Integrating Carbon Credits into Sustainable Business Models: A Study on Solarizing Public Water Systems in Lebanon

MSc. Thesis - Final
August 2024

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Abstract

This thesis, conducted in collaboration with the Netherlands Red Cross (NLRC), explores the integration of carbon credits into sustainable business models with a specific focus on solarized public water systems in Lebanon. Given the ongoing multifaceted economic crisis and the critical need for sustainable water access in Lebanon, this research is highly relevant to environmental, social and humanitarian contexts. Despite the global recognition of carbon credits as a viable financial mechanism, there is a gap in understanding how these credits can be effectively integrated into business models in humanitarian contexts. Existing literature provides insights into carbon markets. However, it lacks practical frameworks that address the unique challenges that are potentially faced by humanitarian organizations. This study aims to bridge this gap through developing an innovative business model that incorporates carbon credits to ensure the financial, environmental and social sustainability of the project. To achieve this objective, the research employed a mixed-methods approach, combining both qualitative and quantitative analyses. The primary research question guiding this study was: *How can carbon credits be integrated into an innovative sustainable business model for solarized public water systems in Lebanon?* The research involved a comprehensive analysis of the standards, processes, participant roles, and integrity criteria governing carbon projects. In addition, the technical feasibility of acquiring carbon credits for Lebanon's solarized public water pumping systems in terms of greenhouse gas (GHG) emissions reduction and credits' integrity was investigated. Lastly, the potential business models integrating carbon credits, assessing their associated benefits and risks in terms of stakeholder roles and cash flow were explored, where a final proposal for the recommended business model was provided. The business models were developed following the Business Model Conceptual Framework (BMCF). Primary data collection was conducted through a focus group with the NLRC to gather feedback and assess the benefits and risks of each proposed business model. The Verified Carbon Standard (VCS) was chosen as the certification standard over a 21-year crediting period. Key findings reveal that while small-scale projects present financial challenges, scaling up the solarized locations can achieve significant emissions reductions, making the project financially attractive. The study found that integrating carbon credits can provide a sustainable financial mechanism for solarized water systems in Lebanon, supporting both environmental and economic goals. Key discussion points highlight how the integration of carbon credits into solarized water systems exemplifies humanitarian innovation and innovative business models that combine environmental and social benefits. Organization-specific considerations such as the trade-offs between financial viability and ethical considerations, capacity versus transparency, and the importance of risk-sharing and localization were further discussed. Ultimately, the study recommends developing more robust frameworks for Business Model Innovation (BMI) and Humanitarian Innovation, addressing the unique challenges faced by humanitarian organizations, and providing tailored solutions for integrating innovative business models into their operations. Additionally, recommendations for the next steps to be taken by the organization are also provided.

Keywords: Carbon credits, voluntary carbon markets, sustainable business models, solar energy, public water systems, Lebanon, greenhouse gas emissions, Business Model Innovation (BMI), Humanitarian Innovation (HI), Business Model Conceptual Framework (BMCF), Humanitarian Innovation Business Model Canvas (HIBMC).

Contents

List of Acronyms

BMI	Business Model Innovation
BMC	Business Model Canvas
BMCF	Business Model Conceptual Framework
CDM	Clean Development Mechanism
CO_2eq	Carbon Dioxide Equivalent
ERPA	Emission Reductions Payment Agreement
GHG	Greenhouse Gas
GS	Gold Standard
HI	Humanitarian Innovation
HIBMC	Humanitarian Innovation Business Model Canvas
ICROA	International Carbon Reduction and Offset Alliance
ICVCM	Integrity Council for the Voluntary Carbon Market
LRC	Lebanese Red Crescent
NDC	Nationally Determined Contribution
NLRC	Netherlands Red Cross
PDD	Project Design Document
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
VCS	Verified Carbon Standard
VCM	Voluntary Carbon Market
VVB	Validation and Verification Body
WaSH	Water, Sanitation, and Hygiene

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1 Introduction

This chapter focuses on establishing the foundation of the present research. First, a background on Lebanon's climate pledges and the study's context is provided. Following this, the research problem is formulated and clearly stated. To address this problem, the research objective and research questions are provided. Lastly, a brief overview on the report's structure is provided.

