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Summary of WP Student Team

Building Portugal's Official Offsetting Platform - a Comprehensive Analysis of Business Model Components and Industry Dynamics to Develop a Robust and Viable Strategic Framework for Entering the Voluntary Carbon Credit Market

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Building Portugal's Official Offsetting Platform - a Comprehensive Analysis of Business Model Components and Industry Dynamics to Develop a Robust and Viable Strategic Framework for Entering the Voluntary Carbon Credit Market

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Abstract

This thesis explores the development of a marketplace for voluntary carbon credits, addressing market challenges and complexities. It underscores the importance of fostering sustainable corporate practices and advancing the voluntary carbon market. The study employs a mixed-methods approach, combining market analysis, interviews, and financial modeling. Findings reveal market dynamics, corporate pain points in credit procurement, and market inefficiencies. The proposed business model, developed in collaboration with Celfocus, offers a unique solution with blockchain technology, enhancing trust and efficiency. Findings are valuable for the development of a marketplace in the offsetting sphere, aiding stakeholders in navigating the evolving landscape.

Keywords: Carbon Credits; Voluntary Carbon Markets; Field lab; Celfocus

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1. Introduction

1.1. Background and Context

The biggest threat facing our and future generations is climate change. From the start of the Industrial Revolution, the amount of greenhouse gases (GHG) in the atmosphere has significantly increased and the evidence points to the fact that it is caused by human activity (European Parliament 2023). The United Nations Youth Forum has aptly captured the urgency of the situation by stating that we are currently consuming resources equivalent to 1.6 Earths to sustain our current lifestyle. This includes a 45% surge in the use of fossil fuels. Immediate action is needed to address this pressing issue (United Nations 2023). As a consequence of human-induced climate change, global average temperatures rose to about 1.1° C from 1912 to 2020 with drastic aftermath to the entire planet's ecosystem. The impacts of climate change are already observable worldwide. Extreme weather events, droughts, and floods have led to regional conflicts, poverty, and food insecurity (National Oceanic and Atmospheric Administration 2021). Confronted with these unparalleled challenges, negotiators crafted the Paris Agreement — an international treaty addressing climate change (United Nations Framework Convention on Climate Change 2023). Consequently, both private and public actors are setting clear targets for reducing emissions that are consistent with achieving net-zero emissions. To reach the Paris Agreement targets, the international consortium proposed market-based mechanisms as part of a holistic solution. Paris Agreement's Article 6.4 enables global collaboration to cut emissions and achieve climate targets (United Nations Framework Convention on Climate Change 2021). As part of a comprehensive strategy to achieve global net zero by the second half of the century, this market-based mechanism provides polluters incentives and tools that mitigate or even eradicate harmful environmental consequences. This mechanism lays the groundwork for the Voluntary Carbon Credit Market (VCM) (Archer and Pandaya 2023).

This field lab work project is a result of a close collaboration between Nova SBE data science knowledge center and the software company Celfocus. The two organizations are part of the broader consortium of various private as well as governmental players under the "Plano de Recuperação para a Europa" aiding Portugal in the green and digital transformation and increasing the country´s economic and social resilience. This initiative is part of the European Commission's plan to convert Europe into a more sustainable economy. Under the European Green Deal the commission sets the goal to *"transform the EU into a fair and prosperous society, with a modern resource-efficient and competitive economy and no net emissions of greenhouse gases in 2050"* (European Commission 2019). To achieve this goal, significant amount of funding is allocated to projects in various European countries. One project is the creation of the official VCM in Portugal - whereby this thesis aims to support with research and the creation of a business model.

1.2. Research Problem

The VCM is seen as a fundamental tool to combat the climate crisis, pooling investments into regions that need it the most and improving the capabilities of carbon offset projects (Trouwloon and Gilde 2021). Unfortunately, it is highly inefficient. While experts are expecting the market to grow up to 100x until 2050, it has yet to deliver the growth and results that many businesses were hoping for (Blaufelder et al. 2021). Though it denotes an extraordinary opportunity for market participants to achieve environmental impact and financial growth, both external and internal factors have limited this potential.

External factors are highly affected by transparency scandals, particularly with REDD+ projects, which has led to the discreditation of the VCM in the eye of many buyers, and to an overall plateauing of carbon credit demand in 2023 (Climate Focus 2023). The unfavorable market environment since 2020 contributes to the problem: As cash is getting more expensive,

less firms are willing to pay for “intangible” carbon credits that, in the worst case, might not even have the impact that they state to have (Twidale and Mcfarlane 2023). This is partially due to the market’s overall complexity and low transparency: Traditional offsets are not regulated and automated, leading to fundamental problems, including impact overstatement or double counting (Fio 2022). Several businesses have been proven to engage in dubious carbon credit practices, which led to some climate activists disregarding carbon offsetting as a modern form of greenwashing (Raji 2023). On the supply side, while the market is overflooded with “low-quality” carbon credits stemming from avoided deforestation projects, there is a growing demand surplus for local carbon removal projects (Blaufelder et al. 2021).

Innovative start-ups have observed these market problems as an opportunity to create businesses that tackle these issues. This led to the emergence of many young and innovative companies, focusing on improving a specific step in the value chain. A large fraction of climate tech VC funding was allocated to these start-ups, with some of them managing to secure a relatively favorable positioning due to their differentiation strategy. This also exemplifies the competitive rivalry in the market as new players emerge in different parts of the value chain over time, which have the potential to gain large market shares and become established powerhouses of the industry.

Most experts agree that a highly functioning VCM will be integral to achieving net zero goals (Kreibich 2021). Skeptics claim that it will never reach maturity and is simply a method for large businesses to engage in greenwashing, investing in alibi impactful projects for improved ESG scores (Montgomery et al. 2023). This report, however, begs to differ. It follows the diagnostics and reports of highly accredited institutions to emphasize recent market developments and aims for a neutral and unbiased approach. It believes that while the problems mentioned

above are significant hurdles, there are ways to overcome them and finally build a profitable and viable venture in this market. The following section describes the overall structure of the thesis, providing the background to how this report aims to provide an answer to the problems.

1.3. Structure of the Thesis

This thesis will provide insights into the VCM by introducing extant literature to provide a theoretical background and establish a thorough understanding of the market. This includes the investigation of its historical development, regulatory drivers, challenges and criticism, the impact of quality and, lastly, emerging trends and innovation in the industry. This provides a sound foundation of secondary data and introduces the thesis research. Next, the methodological approach is to be examined which focuses on the research objectives, the formation of the research questions, the identified research design as well as data collection and analysis. Followed by the literature review, the analytical section of this thesis is divided into four parts according to the respective individual research questions. These parts all build upon each other and are providing the foundation of analysis. Ultimately, the conclusion summarizes these chapters and presents the essence of this thesis and synthesized findings. Moreover, avenues for further research as well as limitations are to be identified to to provide a constructive, holistic overview and outlook.

1.4. Research Scope

The scope of this thesis is based on findings specifically attributed to Celfocus. This implies that the findings are directly applicable to the company and are intended to provide insight for strategic decision-making. To provide tangible and valuable results throughout the analyses, the focus of examination and discussion will be on market entry via a platform-centric marketplace. This is done to align interests with the external thesis partner and to gain in-depth insights

while navigating through this highly complex market. Nonetheless, the creation of in-house credits will be kept in mind as a complement to the initial marketplace throughout the various analytical sections. This is done to ensure a basic understanding in case the business model suggests the creation of own credits to be published on the marketplace. For clarification, these credits refer to the credits created in collaboration with external project developers which are to be registered via a registry operated by Celfocus. In addition, the scope of the primary data collection is to cover key stakeholders across the value chain to gain valuable insights and ensure validity and reliability.

2. Literature Review

2.1. Introduction to Carbon Markets

The carbon market, established as a mechanism to quantify and trade carbon emissions, aims to mitigate greenhouse gas emissions by offering economic incentives for emissions reductions (Spilker and Nugent 2022). This concept was significantly advanced by the 1997 Kyoto Protocol, which introduced the Clean Development Mechanism (CDM), a cornerstone in the development of international compliance markets and a frontrunner to emissions trading schemes (Williams et al. 2009).

The carbon market's importance lies in its encouragement of both businesses and individuals to reduce their carbon footprint. By assigning a monetary value to carbon emissions, it incentivizes the reduction of emissions and the investment in cleaner technologies, also supporting projects aimed at reducing or removing carbon emissions, such as renewable energy or afforestation (Porsborg-Smith et al. 2022).

Carbon markets are divided into two main types: compliance markets and voluntary markets. Compliance Carbon Markets (CCM) are regulatory mechanisms established by national, regional, or global laws or regulations. These markets control the supply of allowances, distributed under caps set on greenhouse gas emissions for specific industries or sectors. Entities must surrender enough allowances to cover their annual emissions, facing penalties for non-compliance. The European Union Emissions Trading System (EU ETS) is a notable example, launched in 2005 as the first major carbon market, covering around 11,000 installations (European Emission 2023).

In contrast, the VCM operates on a non-mandatory basis, where companies and individuals voluntarily buy and sell carbon credits. Credits in the VCM are generated from projects that prevent, reduce, or sequester CO2 emissions, often involving technology or nature-based solutions (Ahonen et al. 2022). These credits are independently verified, each representing one metric ton of CO2 removed or avoided (Favasuli and Sebastian 2021). While CCMs are mandatory, regulated by various geopolitical jurisdictions, VCMs are voluntary, without oversight by a single regulator or government. The generation of credits also differs; CCMs use a cap-and-trade principle, while VCMs generate credits from CO2 emission reduction or sequestration projects (Rowan 2022). CCMs primarily target large greenhouse gas emitters, whereas VCMs are accessible to anyone looking to offset their carbon footprint (Burzec 2021).

Voluntary carbon credits are instrumental in financing carbon reduction projects, such as renewable energy, through the proceeds from their sale (McKinsey 2020). The global carbon market has seen significant growth, driven by the increasing urgency to address climate change and meet emissions targets under the Paris Agreement (McKinsey 2021). However, challenges such as the integrity of carbon offsetting projects and the double counting of emissions reductions must be addressed to enhance the market's effectiveness. Despite these challenges, carbon markets are vital in the global fight against climate change (United Nations 2022).

2.2. Historical Development of Carbon Trading

The utilization of a market-driven approach in reducing greenhouse gas emissions has become a central strategy in the worldwide effort to combat climate change, known as carbon trading. The origins of carbon trading can be identified in the later part of the 20th century, marked by significant milestones that influenced its course. In 1997, the Kyoto Protocol marked a significant leap in international climate change endeavors by introducing emissions trading as a flexible mechanism to achieve emission reduction targets. 41 countries plus the European Union,

were tasked with meeting binding emission reduction commitments through a combination of domestic efforts and international cooperation, including emissions trading (The Editors of Encyclopedia Britannica 2007). Established in 2005, the European Union Emissions Trading Scheme (EU ETS) is recognized as the inaugural global carbon trading system, marking a significant milestone. Designed to cover diverse industries, its primary objective is to regulate carbon dioxide emissions from power plants and industrial facilities. Under this system, participants bought allowances representing the right to emit a defined amount of CO2, incentivizing emission reductions (European Commission 2021). The implementation of the Clean Development Mechanism (CDM) and Joint Implementation (JI) took place in 2008, under the Kyoto Protocol. These mechanisms allowed developed countries to invest in emission reduction projects in developing nations, earning carbon credits known as Certified Emission Reductions (United Nations Framework Convention on Climate Change 2023). The Doha Amendment in 2012 prolonged the commitment period of the Kyoto Protocol, introducing new emission reduction targets. Despite its adoption, widespread ratification has been limited. The Paris Agreement of 2015 aimed to limit global temperature rise to below 2°C above pre-industrial levels, marking a pivotal shift in climate policy. While the agreement did not establish a global carbon market, it encouraged market-based approaches and voluntary cooperation between nations (United Nations Framework Convention on Climate Change 2023). In the 2020s, various countries and regions, including Japan and Australia, have introduced carbon taxes and cap-and-trade systems as part of their carbon pricing mechanisms. (Dawes et al. 2023). Some jurisdictions have linked their carbon markets, fostering global collaboration. The private sector has also embraced voluntary carbon offsetting, with companies purchasing offsets to compensate for their emissions. Despite progress, concerns remain over offset project environmental integrity and market fluctuations (UBS Investment Bank 2023). The future of carbon trading hinges

on ongoing international negotiations, the emergence of new markets, and the need for robust mechanisms to ensure transparency and effectiveness in achieving emission reduction goals.

2.3. Regulatory Drivers

The pressing need to address climate change has led to the emergence of carbon credits, making the VCM an essential tool for companies to counterbalance their carbon emissions through carbon credits acquisition. Establishing regulations and mechanisms to guarantee the credibility of carbon credits is crucial for ensuring the integrity and efficacy of the VCM. This section delves into the regulations and mechanisms governing the issuance of carbon credits in the VCM. The VCM operates separately from the carbon markets mandated by the government. In the absence of a centralized regulatory authority, specific regulatory entities and standards wield substantial influence over both the broader sector and the criteria for carbon credits issued (Riverse 2023). In the following the most important ones are described in detail. Science based target initiative (SBTi), is a coalition of environmental groups, which guides companies to sustainability targets according to a 1.5°C future. With over 1,000 participating organizations, it allows carbon credits for neutralizing residual emissions or funding reductions beyond the company's value chain. The Net-Zero Standard emphasizes in-house emissions cuts while recognizing the importance of external actions for comprehensive net-zero goals (DFGE 2023).

The Voluntary Carbon Market Integrity Initiative (VCMI) collaborates with various stakeholders. Its aim is to enhance the contribution of high-integrity carbon markets towards climate action and the SDGs. To maintain authenticity, VCMI addresses the requirements of both the demand and supply facets within this realm. On the demand side, it introduces the Claims Code of Practice, serving as a rulebook for companies to use carbon credits voluntarily. VCMI offers an Access Strategy Toolkit to guide countries in high-integrity VCM engagement on the supply side. This toolkit supports national climate objectives and economic prosperity by facilitating

the involvement of countries in VCMs while maintaining integrity and credibility (VCMI 2023).

2.4. Challenges and Criticism

While the VCM aims to tackle climate-related issues, some challenges and scandals have arisen over the last years that fostered a discussion regarding the credibility of carbon credits, and in particular, their standards, measurements, and implications. Investigating these issues through a close lens will hence not only aid to provide literature regarding the overall topic of interest, but also enables a critical view on the VCM and the challenges that are to be addressed when looking at the creation of a robust business model. In the following part of the literature review, both general challenges as well as recent scandals will be identified.

There are general challenges that contribute to the complexity of the VCM. The market is characterized by uncertainties in regulation, general market structures, and prices, which require management flexibility (Sumirat and Yulianda 2013). Furthermore, the issue of complexity is highlighted by the high costs associated with operating in the market, as well as the poor integration of biodiversity and climate change considerations (Oosterzee 2012). In addition, ensuring the quality of carbon credits is challenging. This also goes hand in hand with the obstacles of additionality, leakage, durability, baselines, monitoring and verification (Cao et al. 2012). Furthermore, different motivations and interests behind offset projects can create tensions between supporting local communities and production in developing countries (Karhunmaa 2016). This is also partly in line with broader challenges based on the unregulated nature of the market, which leads to verification and credibility issues, as well as a tendency towards corporate greenwashing. These issues therefore contribute to a lack of confidence in the effectiveness of the market (Spash and Theine 2016; Davidson 2008). Finally, there are challenges related to

compliance with global agreements and different regulations. Adjusting VCMs to fit within the legal framework of the Paris Agreement presents a significant challenge, necessitating innovative solutions and political support (Kreibich and Hermwille 2021). In conclusion, the VCM faces a myriad of challenges ranging from its fragmented and complex nature to regulatory uncertainties, issues of quality, standardization, and legal complexities.

Generally, there are controversies regarding transparency, encompassing issues such as human rights abuses, forced evictions, exploitations, corruption and land seizures as well as fraud and misconduct due to the lack of proper regulations (Oakland Institute 2016; Silverstein 2023). This is criticized as it ultimately leads to a negative impact on communities while diminishing the credibility and trustworthiness of the VCM. Going into depth with the headlines circulating in multiple news outlets, REDD+ credits have caused criticism. According to the UN, REDD+ stands for *"reducing emissions from deforestation and forest degradation"* (UNFCCC 2023) and is a multilateral framework designed in conjunction with the Paris Agreement. Being classified as an avoidance credit, REDD+ is measured via a baseline approach, taking predicted emissions into account. Calculating such a baseline is a complicated endeavor as it is highly based on assumptions and cannot be established with a high degree of certainty (Favasuli 2021). Especially Verra, the largest carbon credit registry by market size, has been under scrutiny within the last year based on the accusation of phantom credit creation in the rainforest offset sphere, mainly based on faulty baseline estimations. According to an analysis of scientific studies and an investigation by The Guardian, Die Zeit, and Source Material, 90% of such Verra credits have been deemed worthless as they do not represent genuine carbon reductions. This was mostly based on faulty baseline calculations, as forest loss appeared to be overstated by up to 400% of the actual indications (Greenfield 2023). In fact, only six percent of the credits were found to represent real reductions in emissions (Padín-Dujon 2023). In combination with these

claims, a study by the University of Cambridge has further found that four projects alone accounted for about 75% of the total forest that was protected while other projects merely had any impact at all regarding the emission efforts (Greenfield 2023). Ultimately, the need to standardize the methodological approach to baselines was amplified based on these findings to mitigate overestimation and create credibility and quality assurance. Overall, these scandals and the respective criticism hint towards the faulty system behind the creation of such carbon credits and the necessity to evaluate the influence of quality in the VCM.

2.5. Definition of "Quality" in Carbon Credits

Defining and measuring quality in carbon credits requires a rigorous approach, and is an ever-changing process, determined on technological and informational advancements. Depending on who one asks, different quality definitions will be provided and there is no such thing as a unified standard for assessing carbon credit quality. Nevertheless, there are certain criteria that almost all entities are willing to compromise on, which will be outlined in the following paragraphs. The US Environmental Defense Fund (EDF) examines the factors contributing to high-quality carbon credits in their paper, "What makes a high-quality carbon credit?" (EDF 2020). These criteria are organized into six key areas, which can be broken down into even more subtopics. Firstly, the concept of *additionality* emerges as a critical criterion. Additionality ensures that emissions reductions, avoidance, or sequestration result directly from the support provided by the carbon credit project and would have not occurred without the intervention. For instance, a renewable energy project dependent on carbon credits for implementation satisfies the additionality criteria, while funding an already planned project does not demonstrate additionality (Jonson 2023).

Another pivotal aspect is the establishment of a realistic and credible *baseline*, essential for accurately gauging the impact of a carbon credit project. This baseline should accurately measure a business-as-usual scenario, meaning the emission projections without the intervention. Utilizing historical data or industry benchmarks is standard to prevent overestimation of emissions reductions (Sullivan 2023).

Robust *quantification, monitoring, reporting,* and *verification* practices constitute the third category, emphasizing the necessity of rigorous data collection and third-party verification to maintain transparency and accuracy. Insufficient practices, such as self-reporting and incomplete data, may compromise the credibility of a carbon credit project. Leakage is a result of this, which occurs when a project's emissions reductions lead to an increase in emissions elsewhere (Sullivan 2023).

The concept of *permanence* plays a crucial role in carbon removal projects, ensuring that the carbon dioxide captured stays securely stored and doesn't get released back into the atmosphere. With an afforestation project, for instance; it's vital that the planted forest isn't cut down or burned for a specified period such as 100 years. If the project is reversed during this time frame, such that the forest is logged or burnt down, the once-sequestered carbon dioxide is released back into the atmosphere (Jonson 2023).

Avoiding double counting emerges as the fifth vital factor, aiming to maintain the integrity of carbon credits. Double-counting occurs when a carbon credit is attributed towards multiple carbon credit programs or buyers, which in turn overstates the real impact of a project (Sullivan, 2023). Next to standardized accounting standards, especially the integration of blockchain technology can play a pivotal role, as will be later discussed in this report (Khodai 2022).

Finally, the consideration of *co-benefits* in the sixth category plays a role in determining the quality of a carbon credit. Projects offering additional environmental, social, or economic benefits beyond CO2 reduction or sequestration are often considered of higher quality compared to those solely focused on emissions reductions (Khodai 2022).

Next to the six quality criteria that evaluate the quality of carbon credits, the demand side also asks for more specified criteria, including geographic proximity. Most carbon credit buyers choose to invest in projects that are a), close to their value chain, or b), close in terms of geographic location. Although the geographical location of a carbon offset project does not have a direct impact on reducing global carbon emissions, the consideration of geography becomes significant when determining which projects to invest in. Therefore, the adherence to the criteria is integral for evaluating and ensuring the effectiveness of carbon credit projects in the broader context of mitigating climate change (Sullivan 2022).

2.6. Innovation and Trends

The VCM is undergoing a notable transformation, spurred by technological advancements and a growing emphasis on the quality and diversity of carbon credits. Innovations such as blockchain technology, AI, and IoT are impacting the market, addressing challenges like fraud, double counting, auditing, and project evaluation. Concurrently, there's a distinct shift towards higher integrity and quality in carbon credits, reshaping market dynamics. These developments are indicative of the market's evolution towards greater sophistication, diversity, and a focus on genuine impact and quality (Sylvera 2023).

Blockchain, at the forefront, has become a transformative force in the market. Known for its transparency and security, it addresses key challenges such as double-counting and fraud, fostering greater confidence among stakeholders. Platforms like Ripple are utilizing blockchain to broaden participation and streamline carbon credit trading (World Economic Forum 2022).

