Blockchain and fairness in the VCM

Customer-Centric Fairness: Unraveling Blockchain's Potential in Voluntary Carbon Trading

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by

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Preface

This thesis marks the end of my study in Management of Technology. The focal point of the Management of Technology program is directed towards comprehending and leveraging technology as a corporate asset aimed at improving business processes and enhancing overall outcomes. This thesis delves into a social construct, namely fairness, and explores how it can be addressed through a technological solution blockchain. With its array of benefits within the Voluntary Carbon Market (VCM), blockchain emerges as a potent tool for refining the market ecosystem. This thesis combines all knowledge from my master's into one comprehensive project.

While writing my thesis, I got support from some important people who contributed to my graduation. First, I would like to express my gratitude towards my daily supervisor, Dr. Ir. Z-Roosenboom-Kwee, for taking the time and effort to support me throughout the thesis process. Second, I would like to thank my second supervisor, Dr. G. de Vries, for being my committee chair and giving me crucial feedback to improve my thesis in several ways.

Besides my supervisors from the university, I would like to thank my colleagues at EY Amsterdam. Specifically, I thank Baue Hooft for introducing me to the whole concept of the VCM and sparking my interest in a previously unexplored topic. Second, I would like to thank Rose Stroo for being my buddy at EY, supporting me throughout my journey at EY, and being a sparring partner when I needed someone to talk to. Further, I thank Lisanne Grimme for being my counsellor at EY and support throughout the thesis.

Finally, I thank all my friends and family for supporting me throughout the journey. Specifically, I would like to thank my girlfriend for helping me through tough times and supporting me when I needed someone to talk to. Finally, I thank my friends who studied with me on the IO faculty—special thanks to Dimitri Kras and Olaf de Vries. Our coffee and lunch breaks made the whole process more pleasurable.

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Glossary

Concept	Definition
Carbon Credits	Claim to a reduction of one tonne of GHG gasses.
Carbon Trading	Trading of emission rights with carbon credits.
Voluntary Carbon Market	Overarching term for carbon trading on a voluntary basis.
Compliant market	Obligatory carbon trading marketplace. For heavy emitting industries.
European Trading System	Europe's form of compliant market. Regulated by the EU.
Kyoto Protocol	Legally binding agreement which introduces carbon trading.
Sustainable Development Goals	Overarching goals set by the UN as a universal call to end poverty and work on climate change goals.
Q-methodology	Methodology involves participants sorting statements in a certain order to determine their opinion on a topic.
Transcribing	Changing audio recordings to text to be able to code them.
Word coding	Putting labels on sentences and words to group them together for research.
Atlas.ti	Program used to code the transcribed interviews.
Blockchain	Decentralized ledger technology which uses nodes instead of one central authority. Offers a number of inherent features like transparency and accountability.
Verification bodies	Institutes that check the progress of project producing carbon credits.
Brokers	Intermediaries between buyers and sellers.
Participant loading	Whether participants correlate with a certain factor.
Measurement, Reporting, Verification (MRV)	The total review on a certain project. Often done by verification bodies.

Summary

One of the mechanics to tackle rapid climate change is carbon trading. Carbon trading sets a price on greenhouse gases (GHG), enabling countries and companies to buy emission rights. Carbon trading happens in carbon marketplaces, which can be divided into two different forms: the compliant market and the voluntary carbon market (VCM). The compliant market is formed through governments and is heavily regulated, aimed at heavily polluting industries. Carbon emission rights are given to countries and companies in the form of carbon credits. These carbon credits allow the owner to emit one tonne of GHG. The VCM, on the other hand, has no strict regulation and can be used by anyone looking to compensate for their emissions. Carbon credits are created through different projects instead of given. These carbon credits are used to compensate elsewhere for emissions produced locally.

The creation of carbon credits on the VCM often involves many stakeholders. These include project developers responsible for the actual creation of the project, validation bodies that check and determine the number of credits that become available, brokers that enable carbon credits to be sold, and customers looking to offset their emissions. There are considerable differences in bargaining power between stakeholders as project developers are often in developing countries and much less knowledgeable about the market. Customers, on the other hand, drive market demand and are among the key stakeholders in the VCM. Without a stable demand for carbon credits, there is no need for a VCM. However, customers often face challenges navigating the market's complexities, including ensuring the integrity and fairness of carbon offset projects. As a result of complexity and these power imbalances, issues regarding the fair distribution of revenue are present.

Blockchain technology offers a promising solution by providing transparency and accountability. Through blockchain-enabled platforms, customers can access real-time project information, verify emissions reductions, and ensure fair revenue distribution among stakeholders. This transparency fosters trust and empowers customers to make informed decisions. Despite their importance, research on customer preferences regarding fairness in the VCM still needs to be conducted. To understand how blockchain can enhance fairness, it is essential first to understand what customers perceive as fairness in the VCM. This thesis looks into the perspective of fairness from a customer to understand how blockchain can be applied to enhance fair distribution and fair selection of projects.

The first step was understanding customer issues on the VCM and their perspectives on fairness. Customers and brokers on the VCM were invited to partake in this study. Q-methodology was used to understand the different perspectives on a specific topic. Q-methodology consists of sorting statements by participants in a table with nine columns and only a limited number of places. At the end of the table are most disagree and most agree with only two spots for statements. The statements participants felt most decisive about could easily be sorted. Thirty-two statements were created to encompass all perspectives on the topic. These statements were found in literature and different research papers published online. Statements were further refined to make sure they encompass the entire range of perspectives on the topic. After sorting, interviews were held to understand the answers to the Q-methodology further. The interviews were held between January 2024 and February 2024. The interviews were transcribed and coded using Atlas.ti. The analysis resulted in three perspectives named factors 1, 2 and 3. These factors represent participants with similar perspectives. Within factor 1, participants emphasized community impact and desired more insight into how projects affect communities. Factor 2 participants focused on market participation, stressing the responsibilities of intermediaries like brokers and the need for fair compensation. They believed intermediaries played a vital role in maintaining market integrity. In F3, participants highlighted the importance of intermediaries, particularly brokers, in ensuring fairness. They emphasized the need for transparency in brokers' actions within the market.

Based on the preferences from the different factors through the Q-methodology, a recommendation has been made on how blockchain can be used to enhance fairness. Blockchain implementation should prioritize transparency, standardization, and credibility to increase trust and fairness in the VCM. Participants showed that they relied on brokers for project selection, emphasizing the importance of trust and transparency. Blockchain should focus on increasing transparency throughout the project and carbon credit trading to enhance market credibility and customer trust. Standardization through blockchain simplifies information, making it easier for brokers to explain project differences and enhance market credibility. Increased transparency and understanding of project co-benefits can shift focus beyond emissions reduction, improving benefit-sharing in the VCM. Blockchain implementation should prioritize transparency, standardization, and credibility to increase trust and fairness in the VCM, ultimately leading to better customer engagement and market integrity.

This thesis aims to broaden the discussion on fairness in the VCM and understand what aspects of blockchain can be utilized to enhance fairness. As this thesis shows, brokers have an essential role in the VCM, and blockchain should be used to increase their trustworthiness and credibility. Brokers should stay actively engaged in developments regarding blockchain in the VCM. This research included the social side of the VCM and showed how blockchain can enhance fairness in the VCM. However, the actual implementation will bring other challenges recommended for further exploration.

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Abbreviations

Abbreviation	Definition
AAU	assigned amount units
BCT	Base Carbon Tonne
CDM	Clean Development Mechanism
CSR	Corporate Social Responsibility
ETS	European Trade System
JI	Joint Implementation
MRV	Measurement, Reporting, Verification
NDC	Nationally Determined Contributions
NGO	Non-Governmental Organization
NFT	Non-Fungible Token
REDD	Reducing Emissions from Deforestation and Forest Degradation
RMU	Removal Unit
SDG	Sustainable Development Goal
UNDP	United Nations Development
UNFCC	United Nations Framework Convention on Climate Change
VCM	Voluntary Carbon Market

1

Introduction

1.1. Problem introduction

Rapid climate change is one of our generation's most critical challenges. Countries, governments and all commercial organizations must reduce emissions to tackle increasing global warming. Every year at the climate summit, world leaders come together to discuss their commitments to their goals and set out the road map for future reduction. After the Climate Summit of 1992, the Kyoto Protocol was formed. This legally binding agreement between 192 countries introduced a new emission trading mechanism. Countries and companies could trade emission rights according to their needs (Oberthür and Ott, 1999).

The Kyoto Protocol is meant to operationalize the framework (United Nations Framework Convention on Climate Change) that unites countries to prevent further emissions. Only industrialized countries are legally bound, as the Kyoto Protocol acknowledges them as the main contributors to emissions. The aim is to reduce and limit GHG (greenhouse gasses) emissions according to individual targets (UNCC, n.d.). The voluntary carbon market (VCM) is a counterpart to this compliant market. This much less regulated market is created for anyone looking to offset their carbon emissions. Carbon credits can be created in many ways, ranging from projects that store carbon for long periods to increasing biomass, which removes carbon from the air. Projects on the VCM involve a large number of stakeholders. Project developers, for example, are responsible for the actual delivery of the project. These can then be sold through a marketplace, often facilitated by brokers. Determining the actual amount of carbon credits is a complex process often done by third parties. These credits can be sold and purchased via various platforms to businesses looking to offset their emissions. (Sebastian, 2021).

As with every emerging market, many challenges arise. The VCM is not overseen by any regulatory body, meaning there is no general oversight or standards across the globe. This leads to many different standards and methodologies to measure the environmental impact. It is difficult for customers to assess which projects are most suitable for their needs and create reliable credits. Verification bodies use different methodologies to assess a certain project's environmental impact. Consequently, it becomes even more difficult for customers to decide which type of credit they want to buy. The VCM's complexity and involvement of many stakeholders make it challenging to assess projects. Furthermore, companies can buy their way to net zero through carbon credit rather than reducing their internal emissions first. This can be seen as greenwashing, which damages the integrity of the market (Cheikosman et al., 2023). Furthermore, the stakeholders have large differences when it comes to bargaining power. Project developers in developing countries are often much less knowledgeable than brokers who sell the credits (Solidaridad, 2023). The differences between stakeholders cause difficulties regarding fairness in the market. The definition of fairness remains a subjective and nuanced concept, varying significantly from one stakeholder to another. Research on fairness in the VCM has been very scarce. Howard (2016) has unravelled some perspectives regarding fairness within the VCM. This research includes the opinions of project developers and people working in Fairtrade. However, it lacks the perspectives of the customers in the VCM. Other research does include some customer perspectives. Like Loh and Feng (2018) and Porras et al. (2016) have looked at motivations to participate in this new market, giving insight into what drives these customers. Unfortunately, they do not address the

concept of fairness.

Blockchain as a solution

A potential solution to increase transparency across the value chain and increase the integrity of the market is blockchain. Blockchain is a decentralized digital ledger technology where multiple nodes communicate to maintain a secure and transparent record of transactions. Transactions on blockchain networks are transparent since all nodes keep a record of the previous owners and transactions that happened to the credit. Also, transactions on the network are validated by other nodes on the network rather than one single authority (see section 1.2.3 for a more detailed explanation). Increased transparency on the VCM creates the potential for customers to get better insight into the projects. It contributes to increased trust and a more reliable way of selecting ”high-quality” credits. Previous research has addressed how blockchain can be implemented and utilized on the VCM (Nemanic et al., 2022). Within the research, fairness is addressed as blockchain has the potential to enhance this on the VCM. However, the research does not address the complex nature of fairness. It is recommended to explore how blockchain can be utilized to further enhance fairness (Nemanic et al., 2022). Other research has addressed fairness, but only from a project developer perspective (Howard, 2016). As fairness is a complex construct, it is further recommended to include more actors when researching the construct (Howard, 2016).

As the market is voluntary and driven by customers and their demand for credits, they are among the most critical stakeholders in the VCM. How fairness would be addressed using blockchain and what customers find essential remains to be seen. This thesis will build upon the fairness research by Howard (2016) and the implementation of blockchain to enhance fairness by Nemanic et al. (2022). Fairness will be further explored from a customer perspective to determine how blockchain can enhance fairness (see section 1.3 for a more detailed explanation of the knowledge gap).

1.2. Overview of literature

Different concepts are introduced briefly as this knowledge is needed before the literature review and knowledge gap are mentioned. Carbon trading and the features of blockchain are explained in the following section.

1.2.1. Carbon trading & carbon markets

Carbon markets allow individuals, organisations and countries to purchase specific certificates to reduce carbon emissions. The reductions are often produced elsewhere (Blum, 2019). There have been different ways of participating in these carbon markets. The division is often in the compliant market, which is regulated centrally and aimed at emission-heavy sectors (United Nations Climate Change, 2022) and the voluntary carbon market, which is an initiative from the market and accessible for anyone looking to offset their emissions (Lou et al., 2023).

Carbon offsetting projects

To give more insight into how the carbon credits are created, the life cycle of a carbon credit is mentioned. Figure 1.1 shows an example of the life-cycle as adapted from Porras et al. (2016). The project starts with methodology development. These are the first two steps when a project idea is pitched. Specific criteria must be met to ensure the credits are eligible for GHG reduction. Within carbon offset programs, a range of approved methodologies covers the different projects (Post, 2022). A committee assesses these methodologies. In figure 1.1, this is done by carbon-accounting standard Plan Vivo. The second phase is where the carbon reduction takes place, the project is monitored, and if approved, will have the right to a certain amount of verified carbon certificates (Porras et al., 2016).

At last, after verification by an independent auditor, the credits can be sold. The buyer of the credits can decide to either retire the credit, hold it, or transfer it to another account. Often, credits change owners multiple times before their retirement. Retirement of the credits is when the actual reduction is claimed. It is not possible to put them back on the market once retired.

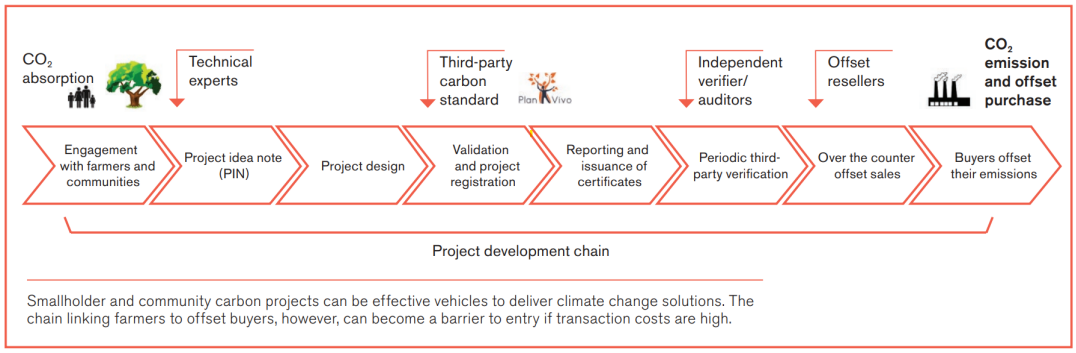

Figure 1.1: Life cycle of a carbon credit, adapted from Porras et al. (2016) p.14

The example by Porras et al. (2016) is meant explicitly for the voluntary carbon market. Trading in a compliant market is different since the projects must comply with more rules and regulations. Companies can use the credits to comply with their carbon tax, used on the VCM to reach CSR goals or net zero claims, or countries can use them to contribute to their Nationally Determined Contributions (NDCs). As mentioned in the introduction, NDCs are goals set after the Paris Agreement to make sure countries set emission goals and report them (Pour et al., 2023)

Avoidance and removal credits

Carbon offsetting projects can be grouped into three different categories:

- *Reduction credits* are most of the credits for transition to net-zero, including projects that reduce fossil-fuel use. They are measured and quantified against existing technology. The projects can range from efficiency investments to low-emission cookstove projects in developing countries.

Within these developing countries, it is often more challenging to measure the exact impact leading to over-crediting (Friedmann and Potts, 2023). Examples of cookstove projects can be found in countries like Brazil or Ghana. Furthermore, the other projects involve transitioning to renewal energy through solar/wind or small-hydro projects (Carbon Offset Guide, 2020).

- *Avoidance credits* include projects that avoid deforestation that would result in the release of CO2 into the air. A large number of certified credits (roughly 75%) are avoidance credits. They are based on existing emissions when projects would not have found funding. Estimates with avoidance credits are often tricky as there is no direct baseline. It is impossible to see what would have happened without project funding. There is often uncertainty on how many credits avoidance projects can produce, sometimes leading to over-crediting (Friedmann and Potts, 2023).
- *Removal credits* are the last type of credits. Different engineering solutions like direct air capture or nature-based solutions like reforestation generate these credits. The amount of removal will be calculated by the difference between the amount of carbon removed and the missions used to facilitate the removal. This is more difficult in nature-based removals as the amount of carbon dioxide removed must be measured over time. Important to take into account is the re-release of carbon in the air. Nature-based removal is often less durable than engineered solutions where carbon can be stored for hundreds to thousands of years (Friedmann and Potts, 2023). The REDD+ project (Reducing Emissions from deforestation and forest degradation in developing countries) is an example of nature-based solutions. This is the preservation and sustainable management of forests (UNFCC, n.d.).

Compliant Carbon Markets

Compliant carbon markets are formed through different agreements between several countries. These markets are heavily regulated and aim to incentivise countries and emission-heavy sectors to innovate to reduce their emissions. Multiple countries have their compliant trading systems. Within Europe, trading happens on the European Trading System. Carbon markets were first introduced after the Kyoto Protocol. This agreement, formed in Kyoto on the eleventh of December 1997, is linked to the United Nations Framework Convention on Climate Change. This protocol commits parties by internationally agreeing on emission reduction targets for greenhouse gasses. The Kyoto Protocol was enacted in 2005 and consisted of three market-based mechanisms to achieve climate target (United Nations Climate Change, 2022).

- Joint implementation (JI): allows countries to invest in projects to reduce emissions in another country, not necessarily a developing country.
- Clean development mechanism (CDM): Countries can invest in emission-reduction projects in developing countries.
- Emission trading: a platform where carbon units generated through JI or CDM can be traded.

By allowing emission trading, greenhouse gas was formed into a new commodity. Several different trading units can be exchanged on this market. These include the allowed emissions called assigned amount units (AAUs) or allowances. Companies receive or buy emissions allowances, which can be traded when needed. Allowances give the owner the right to emit either one tonne of carbon dioxide or the equivalent of another greenhouse gas like nitrous oxide (European Commission, n.d.). The allowances are set at a certain cap, which is reduced yearly according to the climate goals. Carbon allowances differ from carbon offsets in that emission allowances do not represent a reduction of carbon dioxide or greenhouse gases. Allowances are ”allowing” the owner to produce a certain amount of emissions. Allowances do not give companies the right to claim carbon neutral. These allowances can be traded within compliant markets according to their needs (Ricci, 2022). At the end of each year, companies must ”return” one allowance for the amount of carbon dioxide or greenhouse gas emitted. When firms exceed their allowances, additional allowances must be purchased. On the contrary, firms that keep their emissions below a certain level can sell their allowances on the ETS.

Furthermore, other specific units or credits can also be transferred to the scheme. One example is a removal unit (RMU), which is created through activities such as reforestation. Furthermore, the joint implementation project could generate emissions reduction units (ERUs). This is a collaboration between different parties, primarily removing greenhouse gases from the air. Projects within the JI must

be verified, and eligibility requirements must be reviewed before they can be transferred. The Joint Implementation Supervisory Committee oversees this process and determines all relevant requirements before different parties can engage within a project (United Nations Climate Change, n.d.[a]). Finally, certified emissions reduction (CER) can be achieved through CDM. The CDM allows explicit collaborations within developing countries. The mechanism aims to stimulate sustainable development and reach emissions reductions, all while giving developing countries flexibility in meeting their emission targets. Projects through CDM are verified by the Designated National Authorities and are overseen by the CDM Executive board (United Nations Climate Change, n.d.[b]) All these units' transactions are tracked through the registry systems under the Kyoto Protocol. Countries must keep a reserve amount of these credits to ensure they do not sell more credits than are created.

In 2015, further goals were set through the Paris Agreement. Contrary to the Kyoto Protocol, the Paris Agreement requires countries to reduce their emissions to the best of their abilities voluntarily. Each country has to communicate their nationally determined contributions (NDCs) and adjust this every five years. Article 6 of the Paris Agreement further sets out guidelines for cooperation between developed and developing countries to collaborate and promote sustainable development. Projects are supported through the United Nations Development Program (UNDP), which collaborates with the United Nations Framework Convention on Climate Change (UNFCC). The UNDP provides technical support and helps mitigate the complexity of the carbon markets. Regulatory and institutional frameworks are provided to guide the implementation of projects within developing countries (Pour et al., 2023).

European Trading System.

In 2005, the European Trading System was formed. This was the first international emissions trading system formed after the Kyoto Protocol and remains the largest today. The ETS consists of three different phases, each with their distinct features. Phase one included energy-intensive industries and gave out almost all allowances for free. The ETS provided an infrastructure to verify, report and monitor emissions from businesses. The second phase reduced the amount of allowances, and actions became the main way to distribute the allowances. Furthermore, businesses were allowed to purchase credits further to reduce their emissions and comply with their goals. The third phase introduced a single EU-wide cap, and auctioning allowances became the default distribution method. More sectors and gases were included (European Commission, n.d.).

Voluntary Carbon Markets

Contrary to compliant markets, voluntary carbon markets emerge as a solution to achieve the desired net-zero goal. The VCM works parallel to the ETS. The VCM is an open market where any looking to reduce their emissions can purchase carbon credits. The market is entirely incentive-based and the purpose is to compensate for emissions that would otherwise not be reduced (Lou et al., 2023). Companies often go to the VCM to compensate for emissions which are not removed yet or due to financial restrictions (Blaufelder et al., 2021a). The market demand is expected to increase fifteen times by 2030 and, at most, increase up to a hundred times by 2050 (Blaufelder et al., 2021a). The VCM is not regulated as much as the compliant market. Due to this lack of standardization there are different rules with each supplier.

Besides the reduction of emissions, the VCM is also known for the number of co-benefits it brings to rural areas. As projects are often done in low-income countries, the VCM can serve as a great source of income and other co-benefits for the community. As an example, plan Vivo looks to incorporate sustainable development goals (SDG's) in their projects. These SDG's are a set of targets which UN member states are expected to put on their political agenda for the next fifteen years. They range from reducing poverty (SDG1) to increasing growth and employment (SDG8) or the protection of biodiversity and ecosystems (SDG15) (Porras et al., 2016). When looking to purchase carbon offsets, customers have shown to be willing to pay more for credits that also deliver other co-benefits (Shell and BCG, 2022a).

Important stakeholders and their role

The entire value chain of the voluntary carbon market is rather complex. A large number of actors are involved within the whole process. In figure 1.2, the different stakeholders and their role is mentioned.

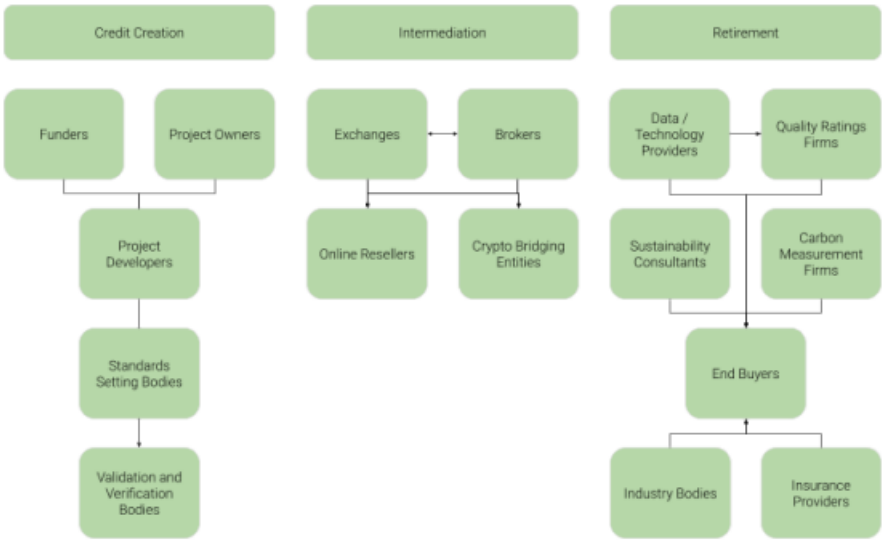

Figure 1.2: Different stakeholders within VCM subdivided in three categories. Adapted from Allied Offsets (2023) p.19

Three different groups of stakeholders are mentioned:

- Credit creations are at the beginning of the value chain in figure 1.1. This includes the smallholder farmers. Often they work together with NGO's to facilitate the creation of carbon credits. Before credits can be sold they need to be verified and validated. Therefore, to verification and validation bodies are also part of the credit creation process.
- *Inter mediation* includes exchanges and brokers. These are the online platforms where buyers can choose and actually select projects. One example of a broker is Rabobank in the Netherlands. Through project Acorn, buyers can select different projects and purchase their preferred offset (Rabobank, n.d.).
- *Retirement* is the category which includes the end buyers. In the case of VCM this can range from technology providers like Microsoft to banks like Rabobank (from (Rabobank, n.d.)). Buyers often take into account more than just the emission reduction, also looking at the added SDG's within the projects. End buyers can decide to retire the credits and claim the offset or to trade it further. Recently through Article 6 of the Paris Agreement countries can buy credits from the VCM as well as long as they comply with the rules from Article 6 (SP Global, 2020)

Standards initiatives and verification bodies

Validation and verification bodies work together with standard setting initiatives and make sure documents are a correct representation of the project. They are audited by the standard setting initiatives and check whether the methodologies are verified (Lovell, 2010).

Another type of standard setting is attempted with Fairtrade carbon credits. Fairtrade is often known for commodities like fruits and chocolate. It enables farmers and producers to have a voice in global decision-making (*What is Fairtrade?* N.d.). With the emergence of carbon credits came the term fair carbon as well. The Fairtrade Climate Standard is different from standard-setting institutes as they focus more on co-benefits and decision-making rather than only the reduction of emissions. Core elements are the inclusion of producers in decision-making processes, transparency about pricing, opportunities for producers to adapt more easily and credible reductions (Fairtrade, 2015). The Fairtrade initiative works together with Gold standard to ensure credible and fair credits. However, the fairtrade credits are still in development as the definition of fair is difficult to put into practice (Howard et al., 2014).

Customer issues on the VCM

It thus seems clear that the VCM needs to scale up to keep up with the increasing net-zero claims and demand from companies. A number of issues keep the market from properly scaling up. As the process is often not transparent, the credibility of the market is often questioned (Espenan, 2023; Nemanic et al.,

2022; Ziegler, 2022). As there is no proper consensus from the buyer side on how to use carbon credits, people are sceptic about their use (Ziegler, 2022). Companies are being accused of green-washing as it is often believed that companies will just try to ”buy” their net-zero claim instead of actually trying to reduce emissions in the first place (Blaufelder et al., 2021b). There should be clear guidelines on how the carbon credits can be used and what processes can be off-sett by purchasing credits (Ziegler, 2022). Besides, market participants are often not able to track the impact of their credits for an extended period of time. The lack of transparency creates potential for money laundering or fraud activities. With no clear know-your-customer guidelines, the integrity of the market is questionable.