1.1 Background

1.1.1 Lebanon's National Climate Commitments

In 2020, Lebanon submitted an updated Nationally Determined Contribution (NDC) under the Paris Agreement, showcasing its commitment to combating climate change and transitioning towards renewable energy sources. The country pledged to unconditionally reduce its greenhouse gas (GHG) emissions by 20% compared to a business-as-usual scenario by 2030 (UNFCCC, 2020). Additionally, Lebanon aims to meet 18% of its electricity demand and 11% of its heating demand from renewable sources by the same year. These targets highlight the nation's dedication to integrating sustainable practices into its energy sector. However, Lebanon's ambition extends further. With international support, the country has committed to enhancing its GHG emissions reduction target to 31%. In this enhanced scenario, the renewable energy goals are also elevated, with 30% of electricity demand and 16.5% of heating demand projected to be sourced from renewables by 2030 (UNFCCC, 2020).

In a broader context, the economic implications of these climate commitments are substantial. Research indicates that every dollar invested in climate-proofing through mitigation and adaptation measures yields savings of $3.20 (UNDP Climate Promise, 2023). These savings arise from various benefits, including improvements in air quality, health advantages, and the avoidance of severe climate change impacts. Additionally, this investment helps reduce biodiversity loss, highlighting the multifaceted value of committing to robust climate action. Therefore, Lebanon's NDC represents a significant step towards environmental sustainability and illustrates the economic prudence of investing in climate resilience. This dual benefit of environmental and economic gains underscores the importance of supporting Lebanon in achieving its ambitious climate goals, ensuring a greener and more sustainable future for the nation (UNDP Climate Promise, 2023).

1.1.2 Multi-layered Crisis

Since October 2019, Lebanon has been struggling with a multi-faceted economic crisis, which is recognized as the most devastating in its modern history (WB, 2022). Since the mid-nineteenth century, this crisis is even deemed as one of the most devastating economic crises globally. The primary cause of the Lebanese economic crisis started in the 1990's, post the civil war. During that time, the government went in extensive debt to implement reconstruction projects, as a result of the insufficient domestic financial capacity for carrying out these projects. In 2019, the debt reached 151% of GDP as a result of the extensive borrowing. The situation has further exacerbated by the impacts of COVID-19 outbreak, and the massive Port of Beirut explosion in August 2020 (WB, 2022). Between 2019 and 2021, there was a decrease of 36.5% in the GDP per capita. This has caused the World Bank (WB) to reclassify Lebanon in July 2022 and to label it as a lower-middle income country, down from upper middle-income status (WB, 2022).

This acute economic contraction resulted in a compromised institutional capacity to supply basic services (Lebanon WaSH Sector, 2022; UNICEF, 2023). The Lebanese pound's devaluation has led to hyperinflation, which in turn affected imports and increased unemployment. Moreover, the minimum wage's significant devaluation has drastically reduced income. This creates significant challenges for the public across the country to purchase power, which causes deprivation and inhibits access to services driving poverty. One major challenge of the economic crisis lies in accessing safe water for drinking and domestic purposes by all population groups in Lebanon. Maintaining the operability of public water supply systems is at risk, increasing the cost of water provision and reducing revenues. As a result, water establishments are struggling to cover operation and maintenance costs, placing the whole sector at the risk of collapsing (Lebanon WaSH Sector, 2022; UNICEF, 2023). Figure 1 illustrates the various challenges impacting access to water in Lebanon in light of the current multi-layered crisis.

