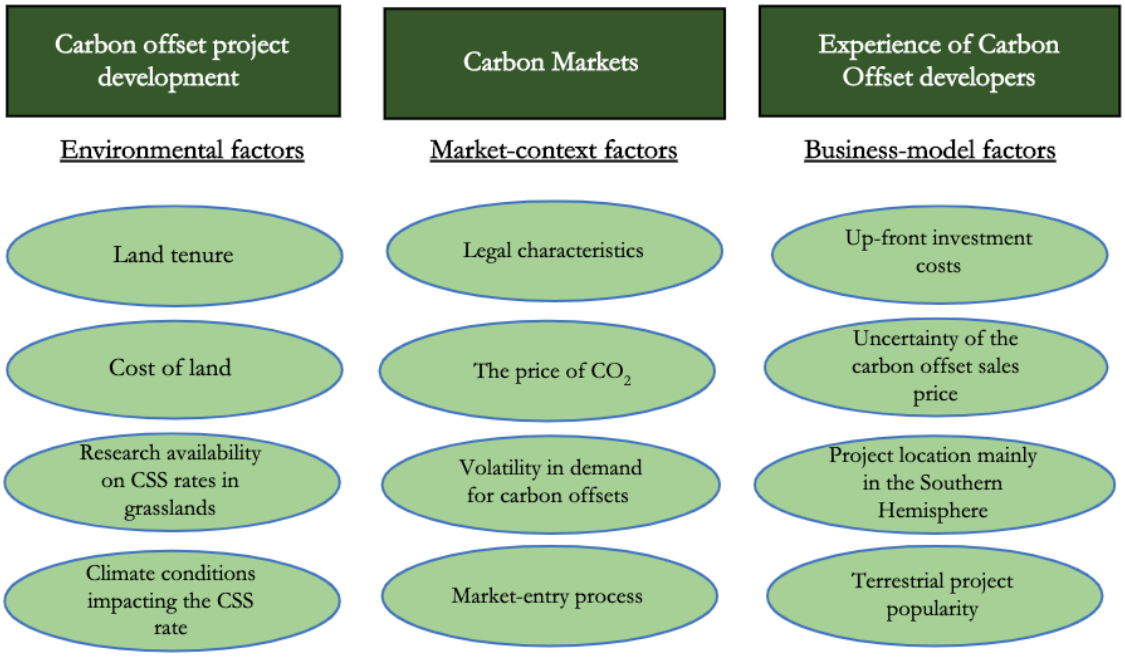


Figure 3-4 'Analytical Framework with factors influencing carbon offset projects on Voluntary Markets'

How the analytical framework relates to each sub-question of this research is shown in Figure 3-5. The carbon offset development and environmental factors relate to sub-question one. The carbon market analysis and market-context factors link to sub-question two. Furthermore, the project development of a carbon offset and experiences from other carbon offsets will be explored in sub-question three. Lastly, findings of all three previous sub-questions will be combined into crafting the carbon offset business-case for Rewilding Europe in sub-question four.

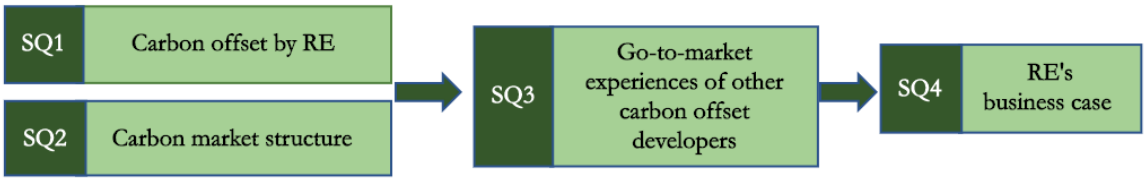


Figure 3-5 Research process from the sub-questions to the research aim

4 Research Design

4.1 Methodology and Research Methods

This research took a deductive approach by crafting the first European wild grassland carbon offset project for Rewilding Europe. Triangulation brings credibility to this research as multiple data collection methods are used (Walliman, 2015). The explorative nature of this research requires a creative combination of data sources to create the context in which the carbon offset case of Rewilding Europe can be developed. Different sources including government bodies, international organizations, NGOs, and scientific databases have been consulted to gather data that together could paint a broad but complete picture of the current situation. Research methods included desktop research including the review of empirical studies, design documents, investigative reports, and journal articles. For the questions that concerned Rewilding Europe, in-depth interviews were held. A detailed explanation of the data collection procedure per sub-question can be found below.

4.2 Data Collection and Procedure

Table 4-1 'Data collection method sub-question one'

Sub-question one	Type	Data collection method
Where could Rewilding Europe start its European wild grassland carbon offset project?	Explorative	Open interviews with Rewilding Europe, and secondary data review from Rewilding Europe's internal sources.

Table 4-1 shows explorative sub-question one, which is geared for a more practical view on where Rewilding Europe can start its project. Next to taking an interview-approach, factors that were of influence on other terrestrial carbon offset project developers were also be discussed. Rewilding Europe has agreed to giving access to data such as documents that will allow secondary data analysis. This data included hectares of the respective project area and its approximate land price. A guide with interview questions and discussion topics can be found in Appendix 2. The two selected employees possess the required knowledge and expertise on this topic. Mr. Wouter Helmer, the co-founder of Rewilding Europe, is an expert in the ecological and governance related field. Second, Timon Rutten, Head of Enterprise at Rewilding Europe, has knowledge of project development and the business and finance-side of interest to this research. In this research, involving more people of this organisation would not have enhanced the quality of the data collected. Therefore, it was chosen to apply triangulation by finding desktop data to verify the data that arose out of interviews and discussions where relevant and possible.

Table 4-2 'Data collection method sub-question two'

Sub-question two	Type	Data collection method
How do carbon market structures affect the possibility of a carbon offset to be embedded?	Descriptive	Literature and document review.

Table 4-2 shows the descriptive question containing a policy-level analysis including establishment of the price of CO_2. This question described the legal structure of both market-types, with the main purpose of evaluating if it is legally possible to offer carbon offsets in the form of natural wild grasslands. The national law of host governments in which the project will

take place was also evaluated. Data sources are desktop research, document analysis, and journal articles from Lund University Library Database. Documents and literature were sourced by using the following keywords on databases and the web: European carbon offsets, farmers and carbon offsets, carbon farming, (wild) grasslands as carbon sinks, carbon sinks finance, carbon finance and (wild) grasslands, carbon markets and global carbon markets.

Table 4-3 'Data collection method sub-question three'

Sub-question three	Type	Data collection method
What influenced other carbon offset projects on their path to the carbon market?	Descriptive	Books, report review, literature review.

As shown in Table 4-3, sub-question three will describe the experiences of other global terrestrial carbon offset projects. It will include the steps that need to be undertaken to create a carbon offset for the carbon market on which it is legally possible to embed a project such as the one of Rewilding Europe, which was one of the outcomes of sub-question two. This will be useful when establishing Rewilding Europe's business model in sub-question four. Methods for data collection are desktop analysis, including literature review, report analysis, and the analysis of graphs and tables.

Table 4-4 'Data collection method of sub-question four'

Sub-question four	Type	Data collection method
How could the business model for Rewilding Europe's carbon offset take shape?	Explorative	Interviews with two of Rewilding Europe's employees.

Sub-question four will use all previous findings and focused on the implementation-side of Rewilding Europe's carbon offset project by crafting its carbon offset business model. Research findings on the legal structure of the carbon markets will determine the market where Rewilding Europe's carbon offset project can be offered to. Data collection methods as shown in Table 4-4 include findings from previous sub-questions woven into interview questions and topics for discussion. First, the go-to-market process of Rewilding Europe's carbon offset project was described, incorporating lessons learned from other terrestrial carbon offset projects in sub-question three. This is followed by an income statement, where the quantitative variables included literature findings on Carbon Storage and Sequestration rates in wild grasslands, the land area of the region and the ha of grassland herein (derived from sub-question one), and projections on the price of carbon offsets derived from sub-question two and three. The quantitative parts of this research including financial calculations will happen in Excel.

4.3 Data Analysis methods and tools

4.3.1 Comparative analysis of literature and the analytical framework

After the literature review, an analytical framework was created, resulting in a figure with factors influencing other terrestrial carbon offset projects on carbon markets. Factors included environmental, market-context, and business-model factors. These factors were taken into consideration when crafting Rewilding Europe's own carbon offset project.

4.3.2 Analysis of newly generated knowledge

New knowledge was expected to be generated when the literature review and findings were analysed using the analytical framework. Data were analysed by finding similarities, contrast, arguments of findings, followed by the analysis and discussion of this review. In the analysis, qualitative and quantitative results arose when combining project design with the financial calculations for Rewilding Europe's carbon offset project, including the time that was needed to arrive at the break-even point on up-front investment. In the final combined analysis that led to answering the main question, literature review, the analytical frame, and research findings were combined into one assessment.

4.4 Limitations and Scope

To date, natural-grassland carbon offset projects in Europe do not exist. Focusing on European nature-conservation better suited the research gap. Namely, current terrestrial carbon offset projects mainly involve forestry projects and agricultural offset projects in croplands (Yowell and Ferrell, 2005 and the Carbon Farming Institute 2018). Research on carbon finance specifically aimed at European wild grasslands had not yet been performed. So, this research only investigated European carbon offset projects aimed at the restoration of European wild grasslands serving as carbon sinks, of which Rewilding Europe would be the project developer. Noteworthy to say, the fact that this research focusses on Europe does not mean that lessons cannot be applied to project developers outside of the EU. The way European carbon offset projects are financed by carbon markets can lead to lessons for new carbon offset projects in the nature-related field anywhere in the world.

Another important scoping decision regards the analysis of carbon markets, which was chosen to be limited to only the legal jurisdictional application of current carbon markets, instead of a full-fledged analysis of the underlying legal framework. This was decided because the researcher wanted to get insight into if and how Rewilding Europe's carbon offset can currently be embedded under the markets that are currently in place. The possible implications this scoping decision was that upcoming markets, carbon taxes, and agreements were merely lightly touched upon, but not gone into in depth. Yet, of course, insight into the current situation of carbon markets will aid in making projections for future systems and regulations.

The way this study was designed enhances its replicability. Research results on the land price and Carbon Storage and Sequestration rates of any respected case-study area, the state of carbon markets, insights on project-design phases for carbon offsets, and the experiences of other carbon offset projects can be used to replicate this study using new data in the future. The way in which variables change over time can provide new answers to the same type of research on the potential of carbon finance for natural carbon sinks.

4.5 Ethical considerations

Throughout this research, a high ethical standard was maintained. This research was conducted independently and impartially. This was achieved by keeping a critical perspective on data collected (Bellamy, 2012). Quality and integrity of this research were valued highly, and the researcher will hold a critical stance to any data that appear in this research. Furthermore, since interviews were involved, interviewees will be handled with respect and can stay anonymous if they wish. The interviews were recorded and transcribed, available for evaluation on truthfulness should this be required.

5 Results

5.1 Where could Rewilding Europe start its wild grassland project?

Different options were considered to serve as a case study, and Rewilding Europe decided on the Coa Valley in Portugal. The Coa Valley consists of privately-owned land, mostly abandoned farmland. Rewilding Europe is currently active in this region and has a partnership with a local NGO called ATN (*Associação Transumância e Natureza*). A map of the region can be found below in Figure 5-6, and the amount of grassland of the Coa Valley and the Carbon Storage and Sequestration potential is listed in Table 5-5. Another reason to decide for the Coa Valley is that carbon finance can be linked to other nature-based business models for this valley. In natural grasslands, carbon finance can be part of a much more integrated variety of nature-based business models (Abberton, 2010). The Coa Valley can contain mosaic landscapes, has old heritage elements that are well maintained in these landscapes, and herds of grazers can walk around, all suitable for eco-tourism and recreation. These herds also deliver meat, and other regional products can be harvested in these landscapes too, such as honey, mushrooms, berries and biomass (wood) in some parts.