This technological progress in the VCM is matched by a significant shift towards credits of higher integrity and quality. Ecosystem Marketplace's "State of the Voluntary Carbon Markets 2023" report provides key insights into this trend. The report indicates a noticeable increase in average carbon credit prices showing a clear reflection of the market's gravitation towards higher-value credits. This trend is not just about price, it's also about a change in buyer preferences, where there's a notable preference towards premium offerings that assure higher quality and integrity (Donofrio and Calderon 2023). This shift suggests a consolidation of the market around a more discerning group of buyers, who are willing to invest more in credits that meet stringent quality and sustainability criteria. The rising demand for these high-quality credits highlights the evolving nature of the market, where emphasis is being placed not just on the quantity but also on the quality and impact of carbon offset projects (Deloitte 2023). Nature-based solutions, including forestry and agricultural projects, are increasingly significant, occupying a substantial market share. Credits with broader environmental and social benefits are in demand, attracting higher prices, especially those aligned with the UN Sustainable Development Goals (Donofrio and Calderon 2023). Artificial Intelligence (AI) is another key trend, revolutionizing carbon auditing and project evaluation. AI tools, capable of analyzing extensive datasets, provide more precise assessments of carbon reduction projects' impacts. AI applications in carbon credits auditing are also particularly noteworthy (Viact 2022). They demonstrate how AI is becoming crucial for accurate carbon accounting in the VCM, where it aids in verifying the authenticity of projects and enhances the efficiency of the auditing process in a complex and demanding market. The use of AI is instrumental in ensuring the integrity and

transparency of the carbon credits, making it a vital component in the evolving landscape of the VCM (Singh 2022). The Internet of Things (IoT) technology also plays a vital role, especially in real-time project monitoring. IoT devices and sensor technology offer continuous data transmission on environmental parameters, crucial for project integrity and effectiveness.

Lastly, the VCM is diversifying, with an increasing focus on both the variety and quality of projects. There is a growing interest in a range of project types, from traditional nature-based solutions to innovative technological approaches in carbon sequestration. This trend reflects the market's evolving sophistication, with participants seeking projects that promise long-term impact and meet stringent quality standards (Sylvera 2023).

3. Methodology

3.1. Research Objectives

Given the limitations of the existing literature and the complexity of the VCM, this thesis aims to shed light on the ever-changing offsetting sphere. In doing so, it can provide valuable learning perspectives. Furthermore, this research will add to the existing literature and provide an in-depth understanding of market and competitive dynamics, while also investigating customer needs and opening potential avenues for the creation of a platform-centric business model. Additionally, an objective is to advise the external thesis partner, Celfocus, in this endeavor. This practical example and research will support them in making valuable decisions to be implemented to create such a business model in accordance with the emergence of the Portuguese VCM and in relation to the received APA grant. Nevertheless, the findings of this thesis are not only applicable to Celfocus itself, but also provide insights to other key stakeholders, institutions, and academics in general. This is to be underlined by finding solutions based on the respective research problem and the challenges faced by entering the market. Ultimately, the intention of this thesis is to identify the strategic implications of market dynamics as well as customer needs and desires to establish a successful business model that is financially viable. Consequently, the underlying core objective of this thesis is to answer the following overarching research question, and sub research questions:

"In the context of the Voluntary Carbon credit market's unique challenges and dynamics, how can a carbon credit marketplace be developed to ensure a viable business opportunity for Celfocus?"

RQ1: *"To what extent do market and competitive dynamics shape the voluntary carbon credit market and what are resulting strategic implications?"*

RQ2: *"How are corporate buyers engaging in the voluntary carbon credit market and what are resulting pain points in the process of buying carbon credits?"*

RQ3: *"What are the critical components and steps involved in developing a successful carbon credit marketplace?"*

RQ4: *"How large is the business opportunity and what are key financial indicators for building a voluntary carbon credit marketplace?"*

3.2. Research Design

This thesis employs a mixed-methods research design to achieve a comprehensive and nuanced understanding of the VCM. By combining qualitative and quantitative methods, the aim is to explore in-depth insights while formulating a sound business model and investigating its financial viability. The study incorporates a triangulation approach to validate and cross-verify findings from both qualitative and quantitative analyses. This enhances the robustness of the research outcomes by ensuring consistency and reliability across different data sources. The nature of this paper can be classified as exploratory and inductive.

In order to allow for comprehensive and valuable findings, the process of gathering secondary data was fundamental. By conducting desk research and establishing an extensive literature review, an understanding of the VCM could be gathered. Based on this secondary data, a value chain could be established and key players as well as stakeholders were identified. This, in turn, aided the process of collecting primary data as it helped to pinpoint the people of interest to conduct expert interviews with. In addition to these interviews, conversations with the external thesis partner Celfocus were utilized to consolidate a market understanding. Selecting the

interviewees along the identified value chain allowed for comprehensive and valuable data which was then analyzed based on existing frameworks. The combination of primary and secondary data was hence solidified via the application of these frameworks and led towards a high quality of findings. Based on this research approach the structure of the following analytical sections has been determined to build upon each other. While the first three parts utilized the above mentioned primary and secondary data as well as the use of frameworks, the last part quantifies these findings by utilizing financial modelling and a scenario analysis. In this way, the reader is guided throughout the sections intuitively and is introduced to the market, the customers pain points and finally the business model as these analyses incorporate each other's findings. Lastly, the quantification rounds up the analytical part by taking these findings into consideration. Figure 1 visualizes the approach previously described, detailing the primary and secondary data sources used for each research question and illustrating the analytical methods applied.

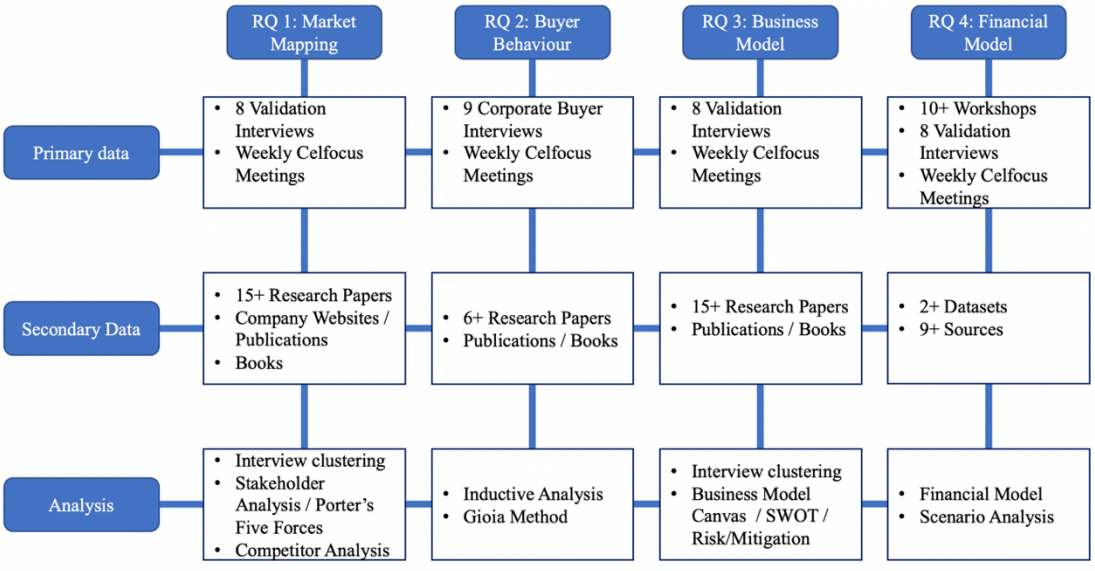

Figure 1 Research Design

3.3. Qualitative Approach

While this thesis employs a mixed-method approach, the qualitative data has been derived via conducting in-depth semi-structured interviews. In the following sections, the data collection as well as the data analysis will be further explained.

3.3.1. Data Collection

To guarantee the efficiency of the data collection, interviews have been divided into two groups. While the first group (Corporate buyer) focuses on demand-side insights, the second group (Industry experts) was utilized to provide market and business insights. Respectively, these interviews were grouped as buyer interviews and validation interviews (Appendix 2). All interviews were conducted between October 2023 and November 2023, totalling 18 sessions each spanning 40 to 60 minutes. Due to the geographic differences of research participants all interviews were hold online using Teams. The demand-side interviews followed a clear structure as per the interview guideline (Appendix 6) while the validation interviews were semi-structured, adapting to the direction of each conversation. In selecting interviewees, key figures involved in the VCM were targeted and research participants were contacted via LinkedIn while sufficient industry knowledge and experience was ensured prior to the interview. This allowed to gather valuable insights from diverse roles including sustainability managers, project developers, consultants, founders, and independent experts closely involved with the VCM in their respective organizations, many with years of experience in the industry. Individuals involved in the development of VCM marketplaces or possessing insightful perspectives on this topic were also interviewed. The interview guide outlined the topics to be addressed and was given to the interviewees prior to the meeting to elicit more reflected responses. This ultimately fostered a higher quality of the empirical data. Beyond the interview guide presented to the interviewees, an internal question overview was created to ensure that the interviewers touched upon

all the most important subjects. During the interview, it was made sure that sufficient information was received on each topic. Furthermore, interviews were also recorded as well as transcribed whereby prior consent was gathered. Recording the interviews was essential to ensure that all information was captured and that responses could be further analyzed afterwards.

3.3.2. Validity and Reliability of Data

Saunders, Lewis and Thornhill (2007) have set out the principles of research design and consider data validity and reliability to be important for research. To ensure data validity, the interview guidelines were designed to meet all important criteria and were drafted after extensive research on the topic. Accordingly, the selected interviewees were carefully selected and screened to ensure that they met all the necessary criteria established in advance. The reliability of the data in question was also ensured by using different methods to collect the data and by using several frameworks to further solidify findings.

However, it is also important to be critical of certain aspects that could potentially undermine the validity and reliability of the data. All the interviews were conducted with people employed by active players along the VCM value chain, based on their expertise in market dynamics. This could potentially lead to restricted insight into their firm's practices. To circumvent this challenge, anonymity was offered to interviewees. Additionally, the authors may have demonstrated a form of observer bias, as the questions selected for the interview guide were informed by previous research. However, this was eliminated, at least to some extent, by the semi-structured interview approach, which allowed for new ideas to generate throughout the discussion. In addition, a lack of inter-firm validity must be taken into account as only one interview was conducted per company. Given a longer period to research this topic, this problem could have been overcome by interviewing up to three employees of different ranks per company. This would

have ensured insight into different perspectives and further demonstrated the validity of the data by reducing participant bias and improving external validity. Nevertheless, several stakeholders within the value chain classifications were interviewed, which also increases the validity of the data by identifying recurring themes and issues. In terms of the generalizability of the data, this paper is somewhat limited to explicit findings based on the external thesis partner Celfocus and its unique attributes, business operations and ideas. Nevertheless, it can be argued that the first two sections of the analysis do indeed present generalizable data based on market research and carbon credit purchasing behavior.

3.3.3. Data Analysis

The data analysis approach in this thesis is tailored to address each specific part of the research, employing a combination of techniques to ensure a comprehensive understanding of the VCM. In the first part of the analysis, primary and secondary data from validation interviews, conversations with the external thesis partner and desk research were utilized to gain a deep understanding of the market and its competitive landscape. The analytical section was introduced via a value chain analysis and a classification of key players on which categorization all following sections were based. Regarding interview data analysis, the perspectives and insights of various stakeholders along the value chain were identified to exhibit key market dynamics, trends, and competitive factors. The interviews thereby helped to validate findings and aided to employ strategic implications for the development of the business model. Moreover, interviews were filtered and organized according to their belonging within the value chain and data was analyzed by grouping findings to support strategic implications. Further, interview transcripts were all thoroughly analyzed, and findings were filtered according to different categories of interest. Thereby, responses were grouped according to key themes and recurring topics (Appendix 3). Finally, the most essential and insightful quotes from these key themes were gathered and used

in combination with the analysis of frameworks to contrive palpable results. Having a strong understanding of existing theories and literature guided the data analysis as it allowed for a better understanding of the topics raised and how to categorize and interpret them. Within this context, frameworks such as Porter's Five Forces were utilized to extract valuable findings that were able to support the qualitative empirical data. An in-depth depiction of this methodological approach is to be found in Appendix 1.

The second analysis part focused on gaining a better understanding on how companies are currently engaging in the VCM. Corporate buyer interview findings were analyzed thoroughly in order to identify trends and commonalities resulting from the conversations. Delving into companies' typical sustainability strategies helped exploring their respective carbon credit approach and scrutinized the criteria for purchasing carbon credits. The findings are presented effectively with the support of own illustrations. The focus of this analysis hereby lies in exploring current pain points organizations are facing when buying carbon credits. Here, the Gioia method, a qualitative data analysis technique, was employed to systematically organize and interpret the data. This method allowed for categorizing the data into first-order concepts (direct quotes or observations) and second-order themes (broader categories or patterns), leading to the development of aggregate dimensions that highlight the primary concerns and challenges faced by buyers in the VCM. This rigorous approach provided a detailed understanding of the demand-side pain points, which are crucial for developing targeted solutions in the business model. Finally, the findings of the of the analysis are thoroughly examined, and existing biases were addressed.

In the third analysis part, validation interviews were analyzed to cluster and extract the most significant market inefficiencies. This involved categorizing and synthesizing the insights from various stakeholders to identify the key inefficiencies plaguing the market. The clustering

process helped in pinpointing specific areas where the market is not functioning optimally. Based on this and the insights from the analyses conducted in part one and two, strategies and solutions were formulated for the proposed business model, aimed at effectively addressing market inefficiencies and enhancing the functioning of the VCM. Consequently, a Business Model Canvas was constructed. Afterwards, a comprehensive examination of the core advantages of the proposed solution was undertaken. Furthermore, tools such as the SWOT Analysis and a Risk Mitigation Strategy were employed to strategically position the solution in the market, identify potential risks, and develop strategies for their mitigation.

3.4. Quantitative approach

While discussing the approach for the qualitative methodology in the earlier part, this report will now further explain the methodological approach for the *quantitative* analysis. It combines secondary data with industry standard methodological approaches and primary assumptions to build a unique financial model. By conducting a scenario analysis, this model also takes future company uncertainties and the volatility of the carbon credit market into account.

3.4.1. Data Collection

Due to the sheer size of assumptions, this methodology section will not do a deep dive into each collection method. Overall, there were two main categories of how specific data points were collected: Primary data and secondary data.

Examples of primary data sources include weekly workshops with Celfocus, in which regular updates on the status of the project and relevant information that could help the work project group and the client, was gathered. These workshops were also thoroughly used to better understand the size and scope of the project, framing the respective relevant cost- and revenue factors for a suitable business model. This report has also partly implemented primary data from

interviews to benchmark certain business metrics, including average transaction size or pricing strategies and levels.

Examples of secondary data mainly encompass datasets or business benchmarks. For example, a report of McKinsey and the Taskforce for Scaling Voluntary Carbon Markets (TSVCM), which analyses carbon credit demand forecast until 2050, taking three different scenarios into account, was used to scale carbon credit demand until 2030 (Blaufelder et al. 2021). Additionally, this report also uses secondary data for internal assumptions, such as CAC benchmarks, or relative emissions, to optimize model precision.

3.4.2. Validity and Reliability of Data

The following section discusses the validity and reliability of the data, as outlined in the previous chapter. There were two main parties involved as the bodies of validation, especially for the primary assumptions. Firstly, Celfocus functioned as the arbiter, inducing that e.g. certain market share aspirations might be too high or the annual team composition too conservative. Subsequent iterations were done after discussing them in weekly workshops, until satisfaction of all parties was reached. Secondly, the Nova SBE Data Science Knowledge Centre was helpful in providing concrete recommendations on how to structure the financial model, which factors to include, and how to provide confidence levels using a scenario analysis. While secondary datasets were “confirmed” as trustworthy sources, the rigorous approach to audit assumptions were mainly done for primary data sources. This, in combination with the scenario analysis, enables confidence that the proposed venture will reach realistic values. However, it should be mentioned that the consortium in which this marketplace operates is still at its beginnings, and strategic tweaks and additional services will have a significant effect on the validity of this solution.

3.4.3. Data Analysis

The logic behind the financial model follows a venture model approach, which operates primarily on market data (growth, market sizing), instead of using past data company on cash flows for revenue and costs predictions. This is due to the lack of this data, as it represents an entirely new business case that is generally not linked to the main business model of Celfocus. Additionally, the volatile and speculative nature of the VCM makes past data a less credible source than market demand predictions. The financial model consists of multiple sub-folders, including revenue projections, cost projections, a break-even analysis and cash flow statements. Moreover, this report offers a unique perspective on how different scenarios affect these variables, providing lower and upper bounds on each of these analytical components. The assumptions were collected and then put into one of four different buckets: Market assumptions, pricing assumptions, revenue assumptions, and cost assumptions. Depending on the nature of each assumption, different calculations were performed to attain the required values. The financial modelling analysis in section 4.4. will provide more comprehensive insights into the logic and results of the mode, and ultimately specific recommendations that can be extracted from this quantitative methodology. All assumptions were discussed and protocoled with the managing Celfocus team, ensuring consistency and a more realistic business case. The goal of this analysis is to draw conclusions on the predicted performance of the business model proposed. This quantitative analysis helps to contextualize the status quo and ultimately paves the way for a more inclusive, differentiated business model for a one-stop-shop marketplace in the VCM.

4. Analysis

4.1. Market Mapping

This section aims to introduce the analytical chapters of the thesis and is essential to foster market knowledge while exploring market and competitive dynamics. Ultimately, it aims to answer the following research question: *"To what extent do market and competitive dynamics shape the voluntary carbon credit market and what are resulting strategic implications?"*

4.1.1. Market Introduction

The VCM is complex in nature, which is why an in-depth analysis is to be performed throughout the following sections. This is vital to understand the market and its value chain, operating stakeholders, market features as well as competitive dynamics and will lay the foundation for the upcoming analyses in the following chapters. The below illustration (Figure 2) depicts a visualization of the VCM based on market research and is simplified for explanatory purposes to portray the most essential activities that are undertaken. It has been divided into three different main categories, namely credit creation, credit trading and demand, which ultimately lead to the retirement of the carbon credit by the buyer.

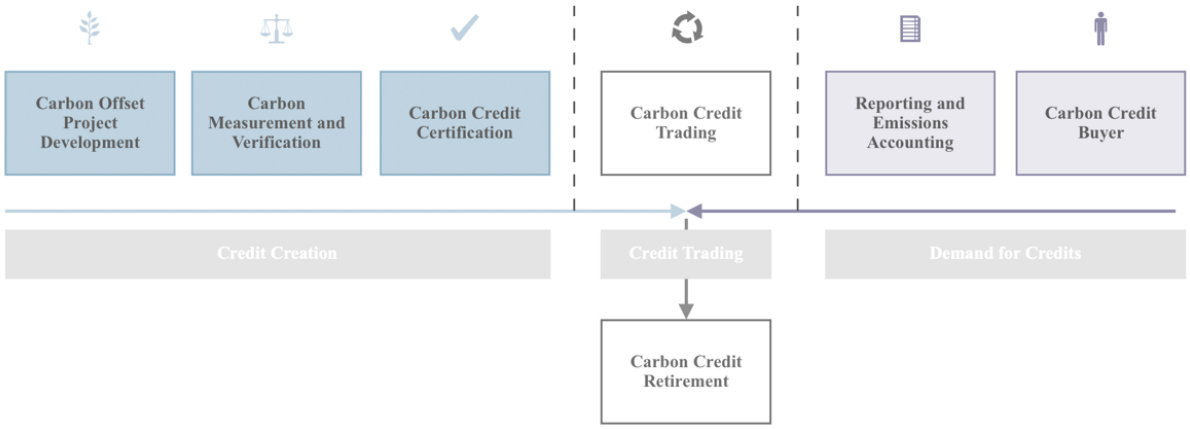

Figure 2 Simplified Value Chain of the Voluntary Carbon Credit Market

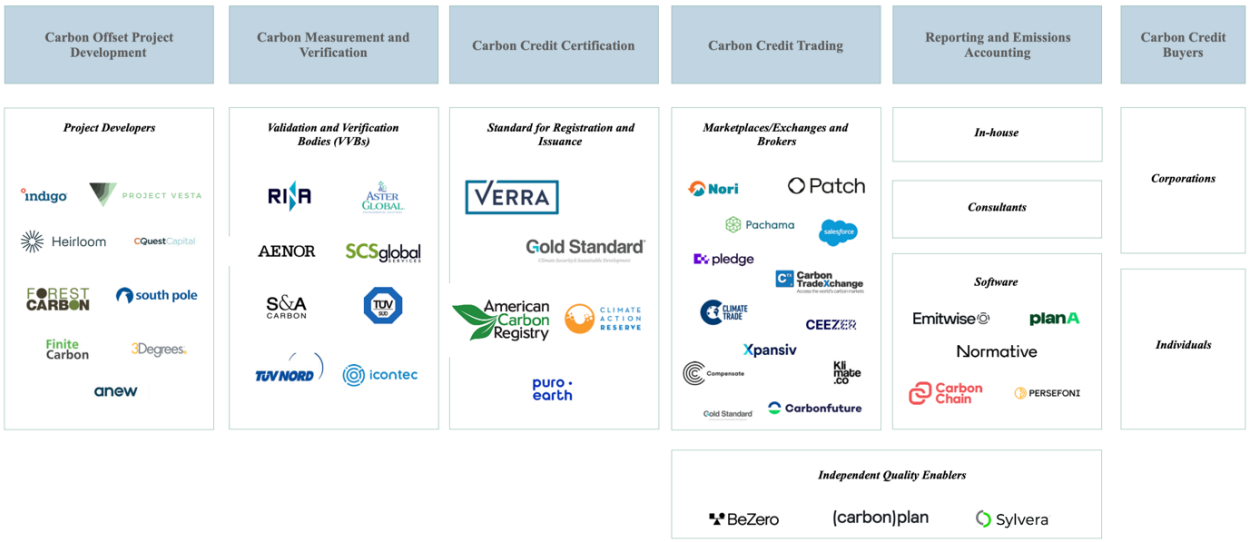

Figure 3 Simplified Map of Key Players in the Voluntary Carbon Credit Market

This value chain has been illustrated to allow for a general overview of this complex market while, additionally, utilizing its categorization for a mapping of key players (Figure 3). Nonetheless, this illustration is not exhaustive of all market players and stakeholders but rather serves as a generalized tool to better understand the market. For an exhaustive illustration, please refer to Appendix 6. Overall, this guarantees a concise structure for following analyses and allows for an understanding of the undertakings of separate responsibilities, influences and strategic implications along those categories and activities.

Going hand in hand with existing complexity, problems arise in the market which must be addressed. Such problems might surface based on the fragmented nature and uncertainty of the market as well as the lack of coherent regulations and issues of visibility. This is further underlined by certain policy failures, the emergence of new players and consequently, the resulting extension of the value chain which in turn increases complexity (Interview F; Interview B). Ultimately, a stakeholder, market and competitive analysis is to follow which will shed some light on underlying dynamics and shall pave the way towards successfully entering the VCM with a robust business model while tackling existing problems.