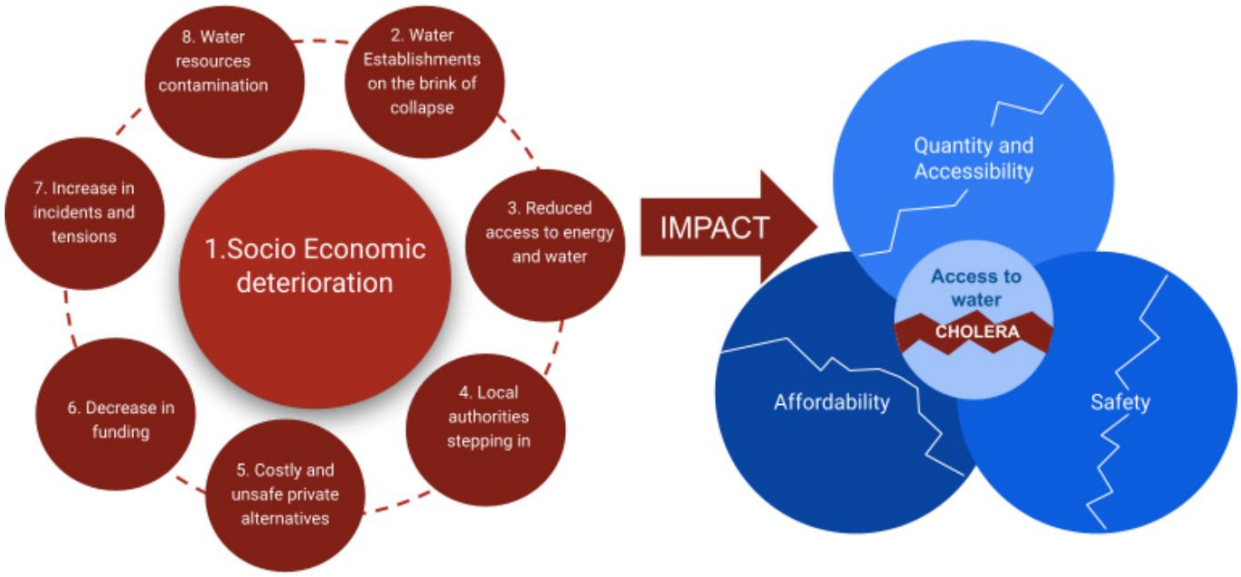

Figure 1: Contextual challenges impacting access to water in Lebanon

(Source: Lebanon WaSH Sector, 2022**)**

The ongoing crisis severely obstructs electricity production, which is the primary power source for water supply systems (i.e., water treatment, water distribution and wastewater treatment) (Lebanon WaSH Sector, 2022; UNICEF, 2023). Limited electricity available from Electricite du Liban, which forms the main energy source for 87% of the water supply systems across Lebanon, has directly decreased the water supply through public networks. With water establishments unable to provide services, some municipalities are intervening, though not officially recognized, and often not equipped to sustain operations, maintenance, or manage financial recovery effectively. A crucial consequence of public service deficiencies is that people are turning to private sources like water trucking, which is largely unregulated, and bottled water. Both sources are susceptible to inflating prices and potentially unsafe water (Lebanon WaSH Sector, 2022; UNICEF, 2023).

In addition, the Water, Sanitation, and Hygiene (WaSH) sector is facing funding constraints, which impacts infrastructure support and service provision, especially for the displaced Syrian population in informal settlements (Lebanon WaSH Sector, 2022; UNICEF, 2023). Inadequate services are fueling inter-communal tensions, with incidents related to water services and increased privatization driving inequality and potentially exacerbating conflict. Figure 2 provides further statistical information about the various population groups in need for water services in Lebanon, which in total represent 2.75 million capita (UNICEF, 2023). Another layer of the crisis lies in the non-operational wastewater treatment plants that cause environmental damage, contaminating water bodies and aquifers. This emphasizes on the urgency of attention and funding to resume operations. Moreover, the latest cholera outbreak in Lebanon poses a serious threat that calls for an immediate action. The Lebanese Ministry of Energy and Water has proposed a "Roadmap to the recovery of the water sector in Lebanon," focusing on stabilizing and financially reviving the sector. However, implementation is slow, and the current rates are insufficient to meet the Water Establishments' operational costs (Lebanon WaSH Sector, 2022; UNICEF, 2023).

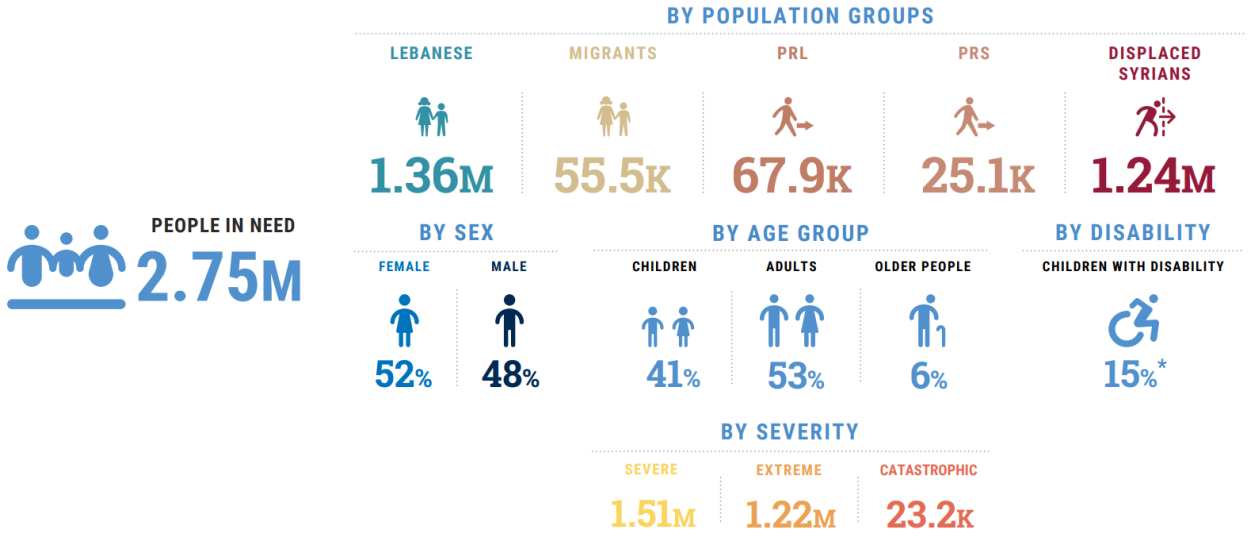

Figure 2: People in need for water services in Lebanon by population group

(Source: UNICEF, 2023)