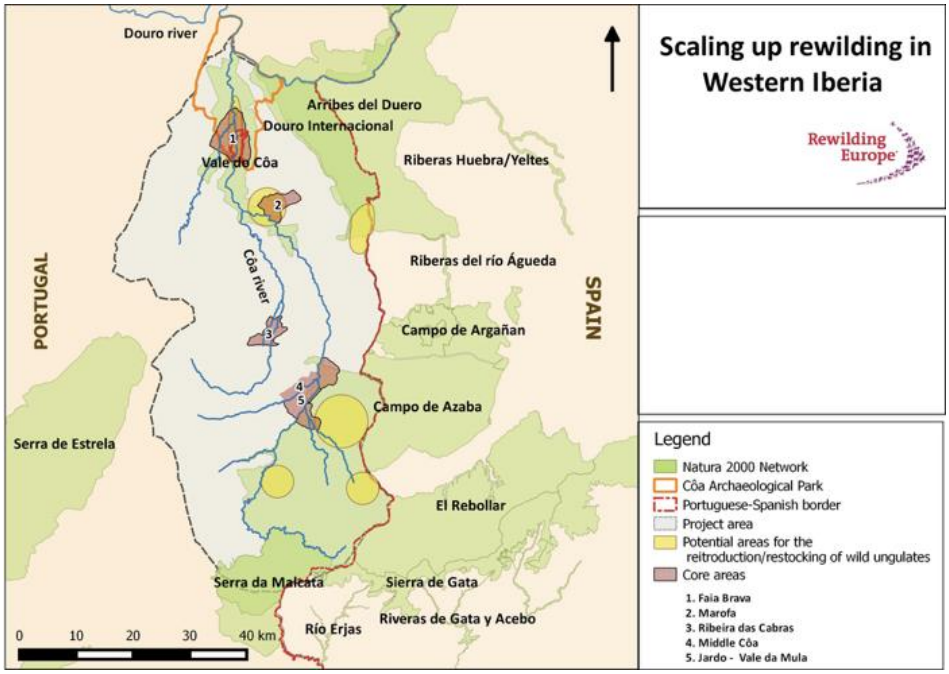


Figure 5-6 'Map of grasslands in the Coa Valley in Portugal'.

Source: Reprinted with permission from ATN 2018 Mail Correspondence with Pedro Patra, April 17th, 2019.

Table 5-5 Grassland surface of the Coa Valley and Carbon Storage and Sequestration rate.

Variable	Number
The land area of the Coa Valley	120,000 ha of which 30% could be developed as wild grasslands= 36,000 ha
Carbon Storage and Sequestration rate	2.61 tCO_2 /ha/yr. (Janowiak et al., 2017, Burke et al., 2008, Lesschen et al., 2012)

Source: Adapted from ATN 2018 Mail Correspondence with Pedro Patra, April 17th, 2019.

5.1.1 Land tenure

> *"How scaling happens is dependent on the region because of the different norms and values, culture, land tenure models, power and pride, and decision hierarchies."* (Helmer W. Interview. April 12th, 2019)

According to Rewilding Europe, every project-region requires a different model. An independent evaluation of the community, population, cultural heritage, and government is required. Rewilding Europe can approach landowners and either buy the land or start a contract-based collaboration. In the case of the Coa Valley, land can be bought, since this land is mostly abandoned and has always been in private ownership. ATN buys land parcel per parcel on a voluntary basis to make it part of one coherent nature reserve. Fujiware et al. (2012) mentioned land abandonment in Mediterranean countries as an opportunity for Carbon Storage and Sequestration projects since these regions are often in dire need for different uses for the land after farmers have moved away, and because this land can be acquired relatively cheaply. Avoiding land-tenure issues is crucial and at the core of every rewilding project. The benefit for the Coa Valley is that Rewilding Europe works with well-anchored parties such as ATN and local nature-based businesses that Rewilding Europe themselves helped to start. Yet, there is no blueprint of how any project will go. In the Romanian Carpathians, for example, culture and local politics are totally different from the Coa Valley and Portugal, and every rewilding project has its own way of achieving Rewilding Europe's objectives. Therefore, the dialogue with the community of landowners needs to be maintained well, and agreements must be captured in contracts, as stated by Duffy (2010). What makes the cooperation interesting for landowners is listed in Table 5-6. For example, cooperation is linked to a good motivation of nature development- that increases the potential for tourists, an increase of values of the herds that walk in these areas -looking at selling biological meat and other regional products-, and potential income from carbon sinks.

Table 5-6 'Land restoration benefits for landowners'

Private owners	Municipalities	National governments
Private owners could contractually give the right to Rewilding Europe to change land management practices. A contract can be made stating: "*In the next 25 years, carbon finance for grasslands will be one of the income sources for this land*". Working with Rewilding Europe will lead to restored landscapes, and potential associated nature-based income.	Sometimes, the land is in ownership of regional governments or communities. Rewilding Europe could go into partnership with the communities with independently governed land and create a land management strategy that reduces environmental threats (such as one of wild-fires) and provide a source of nature-based income.	In the case of state-ownership, mostly occurring in Eastern European countries, Rewilding Europe could acquire lease rights (also called grazing rights). Through the change in land management, carbon finance and other nature-based businesses can lead to multiple co-benefits providing the host-government with more public goods.

Source: 'Helmer W. Interview. April 12th, 2019'

5.1.2 Land cost in relation to the business model

"Compared to what Rewilding Europe can mobilise right now, I expect that with carbon finance, we can financially mobilise multiple projects in Europe and potentially double our project scope. Even with a price between the €18-22 per ton of CO_2. Yet, this is expected to increase as seen the price of CO_2 has been going up steadily over the past decade." (Helmer W. Interview. April 12th, 2019).

Decisions on land-tenure have a big impact on the business model of carbon offset (Kikuchi, 2016). For example, acquiring land involves a higher initial investment than when land is leased, Wouter Helmer explains (Helmer W. Interview. April 12th, 2019). This scalability is important, since Rewilding Europe does not only want to experiment with just one region but instead sees big geographic potential in Europe. Carbon finance could play a big role in this. Rewilding Europe made a rough estimation of geographical scalability for projects, listed in Table 5-7.

Table 5-7 'Geographical scalability of Rewilding Europe's projects in Europe'

Type of land	Location	Hectares
Drained Peatland	Finland	5 million
Forest	Portugal	400.000
Grasslands	Abandoned landscapes all over Europe	Millions

Source: 'Helmer W. Interview. April 12th, 2019'

5.1.3 Carbon Storage and Sequestration rate and environmental conditions

"It is important to show the amount of CO_2 that can be stored and sequestered in wild grasslands. There needs to be increased consensus on this matter to convince buyers and eventually policymakers that these projects are worthwhile undertaking." (Helmer W. Interview. April 12th, 2019)

As for the changing environmental conditions that pose a risk to the Carbon Storage and Sequestration rate of grasslands, there are multiple techniques that diminish these risks. Sustainable land practices to depleted grasses can enable them to cope better with dry conditions (Jones and Donnely, 2004). One strategy with a large impact that Rewilding Europe uses is the reintroduction of large grazers such as wild horses and bison. Also, certain species such as small bushes can provide the shade that prevents the land from drying. Yet, it is true that for some years, net primary production, and thus the Carbon Storage and Sequestration rate, will be lower, Wouter Helmer stated. Rewilding Europe intends to contribute to data collection on Carbon Storage and Sequestration in wild grasslands through its own carbon offset project.

5.2 How do carbon market structures affect the possibility of a carbon offset to be embedded?

As already introduced in section 1.2 on environmental policy and carbon emissions trading, the Kyoto Protocol contains three flexible mechanisms that national governments that ratified the protocol can use to meet their targets (Ahonen et al., 2017). First, Joint Implementation, entails that governments can invest in emissions reductions overseas in other countries, to make up for their own emissions. Secondly, the Clean Development Mechanism allows

industrialised countries to help developing countries with emission abatement with projects, even if these countries have not yet ratified the Kyoto Protocol. Both Joint Implementations and the Clean Development Mechanism were designed to achieve emission reductions most economically efficient (Knox-Hayes, 2016). The third flexible mechanism, central to this research, is the market- based instrument of carbon emissions trading (Ahonen et al., 2017) This trading is done on both Compliance Markets, and Voluntary Markets. These mechanisms, explained next, are essential to understand since they affect the legal possibility to offer carbon offsets to either the Compliance- or Voluntary Markets (Dumanski, 2004).

5.2.1 Carbon Offsets on the Compliance- and the Voluntary Markets

First, the largest Compliance Market globally is the EU ETS (Ibikunle et al., 2016), which will be taken as a representative market since this research only focuses on Europe. On the EU ETS, a cap is set on the overall level that can be emitted, and allowances are given to businesses to emit a certain amount. This policy works by allocating the cost of emitting CO_2 by offering emission allowances (Dey, 2013). According to the CO_2 intensiveness of production, businesses can buy and sell emission allowances. This way, the business that can reduce emissions or invest in low-carbon technologies at the lowest cost will do so, whilst businesses for which this is not economical will acquire allowances (Ahonen et al., 2017). Over time, the cap on allowable emissions is tightened, reducing the amount of CO_2 over time (Frankhauser and Hepburn, 2009). Therefore, the allowances could be seen as the currency of the EU ETS.

Next to reducing emissions, businesses can acquire carbon offsets from third parties (Hungate et al., 2017). For example, businesses in the EU ETS are allowed to use carbon offsets for 0-10% of their emissions (Yowell and Ferrell, 2005). For Compliance Markets, linked to the Kyoto Protocol, only the carbon offsets that come from the above introduced Joint Implementation, and Clean Development Mechanism can be legally accepted (Dumanski, 2004). Within Clean Development Mechanism, REDD (Reducing Emissions from Deforestation and Forest Degradation) is an example of forestry projects in developing countries which is accepted as a carbon offset on most Compliance Markets (European Commission Report, COM (842) final). These Kyoto protocol-linked carbon offsets are referred to as **CERs** (Certified Emission Reductions). On the EU ETS in 2013-2020, only CERs (Certified Emission Reductions), **EUAs** (EU Allowances), and **ERUs** (Emission Reduction Units) are accepted. Carbon offsets that are not part of Joint Implementation, Clean Development Mechanism (and associated programs such as REDD) cannot be legally accepted as carbon offsets on Compliance Markets. (Dumanski, 2004). Interestingly, what is not expected within this range, is CERs and ERUs from forestry; and for phase three, CERs that registered after 2012 must come from the Least Developed Countries (European Commission Report, COM (842) final).

Secondly, Voluntary Markets were created to allow parties to voluntarily offset their CO_2 emissions (Harris, 2007). In this market, if businesses, governments, or individuals want to offset their CO_2 emissions, they can buy offsets on Voluntary Markets. Voluntary Markets are not linked to the Compliance Markets such as the EU ETS in Europe and therefore has its own non-binding rules (Hamrick and Gallant, 2018). **VERs** (Verified or Voluntary Emission Reductions) are therefore sold on Voluntary Markets, and not to Compliance Markets, visualised in Figure 5-7. As can be seen in this figure too, businesses participating in the

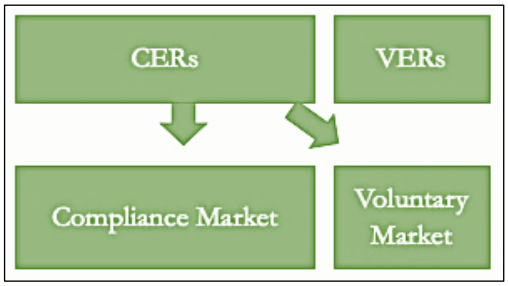


Figure 5-7 'Carbon Offsets per market' Source: Adapted from 'Stockholm Environment Institute 2011, https://www.co2offsetresearch.org/policy/MandatoryVsVoluntary.html

Voluntary Market can also buy CERs if they wish. Certification for voluntary carbon offset projects enhances the ability to sell the carbon offset to buyers (Harris, 2007).

Parties that buy carbon offsets from Voluntary Markets do this for three reasons (South Pole, 2019).

1. To offset their own emissions and claim partially- or full carbon neutral operations
2. To increase their competitive advantage by enhancing their public image and brand management (as part of their Corporate Social Responsibility strategy)
3. To be able to invest in carbon offsets and resell them later for a higher price

There are standard- and verification bodies attempting to guide and guard project developers. The most widely accepted standard is 'the Gold Standard' (South Pole, 2019), further explained in section 5.4.6.1. Following the process to certify, verify, and monitor the carbon offset projects enhances the market position and trustworthiness to the buyer (Harris, 2007).
The only legal requirements that projects developers must comply with is host-government legislation. Governments must individually approve project design documents. They can allow terrestrial projects in grasslands just like the ones in forestry if these projects are in accordance with national legislation, mainly involving land tenure matters (De Clara, 2014). So, if a natural carbon sink is wished to be offered as an offset, the project needs to be in line with national legislation, to be dealt with per individual case (Harris, 2007).