4.1.2. Stakeholder Analysis

To further understand the market and to identify which entities are involved, a stakeholder analysis is crucial. Based on earlier findings, the respective stakeholders are to be separated into different categories based on their engagement in the value chain. The category of additional stakeholders is separated from the value chain classification as these entities and organizations influence multiple aspects or the entirety of the value chain. As stated earlier, the focal point of this thesis is to create a viable business model for a marketplace and thus, the influence of the stakeholder will be based on marketplaces specifically, rather than the market in and of itself. This influence will be colour coded and separated into three tiers: namely high, moderate, and low influence. It is classified as the degree to which the marketplace is to be affected by the different stakeholders along the value chain. Consequently, this analysis will be beneficial for strategic decision making and considerations regarding entering this complex market and will allow for better insights and clarity. Moreover, possible partnership opportunities for vertical integration might be identified and crucial business model implications may arise. The following table (Table 1) depicts the identification and classification of stakeholders, their role and interest in the market as well as their influence on marketplaces and exchanges in the VCM. Influence, in this case, represents the strength and depth of apparent relationships to gauge the market and imply insights into possible positioning opportunities. The outcome of this analysis and the influence coding is to be explained according to the different tiers and indicates synergies which must be explored to understand market dynamics. Hence, this will be valuable for the following analytical chapters in which recommendations for a business model will be given.

Stakeholder		*Description and Interests*	*Influence*
Carbon Credit Creation			
	Project Owners	- Owning the property, facility or land on which carbon credit projects are performed - Seeking financial incentives and support for collaboration	Low
	Local Communities and Indigenous Groups	- Influencing and affected by project within their areas - Protect cultural and environmental interests	Low
	Project Developers	- Driving the development and implementation of carbon credit projects - Seeking profitability and positive environmental impact	High
	Validation and Verification Bodies (VVBs)	- Verifying and validating carbon credits to ensure they meet the standard set by Carbon Credit Registries - Earning revenue from providing verification and validation services	Moderate
	Carbon Credit Registries (Standards)	- Developing and upholding standards for certification of carbon credits - Maintaining the integrity of carbon offset projects - Ensuring accountability and seal of approval - Earning revenue from providing registry services	High
	Quality Rating Firms	- Rating and evaluating the quality and impact of carbon offset projects and providing information to buyers - Creating transparency and earning revenue from providing rating services	Moderate
	Carbon Offset Project Financiers and Financial Bodies	- Providing funding and financial solutions for carbon offset projects to enable project scalability - New potential innovative funding: blended finance vehicles or sector promotion fund via Mezzanine Capital for carbon offset projects - Earning a financial return return on their investment	Moderate
	Insurance Providers	- Providing insurance coverage for carbon offsetting projects to manage associated risk of probable overestimation or project failure - Gaining an insurance commission and minimizing risks for project developers	Moderate
Carbon Credit Trading			
	Carbon Credit Marketplaces and Exchanges	- Providing a platform where buyers and sellers can directly trade carbon credits - Enabling purchase of carbon credits - Earning revenue from sales; often generated by fees to project developers or end-buyers	
	Carbon Credit Brokers	- Facilitating the transaction between buyers and sellers of carbon credits and providing access across commodity markets - Earning revenue via fees for transaction	Moderate
Demand			
a. End-Buyers	Corporations	- Integrating carbon offset projects into sustainability strategies to demonstrate corporate responsibility - Offsetting carbon footprint of business practices	High
	Individuals	- Offsetting personal carbon footprint - Contributing to environmental sustainability	High
b. Supporting Entities	Sustainability Consultants	- Providing advice and guidance on how to reduce carbon footprints - Earning revenue from providing consultancy services and assisting in navigating sustainability challenges	Moderate
	Carbon Measurement Firms	- Providing accurate measurement and verification of carbon-related data and ecological footprint - Earning revenue from providing calculations and measurement services	Moderate
Additional Stakeholders			
	Governmental Bodies	- Setting policies, incentives and regulations that affect the market - Promoting sustainable development and monitor and enforce environmental compliance	High
	Environmental Agencies	- Advocating for environmental conservation and sustainability - Monitoring the impact of carbon credit projects	Low
	Legal Entities	- Establishing legal foundation for creation, verification and transfer of carbon credits - Ensuring legal certainty at global and jurisdictional level	Moderate
	Technology Providers	- Developing technologies for carbon measurement, credit verification, data analytics and transparency to improve efficiency of the voluntary carbon credit market - Earning revenue from providing technology solutions	High
	Media	- Informing the public about carbon offset projects, developments and news which consequently influences public perception and awareness and shapes reputation	Moderate
	Regulatory Bodies	- Enforcing rules and regulations in the voluntary carbon credit market - Ensuring that the market operates with integrity and transparency	High
	Research and Academic Institutions	- Providing research and analysis on the market - Advancing knowledge and predictions	Low

Table 1 Stakeholder Analysis and Influence Mapping

High influence: Project developers, carbon credit registries and end-buyers are essential for marketplaces as these three stakeholders depict the two sides of the platform; project developers and registries being the main responsible credit creators and end-buyers purchasing the credits. Without either side, incentives to utilize the platform are relatively low. This also brings up questions in regard to engaging either side, whereby the interest of the demand side is determined by the amount of high-quality carbon credits on such a marketplace (Geoffrey et al. 2017, 34). Hence, a strategic implication is to ensure a way to attract both sides to the two-sided marketplace to ensure a functioning business model. Throughout the analysis of gathered primary data it has become apparent that demand will be more challenging to attract than supply. This was underlined by a statement from Interviewee J in which he mentioned that *"there is more supply than demand"* (Interview J). Further, governmental and regulatory bodies have a high influence on the marketplace as platforms must conform to set regulations. Governments can also be enablers in the success of these marketplaces by backing them with a seal of approval, which has positive outcomes on the overall trustworthiness and reputation. Lastly, technology providers influence the development of the overall market and demonstrate crucial partnership opportunities. In addition to supporting credit creation, they also greatly influence the infrastructure of marketplaces through innovative technologies such as broadening offerings via tokenized credits (Interview F). Tokenizing carbon credits involves transferring the details and capabilities of these credits to a blockchain. Thereby, the carbon credit is represented as a digital token which enhances transparency (Khodai 2022).

Moderate and low influence*:* The stakeholders next to the project developers and registries within the credit creation classification have a low to moderate influence on the marketplace as they only affect business operations indirectly. Nonetheless, their influence will increase if the marketplace were to create and offer own credits, which must be considered for further strategic

decision-making. Additionally, quality rating entities may have a greater influence than the remaining stakeholders in this category, as the quality of credits is an important offering factor in marketplaces and influences reputation and desirability for the demand of carbon credits (Interview S). Moreover, credit brokers have been attributed a moderate influence on marketplaces as they act as *"indirect competition"* (Interview F). They usually serve larger companies that require specialized services such as customized carbon offset solutions as well as personalized services and, hence, serve a different segment of the market (Dawes, McGeady and Majkut 2023; Interview F). Nevertheless, this may serve as an interesting insight for the business model of marketplaces as value-adding services for corporations are highly demanded and may enable to capture a larger market share. Additionally, these brokers are often the ones to procure the credits, which is why "*engaging these brokers and keeping them on the platform is key"* (Interview J). Both stakeholders within the category of demand-supporting entities, namely sustainability consultants and carbon measurement firms, have been classified to have a moderate influence on the marketplace and may be interesting services to either incorporate into the business model or to engage in a partnership with. Within the final category of additional stakeholders, legal entities and media can be classified as having a moderate influence, affecting business operations and reputation respectively. The media has the potential to shape awareness and reputation within the realms of the VCM positively or even negatively. This can be substantiated with a previously mentioned example of the published piece by the Guardian which was referred to in the literature review (Greenfield 2023). Lastly, environmental agencies and research and academic institutions have a low influence on marketplaces but rather affect other stakeholders in the market. Nevertheless, the latter could be beneficial in creating a functional business model based on analytical insights, predictions and forecasts.

4.1.3. Porters Five Forces

In this section, Porter's Five Forces analysis is conducted to shed some light on the VCM landscape and to guide the decision-making to implement a business strategy in the following chapters. Thereby, competitive forces are highlighted which result in the uncovering of essential strategic opportunities. The model was introduced by Harvard Business School professor Michael E. Porter in 1979 and "*defines an industry's structure and shapes the nature of competitive interaction within an industry*" (Porter 2008).

Threat of New Entrants

The market is relatively crowded with multiple entities competing in it (Interview F). Nonetheless, it is important to closely examine the entry barriers to determine the possibility of future competition via new entrants. Firstly, a multitude of regulatory constraints that players must adhere to, makes it rather difficult to enter the market. Moreover, these regulations and standards may differ on an international and national level, which adds a layer of complexity. Some countries or states such as China, Portugal or California have already indicated the launch of a national VCM, which will have distinct regulations that may defer from the international ones (Interview F; Yin 2023). This *"may inflict issues such as double counting and necessary adjustments"* (Interview F) and hence increases the *"complexity and confusion"* (Interview F) of the market. These high regulatory barriers are accompanied by intensive capital requirements needed to enter the market. However, these capital requirements differ depending on the positioning in the market and the value chain involvement. For instance, entering the value chain in the credit creation stage is very cost intensive due to high upfront costs for project development and verification as well as registration in and of itself (Verra 2022). This should be considered when looking into the creation of own carbon credits which could supposedly be offered on the marketplace. For marketplaces, costs are relatively lower in comparison, while still requiring

necessary funds to cover the costs associated with creating and maintaining the infrastructure. Moreover, these marketplaces would require the establishment of trust, which can be a difficult endeavor especially regarding the uncertainty of quality carbon credits in the market (Interview S). This level of credibility is difficult to attain and is needed to connect demand and supply, which goes in hand with the following: *"... platforms need to solve a chicken- or- egg problem that pipeline businesses don't suffer from: users won't come to a platform unless it has value, and a platform won't have value unless users use it"* (Geoffrey et al. 2017, 34). This also entertains the importance of the creation of network effects, as these are crucial for platforms to be positive. *"In a two--sided market, same--side effects are network effects created by the impact of users from one side of the market on other users from the same side of the market.". "By contrast, cross-side effects are network effects created by the impact of users from one side of the market on users from the other side of the market."* (Geoffrey et al. 2017, 25). Hence, it can be rather challenging to successfully enter the market as a new entrant. Within this context, one must further investigate the economies of scale. As platforms operate with demand economies of scale in contrast to supply economies of scale, this might be difficult to attain for new entrants. *"Demand economies of scale are the fundamental source of positive network effects, and thus the chief drivers of economic value in today's world"* (Geoffrey et al. 2017, 20). Furthermore, brand loyalty and switching costs are important to investigate. In the marketplace sphere, there are relatively low switching costs. Companies often reevaluate where to buy carbon credits based on news and reputation and try to diversify their portfolio while looking to buy high quality carbon credits (Interview A). If hence a focus on diversified credits and an assurance of quality credits can be guaranteed, brand loyalty could potentially be established by offering this value. The creation of a high-quality brand image as well as the collaborations with governmental bodies may help in entering the market and increase the potential of overcoming these high barriers to entry and to manage low switching costs.

Ultimately, the threat of new entrants, especially marketplaces, can be identified as being **low to moderate** based on relatively high barriers to entry, capital requirements, restricting regulatory constraints and other influencing factors.

Bargaining Power of Suppliers

Suppliers, in this market context, are to be classified as the main entities involved in the credit creation of the value chain; namely project developers, carbon credit registries and the validation and verification bodies hired by the respective registries. These entities and players influence the availability of carbon credits in the market as well as their pricing. While the number of offset project developers in the market can be described as relatively high, the number of registries is limited to four main players which generate almost all of the world's market offsets. One player in particular, namely Verra, represents 72% of total issuance recorded in 2022 (Climate Focus 2022). The way in which credit creation is undertaken is that registries collaborate with trusted and official Validation and Verification Bodies and hire them internally to undergo the verification and validation process according to the respective standards (Verra 2023). Hence, it can be concluded that while project developers might have a low bargaining power, registries comparatively possess a higher power based on trusted and rigorous standards, reputational standing as well as market share. Moreover, the standardization of the credits must be taken into consideration. There is a multitude of different carbon credits in the market ranging from nature-based credits to technology-based credits, which can be furthermore categorized into avoidance or removal solutions. Nonetheless, carbon credits are somewhat standardized within each classification based on rigorous certification requirements set in the market (Blaufelder et al. 2021). However, there is still a need for further standardization. Generally, the market has grown rapidly over the last years, indicating that the volume of credits may

drastically increase until 2030 (Dyck 2022). Nonetheless, the offset demand has stalled in 2022 (Bloomberg 2023; Denig et al. 2023).

Overall, the bargaining power of suppliers in the VCM can be classified as being **low to moderate** based on stagnating demand, the competitive supplier landscape as well as a wide range of somewhat standardized credits available to the demand to choose from.

Bargaining Power of Buyers

As the previous analyses indicated, there are multiple sellers operating in the VCM. Therefore, buyers are provided with a multitude of choices as to which credits to purchase, ultimately, increasing their bargaining power. Nonetheless, it has become apparent that buyers are increasingly focusing on the purchase of high-quality carbon credits by conducting interviews and studying the respective literature. Furthermore, brand loyalty to certain existing exchanges or marketplaces can be described as relatively low. Interviewee A for instance stated that *"the answer for the problem of credibility is diversification"* (Interview A) when explaining the buying process of carbon credits. This could entail the switching between marketplaces and projects. With the emergence of certain negatively connotated news in the VCM regarding e.g. the benchmarking and measurement of impact, buyers have become aware of the importance of diversifying risk in the buying process. Nonetheless, brand loyalty can to some degree be built over time by establishing a loyal customer base. This could be achieved by enhancing visibility and offering a broad spectrum of credits known to be high in quality. Additionally, buyers can access information about various credit projects and their environmental impact and have the ability to choose credits on multiple marketplaces depending on their preferences as well as individual offsetting and sustainability goals.

In summary, the bargaining power of buyers can be assessed to be **moderate.** This is based on the high offering of credits, demand for high-quality and risk diversification, the multitude of exchanges and marketplaces to browse through as well as the availability of information surrounding the development of carbon offset projects.

Threat of Substitute Products or Services

While carbon credits may not have direct substitute products, the surrounding challenges and criticism can be seen as a critical aspect which suggest the need for more effective and comprehensive climate action strategies. Nevertheless, addressing such challenges while ensuring quality and transparency within the market can maintain the relevance and effectiveness of carbon credits. Carbon credits remain unique in addressing carbon emissions directly while being an internationally recognized standard practice to achieve carbon neutrality in the offsetting sphere. This reduces the threat of substitute products immensely. Additionally, few alternatives such as a clean development funds exist that are able to offer environmental impact comparable to carbon credits (Sovacool 2010). Nonetheless, one must acknowledge that this market is dynamic and constantly evolving due to new technologies and innovation which tackle the markets inefficiencies (Interview A). Ultimately, future innovations, especially in the technology space, may enable and suggest potential substitute products as the market is still developing and willing to harness such innovations.

Overall, the threat of substitute products can be determined as being **low** based on limited alternatives, international recognition and unique characteristics. Nonetheless, future innovations or technologies may foster the emergence of such substitutes which can only be stated as a hypothetical scenario that would in turn increase this threat.

Intensity of Competitive Rivalry

Competition within the VCM can be described as fierce, based on multiple companies and entities operating in this complex market. The above-mentioned ongoing innovation in the sphere concretizes and increases the standard on which firms operate and, consequently, fuels this rivalry. Additionally, increasing awareness of environmental sustainability and the importance of offsetting may foster market growth, which in turn, enhances competitive forces. While one can identify differentiation factors among competitors, those are, in particularly in the context of marketplaces, relatively insubstantial or overlapping (Interview F). Within this context, this hints towards the need for a clear competitive advantage and strategy to attract demand to the marketplace, ensure success and gain market share while navigating competitive rivalry. Lastly, the carbon credit market is often seen as a commoditized market, whereby carbon credits are traded in a fashion suitable to those of commodities. However, one should keep in mind that while carbon credits might somewhat inhabit standardized features, those credits should not be entirely seen as a commodity or traded as one. This inflicts further strategic implications in the way in which a platform-centric business model is to be built to succeed in this competitive market which shall be discussed at a later stage.

Finally, the intensity of competitive rivalry in the VCM can be described as being **high** due to overall market growth, multiple competitors, ongoing innovation and relatively few differentiation factors. Nonetheless, strategic value creation, a competitive advantage and a clear differentiation from existing competitors may ease this pressure of competitive rivalry.

4.1.4. Strategic Implications

Based on the performed analysis, some strategic implications arise that are valuable to consider regarding the entry into the VCM, ultimately, aiding the development of a suitable business

model. Laying the foundation for the analyses that are to come in the following chapters, an additional force of complementors shall be discussed briefly to provide valuable insights.

Due to the highly competitive rivalry, a **focus on differentiation** of the marketplace's offering is recommended. This could include not only innovative technology or value adding services, but also the creation of own credits to diversify the portfolio. Moreover, Portuguese projects may enhance the likelihood of local demand while supporting and fostering the market in and of itself. Further, it could be interesting to investigate the buying behavior of carbon credits as bilateral project development is the first choice regarding buyer's transaction methods of purchasing such credits (Appendix 7; Ecosystem Marketplace 2022). Hence, this offers insights into possible differentiation strategies while aiming to foster demand and circumvent high rivalry. This also aligns with the low to moderate bargaining power of suppliers, which hints towards engaging in **collaboration** with project developers to secure a diverse and reliable supply of carbon credits on the marketplace. To address the low to moderate threat of new entrants and the competitive landscape of the market, **continuous innovation** is necessary. This could for instance include novel project types or technological advancements. Furthermore, the **creation of positive cross-side and same-side network effects** should be considered due to the infrastructure of the marketplace. Based on the moderate bargaining power of buyers, there should generally be a focus on the offering of what is deemed a **high-quality credit**. It is important to **increase credibility and trust** which may be accomplished by engaging in a collaboration with stakeholders such as rating agencies or governmental bodies. This is important as one of the interviews validated that *"the main problem is credibility"* (Interview A). Moreover, it was further claimed that there are general issues with trust and transparency which affects the demand and were amplified by scandals and articles such as the Guardian (Interview B). This also goes hand in hand with statements posed by the CEO of company E, whereby the issue of

attracting demand is affected by the importance of high-quality credits (Interview E). These high-quality credits should further include credits that foster *"biodiversity and co-benefits"* (Interview F) to serve companies willing to offset in accordance with certain SDGs (Interview A). Additionally, investments should be made regarding **customer education** to further foster essential trust and awareness. This is important as *"the main purpose of such a platform is trust building"* (Interview S). **Value adding services** should be integrated in the marketplace based on high demand. When **broadening the offering along the value chain**, a large pool of customers can be attracted and the challenge of attracting demand to the marketplace would be eased. Lastly, if the decision is made to create own credits via building an in-house registry, **innovative solutions** are needed to effectively manage high upfront costs. Within this regard, a blended finance vehicle or a sector promotion fund may be beneficial to utilize.

Considering an additional force of **complementors**, one can identify their impact on the market as being **high.** They play a crucial role in shaping and enhancing the ecosystem by enabling innovation, expertise or financial support while improving project quality. Collaboration among these entities can inaugurate opportunities for innovation, knowledge exchange and the development of best practices in the market. In this context, a strategic implication would be to **engage in vertical integration and foster partnerships** with entities along the value chain. This would further enhance market credibility, risk mitigation and investor confidence. Consequently, the more activities that can be targeted by the marketplace along the value chain, the higher the differentiation opportunity and possibility to attract demand. Lastly, these **opportunities for collaboration should be monitored continuously** to provide unique value propositions to buyers and utilize emerging opportunities.

4.1.5. Competitive Analysis

To allow a further deep dive into the competitive landscape, six marketplaces and one exchange that operate in the VCM have been selected based on differentiating features and business operations. The table below (Table 2) depicts this comparison, and the consequential information paves the way for creating a successful and robust business model which is to be developed in the following sections. All information has been gathered via rigorous research and includes the implementation of primary data as well as secondary data via investigating each entities' website and publications. The most essential features which have either been integrated successfully or enhance differentiation have been colored in green to mark important findings. These practices have also been gathered in a table in Appendix 8 and help guide the formation of a viable business model.

Strategic implications are to follow based on these differentiations and similarities and are hinged on the highlighted cells. Ultimately, by exploring the competitive forces and such implications, avenues for potential business operations are accentuated.

Criteria	Patch	Ceezer	Nori	Pachama	Gold Standard Marketplace	Climate Trade	Xpansiv Exchange
Type of Credits offered	Broad range of credits: bio-oil, biochar, energy efficiency, afforestation, gas capture, geothermal power, hydroelectric power, kelp farming, blue carbon, direct air capture, regenerative agriculture, solar power, waste to energy and wind power	Broad range of credits: biochar, biomass, blue carbon, CCS, ocean, mineralization, energy efficiency, renewable energy, ecosystem conservation and restoration, fugitives, other land use and soils	NRT (Nori regenerative tonnes = represents approximately 1 tonne of carbon dioxide stored for 10+ years) —> regenerative agriculture projects that store carbon in the soil	Reforestation and conservation	Renewable energy, nature-based solutions, community based energy efficiency, fair-trade	Broad range of credits in different sectors: agriculture, forestry and land use, chemical industry, waste disposal, biochar, energy, household and community, renewable energy	Broad range of credits offered - largest spot exchange for trading carbon credits; handles more than 90% of spot exchange-traded credits globally (Xpansiv 2023)
Founding Year and Base	2020, California	2021, Berlin	2017, Washington	2018, California	2003, Switzerland	2017, Valencia	2016, California
Number of Projects listed	>160	>7000	18	8	34	194	>1000
Credit Purchasing Options	One-time, periodic purchases or multi-year pre-purchase	Possibility to purchase spot or forward credits	One-time carbon removal, subscription and integration	One-time purchases or investment in original Pachama credits	One-time purchases	Possibility to purchase spot or forward credits	Spot exchange for trading carbon credits
Log-In to view Carbon Projects	Yes	Yes	No	No	No	No	Yes
Ease of Use	Modern platform that is easy to use	Easy to use and navigate	Easy to use and buy NRT instantly	Clear display of projects and credits available	Clear display of projects and respective prices	Clear display of projects and respective prices	Easy to navigate and clear listing of product codes, names and standard available
Value Adding Services	Yes; e.g. API - to calculate emissions of transactions and purchases or Patch CarbonOS - an infrastructure to run carbon credit business	Yes: e.g. portfolio building, order management, credit management, portfolio management and enterprise integration	Yes: e.g. consultancy or API and Smart Contract that allows companies and developers to integrate carbon removal into their applications	Building an API for companies to integrate marketplace into product or service Partnerships with key players such as Verra and Sylvera	Climate+ Portfolio: emissions reductions from a variety of projects - priced per tonne.	API for companies to integrate system, carbon footprint calculators	Portfolio management and management of registry access via Xpanisiv Registry to enable combined inventory of carbon credits from multiple registries, auction platform
Blockchain, AI and Tokenized Credits	n/a	n/a	Marketplace is built on Polygon, an energy-efficient blockchain to enable transparency by publicly and immutably recording all transactions	Harnessing satellite data and AI to ensure quality of credits issued - launched the first AI-based tool for evaluating forest carbon projects, to improve quality and transparency	For certification of credits: developed blockchain application for credit tokenization in partnership with project developer south pole and ixo foundation	Blockchain-based marketplace	n/a.
Value Chain Activities	Carbon Credit Trading	Carbon Credit Trading	Carbon Credit Trading, Carbon Credit Certification via Registry	Carbon Credit Trading, Carbon Credit Verification, Bilateral Project Development	Carbon Credit Trading, Carbon Credit Certification via Registry	Carbon Credit Trading	Carbon Credit Trading
Sale of 3rd Party Credits	Yes	Yes	No	Yes	No	Yes	Yes
Creation of Carbon Credits	No	No	Yes	Yes, Pachama original projects	Yes	No	No

Table 2 Competitive Landscape

4.1.6. Strategic Implications

While these marketplaces and exchanges all sell carbon credits, how they are structured is different. The following strategic implications and recommendations are built upon those structures and successful implementations. Thereby, differentiation factors and value-creation strategies are to be considered to attain a competitive advantage and combat competitive rivalry.