In response, The Lebanese Red Crescent (LRC) is assisting the impacted Syrian and Lebanese refugee communities in gaining access to safe water and sanitation services by collaborating with the UNICEF-led WaSH cluster and international Red Cross movement partners like the Netherlands Red Cross (NLRC). As a result to the current inoperability of public water systems, pumping stations in various locations in Lebanon are being solarized to ensure that the system operates in better-sustained manner. Water pump solarization refers to the process of installing photovoltaic (PV) panels to generate energy for running an existing pump that either runs on the grid or diesel generators (Healing Waters Media, 2021). For this project, solarization is mainly for diesel pumps.

1.2 Problem statement

Ensuring safe water access for all populations in Lebanon is growing as a persistent challenge, where solarized public water systems have emerged as a potential solution to this pressing issue, due to acute failure of the currently used energy sources. This offers a pathway to clean energy and consistent water supply. However, the sustainable implementation of such initiatives is jeopardized by the reduced availability of humanitarian funds, highlighting an urgent need for more innovative financing mechanisms to ensure the system's sustainability. In this context, carbon credits potentially provide a source of innovative funding, with the potential of bridging financial gaps while supporting environmental sustainability. Despite this promise, significant uncertainty remains in terms of the technical and business feasibility of acquiring carbon credits for the already solarized and future solarization of water systems within the Lebanese context, especially concerning the prospects for long-term project sustainability. This gap presents a crucial area for exploration.

1.3 Research Objective

In collaboration with the NLRC, this research aims to explore the potential of integrating carbon credits into an innovative and sustainable business model for solarized public water systems. Using Lebanon as a case study, this research can contribute to providing an innovative business model for humanitarian funds in developing countries that can be replicated in or easily adapted to similar contexts.

1.4 Research Questions

To achieve the abovementioned objective, the following question was developed as the main research question for this study:

How can carbon credits be integrated in an innovative sustainable business model for solarized public water systems?

Three sub-questions were formulated to answer the main research question as follows:

1. What standards, processes, participant roles, and integrity criteria govern carbon projects throughout their lifecycle?
2. What is the technical feasibility of acquiring carbon credits for Lebanon's solarized public water pumping systems in terms of GHG emissions reduction and credits' integrity?
3. What are the potential business models integrating carbon credits for solarized public water systems, and what are their associated benefits and risks in terms of stakeholder roles and cash flow?

1.5 Report Structure

After the introduction chapter, this report progresses to the literature review, covering key notions such as carbon markets, business model innovation, and humanitarian innovation. The third chapter details the research design, strategy, materials, methods, and data analysis. Chapter four proceeds to present the key findings of the study, while the fifth chapter provides the discussion where these findings are reflected upon from various lenses. Lasty, the conclusion provides the main takeaways of the research and recommendations for future research are presented.

2 Literature Review

This chapter provides an overview of the key concepts and contextual elements that underpin this research. It mainly covers a brief review of carbon credits, business models and business model innovation, and humanitarian innovation. In addition, the overarching conceptual framework that was used in this research is presented in the last section. This chapter aims to establish a well-rounded understanding of the relevant theories and practices, setting the foundation for the subsequent research activities.

2.1 Overview on Carbon Credits

2.1.1 Carbon Markets and Credits

With the global efforts to mitigate climate change, carbon emissions reduction has been recognized as a commodity that can be traded. This recognition started in 1997 when the Kyoto Protocol was signed. The Protocol was the starter for establishing greenhouse gas (GHG) emission trading (Newell et al., 2013). To be able to understand GHG emission trading, two basic definitions should be established: carbon markets and carbon credits. Carbon markets are pricing mechanisms for governments and non-state actors to trade GHG emission credits (UNEP, 2024), while carbon or emission credits refer to certificates issued under a certain crediting standard against a mitigation outcome that meets relevant criteria (Michaelowa et al., 2022). One ton of carbon dioxide or the equivalent amount of a different GHG (CO2e) accounts for one tradable carbon credit. Carbon credits can be issued for an amount of CO2e that is reduced, sequestrated, or avoided. This reduction is also referred to as 'offset' (UNEP, 2024); Broekhoff et al., 2019).