Besides, the added potential co-benefits from these projects add another layer of complexity as it is often difficult to verify and trace back. This lack of unified standards makes it difficult for companies to compare projects and determine the meaning of high-quality credits causing distrust in the market (Nemanic et al., 2022). On the supply side, sellers are uncertain of future demand and are not certain whether they get a fair price for their work. There is often limited access to finance projects as well as lengthy processes to verify credits. Without a clear signal of demand, project developers are left in uncertainty for the future of the VCM (Ziegler, 2022). Due to these problems, different projects can not be compared fairly as the information on each project differs. Projects can be deemed untrustworthy even when, in essence, they might produce fair carbon credits.

Fairness issues on the VCM

Following the Kyoto Protocol, it is encouraged to channel finances in developing countries as they have reaped much less benefits from industrialisation and economic growth. Often relying more on smaller-scale agriculture. However, as the VCM involves a large number of different stakeholders, it quickly becomes very complex. The project developers often have much less bargaining power when it comes to brokers in developed countries (Howard et al., 2014). However, when it comes to reaping the benefits from the VCM, it often lacks transparency to know whether the funds from the carbon credits actually end up within these developing countries.

Research has been done in collaboration with Fairtrade standards to develop a ”fair carbon credit”. Howard (2016) attempts to define the term ”fair carbon” further and looks at important issues when it comes to creating fair carbon. A theoretical framework from McDermott et al. (2013) is adjusted by Howard (2016) and applied to fairness. Participants were mainly involved at the beginning of the process and consisted of project implementation personnel, advisors or staff involved in fairtrade and carbon project advisors. The research showed three different perspectives or factors. They all had a different viewpoint on the project. Table 2.1 shows the different factors they emphasize and what they deem most important. Besides Howard (2016) there seems to be a lack of research on fairness issues in the VCM. As mentioned by Ziegler (2022), fairness is researched in the context of credibility. Interviewees seemed to be indifferent when it came to fairness’s influence on credibility in the VCM. Interesting to mention is the difference in participants, whereas Howard (2016) stayed closer to the project developers and the creation of credits. Ziegler (2022) interviewees consisted mostly of employees from standard-setting institutes.

Investment motivations from customers

As the market is voluntary, it is driven by the demand for carbon credits from customers. However, there seems to be a lack of scientific research on the demand side of the VCM. To further understand how they perceive fairness in the market, it is interesting to know what drives these customers. A survey was done on different buyers in the VCM (Loh and Feng, 2018). The aim of the research was to find out what drives or motivates these customers to buy offsets. Results showed that the main reasons to participate were due to CSR (Corporate Social Responsibility), enhanced brand reputation, image, market differentiation and employee engagement. Other research by (Porras et al., 2016) looked into motivations for purchasing offsets. Buyers through the Plan Vivo Foundation have been included. The results showed some differences where reasons for buying offsets included a focus on co-benefits on biodiversity and people, moral obligations but also public image and CSR as well. However, it was concluded that due to the increasingly competitive market price has a large impact on projects. This is

also in line with research by Ziegler (2022) as it was found that the main focus for a lot of companies was financial rather than focusing on reducing emissions.

1.2.2. Sustainable development goals

As mentioned before, customers do care about the co-benefits that come along with the VCM. These are often described as the sustainable development goals or SDG's. SDGs are a universal set of goals adopted by the United Nations in 2015. The goals range from socio-economic goals like ending poverty or sustainable economic growth to protecting the environment. They are designed as a universal call to make sure people enjoy prosperity and peace by 2030 (UNDP, n.d.). To achieve this, partnerships need to be formed across all sectors of society. This includes the private sector, governments, international and national NGOs as well as communities themselves. Within the VCM, the SDGs are often mentioned. An example is Plan vivo Standard which often does projects with smallholder forestry. These projects also require an approved strategy to improve local economies as well as protect biodiversity. Activities are designed to provide the farmers with a number of new benefits like a reliable food supply, protection of valuable water sources as well as creating new jobs. By doing so, Plan Vivo can ensure more benefits and make their credits more attractive to buyers and, in turn, increase sales (Porras et al., 2016). According to Plan Vivo, at least seven of the SDGs are implemented in the projects. The following image 1.3 portrays these SDGs.

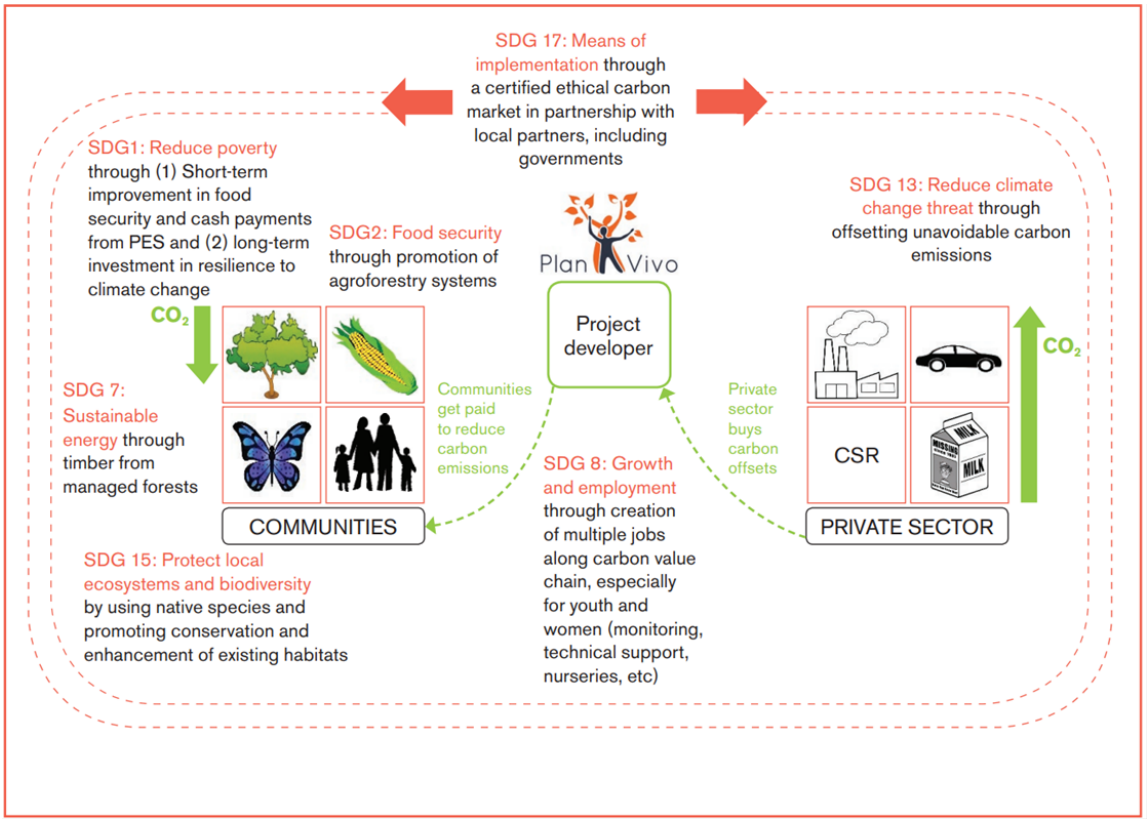

Figure 1.3: Seven of the SDG's highlighted by Plan Vivo adopted from Porras et al. (2016) p.18

According to a survey by Porras et al. (2016) buyers value co-benefits for biodiversity and people as one the main reasons to buy carbon offsets (see figure 2.3 in section 2). Another example is from Gold standard, which requires offset projects to include at least three other SDG's (Loh and Feng, 2018). The research by Loh and Feng (2018) also confirms the theory from Porras et al. (2016) and mentions that it is worth for the market to invest in projects that contribute to co-benefits beside environmental impact. These co-benefits need to be verifiable as this is deemed important by buyers. However, some SDG's like local capacity building or woman empowerment, are inherently difficult to measure. The majority of the cost of these credits need to go to benefiting of local communities rather than administrative work to demonstrate the co-benefits (Loh and Feng, 2018).

1.2.3. Blockchain solving issues on the VCM

Ideally, standards and regulations come into place to enforce integrity in the market and increase the supply of high-quality carbon credits. Pricing on carbon offsets should become more transparent. Verification and traceability of carbon credits should be possible at more frequent intervals. Besides, the time it takes to verify carbon credits should be shortened to reduce costs. As suggested by Blaufelder et al. (2021b) digital processes should be implemented to easily track and verify the impact of carbon credits. The implementation can reduce costs, shorten payment terms and increase the cash flow for project developers. Besides, corporate claims can be made credible as they should be able to trace and verify the impact of their credit. Doing so can create a more even playing field and might increase the supply of high-quality carbon credits in the long term.

A solution that comes to mind when facing problems like transparency, traceability and verifying is blockchain technology. The technology, often well-known as Bitcoin, relies on an intricate network of nodes that check all transactions. In essence, blockchain allows all participants in a network to keep track of transactions that happen in the network. Issuing carbon credits on a blockchain network enables transactions to be traceable and transparent through the whole value chain, as can be seen in figure 1.1 (Puthal et al., 2018). Different stakeholders from each category in figure 1.2 should be able to get more insight into projects when blockchain is implemented. Also, registration of carbon credits on blockchain can reduce costs and allow more projects to have access to funding. Besides, payments can be automated to increase cash flow for project developers and create more fair opportunities for more projects to benefit from the VCM.

Looking at practical implications, only a few technology solutions are fully competitive. Most of the software solutions are still in the early stages, like proof of concept or still have to be validated by the industry (Sipthorpe et al., 2022). Looking at the voluntary carbon market, the application of blockchain, tokenized assets does seem to promote more liquidity and fairness in the market Nemanic et al., 2022. Still, some pressing issues are still present. Scalability issues due to technical issues and a shortage of skills in software engineers cause difficulties in blockchain solutions to go from proof of concept to actual lab validation (Sipthorpe et al., 2022). Also, difficulties in system integration arise. Other emerging technologies are linked to the use of blockchain technology, such as IoT-connected smart devices. The lack of maturity in these other technologies causes barriers in large-scale adaptation (Sipthorpe et al., 2022). More detailed information about blockchain can be found in appendix A.

1.2.4. Blockchain implemented for carbon trading

Blockchain does have some potential to be implemented on the VCM. Only a few solutions are ready for the market, and most are still being explored. The following image 1.4 shows how carbon trading can occur through blockchain.

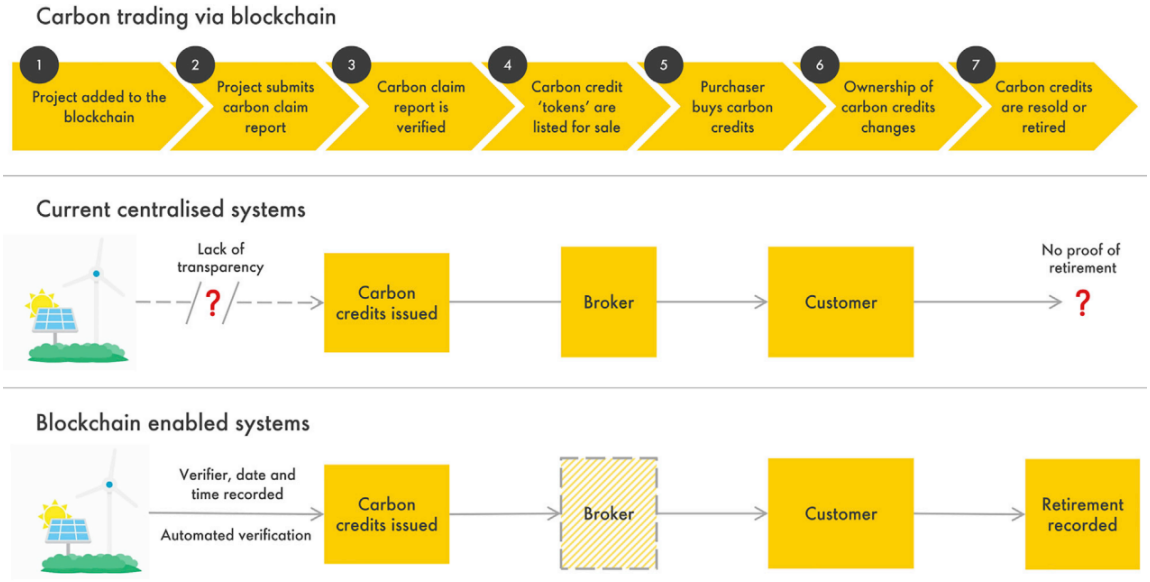

Figure 1.4: Blockchain implemented for carbon trading. The top image projects a potential implementation of carbon trading through blockchain. The middle and bottom images show the advantage of blockchain as the broker's role becomes obsolete. Original image adapted from (Sipthorpe et al., 2022) p.781

The first step in carbon trading through blockchain is adding the actual project. The employees from the project can add carbon claims to the blockchain. These carbon claims must be checked and verified before they can be sold. This can happen through verification bodies like Verra or Gold Standard. After the check, the credits are tokenised and can be sold to companies. This transaction causes the ownership of the credit to change. The new owner can then resell or retire the credit and claim the carbon offset it delivers. From beginning to end, the whole process is transparent and can be seen by all nodes in the network. Inherently, in blockchain, all the other nodes check the transfer of ownership from one node to another. Therefore, the need for a broker between the projects becomes obsolete. Through blockchain, the retirement of credits becomes unambiguous, rendering them permanently untradeable. This new level of transparency is achieved as all nodes within the network have visibility into the retirement claim, ensuring a secure and unchangeable record of credit retirement. Currently, there is no platform where credits are directly sold from project to customer (Sipthorpe et al., 2022). Research by Sipthorpe et al. (2022) shows several potential blockchain solutions for carbon trading. These solutions are used for carbon trading, offset trading, investing, or carbon tracking. The research shows that only a few companies offer a competitive trading platform. Most companies are still in a proof of concept or waiting for deployment. (Sipthorpe et al., 2022) mentions barriers commonly encountered by these solutions. A shortage of skills in software engineers could hinder the process of creating a fully competitive solution. Also, the actual implementation of blockchain is a lot harder. Blockchain is linked to other emerging technologies, like the Internet of Things, which are not fully matured yet (Fernández-Caramés and Fraga-Lamas, 2018). At last, a significant barrier is regulatory concerns. Interaction between companies causes regulatory concerns, and industry-standard practices need to be changed, which can cause problems as changing these projects is a costly and challenging process (Sipthorpe et al., 2022).

Tokenization of credits

Carbon credits first need to be tokenised to use carbon credits in a registry. In blockchain, there are three types of tokens: utility, security, and asset-backed. Tokens can be seen as digital rights that represent either one (Li et al., 2019). Asset tokenisation can be seen as a digital representation of something on the distributed ledger. These assets can be a commodity or something non-tangible like intellectual property rights. The tokens represent the value this asset has (Li et al., 2019). Thus, they can be traded on the blockchain through tokenising carbon credits, representing a specific asset like part of a smallholder farm or forest land.

The tokenisation process with a carbon credit is as follows: The carbon reduction or avoidance

project is first *verified* and *quantified*. This data is then stored on the blockchain. Once the data is stored there, it is immutable, meaning removing or altering the data is impossible. It is recorded on the blockchain and transparent to others. Tokenisation, in combination with smart contracts, can automate the issuance of credit-backed tokens. This process is done without an intermediary and is much more efficient. (Haritonova and Haritonova, 2023)

There are multiple examples of tokenisation within the VCM. The Toucan Protocol, for example, is an online infrastructure where verified carbon credits are retired and tokenised on the blockchain as Base Carbon Tonne (BCT). The BCT can then be traded and sold on the blockchain accordingly Sipthorpe et al. (2022). Furthermore, AirCarbon Exchange uses tokenisation to represent an entire asset instead of an individual project. In this case, a token has the total value of one tonne of carbon dioxide (McCall, 2022). As mentioned, tokenisation has many benefits. Besides increased transparency and the lack of an intermediary, tokenising assets allows the fractional ownership of certain assets. This partial ownership is often smaller than typically seen in stocks or bonds. It is, therefore, easier to participate in capital markets with lower portfolio sizes (Valeonti et al., 2021). Regarding carbon markets, tokenisation can allow easier access to assets, increasing the potential availability for project funding and increasing liquidity in the market (Nemanic et al., 2022). Non-fungible tokens (NFT) are defined by Valeonti et al. (2021) as: ”cryptographically unique, invisible, irreplaceable and verifiable token that represents a given asset, be it digital or physical, on a blockchain. NFT is thus a sort of asset-backed token that is more unique. For example, when owning an asset-backed token that backs real estate, each token is worth the same. However, in the case of an NFT, all tokens are unique and, therefore, can represent a different value.

According to (Valeonti et al., 2021), NFTs bring scarcity into the digital realm. When buying an NFT, the transaction is registered on the blockchain network, and no one can question or challenge the ownership of this asset. Even though NFT seems very promising, the technology must be fully developed. There are still several issues surrounding NFTs. For one, NFTs are not easily interchangeable as they are often tied to a specific blockchain network. Interoperability is, therefore, limited (Valeonti et al., 2021).

1.3. Knowledge gap

Each of the papers used has been documented and mentioned with their respective recommendation, study participants, and main study area. Some studies' participants were irrelevant as no surveys or interviews were conducted. This is why the participants are not mentioned in some studies. Also, the recommendations mentioned in table A.3 in appendix B. are all relevant for this thesis. Only recommendations relevant to the VCM or fairness have been mentioned.

Initially, this literature review focused on blockchain solutions to enhance fairness within the VCM. However, after researching the available documentation, the research in this field is lacking. There is some research available on blockchain enhancing fairness or equity within VCM. Nemanic et al. (2022) found that blockchain implementation within VCM does enhance fairness. However, a fixed definition was used for fairness. It can be argued that this definition is much more nuanced, and Nemanic et al. (2022) recommends further looking into these sub-questions as a separate research question. Looking further into the research on blockchain solutions within VCM, it can be seen that blockchain can be implemented to enhance transparency (Espenan, 2023; Hartmann, 2019; Marchant et al., 2021) and used in the end to create more trust from consumers within the market. Furthermore, specifically Hartmann (2019) mentioned that blockchain could help to even the playing field by providing accurate information for all stakeholders in the market.

Furthermore, the second part of this literature review focused on finding perceptions of fairness from a consumer perspective. However, it was quickly concluded that fairness was mainly researched from a project developer perspective (Howard, 2016). Using the framework by McDermott et al. (2013), three different factors or perspectives within fairness were defined (Howard et al., 2015a). It is recommended that the notion of ”fair carbon” be further researched and that more actors on the carbon value chain

be included.

Porras et al. (2016) and Mustalahti and Rakotonarivo (2012) focused on equity and benefit sharing within carbon projects. Porras et al. (2016) mentioned the importance of credibility and communicating the benefits for local communities to attract more buyers. Mustalahti and Rakotonarivo (2012) recommended to explore the challenges associated with equity and accountability more. Following upon credibility, Ziegler (2022) researched credibility on VCM and also mentioned fairness as one of the aspects of this credibility. This study's participants came from multiple companies, such as consultancies, research institutes, and standard-setting institutes. Unfortunately, fairness was only briefly touched upon, and it was recommended that broader stakeholder engagement be included across the entire value chain.

The drivers and motivations for participation in the literature have been mentioned to get more insight into fairness from a consumer perspective. Loh and Feng (2018) has researched the motives behind participation in the VCM. The research highlighted the distinct roles of personal motivation and employee engagement as drivers of workplace performance, emphasizing the significance of considering fairness as a factor influencing personal motivation. Loh and Feng (2018) recommends further looking into altruistic reasoning for participation within the VCM as this gets much less attention within the literature than economic benefits. Supporting research shows that blockchain enhances fairness within VCM. However, this definition of fairness needs to be more specific. Figure 2.3 shows consumers care about the co-benefits delivered. It remains unclear which co-benefits are precisely mentioned. This thesis will thus address the following knowledge gaps: the lack of definition of fairness from a customer perspective and how blockchain should be implemented to enhance this.

Research direction

Concluding this, there is an opportunity to research whether blockchain enhances fairness. Nemanic et al. (2022) briefly touched upon this topic but only included the project developer side, not the consumer side. Other research did include the role of blockchain and mentioned several features like smart contacts within the blockchain that could enhance transparency and, in the end, fairness (Espenan, 2023; Hartmann, 2019; Marchant et al., 2021). This could lead to more trust from the consumer side within this market. Other research looked into motivation for participation in VCM Porras et al. (2016) and Loh and Feng (2018). Interestingly, customers care about the co-benefits from projects (see figure 2.3). Further looking into the definition of fairness, research by Howard et al. (2015) suggested three different factors or perspectives derived from project developers and standard-setting institutes. Initially, it was thought that the definition of fairness had been researched from a consumer perspective. However, it seems that this is where a knowledge gap remains.

The future of VCM relies heavily on consumer-driven dynamics, which are marked by a high degree of uncertainty. This thesis aims to see whether blockchain enhances fairness and increases trust in the market. A deeper understanding of fairness from a consumer perspective is needed to assess whether blockchain can increase this further.

1.4. Research scope & questions

1.4.1. Research objective

The objective can be summarized in the following sentence: *"To investigate and understand how blockchain technology can enhance fairness in the voluntary carbon market from a consumer perspective, with a focus on exploring diverse viewpoints, identifying key factors influencing perceptions of fairness, and assessing the potential impact of blockchain on consumer trust within the market."* This research will investigate what characteristics of blockchain are most important when addressing fairness in the VCM. The research will look at fairness in the VCM from a customer perspective, as this has been lacking in previous research. The thesis will build further upon research Howard (2016) and broaden the discussion on fairness by including the customer perspective. Since fairness is a difficult concept covering multiple aspects, the framework on fairness created by McDermott et al. (2013) and adjusted by Howard (2016) is used to asses fairness in this specific context. Results from this thesis can be used to improve the market integrity and foster more trust in the market. This can contribute to more fair policies in the future or a stronger project proposition by developers as they know what the customers find important.

1.4.2. Main research question

Fairness is a social construct, and blockchain applications do not directly come to mind when assessing this. However, some of the distinct features of the decentralized ledger technology, blockchain, can help enhance fairness in the VCM. The application of blockchain to enhance fairness has yet to receive much research. Furthermore, more research on fairness in the VCM from a customer perspective is needed. This thesis will include these gaps and apply blockchain technology to a social problem. The main research question is therefore the following:

How can blockchain technology enhance fairness in the voluntary carbon market from a consumer perspective?

1.4.3. Research sub-questions

Several sub-questions are mentioned to help understand the VCM further.
By knowing what drives customers to invest in the market, we can determine what is most important to address when discussing improvements through blockchain on the VCM.

1. *What are customer motivations and priorities when looking to invest in the VCM?*

The second research question explores the different issues plaguing the VCM's development. Understanding customers' issues further creates the base on which this research takes place and how fairness is related to these different issues.

2. *What are the different issues within the voluntary carbon market related to fairness from a customer perspective?*

The third question explores the different perspectives customers can have on the market. It talks about the way the end consumer perceives fairness.

3. *What are the different perceptions of fairness from a customer perspective?*

The last research question links everything together and talks about the different characteristics of blockchain and how they would be implemented to enhance fairness.

4. *How can specific features of blockchain, like smart contracts, be applied to enhance fairness in the VCM?*

Recommendations can be given on integrating blockchain in the VCM by delving into customer priorities and perspectives on fairness.

1.4.4. Scope

This research is centred on the customer aspect of VCM. The focus will only be on large firms looking to offset rather than individual offsetting, as individuals have much lower volumes and, thus less influence in the market as a whole. The study will engage employees from companies actively participating in the VCM by either offsetting their emissions or providing guidance to other customers regarding emission offsetting in the VCM. The thesis aims to delve deeply into customer perspectives, specifically examining their views on fairness. It is important to note that this research exclusively concentrates on the customer side of the VCM and does not encompass the perspectives of project developers or stakeholders involved earlier in the process. This is done by only including articles about customer preferences and perspectives in the VCM rather than reports from project developers. Furthermore, due to time constraints, ethical considerations will not be addressed. The research will include details on blockchain technology when applied to the VCM. Recommendations regarding the most critical aspects of the technology are mentioned. However, technical recommendations regarding blockchain will not be mentioned as this lies outside the scope of this thesis.

1.5. Outline

The outline of this thesis is as follows: First is the general introduction and critical topics necessary to understand the issue and research. After, state-of-the-art research on fairness through the blockchain is presented in section 2. This will include research on fairness and blockchain, fairness in general, and some insight into why companies are investing in the VCM. The following chapter 3 will present the methodologies used for each research question and develop the framework on fairness by McDermott et al. (2013) and adjusted by Howard (2016). The different steps in the Q-methodology will be highlighted, with all steps in between in detail. This section will also include the link between blockchain and the statements on fairness. In section 4, the results of the different research questions will be presented comprehensively. The results will then be compared and linked to the existing literature in the discussion in section 5. This section will also include some limitations of the study. Lastly, section 6 will conclude the research, and the different sub-questions and main research questions will be answered. This section will also include relevance to society, the MOT program, and managerial implications. The research will end with recommendations for a future research agenda.

2

Literature review

This literature review will include all state-of-the-art articles on fairness, blockchain and the voluntary carbon market. The literature search was conducted using Google Scholar in September and October 2023. The first term used was **"Voluntary carbon market" AND Fairness OR equity AND blockchain**, which yielded 106 results. Literature with restricted access and in foreign languages have been excluded. This research will also focus on firms instead of individual offsetting, as individual offsetting has much less influence on the market due to the smaller individual volumes compared to corporate buyers (see section 1.4.4 for more explanation). The first initial title selection resulted in seven valid papers that focused on the combination of blockchain and the VCM. After examining the abstract, introduction, and conclusion, only four remain. Reasons for excluding each paper have been mentioned in table A.1 in appendix A.1, Which can also be seen in the first step in figure 2.1.