5.2.2 Market size and demand-creation for both markets

The EU ETS is the largest carbon trading market operating in 31 countries including all 28 EU member states plus Iceland, Liechtenstein, and Norway and states to cover the emissions of 11,000 operating business emitting greenhouses gasses, covering 40% of the EU's emissions (European Commission, 2016). The current price of CO_2 (in May 2018) on the EU ETS is €25.40/ton of CO_2. A graph visualizing this price from 2009 to 2018 can be found in Appendix two (Markets Insider, 2019). According to (Eijckhout, 2019), this price needs to rise to at least €50 to steer the behavior of companies into developing low-carbon technologies or acquiring more carbon offsets. To give a comparison with the EU ETS, in 2014, 8.33 billion tons of CO_2 were traded (European Commission, 2016). To put this into perspective, the market value of Voluntary Markets can be found in Table 5-8, and was based on all certified and issued VERs, (not counting in the unregistered and uncertified carbon offsets) (Hamrick and Gallant, 2018).

Table 5-8 'Market types and price versus one MtC02e volume for Voluntary Markets'

Market-type	Explanation	Value	$MtCO_2e$
Primary Market	Direct sales from project developer to end-buyer	€76 Million	18.5
Secondary Market	Sales intermediaries to end-buyers	€107 Million	44.8
Total	The primary market and secondary market combined	€183 Million	63.3

Source: Adapted from "Voluntary Carbon Market Insights: 2018 outlook and first quarter trends", by Hamrick and Gallant 2018. https://www.forest-trends.org/publications/voluntary-carbon-markets/.

Unlike Compliance Markets such as the EU ETS, where businesses must decrease their emissions by the law based on the allowable emissions cap; Voluntary Market participants are not obliged to buy credits according to the law but participate in this market out of the free will (Hamrick and Gallant, 2018). This is changing the nature of demand for these markets. On Compliance

Markets, the price of CO_2 it is steered by scarcity on the market for allowances, leading to a CO_2 price equivalent to 1t CO_2 for one allowance or one carbon offset unit (European Commission, 2016). Therefore, the demand for carbon offsets on Compliance Markets is reasonably predictable (Fedosov, 2016). For Voluntary Markets, supply and demand forces are also active, but the buyer has full power to accept or decline the price since there is no legal necessity to acquire the carbon offsets at any price (Carbon Market Watch, 2017).

The price of CO_2 on Compliance Markets is affecting Voluntary Markets too since this price is sometimes used as an indicative price for carbon offsets on Voluntary Markets (Korthuis et al., 2019). Speaking in economic terms, this is because the price elasticity of demand is higher for Voluntary Markets than for Compliance Markets, because when the price of CO_2 increases, parties on the Compliance Markets have no flexibility to not comply with the pollution cap or invest in low-carbon technologies (Dey, 2013).
Summing up, the market-size of Voluntary Markets is relatively smaller than Compliance Markets because demand results from their voluntary willingness to offset CO_2 emissions. On Compliance Markets, demand is driven by regulation, which makes this market substantially larger and demand for allowances or offset credits less elastic than the Voluntary Markets.

5.3 What influenced other carbon offset projects on their path to the carbon market?

Based on the previous sub-question, it was found only Voluntary Markets accept carbon offset projects that are undertaken outside of the Kyoto Protocol. Therefore, this research will now continue with the steps to create a carbon offset that can be sold on Voluntary Markets.

5.3.1 Project development phases

Table 5-9 shows the steps required to create a Verified Emission Reduction. This table was adapted and modified from De Clara (2014).

Table 5-9 'Project development phases to becoming a Verified Emission Reduction'.

No.	Phase	Explanation
1	**Project idea note**	Feasibility and risk assessment of the project
2	**Project design document**	Explains how CO_2 emissions will be avoided or reduced through the project. This document must be checked and approved by the host government.
3	**Validation**	The project design document will be verified by a third party. This can be done by a certification body.
4	**Monitoring and Verification**	After the project has been established, verification happens to see if and how much actual CO_2 reduction was achieved. Verification and monitoring are an ongoing process.
5	**Issuance**	Each offset receives a serial number, which can be traded multiple times until the owner of the serial number chooses to 'retire' the offset after which the impact of the offset can be claimed by the owner (Dey, 2013). It could, therefore, be seen as a crypto-market for registration of sales and acquisitions of carbon offsets. Registries process transaction information, sales information, and insights about the project type, location, and quality. Also, the broker can connect the seller to the buyer of offsets, playing an intermediary role without owning the credit.

Source: Adapted from 'Use of offset credits across emission trading systems and carbon pricing mechanisms. International Emissions Trading Association', De Clara 2014.

https://ieta.org/resources/Resources/3_Minute_Briefings/use%20of%20credit%20offset%20across%20ets_%20briefing_final%20version.pdf

On Voluntary Markets, a standard sets criterion for carbon offsets exist, which can be found in Table 5-10, and which was adapted from the Gold Standard (2019); the most widely accepted standard and was introduced by the World-Wide Fund for Nature. The criteria enhance the reliability or image of the carbon offset and evaluate cases individually with the same methodology (The Gold Standard, 2019).

Table 5-10 'Voluntary Carbon Standard Criteria to be counted as a Verified Emission Reduction'

Criteria	Explanation
Additional	Only the projects that would normally not have happened because of the carbon offset can be counted.
Measurable	The actual CO_2 mitigation that occurs due to the project has to be measured.
Permanent	The abatement of CO_2 that occurs because of the offset cannot be of temporary effect. It must be stored indefinitely.
Independently Verified	The project design document and monitoring plan need to be independently verified by a third party. The verifier specifically investigates the actual CO_2 abatement.
Real	The VER should be registered in a system and has an ID number to avoid double counting.
Not double-counted	The offset equivalent to 1t/CO_2 cannot be sold and used twice to offset the same CO_2 emissions.

Source: Adapted from 'Principles and requirements. The Gold Standard 2018. https://www.goldstandard.org/project-developers/standard-documents

5.3.2 Factors that influence market entry to Voluntary Markets

Based on the literature, it was found that four factors are of major influence on the ability of other carbon offset projects developers to reach Voluntary Markets: up-front investment costs, carbon offset pricing, project location, and the project type.

5.3.2.1 Factor one: up-front investment costs

Up-front investment costs are typically not able to be directly paid back before carbon offset sales start, because the land has to be acquired, land management uses have to be changed, and increased Carbon Storage and Sequestration rates require monitoring to be sold as carbon offsets (De Pinto et al., 2010). Thus, part of the costs involves certification- and verification costs, and the cost of land acquisition or lease (Cacho and Lipper, 2013). Third party verification is needed to approve carbon offsets; this verification process is expensive and involves ongoing monitoring costs (Carbon Market Insights, 2018). Also, prior to the project starts, project developers face difficulties finding a financial institution (or other investor) that is willing to provide a loan, since projects involve risk and do not pay off in the short term (Markowski-Lindsay et al., 2011). Finding a buyer is another risk since there is no central marketplace for Voluntary Markets (Greiner et al., 2019), which means that own marketing and advertising activities must be arranged, or else intermediaries such as brokers can be hired who take responsibility for finding a buyer. Yet, these intermediaries also charge a fee (Cacho and Lipper, 2013).

5.3.2.2 Factor two: carbon offset pricing

First it must be said, that Voluntary Markets, buyers acquire carbon offsets on a voluntary basis, giving them large power as a buyer. If buyers deem carbon offsets to be too costly, they

will bargain a lower price (Ervine, 2018). The average price of all transactions in 2016 was $3.0 (€2,69) per ton of CO_2e. Latin America and Africa mainly involve afforestation and land-use offsets, adding up to an equivalent revenue of $22 (€19.75) and $24 Million (€21.54) (Ecosystem Marketplace, 2018). Figure 5-9 shows the rates of carbon offsets that were bought and retired from 2008 to 2017 (The Gold Standard, 2016). Retiring offsets refer to the act of deciding to exchange the carbon offset for the amount of CO_2 that the business emits. Overall, a rise can be noticed with a sharp spike of projects issued starting in 2016, showing increasing popularity recently. Figure 5-10 shows the number of carbon offsets sold in 2015 and their price per tCO_2e (The Gold Standard, 2016). Dollar amounts were converted to Euro amounts using conversion rates on 23/05/2018 in this text to allow consistent Euro-calculations. Naturally, more projects are sold at a lower price (World Bank, 2017). The price of CO_2 allowances on the EU ETS in May 2019 was €25.40, as can be found in Figure 11 and 12 in Appendix 3 (Markets Insider 2019). The price of the EU ETS could be used as an imaginary (voluntary) price floor, but this is not the status quo (Korthuis et al., 2019).

Figure 5-9 'Average price of carbon offsets in 2015'

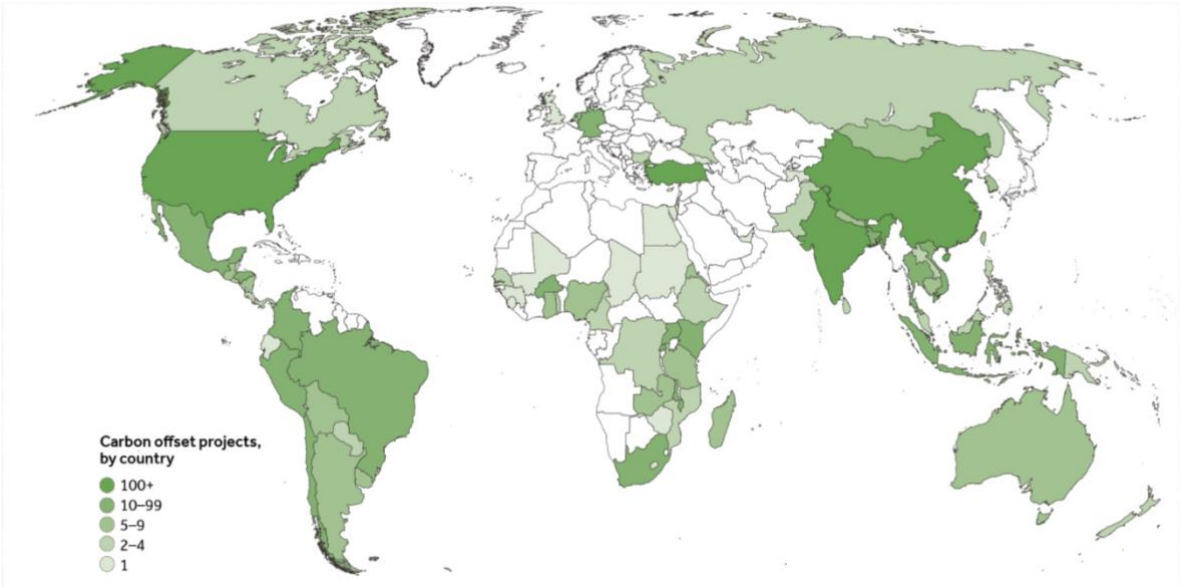
Source: Reprinted from 'Why do prices vary per project type in 2015?'. The Gold Standard 2016. Retrieved from: https://www.goldstandard.org/blog-item/carbon-pricing-why-do-prices-vary-project-type

5.3.2.3 Factor three: project location

Carbon offset project locations by country can be found in Figure 5-10 from 2008-2018. To name one percentage that is in line with what this map visualises, 46% of all carbon offsets come from Asia with an average price of $1.6 (€1.44)/t CO_2e (Hamrick and Gallant, 2018).

Figure 5-10 'Locations of carbon offset projects for Voluntary Markets'

Source: Reprinted from: "Voluntary Carbon Market Insights: 2018 outlook and first quarter trends", by Hamrick and Gallant 2018. https://www.forest-trends.org/publications/voluntary-carbon-markets/.



5.3.2.4 Factor four: project type

Table 5-10 shows the project categories, the amount of VERs issued (meaning the carbon offset is sold to businesses), the volume of CO_2e, and new projects per category (Hamrick and Gallant, 2018). The category with most issued offsets is Energy Efficiency and Fuel Switching with 633 projects and 127.9 t CO_2e, and eight new projects, followed by 611 renewable energy offsets equivalent to 61.9 t CO_2e and two new projects. Forestry and land use (including soil and grassland projects) comes on the fourth place with 170 issued offsets, 95,3 t CO_2e, and three new projects.

Table 5-11 Carbon offset project types for Voluntary Markets 2005-2018

Project categories	Issued offsets	Volume offsets in $MtCO_2e$	New projects
Agriculture	87	6.7	1
Chemical processes	72	63.5	0
Energy Efficiency and Fuel switching	633	127.9	8

Forestry and Land use (including soil and grasslands)	170	95.3	3
Household devices	161	23.4	0
Renewable energy	611	61.9	2
Transportation	43	1.1	0
Waste disposal	238	57.5	0

Source: Adapted from: "Voluntary Carbon Market Insights: 2018 outlook and first quarter trends", by Hamrick and Gallant 2018. https://www.forest-trends.org/publications/voluntary-carbon-markets/.