Firstly, and more generally, it is essential to balance the offer of a diversified carbon credit portfolio, as seen in the example of Patch and Ceezer, with rigorous standards of high quality. The importance of quality and diversification was highlighted in multiple Interviews and constitutes the basis for being competitive (Interview S; Interview A). These marketplaces offer credits that are already available on the market, and which were created by external project developers, verifiers and registries. In contrast, Nori partners with existing project developers while simultaneously acting as a registry to certify credits and only places these NRTs on its marketplace. Hence, a possible differentiation and expansion strategy could include the combination of these offerings, namely selling third-party credits while simultaneously acting as a registry and collaborating with project developers to bring their own credits on the platform. Going hand in hand with this, the example of Pachama and its original Pachama credits might be an interesting avenue for operations. As discussed earlier, bilateral project development is promising to investigate as this ensures the alignment of buyers' interests while guaranteeing a sale of transparent and high-quality credits. In combination with becoming a registry this may represent a promising differentiation in the market and could foster value creation. Furthermore, value adding services should be incorporated to ensure competitiveness. In regard to the design of the platform, Patch constitutes a modern example. However, projects and prices should be available as information without log-in requirements such as in the case of Nori, Pachama, Gold Standard Marketplace and Climate Trade. This would increase visibility and might consequently attract a larger pool of buyers. The Gold Standard marketplace, specifically, has implemented a detailed filter to ensure the smooth process of finding and selecting credits suitable to the buyer. This tool in combination with well thought-through call-to-action buttons is an important consideration to attain customers on the marketplace and decrease the exit rate. Additionally, this competitive analysis has depicted the different purchase options such as spot, forward, periodic and multi-year possibilities. Xpansiv is the largest spot exchange for trading

carbon credits with a market share estimated at more than one third of the global VCM (Xpansiv 2023). It is the world's first trading platform to integrate 24 registries and enables the management of registry access to enable a combined inventory of carbon credits. Interviewee J, an expert in the field, stated that *"if you are an entity like a project developer or a corporate client and you have registry accounts with multiple registries, you can link them and then manage all your inventory of carbon credits without having to log into the registries"* (Interview J). This creates value not only for the credit creation side but also for the demand and mitigates double selling by blocking access to the direct registry account. Even though the operational mechanisms of an exchange are in part different from the ones of a marketplace, this could be an interesting feature to further investigate. Lastly, a potential revenue stream could lie within partnership opportunities and the incorporation of APIs. An illustrative and viable example for this could be the integration of Climate Trade's API in Iberias and TravelX's business operations, whereby *"customers can offset the exact carbon footprint generated by their flights during the purchase process"* (Climate Trade 2023). Via such an implementation the sale of carbon credits could be scaled while opening a new customer stream of B2B2C next to B2B and B2C.

Overall, these competitive insights should be kept in mind when entering the VCM and reflect potential avenues for gaining and retaining customers while navigating competitive dynamics and formulating a value proposition.

4.2. Corporate Buyer Analysis

The following chapter spans the data collection and analysis of the conducted interviews with corporate buyers. Through these profound insights a comprehensive understanding of how buyers engage in the VCM via buying carbon credits is achieved. The focus hereby lies on identifying pain points from corporate buyers when buying carbon credits. The resulting pain points will then build the foundation for the creation of a sound business model in the following chapter, effectively addressing the research question: *"How are corporate buyers engaging in the voluntary carbon credit market and what are resulting pain points in the process of buying carbon credits?"*

4.2.1. Introduction

Speaking with companies planning to or already engaging in offsetting practices helped to understand their current offsetting approach in-depth. Furthermore, conversations with sustainability consultants provided a more high-level understanding about the overall market. In the following, key insights from interviews are summarized according to the interview guide structure (Appendix 4).

This chapter starts off with outlining organizations' overall sustainability strategies, highlighting the role of offsetting. Next, companies' carbon offset approaches are thoroughly examined, where the focus lies on three cases resulting from the conducted interviews. What follows is an analysis and description of the key decision criteria influencing the purchase of carbon credits. Finally, the challenges organizations face as a result of engaging in carbon credits are identified by applying the Gioia method, which offers a structured framework, enhancing the rigor and reproducibility of qualitative data analysis. It enables the identification of patterns and themes,

fostering a holistic understanding of challenges in buying carbon credits through expert interviews (Gioia et al. 2012). The resulting pain points lay the foundation for the creation of a sound Business model in the following chapter.

4.2.2. General Sustainability Strategy

In order to gain a comprehensive understanding of how companies approach sustainability and which role carbon credits play in it, it is beneficial to outline a general sustainability strategy. The following graphic (Figure 4) depicts a typical sustainability strategy shared by one of the interview partners, a large insurance company (Interview A).

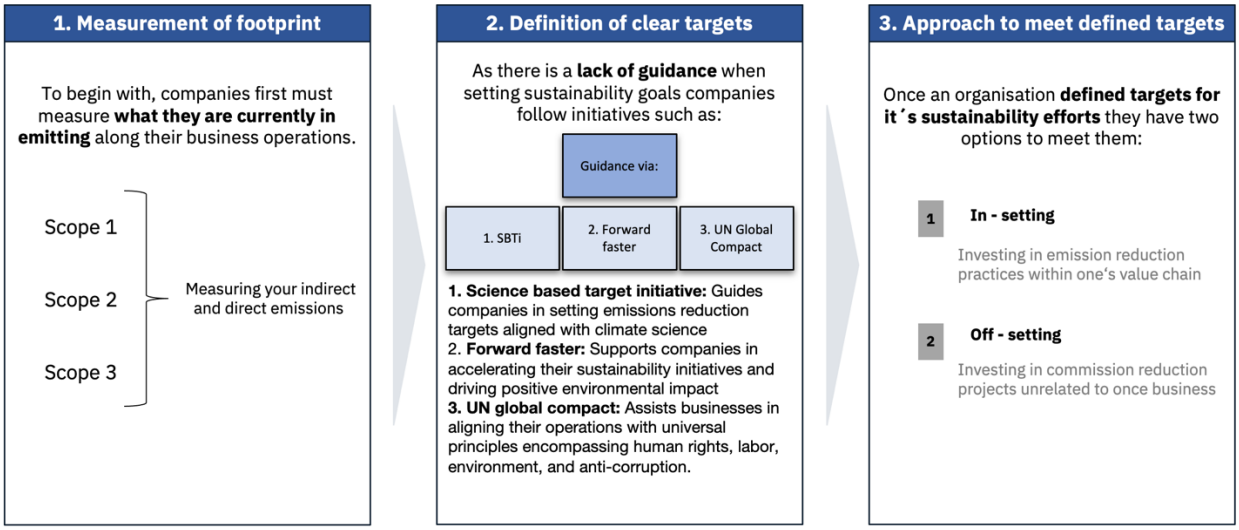

Figure 4 Competitive Landscape

Measurement of Footprint

In the first step, companies can start by conducting a comprehensive assessment of their environmental impact. This involves measuring their carbon footprint from Scope 1 to 3 (National Grid 2023):

- Scope 1 Emissions refer to direct emissions under a company's ownership or control.
- Scope 2 Emissions are characterized by indirect emissions linked to purchased energy.

- Scope 3 Emissions encompass indirect emissions within the company's value chain but beyond its ownership or control.

Our interview partner, a large Portuguese insurance company, reported that especially, scope 3 emissions introduce a spectrum of complexities for organizations, stemming from the diverse nature of indirect emissions across the entire value chain. Resulting from the conversation, one problem the insurer has been confronted within the process of measuring it´s footprint are missing methodologies for certain business areas. Here, the interview partner mentioned investment assets classes, as well as insurance products, which lack methodologies for footprint measurement. Among other reasons, this leads to an inaccurately calculated CO2 footprint, the company reported.

"The only thing I can be certain of is that the carbon footprint is wrong as the number of assumptions [the calculations are based on] is so high" (Interview A)

This problem has surfaced consistently in the discussions, such as in one instance with a Portuguese bank stressing the difficulty in obtaining precise data for measuring their carbon footprint. Still, they believe that this is a crucial step to start any offsetting activity.

"It's very difficult to understand what our footprint is as data is an issue […] we will only start offsetting once we acknowledged our footprint." (Interview L)

Despite the challenge in measuring scope 3 emissions, an interviewee from an educational institution emphasized the importance for organizations to consider these measurements when establishing sustainability goals.

"By the end of the year, we might have our scope 3 emissions and I guess only after that we will be able to start establishing targets." (Interview R)

Definition of Clear Targets

Once the environmental footprint is measured, the second step consists of companies setting clear and ambitious sustainability targets. From the interviews, it became evident that companies clearly differentiate between setting climate neutral targets or net-zero targets.

"Being climate neutral means, when I have too much money, I can completely offset my entire emissions, but if you plan to become net zero, you can merely offset around 5% of your emissions and the rest really must be reduced. "(Interview I)

However, defining precise sustainability goals proves challenging due to regulatory changes, the interviewee reported. As a guidance for defining these targets, companies can follow different initiatives which aim to provide a certain level of standardization and credibility to the companies' sustainability targets. One interview partner, for example, aims to be part of the science-based target initiative (SBTi) helping them to set their sustainability targets.

"Obviously, SBTi helps us a lot to understand [our offsetting efforts], we don't have yet the certification, but I think it is the best that exists at least today. […] it helps us to know if we reduce 'this' we will become net- zero." (Interview A)

Involvement in the initiative necessitates organizations to prioritize emission reduction activities within their company boundaries. Carbon offsetting through credits is only allowed when seeking additional reductions beyond their value chain (Interview I). This is a relevant detail as implementing emission reduction initiatives internally demands considerably more resources,

as argued by the interviewee. Next to clearly defined sustainability targets a respective time horizon needs to be set as well. On that note an interview partner emphasized the difficulty as well as the relevance in setting clear "Interim targets" compared to long term ones. Short to midterm targets create a greater imperative for action, facilitating companies to be on track with their defined targets whereas targets set over a long period of time loose significance.

"As my CEO used to say, I can say anything I want, as I won't be there in 2050 [where the company needs to be net-zero by European regulation]." (Interview A)

Definition of Clear Targets

In a last step, to achieve sustainability targets, companies need to decide between carbon in setting and offsetting measures, or a mix of both. Interview partner A, a large Portuguese insurance company, aims to meet the previously defined targets by carbon in setting. This sustainability action can be described as projects within a company's own supply chain, to reduce or remove emissions as described by the interview partner.

"My responsibility is to answer the question where do I put each euro […] and if I have the chance of buying a carbon credit or reducing, I'm sure where I will put my money [in insetting efforts]." (Interview A)

However, in the long term, the organization plans to invest in offsetting measures to avoid emissions that cannot be avoided internally. The approach of starting with insetting, to then transition to additional offsetting activities over time, is an overall tendency among the organizations that have been interviewed. This finding is supported by a conversation with a sustainability consultancy, which works with a broad range of different organizations supporting them

in their insetting as well as offsetting endeavors. From their experience, offsetting is typically the last step in a company's overall sustainability strategy.

"[Organizations ask themselves] How will they reduce, how will they avoid, and then as a last step, they could do the offsetting with us." (Interview G)

However, some companies, like a major German chemical company, aren't convinced that offsetting is a viable solution. Even with 18 million tons of yearly emissions prompting sustainability actions, they're questioning the efficacy of carbon credits. Instead, they rather focus on insetting measures that are aligned with their core company values.

"In our pursuit of achieving net zero by 2050, we view offsetting as not the primary tool for reaching our goals. Instead, we have a range of different levers [focused on in setting] at our disposal." (Interview I)

4.2.3. Carbon Offset Approach

After outlining the overall sustainability strategy and what role offsetting plays in it, this chapter describes in detail the different offsetting approaches companies can take. Figure 5 depicts the different approaches companies can take engaging in the voluntary carbon market. They can either invest in own carbon credit projects, partner up directly with project developers, or purchase spot carbon credits on marketplaces, leading to different levels of engagement in the carbon credit value chain. Based on the interviews, a trend was identified where companies tend to begin with a low-engagement approach, such as purchasing spot credits, in the short term. As their strategic horizon extends into the future, companies increasingly engage in carbon credit activities, by for example setting up their own carbon credit projects. The following graphic depicts three distinct approaches that companies can adopt for carbon credit offsetting

along their short-term, mid-term and long-term strategic horizon with respective level of engagement.

(1) Low Involvement

"We have our trading desk where we buy and sell credits from broker platforms. Right now, we will not retire on our own but will do so in the future." (Interview D)

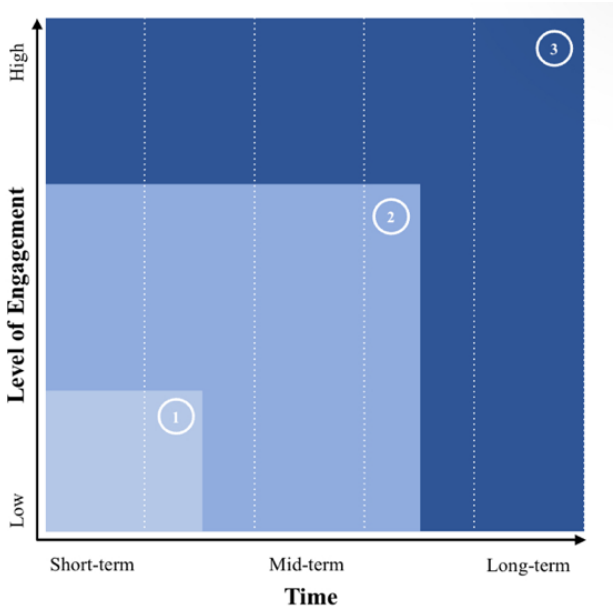

Figure 5 Overview of offsetting approaches

Some companies opt for a less involved approach in the credit creation process, choosing to purchase spot credits directly from broker platforms. An intriguing case surfaced during the interviews, particularly with an energy provider. This organization took a unique approach by establishing an in-house department functioning as a brokerage. This department is dedicated to buying and selling spot carbon credits, showcasing a distinctive strategy within their carbon credit engagement. The credit portfolio they cultivate serves a dual purpose. It can either be utilized to retire credits within their organization or, in favorable market conditions, be sold into the market. This flexibility allows them to strategically manage their carbon credits based on market dynamics.

(2) Moderate Involvement

In adopting this approach, corporate buyers have the opportunity to establish direct partnerships with one or more project developers, fostering a collaborative relationship that spans a considerable long-term timeframe. Throughout this strategic alliance, the corporate entity actively commits to sustaining a reliable and consistent supply of carbon credits, thereby contributing to the stability and continuity of their carbon offsetting initiatives.

(3) High Involvement

"We are building a forestry fund which is SFDR validated, basically meaning that it complies with the Portuguese regulation […]. This is the most important project we are doing, so we are building our own credits and maybe sell to the others". (Interview A)

This case study delves into an insurance company, showcasing a robust carbon offsetting commitment. This company demonstrates its dedication by substantial investments—amounting to 12 million euros—in a carbon credit project based in Portugal. This forestry project extends its impact beyond mere tree planting and emissions sequestration; it embraces a holistic approach, aiming to make a positive social contribution to the region. The project's objectives cover a broad spectrum. This includes establishing a source of high-quality carbon credits for their own use, as they maintain control over every step of the value creation process. Simultaneously, they aim for financial returns by planning to sell these carbon credits to their clients, hence, seeing this project not necessarily as a cost, but rather as an investment. Through discussions with 20 companies within their client base, it already became evident that there's a clear market demand for their credits. Companies are keenly interested in the project primarily due to its credibility. Being the largest insurance company in Portugal, they enjoy widespread recognition, making

them a household name. In the context of purchasing credits, credibility holds utmost importance for companies, and the project leverages this advantage effectively.

Comprehensive Approach

"It's more to have different places where we can get credits from not just relying on the market but having own internal projects and partnerships." (Interview M)

Besides the cases mentioned earlier about how companies approach carbon offsetting, some organizations adopt a more comprehensive strategy encompassing involvement levels. From the interview with an energy provider, it became evident that the company utilizes three distinct offsetting strategies. Firstly, they explore the VCM brokerage avenue. Here, the company buys and sells credits with a brokerage department. According to the interview partner, they are not able to avoid going into the VCM in a short-term timeframe.

"On short term, we wouldn't be able to escape going to the market because [own] projects take some time to develop." (Interview M)

Secondly, there's an emphasis on bilateral partnerships described in the "medium involvement" approach earlier.

4.2.4. Decision Criteria for Buying Carbon Credits

Nature-Based versus Technology-Based Credits

To begin with, the market can be delineated into two distinct types of credits: firstly, nature-based credits, and secondly, technology-based credits. In general, companies purchasing carbon credits at least in Europe, based on the interviews, lean towards nature-based solutions rather than technology-based ones.

Furthermore, buying technology-based credits is rather seen as an investment into the future of the respective technology itself than an offset investment. This perspective resulted from the interview with a sustainability manager from, a leading German machinery manufacturer.

"Because obviously with those [technology based] projects, there's a lot less experience around [hence it is] not necessarily something where you would claim credits for to account emission, [we see it rather as] our contribution towards the technology's future."

(Interview P)

Additionally, another interviewee highlighted a growing interest in nature-based solutions, emphasizing the increasing significance of biodiversity and social aspects which are more effectively met with nature-based projects.

"We are trying to move from a carbon discussion to a nature discussion, because that's the future, including biodiversity, including social, including everything […] people are only focused on carbon and forgetting everything else." (Interview A)

Another argument for the preference of nature-based projects compared to technology-based projects are the considerably higher costs associated with technology-based options.

"Technology based solutions are significantly more costly, so we focus more on nature based." (Interview D)

Decision Criteria when Buying Credits

Based on the interviews, various criteria are pinpointed for purchasing carbon credits, of which the most crucial ones are highlighted in what follows. One consistent theme in interviews with corporate buyers showed that they seek carbon projects closely aligned with their corporate identity. For example, the interview with a Portuguese bank showed that they have a focus on blue carbon credits as Portugal is a country with widespread coastlines.

"All our history is connected with the sea. We have the Azores, Madeira. I think it's a good way to help the country and to empower the ocean." (Interview L)

Furthermore, from the interviews, it becomes evident that companies can have geographical preferences for their carbon credits project they invested. This results from a conversation with a major logistics company in Portugal focusing on national projects.

"Yes, the calculated carbon footprint for our Express and Parcels offer is compensated through the support of a couple of offset programs, focusing mainly on Portugal." (Interview N)

Some interviewees discussed technical criteria for purchasing carbon credits. The Saudi Ministry of Energy, for instance, prioritizes permanence as their primary consideration when looking at carbon credits. It is interesting to note that they prefer technology-based credits as opposed to nature-based solutions contrasting the European preference on nature-based credits described earlier in this section.

"The more permanent the carbon credit is, the more valuable. So, in the case of, let's say, natural-based solutions like reforestation projects, they're not very valuable compared to, let's say, direct air capture or other technologies." (Interview K)

4.2.5. Pain Points Buying Carbon Credits

Following the general overview of how companies participate in the carbon credit market, this section delves into the challenges and pain points they encounter when buying credits — a central focus of this thesis.

To identify pain points, which are representative for the market, the *Gioia method* provides a useful structure bringing robustness to the findings presented in this part of the thesis. To establish the data structure, which represents a central element of the method, a coding process is applied. In this process the empirical observation, resulting from the interviews, are explained in increasingly abstract terms. The first step is an open coding of *first order concepts* describing the findings from the various conversations in a very descriptive manner. Here, the respective first order concepts are backed up by quotes from the conversations that can be found in the data table (Appendix 5) ensuring robustness of the findings. In the next step, *second order themes* are introduced. In a more abstract way of describing the findings, this step helps to categorize the first order concepts providing a detailed overview of existing pain points from corporate buyers when buying carbon credits. In the final step aggregated dimensions help to categorize the respective pain points into internal and external.