Carbon markets generally aim at achieving climate actions through the implementation of cost-effective climate actions. The 2021 Emission Gap Report by the United Nations Environmental Program (UNEP) concluded that 40-60% cost savings can be achieved in 2030 under full utilization of market mechanisms (UNEP & UNEP-CCC, 2021). Carbon markets are divided into compliance and voluntary markets. Compliance market involves national and regional trading schemes where participants join and trade to fulfil and obligation established by a regulatory body (e.g., targets of Nationally Determined Contributions (NDCs)). On the other hand, participants in the voluntary carbon market (VCM) involves non-state actors (e.g., companies) that seek the achievement of voluntary targets without any formal obligations. For instance, a company set a target of carbon neutrality (UNEP, 2024).

2.1.2 Crediting Schemes

The demand for carbon credits has rapidly increased as sectors are relying more on the VCM to offset their emissions as part of their emission reduction objectives (Pudasaini et al., 2024). Protocols on how to define, establish and maintain a carbon credit have been developed to better manage the production and supply of these credits. In all the sectors, a number of carbon offset standards, often referred to as crediting schemes, have been created internationally to incentivize the participation in practices that reduce carbon emissions. Both national (e.g., the Emission Reduction Fund (ERF) in Australia) and international (e.g., Verified Carbon Standard (VCS), Gold Standard (GS), Clean Development Mechanism (CDM), Article 6.4 Mechanism) crediting schemes can be used to categorize the standards. Projects with credits from the national and international standards either participate in the compliance (e.g., CDM) or voluntary (e.g., VCS)

market (Pudasaini et al., 2024). Different market segments have been interacting since the early 2000's when they emerged and have continued to interact at a higher rate since the Paris Agreement (Michaelowa et al., 2022). Figure 3 provides an overview of these interactions.

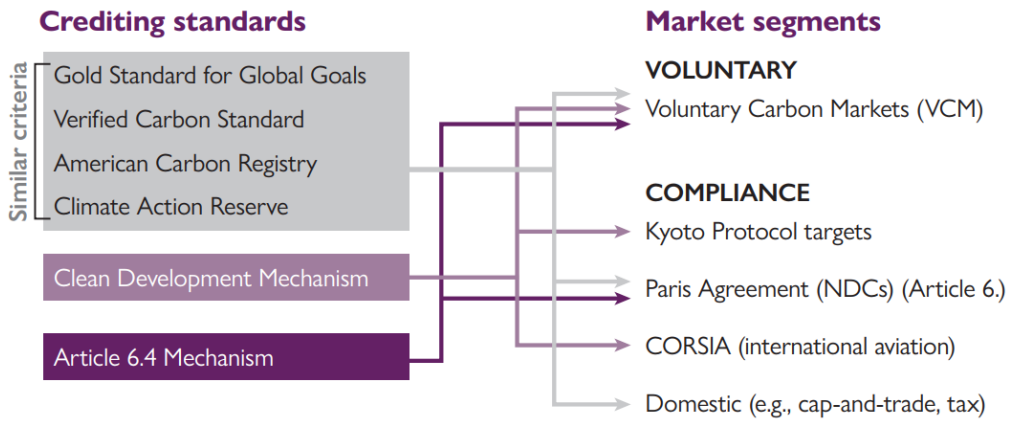

Figure 3: Crediting standards/programs and market segments

(Source: Michaelowa et al., 2022)

2.1.3 Carbon Credits Integrity

Under the carbon markets, an essential component is the credit's integrity, also referred to as quality. A carbon offset's main concept is that it can replace the reductions in greenhouse gas emissions that an organization would have made on its own. For this to be true, using carbon offset credits must benefit the environment as least as much as reducing an organization's carbon footprint would have. When the term "quality" is used to describe a carbon offset credit, it refers to the degree of assurance that using the credit would uphold this fundamental idea. Although the idea seems simple, it might be challenging to ensure in practice (Broekhoff et al., 2019b). There are two primary components in quality. A quality offset credit must, first and foremost, be equivalent to at least one metric ton of additional, long-term, and unreported CO_2 emission removals or reductions. Secondly, an activity that does not substantially contribute to environmental or social damages should be the source of a quality offset credit (Broekhoff et al., 2019b) .