After further reading the papers, there was too little emphasis and mentioning of fairness within the VCM. To include more research specifically addressing fairness, the search term is adjusted to **Fairness Or Equity "Voluntary carbon market"** This resulted in 393 hits on Google Scholar. The search term needs to be further refined. This literature review will mainly focus on motivation and reason to participate within this market from a consumer or customer perspective. Therefore, the search term on Google Scholar has been refined to: **Fairness Or Equity "Voluntary carbon market" AND motivation OR Motivations OR "Market participation reasons" AND Customers OR Consumers**, which resulted in 112 hits. To further narrow the scope, specific case studies outside of Europe have been excluded, as carbon markets across the globe have different customers. The participants in this research will be based in the Netherlands, thus using carbon credits here rather than elsewhere. This thesis will focus on the voluntary carbon market as a whole. Thus, specific case studies in developing countries have been excluded. Also, a specific focus on carbon offsetting for individuals has not been taken into account since this thesis will focus on businesses looking to offset their carbon emissions (see section 1.4.4). At last, research in foreign languages and with restricted access has not been examined in this literature review. The entire table with authors, key message and reason for inclusion or exclusion has been mentioned in table A.2 in appendix A.2

The initial title selection resulted in 10 papers, further examined through the abstract, introduction, and conclusion. Two papers (Howard et al., 2015, 2015a) are part of a larger PhD research (Howard, 2016) which consists of a total of three different papers (Howard et al., 2015, 2015a; Howard et al., 2014) all assessing fairtrade standards and the notion of "fair" within carbon projects. The research was conducted in collaboration with the Fairtrade Institute from the University of Leeds, the environment faculty. As this is elaborative research in the scarce realm regarding fairness in the VCM, the entire PhD and all the papers are included in this literature review. The total number of papers used in this part of the literature review is seven (five from Google Scholar and two more as part of the PhD by Howard, 2016). The total number of papers used for the entire literature review is twelve.

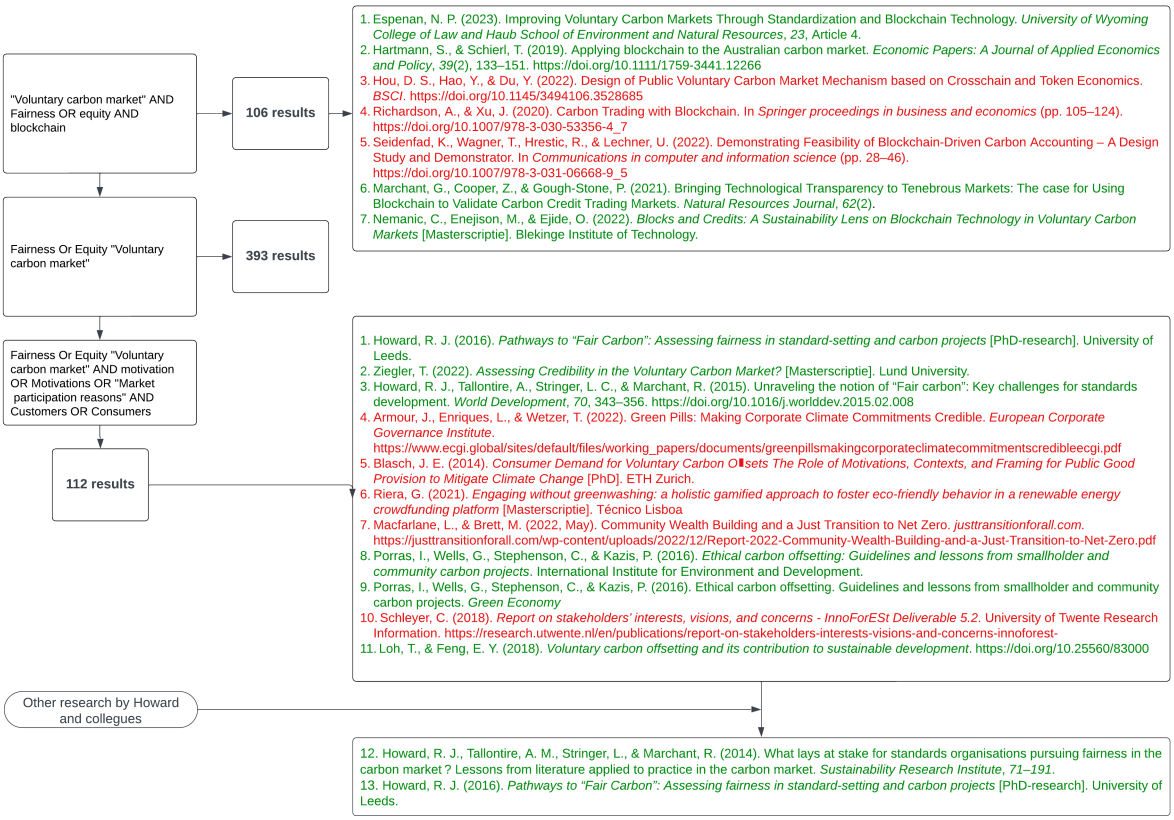

Figure 2.1: Search diagram for the literature review. The amount of hits on google scholar and the selected research is mentioned. In green is the research eventually used, red is excluded. Reasoning is mentioned in table A and table A.2 in appendix A

2.1. Literature review

2.1.1. Blockchain promoting fairness in VCM

Starting off, the focus of this literature review will be to see what the current knowledge is on blockchain and fairness within VCM. Blockchain technology holds significant promise in assessing fairness throughout the carbon value chain. Its decentralized structure reduces reliance on a central authority, diminishing the dominance of a single entity (Chen, 2023). Moreover, blockchain has to ability to foster a more interconnected marketplace by centralizing data storage, thus breaking down information silos (Baim, 2023). Research by Nemanic et al. (2022), highlights blockchain's potential for sustainability within the voluntary carbon market. One of the issues addressed was whether blockchain promoted fairness within carbon trading. According to the authors blockchain does promote this. However, a few side notes were mentioned: due to the permissionless use of blockchain and without a prior check before entering the market, firms with unethical behaviour might participate as well. It is challenging to prioritize the sale of carbon credits to firms with the most environmentally friendly practices instead of firms just looking to buy their way out of reducing emissions. Carbon credits are meant to offset the processes which are impossible to reduce emissions on. It is important to first reduce emissions within the company before looking to purchase offsets (Valiergue and Ehrenstein, 2022). Additionally, the carbon credit market relies on a delicate trust dynamic. Introducing new carbon verification methods could face scepticism until validated within blockchain-based solutions. This caution could reduce the number of carbon verification entities, potentially strengthening the monopoly of existing schemes (Nemanic et al., 2022). The research by Nemanic et al. (2022) used one fixed definition by Crémer et al. (2021): ""the organization of economic activity to the benefit of users in such ways that they reap the just rewards for their contributions to economic and social welfare and that business users are not restricted in their ability to compete" (p.39). It can be argued that this definition is in reality, much more complex. Also, data collected was only through standard-setting institutes, which is part of the stakeholders. Further

research specifically addressing fairness through blockchain within VCM is very limited.

Blockchain increasing trust

Espenan (2023) and Marchant et al. (2021) both mention the issue of trust from end consumers and the potential of blockchain to change this. Espenan (2023) mentions the importance of standardisation and blockchain's application within the VCM. Within the domain of carbon-financed projects, the issue of distrust and transparency remains a large concern. Specifically, doubts often revolve around whether the designated land is genuinely used for carbon offsetting purposes. This scepticism is largely rooted in the perceived lack of oversight by the responsible registries. Registries have the crucial role of verifying that the land is indeed allocated for carbon offset initiatives and frequently conduct less-than-comprehensive investigations, contributing to a sense of mistrust among end-consumers (Espenan, 2023). It is suggested that blockchain technology can be leveraged to enhance transparency within the carbon market. Blockchain's inherent transparency is identified as a potential solution to augment carbon credit information and improve connectivity. Additionally, it introduces a structured framework for project developers to follow, operating in line with a standardised set of regulations. This innovative technological approach emerges as a promising avenue to address the issues of transparency and trust in the carbon offset market (Espenan, 2023).

As highlighted further in the study by Marchant et al. (2021), blockchain technology can offer a means to monitor and assess changes in the original land plot meant for carbon offsetting. This includes scenarios such as forest fires or other natural disasters that may impact the land. Blockchain's inherent capabilities make it a valuable tool for tracking land modifications effectively. Furthermore, Marchant et al. (2021) mentions the utility of smart contracts within the blockchain ecosystem to enhance transparency in business practices and bolster the credibility of their assertions. These smart contracts can be accessed by individuals through the public ledger on the blockchain, providing a mechanism for verifying corporate claims regarding their environmental actions and thus improving the credibility of companies. It is worth noting that while blockchain holds promise for the VCM, its full potential remains a subject of ongoing exploration and investigation. Stakeholders in the VCM express a readiness to experiment with emerging technologies like blockchain, underlining the dynamic and evolving nature of the field (Marchant et al., 2021).

Research by Hartmann (2019) applies blockchain technology to the Australian-compliant market. Even though this is a compliant market and not a voluntary one, the research gives insight into the benefits of increased transparency through blockchain. As mentioned, within the Australian carbon market, carbon service providers (CSPs) hoard information, leading to an uneven playing field. CSPs have more information, which gives them an advantage when bidding on emission reduction funds (ERF). ERF is funding disclosed by the government, which can be used to innovate and adopt new technology practices to reduce their emissions (Australian Government, 2023). Furthermore, Hartmann (2019) mentions the reduced cost for measurement, reporting and verification. Measuring, reporting and verification (MRV) would be automated and standardised when using smart contracts. This reduces cost, which makes small projects more viable, thus evening the playing field and promoting equity and fairness. It is mentioned that the costs for setting up these smart contacts must be balanced against the initial set-up cost.

2.1.2. Fairness in Carbon Offsetting

To further understand whether blockchain can promote fairness, it is crucial to understand the concept of fairness within the VCM. Research by Howard (2016) has done extensive research regarding fairness in the VCM. The PhD consists of two publications and two working papers over four years. The research includes different case studies with multiple smallholder farmers as well as with Fairtrade Institute. The research uses Q-methodology, in which participants give their views and perspectives on specific topics, such as fairness in the VCM. Within Q-methodology, the entire range of opinions on a particular topic has to be encompassed. Howard (2016) has used collected opinions and perspectives on the topic of fairness in the VCM over a period of two years, consisting of interviews, meetings and workshops with employees from Fairtrade Institute as well as others directly involved within projects. As research in the domain of fairness in the VCM is scarce, the research by Howard (2016) presents a complete and elaborate view on the topic and is deemed as valid to build further upon. This will extend the work and

look at the customer side, something which has not been done by Howard (2016).

The research by Howard (2016) starts with a literature review to identify critical challenges in the achievement of ”fair carbon” (Howard et al., 2014) mentions seven different challenges and their related opportunities for development of a fairtrade standard in VCM. Two standard-setting institutes, Fairtrade and Gold Standard, propose different interventions to tackle these challenges. These can be found in 2.2.

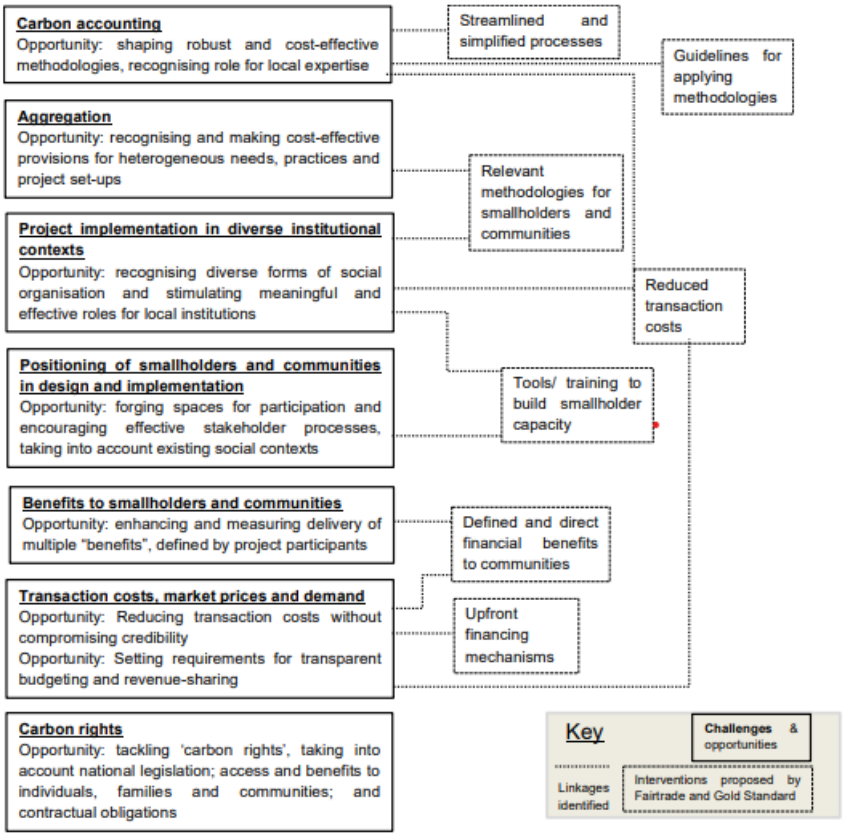

Figure 2.2: Seven identified challenges and linked opportunities from a smallholder farmer perspective. Originally published in a paper by (Howard et al., 2014) p.20

Howard et al. (2014) summarises these challenges from the beginning of the project as this was the focus of Howard (2016). This is useful as a starting point to see where different gaps remain within the literature. From here, it is recommended to seek a clearer definition of fairness. This should be done across the entire carbon value chain, including producers and consumers. A further research agenda is mentioned. (Howard et al., 2015) build further upon this research.Howard et al. (2015) mentions the challenges within the standard setting. These challenges are within the space in which Gold Standard and Fairtrade International operate. The first challenge is weak access to land and carbon rights. Disparities exist between official and traditional land rights, which causes challenges. This could lead to conflicts or uncertainties, especially when the projects are long-term. The intervention and lesson learned from this first challenge was to ensure the rules for using land for carbon projects work with the local people. A fixed set of rules might pose problems. It is important to create methods that work with the farmers' way of life instead of working against them. The second challenge involves the ambiguity and cost complexities in carbon accounting, impacting the financial viability of smallholder and community-focused projects. These issues and the volatility in carbon offset prices make market access a considerable hurdle for these groups. Lessons learned from this challenge are that streamlining processes, reducing costs related to market access, and providing upfront financing mechanisms can enhance smallholders' and communities' access to carbon markets. However, balancing rigour and

simplification is essential when adopting these interventions. Additionally, the potential transformation of the carbon market, particularly through initiatives like fair trade's impact on the coffee market, remains uncertain in the face of a weak carbon market and varying consumer demand. The third and final challenge is the potential for negative impacts on local communities and project reputations, often stemming from issues such as land acquisition and unequal benefit distribution. These negative effects can lead to project failures and harm local communities and project legitimacy (Howard et al., 2014). Lessons for fair standard setting include the importance of considering both financial and non-financial benefits for smallholders and communities in carbon projects, as they have unique motivations and needs (Howard et al., 2014). Additionally, GS and FI should be cautious in raising expectations about the delivery of defined and direct financial benefits, as this could potentially create unmet expectations beyond their control. Howard et al. (2015) also mentions multiple research directions. One is to look further into the term ”fair carbon”.

Different factors or ”perspectives” regarding fairness within the carbon market have been analysed. The research makes use of the framework proposed by McDermott et al. (2013). The framework consists of three different dimensions. The first is contextual, which encompasses the existing preconditions such as political, social and economic distributions—the second is distributive, which evaluates the social impact of an intervention. The third dimension includes procedural equity, which looks at how stakeholders can influence the decision-making process and, therefore, the distribution of benefits. (Howard et al., 2015a) mentions the following definition for each term used in terms of ”fairness”.

- **Fair access** There are different ways people can engage and participate in the carbon markets through carbon projects.
- **Fair procedures** The ways people can participate in the decision-making or implementation of the project itself. This also includes the rules and procedures themselves.
- **Fair-benefit sharing** Different ways the people within the projects can benefit from its outcomes. This includes financial benefits and measurable and non-measurable terms.

From empirical analyses Howard et al. (2015a) found three different factors or perspectives when applying the framework from McDermott et al. (2013) to fair carbon trading. Participants either prioritised producers, the value chain or market efficiency. More detailed explanation of the factors is mentioned in table 2.1.

Interesting to mention is that the group of participants either had experience at Fairtrade International or experience at promoting, financing, implementing or developing standards for the VCM. Part of the group had experience in both of these categories. The interviewees were grouped into three sections according to their answers. The groups were characterised according to different factors or perspectives. The first factor includes the producer's perspective as the main priority, emphasising market participation. The second factor is its focus on the value chain, maximising impact for people and the planet. The last factor emphasises market efficiency with little interference and more benefits for the projects themselves.

Following the results of Howard et al. (2015a), each group had three noticeable disagreements. One of the main areas of disagreement between the different groups was on where to measure fair benefit sharing, whether this should be on the level of the organisations producing the credits, across the commodity chain or at the household level. All three interviewees agreed that intermediaries should be involved in carbon trading non-governmental organisations (NGOs). The level of compensation differs depending on the factors. While the first factor limits their compensation, the second and third favour reasonable compensation. The last significant finding is on the involvement of participants in the creation of a standardisation. While it is agreed that the local smallholder farmers need more capacity to engage in the discussion, there is disagreement regarding how this should be handled. While interviewees from the first factor want to increase capacity, the second and third groups see these limits as a reason to involve additional parties. The three different factors are structured in table 2.1. All research is tied together within Howard (2016) in which recommendations are given for future research directions. Howard (2016) notes that the interactional dimension of fairness is missing from current multi-dimensional frameworks about fairness. Exploring how the interaction between parties

can shape the perceptions of fairness and the outcomes in projects and standard-setting processes is important. Furthermore based of Howard et al. (2015a) more research is needed in the carbon value chain which can be used to identify main stakeholders and look further into the interaction between these stakeholders to determine its influence on fairness. As mentioned before, the empirical study involved mainly carbon developers rather than consumers.

Other research by Mustalahti and Rakotonarivo (2012) talks about the sharing mechanisms implemented to increase community carbon benefits. Issues like transparency make it more difficult to find fair outcomes, especially when multiple stakeholders are involved. Mustalahti and Rakotonarivo (2012) raises questions on who is recognised as an accountable institution and what part of the carbon payment they should receive. Performance-based payment, based on the amount of reduced emissions, is mentioned as a way to provide a fair share of benefits. However, it is tough to measure these emission reductions since there can be a difference in baseline methods and data availability. As mentioned, blockchain might offer a more standardised process, leading to a more fair share of equity (Hartmann, 2019).

Another important consideration is the process by which the sharing of benefits is implemented. This can be done either directly, involving the provision of rewards to individual households based on their performance, or indirectly, where benefits are put into initiatives that promote broader development, and thus enhancing co-benefits. These indirect benefits may include projects such as constructing schools or health centres within the affected communities. It is worth noting that these benefits' distribution spans both national and local levels. The institutional choices made to establish the benefit-sharing mechanism will have an impact on the overall structure and effectiveness of such carbon offsetting initiatives (Mustalahti and Rakotonarivo, 2012). Further research on fairness within the VCM could be more extensive.

2.1.3. Credibility within VCM

This section will go into another related concept to fairness, namely credibility within VCM. Research relating to the two concepts is, unfortunately, very scarce. Research available by Ziegler (2022) aims to develop a framework for credibility in the VCM. The research consisted of extensive interviews with eighteen different employees from consulting firms, standard-setting institutes and research institutes which encompass a whole range of different perspectives. The employees are researchers, directors or partners within the firms further confirming their expertise on the market. Interviews have been conducted in March 2023 and April 2023. As the research consists of a large number of interviews with different institutes, it is deemed valid and will be used further in this thesis. It has been concluded that the stakeholders primarily focus on the financial potential of VCM rather than its emissions reduction potential. This framework consists of three multidimensional characteristics (competence, character and goodwill). Each of these characteristics has been further divided among different principles. One of these principles from the characteristic ”goodwill” includes the assessment of whether the interviewees found the VCM to be ”fair”. Fairness has been defined as: ”The initiative engages a balanced and representative group of stakeholders that is impartial, diverse and equitable, and it empowers stakeholders to resolve complaints with fair mechanisms (Ziegler (2022) p.54).” Furthermore, it is assessed by the degree in which stakeholders have an equal opportunity to participate and influence the decision-making process. From the interviews, Ziegler (2022) concluded this definition of ”fairness” to have a medium impact on credibility which means from the interviewees were indifferent when it came to ”fairness”. This definition seems to be in line with Howard et al. (2015a) first factor since the priority is among the decision-making process and whether all participants have an equal vote. There was a difference in the group of interviewees, Ziegler (2022) mostly focused upon standard-setting organisations within the VCM, whereas Howard (2016) were participants from fairtrade standards. This difference is interesting to mention as it could be possible the participants from Ziegler (2022) might have the same three factors or perspectives as found by Howard (2016).

2.1.4. Investment motivation

As the market is voluntary rather than obligatory, customer demand is crucial. Therefore, customers are crucial stakeholders. There is a lack of research when looking at fairness from a consumer perspective. This part will look into investment motivations to see what companies drive to invest in the VCM to understand their perspectives on the VCM as this lies within the scope of this thesis (see section 1.4.4 for a more extensive explanation). Loh and Feng (2018) looks at the contribution to sustainable development of voluntary carbon offsetting. The research consists of two different surveys conducted on a number of different respondents. Both surveys aim to asses the motivation for willingness-to-pay among offset users. The second survey is to examine the underlying motivations for organisations' participation in the voluntary carbon market. The respondents from these surveys consisted of a large number of sectors. These included for-profit, government and non-profit organizations. According to the results, the main reason to participate in the voluntary carbon market for reasons related to Corporate Social Responsibility (CSR) is to enhance brand reputation and image, market differentiation and employee engagement. Personal responsibility and care for the environment came forward as drivers for participation. When it comes to brand image, Ehrenstein (2021) mentions that firms often use carbon offsetting purely to buy "the green image". This can be leveraged by sustainability officers within firms to find more company internal support.

Porras et al. (2016) is a study developed in collaboration with Plan Vivo Foundation, which gives some guidelines on how smallholder and community projects can enter the carbon market. A survey was held of buyers from the Plan Vivo Foundation. A total sample of 117 respondents was included. From this, it became clear that the most important factors affecting the purchase of offsets were standard, price, economic co-benefits, social co-benefits and monitoring (in order of importance). Furthermore, the following figure 2.3 mentions the other reasons why companies buy carbon offsets. This is different from figure 2.4 as this is focused upon the priorities when purchasing offsets.

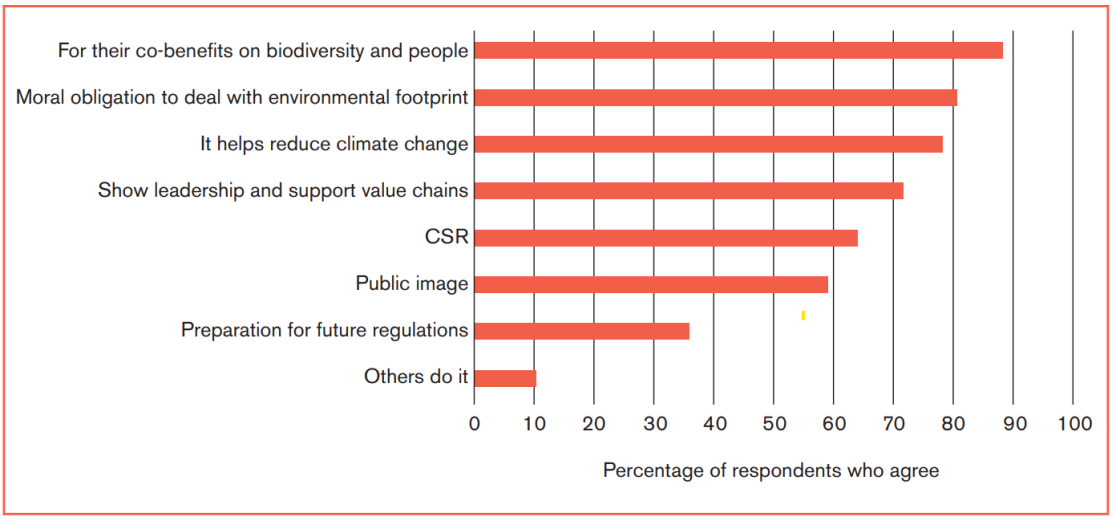

Figure 2.3: Results from a survey about reasons why firms buy carbon offsets. Adapted from (Porras et al., 2016) p.27

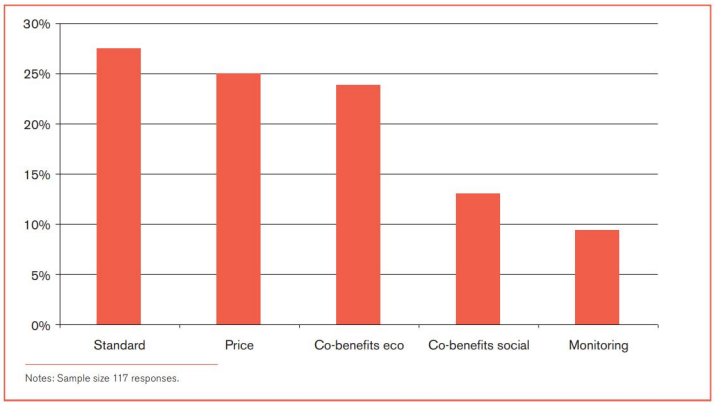

Figure 2.4: Results from a survey about the most important factors affecting carbon credit purchase. Adapted from (Porras et al., 2016) p.27

Interesting to mention is that 37 percent of customers buy carbon offsets due to the co-benefits they deliver. Impacts on the environment were ranked higher than impacts on local people. It is uncertain whether this is because buyers assume co-benefits for locals are coupled to the type of offset. Furthermore, buyers mentioned a strong belief in reducing company and individual environmental footprint (Porras et al., 2016). Research by Ziegler (2022) concluded the main focus of VCM to be financial rather than its ability to reduce emissions. This is in contrast to (Loh and Feng, 2018), which emphasized personal responsibility and employee engagement. This difference could be attributed to the different sample of interviewees. Loh and Feng (2018) included a large number of participants from all different sectors while (Ziegler, 2022) participants were from either research institutions, consultancies or standard-setting institutes, which could have a more negative view on the market surrounding carbon offsets.

Additionally, the interviewees often mentioned that companies are hesitant to invest in VCM due to allegations of greenwashing and the negative press reaction Loh and Feng (2018) and Ziegler (2022) which mention that participation in the VCM is also to buy a certain brand image. The willingness to pay for carbon offsets is quite high in buyers of credits as these projects tell a tangible story and can be used to communicate an improved or likeable brand image. Companies should first focus on reducing their footprint and must only use their offset credits for unavoidable emissions (Valiergue and Ehrenstein, 2022).

2.2. Key findings from the literature review

Initially, this literature review aimed to collect all relevant research regarding enhancing fairness in the VCM through blockchain. Furthermore, the thesis will use Q-methodology to compare the research to the results from Howard et al. (2015a). This methodology consists of several statements that participants must place in a specific order on a table, from most disagree to most agree. These statements are about fairness in the VCM and must encompass various perspectives. The research found in this literature review was later used to create the statements used in the Q-methodology (see section 3.6 for more information about statements and their origin).