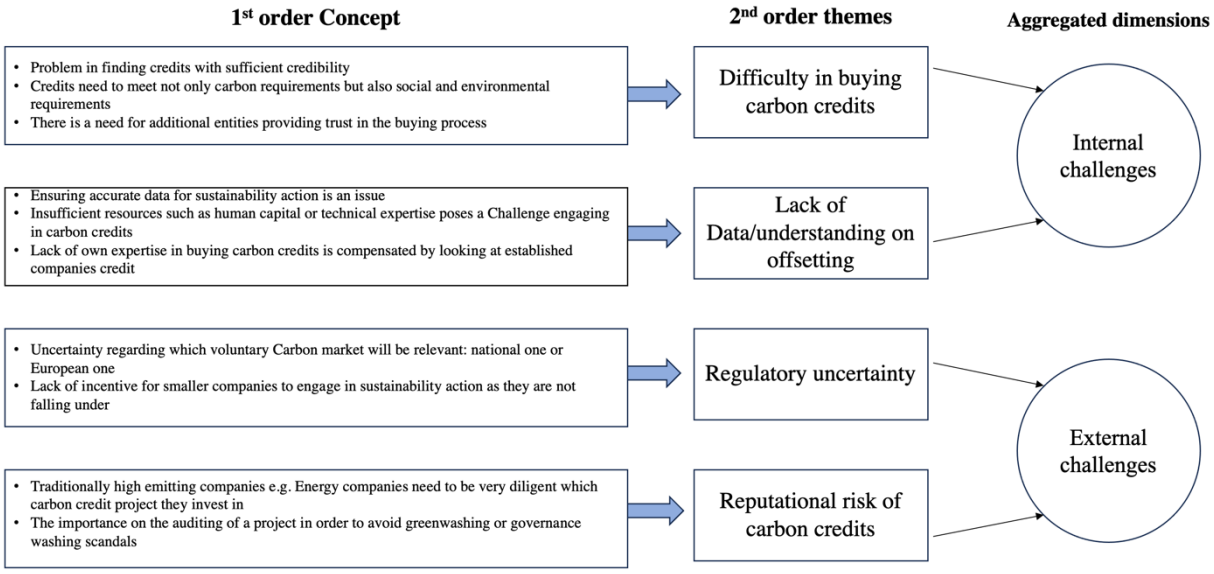

Figure 6 Data Structure

Figure 6, depicts these relevant pain points gathered from the interviews, describing challenges such as selecting the appropriate credits, navigating regulatory uncertainty, facing reputational risks linked to recent greenwashing scandals in carbon credit projects, and dealing with a shortage of relevant data and understanding regarding carbon credits. The respective pain points are then categorized in internal and external challenges corporate buyers are facing when engaging in carbon credits.

4.3. Business Model

In the VCM, an efficient marketplace is vital, providing a platform for the interaction of supply and demand. It's important to have a trustworthy organization to guarantee the quality of the credits traded. Thus, in partnership with Celfocus, the main objective of this sub-thesis is to create a business model structure for a VCM marketplace. The research question is the following: "*What are the critical components and steps involved in developing a successful carbon credit marketplace?"*

4.3.1. Market Inefficiencies

The business model for this marketplace will be developed in collaboration with Celfocus. Therefore, the primary aim of this analytical section is to develop the business model structure for a VCM marketplace. To accomplish this, incorporating the key findings from part one (market mapping) and part two (corporate buyer analysis) is crucial. Identifying additional market inefficiencies will be important to fully understand the market's complexities and to ultimately propose a suitable solution.

Part 1 provided a detailed analysis of the VCM, identifying key stakeholders and competitive dynamics to provide strategic implications for a viable business model, with insights and best practices from established marketplaces detailed (Appendix 8).

Part 2 focused on the challenges faced by corporate buyers in the VCM, uncovering issues like credibility, complex buying processes, and the demand for quality carbon credits. These findings, crucial for shaping the platform, guide the development of features and services to align with the specific needs and preferences of the market.

To gain a deeper insight into the challenges of the VCM, validation interviews were conducted, focusing on identifying and extracting the key market inefficiencies (Figure 7). Through the analysis of various interviews, market inefficiencies were grouped and assigned to each interview partner. These discussions highlighted various problems the demand side faces, pointing out many similar industry concerns. The market is challenged by fluctuating demand and high project development risks due to upfront costs, further complicated by unclear regulations (Interview E). An imbalance of supply and demand has been created by quality concerns and regulatory uncertainty, while transparency and trust issues further fragment the market (Interview H; Interview B). Moreover, a lack of standard protocols and guidelines exist, which complicates risk assessment and management (Interview J; Interview F). There's also an absence of agreed-upon methods for measuring and verifying carbon offsets. This is particularly problematic for large corporations, which seek assurances about the quality and legitimacy of carbon credits through certifications (Interview O). The European market does also face unique supply challenges, such as the lack of certification bodies and developers, compared to more developed markets like Australia and the US, indicating the need for regional market adaptations (Interview O; Interview E). Further, the importance of transparent and reliable carbon offset projects, along with the necessity of customer engagement in sustainable practices, was emphasized (Interview H). Ultimately, challenges in quantifying and validating carbon offsets have been addressed, with a stress on the need for effective, scalable solutions for carbon sequestration (Interview B).

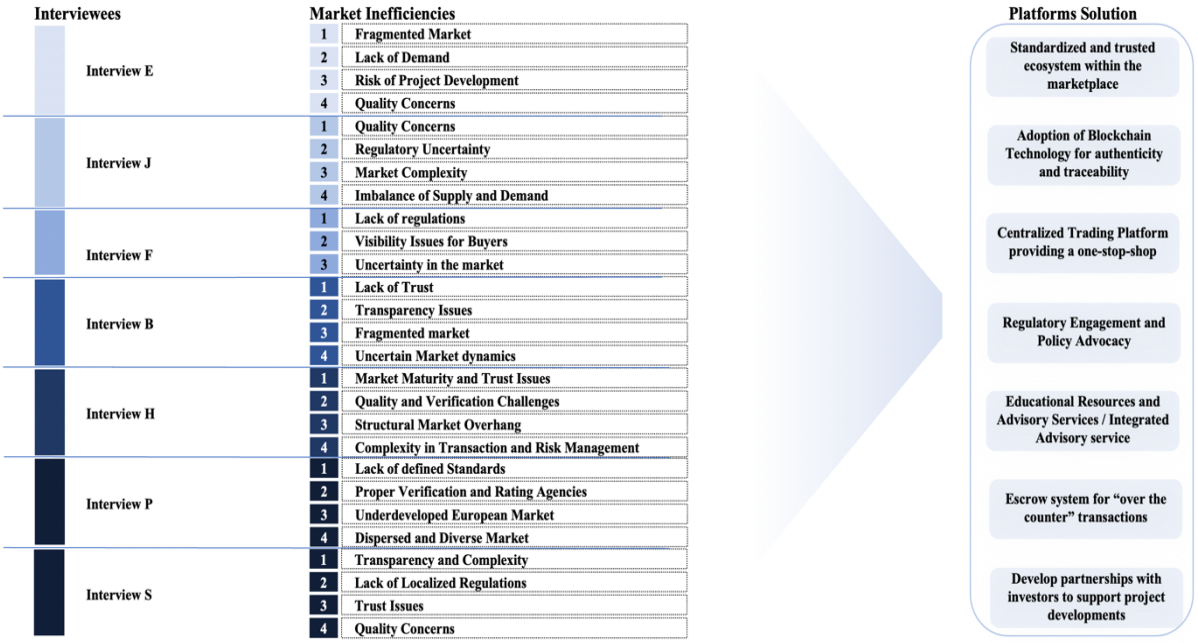

Figure 7 Market Inefficiencies

From the analysis of the validation interviews, a set of platform solutions has been deduced to counter the VCM's identified inefficiencies (Figure 7). It is proposed that a standardized and trustworthy ecosystem is established which includes the integration of blockchain technology to authenticate and trace the credits. A centralized trading platform, acting as a comprehensive one-stop-shop, is therefore recommended. The solution includes active regulatory engagement and policy advocacy, alongside providing educational resources and advisory services to empower market participants. Additionally, the implementation of an escrow system for secure over-the-counter transactions and the development of partnerships with investors to support project developers have been indicated as instrumental strategies derived from the interviews (Figure 7).

4.3.2. Business Model Canvas

The following section is about creating the Business Model Canvas (Figure 8) for the Marketplace. The aim is to strategically map out and align the platform's key components by using this

framework. This will enable a comprehensive understanding and effective implementation of the business strategy, ensuring the marketplace's success in the evolving carbon credit market.

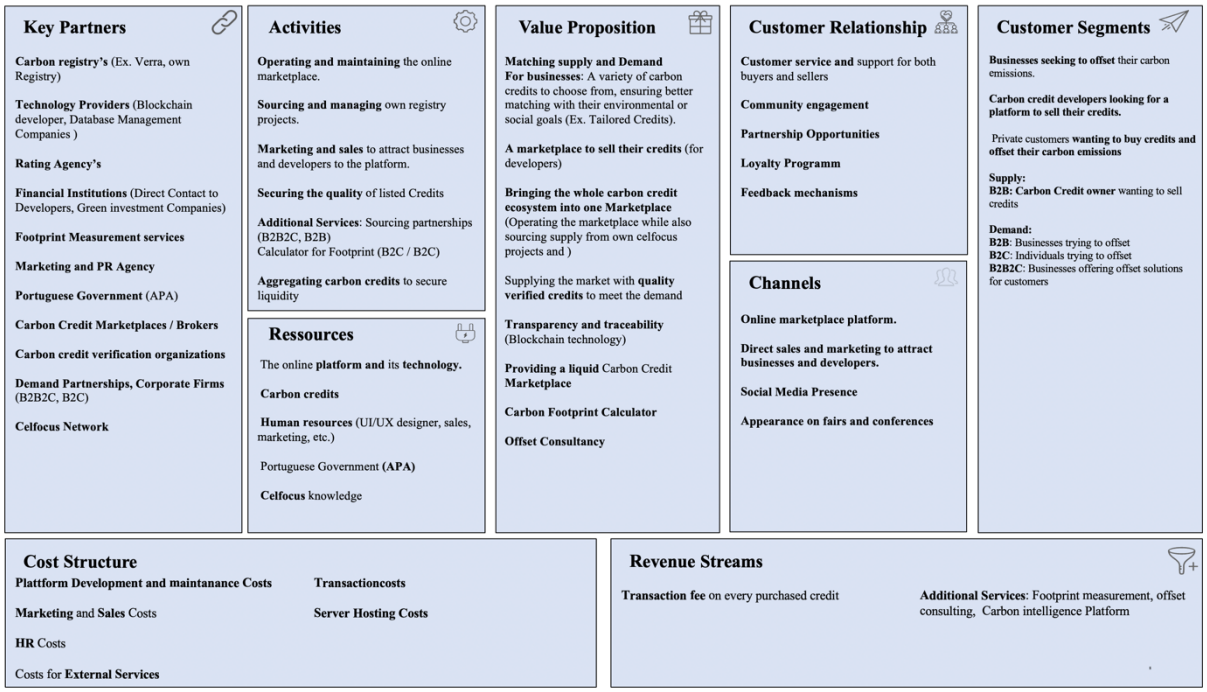

Figure 8 Business Model Canvas

The platform's success hinges on forging solid **Key Partners** in the carbon credit domain. Notably, carbon registries and rating agencies play a pivotal role. Reflecting on Interviewee E experiences with a similar marketplace, the demand issue he faced was primarily through the lack of high-quality credits (Interview E). This challenge can be addressed by either partnering with registries or by introducing own rigorously verified projects, ensuring standardized quality. A mutually beneficial revenue-sharing model with registries like puro.earth, in which they offer their credits on the marketplace, can enhance the platform's appeal while pushing towards collaborations. Partnerships with rating agencies play a crucial role in guaranteeing that customers receive secure and high-quality credits upon rating these in advance of purchasing. Technology experts specializing in blockchain, and database management are vital, given the complexities of blockchain infrastructure development. Green investment-focused financial institutions and carbon credit project developers form another segment of key partners, bolstering

the supply side of the marketplace. Engaging companies that embed offsetting in their operational framework, like airlines, can effectively address the B2B2C demand segment (Interview J). A partnership with an airline would involve integrating an API into their business operations, enabling individuals to offset the emissions directly linked to their purchased flights. Collaborating with established Carbon Credit Brokers, who have existing connections with the demand segment, can be instrumental in developing a customer base in this market area (Interview J). Additionally, aligning and working closely with the Portuguese Government lends credibility and trust to the platform. Footprint measurement services and marketing agencies will enhance the operational efficiency and aid in effectively communicating value propositions.

Key Resources encompass the technology driving the online platform and the comprehensive inventory of carbon credits. The Celfocus Network, encompassing rating agencies and strategic partnerships, is invaluable. Human resources are essential, including chief levels, expert UI/UX designers, AI and Blockchain developers, marketing professionals, and sales representatives. Celfocus' expertise infuses critical insights and knowledge into the venture.

The platform's **Core Activities** lie in ensuring its operational self-sufficiency, complemented by dynamic sales and marketing strategies to engage and attract users on both sides of the two-sided-marketplace. In terms of key activities, it is essential to provide and sustain an API that allows customers to integrate the Marketplace on their own websites, which is a critical step in establishing a robust customer base. Another activity centers on aggregating carbon credits, thereby simplifying the search process for buyers by offering a diverse range of credits. It is therefore crucial to establish partnerships with other registries and to aggregate credits to ensure liquidity and a broad portfolio for the users. A fundamental operation involves the management and sale of own carbon credits registered by an internal registry in cooperation with external

project developers, differentiating the platform with unique benefits and liquidity. While the sourcing of projects is consistent with Celfocus' broader strategies, it serves as a supportive element within the marketplace. A critical priority is maintaining stringent quality standards for all credits listed on the platform. Overall, the significance of creating a one-stop shop in the VCM by incorporating as many activities as possible along the value chain is crucial. Such activities include footprint measurement services and offset consultancies along with a carbon credit intelligence platform. These additional services play a pivotal role in generating demand and enhancing the market's appeal, while attracting additional users and revenue.

The **Value Proposition** extends beyond being just a marketplace by providing additional offerings. Through adopting strategies similar to other exchanges like Xpansiv, the goal is to facilitate over-the-counter transactions between suppliers and buyers, which is key in capturing a significant portion of the market share. Interviewee E stated: “about 90% of carbon credit transaction are over the counter transactions”, which means that two entities agree on a deal independently, and then use the platform to finalize the trade. Therefore, including a secure mechanism for escrowing credits and the corresponding payments until both parties approve the transaction. Furthermore, integrating a Carbon Footprint Calculator, tailored for both individual and corporate users, is important, as the inability to calculate ones Footprint hinders companies to offset (Interview H). This tool is designed to aid in tracking and managing carbon emissions more effectively while consultancy services help with assessing the company’s carbon footprint. The distinct value of the platform will therefore lie in its ability to create a unified ecosystem (Interview H). This ecosystem not only facilitates the connection between buyers and sellers of carbon credits but also ensures the authenticity and quality of the traded credits. It accomplishes this by offering a comprehensive, all-inclusive one-stop shop dedicated to carbon credit trading.

The main **Channel** of interaction would be the marketplace's platform. To establish a strong digital footprint and expand its reach, it is important to focus on direct marketing and engage with other stakeholders in the market. Additionally, participating in fairs and climate related conferences can also greatly enhance the company's presence.

The essence of the platform revolves around its **Customer Relationship**. Offering impeccable customer service and engaging with the community through events and workshops will foster a sense of belonging and trust among the customers. The platform enhances customer relationships by combining personalized communication, effective feedback mechanisms, and a rewarding loyalty program. Tailored interactions ensure users feel uniquely valued, while feedback channels facilitate continuous improvement. The loyalty program incentivizes and rewards ongoing engagement, fostering habitual users.

Initially, the marketplace's **Revenue Stream** will mainly rely on transaction fees from credit trades, with a flat fee model on each traded credit. Diversifying revenue streams through the footprint measurements and offset consulting services will cater to a broader audience while helping to establish relationships with potential customers. Introducing a subscription fee for the Carbon Intelligence Platform will create an additional source of revenue.

Significant **Costs** for the platform encompass maintenance costs, staffing, and external services. Additionally, initial platform development and general expenses, such as server hosting, form another stream of costs. Marketing expenses are dependent on the Customer Acquisition Costs (CAC) while an effective financial management is vital for sustainability and profitability.

The **Customer Segmentation** of the two-sided platform ranges from businesses seeking to offset carbon emissions, to carbon credit developers looking for a reliable marketplace to sell their credits. The "Business to Business to Consumer" model will play a crucial role in reaching individuals who are keen on purchasing products and simultaneously wish to balance their carbon footprint through offsets. Companies interested to understand the size of their carbon footprint will utilize the carbon footprint calculator, while those seeking support with offset strategies will turn to the Offset consultancy services. Main Customers are corporate companies that are looking to offset their carbon emission by purchasing carbon credits. These are mainly big corporates like tech companies, airlines, or firms from heavy industries such as oil, gas, metal, and mining (Interview J). By understanding and addressing the distinct needs of each segment, it is possible to tailor services for optimal user satisfaction.

The addition of specialized services such as offsetting consultancy, carbon footprint measurement, and access to a carbon intelligence platform and blog is a pivotal aspect of the marketplace's strategy. These services play a crucial role in aiding companies to effectively manage their carbon responsibilities and fulfill their sustainability commitments. In an environment with such evolving dynamics and shifting regulatory landscapes, relying solely on the marketplace's traditional operations may be insufficient. Incorporating these targeted services addresses a critical market need, especially as the pursuit of carbon neutrality becomes a priority for the vast majority number of companies. As the demand for holistic and effective carbon management solutions escalates, these additional offerings are not just beneficial but necessary. Starting with partnerships with established service providers, these services can be initially outsourced, providing immediate value to the marketplace's users. Ultimately, the vision is for the marketplace to become a one-stop-shop for all carbon-related needs. By offering a wide range of services under one umbrella, the marketplace aims to simplify the process for its users,

thereby becoming the go-to hub for comprehensive carbon management solutions. This evolution aligns with the growing trend towards integrated environmental solutions and positions the marketplace at the forefront of the carbon management industry.

4.3.3. Competitive Advantages

4.3.3.1. Advantages of Blockchain Technology in the Marketplace

The value of employing blockchain technology and tokenization in the development of the carbon credit marketplace platform cannot be overstated, especially in a market where transparency, verifiability, and efficiency are paramount. One of the compelling reasons why blockchain technology or, at the very least, tokenization of carbon credits is a strategic choice for the platform stems from the aspect of inclusivity and market expansion (Kotsialou et al. 2022). Blockchain technology is uniquely positioned to drive the carbon market's continued growth by making it more accessible to a wider range of participants. As the carbon market burgeons, blockchain paves the way for broader participation, which in turn fosters a more robust and diversified market (World Economic Forum 2022). By keeping the process transparent and curbing fraudulent practices, blockchain addresses the challenges that have historically plagued the sector, such as double-counting and other forms of cheating (Schmedders et al. 2023). On the facet of asset tokenization, blockchain stands out with its intrinsic feature that can be leveraged to represent carbon credits as digital tokens. This not only facilitates easier trading and management of carbon credits but also opens the door for innovative decentralized financial structures that can further stimulate the carbon credit market (Weber 2022).

Additionally, the escrow system of the marketplace can be fortified using smart contracts. These smart contracts are executed once both the credits and funds are transferred to the contract adding a layer of security and automation to the transaction process. This approach ensures that

the transaction is only completed when both parties fulfil their respective obligations, thereby enhancing trust and efficiency in the marketplace. Thus, the strategic integration of tokenization and blockchain technology positions the platform to excel in a market where verifiability, transparency, and integrity are paramount for success. These features foster trust among stakeholders, streamline transactions, and ensure equitable access, which are essential for widespread adoption and a competitive edge (Mills 2022).

When examining potential future integration for the marketplace, **Automated Market Makers (AMMs)** within the blockchain-based carbon credit marketplace, might offer substantial advantages. These systems, replacing traditional order books with algorithmic liquidity pools, can significantly enhance the trading of tokenized assets (Deible 2022). The primary benefit of AMMs is their ability to improve liquidity, crucial for the platform due to the unique and diverse nature of carbon credits, which often leads to limited trading volumes. By enabling liquidity providers to deposit their tokenized credits into pools, AMMs ensure continuous trading and stable market conditions, in line with the platform's goal of operational efficiency (Saraji and Borowczak 2021). Furthermore, the automated pricing mechanism of AMMs offers a significant advantage in managing the price volatility typical in the carbon credit market. This feature facilitates real-time and fair price discovery, crucial for the activities of managing and selling carbon credits (Mohan 2022). AMMs facilitate greater accessibility to the carbon credit market by reducing entry barriers, enabling broader participation, and aligning with the aim to cater to a varied customer base, including both corporate entities and individuals committed to sustainable practices (Liu et al 2023). This inclusivity is essential for the broader participation of various stakeholders in carbon credit initiatives. While being aware of risks such as impermanent loss, the potential benefits present a compelling case for integrating AMMs into the marketplace is an interesting aspect to consider. There are real-world examples where AMMs are being

utilized in carbon credit marketplaces. A notable example is the partnership between Solid World and Polygon, which led to the creation of a forward carbon assets pool on an AMM (Solid World 2023). In this model, projects could pre-sell future carbon credits at a price determined by the AMM, providing much-needed certainty and funding to long-horizon carbon credit projects. This case exemplifies how AMMs can be leveraged to enhance market liquidity and provide efficient trading mechanisms in the carbon credit sector (Gkritsi 2023).

4.3.3.2. Advantages of Celfocus' existing Partnerships

The Marketplace stands to gain considerably from Celfocus' existing and ongoing collaborations. As gathered from the external thesis partner throughout weekly meetings and workshops, two key partnerships stand out: the collaboration with the Municipality of Fundão in Portugal and the partnership with the Portuguese Government, facilitated through the grant from the Agência Portuguesa do Ambiente (APA). The collaboration with the Municipal do Fundão offers a practical testing ground for the Marketplace. By utilizing Fundão's interest in piloting carbon offset projects using municipal land, Celfocus can demonstrate real-world applications of the marketplace, refine its technology and functionalities, and gain valuable feedback. This pilot project could serve as a model for others, showcasing the platform's capabilities in managing and facilitating carbon credit transactions at a local government level while creating domestic credits.

The APA Grant represents another strategic advantage for Celfocus. This funding, coupled with the regulatory insights and endorsement from a government body, adds credibility to the platform. It allows Celfocus to align the marketplace with national carbon reduction goals and regulatory frameworks, ensuring compliance and relevance in the evolving carbon market landscape. The grant can also be used to enhance the platform's technological infrastructure, develop

new features, or expand its outreach and education efforts, helping to attract more users and stakeholders to the platform. Working within the network of the consortium will be highly valuable for the development as insights from other projects are able to improve the quality and scope of the Portuguese VCM.

These partnerships provide Celfocus with a unique blend of practical application and regulatory alignment, crucial for the marketplace's success. The Fundão pilot project exemplifies the platform's operational capabilities, while the APA Grant fortifies its credibility and compliance with national environmental objectives.