The Core Carbon Principles (CCPs) serve as an international standard for high-integrity or high-quality carbon credits, establishing strict criteria regarding transparency and sustainable development (ICVCM, 2024) . Aligned with recent scientific advancements and best practices, the CCPs offer a reliable method for recognizing high-integrity carbon credits that effectively contribute to measurable climate impact. These CCPs were formulated through collaboration among various entities across the VCM. Ten main CCPs are developed and categorized as relevant to emission impact, governance, and sustainable development. Figure 4 presents the main principles under each category (ICVCM, 2024).

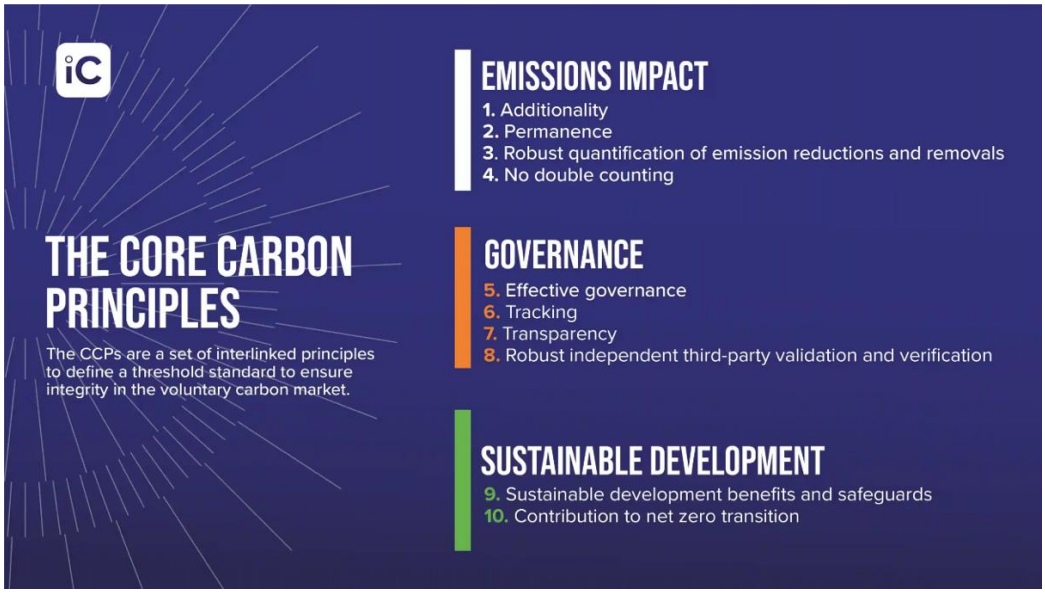

Figure 4: The Carbon Core Principles (CCPs)

(Source: ICVCM, 2024)

2.1.4 Critiques of Voluntary Carbon Markets

VCMs have drawn significant attention as a potential mechanism to drive private sector investment in carbon reduction projects. However, the efficacy and integrity of VCMs have been subjects of substantial critique in the academic and policy literature. Key critiques focus on issues of greenwashing, the reliability of carbon credits, and broader ethical and economic implications.

2.1.4.1 Greenwashing and Credibility Issues

One of the most pervasive criticisms of VCMs is the risk of greenwashing (Miltenberger et al., 2021), which occurs when organizations exaggerate their environmental efforts to appear more sustainable. This is particularly problematic at the system level, where the collective impact of carbon credits can be overestimated (ISDA, 2024). For instance, companies may claim to achieve net-zero emissions primarily through offsets without making substantial changes to their operational emissions. Such practices can undermine the credibility of VCMs and lead to skepticism among stakeholders (ISDA, 2024). This not only affects individual companies but also erodes trust in the entire market mechanism.

At the individual credit level, greenwashing can occur when the projects that generate VCCs fail to deliver the claimed emissions reductions (ISDA, 2024). Issues such as lack of additionality, inaccurate baseline assumptions, and leakage contribute to this problem (Miltenberger et al., 2021). Additionality is a critical criterion for VCCs, ensuring that the emission reductions are genuinely incremental to what would have happened in the absence of the project. However, many projects have been criticized for claiming reductions that would have occurred anyway, thereby alleviating the environmental integrity of the credits. For example, the Guardian exposed allegations against South Pole, a carbon credit developer, which sold credits from projects with weak evidence of preventing deforestation (ISDA, 2024).