The key findings from the literature review include three different factors on fairness from a project developer perspective as found by Howard et al. (2015). The factors are described using the following table 2.1.

Factor	Factor 1	Factor 2	Factor 3
Priority	Producers a priority	Value chain	Market efficiency
Emphasis	Market participation	Impact on people and the planet	Little interference, more for projects
Where to measure fairness	Organizations producing credits	Along commodity chain	Household level
Intermediaries compensation	Limited	Reasonable	Reasonable
Participant involvement	Increase local capacity	Involve additional parties	Involve additional parties

Table 2.1: Different factors on how participants view fairness within the voluntary carbon market. Based on (Howard et al., 2015a).

Furthermore, the findings from the Q-study can be coupled to blockchain to see whether blockchain can enhance fairness in the VCM. Nemanic et al. (2022) research shows the potential to enhance fairness in the VCM using blockchain. Furthermore, Espenan (2023) and Marchant et al. (2021) mention blockchain implementation to enhance trust in the market by increasing transparency. Blockchain could provide a standardized way to provide more insight into the projects. Furthermore, research by Hartmann (2019) highlights that different organizations might have access to more information on the VCM, creating an uneven playing field. Blockchain provided more transparency and even the playing field for all buyers involved. Furthermore, implementing blockchain might further reduce MRV costs, as the process can be automated.

Regarding investment motivations, several different reasons were provided by Loh and Feng (2018). The study showed different reasons for investing in companies. Most were related to CSR, brand reputation, market differentiation and employee engagement. Porras et al. (2016) showed many different reasons mainly focused upon co-benefits, whereas Ziegler (2022) showed the priority to be mainly financial. At last, the companies seem hesitant to invest due to allegations of green-washing (Loh and Feng, 2018; Ziegler, 2022). The priorities and most pressing issues will be further explored in this thesis.

3

Methodology

3.1. Research approach

This thesis consists of four sub-research questions supporting the main research question. The following table will include the methodology for each of the different research questions.

Research Question	Methodology	Deliverable
What are the different issues within the VCM related to fairness from a customer perspective?	Results from the literature review (see section 2) in combination with interviews.	A comprehensive report outlining the various issues within the voluntary carbon market, synthesized through a combination of desk research and interviews.
What are customer motivations and priorities when looking to invest in the VCM?	Results from the literature review (see section 2) in combination with interviews.	A comprehensive report outlining customer motivations and priorities in VCM investment, created from a combination of desk research and insights gathered through interviews.
What are the different perceptions of fairness from a customer perspective?	Results from Q-methodology and supporting interviews.	Correlation results from the Q-set as well as motivation for different perspectives on fairness through interviews.
How can specific features of blockchain, like smart contracts, be applied to enhance fairness in the VCM?	Results from the Q-methodology.	The Q-set is linked to blockchain and fairness thus the result will show which areas of blockchain are most important to focus upon when enhancing fairness.

Table 3.1: Four research questions and the method used to answer them as well as the deliverable

This thesis will use different methodologies, including a literature review, interviews, and Q-methodology. Issues from a customer perspective related to fairness and motivations and priorities to invest in the VCM are provided through the literature review in section 2 and later validated through interviews with customers in the VCM to compare theory with practice. These interviews took place in January 2024 and February 2024 and consisted of customers in the VCM. These are found through cold outreach on Linkedin. This research used the same participants to answer all different research questions (see section 3.6.1 for more information on the interviewees). Perceptions of fairness from a customer perspective will be provided through Q-methodology. Q-methodology tests many statements regarding a topic (in this case, fairness in the VCM). Participants in the Q-methodology are asked to arrange the statements in a specific order, ranging from most disagree to most agree. The method is used in this thesis since it can be compared to research by Howard et al. (2015a) in the discussion (see section 5.1.1 for the comparison).

The last question regarding specific features of blockchain was also provided through the results of the Q-methodology. The statements in the Q-methodology were linked to a blockchain feature like transparency, decentralisation, tamper-proof record keeping, traceability and standardisation (see section 3.6.1 for more detailed explanation). The statements which participants agree or disagree with will indicate the most important features of blockchain.

3.2. Fairness framework

The fairness framework defines statements in the first two steps of the Q-methodology. The original framework was created by McDermott et al. (2013) and adapted to another study on fairness in the VCM by Howard et al. (2015a). This thesis will use the same framework to create statements related to fairness in the VCM (see section 3.2.2). However, the methodology differs from Howard et al. (2015a) as it focuses on customers in the VCM rather than at the beginning of the value chain (project developers and project enablers).

3.2.1. Equity framework

The framework by McDermott et al. (2013) is previously used to assess how local equity will be affected when projects are commercialised. The framework has been applied in two cases, both related to fairness within complex projects involving several stakeholders. The first is REDD+ (Reduced Emissions from Deforestation and Forest Degradation), an initiative to foster financial investments to reduce deforestation and preserve forests in developing countries. The framework analyses how the sudden commercialisation of forest carbon credits influences local equity (McDermott et al., 2013). The second case is PES (Payment for Ecosystem Services), which, in essence, is the preservation of ecosystem services like biodiversity conservation. For PES, the framework has been applied to analyse the distribution of benefits among local actors (McDermott et al., 2013). The framework is relevant as this thesis will examine fairness within projects with many stakeholders and look into the ways fairness is assessed by one of the main stakeholders. The framework can be seen in figure 3.1.

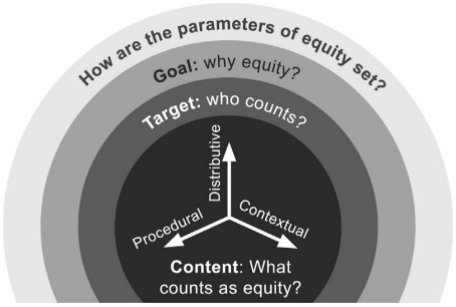

Fig. 1 – Equity framework.

Figure 3.1: Equity framework adapted from (McDermott et al., 2013) p.420

The core comprises three dimensions: contextual justice, distributive justice and procedural justice. These dimensions are all adjusted to fairness in the VCM and used in this research (see 3.2.2). Surrounding the core are three different parameters of equity: *Who* counts as a subject of equity? Along the value chain, this includes social scales on different levels, like individuals, households, and communities. *Why* equity or not; what are the goals about equity? And the last *How* are the parameters defined?

Contextual Justice

Contextual justice takes into account the context in which justice is defined. The uneven playing field created by pre-existing economic, social and political conditions is considered. This could limit the capacity for different stakeholders to engage in the whole equity process. Contextual justice includes the level of individual actors and considering community level and higher organisational levels (McDermott et al., 2013).

Distributive Justice

Distributive justice is about allocating costs and benefits among the different stakeholders. The economic dimension of justice is (mostly) considered in this dimension. Distributive justice can considered into two different categories. The first is consequence-based, which focuses on maximising individual benefit. In this case, The market is considered efficient at distributing social costs and benefits that maximise social welfare (McDermott et al., 2013). Secondly, rule-based theory judges outcomes not on their own terms but takes into account whether they happen from the application of a set of fair rules. Distribution should consider diverse needs across various groups, recognising the unique challenges faced by certain groups, and it should therefore address the varying requirements emerging from the different circumstances experienced by these groups (McDermott et al., 2013).

Procedural Justice

Procedural justice is fairness in processes that can be seen as political. These are processes that allocate resources and resolve disputes. Justice, in this case, represents the involvement of stakeholders in creating these procedures.

3.2.2. Framework applied to fairness

Howard (2016) introduces the framework of McDermott et al. (2013) to a specific case of fairtrade standard setting in the VCM. The definition of fairness, as mentioned by (McDermott et al., 2013), is altered. Contextual equity is changed into fair access, procedural equity becomes fair procedures, and distributional equity has become fair benefit sharing (Howard et al., 2015a). Howard (2016) has extensively researched fairness and standard setting using the fairtrade system. The original definitions by McDermott et al. (2013) will be taken into account when defining and looking for the different statements. This is because the PhD by Howard (2016) assesses fairness in the same environment but in a different context. The context of this thesis will be looking at consumer-defined fairness instead of fairness in terms of fair trade. Due to time and resource constraints, the definitions used by Howard (2016) will remain the same in this thesis. The framework with the terms changed by Howard (2016)is mentioned in figure 3.2

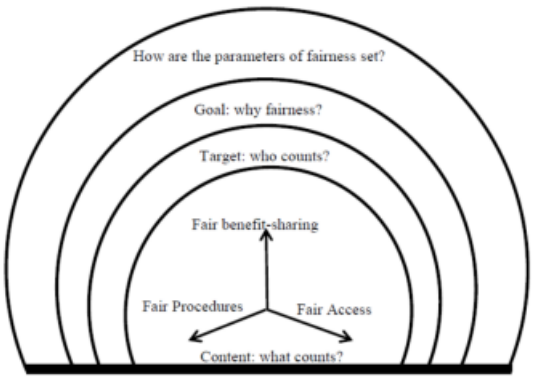

Figure 3.2: Multi-dimensional fairness framework applied to fairtrade standard setting in the VCM. Changed and adopted by (Howard, 2016) p.34

3.3. Investment motivations and priorities

Significant to mention is the difference between investment motivation and investment priority. The definition of investment motivation in this thesis is seen as something that drives customers to purchase carbon credits more as a reason to do so. Examples of this can be to help further support projects, from a moral obligation standpoint, to mitigate climate change or to boost the company's public image further. Priority, however, is focused on which of these motivations or reasons they find most important. Examples of this are a low price or a backstory related to the company. Some examples can be both a motivation and a priority. Co-benefits, for example, can be either a reason to invest, like a motivation, or a priority when it comes to seeing what companies find essential. To further understand the different participants' perspectives, what motivates them and their priorities when investing in the VCM are

identified. Several priorities and motivations are already mentioned in the literature review (see section 2.1.4). These will be categorised and grouped within the results section to give a better overview. Motivations and priorities to invest will not be connected to any dimension of fairness as it is aimed at further understanding the different perspectives of customers.

The interviews will be transcribed and coded using Atlas.ti. The interviews will be analysed using the motivations and priorities found in the literature to see whether they align with the literature. Furthermore, if present during the interview analysis, other motivations and investment priorities will also be named.

3.4. Issues on the VCM

To further understand the context and how customers perceive fairness in the VCM, the framework by Howard (2016) is adjusted to use as a guideline when looking for issues related to fairness in the VCM. More general or irrelevant issues from a customer perspective have been excluded from the results.

1. **Parameters of Fairness:** Customers use various issues and criteria to define fairness within the carbon market. This encompasses considerations such as the lack of uniformity between projects, transparency, methodologies, information asymmetry, and overall ethical dimensions influencing customer perceptions of fairness.
2. **Goal of Fairness:** The overarching objectives the VCM should aim for are addressing customer fairness issues. This involves mitigating trust issues, enhancing accessibility, and aligning with customer expectations and ethical standards.
3. **Target of Fairness:** The specific entities, practices, and challenges within the carbon market that are the focus of efforts to enhance fairness, with a particular emphasis on customers. This includes addressing issues related to market fragmentation and reliability of carbon projects.
4. **Fair Procedures & Fair Access:** The processes and mechanisms addressing issues that allow customers to actively participate in decision-making within the carbon market, promoting transparency and inclusivity. This includes standardised counting and recording methodologies, reducing transaction costs, establishing transparent data infrastructure, and fostering fair competition through accessible and equitable market participation.
5. **Fair Benefit Sharing:** The various issues related to benefit distribution for customers from carbon market projects. This involves addressing issues related to smallholders and communities, defining and verifying credits, and safeguarding market integrity to prevent greenwashing and credibility issues.

3.4.1. Issues from literature

The different research in section 2 is used to find the different issues. All different papers were scanned to find different issues related to fairness. Besides, several extra resources have been used to find more issues. These extra resources are because there were too few statements in the literature review. Further explanation about these resources can be found in section 3.6. Different related issues have been grouped and categorised according to the dimensions of fairness.

3.4.2. Issues from the interview

As mentioned in table 3.1, issues will also be discussed during the interview to compare the theory with industry knowledge. The issues identified in the literature have been coded using Atlas.ti. The interviews are transcribed and coded using the same categories to find supporting quotations on different issues. The total number of times an issue is mentioned will be described according to different factors. The results from the Q-set determine the amount of factors. Not all different issues will be analysed in depth as this is impractical and lies outside the scope of this thesis. However, several issues were mentioned significantly more than others. Issues mentioned ten or more times in the interviews will be analysed in more detail. The quotations in these interviews will be analysed to see whether there is agreement or disagreement on the particular issue.

3.5. Q-methodology summary

The Q-methodology is used to present different views and perspectives of different participants. It can be used to view subjectivity on specific topics (Cordingley et al., 1997). It is applied to assess whether blockchain can enhance fairness within the voluntary carbon market. The participants are end-consumers or customers within the voluntary carbon market. The Q-methodology consists of a few different steps.

1. **Define the concourse**: The first step in Q-methodology consists of collecting a full range of opinions and perspectives on fairness and trust in the VCM. The concourse encompasses all participants' perspectives on a certain topic. The concourse is either naturalistic, verbal communication, often through interviews, or ready-made, which includes articles or scientific research (Banasick, 2019). Multiple different articles have been mentioned in the literature review (Loh and Feng, 2018; Mustalahti and Rakotonarivo, 2012; Porras et al., 2016). This first step builds further upon this literature. It includes articles (Blaufelder et al., 2021b; Shell and BCG, n.d., 2022a,b) as these are written in collaboration with customers in the VCM and provide useful insight into the perspectives of customers.
2. **Refine the Q set** From these articles, different statements are generated, including the various aspects of fairness from a customer perspective. Multiple iterations have been done to come to the final Q-set. These statements were designed to evoke positive and negative participant reactions and reduce bias.
3. **Participant Selection** This study is performed in collaboration with the financial service offering (FSO) team from Ernst & Young (EY). The participants were selected based on a diverse set of opinions and perspectives. Participants need to be familiar with the VCM. This can be investing in the market, planning on doing so or trading in the VCM. Participants were found through cold outreach on Linkedin as well as through the professional network of EY.
4. **Q-sort and Interviews** During the interviews, participants are presented with statements created during the previous steps. The participants sorted the statements according to priority and whether they agreed or disagreed with them. They were asked for explanations of their choices. The interviews were held online and took place between January 2024 and February 2024.
5. **Data analysis and interpreting results** The Q-sorts were analysed using Q-analysis to identify patterns and factors among participants further. Different themes and categories will be identified. The different perspectives of customers will be found through distinguishing statements.
6. **Developing narratives and identifying implications for blockchain in VCM** The themes were further refined to gain more understanding of the different perspectives of the interviewees. Reflection on the different statements was also taken into account to make sure the statements were understood similarly. The interviews were related to the role of blockchain technology in answering the main and sub-research questions.

3.6. Q-methodology in detail

1. Define the concourse

The first step in the Q Methodology consists of collecting all different opinions and perspectives on a certain topic. These can be found in articles, through interviews or scientific literature (Rieber, 2020). All different statements will be grouped, and a list of all different statements is constructed.
The main sources of statements will be articles online and scientific research.
The concourse for this Q-set will consist of articles from the literature review in section 2 and some added articles written in collaboration with customers. Statements regarding blockchain and fairness in the VCM have been directly copied. The entire document is scanned through to find the most interesting sections. These sections will be analysed more thoroughly; the results section was, in most research, the most useful for finding opinions and perspectives.

Concourse strategy

Defining the concourse includes finding statements encompassing all perspectives on a topic (Rieber, 2020). Research from the section 2 has been used to find customer statements and perspectives. These statements can be found through quotations from interviews and claims by the research. Statements should discuss any perceptions of fairness or customer insights on the VCM. The research in

the literature review has been read thoroughly to find any relevant material for the concourse. Of the twelve papers used in the literature review, only five included statements on fairness in the VCM. Loh and Feng (2018) surveyed the WTP (willingness to pay) for different buyers in the VCM. Statements and quotes from interviews have been used in this concourse. Porras et al. (2016) issued a paper in collaboration with Plan Vivo, including a guideline for smallholder and community carbon projects when they want to participate in the market. The report included a survey distributed among offset buyers from Plan Vivo. A total of 117 respondents mentioned their preferences and drivers for buying offsets. Some of these statements by participants have been included in the concourse, such as Porras et al. (2016): ”The share of costs and benefits along the value chain need to be clearer, including the impact of risk for project developers and farmers” (p.21).

Mustalahti and Rakotonarivo (2012) mentions two different benefit-sharing mechanisms in REDD+. The author mentions different ways of sharing benefits, such as direct or indirect benefit sharing, and pays on a community level or individual performance-based payment. Even though the statements are not direct opinions, they are included as they can be used to assess the fairness opinion.

Research by Nemanic et al. (2022) was used extensively, including interviews with organisations that used blockchain technology in the VCM. The research included statements and opinions on a range of topics regarding blockchain. Nemanic et al. (2022) mentions the following about one of the organisations when talking about trust in the VCM: ”Organisation 4 thinks transparency is necessary to have trust in the accounting systems, stating that blockchain has a strong case for providing that ultimate transparency” (p. 16). Furthermore, Ziegler (2022) researched credibility in VCM. A case study was done using the ICVCM (Integrity Council for the Voluntary Carbon Market). The research included interviewees who were either voluntary initiatives and standards, consultancy, or research institutes. The study looked into different themes regarding credibility surrounding carbon credits. Ziegler (2022): ”The results show that the dominant discursive position focuses on the financial potential rather than the emissions reduction potential of VCMs” (p.66).
In the literature review, three different papers went in specifically on blockchain technology (Espenan, 2023; Hartmann, 2019; Marchant et al., 2021). These papers analysed statements regarding fairness in the VCM. Unfortunately, no direct statements were useful for the Q-set in this study. Besides, research by Howard (2016) has also been used extensively in the literature review. However, the research is from a project developer’s perspective. As this thesis looks at the demand side, the papers were not included.

After creating the first concourse set, fifty statements were left. It was determined that these needed to include insights from a customer perspective. Unfortunately, research on the opinion on fairness in the VCM from a customer perspective is very scarce. To get more perspectives on the topic, articles published by large consulting companies were included as well. Even though these articles are less credible than the literature from the literature review, they have more industry-wide access and have a broader view (Da Costa et al., 2013). After reviewing several articles, four were deemed helpful in defining the concourse. The articles included many interviews and quotations from customers with different perspectives.

Three different reports (Shell and BCG, n.d., 2022a,b), all published by Bain in collaboration with Shell, give some insight on the current state and trends in the VCM. These reports included several interviews and surveys with stakeholders and buyers in the VCM. These gave some insights into market preferences by customers in the VCM. As an example by Shell and BCG (2022a), ”Our focus first is on the credibility of the credits. We are so busy worrying about credibility that we are not as focused on benefit sharing. But if it could be more transparent, then for sure we’d look at it more” (p.13).
Blaufelder et al. (2021b) published a report on their outlook for the future of VCM. Some statements include a perspective on the VCM, like: ”Rating agencies will play a vital role in future; more sustainability managers will rely on them to decide what to get” (p.1). After including these extra articles, the total concourse set reached 63 statements. All different articles used with further explanation are mentioned in figure 3.3

Title	Author	Source	Year		Reason for inclusion or exclusion	Statements
Improving Voluntary Carbon Markets through Standardization and Blockchain Technology	NP Espenan - Wyo. L. Rev.	Literature review	2023	Excluded	Nothing useful, to specific on blockchain only	0
Applying blockchain to the Australian carbon market	S Hartmann, S Thomas	Literature review	2020	Excluded	Nothing useful, to specific on blockchain only	0
Bringing Technological Technological Transparency to Tenebrous Markets: The Case for Using Blockchain to Validate Carbon Trading Markets	G. Marchant, Z Cooper P. Gough-stone	Literature review	2022	Excluded	Nothing useful, to specific on blockchain only	0
Blocks and Credits: A Sustainability Lens on Blockchain Technology in Voluntary Carbon Markets	C. Nemanic, M Enejison, O Ejide	Literature review	2022	Included	Includes a lot of quotes from interviews	10
Which "fairness", for whom, and why? An empirical analysis of plural notions of fairness in Fairtrade Carbon Projects, using Q methodology	RJ Howard	Literature review	2015	Excluded	Mainly focused on project developer side, no usefull statements in regard to customer perspectives.	0
Assessing Credibility in the Voluntary Carbon Market?	T Ziegler	Literature review	2023	Included	Includes customer motivations to participate in the VCM through interviews.	13
Unraveling the Notion of "Fair Carbon": Key Challenges for Standards Development	RJ Howard, A Tallontire, L Stringer, R Marchant	Literature review	2015	Excluded	Mainly focused on project developer side, no usefull statements in regard to customer perspectives.	0
Ethical carbon offsetting Guidelines and lessons from smallholder and community carbon projects	I Porras, G Wells, C Stephenson, P Kazis	Literature review	2016	Included	Includes customer motivations to participate in the VCM, gives insight in what customers find important.	11
REDD+ benefit sharing mechanisms: Does it make a difference in equity?	L Mustalahti, S Rakotonarivo	Literature review	2012	Included	Includes customer motivations to participate in the VCM, gives insight in what customers find important.	4
Voluntary carbon offsetting and its contribution to sustainable development	Tan Loh, E Feng	Literature review	2018	Included	Includes customer motivations to participate in the VCM, gives insight in what customers find important.	12
What lays at stake for standards organisations pursuing fairness in the carbon market ? Lessons from literature applied to practice in the carbon market	RJ Howard, A Tallontire, L Stringer, R Marchant	Literature review	2014	Excluded	Mainly focused on project developer side, no usefull statements in regard to customer perspectives.	0
Pathways to "Fair Carbon": Assessing fairness in standard-setting and carbon projects	RJ Howard	Literature review	2016	Excluded	Mainly focused on project developer side, no usefull statements in regard to customer perspectives.	0
A blueprint for scaling voluntary carbon markets to meet the climate challenge	C Blaufelder, C Levy, P Mannion, D Pinner	Consulting article	2021	Included	Consulting article including interesting interviews with customers.	2
VCM: insights and trends	Shell, BCG	Consulting article	2022	Included	Consulting article including interesting interviews with customers.	1
An outlook on the voluntary carbon market	Shell, BCG	Consulting article	2022	Included	Consulting article including interesting interviews with customers.	3
Strategic approach VCM	Shell, BCG	Consulting article	2022	Included	Consulting article including interesting interviews with customers.	7

Figure 3.3: All documents used for the concourse, including the reason for inclusion or exclusion and the number of statements directly taken from each article.

2. Refine the Q-set

The second step in the Q-methodology involves the creation of the actual statements. All statements derived in the first step of the Q-methodology will be categorised to encompass all perceptions. The statements can differ from a few dozen to over a hundred. However, studies with such many statements are relatively scarce as they become unmanageable for the participants (Davis and Michelle, 2011). To keep the number of statements manageable for participants, the aim is to create statements anywhere from twenty to forty. The framework by McDermott et al. (2013) consists of three different dimensions (*Procedural, distributive* and *conceptual*) and three different parameters of equity (*Who counts as equity, why equity* and *how are parameters defined*. Each of these dimensions and parameters should have several statements. Between twenty and forty statements seem manageable for the time frame and encompass all perspectives. The total amount of statements found in the first step is 65.

The first step in refining the Q-set is sorting all raw statements according to the different dimensions and parameters of equity within the adjusted framework by Howard et al. (2015a). To define the Q-set Howard et al. (2015a) combines different concepts. The focus in Howard et al. (2015a) was on project developers and enablers. As this thesis is focused on customer-centering fairness, the different categories will have different definitions.

1. **Parameters of fairness**: Statements on how customers define fairness and who is involved in shaping this definition.
2. **Goal of fairness**: Statements on what the VCM should aim for to ensure customer fairness.
3. **Target of fairness**: Statements on who and what is considered a target to enhance fairness in the carbon market, specifically focusing on customers.
4. **Fair procedures & Fair access** : Statements about how customers can actively participate in decision-making processes and engage in the carbon market, emphasising accessibility for all, should be accompanied by transparent procedures that ensure fairness. Procedures talk about the ways participants can participate in decision-making processes regarding fairness. Fair access involves accessibility and how customers can participate in the market itself, and they are combined into one.
5. **Fair benefit sharing**: Different ways customers can benefit from projects in the carbon market, ensuring that the distribution of benefits is fair and aligns with customer perspectives.

All different statements are distributed according to the different categories. After initial sorting based on the statements directly cited from the source, 63 statements remained in the concourse.

The next step includes further refinement among the statements in each category. Statements about the same concept are grouped to see whether they can be used to form one final statement for the Q-set. Looking at the main research question, each statement should include a feature or component of blockchain, like smart contracts to automate agreements or the inherent verifiability of transactions on the blockchain. As participants in the interview are often not blockchain experts, the feature will be mentioned in the statement while removing the explicit mention of blockchain.

Also, the statements should cover one dimension when discussing fairness in the VCM. Therefore, the next step in creating the Q-set is linking the direct statement citations to blockchain and fairness. The statements undergo five refinement stages before the actual set is presented. The following table 3.4 gives an example of the whole process.

Citation	Link to blockchain	Link to fairness	Final statement
”Organization 7 also thinks that at some point, conditional upon market liquidity, it will become more cost efficient to just not emit than to buy carbon credits.” (Nemanic et al., 2022, p18)	Blockchain can play a role in tracking emission reduction efforts within companies increasing reliability in the process.	This approach promotes fairness by rewarding companies based on their actual impact on the environment rather than their financial capabilities, creating a more level playing field for companies actively committed to reducing emissions.	”I will stop investing in the VCM when not emitting becomes cheaper, even if the ability to measure co-benefits becomes more reliable.”

Table 3.2: Example from going to a statement from the literature to the final statement that is tested. The final statement was created after five different revision moments. The original statement is adapted from (Nemanic et al., 2022).