4.3.4. SWOT Analysis

The following SWOT analysis (Figure 9) provides a comprehensive evaluation of the strengths, weaknesses, opportunities, and threats for the proposed marketplace solution. This critical assessment is essential for strategic planning, as it helps identifying key areas for improvement and potential growth, ensuring informed decision-making and long-term success in the carbon credit market.

Figure 9 SWOT Analysis

The proposed business model has multiple **Strengths**. Starting with its strategic partnership with the Portuguese government, providing a reliable foundation of credibility and trust. It is therefore crucial for gaining stakeholder trust and positioning the marketplace as a leading trusted entity in the Portuguese market, especially considering the importance of trust and credibility in the wake of recent scandals and buyer uncertainty in credit selection. The infrastructure is secured by advanced technology and blockchain, guaranteeing transaction transparency and security. A commitment to quality assurance positions the platform as a dependable source for high-quality carbon credits. The inclusive offerings within this one-stop-shop solution, including services such as carbon footprint measurement and offset consulting make it an adaptable hub for trading carbon credits. By providing API integrations and a secure escrow system for over-the-counter transactions, the marketplace is well-positioned to foster market growth and enhance trust among users. Celfocus can also use its vast knowledge and network to gain a competitive advantage, while existing partnerships propel creativity and client involvement.

Although the approach has its merits, it does imply some **Weaknesses**. One of these relates to the possibility of insufficient market liquidity due to the high-quality standards that may not be consistently met (Kasih 2023). The platform's partnerships are key to its success, but they also reduce autonomy and agility. When optimizing the Business Model around key partners, maintaining, and securing a high standard of work quality becomes critically important. Additionally, relying on consistent credit quality can pose a threat to market confidence if compromised but not complied with. Managing marketplace liquidity is a challenge that needs careful attention, especially as the present condition of the market significantly lacks the capacity to attract demand for carbon credits (Interview J).

But there are also **Opportunities** to be explored. The changing surroundings present many chances. Green investments and the carbon offsetting sector are experiencing significant growth, with an increasing demand from businesses to customers (Blaufelder et al. 2021). The platform can grow by offering diverse services and expanding its sources of income. By having structured market positioning and engaging digitally, visibility can increase, and users can be attracted. Possessing the potential to establish a trustworthy platform can set a new industry benchmark. Regulatory alterations could increase demand, while aspirations for global expansion may unveil fresh markets and customer sectors.

However, the platform faces external **Threats** from increased market competition and the constant risk of changes in public perception, possibly due to scandals that could lead to shortage in demand. Supply issues may impact the accessibility of high-quality credits, and demand fluctuations may materialize from several macroeconomic factors, such as downturns, which could affect the platform's profitability. An additional threat lies in the potential scenario where businesses, in response to market scandals, opt to discontinue buying carbon credits. Instead, they may shift towards becoming bilateral project developers, resulting in a loss of need for the marketplace's services.

In summary, the business model's robust foundation and strategic partnerships position it well to take advantage of the burgeoning carbon credit market. To achieve sustained growth and success, the platform must address technological challenges, uphold credit quality, and manage liquidity while exploring prospects for expanding services and global reach that could counteract threats from competition and market volatility.

4.3.5. Risk Mitigation Strategy

When looking at the threats and risks of the business model it is important to evaluate these carefully and figure out the best strategies to address them. The deployment of a comprehensive risk mitigation strategy, supported by a Likelihood/Severity Matrix, grants insight into the potential impact of these risks, prioritizing and managing them effectively (Figure 10).

#	Risk	Mitigation
1	**Liquidity Shortage**	➢ Offer incentives to early adopters ➢ Conduct extensive marketing ➢ Partner to promote platform and gain demand ➢ Aggregate carbon credits to gather supply
2	**Competitive Risks**	➢ Competetive pricing and quality assurance ➢ Using strong partnerships for competetive positioning ➢ Offer unique features and services ➢ Cooperation with the prtuguese government
3	**Carbon Credit Quality**	➢ Use own registry projects to ensure quality ➢ Partner with known Registrys and rating agency's to ensure quality ➢ Keep close relationships with project developer
4	**Monetization Risk**	➢ Build flexibility into business operations to quickly adapt to regulatory and market changes ➢ Diversify revenue streams

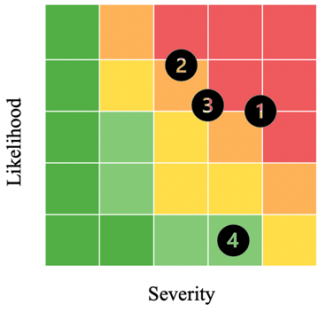

Figure 10 Risk Mitigation Strategy

In the complex task of establishing the carbon credit marketplace, awareness of risks that could undermine stability and growth is critical. Addressing the risk of **Liquidity Shortage** requires a multifaceted approach, including the provision of incentives to early adopters to foster initial transactions. A strategic marketing initiative is important to increase visibility and inform potential customers about the marketplaces unique value. Moreover, forming strategic partnerships, especially with key industry stakeholders like registries, rating agencies and project developers, is crucial to enhance credibility, reach and supply. Forming partnerships with big corporations that are seeking to offset their carbon footprint, can significantly contribute to building a customer base on the demand side. Additionally, serving as an aggregator to collect a supply of carbon credits can be an effective method to address any potential shortages in

supply. The risk is considered highly severe and highly likely. It primarily concerns the substantial impact on the trading volume of the marketplace. Given that this risk mirrors the present condition of the market, it underscores an urgent need for attention. The high likelihood and severity of this risk suggest that it could significantly disrupt market operations if not adequately addressed (Figure 10).

Navigating the **competitive terrain** of carbon markets demands the implementation of competitive pricing and the assurance of high-quality carbon credits, positioning the platform as a premier choice for discerning customers. Utilizing solid partnerships strategically is essential to gain a competitive advantage, bolster the platform's reputation, and grow the customer base. Working in close collaboration with the Portuguese government can offer a strategic edge over competitors, positioning the marketplace to benefit from regulatory compliance and insights that could provide a significant competitive advantage. This risk is classified as medium severe but highly likely. Currently, the absence of significant competitors in the market implies a moderate level of severity. However, the market conditions could change rapidly, introducing new competitors and altering the market dynamics. The high likelihood of this risk necessitates constant market analysis and strategic planning to stay ahead of potential competition (Figure 10).

The integrity of the marketplace is highly dependent on the **quality** of carbon credits (Interview E 2023). Ensuring the highest standards involves collaboration with established carbon registries rating agencies and project developers to maintain and validate the quality of the credits offered. This dedication to quality is fundamental to building and sustaining customer rust. The risk related to the quality of carbon credits is identified as likely with severe outcomes. There is a concern that the future quality of carbon credits may not be robust, potentially leading to negative consequences. This could result in carbon credits becoming less appealing to

businesses, possibly causing a shift in the market towards bilateral project development. The severity of this risk lies in its potential to change the fundamental attractiveness of carbon credits as a market commodity (Figure 10).

Monetization risks, stemming from regulatory shifts and economic fluctuations, present another challenge. Keeping abreast of regulatory developments and engaging with regulatory bodies is vital for timely adaptation to new regulations. Incorporating operational flexibility allows for a swift response to market changes, thus protecting revenue streams and financial stability. This risk is considered not very likely to occur but is characterized as very severe if it does happen. The impact on the business model would be significant, suggesting that while the probability of this risk materializing is low, its potential consequences warrant careful monitoring and contingency planning (Figure 10).

4.4. Financial Model

4.4.1. Introduction

The goal of this part is to generate a financial model on the venture proposed and outlined in the previous chapters. Hence, this section will not re-investigate the strategy behind the business model, but rather it aims to quantify the business opportunity and deliver tangible results on relevant cash flow streams. The final deliverable is a modifiable business case analysis, accounting for multiple scenarios with the goal to accurately provide predictions on revenue, sales, costs, and overall profitability. Throughout the following sections, this report will offer specific comparisons into how these assumptions affect relevant business metrics, including macroeconomic (demand, market sizing, pricing) and microeconomic (revenue, costs, profitability) indicators. The research question is the following: *"How large is the business opportunity and what are key financial indicators for building a voluntary carbon credit marketplace?"*

Firstly, an overview of the relevant components and assumptions for the quantification of the business case is being provided. Secondly, the implementation of these assumptions and its corresponding results are visualized. Thirdly, a comprehensive scenario analysis will be undertaken to account for variance in the face of dynamic market conditions and other factors. Finally, the results will be summarized and discussed, before offering concrete recommendations to Celfocus.

4.4.2. Demand Assumptions

To address the challenges associated with accurately forecasting demand in a highly volatile market, McKinsey has introduced three distinct scenarios for global carbon credit demand until

2050 (Blaufelder et al. 2021). These assumptions were introduced by the Taskforce on Scaling Voluntary Carbon Markets (TSVCM), a private-led consortium of international players with the goal to "scale an effective and efficient voluntary carbon market to help meet the Goals of the Paris Agreement" (TSVCM 2023).

According to TSVCM, for the required volume of negative emissions to align with the 1.5-degree warming objective, they project that the yearly worldwide demand for carbon credits must range from 1 to 2 gigatons of carbon dioxide (GtCO2) by the year 2030, a 10x increase since 2020 (Blaufelder et al. 2021).

The baseline for this report will be the neutral scenario (2030: 1 Gt), derived from the TSVCM survey, which will be utilized for the financial modelling of the proposed venture. This scenario is deemed the most realistic, allowing for potential market volatility in both positive and negative directions. implying exponential growth. Figure 11 offers a visualized snapshot of how McKinsey projects market growth until 2030, with in-between values being calculated with the Compound Annual Growth Rate (CAGR) method:

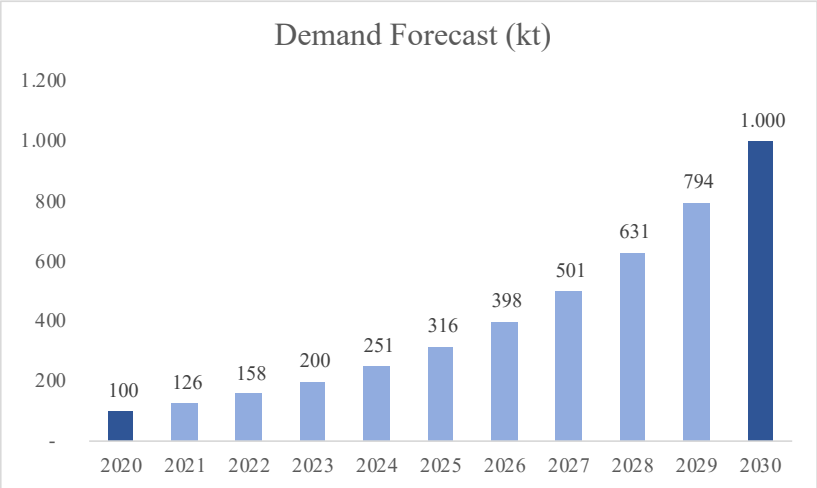

Figure 11 Demand Forecast (Neutral Scenario)

4.4.3. Market Sizing Assumptions

After projecting demand growth, this report now delves into specific market sizing assumptions, calculating the Total Addressable Market (TAM), the Serviceable Addressable Market (SAM), and the Serviceable Obtainable Market (SOM). These sales terms are widely used and represent metrics that help businesses define the customer and revenue opportunities within their market (O'Connor 2022). Table 3 offers a comprehensive summary of the assumptions involved in the financial modelling of the market size.

Topic	Assumption	Comment	Source	Type	2024	2025	2026	2027	2028	2029	2030
MARKET											
TAM	Percentage of Total Demand	The total market opportunity, hence the total demand of carbon credits.	Research	Input	100%	100%	100%	100%	100%	100%	100%
				Output	251.189	316.228	398.107	501.187	630.957	794.328	1.000.000
SAM	Relative Emissions of Europe	The SAM focuses on a niche market, the carbon credit demand in Europe.	Research	Input	17%	17%	17%	17%	17%	17%	17%
	Yearly Growth Rate	The SAM is growing due to International expansion.	Workshop	Input	15%	12%	10%	9%	8%	7%	6%
				Output	42.702	47.826	52.609	57.344	61.931	66.266	70.242
SOM	Attainable Market Share	We expect these market shares to be attainable in the given time period.	Workshop	Input	5%	8%	10%	12%	14%	17%	20%
				Output	2.135	3.826	5.261	6.881	8.670	11.265	14.048
Customer	Avg Transaction Volume (kt)	The average transaction volume of carbon credit buyers in Europe is 15.000 credits per company.	Interview	Input	15	15	15	15	15	15	15

Table 3 Market Assumptions (Neutral Scenario)

The Total Addressable Market (TAM) reflects the maximum potential market size or revenue achievable by a business with its product or service. This assessment does not take into account factors such as competition, geographical constraints, marketing budgets, or other limitations that could narrow down the market scope. (O'Connor 2022). This report calculates the TAM by assuming that the venture proposed would theoretically be able to satisfy 100% of the total demand, as lined out by the neutral McKinsey / TSVCM scenario.

The SAM constitutes a portion of the Total Addressable Market, defined by the demographics specific to the product niche. Therefore, it represents the size of the market segment that can be accommodated by the product and business model (O'Connor 2022). This financial model will focus on the European demand side, which is calculated by dividing the TAM with the relative emissions stemming from Europe (~ 17%). Additionally, due to international expansion efforts,

this report also assumes a dynamic growth rate for the SAM, which is also common practice in financial modelling (6sense 2022).

Finally, the SOM offers a practical perspective on the attainable market share that a business can reasonably secure in the coming years. (O'Connor 2022). The values of the SOM in Table 1 were derived via workshops with the client, taking attainable market share goals into account. Figure 12 highlights the three market sizing indicators to the corresponding base year (2024) of the venture.

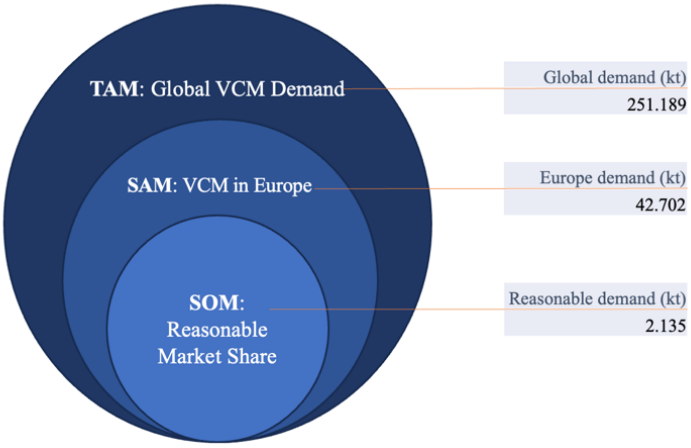

Figure 12 Market Sizing (Neutral Scenario)

Moreover, the working group has adopted an average annual demand estimate of approximately 15 kilotons of carbon credits per company. This figure has been derived through a comprehensive analysis of the findings in collaboration with several interview partners of various company sizes. However, it is important to note that the limited number of interview partners may impact the accuracy of this statistic in its ability to reflect reality.

4.4.4. Pricing Assumptions

The fundamental and most basic business model structure of a VCM marketplace involves generating revenue through transactions, either via a fixed fee or, alternatively, as a profit margin based on the credit price. As mentioned in the previous analysis, the project group has chosen to adopt a flat fee for each carbon credit sold. This decision offers a distinctive advantage, as it simplifies revenue analysis by eliminating the need for specific inputs on various project types, costs, and future price developments. For the sale of carbon credits via a marketplace, this section draws a distinction between existing and newly created carbon credits, acknowledging that they may warrant different pricing strategies. Commodities usually have a rather low-price elasticity, meaning that a change in price does not necessitate a change in demand (Rafaty et al. 2021). However, due to the high level of competition, which was thoroughly described in part one, and due the fact that carbon credits can be considered as non-essential commodities, this financial model assumes a flat fee priced near industry average. This is especially relevant for existing carbon credits, which refer to credits that are verified by third parties and are available for sale on any given marketplace. In contrast, new carbon credits result from projects initiated by the Portuguese consortium, reflecting the organization's direct efforts for increasing the number of high-quality carbon credits. These credits will be priced with a slight premium, as the consortium has full ownership of those.

In the long term, revenue streams are expected to diversify as part of the differentiation strategy, including several value-adding services within the decarbonization and offsetting ecosystem. Services include a Carbon Footprint Measurement Tool, a Carbon Intelligence Blog, and Offset

Consulting. These services will be explored from Year 2 onwards and can help build a sound differentiation strategy, unlocking real growth potential in the long run.

The AI-based *Carbon Footprint Calculator Tool* serves as an entry point for businesses that want to understand their emissions and is priced with a one-time fee. *Offsetting consulting* services are labor-intensive operations that help businesses develop regional, high-quality carbon credits and that want individual advisory services on their specific needs. This report envisions fees from offsetting consulting services to be the most crucial revenue source in the long-run and can help strengthen a differentiation strategy. As these processes are labor intensive and require skilled workers, they are priced relatively high. Finally, the *Carbon Intelligence Blog* is designed to assist businesses in optimizing decisions related to the purchase of carbon credits, providing concrete data, and purchasing recommendations. This service is monetized through an annual subscription fee, tailored to the size and needs of individual customers.

Table 4 demonstrates how these services are expected to develop in prizing, while utilization assumptions to calculate revenue will be discussed in the following section.

Topic	Assumption	Comment	Source	Type	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*
PRICING											
Existing Carbon Credits	Flat fee per credit	The average flat fee per credit is near industry standard.	Interview	Input	0,10 €	0,10 €	0,10 €	0,10 €	0,10 €	0,10 €	0,10 €
New Carbon Credits	Flat fee per credit	There will be a premium for newly produced carbon credits.	Workshop	Input	0,50 €	0,50 €	0,50 €	0,50 €	0,50 €	0,50 €	0,50 €
Footprint Calculator	One time fee	There will be a one-time fee for estimating the carbon footprint on the AI tool.	Research	Input	100 €	100 €	100 €	100 €	100 €	100 €	100 €
Offset Consulting	Annual consulting expenses	There will be revenue from consulting offset consulting services.	Research	Input	5.000 €	5.000 €	5.000 €	5.000 €	5.000 €	5.000 €	5.000 €
Carbon Intelligence	Annual subscription fee	A subscription platform with annual payments will bring in additional revenue.	Research	Input	150 €	150 €	150 €	150 €	150 €	150 €	150 €

Table 4 Pricing Assumptions (Neutral Scenario)

4.4.5. Revenue Assumptions

In the preceding paragraph, the pricing assumptions were integrated into the financial framework. Pairing these assumptions with the utilization of each revenue stream, allows for unique perspectives on revenue forecasts, which were reflected upon in multiple workshops involving the project group and Celfocus. Table 5 delineates the relevant assumptions underpinning each revenue stream, presenting the aggregate value generated by each stream in the Neutral scenario.

Topic	Assumption	Comment	Source	Type	2024	2025	2026	2027	2028	2029	2030
REVENUE											
Existing Carbon Credits	Share of credits sold	The share of carbon credits from other registries sold on the marketplace.	Workshop	Input	100%	100%	95%	93%	91%	90%	88%
				Output	213.510 €	382.611 €	499.785 €	639.956 €	789.004 €	1.013.877 €	1.236.267 €
New Carbon Credits	Share of credits sold	The share of carbon credits from own production sold on the marketplace.	Workshop	Input	0%	0%	5%	7%	9%	10%	12%
				Output	- €	- €	131.522 €	240.844 €	390.167 €	563.265 €	842.909 €
Footprint Calculator	Users share of SOM	The share of customers on the platform making use of the Carbon Footprint Calculator Tool.	Workshop	Input	0%	40%	60%	60%	60%	60%	60%
				Output	- €	10.203 €	21.044 €	27.525 €	34.682 €	45.061 €	56.194 €
Offset Consulting	Users share of SOM	The share of customers on the platform making use of Offset Consulting Services.	Workshop	Input	10%	10%	10%	10%	10%	10%	10%
				Output	142.340 €	255.074 €	350.726 €	458.750 €	578.025 €	751.020 €	936.566 €
Carbon Intelligence	Users share of SOM	The share of customers on the platform making use of the Carbon Intelligence Subscription.	Workshop	Input	0%	5%	10%	15%	20%	20%	20%
				Output	- €	3.188 €	8.768 €	17.203 €	28.901 €	37.551 €	46.828 €
TOTAL REVENUE					**355.851 €**	**651.076 €**	**1.011.845 €**	**1.384.278 €**	**1.820.779 €**	**2.410.773 €**	**3.118.764 €**

Table 5 Revenue Assumptions (Neutral Scenario)

To begin with, this report assumes a specific distribution between existing and new carbon credits sold. This allocation considers, firstly, the time of credit production, and secondly, acknowledges that new carbon credits are exclusively sold on the client's marketplace. Consequently, the working group anticipates a progressive increase in the share of carbon credits sold, with the commencement of Year 3 marking the sale of the first credits from newly established projects. The utilization of additional services is calculated as a percentage of the customers that the working group predicts to make use of and will be further outlined in the upcoming paragraphs.

Given the development timeline of the footprint calculator, which is developed in Year 1 with subsequent iterations in Year 2, the work group anticipates a rising demand starting in Year 2.

With relatively low entry barriers and costs associated with the tool, it is expected to attract significant interest from customers, stabilizing at approximately 60% of annual prospective customers. Furthermore, consultancy services for offsetting will play a pivotal role in facilitating clients' acquisition of high-quality carbon credits from the Iberian region. These services are designated to contribute substantially to marketplace revenue streams, predicting a conservative utilization rate of 10% throughout the years. Lastly, the revenue stemming from the carbon intelligence platform, which provides clients with timely and relevant data on news from the VCM, relies on an annual subscription fee. The financial model envisions a growing interest from clients, as the platform offers substantial value to their sustainability teams. When aggregating the results, one can draw multiple conclusions. As one can observe in Figure 13, most revenue stems from the sale of carbon credits, with newly produced carbon credits gaining popularity over time. Additionally, this report expects a growing share of offset consulting services to contribute to total revenue, as described in the section above. However, the contribution of the carbon footprint calculator and the carbon intelligence subscription to total revenue will be rather minimal, as they serve a strategic role to attract more customers to the platform.