2.1.4.2 Market Fragmentation and Standardization Issues

The current lack of standardized methodologies and regulatory oversight across VCMs contributes to variability in credit quality and increases the risk of greenwashing (Dawes et al., 2023). This fragmentation can lead to confusion and mistrust among market participants, as it becomes challenging to assess the true environmental impact of different credits. Efforts by organizations like the Integrity Council Voluntary Carbon Market (ICVCM) and the International Carbon Reduction and Offset Alliance (ICROA) aim to address these issues by providing guidelines and best practices for high-integrity credits (Dawes et al., 2023). However, the implementation and widespread adoption of these standards remain ongoing challenges.

2.1.4.3 Ethical Concerns

Beyond the technical and regulatory issues, there are significant ethical concerns associated with VCMs. The primary ethical risk is that VCMs may allow companies to continue high-emission activities while appearing to take climate action, thus delaying the necessary transition to low-carbon practices. This could lead to a moral hazard where the availability of offsets reduces the pressure on companies to reduce their actual emissions (Battocletti et al., 2024). Additionally, there is concern that the benefits of carbon offset projects do not always reach local communities, especially in developing countries where many projects are implemented.

2.1.4.4 Impact on Global Emissions

Critics argue that while VCMs can facilitate emissions reductions in specific projects, they do not always contribute to a net decrease in global emissions. This is because the reductions achieved through VCMs can be offset by continued or increased emissions elsewhere, particularly if companies use carbon credits as a way to avoid making deeper systemic changes to their operations (ISDA, 2024). This critique underscores the importance of integrating VCMs with broader regulatory frameworks and ensuring that offsets are used as a supplementary measure rather than a primary strategy for achieving climate goals. By addressing these critiques and implementing stringent standards, VCMs can enhance their credibility and effectiveness as a tool for global decarbonization. Ensuring transparency, enforcing rigorous verification processes, and fostering market standardization are essential steps towards building a robust and trustworthy VCM ecosystem.

2.1.5 Renewable Energy and Carbon Offset

A significant contribution to the rapid recognition of the carbon market is attributed to renewable energy sectors. In 2020 and 2021, they accounted for the largest and second largest volumes of transactions in the VCM, respectively. Moreover, renewable energy projects predominate the CDM projects (Lo, 2023). Implementing renewable energy technologies in water systems improves accessibility, affordability, and safety, which collectively promote water security (Ferroukhi et al., 2015). One intervention could be shifting from diesel generators to solar pumps, which cuts emissions. Besides the social benefits, this highlights the environmental benefits associated with adopting renewable energy in water supply systems (Millenium Water Alliance, 2024). To further advance the effectiveness and sustainability of such initiatives, understanding the business models associated with WaSH-related renewable energy emission reduction projects in the humanitarian context is crucial.

2.2 Business Models

2.2.1 Definition

A review of the existing literature on BM by Novak (2014) revealed that there is a lack of consensus on a universally accepted definition of 'business model'. The various perspectives and conceptualization approaches adopted by the literature tackling this concept contribute to a fragmented understanding, creating a 'cognitive gap'. This gap is highly attributed to most of the empirical studies in the literature being context-dependent and limited scope. This creates challenges for applications in this field, whether for research or in practice. A list of BM definitions that are relevant to the scope of the present study are presented in Table 1.

Table 1: Selected business model definitions that are most relevant to the current study

(Source: Novak, 2014)

Source	Definition
Zott & Amit, 2007 (93 WoS citations)	Business model is considered as 'the structure, content, and governance of transactions between the focal firm and its exchange partners, and represents a conceptualization of the pattern of transactional links between the firm and its exchange partners' (p. 183).
Zott & Amit, 2010 (78 WoS citations)	They conceptualize a firm's business model as 'the system of independent activities that transcends the focal firm and spans its boundaries. The activity system enables the firm, in concert with its partners, to create value and also to appropriate a share of that value' (p. 216)
Casadesus-Masanell & Ricart, 2010 (59 WoS citations)	A business model refers to 'the logic of the firm, the way it operates andhow it creates value for its stakeholders (p. 196). It is a reflection of the firm realized strategy' (p. 204)

Inspired by the definitions in Table 1, the following definition of a BM is developed to better address the scope of this research:

"A business model is a structured framework outlining how an organization, along with its partners, manages the flow of resources and value."

The defined BM encompasses a network of interconnected activities that extend beyond the organization's boundaries, focusing on the management and distribution of value. The value in this case refers to the carbon credits and cash flow. This model also delineates the roles and relationships among various parties involved in the project, ensuring that value is effectively and equitably shared.