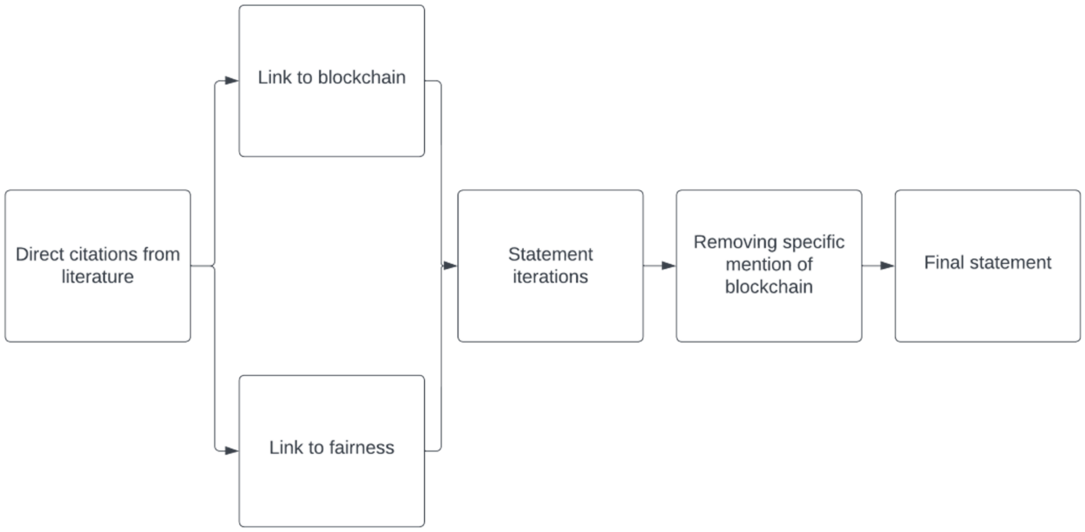

Figure 3.4: Process from a statement from literature to statement used in the Q-set.

About half of the statements are positive, while the others are negative. All statements together make the Q-set neutral to reduce bias in the Q-sorting. Furthermore, the statements are changed to remove ambiguity and vague wording. The Q-set is then tested with a random subject to ensure the task is clear. An example of a statement going from the original citation to the final statement that is tested is presented in table 3.2. The final list of statements can be found in appendix A, table A.1

3.6.1. Blockchain related to fairness

Using the Q-methodology, the Goal is to determine which aspects of fairness customers find essential. This thesis aims to determine whether blockchain can enhance these aspects of fairness. Section 2.1.1 in the literature review highlights the possibility for blockchain to increase fairness in the voluntary carbon market. Through the decentralised structure, there is less reliance on one central authority (Chen, 2023). Also, blockchain can promote further trust in the VCM by increasing transparency and giving more insight to stakeholders (Espenan, 2023). To further understand how blockchain can be implemented, each of the different statements was linked to an inherent blockchain feature, as seen in the example (figure 3.2). Several different features related to blockchain are mentioned that can increase fairness.

1. **Transparency**: The first and most obvious is increasing transparency in the VCM. Depending on

the type of rules within a blockchain network, all information is often accessible to all nodes and publicly available. This is one of the most important features often mentioned in all dimensions of fairness.

2. **Decentralisation**: Transactions on the blockchain can be verified in several ways. Depending on the consensus algorithm, transactions on the blockchain are verified in different ways. Often, this is done by several different nodes rather than one entity. This removes the centralised ownership and dependence on one intermediary to keep track of all transactions. Within the VCM, this can be useful for reducing the power from certain entities and creating more fair procedures and an even playing field for all nodes involved.
3. **Tamper proof record keeping**: Within each node, a record is kept of all transactions on the network. Data can not be altered or deleted once verified. This is useful for the VCM as it can increase data reliability and thus improve the credibility of specific projects. Also, it decreases the chances of fraud and unauthorised change of data.
4. **Traceability**: Related to tamper-proof record keeping and transparency is traceability. As all nodes keep a record of all transactions across the network, it is possible to trace back all the different steps on the blockchain. This is related to transparency but aimed more at the different steps that happened to a carbon credit and tracing back data.
5. **Standardization:** Blockchain offers standardised protocols for verifying and recording data. This ensures consistency and compatibility across the network, which, in terms, can make the data easier to understand. Standardisation is a characteristic mentioned across almost all dimensions of fairness.

3. Participant selection

The Q-set will be tested during interviews. Participants will arrange the different statements in the Q-sort matrix. They will be encouraged to speak up and share their thoughts on why they put statements in a certain order. The participants in the Q-methodology are named the Q-set and are not chosen randomly. The Q-set is chosen to be as heterogeneous as possible to include as many different perspectives (Davis and Michelle, 2011). The goal is not to source a single truth but to include all perspectives.

As this thesis is written in collaboration with Ernst & Young, the participants will be selected through this extensive network. The participants will include employees from the banking sector or consulting firms that are involved in investing in the VCM. Often, companies do this to offset their emissions. Employees involved in this process can include sustainability officers, managers, and CSR (corporate social responsibility) officers and managers. Within Q-methodology, it is not necessary to include many participants. Effective studies have been carried out with few participants. However, if one wants to show a shared viewpoint, having a larger sample group is useful. Saturation is where there is little to no extra information provided by a new sample, and it is difficult to fully determine (Watts and Stenner, 2005). For this Q-study, all participants come from different firms. Due to time and resource constraints, the aim would be to include at least 8 participants, with a maximum of 12 Participants within the study who should either already invest in the VCM or plan on doing so.

4.Q-sort and interviews

Before each interview, the participants get a small introduction to the VCM. As participants in the Q-set are involved in the VCM, they are expected to know most of how the market works. Also, the specifically mentioned blockchain has been removed, and the focus thus relies on characteristics of blockchain, such as increased transparency or the removal of an intermediary. It is thus optional for the participants to know anything about blockchain.

The interviews will take place online using Microsoft Teams and will be held between January 2024 and February 2024. The participants will place the statements from ”least like how I think” to ”most like how I think.” This is done using an online platform called Q-tip. Sorting the Q-set is done before the interview, giving participants more time to fill in the results without feeling pressured. The Q-sort table can be seen in the following figure 3.5.

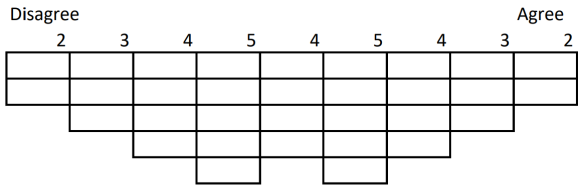

Figure 3.5: Q-sort table, participants could drag and drop statements according to whether they agree or disagree.

An interview will take place in which the participant is asked several questions regarding sorting the statements. Beforehand, the participants' results are closely evaluated to see if there are any contradictory statements. As the participants were asked to sort 32 statements, only a few will be selected to elaborate more. Statements at the ends of the spectrum are most interesting as there are only two spots for statements. These are the ones the participants feel most strongly about.

After talking about the Q-sort, additional questions based on the research questions in 3.1 are asked of the same participants from the Q-methodology. These give some more insight into their perspective of the market. Additional questions asked were:

- What do you see as the main problems in the VCM causing the market to grow so slowly?
- Why do you think there is a lack of trust in the market?
- What do you think is most important for customers?
- How do you see the VCM develop in the future?

A basic template was used for the interviews. This can be found in the appendix E. The participants were also asked to fill in a consent form beforehand. This can be found in Appendix F.

5.Data Analysis & Result interpretation

The interviews have been transcribed using Microsoft Word. The results from the Q-study are analysed using Kade Q-analysis software. The statements have been exported from the online Q-method software Q-tip. Analysis of the data is done according to the following steps. The Q-set and statements are loaded in the Kade software package. The correlation between the participants is then calculated. After, either principal components analysis (PCA) or centroid analysis is conducted on the correlation matrix. PCA and centroid analysis are useful in different cases:

- **PCA:** PCA is a statistical method used to look for correlations between variables and reduce them to a smaller number of "principal components (Aachen, 2003). PCA is less dependent on participant differences but more sensitive to outliers. It is a more consistent method compared to the centroid analysis. It is more applicable when dealing with many statements (Aachen, 2003).
- **Centroid analysis:** Centroid analysis revolves around a central point and looks at how much the participants differ from this point. For each of the participants, the deviation between their Q-sorts is determined. Participants can have the same amount of deviation and can, therefore, be placed in the same "factor" (Ramlo, 2016). The method is less sensitive to outliers and produces results that are easier to compare than with PCA. However, centroid analysis can produce "empty" factors, for which no significant participants are leaning on this factor. It is often used in exploratory research where the amount of factors is unclear (Ramlo, 2016).

The factor solution maximises the participant loading on one factor and minimises the participant loading on more than one factor. Both methods are tested in the results to find out which is more appropriate in this specific case. After analysis, varimax rotation is applied to make the factors more clear (Stenner and Watts, 2012). The number of factors chosen is based on the spree plot, where there are no significant changes when more factors are included. The different loadings are then determined to determine statistically significant participants in some factors. A P-factor of 0.05 is chosen. When the different factors explain at least 35% of the variance in the study, it is considered sound (Kline, 2014). The factors produced by the analysis of the Q-set are compared to the results from the interviews.

Statement analysis

Data from the analysis is sent to the output, where the threshold for distinguishing statements is determined. This threshold determines when a statement is statistically significant enough to be considered. This threshold is set between 0.05 and 0.1, which strikes a balance between finding statistically significant statements while still trying to include much of the important information.

Through the Kade software, statements that are significant enough are generated. After, they are grouped and form the three different factors in this study. As the Q-study included brokers and customers in the VCM, each participant is identified as either a broker or customer and then compared. Important to note is that the Kade software returns the statements that participants put in almost the same place. However, it does not mean that these statements are all agreed upon. They range from most agree to most disagree.

Dimensions of fairness

Furthermore, the Q-set consisted of five different dimensions of fairness. The statements belonging to each dimension are mentioned with a Z-score. The magnitude of this score indicates how strongly participants felt on specific topics. A positive number indicates agreement, while a negative number indicates disagreement. Each dimension will be mentioned to see what the participants found most important. These sections will be supported through quotes and insights from the supporting interviews.

3.6.2. Interview coding for factors

Interviews support the results in the Q-set. The statements that are statistically significant enough are coded into Atlas.ti. These are statements with a p-value smaller than 0.05, which means there is a low chance of these statements occurring randomly. Coding supporting quotes is found in the interviews. Each of the different statements was labelled during coding. After, the quotations from the interviews will be presented to see whether they align with the results from the Q-set. Due to the large amount of data, the interviews will be analysed and scanned on specific topics to include some more depth into the Q-set. The participants from different factors will be grouped to find differences or agreements between them.

4

Analysis & Results

This chapter will present the results from the interviews and Q-methodology. To give structure, the results are presented according to three different factors. These factors can be seen as perspectives on fairness in the VCM. Participants from this study had to sort thirty-two statements according to a table ranging from disagree to agree (see section 3.5 for more explanation on Q-methodology) Participants with similar sorting results were placed within the same group, which was called a factor. These factors were used as a guideline to structure the interview results, as participants within the same factor also responded similarly to the interview questions.

4.1. Motivations and priorities from consumers

The different motivations found in the literature and through interviews are mentioned to further understand the different groups of participants from each factor. Section 2.1.4 mentions different relevant research papers. The following structure is created specifically for this thesis and is used to structure the different motivations. There are three different areas:

1. **Project related**: This includes financial reasons and motivations to support co-benefits of projects.
2. **Feeling of responsibility:** This is about moral obligations and personal motivations to reduce the effects of climate change.
3. **Company image**: Everything regarding company image is included in this category, such as CSR, company brand image, preparations for future regulations as well as engaging employees in the firm.

Some sub-motivations are mentioned within these main motivations. According to the number of times a certain sub-motivation is mentioned, it can be determined what participants from these factors have as the main priority.

Main motivation	Sub-motivation	Author
Project related	For co-benefits of projects.	Porras et al. (2016)
	Due to financial reasons.	Ziegler (2022)
Feeling of responsibility	Moral obligation from employees.	Porras et al. (2016), Loh and Feng (2018)
	To reduce the effects of climate change.	Porras et al. (2016)
Company image	Corporate Social Responsibility (CSR)	Porras et al. (2016), Loh and Feng (2018)
	For the company brand image.	Porras et al. (2016), Loh and Feng (2018), Valiergue and Ehrenstein (2022)
	Preparation for future regulations.	Porras et al. (2016)
	To engage employees within the firm.	Loh and Feng (2018)

Table 4.1: Investment motivations and priorities from customers.

4.1.1. Motivations and priorities from the interviews

Participants in this study were interviewed to explain more about the Q-sort and answer extra questions. The results presented here are from these interviews. The motivations and priorities of the interviews were limited. Regarding motivations and priorities, almost all quotations came from one primary focus:

project-related. Two of which were mentioned in the literature as well. However, results from the interviews show that there are four more priorities for customers when looking to invest in the VCM rather than motivations. The following table will give an overview of the number of times a motivation is mentioned in the interviews.

		# of motivations mentioned in the interview		
Main motivation	**sub-motivations**	**Participants F1**	**Participants F2**	**Participants F3**
Project related	For co-benefits of projects.	1	7	5
	Due to financial reasons.	8	1	1
	Relatable back-story	5	2	5
	Quality of credits	15	1	2
	Environmental reasons	3	0	7
	Insight through more transparency	3	3	4
Feeling of responsibility	Moral obligation from employees.	2	0	0
	To reduce the effects of climate change.			
Company image	Corporate Social Responsibility (CSR)	3	2	4
	For the company brand image.			
	Preparation for future regulations.			
	To engage employees within the firm.			

Table 4.2: Frequency of investment motivation or priority. Participants from the same factor are grouped.

Table 4.2 shows that several motivations are mentioned more often than others. The motivations most mentioned are seen as priorities for participants from these factors.

Factor 1

Participants in the first factor mainly mentioned financial reasons to be a motivator, the quality of credits, and more insight through more transparency. In terms of financial reasons, it was mentioned a total of eight times. Interesting to mention is that Participant Two, a broker, mainly did this. Credits on the VCM were compared to coffee: ”Everybody wants sustainably sourced coffee, but they do not want to pay the price.” All three participants mentioned quality credits. Participant 3, a customer, mentioned the importance of clarity when it comes to the offset’s standards to ensure they are high quality enough. Participant One, a broker, mentioned that high-quality credits must be supplied through brokers. ”it would help to hire consultants that can advise with expertise that can advise you on projects and what projects are high quality, what projects are low quality.” Participant Two mentioned that the companies’ importance of high-quality credits or prices differs. At last, even though it was only mentioned very briefly by participant three, a customer very clearly stated that the lack of transparency was one of the reasons they do not participate in the market yet: ” As a customer of this market, we do not participate in it is because of this lack of current transparency and at the same time, we have not, I would say, not step back into the market yet.”

Factor 2

Within factor two, participants mainly talked about the importance of a relatable back story being a priority when it comes to buying carbon credits. Participant Four, a broker: ”What they can do and also something that’s close to their business. So for example, people that make paper and cardboard, want to invest in forests, but people who are making energy, want to invest in, wind and solar power.” This is further confirmed by Participant Five, a customer who mentions the importance of investing in projects closely related to their portfolio. Furthermore, only a few comments explicitly showed a priority on other motivations. This could be attributed to factor two only containing two participants compared to three in factor one and four in factor three.

Factor 3
Motivations from participants from factor three were only partially focused on one area. Co-benefits were mentioned briefly, but it was mentioned more often that companies differ a lot regarding motivation. A broker, Participant Seven: ”Some buyers want to purchase credits from areas with higher impact building environments like it’s hard to say what wasn’t very valuable project looks like because all the buyers in the market have different standards to that.” Participant Six, a broker, mentioned the differences per project: ”It depends on the project and the co-benefits. We have some clients who are also interested in the reputation of their workforce. We also have clients who are interested in the co-benefit.” Within the analysis of interviews from participants in the third factor, there is no main priority regarding motivations to invest in the VCM. The interests of companies are extensive and are primarily individual. It was also believed that understanding projects was important however, it remained difficult due to the lack of transparency: ”It’s very specific and specialized language. So it’s not very easy to read. So yeah, it’s almost like a scientific reporting that let’s put it like that. The ease of use is not very high. And it’s also put in a report so it’s not very. Yeah, transparent. It can’t easily compared to other projects.” Participant eight, a customer, confirms this and mentions the lack of understanding from the buyer side: ”I think there is a lot clearer honest to be understanding of information, but there’s not always enough time and enough knowledge, especially also on buyer side to make for that choice.” Participant Seven, a broker, mentions that quality low quality is still acceptable. However, it is argued that a lot of projects have a lack of transparency when it comes to benefit-sharing: ”I see some projects don’t disclose how much they paid to local communities or they don’t explain how they involve native inhabitants of an area or there are some irregularities or how governments are involved in terms.”

4.2. Fairness issues on the VCM

Issues regarding fairness from a customer perspective in the VCM have been found through the literature and supporting interviews. The following section will briefly review the results from the literature and the findings through the interviews. Comparing the literature to the interviews is done in the discussion section.

4.2.1. Issues from literature

The following table 4.3 shows the different issues found in the literature. The different closely related groups have been grouped together to create a better overview.

Dimension of fairness	#	Issues	Author mentioning the issue
Parameter, target	1	Uniformity and Standardization	Espenan (2023), Howard et al (2014), Porras et al. (2016)
Parameter, target, procedures & access,benefit sharing	2	Transparency, verification and monitoring	Blaufelder et al. (2021), Howard et al. (2014), Espenan (2023), Marchant et al. (2021), Nemanic et al. (2022), Porras et al. (2016),
Parameter, goal	3	Quality of credits and credit usage	Nemanic et al. (2022), Ziegler (2022)
Parameter	4	Trust and integrity issues	Blaufelder et al. (2021), Espenan (2023), Nemanic et al. (2022)
Parameter, procedures & access, benefit sharing	5	Uneven access to information	Hartmann & Thomas (2019), Nemanic et al. (2022)
Goal	6	Market efficiency and complexity	Blaufelder et al. (2021), Espenan (2023), Hartmann & Thomas (2019), Nemanic et al. (2022),
Target	7	Credit reliability and credibility	Nemanic et al. (2022), Ziegler (2022)
Target, procedures and access, benefit sharing	8	Stakeholder Engagement	Howard et al. (2014), Nemanic et al. (2022), Mustalahti & Rakotonarivo (2012), Ziegler (2022)

Table 4.3: Different issues grouped together from research in the literature.

The following list will include more explanation on the different issues.

1. **Uniformity and standardization** These include issues regarding a lack of uniformity and standardization between projects. There are different standards between projects and methodologies used for monitoring and verification. Each verification body uses another kind of methodology that is hard to compare.
2. **Transparency, verification and monitoring** Privacy issues often concern how much information project developers or brokers disclose on a certain project. Often, the exact distribution of benefits is not mentioned. Besides, verifying and monitoring different co-benefits from projects is often not transparent or very difficult.

3. **Quality of credits and usage** Within the market, there seems to be no one rule regarding the quality of credits. This differs from standardization in that customers often determine what they consider ”high-quality.” However, many companies do not have any clear guidelines on this. Furthermore, there are no general guidelines regarding how carbon credits are used within a company's strategy. These issues cause an uncertain demand for project developers.
4. **Trust and integrity issues** Many companies lack trust in the market as a whole, verification bodies or projects themselves. As this is closely related to integrity issues, potential for errors, fraud or money laundering, these issues are also mentioned here.
5. **Uneven access to information** Different from transparency issues, some information is available on the market. Unfortunately, it is often difficult to access or difficult to find. Large corporations, for example, might have the resources to do so, but smaller, less resourceful companies might not.
6. **Market efficiency and complexity** Carbon markets are often described as inefficient and complex due to a lack of transparency. However, as transparency is not the only factor influencing market efficiency and complexity, it has been mentioned separately. Blockchain has been suggested to reduce transaction costs within the market and increase efficiency.
7. **Credit reliability, credibility and integrity** These issues are related to how customers perceive different projects. This includes how credible projects and project developers are deemed and how reliable the credits produced by them are.
8. **Stakeholder engagement** Issues regarding stakeholder engagement concern a lack of coordination due to no direct overseeing body.

A more detailed schematic with all the different issues from the literature can be found in Appendix G.

4.2.2. Issues from the interviews

The issues are structured in the same way as the investment motivation and priorities using the results from the Q-methodology. A total of nine interviews have been held. Participants were asked about their Q-set and some supporting questions in the interviews. During the interviews, participants were asked to think aloud and share their thoughts. The following table 4.4 the number of times an interviewee mentions each issue. Issues mentioned more than ten times are further discussed.

		# of issues mentioned in the interview		
Dimension of fairness	**Issues**	**Participants F1**	**Participants F2**	**Participants F3**
Parameter, target	Uniformity and Standardization:	3	13	1
Parameter, target, procedures & access, benefit sharing	Transparency & monitoring	9	1	9
Parameter, goal	Quality of credits and credit usage	9	4	10
Parameter	Trust and integrity issues	20	10	8
Parameter, procedures & access, benefit sharing	Uneven access to information	6	2	4
Goal	Market efficiency and complexity	13	4	17
Target	Credit reliability and credibility	2	4	5
Target, procedures and access, benefit sharing	Stakeholder Engagement:	4	0	9

Table 4.4: Frequency of different issues are mentioned per specific factor.

Within the table, several issues are mentioned significantly more than others. For each factor, the issues mentioned more than ten times will be further analyzed in detail.

Factor 1

- **Trust and integrity issues**: This particular issue is mentioned twenty times. Participant Three, a potential customer in the VCM, mentioned the issue regarding green-washing and scandals as one of the main reasons for not being offset in the VCM. ”We don’t want to participate currently, it’s not forever, maybe currently at this stage, is because of the reputational risk from investing in a certain project that was pitched to you or sold to you by a certain organization to deliver certain sort of impact. And then it doesn’t deliver in due course or there is some negative media around it. ” Furthermore, integrity is one of the main topics mentioned. Related to bad publicity is intermediaries acting with low integrity. As intermediaries have much more bargaining power than smallholder farmers, each intermediary must act with integrity. Participant Two mentioned the importance of including the changes a community has to go through and taking them into account as well. Participant one mentioned this on the integrity of intermediaries: ”I think you know these organizations all have their role, but also very much depends on the integrity of those organizations acting in the market.”
- **Market efficiency and complexity:** Participant one said this about the complexity between projects: ”And also, what’s the quality of the technology being used? Is it very low-tech? Improved cookstoves that do very little to actual health. Or is it a high-tier stuff that actually has a health impact? So I mean and you can understand then it becomes you know quite complex, yeah.” Participant two mentioned this supporting statement regarding market complexity: ”you need quite a level of intelligence to get all information well structured”.

Factor 2

- **Uniformity and standardization:** Uniformity and standardization are mentioned thirteen times by participants in the second factor. Participant Four particularly mentions the different types of methodologies used and the current lack of uniformity: ” The methodologies are all different and all vary from very beautiful institutions, but uniformity would be greatly appreciated if they should be integrated into one registry.” Participant Four acts as a broker in the VCM; it is mentioned that it is unclear why certain projects are perceived as more valuable. ”I say that it’s probably gonna have to do with the methodology behind it and the size of the project.”
- **Trust and integrity issues**: In terms of trust and integrity issues, this is also linked to methodologies mentioned before. Participant Four mentioned: ”So these controversies, they are part of. The growing process. And so the more we improve these methodologies, the better the technologies are to assess these projects, the better the VCM becomes, the more trustworthy it becomes, the more people will buy it.” A trade-off has to be made between growing fast and controversies: ”Do you do you want a lot of controversies and grow slowly and eventually very trustworthy or you grow very fast and then eventually there’s gonna be a real large controversial controversy in the future and then nobody wants to buy it anymore” (participant four).

Factor 3

- **Quality of credits and credit usage** In terms of quality of credit and usage, the main issue forward is how carbon credits are used in the VCM. Participant Seven: ”I think it should be prioritized to reduce emissions. I think that’s always the most important sustainability strategy for a company, and the VCM should be an alternative.” Participant Six also confirms this further: ”But they can only reduce. So much each year in order, and because you have to change your process and stuff. So in my personal opinion, it doesn’t harm if you reduce, but at the same time store carbon.”
- **Market efficiency and complexity:** participants mention the involvement of stakeholders and brokers in terms of a complex market. Participant Seven:” I don’t necessarily think there are too many stakeholders. I think it’s important to build a professional market so verification bodies, and integrity Councils, I think they’re all necessary. What I do see is that it slows down the development of this market.” Participant Eight mentions the preference for a chaotic marketplace when asked about the intermediaries and verification of co-benefits: ”But can you really wish to verify co-benefits? Remains a big question, so yeah. Within the open marketplace some say yes, some say no. Preferably as much as possible, but I would still embrace the chaotic marketplace.” Furthermore, participants mentioned a lack of knowledge from the customer’s side. Participant six: ”But because I noticed that since sustainability managers have been in the market for a long

time, they have no idea what it means buying a credit, what it means with regards to biodiversity and. water management and all those kinds of things so that education needs to be more clarified." Participant Six mentions this later in the interview: "Plus, the entire education is missing. As I said, it's very complicated for clients to understand what it means for credits and about the co-benefits." Interesting to mention is that participant nine, a customer in the VCM, mentions no interest in further development of knowledge on the VCM: "Yeah, we don't have the knowledge in-house and I don't think we're going to develop it."

4.3. Q-set analysis

As mentioned in section 3.6.1, the results from the Q-set are analyzed using Kade software. Two different factor calculations have been compared. The results of this analysis consist of scree plots, eigenvalues, % explained variance, and cumulative % explained variance. The factors are created by combining different statements in the Q-methodology. Factor one, for example, consists of several statements (see appendix H1, A for the exact number of statements from factor 1). The eigenvalues explain how much total variance is captured when including a particular factor. This corresponds with the % explained variance. The cumulative % explained variance adds all previous %explained variance together. The scree plot shows the point at which there is a diminishing return when a new factor is included. This can be seen as the point where the curve further flattens. Participants can "load" on a particular factor which is how much they correlate with placing different statements. Certain factors may be loaded empty when none of the participants correlates strongly to one factor.

4.3.1. Centroid analysis

Horst analysis

The first test is centroid analysis, choosing between Brown's method and Horst's. Looking at the scree plot After testing both methods, the results from the Horst test showed a scree plot in which the five different factors have to be taken into account, as less does not explain enough variance. This can be seen in the scree plot in figure 4.1 at the fifth-factor number and in the table 4.5. Two factors remained empty without any loading by the participants. This means the factors explain the variance, but none of the participants correlates to the factors themselves. Therefore, this method is not deemed suitable for this case. Furthermore, as there are only nine participants in the Q-set study, five factors might be too much resulting in empty factors.

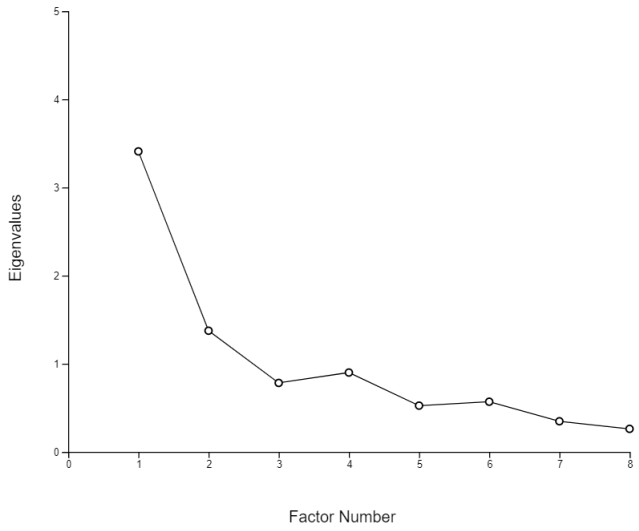

Figure 4.1: Scree plot from the Centroid analysis using the Horst calculation method.