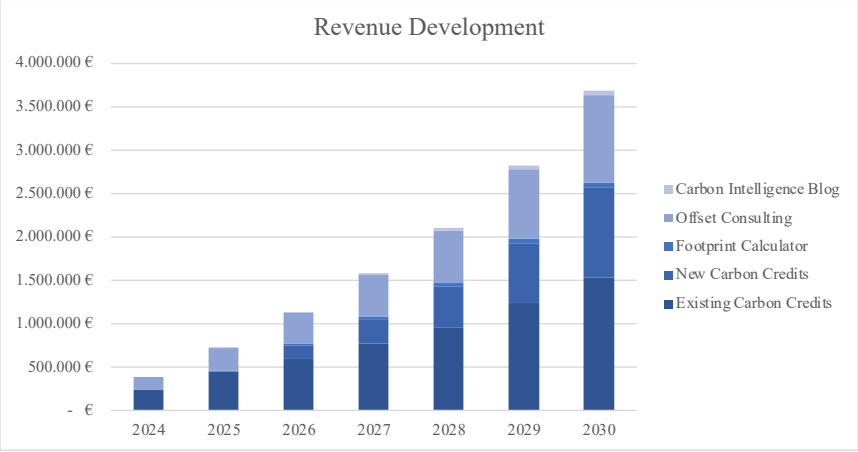

Figure 13 Revenue Factors Development (Neutral Scenario)

4.4.6. Cost Assumptions

Within the realm of cost assumptions, the financial model weaves together the following essential elements for maintaining operational efficiency:

Cost of Goods Sold (COGS) encompasses various dimensions: Blockchain Transaction Costs are directly tied to annual transaction volume, guided by blockchain standard rates (50€) and multiplied with the average number of annual transactions via the platform (Blockchain.com 2023). Additionally, Server Hosting Costs, commencing at €1200 in the first year, dynamically rise in relation to demand growth (Simonson and Main 2023).

Human Resources (HR) Costs stand out prominently, with Employee Compensation as the most significant cost factor. This cost is calculated by multiplying the employee numbers per position with their respective average salaries in Portugal (Statista 2022). In anticipation of increasing demand, the model accommodates additional hiring to meet evolving operational needs. The table in Appendix 9 provides a snapshot of the annual team composition, compared with the annual average salary per team member.

Rent and Legal Costs, expressed as a percentage of revenue, align with industry standards, reflecting a proportional commitment to a conducive working environment (Branson 2022).
The domain of Marketing & Sales involves a further calculation, factoring in CAC and a churn rate. CAC, aligned with industry averages for SaaS Cleantech, forecasts costs associated with acquiring new customers (Userpilot 2023). Simultaneously, the churn rate, drawn from industry averages in the financial crediting sector, denominates the annual percentage rate at which customers stop subscribing to a service, and underscores the importance of effective retention strategies in mitigating customer attrition (Tessitore 2023). It should be noted that the churn rate for

this sector accounts as one of the highest from all industries, which results in a higher budget needed to attract new customers to the platform.

Research & Development (R&D) investments are allocated for the development of the marketplace infrastructure. This model assumes a cooperation of in-house development, which is allocated in the HR costs, and outsourcing efforts that help build the platform and relevant products to enable additional revenue sources (Babych 2023). As mentioned above, there will be a high reliance on outsourcing development capabilities in year 1 and 2, which is expected to be moved in-house afterwards.

Figure 14 summarizes the evidence given above, portraying the development and distribution of all cost factors over time. One can observe that while in the beginning a large fraction is attributed to Platform Development Costs, HR and Marketing Costs will become the leading cost factor as the business timeline progresses:

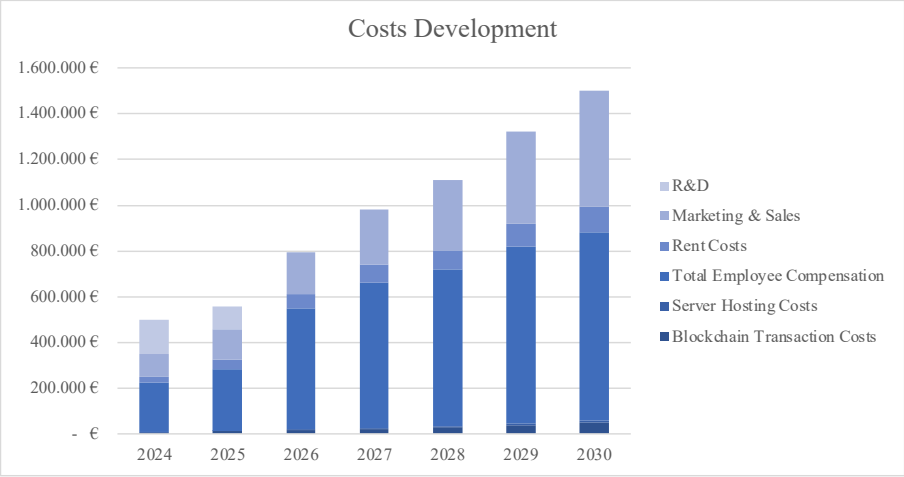

Figure 14 Cost Factors Development (Neutral Scenario)

All the cost factors described above are quantified in Table 6. In the first three years, Total Costs of around €1.8 million are assumed, which would fall well within the given budget that Celfocus has received by the consortium.

Topic	Assumption	Comment	Source	Type	2024	2025	2026	2027	2028	2029	2030
COSTS											
COGS	Blockchain Transaction Costs	With every transaction via a Blockchain, costs for the business will incurr.	Research	Input	50 €	50 €	50 €	50 €	50 €	50 €	50 €
				Output	7.117 €	12.754 €	17.536 €	22.938 €	28.901 €	37.551 €	46.828 €
	Server Hosting Costs	With a growing demand, server hosting costs will also increase (Base Year Value).	Research	Input	1.200 €	- €	- €	- €	- €	- €	- €
				Output	1.200 €	2.150 €	2.957 €	3.867 €	4.873 €	6.331 €	7.896 €
HR	Total Employee Compensation	The detailed assumptions can be found in the HR sheet.	Research	Output	219.345 €	268.088 €	526.816 €	633.897 €	682.641 €	774.711 €	823.455 €
	Rent Costs Share of Revenue	The average % share of rent costs of total revenue.	Research	Input	7%	6%	6%	5%	4%	4%	3%
				Output	23.130 €	39.065 €	55.652 €	69.214 €	72.831 €	84.377 €	93.563 €
Marketing & Sales	CAC	Based on standard industry benchmarks, we expect the following CAC.	Research	Input	674 €	674 €	674 €	674 €	674 €	674 €	674 €
	Churn Rate	Based on standard industry benchmarks, we expect the following Churn Rate.	Research	Input	0,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%
				Output	95.937 €	128.940 €	177.292 €	231.898 €	292.192 €	379.640 €	473.434 €
R&D	Platform Development Costs	We expect the following fees in the production of the platform.	Research	Output	150.000 €	100.000 €	- €	- €	- €	- €	- €
TOTAL COSTS					**496.730 €**	**550.997 €**	**780.253 €**	**961.814 €**	**1.081.438 €**	**1.282.611 €**	**1.445.176 €**

Table 6 Cost Assumptions (Neutral Scenario)

4.4.7. Scenario Analysis

The assumptions outlined earlier and described in the tables were based on a "neutral" scenario. However, to account for market volatility and changing internal factors, this financial model also provides concrete data and insights for a pessimistic and an optimistic scenario. This will lead to more comprehensive results and can help Celfocus planning for various changing market conditions. While the following paragraphs will highlight specific upper and lower bounds that were decided on in the workshops, Celfocus received a fully automated Excel file, in which they can select between specific buckets (market, pricing revenue, costs) and modify the given assumptions to interpret the changes. Appendix 10 consolidates all assumptions and provides an overview of the specific assumptions that are affected by the scenario analysis, marked with a red "x".

For this analysis, three different scenarios are assumed: Firstly, a *neutral* scenario, which serves as the baseline and is composed of the assumptions that were discussed in the paragraphs above,

holding all categories neutral. This scenario is in line with the theory and aims to stay, as the name suggests, neutral towards internal and external factors that might impact the financial model. Secondly, the *pessimistic* scenario, which assumes a 15% decrease in demand and revenue assumptions, and a 15% increase in cost factors, while holding the pricing strategy neutral. This scenario has rather conservative views on the development of the VCM, taking past hurdles and challenges that have previously hindered it from significant growth into account. On the flip side, the *optimistic* scenario assumes a 15% increase in demand and revenue assumptions, and a 15% decrease in cost factors, while also holding the pricing strategy neutral. This scenario believes in the that the VCM will finally reach its full potential and that the proposed venture will be able to convince potential customers to utilize the offerings, while making revenue and cost operations more efficient. Once again, the additional scenarios show the variance in which the financial model is expected to operate in. Even though the 15% variance seems like an arbitrarly chosen number on a first glance, it was unifiedly decided on with Celfocus. This is due to its statistical significance, while still maintaining a relative proximity to the baseline. If required, Celfocus has the possibility to modify the significance level, leaving plenty of room for further adjustments. The results of the sceanrio analyis will be discussed in the proceeding section.

4.4.8. Results

This report finds that depending on the scenario, vastly different results on market size, revenue, costs, and therefore profitability will be established. Figure 15 shows the *revenue* spread, with the optimistic scenario serving as the upper bound and the pessimistic scenario as the lower bound.

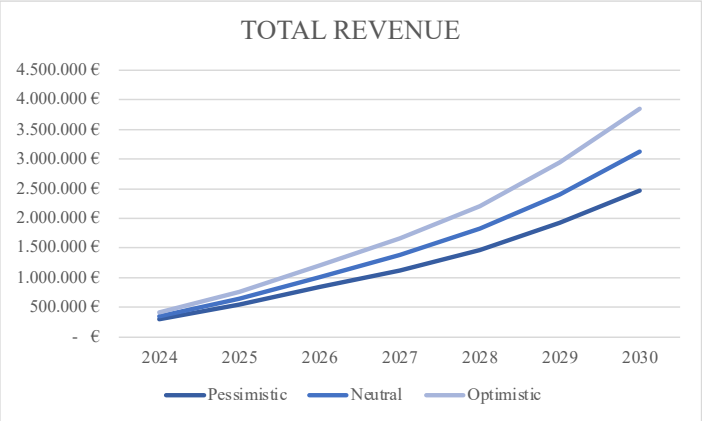

Figure 15 Revenue Development (All Scenarios)

The most substantial factors influencing total *revenue* are different market sizing assumptions, significantly affecting the volume of carbon credits sold and the total amount of customers engaging in additional services provided by the marketplace. While the neutral scenario expects a total revenue of around €3.1 million in 2030, the lower and upper bounds assume a €500 k variance into both directions.

On the *cost* side, a pessimistic scenario expects higher overall costs. As observable in the graph below, this report expects a more direct and highly correlated cost development of each scenario over time, as costs are expected to grow linearly and not exponentially. Figure 16 shows the cost development of the three different scenarios.

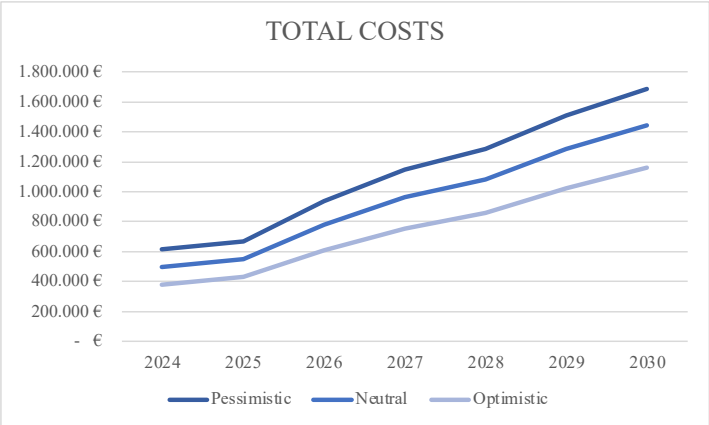

Figure 16 Cost Development (All Scenarios)

To investigate profitability of the venture, this report combines both revenue and costs. Figure 17 shows the net profitability for each scenario, showcasing the vast differences in implications of each scenario:

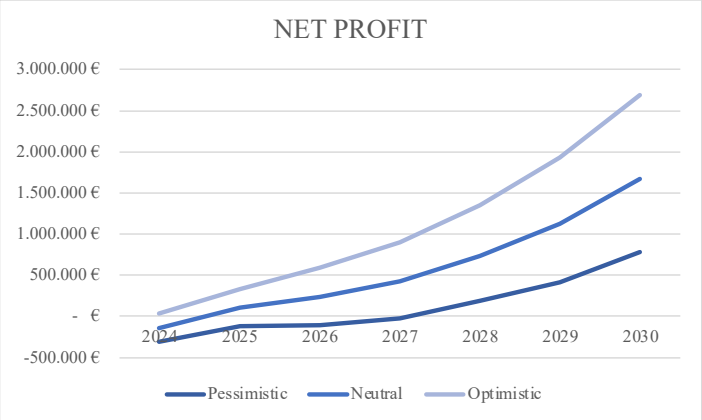

Figure 17 Net Profitability (All Scenarios)

Net Profit refers to the amount of money a company has left over after deducting all its expenses from its total revenue and is a single periodic metric. While the neutral and optimistic scenarios expect net positive cash flows in 2025 already, the pessimistic scenario will not be profitable until 2027.

The Cumulative Profit chart, which refers to the total profit earned by a company over a series of consecutive periods, helps draw a similar conclusion. While the optimistic scenario assumes total net positive profitability in 2025 already, the pessimistic and neutral scenario are more conservative in this area: They anticipate cumulative profitability in 2029 and 2026, respectively. This implies that there is a viable chance that revenue from business operations will be able to finance associated costs in 2026 already, paving the way for an impactful and sustainable venture case.

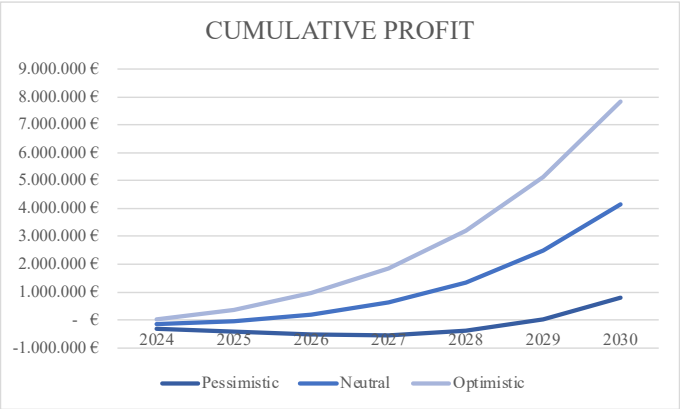

Figure 18 Cumulative Profitability

Drawing a conclusion from the evidence given above, all scenarios expect a net-and cumulative positive return until 2030. However, the volatile nature of the industry, dynamic regulatory conditions, and advancing technological breakthroughs can lead to new demand, revenue, and costs pathways, which was accommodated by the scenario analysis.

4.4.9. Recommendations

The findings suggest that there is potential for a financially viable marketplace business model, depending on certain preconditions. Firstly, the demand growth and market sizing section confirm that a venture in the VCM has the potential to generate immense growth: Until 2030, demand is expected to grow 4x. Through a highly differentiated business model with multiple service offerings, Celfocus can diversify revenue streams, providing additional value with exponential revenue growth and linear cost growth. These diversified revenue streams will gain prominence as business operations timeline progresses. Additionally, this working group suggests that Celfocus should leverage its unique position to collaborate with companies from Portugal and especially within the consortium, helping to bring new and locally sourced carbon credits on the platform, ultimately adding value to all stakeholders.

5. Conclusion

5.1. Summary of Findings

In addressing the central research question - *"In the context of the Voluntary Carbon credit market's unique challenges and dynamics, how can a carbon credit marketplace be developed to ensure a viable business opportunity for Celfocus?"* - a comprehensive analysis across four distinct parts provides a nuanced understanding of the complexities and opportunities within the VCM for Celfocus. Based on a combined assessment of quantitative and qualitative analyses, it is recommended that Celfocus should launch a one-stop shop marketplace, to capture more of the credit value chain.

The journey began with a detailed analysis of the VCM landscape, identifying key players, stakeholders, and the interplay of market dynamics. This initial phase shed light on the competitive environment and highlighted the necessity of strategic alliances and innovative approaches to navigate the complex market terrain effectively. Key findings underscore the intricacies of the VCM, revealing a web of interdependencies and a dynamic interplay of market forces. Robust strategic partnerships are emphasized as key to navigating this competitive landscape successfully. Further, it underscores the importance of a differentiation strategy, the need for innovative solutions and the quality assurance of carbon credits. The highly competitive rivalry and landscape suggest the adoption of successful business practices while also identifying the need to further expand business offerings along the value chain. Ultimately, the potential for integrating value-added services, embracing technological advancements, and establishing a strong competitive advantage as well as value creation strategy are identified as crucial components for achieving market relevance.

Subsequently, the research delved into understanding the perspectives and challenges faced by corporate buyers in the VCM. Insights regarding their preferences for carbon credit purchasing, along with their concerns about credibility and the complexity of the buying process, underscored the need for a marketplace that offers transparency and diversity in credit options. A notable observation is the long-term goal of major organizations to actively participate in the VCM by initiating their own carbon credit projects. Interviews revealed that the primary motivation is to guarantee high-quality carbon credits. Another important discovery from the interviews highlights a significant lack of knowledge among corporate buyers in navigating this dynamic field. Consequently, pain points emerged, including a lack of understanding about offsetting and challenges related to regulatory uncertainty.

Building upon these insights, a comprehensive business model canvas that highlights the critical role of utilizing technologies such as blockchain for enhanced transparency and security was developed. This business model goes beyond mere transaction management, establishing a hub for the carbon credit market. It integrates services like offset consultancy, footprint measurements, and a carbon intelligence blog, offering a holistic solution. The model also emphasizes the importance of forging key partnerships, maintaining rigorous quality assurance, and crafting a unified platform tailored to meet the diverse requirements of its customer base. The conducted SWOT analysis highlighted the model's strengths in technology and partnerships, acknowledged challenges in quality control and liquidity, and identified growth opportunities due to environmental trends. The strategic risk mitigation plan, detailed with a likelihood/severity matrix, prepared the marketplace to navigate risks and sustain its competitive edge, ensuring responsiveness to market uncertainties.

The final phase involved quantifying the business opportunity, taking various scenarios to predict revenue, sales, costs, and overall profitability into account. This rigorous financial analysis provided tangible insights into the economic viability and sustainability of the proposed marketplace. Built on the differentiation strategy, the market size was quantified, utilizing a top-down analysis for finding the TAM, SAM, and SOM. In a next step, different revenue streams were prized. The utilization of these revenue streams was later assumed, building the foundation for the revenue side of the business model. The cost side was also discussed, splitting costs up into different buckets and analyzing how they will develop over time. Ultimately, a scenario analysis was proposed, which assumes a 15% variance into both directions to account for external and internal uncertainties. The most impactful assumption affecting profitability was the market size, as it significantly changes the volume of carbon credits sold and the number of customers engaging in additional offsetting services. These results were compared, and finally, concrete, and actionable recommendations for the clients were provided.

The findings of this thesis offer substantial contributions to both academic and practical realms. Academically, it enriches the understanding of VCM dynamics, buyer behavior, and the intricacies of developing a business model in a complex market. Practically, it serves as a guiding framework for companies like Celfocus, aiding them in navigating the VCM with strategic acumen and foresight. It also informs policymakers about the critical role of regulatory clarity and market standardization.

In sum, this master thesis offers a comprehensive and insightful exploration of the VCM, delineating the complexities and opportunities inherent within. It provides a strategic roadmap for establishing a successful carbon credit marketplace, balancing the demands of market efficiency, technological advancement, and environmental integrity. The research underscores the

imperative of adaptability, innovation, and collaboration in navigating the VCM, ultimately contributing to a more sustainable and responsible approach to carbon trading. As such, this thesis stands as a significant academic contribution and a practical guide, poised to influence the future trajectory of the VCM.

5.2. Limitations

The findings of this thesis are supported by primary and secondary data, using a sound methodological approach. Nevertheless, there may be some limitations due to potential biases, the construction of assumptions, the inherent complexity of the market and the generalizability of the data due to the research partnership with Celfocus.

The validity and reliability of the data collected for this study present a notable limitation. Given the reliance on expert interviews, participant and observer bias may have influenced the findings. The subjective nature of interpreting qualitative data can lead to bias, potentially skewing the derived insights. Additionally, the lack of inter-firm validity of the data, where findings from one interviewee may not be applicable or representative of the entirety of the company, further represents a limitation. Furthermore, the number of interviewees represents a finite subset of the broader landscape of practices. The sampling method employed, while rigorous, introduces an element of selectivity that warrants consideration. The depth and breadth of these insights are thus influenced by the specific parameters guiding participant selection.

Moreover, the financial model developed in this thesis is assumption-based, which inherently limits its accuracy. In a field as complex and unpredictable as the VCM, crafting assumptions that accurately reflect future market conditions is challenging. This limitation is significant as it affects the precision and applicability of the model's predictions.

More generally, the VCM is characterized by its complexity and constant evolution. This dynamic nature makes it difficult to accurately capture all nuances, market forces and prospects. This challenge is compounded by the rapid emergence of new players, evolving regulations and technological advances. As a result, findings and analyses can quickly become outdated or less relevant, affecting the long-term applicability of the research.

Ultimately, the scope of this thesis is specifically tailored to the strategic needs and context of Celfocus. While this provides in-depth insights for Celfocus, it limits the generalizability of the findings to other entities or stakeholders interested in entering the carbon market. The focus on Celfocus' network, capabilities and objectives means that the strategic implications and recommendations may not be directly applicable or relevant to other organizations with different profiles and operational contexts.

5.3. Avenues for Further Research

As the VCM continues to evolve, it provides a rich ground for numerous research opportunities that can significantly contribute to the advancement and refinement of such marketplaces. While this thesis has laid the groundwork for understanding and developing a platform-centric marketplace in partnership with Celfocus, the dynamic and complex nature of the market prompts a deeper exploration of several critical areas that would be interesting to explore on a larger scale.