5.4 How could the business model for Rewilding Europe's carbon offset take shape?

Rewilding Europe said its partnerships to be of crucial importance in overcoming the struggles other carbon offsets mentioned when entering carbon markets. Secondly, quantitative results are presented, including a revenue calculation with payback time on land investment and an income statement based on carbon offset sales, in this case, for the Coa Valley. Table 5-12 gives an overview of the six go-to-market phases, as was envisioned by Rutten (Rutten, T. Interview. April 12th, 2019) and in line with table 5.9 (de Clara, 2014). Below, a description per phase can be found.

5.4.1 Go-to-market process and partners involved

Table 5-12 'Go-to-market process for Rewilding Europe'

Nr.	Action	Actor	Partner for Rewilding Europe
1	Find and design appropriate projects	Landowners and local Organisations	Private landowners, ATN (Associação Transumância e Natureza) in the case of the Coa Valley
2	Identify potential buyers	Carbon offset buyers	Large Corporations (to start with)
3	Find investors willing to provide a loan for land acquisition	Financial institutions	Green banks
4	Verification	Independent Verification Bodies	South Pole
5	Monitoring	Monitoring Organisations, and third parties verifying monitored rates	Land Life
6	Issue and sell the carbon offset	Intermediary: broker	South Pole, The Gold Standard (potentially)

Source: 'Rutten, T. Interview. April 12th, 2019'

5.4.1.1 Step one: Find and design appropriate projects

As Rewilding Europe explained in part 5.1, land should be acquired, leased, or given access to through contracts with landowners. The land-tenure situation depends on the European region.

Together with ATN, a calculation of the grassland area of the Coa Valley has to be made after the land is acquired from private owners. Rewilding Europe's main role will be to start and execute projects, collaborating with local partners to tell this narrative to the carbon offset buyers. The project idea note will be developed, where a feasibility and risk assessment of the project is conducted. Land acquisition expenses are presented in Table 5-13 and the income statement in Table 5-14.

5.4.1.2 Step two: identify potential buyers

There is an urgent need for transparent projects that large corporations can invest in (World Bank 2017). Pressure from customers and stakeholders regarding transparency and the location of this project makes large corporations interested in projects closer to home with enhanced transparency (Hamrick and Gallant, 2018). A majority of carbon offsets are bought by large affluent corporations in countries located in the Southern Hemisphere (Hamrick and Gallant, 2017); some of these projects are not transparent and do not lead to the removal of atmospheric CO_2 (Leahy, 2011 and Rogers, 2010). As Rutte stated (Rutten, T. Interview. April 12th, 2019), potential buyers for Rewilding Europe's carbon offsets are large corporations: financial institutions, construction businesses, oil corporations, etc. He explained that these buyers are rich and have a financial portfolio that allows them to spend money on carbon offsets, which as was confirmed by the World Bank (2018). Rewilding Europe expects that by offering carbon offsets with full transparency through European wild landscape projects, corporations should be willing to pay a higher price, first because it is closer to home -should these large corporations be in the Northern Hemisphere-. Second, they can be reached through profound storytelling. Rewilding Europe wants to connect these corporations to European projects. Secondly, acquiring high-quality carbon offsets is in the interest of the corporation too, because their carbon offset-actions will directly impact the corporate social responsibility -by offsetting own operations- and customer relationship management strategy -by offering the option to individual buyers to offset the emissions they cause from consuming products or services from the corporations- (Liu, 2018).

Bakan (2003) states in his book: 'The Corporation' that businesses are only willing to make investments for the sake of attracting profits and extra customers. How will you anticipate the potential criticism to Rewilding Europe as a nature organisation potentially contributing to the whitewashing business-operations?

"Rewilding Europe will establish a document with criteria for carbon offset buyers. One criterion entails that businesses, next to buying offsets, must first of all work for emission reduction, and show how they accomplish this. Yet, it is likely that the buyers of carbon offsets already work to decrease their carbon footprint, this is in their own interest, because of customer pressure and the need to stay ahead of government regulation".
(Rutten, T. Interview. April 12th, 2019)

5.4.1.3 Step three: find investors willing to provide a loan

Rewilding Europe has a noteworthy range of well-known projects and partners they work together with. Partners are for example The Postcode Lottery, World-Wide Fund for Nature, and the European Investment Bank. These projects and partners show Rewilding Europe can be trusted as an organisation that delivers *on the ground* and can mediate in finding a green financial institution that is willing to provide a loan. Interest will be paid on the loan, which is presented as an expense on the income statement of Table 5-14.

5.4.1.4 Step four: verification

On Voluntary Markets, Rutten (Interview. April 12th, 2019) mentioned that no project in the nature-conservation or wild grassland field is currently undertaken. South Pole is an intermediary for carbon offset projects. Rewilding Europe is an interesting client for South Pole since its

carbon offset project will be Europe-based instead of based in the Southern Hemisphere where currently most projects take place (Hamrick and Gallant, 2017), as well as being nature-oriented. Two bottlenecks are remedied by South Pole, making this organisation an essential partner. First, transaction costs are substantial. Cacho and Lipper (2013) stated that project developers need to buy land, pay for verification and monitoring, requiring substantial up-front investment prior to the sales of carbon offsets can start. This results in the first few years of a project being financially risky. Namely, once a carbon offset is issued, the project developer is first, not certain that they will find a buyer and second, not able to fully determine the price since it is a bargain between buyer and seller (Jinski et al. 2008). Moreover, attracting financial investment is a big challenge for project developers since project developers need to fund this with help of financial institutions that will be generally reluctant to provide loans for projects with this risk-profile (Jindal et al., 2008). South Pole pays for the transaction costs and asks for a commission when carbon offset credits are sold (South Pole, 2019). This helps project developers with at least the transaction costs. Yet, project developers still have to bear the land acquisition costs and project execution expenses.

5.4.1.5 Step five: monitoring

Land Life is a partner of Rewilding Europe, mainly working on afforestation but willing to expand their activities to grazing systems (Land Life 2019). With Land Life, Rewilding Europe could start a monitoring system with drones that fly over lands that monitor Carbon Storage and Sequestration according to the type and the state of vegetation. Data on Carbon Storage and Sequestration rates will be generated, and Rewilding Europe will be able to factually back up what they truly store and sequester in wild and varied grasslands, and thus how much revenue they can collect per tCO_2. There is large rewilding potential in the Coa valley, which is also scalable to more projects in Europe, including not only wild grassland projects, but also peatland, and forestry projects, all following the same rewilding strategy. Carbon Storage and Sequestration monitoring can happen for either of these vegetation-types, helping to bridge the missing consensus needed to include Carbon Storage and Sequestration in vegetation in larger climate-adaptation programs, and commonly accepted as carbon offsets, perhaps even on Compliance Markets (Lal, 2009).

5.4.1.6 Step six: issue and sell the carbon offset

Rewilding Europe stated it will not sell the credits itself. Sales, administration, and verification are arranged by an independent party, such as the aforementioned potential partner South Pole. Next to South Pole, Rewilding Europe could work together with the Gold Standard to obtain certification. Whether certification will be pursued depends on Rewilding Europe's compliance with the Gold Standard. The Gold Standard is the most widely-accepted and highest-ranked amongst Voluntary Market standards (Carbon Market Insights, 2018). The two most important rules for the gold standard are additionality and avoiding double counting (The Gold Standard, 2018). Regarding *additionality*, Rewilding Europe's goal is to make the rewilding areas protected, leading to a law-structure that makes it very hard for anyone to take away the protected status of this land. A nature-protection status is reasonably secure and well protected against privatization, Wouter Helmer said (Helmer, W. Interview. April 12th, 2019), which was also acknowledged by Gilbert (2018) in literature. Secondly, *double counting* will be avoided by providing a unique credit number per hectare, in this case within the Coa Valley. Rewilding Europe stated that it needs to evaluate if it is worthwhile to certify its carbon offset, or if it can rely on its own network to build trust and find buyers without certification, while at the same time delivering its own and independent higher ecological and social standards.

5.4.2 Revenue calculation

The revenue for this carbon offsetting in the Coa Valley case study, was calculated in the following way:

Land Price x Carbon Storage and Sequestration rate x CO_2 price

The financial calculation of the payback time of land is shown in table 5-13, for which the numbers were provided by Rewilding Europe. An income statement for Rewilding Europe in the Coa Valley can be found in table 5-14. The price of €21.35 is based on the EU ETS price of CO_2 for offset allowances in April 2018 (Market Insider, 2019), since that was the time this calculation was made. The prices €27 and €50 are projections of where the EU ETS CO_2 price is going (European Commission, 2016), which Rewilding Europe could see as a potential price-floor for its carbon offset.

Table 5-13 'Payback time of land acquisition for the Coa Valley'

LAND ACQUISITION COA	Ton CO2 Per ha/yr	Revenue Per ha/yr	Paybacktime in years At value of land:		
CCS rate	2.61				
			MARGINAL	AVARAGE	HIGH
Acquisition costs of land			€ 1,000	€ 1,500	€ 3,000
Marketprice CO2/ton/year					
€ 21.35		€ 55.72	17.9	26.9	53.8
€ 27.00		€ 70.47	14.2	21.3	42.6
€ 50.00		€ 130.50	7.7	11.5	23.0

Source: Rutten, T. & Wouter, H. Interview. April 12th, 2019.

Table 5-14 'Income statement from carbon offsets in case of the Coa Valley'

INCOME STATEMENT	Ton CCS Per ha/yr	Revenue Per ha per yr	Paybacktime in years At value of land		
CCS rate	2.61				
			MARGINAL	AVARAGE	HIGH
Acquisition value land/ ha			€ 1,000	€ 1,500	€ 3,000
Marketprice CO2/ton/year					
€ 21.35		€ 55.72	17.9	26.9	53.8
€ 27.00		€ 70.47	14.2	21.3	42.6
€ 50.00		€ 130.50	7.7	11.5	23.0
Grassland area of the Coa Valley/ha			36,000	36,000	36,000
Investment land acquisition			€ 36,000,000	€ 54,000,000	€ 108,000,000
Yearly interest on investment 2% *			€ 720,000	€ 1,080,000	€ 2,160,000
Number of years in pre-funding			7.7	11.5	23.0
Total interest burden			€ 5,517,241	€ 12,413,793	€ 49,655,172
Management and Maintainance costs**			0	0	0
Other income for the Coa Valley***			0	0	0
Total costs			€ 41,517,241	€ 66,413,793	€ 157,655,172
Income from carbon offset at € 50,00/ton/y		€ 130.50	€ 4,698,000	€ 4,698,000	€ 4,698,000
Breakeven point after year			8.8	14.1	33.6

*Yearly interest on investment
** In partnership with ATN
***Funding from other sources of income such as grazing, tourism etc,

Source: Rutten, T. & Wouter, H. Interview. April 12th, 2019

5.4.3 Summary of three other influences on Rewilding Europe's business model

A discussion with Rewilding Europe on other factors potentially influencing its own carbon offset business model led to three points of interest. The texts below are interpreted from what was said in the discussion.

5.4.3.1 Agricultural subsidies

When subsidies require certain land-use models, this will affect the behaviour of landowners. In the EU, 40% of tax money is going to the common agricultural policy, Wouter Helmer said, which was acknowledged by Rabbinge and Van Diepen (2000). A part of that money is meant to support marginalised agricultural areas (to still function and not go out of business) and make the agricultural sector more sustainable (Jaeger, 2005). The argument often used to justify the system of agricultural subsidies is that regardless of it costing a substantial amount of tax money, it will in return result in large quantities of affordable food (Quiroga et al., 2017). However, in practice, landowners get sometimes as much as €300/ha/yr. from European subsidy funds to plough their lands and mow their grass. There is no obligation to produce food to get this subsidy. So, what happens, is that some landowners sometimes even buy land, to mow and plough, and receive the funds, pay off their investment (of land acquisition) in three to four years. These policies are counter-effective and are weaving mistakes, as stated by Wouter Helmer (Interview. April 12th, 2019).