Horst	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Eigenvalues	3.4087	1.3743	0.7822	0.8999	0.5245	0.5689	0.3472	0.2611
% explained variance	38	15	9	10	6	6	4	3
cumulative % explained variance	38	53	62	72	78	84	88	91

Table 4.5: Result from the centroid analysis and Horst calculation method. The calculated eigenvalue, the % explained variance and the cumulative % variance are mentioned.

Browns method

Using Brown's method, there are three factors with significant loading. As can be seen in the scree plot (figure 4.1, after this, no more significant variance is explained. This is deemed a more suitable amount for this study with nine different participants. However, when looking at the cumulative explained variance, the total comes down to 51% (see table 4.6. Even though the method seems likely to produce adequate results, it is still not selected, as the % explained variance using another method, PCA, is even higher, namely %67 when using three factors. A higher explained variance explains more of the data in the Q-set. Therefore, PCA is chosen.

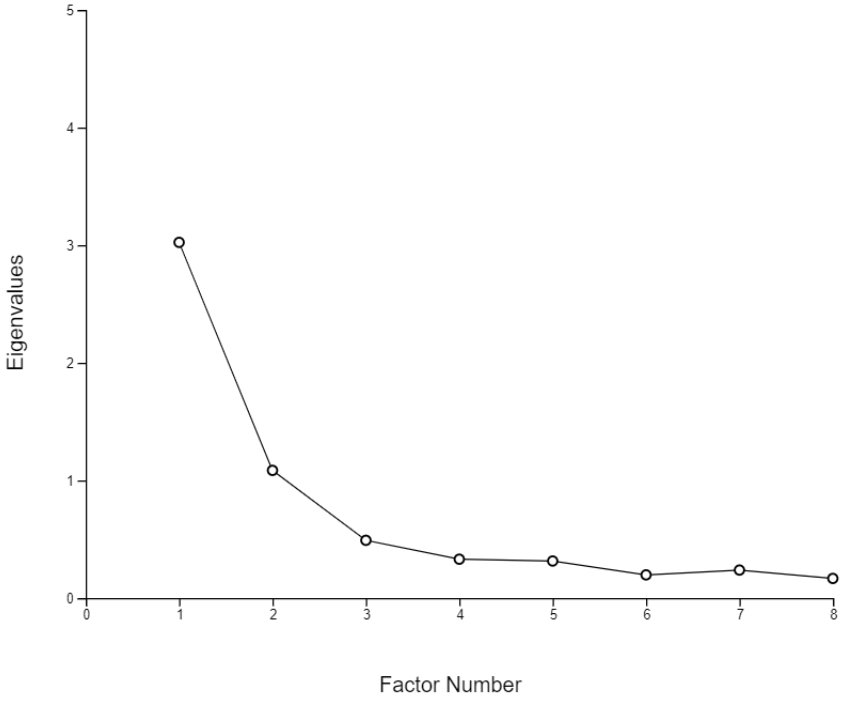

Figure 4.2: Scree plot from the Centroid analysis using the Brown calculation method.

Brown	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Eigenvalues	3.0238	1.0855	0.4910	0.3304	0.3150	0.1972	0.2380	0.1668
% explained variance	34	12	5	4	4	2	3	2
cumulative % explained variance	34	46	51	55	59	61	64	66

Table 4.6: Result from the centroid analysis and Brown calculation method. The calculated eigenvalue, the % explained variance and the cumulative % variance are mentioned.

4.3.2. Principal components analysis

The principal components analysis is the last method tested and used for further analysis. This method has the highest explained cumulative % variance of all methods tested of 67% compared to 62% using

centroid analysis and Horst calculation method or 51% using centroid analysis and the Brown calculation method. Looking at the scree plot, it seems that four factors would be best suitable since after four, there is no little increase in explained variance, as can be seen in table 4.7. However, using four factors resulted in an empty factor loading, meaning no participants correlated enough to this one factor. Therefore, three factors are used in this analysis. Each factor has significant enough loading when using an α smaller than 0.05 and is therefore statistically significant. The data is then sent to the output to further determine the statements that form the three different factors.

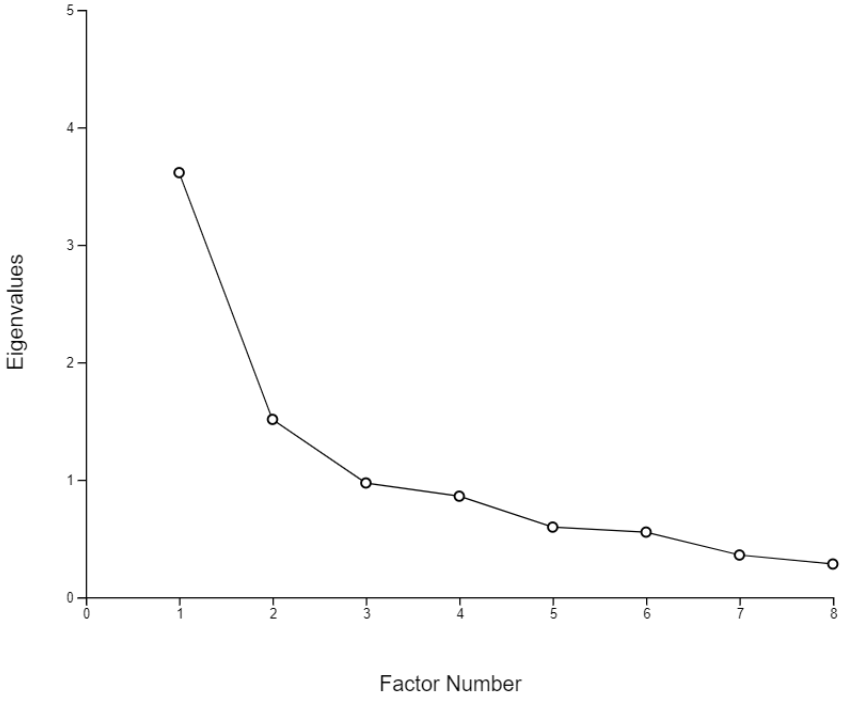

Figure 4.3: Scree plot from the PCA. The calculated eigenvalue, the % explained variance and the cumulative % variance are mentioned.

PCA	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8
Eigenvalues	3.614	1.5135	0.9723	0.8598	0.5965	0.5541	0.3580	0.2823
% explained variance	40	17	11	10	7	6	4	3
cumulative % explained variance	40	57	68	78	85	91	95	98

Table 4.7: Result from the PCA.

4.3.3. Statement analysis

The output from the PCA is analyzed to find the distinguishing statements. As can be read in section 3.6.1, the threshold for including statements is between 0.05 and 0.1. The Kade software provides the different most significant statements for each factor. The statements are ranked from the most minor threshold to the largest. Statements with a small α value have greater influence and are more statistically significant than a more considerable α value. The exact statements for each of the different factors ordered from a small α to a large value are mentioned in appendix H1 to H3. The Z-score is also indicated, in which a negative Z-score represents disagree and a positive Z-score represents agree. The magnitude of the Z-score represents how strongly participants feel about the topic.

4.4. Q-study results

4.4.1. Q-set

The following section will describe the results from each different dimension of fairness. The dimensions will be assessed, and the participants who load significantly on each will be named. The Z-factor indicates how strongly participants felt about statements. The far left (disagree) has a large negative Z-factor of -4, and the far right (agree) has a large positive Z-factor of 4. Within the dimensions of fairness, the Z-score will be mentioned to indicate how strongly participants felt about a certain factor. A higher score thus suggests a stronger preference for a certain statement. Quotations from the interviews will be provided on certain topics to give more nuance in topics.

The title and results from the Q-methodology are created by analyzing the data using the PCA method. Statements for factor 1 can be found in appendix H1 (A), statements for factor 2 can be found in appendix H2 (A) and statements for factor 3 in appendix H3 (A).

Factor 1 (F1), Community involvement and standardizing

Factor 1 explains 40% of the variance and had three participants strongly correlating: one customer and two brokers. This factor focuses on co-benefits besides environmental impact and more standardization in the market. The total number of distinguishing statements with a $P < 0.05$ is eleven. The statements are in table A.3 in appendix H1.

- **Parameters of fairness:** Within parameters, participants had their focus on more than just the environmental impact (-4). Also, it is believed that transparency in carbon accounting is very relevant when looking at fairness in the VCM (-4).
- **Goal of fairness:** It is disagreed upon that companies increase participation in the VCM when they know other companies do so (-1). Furthermore, there is indifference to the amount of intermediary involvement as they believe each can play a certain role within the market (0).
- **Target of fairness:** The target of fairness strongly focuses on community impact when looking at the distribution of benefits (4). Besides, countries with non-mature financial systems should **not** be excluded even though projects might be unreliable (-2).
- **Fair procedures & fair access:** On procedures, participants from this factor mostly valued insight into environmental, social and economic risk when looking at projects (4). The involvement of intermediaries for verification and issuance is argued that it should be done by other organizations rather than the same (-3). It was mentioned that certain buyers have more access to information than others. However, this opinion was not very strong, with a Z-score of 2. Finally, standardization is needed as it was felt that the VCM is uncoordinated and needs more standards to ensure fairness (3).
- **Fair benefit-sharing:** Participants felt like the impact should be measured on the community level (1).

Factor 2 (F2), Market efficiency and participation

Factor 2 explains 17% of the variance and had two significant participants correlating to this factor one customer and one broker. This factor focuses mainly on an efficient market and a need for intermediary involvement. The total number of distinguishing statements with a $P < 0.05$ is nine. The statements are in table A.4 in appendix H2.

- **Parameters of fairness:** The opinion was that price should align with more than just environmental impact (-3). Also, reliability was not seen as a major factor influencing fairness on the VCM (1).
- **Goal of fairness:** This factor places large emphasis on participation in the VCM, as it was agreed upon that everyone should have access to the VCM regardless of what they do to their emissions internally (4). Also, greenwashing is thought to be less when there are standards on how customers should use credits (-2).
- **Target of fairness:** In terms of target, the influence of a verified back-story seems less important (1). There is no preference to pay more when the impact can be verified more easily (3).

- **Fair procedures & fair access:** There was a strong preference for verification and credit issuance by the same organization, thus reducing the number of intermediaries (-4). Also, all information in the market is believed to be openly available to rating agencies (4). For buyers, all project information was believed to be available (-1).
- **Fair benefit-sharing:** In terms of benefit-sharing, there are no significant statements in this category.

Factor 3 (F3), Lack of corporate involvement, transparent markets
Factor 3 explains 16% of the variance and had four participants correlating to this factor. Two customers and two brokers. This factor focuses mainly on an efficient market and a lack of intermediary involvement. The total number of distinguishing statements with a $P < 0.05$ is six. The statements are in table A.5 in appendix H3.

- **Parameters of fairness:** In terms of parameters of fairness were no distinguishing statements.
- **Goal of fairness:** there were two distinguishing statements for goals of fairness. It was argued that carbon credit issuance and verification should be done by different organizations (-1). The plan for the VCM was argued to be that the VCM should only be used to trade carbon credits (1). Both had a relatively low Z-score.
- **Target of fairness:** There were no distinguishing statements in terms of targets of fairness.
- **Fair procedures & fair access:** In terms of fair procedures and access, buyers are believed to have access to all information about projects (-2).
- **Fair benefit-sharing:** It was believed that corporations have no shared responsibility to invest in the VCM (1). Furthermore, the process is agreed upon that benefit-sharing in projects must be more transparent (3). At last, it is agreed upon that benefits should be measurable on the individual level of farmers (1)

4.4.2. Q-set from interviews

The following section will go into depth about the interview, following up on the Q-set. The different dimensions of fairness will be mentioned and supported through quotations from the interview. The results are presented according to the factors through the Q-sort.

Factor 1 (F1), Community involvement and standardizing

- **Parameters of fairness:** Regarding environmental impact, the participants differed from what was mentioned in the Q-set. Participant three, a customer, mentioned: ”Well, as long as there is impact. So, my use of use case for voluntary carbon markets is primarily for impact. Moreover, that impact is on the environment and the second on communities.” Furthermore, in terms of increased transparency, participants supported the fact that increased transparency is important for the fair assessment of projects. Participant One, a broker, mentioned: ”If you want to sell a credible claim or carbon credit with environmental integrity. Then you have to be transparent on how these calculations are made and that presents the only fair story to the buyer of carbon credits.” Participant Two, a broker, also confirms this by saying: ”There, but there’s a lack of transparency in what they exactly take, and therefore, there’s no fair contribution to the farmers producing credits, right?”.
- **Goal of fairness:** Participants slightly disagreed When it comes to investing due to other companies investing as well. However, in the interviews, Participant One mentioned that companies often follow the large trendsetters in the market. There were several different viewpoints regarding intermediary involvement. Participant Three, a customer, said that intermediaries in the market should receive more benefits than the minimum when they add some value to the VCM. It was believed that the market works when there are more separate roles. Participant 1, a broker, agrees with this standpoint and thinks intermediaries like brokers have a role in the market if they add value. The broker should act as the expert to ensure buyers get quality credits. Participant Two, another broker, mentions this as well: ”Because I think much understanding the market, how it works and what benefits are going where should be addressed by the intermediates and can be addressed by the intermediates.”

- **Target of fairness:** From the interviews, participants mentioned the importance of communities in the value chain. Participant Two mentioned: ”Community level GIS maps and every household map one-on-one. But that is the ideal world.” It was even stated that the communities are the principal shareholders in the VCM. In terms of excluding mature participants, only one participant mentioned the importance of including them, as this is one of the focus areas of the VCM.
- **Fair procedures & fair access:** The involvement of intermediaries is further explained in the goal of fairness. Regarding access to information, Participant One mentioned that information is publicly available but difficult to compare. Participant Two also confirmed this when it came to comparing projects. A preference for one central body is also mentioned.
- **Fair benefit-sharing:** As mentioned in the target dimension of fairness, participants believed the community impact to be significant when considering benefit-sharing.

Factor 2 (F2), Market efficiency and participation

- **Parameters of fairness:** In terms of environmental impact, there were no nuances from the interviews.
- **Goal of fairness:** This factor places large emphasis on participation in the VCM, as it was agreed upon that everyone should have access to the VCM regardless of what they do to their emissions internally. This was not further addressed in the interviews. Also, for greenwashing, Participant Five mentioned: ”Because greenwashing accusations will always happen anyways, there will always be issues even when the standard is not one size fixes all solutions.”
- **Target of fairness:** In terms of back-story, there were no remarks on this. Regarding willingness to pay, Participant Five, a customer, mentioned the willingness to pay for co-benefits.
- **Fair procedures & fair access:** There was a strong preference for verification and credit issuance by the same organization. Participant Four mentioned that verification bodies like Verra or Gold Standard should take full blame when something happens regarding the quality of credits. Furthermore, Participant Five also stated that decreasing the amount of intermediaries might increase transparency. In terms of access to information, Participant Four mentions that even though there are companies with more access than others, it is still challenging to find out which projects will succeed and which will have problems.
- **Fair benefit-sharing:** Regarding benefit-sharing, there are no specific mentions of this in the interviews.

Factor 3 (F3), Lack of corporate involvement, transparent markets

- **Parameters of fairness:** In terms of parameters of fairness, there were no distinguishing mentions in the interviews.
- **Goal of fairness:** Within goals, participants nine and eight stated that intermediaries should get fair compensation when adding value to the market. Participant nine mentioned: ”Yeah, right. I would say it is logical if you add something to the process. or instance by the supply of VCM then it would make sense that it, yeah, that it’s compensated for it.” Participant six mentioned that they do have a role but there might be too many at the moment since everyone can start their body involved in the VCM. Participant Seven agrees with this: ”I think in a sense there are too many players, but I find it hard to pinpoint who also leads, and when you look at the integrity standards, for example, they. Generally, all rely on any variety of something else.” In terms of the future of the VCM and other benefits trading, there are no quotations from the interviews.
- **Target of fairness:** In terms of target of fairness, there were no distinguishing mentions in the interviews.
- **Fair procedures & fair access:** In terms of fair procedures and access, it was believed that buyers do have access to all information about projects; there were no interview statements specifically regarding this.
- **Fair benefit-sharing:** Regarding responsibility, Participant Nine argued that corporations buying credits should not directly be involved in improving the market. When talking about benefit-sharing, Participant Nine mentions that brokers should make the process more transparent to make the market more attractive and that much information is available regarding certain effects of projects on local communities. Participant Seven confirms this: ”I think I put it there because I find benefits sharing important. And I think it’s easier to focus on such a topic when processes are more transparent.”

5

Discussion

5.1. Key findings from the Q-set, issues, and motivations

Within section 4.3, it can be seen that the PCA method has the highest cumulative % explained variance of 67% when considering three different factors. Therefore, the PCA method is used to analyse this thesis's statements further. The most pressing issues and motivations or priorities were identified through coding in Atlas.ti from transcripts of the interviews.

The table 2.1 is recreated using the factors found in this study and is on the right of table 5.1. The only difference between the table created for Howard et al. (2015a) and this study is at the bottom row at the most left column. As this research was focused on customers, this is added to the table. Participant involvement is thus for Howard et al. (2015a), and customer involvement is for the research results from this study.

Howard et al. (2015a) had used different participants in the study, namely project developers, project enablers and employees from Fairtrade. It was expected that results from this study differed slightly from the results by Howard et al. (2015a) as the participants were customers at the end of the value chain instead of at the beginning. This can cause differences in knowledge and priorities for the participants in the study. Still, there are some similarities. Results from Howard et al. (2015a) are compared to results from this study in section 5.1.1. Each of the different dimensions (*parameters*, section 5.1.2, *goal* section 5.1.3, *target* section 5.1.4, *procedures and acces* section 5.1.5, *benefit-sharing* section 5.1.6) of fairness will be compared to each other as well as to the results from the interviews and literature.

The discussions mention F1, F2 and F3, which are the different study participants grouped according to their factors. Participants from F1 are thus the participants in this study who share the same perspective on fairness in the VCM from factor 1. The priorities, emphasis and what participants from each factor found important are mentioned in table 5.1.

	Howard et al. (2015)			Research results		
Factor	**Factor 1 (F1)**	**Factor 2 (F2)**	**Factor 3 (F3)**	**Factor 1 (F1)**	**Factor 2 (F2)**	**Factor 3 (F3)**
Priority	Producers a priority	Value chain	Market efficiency	Community impact	Market participation	Market functions on its own
Emphasis	Market participation	Impact on people and the planet	Little interference more for projects	Community involvement	Efficiency	Transparency
Where to measure	Organizations producing credits	Along commidity chain	Household level	Community level	-	Individual level
Intermediaries compensation	Limited	Reasonable	Reasonable	Reasonable as long as value is added	Reasonable compensation large responsibility	Reasonable as long as value is added
Participant/ customer involvement	Increase local capacity	Involve additional parties	Involve additional parties	More involved, rely on brokers	Lack of involvement rely on broker	Lack of interest no knowledge in-house

Table 5.1: Three different factors from the research by Howard et al. (2015a) and the results from this thesis in one table.

5.1.1. Implications on fairness

The following section will compare the different factors found by Howard et al. (2015a) to those found in this research. The implications these factors have on blockchain implementation will also be mentioned. Comparing the table on the right from figure 5.1 to the results from Howard et al. (2015a), there is some overlap. F1 from Howard et al. (2015a) is comparable to F1 from this study as both focus on the involvement of the community or producers. Participants from Howard et al. (2015a) valued their participation from the project developers more, and their involvement was the main priority for communities. The role of intermediaries, in their eyes, should be limited since most of the credit producers are the main focus. The Q-sort from participants in F1 from this study also focuses on the benefits besides only the environmental impact of projects. The only main difference is in the role of intermediaries in the market. F1 from Howard et al. (2015a) believed the payments for intermediaries to be limited, while F1 in this study showed that the intermediaries should be paid reasonably as long as they add value to the market. F2 and F3 in both Howard et al. (2015a) and this study share the same opinion regarding their compensation. Furthermore, F1 in the research by Howard et al. (2015a) is the different one of involvement. As local communities producing credits are often underdeveloped, it seems that participants from F1 want to increase their capacity and understanding of the market. F2 and F3 in Howard et al. (2015a) want to involve additional parties rather than focus on educating the local communities. In this study, F1, F2, and F3 seem to align with this and rely more on the broker in a way. The difference between the factors is the amount of reliance on their broker. F1 is more involved in the projects themselves. At the same time, F2 and F3 seem to rely fully on the broker; one participant from F3 even showed no interest in developing knowledge in-house.

While there are some similarities between the factors found in the study by Howard et al. (2015a) and this study, it seems that customers lack the urgency for faster development of the VCM. This can be attributed to the fact that the study by Howard et al. (2015a) is part of a standard-setting institution where most participants were closely involved in the projects. The customers in this study seem to find it difficult to fully understand the market and see it as something additional rather than something they want to invest in to develop further.

5.1.2. Parameters of fairness

In terms of parameters of fairness, there is an agreement between participants from F1 and F2 on the fact that the quality in the VCM should reflect more than just environmental impact. Interestingly, the Q-set of participants from F1 is opposed to what participants said in interviews, as here, it mainly emphasised the environmental impact rather than the social co-benefits in the VCM. Interestingly, participants from F1 still mentioned price as the primary motivator when looking at projects. An earlier study, where buyers' priorities from the standard-setting initiative Plan Vivo participated, showed the same, emphasising environmental impact over social impact (Porras et al., 2016). Still, the price was deemed more important than any co-benefit as the main reason to invest will be financial rather than the ability to reduce emissions (Ziegler, 2022). Besides, there was a mention of transparency to increase

the credibility of projects. However, it is debatable whether increased transparency would lead to more focus on community involvement.

Regarding issues, trust and integrity issues are mainly recalled by participants from F1 and F2. Both talked about green-washing. Participants from F1 mentioned trust and integrity in intermediaries as they often have much more bargaining power than smallholder farmers. Participants from F2 looked at it from a different point of view and mentioned trust in the different methodologies. Controversies are believed to be present in any form of growing market, and there was a trade-off between a fast-growing market with a lack of trust and a slow-growing market with more trust from customers.

Earlier research showed promising results regarding increasing trust through transparency when implementing blockchain (Marchant et al., 2021). Increased transparency might shift more focus on all co-benefits and increase customer trust in the VCM. As mentioned by Loh and Feng (2018), a lack of interest might be due to the lack of tangible benefits. Implementing blockchain can help shift focus on co-benefits for customers as it can provide more insight in projects. Results from this study are contradictory as the Q-study showed the importance of co-benefits, while participants in the interviews placed less emphasis on co-benefits. More research is needed to confirm whether tangible benefits will shift the focus on co-benefits.

5.1.3. Goal of fairness

Regarding the goals of fairness, results from the Q-sort showed that participants from F2 had the strongest opinion, emphasising market participation. Results from neither participants from F1 nor F3 did not have any strong opinions regarding the goal of fairness. The lack of interest from F3 can be attributed to their lack of involvement. F1 is interesting as they did mention the goal in the interviews rather than through the statements from the Q-set. It was mainly focused on the role of intermediaries, as it was believed there should be fair compensation for intermediaries as long as they add value to the market. Compared to the parameters of fairness, it is a logical standpoint as participants from F1 did emphasise trust in the brokers.

Both participants from F1 and F3 did mention issues related to the goal of fairness, as it was often about market efficiency and complexity. Participants from both factors believe the market needs to be simplified and easier to understand all different projects fully. Interestingly, within F3, it was mentioned that besides the need for more understanding, there is also no interest in developing knowledge on the market. This is comparable to F1 since it could indicate more trust in brokers to act integer and find high-quality credits.

Implementing blockchain could enhance customer participation in the market, as participants from F2 preferred it; however, without any due diligence on buyers, it might cause difficulties. Prioritising companies that try to meet their long-term goals, rather than buying their way out short term, might become difficult (Nemanic et al., 2022). As customers previously addressed, brokers in the market should safeguard market integrity by denying access to companies through unethical practices. One of the main issues that resulted from this study is the complexity of the market, as can be seen in figure 4.4; this is mentioned more often by both participants from F1 and F3. Customers are less involved and only have limited knowledge of verification, blockchain should focus on increasing trust in brokers from customers. Blockchain can be implemented to help brokers navigate the market more efficiently and enhance their reputation and credibility.

5.1.4. Target of fairness

The target of fairness differs between F1 and F2. Participants from F3 have no clear opinion, which can be related to their focus on a lack of involvement. Participants from F1 emphasised community impact. The results from F1 are controversial as the focus is again on communities; however, as mentioned in the parameters of fairness, results from the interviews showed a lack of interest and more focus on price. The research by Ziegler (2022) showed uncertainty regarding whether customers were willing to pay a premium for verified impact. The Q-set findings suggested that people from F2 were not very keen on paying for verified benefits that had a community impact. The study by Loh and Feng (2018)

showed different results. The study consisted of two surveys between offset users and non-offset users. It showed there was an actual willingness to pay for verification of co-benefits. Within F2, it was also mentioned that there was no direct sign to tell which project would be perceived as more valuable than others. As mentioned within the goal of fairness by F1 and F3, the market seems too complex to navigate; therefore, the value of a project is rather difficult to determine.

Blockchain should be implemented to help decrease the complexity of projects in the market further and create a form of standardization that makes comparing projects easier. Furthermore, the lack of willingness to pay for verified co-benefits further shows that the market is mainly driven by price. Whether blockchain leads to an increase or decrease in price is still unknown. As blockchain implementation might decrease Measurement, Reporting and verification, implementation and operation costs should be weighed against it.

5.1.5. Fair procedures & fair access

Fair procedures and fair access are dimensions in which all participants across the factors had strong opinions. Participants from F1 emphasised the importance of getting insight into the risks associated with starting a project that aligns with their focus on community involvement. Further, participants from F1 believed the VCM to be uncoordinated and needed standardisation. This is comparable to participants from F2, who focused on market efficiency and believed that too many intermediaries were involved. Within interviews of F2, it became clear that the standardisation was aimed at methodologies. Previous research showed that the main priority when purchasing offsets is to be standards in monitoring as well (Porras et al., 2016). Within access to information, the participants had opposing views. The participants from F1 slightly leaned towards uneven access to information, whereas participants from F2 and F3 agreed that all information was available. Still, within F2, it was believed that even though the information was available, it could still be difficult to understand fully.

The involvement of intermediaries was a point of disparity between participants from F1 and F2. F1 favoured more intermediary involvement and argued they should get sufficient compensation as long as they add value; participants from F2, on the other hand, believed too much involvement of intermediaries and would rather see a reduction. Fewer intermediaries might lead to more transparency.