One promising area for future research is the exploration of bilateral project development, which has emerged as the preferred method of purchasing carbon credits. This trend underlines the growing desire of companies to be actively involved in the credit creation process, as it

allows them to ensure the quality of credits and tailor projects to their specific sustainability strategies. This also goes hand in hand with mitigating challenges regarding purchasing carbon credits, whereby recent criticism was voiced. Exploring the feasibility and implications of establishing an internal registry within this framework could provide invaluable insights. Such an approach could revolutionize the way carbon credits are sold, offering more tailored and transparent solutions to businesses. While this has been highlighted in the report, further investigation and research into its feasibility in the context of this marketplace would be valuable. Further research is also needed to ensure the successful integration of an in-house registry on which credits on the marketplace depend.

Another aspect that requires further investigation is the regulatory landscape surrounding the VCM respective to the emergence of the marketplace. Understanding how evolving regulations could affect the launch and operation of the respective marketplace would be insightful. This research should not only focus on the current regulatory framework, but also anticipate future legislative trends and their potential impact. Such further analysis would assist in ensuring compliance and provide insights into how to strategically navigate the complex regulatory environment of the carbon credit market.

The evolving landscape of the VCM is increasingly influenced by technological innovations, particularly in the realms of AI and blockchain. This underscores a growing need for comprehensive research into how these technologies can redefine market operations. AI's role in the verification and monitoring of carbon offset projects is a significant area for exploration, ensuring the integrity and effectiveness of these projects.

Parallel to AI, the integration of blockchain technology, specifically through tokenization and smart contracts, presents a transformative opportunity for the carbon credit trading process. Even though this was included in this report, a deeper exploration could enhance the business model's future viability. Blockchain can significantly enhance transactional efficiency and security, addressing key challenges such as fraud and lack of transparency. Additionally, the introduction of Automated Market Makers (AMMs) within this blockchain framework could resolve liquidity challenges, further stabilizing the market and is therefore highly recommended to further explore. The importance of further research in these technologies is pivotal for establishing a more efficient, transparent, and credible carbon trading ecosystem. This is also supported by their potential to address current market challenges while paving the way for future growth.

Ultimately, these avenues for further research open opportunities to expand and support the understanding of market needs, regulatory requirements and future prospects. Consequently, further research should build on these areas to broaden the applicability and feasibility of the proposed business model.

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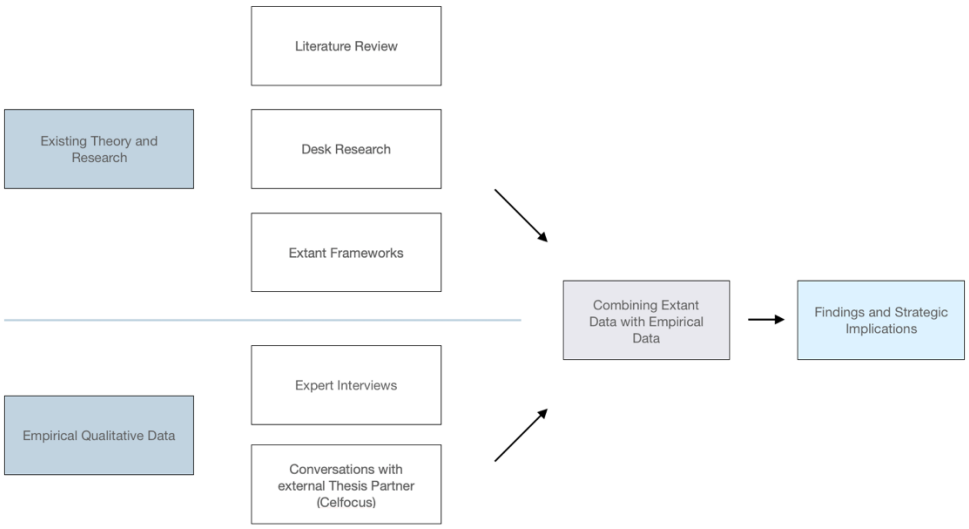
7. Appendix

Appendix 1: Methodological Approach - Analysis Part One Market Mapping



Appendix 2: List of Interviews

#	Role	Company	Date	Duration	Category of interviews: Validation inter-views	Buyer inter-views
A	Head of sustaina-bility	Insurance company	16.10.23	45 min	X	X
B	Business devel-opment and sales	Consultancy	16.10.23	45 min	X	
C	Cofounder and CPO	Energy Company	19.10.23	30 min		X
D	Carbon offset trading manager	Energy company	19.10.23	45 min	X	
E	Founder and CEO	Project developer	20.10.23	45 min	X	

F	Ex-founder associate	Carbon credit registry	23.10.23	45 min	X		
G	Sales manager	Consultancy	24.10.23	1 hour			X
H	CFO and head of investment	Consultancy	25.10.23	30 min	X		
I	Sustainability manager	Chemical company	27.10.23	45 min			X
J	Head of carbon markets	Marketplace	28.10.23	1 hour		X	
K	Sustainability manager	Governmental institution	30.10.23	1 hour			X
L	Head of sustainability	Portuguese bank	31.10.23	45 min			X
M	Sustainability manager	Energy company	03.11.23	45 min			X
N	Head of sustainability	Logistics company	08.11.23 (by mail)	NA			X
O	Consultant for sustainable farming investments	Consultancy	13.11.23	30 min	X		
P	Sustainability Manager	German Machinery manufacturer	15.11.23	45 min			X
Q	Sustainability manager	Sports good company	06.11.23	45 min			X
R	Director of Sustainability	Academic institution	10.12.23	1 hour			X
S	Partner	Sustainability consultancy	10.12.23	1 hour		X	

Appendix 3: Interview Classifications and Data Analysis – Part One and Three

Supply Chain Involvement	Interviewee	Market Mapping; Analysis Part 1				Business Model: Analysis Part 3	
		Market Understanding	Stakeholder Engagement	Porter's Five Forces	Competitive Analysis	Market Inefficiencies	Business Model Implications
Credit Creation	Interview F	✓	✓	✓		✓	✓
	Interview B	✓		✓		✓	✓
	Interview E			✓		✓	✓
	Interview S		✓	✓	✓	✓	
	Interview O					✓	✓
Credit Trading	Interview J	✓	✓		✓	✓	✓
	Interview H				✓	✓	
	Interview E			✓		✓	
Demand	Interview A	✓		✓	✓		
	Interview S		✓	✓	✓	✓	

Appendix 4: Interview Transcript of Corporate Buyer Interviews

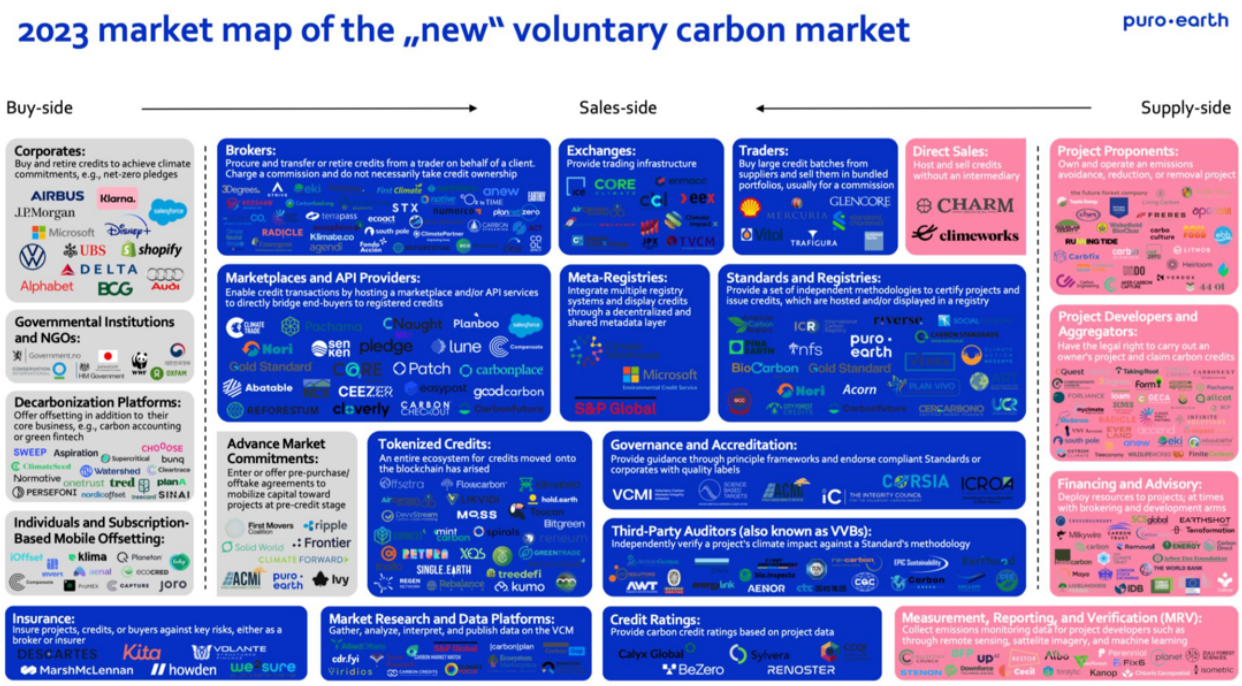
Introduction
• Thank the interview participant for their time. • Personal introduction of the interviewer and interviewee. • General introduction regarding research objectives and interview procedure. • Request for permission to record the conversation. • Personal introduction of interviewee (general understanding what the interviewee is doing).
Section A: Company profile – What is the current situation?
• Does your company engage in offsetting? • What are your touch points in this process? • What are your organizations main motivations to engage in offsetting (e.g. sustainability, regulations, financial)?

• Who in your organization is responsible for carbon offsetting?
Section B : Buying process - How do you currently buy Carbon credits?
• Could you give us a brief overview of your credit buying process? • Are you following an avoidance or a removal strategy? • What tools/platforms do you use such as rating agencies marketplaces brokers. Please name them. • Who in your organization is buying the carbon credits? • When do you buy/invest in the carbon crediting process (early-stage projects or already issued credits on marketplace) and why? • How do you define quality in carbon credits? Please name and rank the quality criteria (e.g., additionality, project type, permanence). • What are the decisive factors for buying or not buying a carbon credit (e.g., certifier, price, type, location)? Please rank them.
Section C: Pain points - How can your Carbon credits buying experience be improved?
• From your perspective, what factors contribute to the complexity or problems in the voluntary carbon credit market (e.g., quality, transparency, financial problems)? • How big is the problem? • Can you identify any notable challenges experienced by stakeholders in the market (e.g., marketplaces)?
Section D: Future outlook
• What will be your next steps for your carbon offsetting strategy? • How do you envision the ideal carbon marketplace? • From your perspective, what are potential strategic approaches that entities can adopt to position themselves effectively in the market?
Closing questions
• Is there anything we have overlooked? • Is there anyone else you would recommend I should talk to in your network? • Could I reach out to you again to seek your expert opinion on our advanced research process?

Appendix 5: Data Table for the Gioia Method

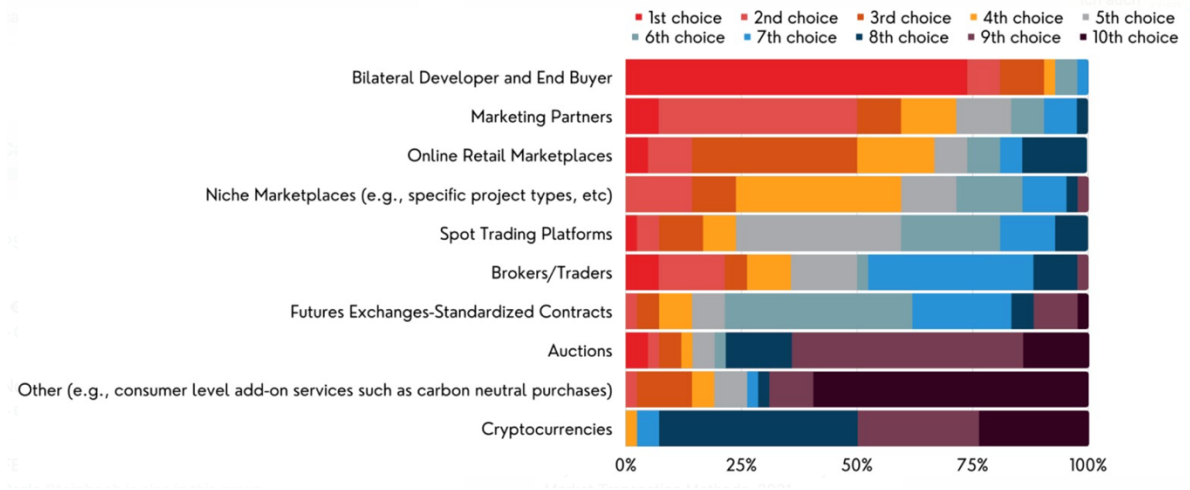
Second order concepts	First order Concept and representative quotes
Difficulty In buying credits	*"But again, the problem is credibility. Okay, not only price but mainly credibility." (Interview A)* *"We would like to offset in projects that connect both the environment and the community, not just the environment." (Interview L)* *"An additional layer of trust such as rating agencies would help us by credit form for example marketplaces." (Interview D)*
Regulatory Uncertainty	*"I don't know if I will be validated by the European or the Portuguese Regulation. I don't know which will be first." (Interview A)* *"There are new regulation, Net zero strategy, CSRD for the reporting coming up and Switzerland is still waiting to understand the landscape and where to go." (Interview I)* *"There's no real incentive to buying carbon credits, unless you are a really big company." (Interview R)*
Reputation risk of carbon credits	*"as an Energy company we are very much under scrutiny by the public, we need to be very cautious which projects to support." (Interview D)* *"Also, how we can follow the project and how it's audited so that we'll never have any kind of social or greenwashing or governance washing." (Interview L)*
Lack of Data/understanding on offsetting	*"Data is an issue that we need to manage as well because, as you know, it's sometimes not so accurate as we would like." (Interview M)* *"Many companies perhaps don't have a specific sustainability department or team (...) you have to have a certain amount of technical expertise related to." (Interview K)* *"I trust when big players such as Microsoft, Swiss Re, BCG, and some of the companies that are investing, JP Morgan, these types of companies that are much, much bigger than ours, that can do very deep due diligence. "(Interview A)*

Appendix 6: Key Players Puro Earth Illustration



(retrieved from Interviewee F)

Appendix 7: Buyers' and Sellers' Preferred Transaction Methods



(retrieved from (Ecosystem Marketplace 2022)

Appendix 8: Marketplaces Best Practices – Main Findings from Competitor Analysis

#	Marketplace Name	Best Practice / Most valuable to copy
1	Climate Trade	- Integration of APIs within External Business Processes (B2B2C Stream)
2	Xpansiv	- Harmonized Integration Across Multiple Registries - Comprehensive Inventory Management Systems
3	Patch	- APIs for Emission Calculations - A Wide Range of Credit Offerings
4	Gold Standard	- Transparent Presentation of Projects - Credit Portfolio Offerings
5	Pachama	- Original Credits by Pachama (Creation of Credits) - Collaboration with a Rating Agency (Silvera)
6	Nori	- Functioning as a Registry with Its Own Credits (NRT)
7	Ceezar	- Offers of a Wide Variety of Additional Services

Appendix 9: HR Composition Table

Human Resources Costs	*2024*	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*
Position				Headcount [#]			
CEO	0	0	1	1	1	1	1
CFO	0	0	0	1	1	1	1
COO	0	0	1	1	1	1	1
CTO	0	0	1	1	1	1	1
Head of Product	0	0	1	1	1	1	1
Head of Partnerships	0	0	1	1	1	1	1
Blockchain Dev	1	1	1	1	1	1	1
AI Dev	1	1	1	1	1	1	1
UI/UX Designer	1	1	1	1	1	1	1
Sales Rep	0	0	0	1	1	2	3
Marketing Rep	1	2	2	2	3	4	4
Business Dev Rep	1	1	1	2	2	3	3
Offset Consultant	1	2	2	2	3	4	5

	2024	*2025*	*2026*	*2027*	*2028*	*2029*	*2030*
Position				Salary [€]			
CEO	€ 63.754	€ 63.754	€ 63.754	€ 63.754	€ 63.754	€ 63.754	€ 63.754
CFO	€ 63.754	€ 63.754	€ 63.754	€ 63.754	€ 63.754	€ 63.754	€ 63.754
COO	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159
CTO	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159
Head of Product	€ 46.035	€ 46.035	€ 46.035	€ 46.035	€ 46.035	€ 46.035	€ 46.035
Head of Partnerships	€ 40.619	€ 40.619	€ 40.619	€ 40.619	€ 40.619	€ 40.619	€ 40.619
Blockchain Dev	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159
AI Dev	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159	€ 54.159
UI/UX Designer	€ 40.619	€ 40.619	€ 40.619	€ 40.619	€ 40.619	€ 40.619	€ 40.619
Sales Rep	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664
Marketing Rep	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664
Business Dev Rep	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664	€ 21.664
Offset Consultant	€ 27.080	€ 27.080	€ 27.080	€ 27.080	€ 27.080	€ 27.080	€ 27.080

Appendix 10: All Assumptions

Topic	Assumption	Comment	Source		Type	2024	2025	2026	2027	2028	2029	2030
MARKET												
TAM	Percentage of Total Demand	The total market opportunity, hence the total demand of carbon credits.	Research		Input	100%	100%	100%	100%	100%	100%	100%
					Output	251.189	316.228	398.107	501.187	630.957	794.328	1.000.000
SAM	Relative Emissions of Europe	The SAM focuses on a niche market, the carbon credit demand in Europe.	Research		Input	17%	17%	17%	17%	17%	17%	17%
	Yearly Growth Rate	The SAM is growing due to International expansion.	Workshop	x	Input	15%	12%	10%	9%	8%	7%	6%
					Output	42.702	47.826	52.609	57.344	61.931	66.266	70.242
SOM	Attainable Market Share	We expect these market shares to be attainable in the given time period.	Workshop	x	Input	5%	8%	10%	12%	14%	17%	20%
					Output	2.135	3.826	5.261	6.881	8.670	11.265	14.048
Customer	Avg Transaction Volume (kt)	The average transaction volume of carbon credit buyers in Europe is 15.000 credits per company.	Interview		Input	15	15	15	15	15	15	15
PRICING												
Existing Carbon Credits	Flat fee per credit	The average flat fee per credit is near industry standard.	Interview	x	Input	0,10 €	0,10 €	0,10 €	0,10 €	0,10 €	0,10 €	0,10 €
New Carbon Credits	Flat fee per credit	There will be a premium for newly produced carbon credits.	Workshop	x	Input	0,50 €	0,50 €	0,50 €	0,50 €	0,50 €	0,50 €	0,50 €
Footprint Calculator	One time fee	There will be a one-time fee for estimating the carbon footprint on the AI tool.	Research	x	Input	100 €	100 €	100 €	100 €	100 €	100 €	100 €
Offset Consulting	Annual consulting expenses	There will be revenue from consulting offset consulting services.	Research	x	Input	5.000 €	5.000 €	5.000 €	5.000 €	5.000 €	5.000 €	5.000 €
Carbon Intelligence	Annual subscription fee	A subscription platform with annual payments will bring in additional revenue.	Research	x	Input	150 €	150 €	150 €	150 €	150 €	150 €	150 €
REVENUE												
Existing Carbon Credits	Share of credits sold	The share of carbon credits from other registries sold on the marketplace.	Workshop		Input	100%	100%	95%	93%	91%	90%	88%
					Output	213.510 €	382.611 €	499.785 €	639.956 €	789.004 €	1.013.877 €	1.236.267 €
New Carbon Credits	Share of credits sold	The share of carbon credits from own production sold on the marketplace.	Workshop		Input	0%	0%	5%	7%	9%	10%	12%
					Output	- €	- €	131.522 €	240.844 €	390.167 €	563.265 €	842.909 €
Footprint Calculator	Users share of SOM	The share of customers on the platform making use of the Carbon Footprint Calculator Tool.	Workshop	x	Input	0%	40%	60%	60%	60%	60%	60%
					Output	- €	10.203 €	21.044 €	27.525 €	34.682 €	45.061 €	56.194 €
Offset Consulting	Users share of SOM	The share of customers on the platform making use of Offset Consulting Services.	Workshop	x	Input	10%	10%	10%	10%	10%	10%	10%
					Output	142.340 €	255.074 €	350.726 €	458.750 €	578.025 €	751.020 €	936.566 €
Carbon Intelligence	Users share of SOM	The share of customers on the platform making use of the Carbon Intelligence Subscription.	Workshop	x	Input	0%	5%	10%	15%	20%	20%	20%
					Output	- €	3.188 €	8.768 €	17.203 €	28.901 €	37.551 €	46.828 €
TOTAL REVENUE						**355.851 €**	**651.076 €**	**1.011.845 €**	**1.384.278 €**	**1.820.779 €**	**2.410.773 €**	**3.118.764 €**
COSTS												
COGS	Blockchain Transaction Costs	With every transaction via a Blockchain, costs for the business will incurr.	Research	x	Input	50 €	50 €	50 €	50 €	50 €	50 €	50 €
					Output	7.117 €	12.754 €	17.536 €	22.938 €	28.901 €	37.551 €	46.828 €
	Server Hosting Costs	With a growing demand, server hosting costs will also increase (Base Year Value).	Research	x	Input	1.200 €	- €	- €	- €	- €	- €	- €
					Output	1.200 €	2.150 €	2.957 €	3.867 €	4.873 €	6.331 €	7.896 €
HR	Total Employee Compensation	The detailed assumptions can be found in the HR sheet.	Research	x	Output	219.345 €	268.088 €	526.816 €	633.897 €	682.641 €	774.711 €	823.455 €
	Rent Costs Share of Revenue	The average % share of rent costs of total revenue.	Research	x	Input	7%	6%	6%	5%	4%	4%	3%
					Output	23.130 €	39.065 €	55.652 €	69.214 €	72.831 €	84.377 €	93.563 €
Marketing & Sales	CAC	Based on standard industry benchmarks, we expect the following CAC.	Research	x	Input	674 €	674 €	674 €	674 €	674 €	674 €	674 €
	Churn Rate	Based on standard industry benchmarks, we expect the following Churn Rate.	Research	x	Input	0,00%	25,00%	25,00%	25,00%	25,00%	25,00%	25,00%
					Output	95.937 €	128.940 €	177.292 €	231.898 €	292.192 €	379.640 €	473.434 €
R&D	Platform Development Costs	We expect the following fees in the production of the platform.	Research	x	Output	150.000 €	100.000 €	- €	- €	- €	- €	- €
TOTAL COSTS						**496.730 €**	**550.997 €**	**780.253 €**	**961.814 €**	**1.081.438 €**	**1.282.611 €**	**1.445.176 €**