When Rewilding Europe approaches landowners, they often find themselves competing against income landowners receive from subsidies. Imagine Rewilding Europe would try to implement a grazing project which leads to a healthier landscape and perhaps tourist that visit a bed and breakfast, they might earn €50/ha of grassland, which is sometimes less than what the

landowner receives in subsidy funds. In fact, Rewilding Europe is being outpriced by agricultural subsidies, which becomes an even harsher reality when these subsidies are not leading to the results for which they are intended. Rewilding Europe is now working with the European Commission to help to develop sustainable grazing models. This is public money that the EU and Rewilding Europe want to utilise for public improvement in the form of grazing systems instead of ploughing and mowing of grasslands, intensive agriculture, and forestry. If Rewilding Europe achieves to deliver the arguments necessary to adjust the current subsidy system, EU money can be redirected to these more sustainable systems. The reason why this is relevant to this research is that Carbon Storage and Sequestration are one of the functions that promote a public objective of reducing our societal carbon overshoot and contributing to multiple other co-benefits such as the climate adaptation of grasslands as is argued by Mengistu and Mekuriaw (2014). If Rewilding Europe proposes different land use models with a suitable business model that shows independent financial facilitation for this land use model, the impact Rewilding Europe has on land use and subsidy schemes could be substantial.

5.4.3.2 Business model scalability

Rewilding Europe sees carbon finance as one of the crucial enablers for the large-scale facilitation of their projects (Rutten, T., & Helmer W., Interview. April 12th, 2019). This organisation has 50,000 ha for rewilding contracted as an organisation, and influence over a larger land area of another 50,000 ha. If it wants to expand this to a million or 5 million ha in Europe, they cannot only do this with donor money. Rewilding Europe currently has €4 million annually as an operating budget, which can grow but will never be €400 million, as stated by Timon Rutte. One success of terrestrial carbon offsets is forestry projects, yet, these tree plantations are focused on Carbon Storage and Sequestration, not on nature (Bland et al., 2018). These forestry projects often involve monoculture forests, not ecologically interesting or good for biodiversity (Veldman et al., 2015). If Rewilding Europe can change this by showing how soil carbon in wild grasslands can make a significant change, this can have a big impact on nature organisations and biodiversity conservation. Rewilding Europe's needs to build trust that wild grasslands effectively perform, and then it needs to find a market. What is essential is that this market-based finance remains, even when subsidies and donations eventually increase.

5.4.3.3 Market potential and risks

There were five additional market-based insights that arose from the discussion. The first one concerned CORSIA. Rutten (Interview. April 12th, 2019) explained that many countries are working on a carbon tax, also agreed on by (Goers et al., 2010). The most recent one is CORSIA, a tax that requires offsetting from the aviation industry (Scheelhaase et al., 2018). However, what will be accepted as a carbon offset is not yet clear. If carbon offset projects from the voluntary market will be accepted as carbon offsets (certified with the Gold Standard for example), this will have big implications for Rewilding Europe. In case CORSIA or other market-based tax-mechanism decide to accept Gold Standard Offsets, this will change, since a huge demand will be unleashed when Rewilding Europe can get access to this pool of potential carbon offset buyers, creating an economic reason to pursue certification. So, this research into carbon finance of natural wild grasslands serving as carbon sinks has tremendous momentum.

Even though access is only provided to Voluntary Market for now, when a carbon offset project for Rewilding Europe is established, this carbon offset project can also function on other markets (eventually perhaps Compliance Markets if this is a possibility in the future), or if carbon taxes allow types of carbon offsets that operate outside of the Kyoto Protocol. Therefore, even though market conditions are not ideal for Voluntary Markets, setting up a carbon offset project for Rewilding Europe can provide a head start when the industry and political environment around carbon offsetting changes.

The second point concern increased interest when governments realise that carbon offsetting can help them with achieving their Paris Agreement commitments. Environmental carbon offset projects have shown to be most effective if they are designed with- and incentivised by nation states (De Clara, 2014). Namely, if policies stimulate carbon offset projects, this can have big impacts for governments, businesses that want to offset their unavoidable emissions, and society that benefits from the co-benefits that arise. Governments can use carbon offsets for their climate change mitigation strategies and commitments to the Paris Agreement (UNFCCC, 2017).

The third point concerns volatile demand on Voluntary Markets since businesses that participate act out of a free will, they can decide to buy any credit for any price on Voluntary Markets and communicate they have offset their emission, even when quality from one carbon offset to the other varies (Heitzig and Kornek, 2018). Rewilding Europe said a risk would be encountering problems with homogenous 'quality' on the market. Namely, some carbon offsets will have none or fewer co-benefits and a different impact-level. Rewilding Europe thinks that the additional benefits should be included in the carbon offset price. Best would be to have a bottom price, which could, for example, be the price of CO_2 on the EU ETS. Then, in addition to that bottom price, additional benefits that for example count impacts on biodiversity, social co-benefits, and others, which they can include in the price and differentiate themselves with on the Voluntary Market (Rutten, T. Interview. April 12th, 2019)

Fourth, the linking of carbon markets was discussed. Projects undertaken outside of the Kyoto-mechanism cannot be offered to Compliance Markets such as the EU ETS. The linking of Voluntary- and Compliance Markets (or making all into a regulated market plus allowing other carbon offset projects without regulated systems like the Clean Development Mechanism to participate) would trigger a tremendous change for carbon offset project offerings (Scheelhaase (2018). Hence, also on the potential for Rewilding Europe to get access to carbon finance (Rutten, T. Interview. April 12th, 2019)

Fifth, there is a risk in linking the income of an organisation to the market economy. The economy is doing well these days, resulting in corporate money to be spent on Corporate Social Responsibility and other customer-binding and loyalty strategies (Liu, 2018). Yet, one could question what could happen if a financial crisis like the one in 2007 repeats itself. A question is if governments will continue to pressure industry to emit less and if industries will continue to invest in low-carbon technologies or carbon offsets instead of saving money to continue their operations during economic recession (Richstein et al., 2015). Especially on Voluntary Markets, demand is linked to economic prosperity. Carbon Markets are by nature more risk full than for example a set carbon tax, which is not voluntary and will provide a stable income, since the tax should still function in a time of economic recession (Goers et al., 2010).

6 Discussion and Analysis

Structured according to the four sub-questions, this chapter will weave together the arguments of the literature review, the factors from the analytical framework, and newly generated knowledge. Secondly, three new insights at large will be discussed and will show the deeper significance of the research findings.

6.1 Comparative analysis of findings from the literature, factors from the analytical framework, and research results

6.1.1 Sub-question one: Where could Rewilding Europe start its European wild grassland carbon offset project?

Land tenure has an effect on carbon finance for wild natural grasslands. Next to the economic incentives for the adoption of land use models, climate-related environmental risks increase for planet and society (Verdú et al., 2018). Droughts and eroded soils present challenges for farmers, trying to increase crop yields under severe climatic conditions such as droughts and decreasing precipitation, forcing them to use the land even more intensively, resulting in a vicious cycle of land degradation (Erb et al., 2018). These abandoned lands are left in bad ecological conditions. Another trend that is linked to these environmental and economic challenges of land use are demographic shifts resulting in land abandonment. Depending on the rate of land abandonment, land prices are relatively low (Fujiware et al., 2012). The Mediterranean region is associated with socio-economic challenges such as land abandonment and economic deprivation is a reality (Abberton 2010), of which the Coa Valley in Portugal is a perfect example. Hence, the Coa Valley was chosen as a case-study region for this research. Land can be voluntarily acquired from private owners. To avoid land tenure issues, Rewilding Europe stated that it will capture agreements in contracts carefully, preventing accusations of privatisation and land grabbing (Fairhead et al., 2012). Also, different rates of Carbon Storage and Sequestration together with the land management strategy and the subsequent return in carbon offset revenues need to be captured in these contracts to avoid confusion (Markowski-Lindsay, 2011), acknowledged by Rewilding Europe. In the Coa Valley, carbon finance could be combined with other nature-based business models such as eco-tourism, and small-scale organic agriculture. Regarding the increasing need for alternative economic models for land, and large-scale land abandonment resulting in the lower land price, a significant potential arises for Rewilding Europe to undertake projects all over Europe. This proves the geographical potential for Rewilding Europe by pursuing carbon finance for its projects on a larger scale.

After discussing land-tenure and land-cost issues, the third point of analysis concerns research availability on Carbon Storage and Sequestration in wild grasslands (Verdú et al. 2018). First, Smith (2014) notes that there is more research available on Carbon Storage and Sequestration in wild grasslands, but that missing popularity as opposed to carbon offsetting in forests to be the status quo when talking about terrestrial bio-sequestration. Ghosh and Mahanta (2014) pointed to the subsequent mismanagement of lands, including afforestation of large monoculture forests that do not add to the ecological improvements of the land. Yet, the data on Carbon Storage and Sequestration in grasslands is thus far unable to reach the consensus under policy-makers to include this type of Carbon Storage and Sequestration into climate adaptation strategies and agendas (Robotyagov, 2010). Current policies, therefore, involve mismanagement of lands, including large monoculture afforestation projects that are prone to larger threats such as pests and wildfire (Swallow and Goddard, 2013).

Rewilding Europe acknowledges the concerns of the scholars above. Yet, Rewilding Europe's land management approach, not only Carbon Storage and Sequestration will be enhanced, but many co-benefits will arise from rewilding projects. Rewilding Europe spoke out of the experience when explaining that responding to degraded lands through the restoration of mosaic landscapes instead of forest plantations has shown to be more ecologically effective. Dumbinsky (2014) and Jones and Donnely (2004) proposed similar land management strategies, including the elimination of artificial fertilisers, increasing species richness, and introducing grazers. Rewilding Europe's carbon offset project will be designed according to its rewilding projects since all the strategies mentioned above are reviving the lands and increasing its Carbon Storage and Sequestration potential. Rewilding Europe stated that it is true that in periods of extreme heat and drought, Carbon Storage and Sequestration rates will be lower even in areas under its guidance, but at rates incomparable to if their strategies above not have been applied.

Regarding the missing consensus on Carbon Storage and Sequestration in wild grasslands Rewilding Europe can -through its own carbon offset project- contribute to new science by establishing a monitoring system with their partner Land Life. Therefore, Rewilding Europe will not wait until more science is generated to gather the proof that wild grasslands are viable carbon sinks, but rather actively contribute to scientific data-collection themselves.

6.1.2 Sub-question two: How do carbon market structures affect the possibility of a carbon offset to be embedded?

They are two markets that both exist in the purpose of reducing atmospheric CO_2, but the legislative base that defines them is different (Hamrick and Gallant, 2018), eliminating the possibility of Rewilding Europe to embed its carbon offset project to the larger, more liquid, and more stable Compliance Market. Only the carbon offset projects that fall under the Kyoto protocol can be accepted as Carbon offsets on Compliance Markets. On Compliance Markets, there are regulations that businesses must comply to by law, the participants on Voluntary Markets are merely guided by voluntary standards. On Voluntary Markets, all types of carbon offset projects are accepted. The only legal obligation is that project developers must comply with host-government regulation. In the case of Rewilding Europe to start a project in the Coa Valley, working together with the Portuguese government is a prerequisite.

Gold Standard certification could increase the likelihood of Rewilding Europe to sell its carbon offset. Rewilding Europe said that they will evaluate if they are either worthy of receiving the certification or if it can sell their carbon offsets under their own 'rewilding' standards, backed-up by their trustworthy network. Rewilding Europe can use the parameters of the Gold Standard as a guideline, and independently prove that they fulfil all these requirements and contribute to more co-benefits.

The price of CO_2 for Compliance Markets is established by the market forces of supply and demand for carbon allowances. McNish (2012) and Gössling (2009) both criticised the EU ETS, for providing so many allowances that scarcity was not able to occur in the past, and therefore, eliminating the market-mechanism needed to force businesses to decrease CO_2 emissions. Another criticism was brought to light by Boyd and Salzman (2011) and Ervine (2018) and concerned fraudulent 'paper trading' with which the speculation of offset allowances is meant. Contrastingly, high-quality carbon offsets can be utilised to incentivise positive impact, more than the free allocation of allowances, as stated by Belfry (2016). Nevertheless, the price of the EU ETS has increased over the last decade as can be seen in figure 14 in Appendix 3. In the course of this research, the price of CO_2 has already increased from €21.35 in April to €25.40 in May 2019. Eijckhout (2019) states that the price of CO_2 needs to increase to €50 to take flight

(2019). For carbon offset projects on the ETS, the daily carbon price is used. So, the higher the price, the more favourable it will be for carbon offset projects if Rewilding Europe uses a price floor. The increasing price of CO_2 on Compliance Markets will also impact Voluntary Markets, as stated by Ahonen et al. (2017) since the price of Compliance Market's is often used as an average price for projects. The higher the price for CO_2, the more financial room there will be for project developers to execute carbon offset projects.