Blockchain technology has the potential to significantly impact fairness dimensions such as transparency in procedures and access to information. Previous research by Espenan (2023) has demonstrated that standardising information presentation can increase customer involvement. This research shows that standards in creating and issuing carbon credits would connect the project developer and consumer better and create more trust in the market. It is uncertain whether the amount of intermediaries decreases when using blockchain for carbon trading. It can be argued that blockchain can enhance the credibility of existing intermediaries and show which ones are more reliable. However, this may also raise concerns about potential long-term monopoly (Nemanic et al., 2022). Still, findings from this study suggest that reducing the number of unreliable intermediaries could benefit market development. Fewer intermediaries that are trustworthy on the market will most likely also decrease the bad publicity.

5.1.6. Fair benefit sharing

Only participants from F1 and F3 had significant statements for fair-benefit sharing. In line with the other statements for F1, the participants believed community impact to be the most important in terms of benefit sharing. Participants from F3, on the other hand, focused more on the process. Within fair-benefit sharing, participants from F3 believed corporations have no shared responsibility to invest in the VCM. Interestingly, research by Loh and Feng (2018) showed that altruistic motivation was one of the main drivers for buying carbon credits. Other research by Porras et al. (2016) confirms this further as a moral obligation to deal with the environmental footprint is also mentioned as one of the main reasons. These results suggest a shared responsibility, contrary to the results in this study. These differences could be attributed to how both Porras et al. (2016) and Loh and Feng (2018) have done their research. Both used surveys in their research, which might have led to morally right answers. The results from the Q-sort in this study were supported through interviews, where companies could have answered

more honestly as questions were asked face-to-face rather than online through a survey.

As there were only a few distinguishing statements in F3, this follows the same pattern of lack of interest. The interviews confirm this and show a lack of responsibility to improve the market. However, it was mentioned that increased transparency could lead to more focus on benefit-sharing. The absence of statements from F2 can be attributed to the fact that there is more focus on what the market would look like (target of fairness) and how it should function (fair procedures & fair access) and less on the actual benefit-sharing. F2 and F3, however, did mention the differences between certain types of buyers. For some buyers, transparency might increase the focus on benefit-sharing. Blockchain can play a significant role in increasing transparency in the market, as participants from F3 value this highly. When seeing the actual impact of projects, increased transparency could help. However, as previously mentioned in other dimensions of fairness, the market remains complex and customers mostly rely on brokers. Therefore the increased transparency can help brokers convey customers more easily in showing the benefits of different projects.

5.2. Limitations

This thesis aimed to determine customers' preferences for fairness in the VCM and then look into how blockchain can be implemented. After finalizing the research, one of the main limitations is the need for more thorough research on blockchain implementation. Through Q-methodology, customers' perspectives on fairness in the VCM were assessed. It would be advised to talk to blockchain experts after the interviews were analyzed. Unfortunately, this has not been done due to time and resource restraints. The study could be further improved by delving deeper into blockchain's technical possibilities by interviewing blockchain experts and finding out how the implementation would benefit fairness in the VCM.

There were several other limitations related to the Q-methodology in this research. Primarily, the concourse of the Q-set aimed to encompass all opinions and perspectives on the topic. However, this was constrained by the limited time frame of the research. In contrast, Howard (2016) undertook a more extensive approach, utilising a larger pool of articles and conducting interviews over approximately two years to ensure a more comprehensive coverage of perspectives. Moreover, eliminating bias among participants proved difficult within the Q-set. The sequence in which statements were presented could influence preferences as participants could have placed statements they felt strongly about in one of the columns before knowing all the statements. Although participants could adjust statement placement during sorting, a better approach would have involved an initial pre-sorting phase, grouping statements according to participants' positive, negative, or neutral preferences. Unfortunately, multiple participants had already filled in the Q-sort before any adjustments to the interview protocol could have been made. Therefore, the choice was made to let the other participants also fill in the software without pre-sorting, as changes during the process would be too time-intensive and complicate the results too much. Analysis of the results would have been too time-intensive for this research.

Despite efforts to analyse interviews neutrally, prejudice or researcher bias still exists. Researcher bias is defined as the prejudice present when analysing the interviews, which could cause a certain order of statements to be selected based on personal opinion.

Due to the large amount of mentions for a certain topic, it is impractical to highlight them all. Therefore, certain quotes about the same topic are presented together to give the interviews more structure. Categorising these statements is influenced by researcher bias as the statements are categorised according to the researcher's opinion. Furthermore, each interview differed due to variations in the Q-set among participants. Participants sharing common factors were grouped to assess alignment in views regarding issues or motivations within the VCM to impose some structure. Nevertheless, the frequency of certain issues or motivations mentioned lacks reliability, given that some participants strongly associated with specific topics.

There were some limitations to the selection of participants. The customers in the interviews mainly

came from large corporations (1000+ employees). Determining which projects will be supported within these organisations is often a very complex process. The participants were all directly involved in the VCM. However, it is most certainly a decision made with much more involvement. For this research, the choice was to look into more than one organisation rather than several participants in the same organisation. This issue was much less present as brokers were often from smaller organisations.

Using figures from Appendix I, A.6, A.7 and A.8, it can be seen that certain participants' preference for a certain perspective is not entirely set on one factor and there is a large spread. One way to increase certainty would be to increase the Q-set to a larger sample size until at least three people per factor have a strong preference. While more participants increase reliability, three participants per factor remain practical and feasible.

At last, while this study focused on determining perspectives from a customer viewpoint, not all participants were customers. About half of the interviewees were brokers. As brokers stand between projects and buyers, they have a larger view of the market and know what customers find necessary. While the results show no clear favour for brokers or customers in a particular factor, it can still produce some bias as it showed that brokers were much more involved in the project than the customers in the market.

6

Conclusion

6.1. Research questions

The following section will answer each sub-question using the results throughout the report.

6.1.1. Research sub-questions

Four sub-questions must be answered before the main research question can be addressed.

1. What are customer motivations and priorities when looking to invest in the VCM?

The main priorities of customers when investing in the VCM are the quality of credits, financial reasons, and a relatable back story. Even though companies want their own highest-quality credits, the market remains price-driven. Customers set aside a budget and are more leaning towards cheaper credits, rather than more expensive credits which have been verified. Research by Loh and Feng (2018) showed a willingness to pay for the verification of methodologies, however, it remains debatable whether it will happen or not. Lastly, the back story of credits seems to be of importance for customers. Companies want to have something relatable to their own story. One customer mentioned the fact that their portfolio is aimed at the Dutch market, and they want to invest in Dutch projects. As mentioned by most brokers through the interviews, there are significant differences between types of buyers. Depending on their carbon footprint, the company culture, and the amount they have in their budget for offsetting, they decide between different projects. Customers often trust their brokers to find them the most suitable credits for their needs.

2. What are the different issues within the voluntary carbon market related to fairness from a customer perspective?

The main issues within the VCM related to fairness from a customer perspective are trust and integrity concerns (1), complexity and lack of understanding (2), inefficiency due to lack of standards and uniformity (3) and quality and usage of credits (4).

Integrity and trust (1) are most prominent and can be seen as trust in the projects, trust in the intermediaries like brokers and verification bodies, and trust in the market as a whole (Blaufelder et al., 2021a; Espenan, 2023; Nemanic et al., 2022). Results from the interviews show that participants are mostly afraid of publicity scandals or greenwashing accusations. While some argue this is part of a growing market, others perceive the VCM to be too risky and currently do not buy any credits.

Trust and integrity issues on the VCM are closely related to the complexity of the market (2). The interviews showed that customers did not understand the market fully. Customers appeared to require awareness of the potential benefits offered by the VCM. In the interviews, brokers showed more understanding but emphasized the complexity and lack of understanding from customers. This can be attributed to the fact that the VCM includes a wide range of projects across the entire globe. As the name implies, participation in the market is voluntary rather than obligatory and customers need more incentive to understand the market better.

As can be seen in table 4.3 in Appendix G, the literature mentioned an inefficient market rather than a complex one. Within the interviews, complexity was mentioned more explicitly. Still, the complexity also causes an inefficient market but rather through participation than due to high transaction cost (Blaufelder et al., 2021a; Espenan, 2023; Hartmann, 2019; Nemanic et al., 2022) or the lack of a clear data infrastructure (Blaufelder et al., 2021a).

Complexity and inefficiency in the market are related to a need for uniformity and standardization (3). The lack of uniformity and standardization makes the project hard to compare. Mostly, the large number of different methodologies used is mentioned as an issue. Results from Porras et al. (2016) and Loh and Feng (2018) showed the importance of standards for customers when purchasing credits. As no direct overseeing body is in place, it is difficult for customers to compare the projects. Organizations like the ICVCM seem promising to increase trust and create an integer overseeing body with more standards Ziegler (2022), but it still seems like the development is not there yet.

At last, companies use carbon credits differently and have different standards for high quality (4). There is no clear guideline on net zero, which causes the term to be interpreted differently by different companies. Companies claiming net zero by buying cheap credit from the VCM remain a pressing issue (Ziegler, 2022). These reputation issues on the VCM affect the market as a whole and can further decrease participation in the market.

3. What are the different perceptions of fairness from a customer perspective?

There are three different perceptions of fairness from a customer perspective. They are categorized as factor 1 (F1), factor 2 (F2) and factor 3 (F3). The table on the right in 5.1 shows the different factors as found in this study.

The perception of fairness from participants in F1 revolved mostly around the impact on communities. Several statements indicated their preference for more insight into the community's sight of projects. They believed brokers should play a role in the VCM ecosystem as they have easier insight into projects. Still, the results showed that participants were willing to go further into details as they valued community impact more. Within F2 there was a focus on market participation. Brokers and other intermediaries on the market had large responsibilities and should be compensated accordingly. The participants needed more involvement when looking at projects. From their perspective, it was believed that intermediaries are important to safeguard the fairness of different projects in the market. Intermediaries should bear large responsibility when it comes to safeguarding the market integrity. The last perspective is from F3 where participants mainly looked at the role of intermediaries regarding fairness in the VCM. Brokers should play an important role as they should act as project experts and know where the benefits go. More insight through transparency was seen as important, but mostly when looking at how the brokers act within the market.

This research showed that intermediaries as brokers are the most important when determining fairness in a project. Brokers should have a more centralized role and act as experts within the market. All participants believe they should be compensated accordingly as long as it is disclosed what portion they take.

4. How can specific features of blockchain, like smart contracts, be applied to enhance fairness in the VCM?

Features of blockchain will influence fair procedures & fair access, and fair benefit sharing most. Transparency on carbon projects should increase trust while also shifting the focus on co-benefits. Standardization can help reduce complexity in the market. Blockchain should help brokers and customers help make better informed decisions when choosing projects.

For fair procedures and access, blockchain implementation aims to enhance fairness by increasing transparency in tracking project progress. This should result in increased accountability of projects and intermediaries, fostering greater customer trust. Leveraging blockchain's transparent and immutable

ledger, stakeholders can establish standardized protocols for project tracking and information storage, streamlining processes. This enhanced transparency and standardization empower brokers to track project progress more effectively and provide customers with clear information about carbon credit projects. Additionally, standardization can help reduce complexity, which influences fair benefit-sharing. While customers believe information is available, it is often perceived as too complex to understand. When blockchain is implemented in a carbon trading place, the information should be provided more comparably, making it easier for brokers to explain the differences between projects. Blockchain technology can impact fair benefit-sharing by providing transparent and standardized platforms for showcasing project information and co-benefits. By simplifying information and making it more accessible, blockchain enhances customer understanding. It facilitates fairer decision-making in carbon project selection.

At last, regarding fair benefit-sharing, increased transparency in projects through blockchain can help create a better understanding of co-benefits. Projects with multiple benefits showcase their progress, such as creating new job opportunities. The implementation of blockchain technology can significantly impact benefit-sharing within the VCM. By enabling transparent and accessible information about project co-benefits, blockchain empowers brokers to provide better-informed project options and support projects aligned with their values. This increased transparency not only helps create a better understanding of co-benefits but also has the potential to shift focus towards broader outcomes beyond emissions reduction.

6.1.2. Main research question

How can blockchain technology enhance fairness in the voluntary carbon market from a consumer perspective?

The Q-sort and interviews show that customers rely on and trust their broker when choosing projects. Trust and integrity, in turn, are some of the most pressing issues. Therefore, implementing blockchain should focus on increasing trust from customers in brokers and the market. This can be done by increasing transparency in the project life-cycle and trading carbon credits. Customers should be able to get insight into the different projects. However, brokers will remain the experts in the market. Customers have minimal knowledge of the possibilities and are generally less involved. The broker is the key player in the market for fostering fairness. When specific projects are recommended, the broker should disclose the percentage they take from the project themselves and other fees that need to be paid. By doing so, customers have an easier way of navigating the market. Complexity and lack of understanding are the market's main issues that should be improved to enhance fairness in the VCM. Going further, it would seem that the customers will not develop in-house knowledge but keep relying on their broker. By implementing blockchain, a standard way of storing and transferring carbon credits should be developed to help decrease the complexity of the market. Brokers can more easily explain the nature of the projects they sell and gain more insight into them.

Having more metrics and an easier way of understanding the market can help brokers further enhance the market's credibility. Blockchain implementation should increase transparency on the project level and how these projects are assessed, giving more projects the chance to be sold on the VCM.

Customers on the VCM still focus mainly on the price of carbon credits. The increased transparency through blockchain and better understanding of projects will cause an increase in trust from customers. Customers are more likely to buy from a credible broker rather than one that does not disclose all project information. Therefore, the implementation of blockchain should be aimed at increasing the credibility of brokers to enhance further trust in the market.

6.2. Relevance

6.2.1. Scientific contributions

This thesis's scientific contributions seek to extend the definition of fairness in the VCM further. While the work of Howard (2016) initiated the debate on fairness, primarily from a project developer side

perspective in collaboration with the Fairtrade Institute, this research looks to widen the discussion on fairness by incorporating insights from the demand side of the VCM. By acknowledging the multidimensional nature of fairness and considering various stakeholder perspectives, including customers, brokers, and project developers, this research aims to foster a more inclusive approach to fairness in carbon trading. Moreover, the insights from this research hold implications for establishing standardized practices and regulations governing fair carbon trading. Organizations such as the International Carbon Voluntary Carbon Market (ICVCM) and Fairtrade can leverage the findings to develop comprehensive frameworks that address fairness concerns across the entire market ecosystem. By including diverse perspectives on fairness, these organizations can adapt their approaches to better align with the needs and expectations of stakeholders, thereby promoting greater equity and fairness within the VCM.

In addition to broadening the discussion on fairness, this research also contributes to improving conceptual frameworks for its analysis. Building upon the framework proposed by McDermott et al. (2013) and refined by Howard et al. (2015a), this study seeks to broaden the dimensions of fairness to make them applicable across different contexts and perspectives within the VCM. By changing terminology and using insight from the demand-side stakeholders, this research aims to better incorporate the complexities of fairness in carbon trading.

Additionally, the research seeks to validate further the findings of Porras et al. (2016) and Loh and Feng (2018). By confirming and expanding upon motivations and priorities identified in previous research, this thesis emphasizes financial considerations as a primary driver for purchasing carbon credits. Further, the research contributes to creating a priority list for addressing fairness issues within the VCM. While acknowledging the number of issues identified in existing literature (as depicted in Figure 4.3), this research offers a priority list when approaching these issues, giving direction on which issue should be addressed first.

At last, this research aims to combine a technological solution for a social problem. By looking into the different perspectives on fairness and combining this with blockchain, researchers can understand how technology can help increase trust in the VCM. Earlier research by Espenan (2023), Marchant et al. (2021), and Nemanic et al. (2022) have looked into the ways blockchain can be used to improve fairness or trust in the VCM. However, the research does not focus on the demand side of the VCM. This research shows the possibilities of blockchain integration to enhance transparency, accountability, and integrity within the market. By leveraging blockchain's immutability and creating more transparency, stakeholders can have greater confidence in projects and the market as a whole. This integration addresses existing fairness concerns. Moreover, by bridging the gap between social considerations and technological advancements, this research focuses on the importance of collaboration between stakeholders when addressing complex social issues like fairness in carbon trading.

6.2.2. Societal relevance

The VCM is a way to mitigate climate change using a market-based solution. The VCM can act as a way for companies to offset emissions which are impossible to mitigate. Also, companies can use it to contribute something more to global sustainability and climate goals. Often, projects have more goals besides removing or avoiding carbon dioxide from the atmosphere. In line with the SDGs developed by the United Nations, projects can help reduce poverty and create a source of income for low-income or developing countries. According to Blaufelder et al. (2021b), the VCM should grow tenfold in 2030. There are still several problems in the market that hinder this growth. This thesis addresses the problem by looking at fairness in this market and the application of blockchain. Looking at fairness from a customer perspective creates an understanding of what they find essential in the market. Also, as blockchain is not utilized fully within the VCM, this thesis can serve as another potential advocate for the technology. Understanding the role of fairness and blockchain in the VCM can eventually help to increase customers' trust in the market and increase the integrity of the VCM. In the ideal situation this would lead to greater participation, higher demand in the market and therefore more financial means to developing countries while actively offsetting carbon dioxide in developed countries.

6.2.3. Managerial implications

The implications of this study are primarily directed towards brokers within the Voluntary Carbon Market (VCM). This thesis shows that customers place significant trust in brokers when selecting carbon credits from various projects. Given this reliance, brokers should look to employ blockchain technology to create more credibility and trustworthiness within the market. The implementation of blockchain holds the potential to enhance multiple aspects of the VCM such as easier comparison of projects and providing greater transparency to customers. Considering the evolving nature of blockchain technology, it is also important for brokers to remain actively engaged in the developments within the VCM.

As blockchain technology is expected to enhance transparency across various aspects of the VCM, it will simplify customer explanations. Given the issues of market complexity, brokers can leverage blockchain to highlight project differences more effectively to customers, thereby improving market understanding and decision-making processes. Brokers should look to simplify information on the VCM to create more trust from customers.

For customers, it is recommended that broker credibility be closely evaluated. As brokers are much more knowledgeable on the market and have a strong bargaining position, it is important to closely evaluate the different brokers on the market and find the most suitable one.

6.3. Recommendations

This study seeks to provide further insight into the fairness debate on the VCM. Research on the VCM was done from a project developer-side by Howard (2016). This study is aimed more at the consumer side of the market. Three different factors have been identified and compared against the current literature. Still, there remain some disparities between the perspectives of fairness. While the three new factors give insight into mostly the consumer side, there is still much uncertainty. It would be recommended to further look into the consumer side of the VCM and test the factors more in-depth with a larger population.

As blockchain can help further improve the VCM, there are still some areas for further research. For one, this thesis looked into implementing blockchain to increase fairness. While the results show that implementing blockchain will increase trust and integer behaviour on the VCM, it is still all in a theoretical context rather than actual implementation.

Besides, one of the pressing issues was market complexity and inefficiency. Implementing a new technology such as blockchain can cause more confusion in the already complex market. It is therefore recommended that the opinion and usage of blockchain on the VCM be explored further. Further, more research is needed to find out whether the implementation of blockchain might shift more focus on co-benefits in the VCM. Increased transparency and less complexity can give more insight but it remains to be seen whether customers are willing to look into it.

As this research seeks to combine the social construct with blockchain technology, some recommendations exist on how blockchain can improve fairness in the VCM. Still, much is being determined about the technical details of implementing blockchain on the VCM. As there are a large number of stakeholders involved, it is important to create an infrastructure that is accessible throughout the whole life cycle of the carbon credits. However, as projects often start in rural areas, it might not be easy to implement the technology in these areas. Further research is needed to determine what can be done to ensure blockchain technology is utilized fully by stakeholders on the VCM once implemented.

At last, this research makes use of Q-methodology combined with interviews. While the interviews were mainly aimed at supporting the Q-sort, further research is needed to find out how interviews can be implemented more efficiently in the results of the Q-sort.

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A

Appendices

Appendix A - Search tables

Appendix A.1 - Search term: "Voluntary carbon market" AND Fairness OR equity AND blockchain (106 results)

Papers found						
No.	**Title**	**Author**	**Year**	**Included/excluded**	**Reason for inclusion or exclusion**	**Key message for the literature review**
1	Improving Voluntary Carbon Markets through Standardization and Blockchain Technology	NP Espenan - Wyo. L. Rev.	2023	Included	Talks about blockchain and its potential to increase transparency	Standardization through blockchgain, enhance transparency through blockchain.
2	Applying blockchain to the Australian carbon market	S Hartmann, S Thomas	2020	Included	Case study on blockchain in Australia, equity is included	Blockchain in the Australian market leads to more knowledge about pricing, thus evening the playing field.
3	Design of Public Voluntary Carbon Market Mechanism based on Crosschain and Token Economics	D. Hou, S Hao, Yu Du	2022	Excluded	Paper talks about a certain type of blockchain to implement within the VCM. However the main focus is on individual offsetting not on corporations.	x
4	Carbon Trading with Blockchain	A Richardson X Jiahua	2020	Excluded	Talks only about the ETS and implementation of blockchain there, gives not insight in the VCM	x
5	Demonstrating Feasibility of Blockchain-Driven Carbon Accounting – A Design Study and Demonstrator	K Seidenfad, T Wagner, R Hrestic, U Lechner	2022	Excluded	Is about implementation of blockchain technology within the ETS not the VCM.	x
6	Bringing Technological Technological Transparency to Tenebrous Markets: The Case for Using Blockchain to Validate Carbon Trading Markets	G. Marchant, Z Cooper P. Gough-stone	2022	Included	The paper talks about the use of blockchain to increase transparency interesting to include.	Smart contracts to enhance transparency, verifying corporate claims to enhance crediblity from companies.
7	Blocks and Credits: A Sustainability Lens on Blockchain Technology in Voluntary Carbon Markets	C. Nemanic, M Enejison, O Ejide	2022	Included	Paper actually adresses the issue of fairness through blockchain as a sub-question	Blockchain promotes fairness within the VCM. Due to permissionelss nature it could lead to unethical behavior. Skepticism could arise when new standards arise which are not validated through blockchain. Could potentially lead to

Figure A.1: Table with all papers used from the first search term. With a total of **106 results** The title, author, and year are mentioned as well as the reason for inclusion or exclusion. After the key message used in this literature review is mentioned.

Appendix A.2 Search term: Fairness Or Equity "Voluntary carbon market" AND motivation OR Motivations OR "Market participation reasons" AND Customers OR Consumers (112 results)

No.	Title	Author	Year	Included/excluded	Reason for inclusion or exclusion	
1	Which "fairness", for whom, and why? An empirical analysis of plural notions of fairness in Fairtrade Carbon Projects, using Q methodology	RJ Howard	2015	Included	Asses fairness within the VCM.	Defines three different defintions on fairness according to the framework of Mcdermott. (2013). Finds three different factors or perspectives on fairness after research. Agreements and disagremeents between the perspectives are mentioned as well.
2	Assessing Credibility in the Voluntary Carbon Market?	T Ziegler	2023	Included	Thesis discussing credibility issues in the VCM. Fairness is also mentioned as an indicator	Mentions fairness as part of the framework to assess credibility. Concludes that fairness only has a medium impact on credibility.
3	Unraveling the Notion of "Fair Carbon": Key Challenges for Standards Development	RJ Howard, A Tallontire, L Stringer, R Marchant	2015	Included	Same author as 1, literature review on fairness within the VCM	Gives insight on fairness issues from a smallholder view. Involves lessons learned from multiple cases and the opportunities Gold Standard and Fairtrade international propose.
4	Green Pills: Making Corporate Climate Commitments Credible	J Armour, L Enriques T Wetzer	2022	Excluded	Not necessarily talks about the VCM. Is mainly focused upon the legal side of corporate sustainability claims. Not very interesting to include.	x
5	Consumer Demand for Voluntary Carbon Osets. The Role of Motivations, Contexts, and Framing for Public Good Provision to Mitigate Climate Change	JE Blasch	2014	Excluded	Focus is mainly on individual offsetting and not in a corporate context	x
6	Engaging without greenwashing: a holistic gamified approach to foster eco-friendly behavior in a renewable energy crowdfunding platform	GM Riera	2021	Excluded	Does mention the VCM and behavior to participate, however is not complete and in a gamification setting	x
7	Community Wealth Building and a Just Transition to Net Zero	L Macfarlane, M Brett	2022	Excluded	Research is very specifically aimed at land-owners within Scotland. Little generalizability is possible from the research	x
8	Ethical carbon offsetting Guidelines and lessons from smallholder and community carbon projects	I Porras, G Wells, C Stephenson, P Kazis	2016	Included	Talks about the ethics of carbon offsetting	Includes different factors important for buyers of carbon offsets. From this it is mentioned that the buyers are also interested in the co-benefits carbon credits bring.
9	REDD+ benefit sharing mechanisms: Does it make a difference in equity?	L Mustalahti, S Rakotonarivo	2012	Included	Distribution of benefits are mentioned within a certain project within REDD+.	Raises useful questions to who should be included to receive benefits. Performance based payments are mentioned as a solution, which is difficult since there is no clear baseline. Used as an example as blockchain can give more clear guidelines
10	Report on stakeholders' interests, visions, and concerns	C Schleyer, J Kister, M Klinger P Stegmaier, E Aukes	2018	Excluded	Is a stakeholder analysis, on a forest ecosystem services. Does mention fairness and equity briefly. However, the cases analysed were not within VCM.	x
11	Voluntary carbon offsetting and its contribution to sustainable development	Tan Loh, E Feng	2018	Included	Did research in a large number of participants within the voluntary carbon market to get insight in motivation.	Multiple reasons for participation were found: personal responsibility, CSR, brand image, employee engagement.
	Both from Howard:					
12	What lays at stake for standards organisations pursuing fairness in the carbon market ? Lessons from literature applied to practice in the carbon market	RJ Howard, A Tallontire, L Stringer, R Marchant	2014	Included	Literature review from Howard. Part of the PhD about fairness within the VCM.	Mentions seven challenges related to standard setting institutions, gives insight in smallholder perspective on fairness.
13	Pathways to "Fair Carbon": Assessing fairness in standard-setting and carbon projects	RJ Howard	2016	Included	PhD from Howard about fairness within the VCM	Ties all research toghether on fairness in VCM. Gives recommendations on further exploration in interaction between different parties within VCM. Further recommends to look into the carbon value chain and define fairness from more stakeholders.

Figure A.2: Table with all papers used from the first search term. With a total of **112 results** The title, author and year are mentioned as well as the reason for inclusion or exclusion. After the key message used in this literature review is mentioned.