The volatility of demand is higher in Voluntary Markets since the demand for carbon offset projects is merely dependent on the willingness of mostly affluent corporations to offset their carbon emissions (Hamrick and Gallant, 2018). The volatility in demand of Voluntary Markets adds a risk for Rewilding Europe, since it cannot anticipate on how many businesses would want to offset their emissions at any given point in time, because their demand for carbon offsets is not linked to any sort of compliance, nor is it to the price of Compliance Markets. Heitzig & Kornek (2018) talked about this problem, and pledge for a linking of Compliance Markets and Voluntary Markets on two points. One is the price of CO_2, or at least the instalment of a CO_2 price floor for both markets. the second point of linking would be to allow carbon offsets from multiple mechanisms, not only the Clean Development Mechanism and Joint Implementation but also carbon offset projects with quality assurance such as the Gold Standard. Heitzig and Kornek (2018) also state that allowing carbon offset projects outside of Kyoto-based programs to be sold to EU ETS, for example, would trigger a huge increase in the amount of carbon offset projects because of more favourable market-conditions on Compliance Markets as opposed to Voluntary Markets. For Rewilding Europe, linking of carbon markets would indeed be of paramount influence, since both markets will become more liquid by means of how many CO_2 is traded (Ibikunle et al., 2016) and how many carbon offsets are demanded and sold, as stated by Fedosov (2016). For Rewilding Europe this means a larger pool of potential buyers, and more potential carbon offset sales. Goers et al. (2010) argued against market-linking, but for a universal carbon tax. In this way, regulators would have more power over influencing the price of CO_2, since emitters would pay a tax per ton of emitted CO_2. If carbon offsetting is allowed under this tax mechanism, as will be the case in CORSIA, the aviation carbon tax, and if carbon offsets with a Gold Standard are accepted, Rewilding Europe could pursue a carbon offset with this standard and secure its buyers, adding to their supplier-stability.

6.1.3 Sub-question three: What influenced other carbon offset projects on their path to the carbon market?

Carbon offset projects undertaken outside of the Kyoto- based programs can only be embedded in Voluntary Markets (Dumanski, 2004), which the market entry takes five steps: project idea notes, project design document, validation, monitoring and verification, and issuance. Each step has shown to involve a bottleneck for implementation of carbon offset projects.
Figure 9 showed that 401.5 MtCO2e was issued and 212.4 $MtCO_2e$ was retired between 2008 and 2017 (Hamrick and Gallant, 2018). To give a comparison with the EU ETS, in 2014, 8.33 billion tons were traded (of both including emission allowances, and carbon offsets). Voluntary Markets naturally only include the trade of carbon offsets. Yet, this comparison still shows the significant difference in market-size, providing carbon offset projects developers on Voluntary Markets a smaller potential to attract revenue than on Compliance Markets such as the EU ETS. This point was also discussed in sub-question two which regarded liquidity and market size. Prior to a carbon offset being able to generate sales-revenue, a large up-front investment is involved, including the land acquisition or lease and transaction costs (De Pinto et al., 2010). Then, after the bottleneck of start-up costs is overcome, the quality of carbon offsets on Voluntary Markets often vary as a result of the lack of binding regulatory, and monitoring verification systems to guard the homogeneous quality of carbon offsets. Varying quality of

carbon offsets can create a stigma around transparency of all carbon offset projects; therefore, certification is sometimes used to enhance the market position of the carbon offset project. The Gold Standard is the most widely used and accepted certification, this is costly (Simone et al., 2017). This presents risks to small farm-holders or private landowners, who are unlikely to bear the risk that involves starting a wild grassland carbon offset project. Notwithstanding the reluctance of financial institutions to providing them a loan to start their project.
Moreover, the average price of all transactions in 2016 was €2.69 per ton of CO_2e (Ecosystem Marketplace, 2018). This, of course, does not compare to the price of CO_2 on the EU ETS, which is €25.40/tCO_2e in May 2019. Linking this finding back to literature, the uncertainty of the sales price was generally perceived as one of the most challenging as stated by Moss and Carlo (2014). Furthermore, Simone et al. (2017) explained that project developers are fully dependent on the willingness of businesses to buy their offsets, meaning if demand for the carbon offset stops, the project cannot continue. This financial instability adds a risk to even consider starting the project in the first place.

Figure nine showed the average price of carbon offsets per tCO_2e in 2015 per project type. Agroforestry sold for the third highest price of €9.90 per tCO_2e, then improved forest management for €9.60, and tree planting sold for an average price of €7.50 per tCO_2e. An explanation for the relative popularity of terrestrial carbon offset projects can be explained by looking at the business model behind these projects. Forest plantations could be harvested and re-sold as biomass once the carbon offset has been retired, and agricultural rangeland could simultaneously be used for cattle for the meat industry (Swallow and Goddard, 2013). Forest- and grassland projects on their own are not likely to be fully financed by the small return that carbon finance offers. This could be an explanation for the non-existence of wild grassland and nature-based projects (Li et al., 2017).
As the findings show, the large up-front investment and uncertainty of the price of carbon offsets result in two major impacts. First, the project location, and second, the carbon offset project type. First, seeing the low carbon offset price, most projects are undertaken in the Southern Hemisphere, where resource costs (such as labour) are relatively low. Figure 5-10 shows data from 2,008 certified projects in 82 countries. The world regions with the highest number of carbon offset projects are Latin America and Asia. What one could notice, is that most projects to occur in this part of the world, and relatively less in Europe. In literature, Klein (2015) argues that a limitless amount of carbon offsets can be bought from the global south at very low prices, and often with missing verification systems. The types of projects that involve the change of some group's living space or livelihood, a risk is involved which reaches back to the issue of land tenure addressed in sub-question one of this research (Osborne and Shapiro-Garza, 2018). Earning carbon offset revenues could be perceived as the commodification of nature, and when land rights are involved (or the lack thereof because of non-existing land-ownership contracts as is often the case with indigenous communities), social relationships should be maintained. This links back to land-tenure issues discussed in sub-question one and is of significant relevance to Rewilding Europe if it were to start its pilot project in the Coa Valley.

Figure nine included several project types. One can note that the project types in energy (whether it be solar, renewables, hydro, or geothermal, and even biomass and biogas) may typically have a larger commercial intend too. Namely, an explanation for more projects funded in renewable energy despite the larger tonnage of t CO_2 offset by forestry and land use projects can be attributed to the fact that buyers of carbon offsets have a commercial interest in renewables, therefore benefiting from investing in this type of carbon offset (Liu, 2018). Table 5-11 showed different project categories from another source, listing the volumes of carbon offsets offered from 2005-now, including the alternate started carbon offset projects per

category. Project types included agriculture, chemical processes, and industrial manufacturing, energy efficiency and fuel switching, forestry and land use, household devices, renewable energy, transportation, and waste disposal. Merging the insights from the tables above, terrestrial carbon offsets are offered to Voluntary Markets have shown to be in the upper price-range compared to other carbon offset projects. An explanation is mentioned by Allward (2011) in the literature review of this study. The income from carbon offsets in the environmental field is dependent on the performance of nature for income since Carbon Storage and Sequestration rates determine the tons of carbon that can be sold as an offset. Allward (2011) also mentioned that landowners such as farmers are not aware of the carbon finance potential of their land, and not of the existence of Carbon Storage and Sequestration as a natural function that could be commodified by exchanging this for carbon offset revenues. This argument links to the missing knowledge addressed in sub-question one, where Smith (2014) pointed to the not so common -but highly relevant knowledge for landowners- knowledge that wild grasslands are efficient natural carbon sinks.

6.1.4 Sub-question four: How could the business model for Rewilding Europe's carbon offset take shape?

Geographically, Rewilding Europe saw an ability to scale its carbon offset projects to areas across Europe looking at the opportunities of land abandonment and cheap land prices as discussed in sub-question one. Lal (2009) and Minasny et al. (2017) argue that the global potential of the restoration of wild grasslands, and the conversion from artificial- to sustainable land management practices can lead to a Carbon Storage and Sequestration rate between 2,5-3 gigatons on average. If we look at table 5-7, Rewilding Europe stated to target millions of ha of abandoned European grasslands all over Europe. On top of these grasslands, other natural carbon sinks such as Portuguese communal forests (400.000 ha), and Finnish drained peatlands (5 million ha) could be considered as potential project areas for Rewilding Europe's projects, showing the significant scale that Rewilding Europe has in mind when it comes to the projects that can be financially facilitated with carbon finance. Whether land has to be bought or leased impacts the business model, since acquiring grazing rights from governments that own land (which is the case in most of Eastern Europe), will lower the up-front investment costs for the carbon offset project will be lower. In places such as the Mediterranean, land has to be acquired, but is relatively cheap due to high rates of land abandonment because farmers move away, an urgent need for alternative business models for these regions, and the critical need for land management practices that decrease the risks of wildfires and other types of environmental risks. In places where land has to be acquired at a very high price, Rewilding Europe would first have to evaluate whether the results from sales of carbon offsets will outweigh the up-front investment. Table 5-13 presents a typical calculation on the payback-time when land is acquired, which will have to be evaluated based on the location Rewilding Europe has in mind for its carbon offset project. Not only the land price but also the price of CO_2 will matter to Rewilding Europe.

Even though other carbon offset projects have shown that Voluntary Markets is challenging due to uncertain prices (the average price of all transactions in 2016 was €2.69 per ton of CO_2e), high demand volatility, and high buyer-power, Rewilding Europe has large ambitions with the development of its own high-quality carbon offsets. Even though it is bound to start offering a carbon offset project to Voluntary Markets, it will not limit itself to the average market price. Rewilding Europe could establish its own price based on a price floor of €21.35 (the price of CO_2 allowances on the EU ETS on April 2018). In the future, Rewilding Europe could also decide to account for the co-benefits generated with their projects.

Regarding the quality of this carbon offset, and Rewilding Europe's trustworthiness as a project developer, Rewilding Europe stated that it will either explore the benefits of the Gold Standard, or otherwise, Rewilding Europe's network of partners also shows its credibility.
An explanation of why forestry projects are more popular might be because the secondary market for biomass might cover the small return from carbon offset sales (Tilman et al., 2006). For Rewilding Europe, the timber industry is, therefore, a large competitor on carbon markets. Partners are expected to help Rewilding Europe overcome the bottlenecks that arose for other carbon offset projects in the environmental field. What South Pole was shown to remedy is both cash flow and risk-profile bottlenecks, two issues that generally withhold project developers from undertaking terrestrial carbon offset projects in the first place. Land Life can be a partner to develop a Carbon Storage and Sequestration -monitoring system for Rewilding Europe's projects, contributing to scientific data collection. Green Banks can help provide a loan for the acquisition of land of the Coa Valley, which ATN (*Associação Transumância e Natureza*) will acquire and subsequently manage together with Rewilding Europe. ATN will also help with local ties to the region and building trustworthiness and connection to the Coa Valley.

A calculation of revenues was shown in Table 5-14, the higher the price of CO_2, the better the chance of a carbon offset project around this price, and the earlier investment costs by Rewilding Europe can be paid back. Table 5-13 entails the payback time of land acquisition in case of the Coa Valley taking into consideration the three variables including Carbon Storage and Sequestration rate, the acquisition cost of land, and the market price of CO_2/t/yr. If we look at the situation of April 2016, a price of €21.35 with a rate of 2.61 tCO_2e, payback time per land acquisition value changes. The table with variables shows that the most favourable situation for Rewilding Europe would be a high CO_2 price, high Carbon Storage and Sequestration rate, and low land acquisition cost. Projections are that in the future when the cost of CO_2 will reach its ideal level of €50 (Eijkhout 2019), and at a low-cost price for land in typical lands with high land abandonment (€1000 /ha), and the currently most recent Carbon Storage and Sequestration rate of 2.61/t CO_2/ha/yr., payback time of land investment is 7.7 years.
Figure 12 shows Rewilding Europe's carbon offset income statement as stated by taking into consideration the previous return on investment calculation of Table 5-13, the total cost of the carbon offset was projected to be €41,517,241 when the land costs are low, due to marginal conditions, €66,413,793 when land cost are average, and €157,655,172 when land costs are high. At a price of €50 per ton of CO_2 a year, income will be €130.50/ha/yr., resulting in an income of €4,698,000 per year for the whole Coa Valley. This means the breakeven point for this carbon offset project can be reached after 8.8, 14.1, and 33.6 years respectively (dependent on the land price). Regarding the time scale for implementation, Rewilding Europe can first approach affluent corporate buyers, after which it can start implementing its projects. Then, offering carbon offsets for smaller businesses and individual buyers can also be made. In the meantime, Rewilding Europe hopes for market developments such as a universal carbon tax and the aviation tax of CORSIA would be favourable to occur, in which case it might be able to meet this significant demand with its carbon offset project in the Coa Valley. Anticipating on these market changes by already creating a rare nature-based carbon offset project with many co-benefits and a good narrative is expected to give Rewilding Europe a head-start in marketing their carbon offsets.

6.2 Insights based on newly generated knowledge

The analysis above provides the building blocks for fulfilling the research aim of this study, but the three subsequent insights stated below will show the societal impact and significance of research findings.

6.2.1 Agriculture and incentives for land-use models

The increasing pressure for more food production over the years has driven farmers to move to large-scale industrial farming practices (Erb et al., 2018). This results in the use of more intense and artificial land use practices, such as monoculture crops production and heavy use of aggressive pesticides and fertilisers. Negative externalities of these practices are soil erosion and land degradation, resulting in lower Carbon Storage and Sequestration rates. Governments are currently finding themselves in a trade-off between either heavily subsidising the agricultural industry to meet societies' increasing demand for food or giving space to nature development to restore degraded lands and decreasing risks such as wildfire, decreasing water quality and the like. Because of decreasing yields from exhausted lands, subsidies are allocated to prevent farmers from going out of business (Hungate et al., 2017). Agricultural subsidies are currently taking up 40% of the total sum of EU taxpayers' money. Without subsidies, the agricultural industry would not operate as it currently does. This has a detrimental impact on what Rewilding Europe is trying to achieve with its alternative land use models because they are outcompeted by agricultural subsidies. Agricultural subsidies are also a competition to carbon finance for natural sinks since the returns from sustainable land management practices able to attract carbon finance will be compared to the returns farmers receive from EU subsidies.

6.2.2 The effect of the market economy on the popularity of carbon offsetting

A risk of paramount importance to the evaluation of the potential of carbon markets to finance nature-based solutions is the stability of the market economy. Namely, investment into carbon offsets is typically linked to a favourable market-economy. This begs the question if businesses are still willing to acquire carbon offsets if they are themselves struggling to make profits. The question is also what politicians will do in times of financial crisis. The big risk behind this idea is that carbon offsetting will only work in times of economic prosperity. The last years, the economy has seen growth, and so have carbon markets and climate-mitigation regulations. However, the question is if politicians will still exercise pressure on industries in times of financial crisis. Moreover, the power of large corporations on policies has shown to influence politics tremendously, which is only expected to increase when they find themselves in hardship. An individual carbon tax on all emissions would be an alternative to count on a stable source of income. Namely, when a tax is installed, carbon mitigation would not have to rely on a carbon cap or the number of allowances on the market (Goers et al., 2010). Market conditions will change, and political environments around CO_2 too. In the meantime, and with the model elaborated in this research, Rewilding Europe can create a pilot project, as an experiment with the carbon finance options available. In the worst case for Rewilding Europe, as Wouter Helmer said, a stagnation of the sales of carbon offsets will only impact the financial model of Rewilding Europe's projects, not necessarily the rewilding projects that have already been started (Helmer W. Interview. April 12th, 2019). In that sense, landscapes are already helped and will continue to develop itself. In the best case, Rewilding Europe will have an increased European project-base financed by the sales of carbon offsets.

6.2.3 The Paris 2020 goals, CORSIA, and other market movements

Interestingly, the level of impact that the development of carbon offset projects -such as the Rewilding Europe's hypothetical project in the Coa Valley- might be able to echo. Namely, the carbon offset in the nature-related field might help governments achieve the Paris Goals of 2020 (Kansky, 2016), by investing in offsets and reducing CO_2 emissions. Other than reducing CO_2 emissions from industry, carbon offset credits may be included in reduction commitments. This, in turn, can contribute to nature-based solutions and climate adaptation of own country (for example a solution for wild-fire in Portugal). Lastly, as said in the argument on the change of agricultural policy, countries might also be able to reduce agricultural subsidies and let sustainable land management of grassland be funded through the market economy, saving tax-money that can be allocated to projects. However, as stated before, VER's cannot be acquired by governments for the purpose of committing to their emissions reduction targets, since emission reductions are only allowed to come from Kyoto-linked mechanisms. With the above-stated argument, governments and policy-makers might find an incentive in developing favourable market-conditions for nature-based solutions such as Carbon Storage and Sequestration in grasslands, as to create the most impact with money spent on climate action, goal 13 of the United Nation's Sustainable Development Goals (Harris, 2007). This is to say; everyone is bound by making carbon finance for natural sinks work.

6.3 Critical reflection on the generated data

A choice was made to explore this topic through exemplification of a case-study, leading to a first screening of the context of this topic and available data through literature. For data collection needed to build the case, full light was shone on Rewilding Europe. Expert information was chosen to be the core research methods, followed by careful triangulation with desktop research. As also mentioned in the Limitations and Scope section of 4.4, a focus was laid on a current situation of how carbon markets can be utilised to support Rewilding Europe's activities. Other systems, such as carbon taxes and new regulations aimed to curb the carbon overshoot was only deliberately lightly touched upon in order to evaluate carbon markets with greater focus. An evaluation of the current systems in place that could impact organisations like Rewilding Europe seemed most practical in this pioneering study field. Seen the pioneering nature of this research topic, and the non-existence of carbon offsetting in wild grassland projects to date, conducting this experimental case-based research was perceived as suitable to suit the current gap in knowledge as most suitable to address the gap in knowledge.

7 Conclusions

Society faces a tremendous threat because of the amount of atmospheric CO_2 that is currently in the air. CO_2 reductions need to be made and investment in low-carbon technologies need to happen. Simultaneously, CO_2 needs to be removed from the atmosphere as soon as possible. Wild grasslands are not only the most endangered biotopes in the world, they are also tremendously important for their stabilising effect on CO_2 levels because they act as carbon sinks. The research aim was to explore, in the current situation, how an organisation like Rewilding Europe can utilise current forms of carbon markets to support their activities. It hereby investigated the process of offering a carbon offset project of a wild-grassland type, showing the potential of tangibly increasing the economic value of natural carbon sinks. A reiteration of the research questions is: **"How could projects seeking to enhance the nature-based solution of wild grassland carbon sinks benefit from carbon markets at present?"**

Answers to the four sub-questions of this research are the following. First, to date, Carbon Storage and Sequestration in wild grasslands have received little to no consideration in climate change mitigation strategies, even though science points to the large potential of wild grasslands as natural carbon sinks. Experimenting with a Carbon Storage and Sequestration project in wild grasslands of Europe can lead to interesting and highly necessary scientific research. Namely, Rewilding Europe can monitor the Carbon Storage and Sequestration rates in their project areas, contributing to the existing body of knowledge required to build political a consensus that wild grasslands could indeed become effective carbon sinks compared to other types of vegetation. Rewilding Europe could start a wild grassland carbon offset project in the Coa Valley of Portugal, an area characterised by land abandonment, economic stagnation, and environmental challenges such as droughts and wildfires.

Second, project developers such as Rewilding Europe can only offer carbon offsets to Voluntary Markets, because Compliance Markets have a different legal and administrative structure that only perceives projects under the Kyoto Protocol as legal carbon offsets. Voluntary Markets can embed wild grassland project, provided the project developer is willing to take a pioneering position since no such project has been undertaken yet. On Compliance Markets, for example, on the EU ETS, the market price of €25.40 is paid to offset $1tCO_2e$ in May 2019. On Voluntary Markets, the price for carbon offset projects is based on negotiation. Sometimes, the Compliance Market price is taken as an example. A price rise of CO_2 on Compliance Markets affects Voluntary Markets since the overall rise in the price of CO_2 can also imply a higher value of offsetting this CO_2, leading to a better negotiation position when establishing the carbon offset price. On Voluntary Markets, the Voluntary Gold Standard is a certification for carbon offsets with the highest value, increasing the market potential for sales of these carbon offsets. Rewilding Europe will evaluate whether they will pursue this certification, or sell without certification, trusting on their network and project legacy to show their trustworthiness. Future linking of carbon markets, and setting a price floor, and allowing the intersectional sales of carbon offset project (from Voluntary Markets to Compliance Markets) would increase the potential of Rewilding Europe to reach a stable base of potential buyers.

Third, for project developers on Voluntary Markets, the biggest bottleneck is the large up-front investment required, mainly involving land acquisition costs. They involve transaction costs such as verification, monitoring, and optionally certification. Moreover, low prices paid for most carbon offset projects causes that most of these projects are currently being undertaken in the Southern Hemisphere, where costs such as labour are typically lower than in the Northern Hemisphere. Varying quality of carbon offsets is also a reality, which can be attributed to a missing binding regulatory system for carbon offset projects that monitor how much CO_2 is really saved- or removed from the atmosphere.

Fourth, Rewilding Europe estimated that hundreds of thousands of ha of grasslands can be converted to sustainable lands, indicating substantial potential for geographical scalability of carbon finance for their projects. On top of these grasslands, other natural carbon sinks such as Portuguese communal forests (400,000 ha), and drained Finnish peatlands (5 million ha) could be considered as potential project areas for Rewilding Europe's projects, showing the significant scale that Rewilding Europe has in mind when it comes to the projects that can be financially facilitated with carbon finance. Land acquisition costs, the Carbon Storage and Sequestration rate, and the price of CO_2 on Compliance Markets all affect Rewilding Europe's business model. First, leasing versus acquiring the land influences the amount of up-front investment that needs to be made prior to starting the project. The Carbon Storage and Sequestration rate determines how much money 1 ton of CO_2 can result in since the price of an offset. Rewilding Europe can collaborate with organisations like Land Life to monitor rates and use these Carbon Storage and Sequestration rates on top of the calculation of co-benefits to arrive from the project. Rewilding Europe can use the price from the EU ETS as a guiding price or perhaps even as a price floor. In this research, this has been elaborated for a case study in the Portuguese Coa Valley. At a price of €50/t CO_2e, it was calculated that carbon finance income will be €130.50/ha/yr., resulting in an income of €4,698,000 per year for all the wild grasslands in the Coa Valley of Portugal. The breakeven point for this carbon offset project can be reached after 8.8, 14.1, and 33.6 years respectively, depending on the price of the land. The higher the price of CO_2, the sooner will Rewilding Europe be able to reach its break-even point. This price (€50/t CO_2e) was not deemed as unrealistic, seen the level of intensity of the political and larger societal discussions around CO_2, climate strikes, pressure on the reputation of businesses, and stricter regulations.

Essential is the understanding that Rewilding Europe is not limited to the sales of carbon offsets to generate financial investment flows. Starting projects that are marketable, whether it be through carbon offset sales or future demand created for carbon offsetting from carbon taxes, rather enable more financial opportunities. By showing a viable business model for the nature-based solutions, Rewilding Europe's carbon offset project could also inspire agricultural policy changes, making sustainable land management options more economically competitive than unsustainable practices when showing that carbon finance can lead to the financial autonomy of nature-based solutions, as opposed by some forms of agriculture that are kept alive by subsidies.

Duly, carbon finance can be one of the financial mechanisms that prove the economic viability of nature-based solutions. It is one step in the direction of creating living solutions for the environment that stand a chance at being able to carry the weight of our existence, bringing back our society to function within planetary boundaries, and create an economy that is only able to sustainably thrive when the power of these two pillars are combined.

8 Recommendations and suggestions for future research

Rewilding Europe is recommended to start a pilot project in the Coa Valley of Portugal, designed for Voluntary Markets but holding in mind the future potential for lucrative carbon offsetting when market conditions change. Undertaking the steps presented in this research, including the building of ties with partners such as financial institutions, intermediaries such as South Pole, screening potential buyers, and evaluating the pros and cons of obtaining Gold Standard Certification is recommended.

Rewilding Europe is also recommended to start a dialogue with the EU based on the arguments presented in this research. Namely, the EU could consider supporting Rewilding Europe's pilot project in the Coa Valley (and more European regions) by providing funds from the agricultural subsidy portfolio, kick-starting a Carbon Storage and Sequestration project for Rewilding Europe, and with this, potentially unlocking the potential of carbon finance for economically deprived and environmentally endangered rural European regions. Ideally, subsidies for these sustainable land use systems providing nature-based solutions can ultimately be eliminated because they are able to run on carbon finance independently.

For future researchers, a lot of work is to be done in this area. Partnering with Rewilding Europe as a case study organisation offers a good breeding ground for pioneering and highly relevant academic- and empirical research. Research is recommended to be conducted on:

- Carbon Storage and Sequestration dynamics in wild grasslands, and other types of vegetation (such as peatlands and forests). This would strengthen the scientific consensus on wild grasslands being competent natural carbon sinks. It is also relevant to monitor the effect of droughts have on Carbon Storage and Sequestration Rates in Mediterranean areas.
- What potential carbon finance for natural sinks can mean in terms of a welfare improvements to current land-use models of subsidised agricultural lands. This could generate a redirection of the EU innovation subsidy into the kick-starting of Rewilding Europe's wild grassland projects.
- The future of carbon markets, taxes, and protocols such as the Kyoto Protocol and their effect on carbon offsetting.
- A buyer analysis on potential large corporations willing to be included in the front-runner group to acquire Rewilding Europe's carbon offsets. This includes buyer-characteristics, preferences, and a study on the willingness to pay for carbon offsets.
- The impact of carbon offsets versus a carbon tax on the emission behaviour of companies. One risk is that carbon offsets are used to continue business-as-usual, which would not decrease the overall level of CO_2 in the atmosphere when Carbon Storage and Sequestration is presented as the only solution.