Appendix B - recommendations per paper

Papers found

No.	Title	Author	Year	Recommendation	Study participants
1	Improving Voluntary Carbon Markets through Standardization and Blockchain Technology	NP Espenan - Wyo. L. Rev.	2023	Establishing industry-wide calculation standards.	-
2	Applying blockchain to the Australian carbon market	S Hartmann, S Thomas	2020	Consider blockchain applications for other existing carbon markets.	-
3	Bringing Technological Technological Transparency to Tenebrous Markets: The Case for Using Blockchain to Validate Carbon Trading Markets	G. Marchant, Z Cooper P. Gough-stone	2022	Implementing blockchain and smart contracts can address double counting and improve transparency.	-
4	Blocks and Credits: A Sustainability Lens on Blockchain Technology in Voluntary Carbon Markets	C. Nemanic, M Enejison, O Ejide	2022	Further nuances in what a quality carbon credit entails and more research is needed whether: blockchain strenghtens voluntary carbon buyers commitment to net zero, contribute to high-quality carbon credits, use of blockchain technology promote fairness in carbon trading.	Employees within standard setting organizations

No.	Title	Author	Year	Recommendation	Study participants
1	Which "fairness", for whom, and why? An empirical analysis of plural notions of fairness in Fairtrade Carbon Projects, using Q methodology	RJ Howard	2015	Future research should include multiple perspectives from different stakeholders that could have influence on the standards within VCM. Also more research is needed on the interaction between different stakeholders.	Carbon project staff, employees within fairtrade institutions and Gold standard
2	Assessing Credibility in the Voluntary Carbon Market?	T Ziegler	2023	Further research should include broader stakeholder engagement across the entire VCM value chain and increase the accuracy of each mentioned principle.	Researchers, and responsible employees for carbon trading within consultaning firms, voluntary standard initatiatives or research institutions
3	Unraveling the Notion of "Fair Carbon": Key Challenges for Standards Development	RJ Howard, A Tallontire, L Stringer, R Marchant	2015	Define the term " fair carbon further from a target standpoint (from framework Mcdermott. 2013).	Carbon project staff, employees within fairtrade institutions and Gold standard
4	Ethical carbon offsetting Guidelines and lessons from smallholder and community carbon projects	I Porras, G Wells, C Stephenson, P Kazis	2016	Credibiliy is key within carbon value chains. It is recommended to document and communicate co-benefits to attract buyers.	Plan Vivo Foundation offset buyers from all over the world
5	REDD+ benefit sharing mechanisms: Does it make a difference in equity?	L Mustalahti, S Rakotonarivo	2012	Investigate the risks and challenges associated with equity and acountabiliity. Explore the impact of capture, adaptation cost and benefit-sharing mechanisms on distribution of benefits.	Tanzanian Community Carbon Enterprise
6	Voluntary carbon offsetting and its contribution to sustainable development	Tan Loh, E Feng	2018	Focus on tangible benefits of offsetting, raise awareness on the role and promote sustainable development. Also invest in verfification of offsets to enhance credibility and trust	Respondants from all different sectors and all organization types (private, non-profit and government), mainly in europe.
7	What lays at stake for standards organisations pursuing fairness in the carbon market ? Lessons from literature applied to practice in the carbon market	RJ Howard, A Tallontire, L Stringer, R Marchant	2014	More research is needed across the value chain. External factors should be taken into account.	Carbon project staff, employees within fairtrade institutions and Gold standard
8	Pathways to "Fair Carbon": Assessing fairness in standard-setting and carbon projects	RJ Howard	2016	Future research is needed on the interactional dimension of fairness and how this shapes perception.	Carbon project staff, employees within fairtrade institutions and Gold standard

Figure A.3: Recommendations of all useful papers within the literature review. Study participants are also mentioned when relevant.

Appendix C. Blockchain technology in detail

To further understand the technology the following section will mention some of the functionality and features of blockchain. Blockchain is an emerging technology mainly known from crypto concurrency. The first major introduction was through bitcoin. Blockchain introduced a way of sharing information through a distributed system. Different nodes on the network check transactions and cut the need for an intermediary (Di Pierro, 2017). Blockchain is often used applied in financial transactions. Conventionally, transactions go through a single entity often a bank, which has to be trusted by both parties involved. The only verifiable link on the transaction between the two parties is a digital signature. This signature often does not guarantee anything about the time the document was signed. Within financial transaction, time is of importance. Each of the transactions has to be audit able and can be checked by an independent certified institution (Di Pierro, 2017)
Within blockchain, all transactions on the network are digitally signed with the credentials of the seller. Each node involved in the blockchain network keeps a history of the previous credentials of sellers in chronological order(Puthal et al., 2018). Certain (often multiple if not all, depending on the type of blockchain) nodes in the network approve a transaction (Di Pierro, 2017). This cuts the need for a middle man and ensures integrity among the network as all nodes can view the history of the transaction (Chen, 2023).
Blockchain comes forward as a new technology to provide a transparent and secure ledger within carbon trading. Credits can be easily tracked through the entire network as the history of each transaction is kept on the nodes within the blockchain network (Ashley and Johnson, 2018). Blockchain technology includes several distinct properties that are usefull within financial transactions and carbon trading. First the data being stored on the entire blockchain synchronized will all nodes will make it immutable. Each of the different parties can access the history of a certain instrument ensuring data integrity as well. As there are no specific validator nodes it further promotes transparency and equal rights among all nodes. At last, blockchain ensures trust among the participants as there is no single third party to facilitate transactions, instead relying on the blockchain network itself (Puthal et al., 2018).

Features and technical details

To further understand the application of blockchain in the VCM an introduction is given on some of the technical features. In essence, blockchain is a sequence of nodes that holds a list of of all transactions that took place. These blocks are uniquely identified by a hash and timestamp. A hash is a mathematical function that produces a fixed output at variable lengths of input, thus providing a unique code. Due to the nature of this function it is near impossible to derive the original input. Some of the distinct properties of blockchain come from hashing and it is the backbone of a blockchain network (Puthal et al., 2018).
To facilitate transactions, owners within blockchain each have a private and a public key. The public key, is publicly available and can be seen as the ”address” of a participant in the blockchain, which is needed to send currency to or from this wallet. On the other hand, the private key is used in this transaction to ensure ownership of a wallet and verify the transaction. Besides, whereas the public key encrypts blockchain transactions, a private key is needed to decrypt the transaction. While it is possible to generate as many public keys from your private key as possible, it is almost impossible to generate a private key from a public key (Zheng et al., 2017). Applied to carbon markets, this means that each credit has a unique number and specific timestamp making the credit easily traceable. Different features are mentioned when it comes to blocks within blockchain (Zheng et al., 2017):

- Block version: indicating which set of validation rules to follow
- Merkle tree root hash: Value of the hash of all transactions from the block
- Timestamp: time in seconds in universal time
- NBits: target treshold of a valid block
- Nonce: 4-byte field, starts with 0 and increases with each hash calculation
- Parent block hash: 256-bit hash value which directs to the previous block.

Each node in the network consists of a block header and transaction counter. As can be seen in figure A.4

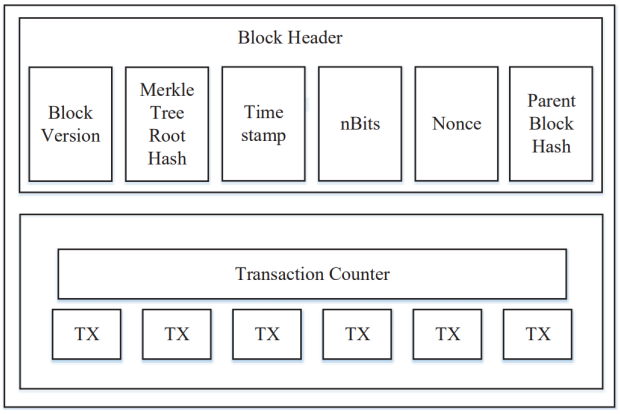

Figure A.4: Structure of a block within blockchain. Adapted from Zheng et al. (2017) p.558

Types of blockchain

Furthermore there are three distinct systems when it comes to blockchain: private blockchain, public blockchain and consortium blockchain. (Zheng et al., 2017) mentions the differences in the following table A.5

Property	Public blockchain	Consortium blockchain	Private blockchain
Consensus determination	All miners	Selected set of nodes	One organization
Read permission	Public	Could be public or restricted	Could be public or restricted
Immutability	Nearly impossible to tamper	Could be tampered	Could be tampered
Efficiency	Low	High	High
Centralized	No	Partial	Yes
Consensus process	Permissionless	Permissioned	Permissioned

Figure A.5: Three different types of blockchain compared on a few properties. Table adapted from (Zheng et al., 2020)

The differences mentioned are listed through a few key properties:

- Consensus determination: which different nodes are responsible for validation of a block. Within a public blockchain all nodes are responsible, while in a consortium blockchain only a selected set of nodes can verify. In a private blockchain one organizations controls the chain and determines final consensus.
- Read permission: which nodes have access to what transactions. In public, all nodes can access this information, while consortium and private this depends on the nature of the chain.
- Immutability: the records are mostly stored on a large number of participants within a public blockchain. In the case of private and consortium this is only on a limited number of participants making it more easy to tamper with.
- Efficiency: the time it takes to propagate transactions. Due to less nodes, private and consortium chains are often more efficient.
- Centralized: this includes the main difference between the types. Public is entirely decentralized while consortium is partly decentralized and private is fully controlled by a single group making it centralized.
- Consensus process: this is the difference on who can join the consensus process within the blockchain. In public, all nodes can joint his process while in consortium and private this must be done with permission.

Smart contracts

Smart contracts in blockchain are a part of code that will be executed automatically when a certain requirement is met. In essence smart contracts are real-world contracts represented digitally (Sadawi et al., 2021).The requirement is stored on the blockchain and through an API it can be checked whether

the conditions are met. If so, the transaction will be fulfilled automatically (Di Pierro, 2017), (Zheng et al., 2017). Smart contracts have a number of advantages over conventional contracts. As mentioned by (Zheng et al., 2020) due to the immutability of blockchain smart contracts can not be changed once issued. Behavior like fraud can be mitigated this way. Furthermore, the efficiency of business processes is greatly improved improved. Financial transactions are automatically completed removing the need for a supply chain procedure to start the transaction(Zheng et al., 2017). This also improves the turnaround time greatly. Automation is proven to be very useful within carbon trading. Transaction of a certain value can be triggered automatically when a carbon credit fulfills a specific condition. Smart contracts also, through their automated and programmable nature, offer increased transparency. This transparency serves as a mechanism to enhancer equality and fairness among the participants involved in these contractual arrangements (Sadawi et al., 2021).

Appendix D. Statements used in the Q-methodology

Statement
”Increased transparency in carbon acounting does not matter for fair assesment of projects” (Pa)
”Price and payment on carbon credits should align with environmental impact and should happen automatically.” (Pa)
”I will focus more on co-benefits when the actual impact becomes more transparent. ” (Pa)
”Reliability in projects does not matter for fairness in the VCM.”(Pa)
”I judge the quality of a project on environmental impact and co-benefits.” (Pa)
”I judge the quality of a project mainly on environmental impact.” (Pa)
”Increased transparency in projects does not increase value of carbon credits. ” (Pa)
”I believe standardization on carbon quality across the globe for does not increase fairness for all projects.” (Pa)
”I believe the VCM should eventually be used to trade other benefits besides carbon credits as well.” (G)
”Integrity of the VCM is increased by decreasing amount of intermediary (brokers, verififcation bodies, integrity council) involvement in the value chain.” (G)
”I am more inclined to participate in the VCM when I know other companies do so as well.” (G)
”Enhancing the ability to track and verify benefits contributes to fairness in the VCM by ensuring the that projects actually deliver on their promise.” (G)
”I think greenwashing accusations will still happen when there is a standard on how carbon credits should be used by companies. ” (G)
”Access to the VCM should be granted to everyone looking to offset their emissions, regardless of what they do about their emissions internally.” (G)
”Projects in countries with a non mature financial system (still developing, no robust banking sector) should be excluded from participating in the VCM as this decreases reliability of projects.” (T)
”I will stop investing in the VCM when not emitting becomes cheaper, even if the ability to measure co-benefits becomes more reliable.” (T)
”I am not willing to pay more for credits when their impact can be verified more easily.”(T)
”I do not care whether my carbon credits have a verified back story or not.”(T)
”I believe intermediaries (brokers) should get a minimal compensation for facilitating the market.” (T)
”I believe governments should be involved in the distribution of benefits” (T)
”I believe the community impact is most important when determining the distribution of benefits.” (T)
”I believe carbon verification and credit issuance should be done by the same organization to reduce the amount of intermediaries involved in the process. ” (Fp&A)
”I will focus more on benefit-sharing when the process is more transparent.” (Fp&A)
”I believe rating agencies do not all have access to the same information in the market and therefore do not treat all projects equally.” (Fp&A)
”I make my own judgement on high-quality credits and do not rely on rating agencies.” (Fp&A)
”I believe certain buyers have more access to information about projects than others, creating an uneven playing field. ” (Fp&A)
”I believe the VCM is uncoordinated and standardisation is needed to ensure fairness for all stakeholders involved.” (Fp&A)
”Insight in environmental, social and economical risk is important to ensure project developers and farmers get a fair evaluation of their project.” (Fp&A)
”Willingness to pay for added co-benefits besides environmental impact by customers is essential for fairness in the VCM” (B)
”I believe there is no shared responsibility by corporations to invest in the VCM.” (B)
”The impact from co-benefits in the VCM should be measurable on the individual level of farmes.” (B)
”The impact of co-benefits in the VCM should be measurable on the community level.”(B)

Table A.1: Different statements with their dimension of fairness. Pa stands for parameter, G for goal, T for target, Fp&A for fair procedures and access, B for benefit sharing.

Appendix E - standard interview protocol

Interview protocol

1. Chit chat
2. Formal stuff: state the following things:
    a. Your name
    b. Your profession
    c. Your company
3. Did you sign the consent form and is everything clear?
4. Introduction about the topic:
    a. The VCM is a new market that still needs to take off, there are a lot of integrity and trust issues currently hindering the progress of the VCM. This research will contribute to enhancing fairness in the market by looking at the opinions of experts and customers in the VCM. The statements will mainly go over how you perceive fairness in the market.
5. Discussion about the results of the Q-sort
    a. Why did you place certain things where?
    b. How do you perceive integrity in the VCM?
    c. Do you think projects are assed fair?
6. Other questions:
    a. What do you see as the main problems in the VCM causing the market to grow so slowly?
    b. Why do you think there is a lack of trust in the market?
    c. What do you think is most important for customers?
    d. How do you see the VCM develop in the future?
7. Do you have any further remarks or questions?
8. Thank you for the interview!

Appendix F - Consent form

Opening statement

Thank you for participating in this Q-sort interview. Before you begin, we would like to explain the purpose of this project/activity and request your consent to participate.

You are being invited to participate in a research study titled: *Enhancing Fairness in the Voluntary Carbon Market from a Customer's Perspective: Exploring Blockchain as a Solution.* This study is being done by Julian Roza from the TU Delft and Ernst & Young.

The purpose of this research study is to sort statements in a certain order to find out what the perception of fairness is within (potential customers) in the Voluntary Carbon Market and will take you approximately 40 minutes to complete. The data will be used for a master thesis at TU Delft. We will be asking you to sort 25 different statements in the order of least important to most important.

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by doing the interview completely anonymously. The personal data will be stored in a secure OneDrive environment from the TU Delft.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions. This interview will be recorded and transcribed. This data will be deleted in a maximum of one month after graduation. Access is only possible by the corresponding researcher and responsible researcher. The order of the statements is used in the master thesis as well as a summary of the interview.

Corresponding researcher:
Julian Tigor Roza

_____

Responsible researcher:
Dr. Ir. Z. (Zenlin) Roosenboom-Kwee
Z.Roosenboom-Kwee@tudelft.nl

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated [*DD/MM/YYYY*], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.	☐	☐
3. I understand that taking part in the study involves: - Partaking in the recording of a video that is transcribed after. The data will be deleted at most one month after graduation. - Sorting statements in the order of priority	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study also involves collecting specific personally identifiable information (PII) [name and job description] with the potential risk of my identity being revealed	☐	☐
7. I understand that the following steps will be taken to minimise the threat of a data breach, and protect my identity in the event of such a breach: the data is stored in a secure environment (OneDrive) at the TU Delft, only accessible to the responsible and corresponding researcher. Job descriptions will be very general, and summary will be anonymised	☐	☐
8. I understand that the (identifiable) personal data I provide will be destroyed at maximum one month after graduation.	☐	☐
9. I agree that my responses, views or other input can be quoted anonymously in research outputs	☐	☐

Signatures

_____	_____	_____
Name of participant	Signature	Date

I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____	_____	_____
Name of participant	Signature	Date

Study contact details for further information: [Julian Roza, +31683366942, jroza@tudelft.nl]

Appendix G. Issues and sources in detail

Dimension of fairness	Issues	Sub-issues	Author specifically mentioning the issue
Parameter, target	Uniformity and Standardization:	Lack of uniformity between projects	Espenan (2023)
		Too many methodologies in regard to carbon counting and verifying. No standard in place.	Espenan (2023), Howard et al. (2014), Porras et al. (2016)
Parameter, target, procedures & access, benefit sharing	Transparency & monitoring	Lack of transparency in verification and within brokers.	Blaufelder et al. (2021), Howard et al. (2014), Espenan (2023), Marchant et al. (2021), Nemanic et al. (2022), Porras et al. (2016),
		Lack of monitoring and enforcement within projects.	Howard et al. (2014)
Parameter, goal	Quality of credits and credit usage	Standards on high quality unclear.	Nemanic et al. (2022), Ziegler (2022)
		No clear guidelines on how credits are used in the private sector.	Ziegler (2022)
Parameter	Trust and integrity issues	Lack of trust in verification bodies and the market as a whole.	Blaufelder et al. (2021) Espenan (2023), Nemanic et al. (2022)
		Greenwashing: no standards on what neutrality claims mean.	Ziegler (2022)
		Market integrity is not safeguarded.	Blaufelder et al. (2021)
Parameter, procedures & access, benefit sharing	Uneven access to information	Uneven access to information about projects.	Hartmann & Thomas (2019), Nemanic et al. (2022)
		Limited pricing data available for fair competition.	Hartmann & Thomas (2019)
Goal	Market efficiency and complexity	Inefficient market due to high transaction cost.	Blaufelder et al. (2021), Espenan (2023), Hartmann & Thomas (2019), Nemanic et al. (2022)
		No clear data infrastructure in place in the market	Blaufelder et al. (2021)
		Market fragmentation and complex market.	Nemanic et al. (2022)
Target	Credit reliability and credibility	Unreliable carbon credits from projects.	Nemanic et al. (2022), Ziegler (2022)
		Issues with the credibility of the VCM as a whole.	Ziegler (2022)
Target, procedures and access, benefit sharing	Stakeholder Engagement	Lack of coordination between stakeholders in the market.	Nemanic et al. (2022), Mustalahti & Rakotonarivo (2012), Ziegler (2022), Howard et al. (2014)
		No overseeing body acting as the main intermediary.	Howard et al. (2014), Nemanic et al. (2022)

Table A.2: Issues and sub-issues mentioned in the literature in detail.

Appendix H1. Factor 1 - Community involvement and standardizing-distinguishing statements

Dimension of fairness	Z-score	Statements
Procedures & access	**4**	”Insight in environmental, social and economical risk is important to ensure project developers and farmers get a fair evaluation of their project.”
Target	**4**	”I believe the community impact is most important when determining the distribution of benefits.”
Procedures & access	**3**	”I believe the VCM is uncoordinated and standardization is needed to ensure fairness for all stakeholders involved.”
Procedures & access	**2**	”I believe certain buyers have more access to information about projects than others, creating an uneven playing field. ”
Benefit-sharing	**1**	”The impact from co-benefits in the VCM should be measurable on the community level.”
Goal	**0**	”Integrity of the VCM is increased by decreasing amount of intermediary (brokers, verifiifcation bodies, integrity council) involvement in the value chain.”
Goal	**-1**	”I am more inclined to participate in the VCM when I know other companies do so as well.”
Target	**-2**	”Projects in countries with a non mature financial system (still developing, no robust banking sector) should be excluded from participating in the VCM as this decreases reliability of projects.”
Procedures & access	**-3**	”I believe carbon verification and credit issuance should be done by the same organization as to reduce the amount of intermediaries involved in the process.”
Parameter	**-4**	”I judge the quality of a project mainly on environmental impact.”
Parameter	**-4**	”Increased transparency in carbon accounting does not matter for fair assessment of projects”

Table A.3: Distinguishing statements for factor 1: Community involvement and standardizing. There were a total of eleven distinguishing statements. In total they explain 40% of the variance

Appendix H2. Factor 2 - Market efficiency and participation - distinguishing statements

Dimension of fairness	Z-score	Statements
Goal	**4**	”Access to the VCM should be granted to everyone looking to offset their emissions, regardless of what they do about their emissions internally.”
Procedures & access	**4**	”I believe carbon verification and credit issuance should be done by the same organization as to reduce the amount of intermediaries involved in the process.”
Target	**3**	”I am not willing to pay more for credits when their impact can be verified more easily.”
Parameter	**1**	”Reliability in projects does not matter for fairness in the VCM.”
Target	**1**	”I do not care whether my carbon credits have a verified back story or not.”
Procedures & access	**-1**	”I believe certain buyers have more access to information about projects than others, creating an uneven playing field. ”
Goal	**-2**	”I think greenwashing acuisations will still happen when there is a standard on how carbon credits should be used by companies. ”
Parameter	**-3**	”Price and payment on carbon credits should align with environmental impact and should happen automatically.”
Procedures & access	**-4**	”I believe rating agencies do not all have access to the same information in the market and therefore do not treat all projects equally.”

Table A.4: Distinguishing statements for factor 2: Market efficiency and participation . There were a total of nine distinguishing statements. In total they explain 17% of the variance

Appendix H3. Factor 3 - Lack of corporate involvement, transparent markets- distinguishing statements

Dimension of fairness	Z-score	Statements
Benefit-sharing	3	”I will focus more on benefit-sharing when the process is more transparent.”
Benefit-sharing	1	”I believe there is no shared responsibility by corporations to invest in the VCM.”
Benefit-sharing	1	”The impact from co-benefits in the VCM should be measurable on the individual level of farmers.”
Goal	-1	”I believe carbon verification and credit issuance should be done by the same organization as to reduce the amount of intermediaries involved in the process.”
Goal	-1	”I believe the VCM should eventually be used to trade other benefits besides carbon credits as well.”
Procedures & access	-2	”I believe certain buyers have more access to information about projects than others, creating an uneven playing field. ”

Table A.5: Distinguishing statements for factor 3: Lack of corporate involvement, transparent markets. There were a total of six distinguishing statements. In total, they explain 11% of the variance

Appendix I. Participant preference

By using the Kade software for analysis, the preference for each of the different factors can be visualized. The images show the correlation to factors. The x-axis and y-axis are both factors. The dots indicate how much correlation participants have with the factor. As can be seen from the images some participants have a higher correlation to one factor than the other. The following figures A.6, A.7, A.8 show the three different comparisons between the participants in which the nuance between the different factors is identified.

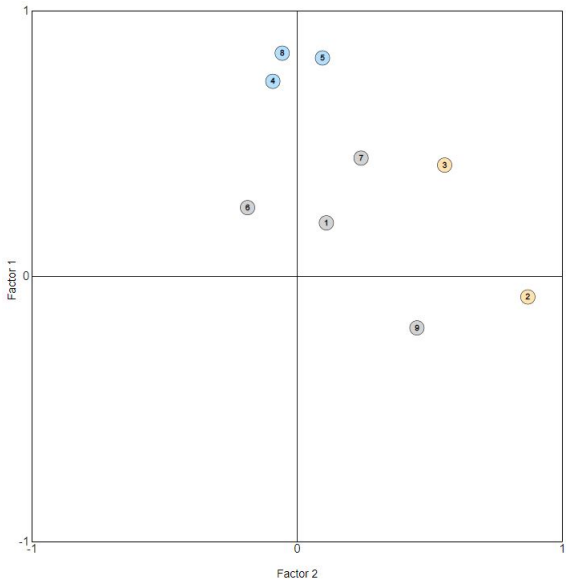

Figure A.6: Comparison of participants preference for factor 1 or factor 2, the blue dots indicate preference for factor 1, the yellow dots indicate preference for factor 2.

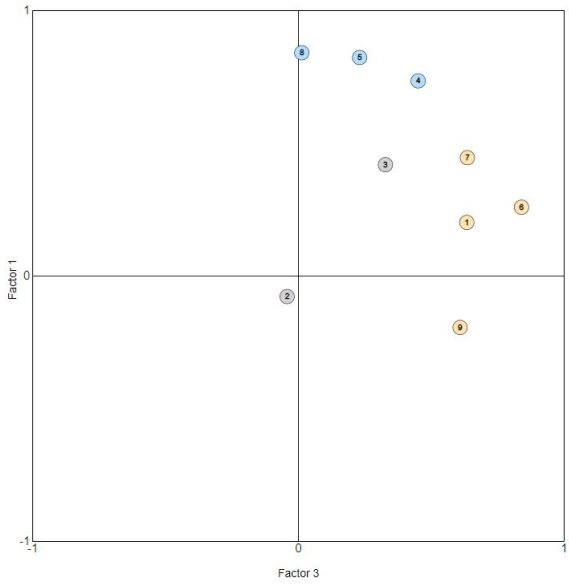

Figure A.7: Comparison of participants preference for factor 1 or factor 3, the blue dots indicate preference for factor 1, the yellow dots indicate preference for factor 3.

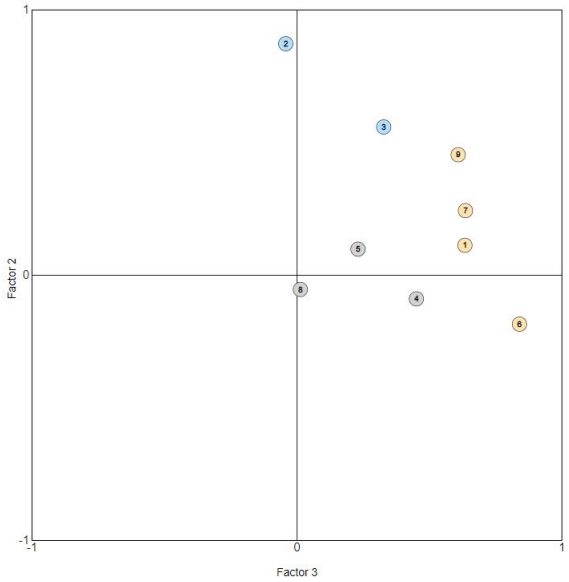

Figure A.8: Comparison of participants preference for factor 1 or factor 2, the blue dots indicate preference for factor 1, the yellow dots indicate preference for factor 2.

As can be seen from the figures, participants do not correlate 100% to one factor, as this would mean they are either exactly on the x-axis or y-axis. Instead, participants are somewhere in the middle, indicating they do correlate partially with one factor.