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Appendix

Appendix 1: Justification of the analytical framework

Environmental factor	What will be covered	Source
Land tenure	-Legal issues regarding land ownership of land -Commodification of nature, and the proper embedment of social relations are essential to consider -Possible speculation with land for investments called *green grabbing*.	(Osborne and Shapiro-Garza, 2018) (Bambus, 2011) (Duffy, 2010) (Fairhead et al., 2012) (Markowski-Lindsay, 2011)
Cost of land	-High cost of land is a barrier for project developers -Secondary sales of commodity after land has been used for carbon offsetting (the sales of biomass of tree plantations) -Large-scale land abandonment drives land prices down in the Mediterranean	(Cacho and Lipper, 2013). (Searchinger, 2010) (Bryan and Wang, 2018) (Fuijware et al., 2012)
Research availability CSS	-Missing trust in consensus that wild grasslands are effective in storing carbon, leading to misguided policies -Farmers not being aware of the option to attract carbon finance -Lack of monitoring is a consequence of the general lack of information about CSS in wild grasslands -The terrestrial projects that do count on CSS are in some cases poorly monitored and verified, leading to unreliable projects and varying quality, creating a stigma for these projects -It is essential to monitor how much and for how long carbon can be stored in vegetation	(Verdú et al., 2018) (Smith, 2014) (Ghosh and Mahanta, 2018) (Swallow and Goddard, 2013) (Allwardt, 2011) (Andonova, 2019) (Simone et al., 2017) (McNish, 2012) (Moss, 2014) (Robotyagov, 2010) (Adams et al., 2014) (Jindal et al., 2018) (Nur, 2007) (Haim et al., 2015)
Climate conditions	-Environmental conditions influence the CSS rate in vegetation and soils -Risks involved in forestry projects including droughts and insect outbreaks -A question of the natural function versus the impact made by the project: a question of additionality -Certain land management strategies can decrease the risk from environmental harm to the land	(Erb et al., 2018) (Allwardt, 2011) (Swallow and Goddard, 2013) (Pohjola et al., 2018) (Schmidt, 2009) (Jones and Donnely, 2004)

Market-context factor	What will be covered	Source
Legal characteristics	The nature of carbon markets differs, providing a barrier to the type of terrestrial projects to be embedded	(Trumpeter, 2008)
Co2 price	-Willingness to pay for a carbon offset is largely in hands of the buyer due to the negotiation-nature for carbon offsets. -Low CO_2 price makes it easy for businesses buying carbon offsets to claim carbon neutrality	(Korthuis et al., 2018) (Ervine, 2018) (Goers et al., 2010) (Robotyagov, 2010) (McNish, 2012) (Fedosov, 2016)

	-Voluntary and Compliance Markets should be linked to increase liquidity and trade	
Volatility in demand	-Regulatory weakness of Voluntary Markets leading to unstable demand -Due to the voluntary participation of businesses on the Voluntary Market, demand is less predictable	(Swallow and Goddard, 2013) (Goers et al., 2010) (Heitzig and Kornek, 2018)
Market-entry process	Regulatory structures of carbon markets differ, providing a barrier to enter for carbon offset projects to be sold on both Voluntary- and Compliance Markets	(Korthuis et al., 2018)

Business model factors	What will be covered	Source
Up-front investment	Gaining financial capital with which land can be bought to start a project,	(Cacho and Lipper, 2013) (De Pinto et al., 2010)
Price uncertainty	Estimating the cost of the carbon offset is sometimes an issue since revenues are made only after the project has been started	(Cacho and Lipper, 2013) (Hungate et al., 2017)
Project location	-Limitless carbon offsets can be bought from abroad -Sometimes human rights are violated due to projects being undertaken in the Southern Hemisphere, were laws and institutions are typically less secure than in the Northern Hemisphere -Corruption occurs and some projects do not happen at all	(Klein, 2010) (Duffy, 2010) (McNish, 2012) (Rogers, 2010)
Project type popularity	-Most terrestrial projects are in afforestation -Different project types have different prices associated with them -CSS rates (see environmental factors) affect the popularity for terrestrial projects (sometimes not knowing rates lead to corruption) because claims can be made without verification	(De Pinto et al., 2010) (Barkin, 2017) (Leonardi, 2017) (Kelly, 2016)

Appendix 2: Open Interview questions and discussion topics

There is a list of factors that influenced the success of currently-ongoing carbon offset projects around the world (1). These factors will most likely also be of concern to Rewilding Europe's case. After reviewing these factors, we will look specifically at Rewilding Europe's carbon offset case (2). Then, we will move to the interview questions that arose based on the literature review done on other empirical carbon offset cases around the world (3). The questions were inspired by the analytical framework shown in Appendix 1.

1) **Factors that influence the success of carbon offset projects according to the literature review**

Factors pertaining to Carbon Storage and Sequestration

- The availability of accepted/proved/verified information on how much CO_2 can be stored and sequestered in vegetation
- Environmental conditions that influence the Carbon Storage and Sequestration 'ability' of vegetation (i.e. drought, lack of rain, soil erosion)
- Lack of knowledge on land management practices to increase Carbon Storage and Sequestration potential
- Uncertainty about the duration that CO_2 is stored and sequestered in the soil

Market-context/financial investment related factors

- The price of carbon offsets, which can be affected by e.g. the volatility of the carbon market conditions, regulations, and the amount of 'free' allowances issued all having an effect on the price of carbon offsets
- Whether the 'true market value' of the Carbon Storage and Sequestration in vegetation can be correctly determined and translated into carbon offset prices
- The number of carbon offset projects offered on the market (competition)
- Available starting-capital for a carbon offset project prior to entering the carbon market
- The longevity of the carbon offset project and ensure continuation of carbon offset payment to sustain the financial income-flow to maintain this project until revenues outweigh costs
- Dependability on foreign demand of carbon offsets creates a risk for parties undertaking the carbon offset project
- High transaction costs for small parties undertaking carbon offset projects: monitoring expenses, reporting, and verification of the changes in Carbon Storage and Sequestration uptake, and organisation costs of clustering farming-activities

Governance/institutions related factors

- State-regulation of carbon offset requirements
- Land tenure and ownership issues
- Public acceptance of the commodification of nature
- The varying quality of carbon offsets offered
- Corruption of the carbon market
- Corruption of carbon offset projects
- A missing monitoring system for the quality of carbon offset projects

- Lack of institutions to start projects and take them to the market, including the lack of information on how to do so
- Policy-makers point to the lack of scientific evidence of proven Carbon Storage and Sequestration in vegetation. Therefore, they have not yet been able to bring carbon offset projects into the general climate-mitigation portfolio. Doing so might stimulate carbon offset projects in natural sinks and enhance financing options for these projects

2) Rewilding Europe's: project idea and planning

- What geographical area are we talking about (number of hectares and where in Europe)?
- What financial resources are necessary for this project? (land acquisition, restoration, management costs)
- What non-financial resources are necessary for this project? (knowledge, information, manpower)
- How are Rewilding Europe's projects currently financed and what would be the estimated percental share of carbon offset revenues in this financial picture?
- Do financial benefits of the carbon offset projects need to outweigh the costs of the rewilding project?
- How does the ownership of the land you intend to rewild look like?

-and what effect has this on the business model?
-what effect does this have on the legal structure?
-and the expected pattern of landowners and the government?

- Do you have to be the owner to rewild the land? Or can you make deals and arrangements with landowners?
- What concrete conditions need to be met for Rewilding Europe to satisfy its operations?
- What makes you satisfied with the outcomes of this undertaking specifically related to carbon finance? (both in terms of rewilding and in terms of financial gains?)

3) Factor-related questions

<u>PART 1: Carbon Storage and Sequestration</u>

- Is there data available on how much carbon can be stored and sequestered in this area (of natural grassland vegetation) as it is, and do you know what the enhanced Carbon storage and sequestration potential will be in the future after rewilding it?
- How will you prove the Carbon Storage and Sequestration gain of CO_2 into the area? Will there be a monitoring system in place?
- What might be the environmental conditions that may have an influence on the Carbon storage and sequestration potential in the area and how are you planning to cope with them?
- Do you know anything about the duration of CO_2 stored in (natural grassland) vegetation? If so, how long would it be?
- What has been your experience of searching for necessary information on how to access the carbon market?

PART 2: The Carbon Market & financial resources

- Do you know how to calculate the price of the carbon offset as to cover the project-expenses of rewilding the land?
- What would be the added value of Rewilding Europe's carbon offsets over carbon offsets offered under the Clean Development Mechanism to name an example? i.e. why should businesses be willing to acquire your carbon offsets instead of others?
- Do you have a strategy to advertise the carbon offsets on this relatively competitive market? if so, how does it look like?
- What is your view on the current price of CO_2 and how will this effect Rewilding Europe's decision to offer -or not offer a carbon offset to the market?
- Regarding monitoring and verification, what is the system you are intending to use?
- Are there any foreseeable opportunities or challenges that come to mind on the monitoring and carbon offset-verification process?

PART 3: Governance and Institutions

- How do you deal with land tenure rights/land ownership when you execute your projects?

-and what do you do to prevent conflict?

- Who will administratively sell the carbon offsets, the landowner, or Rewilding Europe?
- The literature points to a missing monitoring system for the quality of carbon offset projects, do you think this poses a threat to the carbon offsets Rewilding Europe wants to sell? What is your strategy regarding monitoring?
- Policymakers argue that not enough information is available on the consistent Carbon storage and sequestration in wild grasslands, how are you planning to deal with these claims?

- Finally, are there other hampering or promoting factors that come to mind
- Do you have anything you wish to add?

Appendix 3: European Emission Allowances Price Chart

Figure 11 'Emissions Allowances Chart price trend line for May 2019 for the EU ETS'
Source: 'Mark Insider 2019'

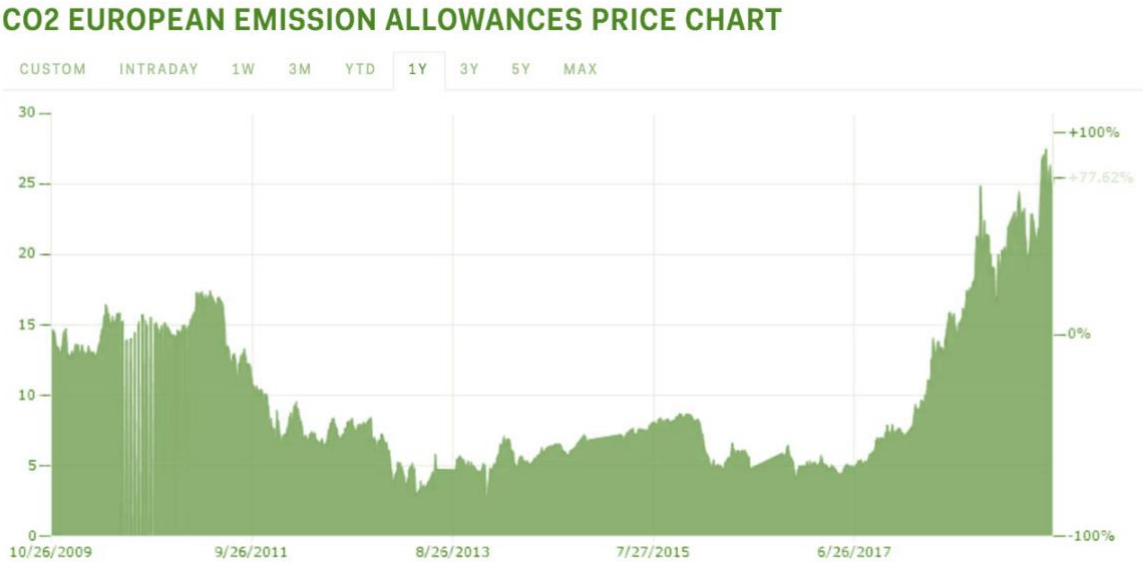

Figure 12 Emissions Allowances Price trendline May 2009-2019 for the EU ETS
Source: 'Mark Insider 2019'