2.2.2 Business Model Canvas

The Business Model Canvas (BMC) is a strategic management tool that provides a visual framework for developing, describing, and analyzing business models and was created by

Osterwalder & Pigneur, 2010). It is particularly well-suited for market-driven entrepreneurs who need to adapt quickly to changing market conditions and technological advancements (Murray & Scuotto, 2015). The BMC is divided into nine building blocks, each representing a crucial element of a business model. These building blocks collectively provide a comprehensive view of how a company creates, delivers, and captures value (Murray & Scuotto, 2015; Osterwalder & Pigneur, 2010).

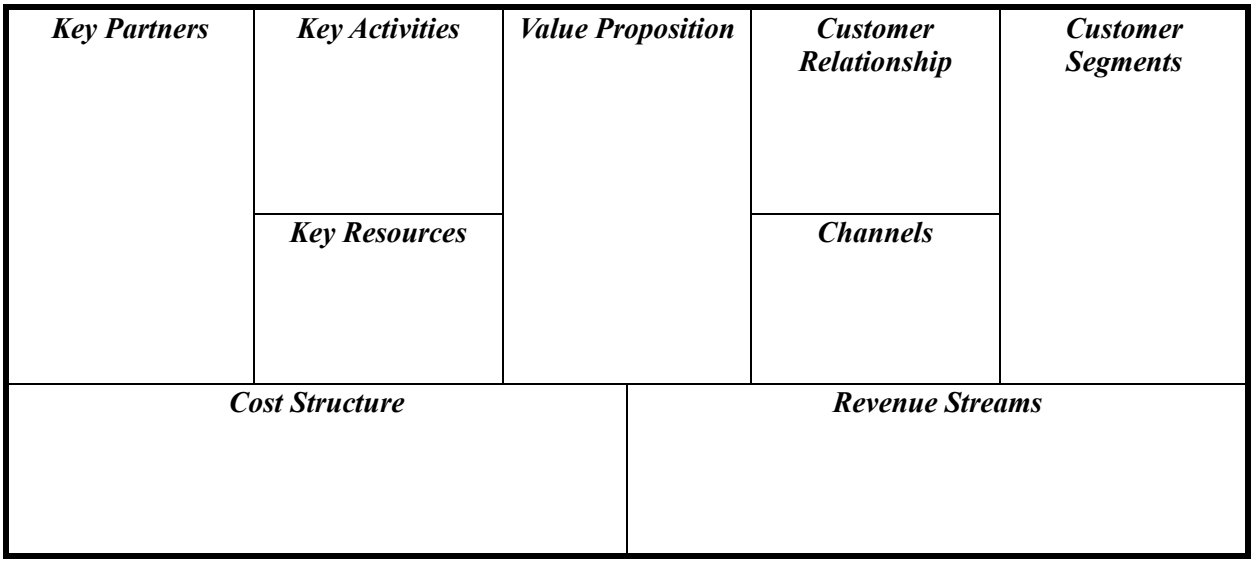

Figure 5: Business model canvas

(Adapted from: Osterwalder & Pigneur, 2010)

2.2.2.1 Value Proposition

The value proposition defines the unique benefits and solutions a business offers to its customers (Murray & Scuotto, 2015). It addresses customer needs and differentiates the company from its competitors. A well-defined value proposition is essential for attracting and retaining customers by clearly communicating what makes the company's product or service unique and valuable (Osterwalder & Pigneur, 2010).

2.2.2.2 Customer Segments

Identifying and understanding different customer segments is critical for tailoring products and services to meet their specific needs (Murray & Scuotto, 2015; Osterwalder & Pigneur, 2010). By segmenting the market, businesses can better target their marketing efforts and develop offerings that resonate with distinct groups of customers.

2.2.2.3 Channels

Channels describe how a company delivers its value proposition to its customers. This includes various marketing and distribution channels, such as online platforms, physical stores, and direct sales teams (Murray & Scuotto, 2015). Effective channel management ensures that customers can access the product or service conveniently and efficiently.

2.2.2.4 Customer Relationships

Building and maintaining strong customer relationships is essential for customer retention and loyalty. Different types of customer relationships include personal assistance, self-service, automated services, and communities (Murray & Scuotto, 2015). The BMC helps businesses plan and manage these relationships to enhance customer satisfaction and loyalty.

2.2.2.5 Revenue Streams

Revenue streams represent the various ways a company generates income from its customer segments. This could include sales, subscription fees, licensing, and other methods (Murray & Scuotto, 2015). Understanding and optimizing revenue streams is crucial for the financial health and sustainability of the business.

2.2.2.6 Key Resources

Key resources are the assets required to deliver the value proposition, reach markets, maintain customer relationships, and earn revenues (Murray & Scuotto, 2015). These resources can be physical, intellectual, human, or financial. Identifying and managing key resources effectively is vital for operational efficiency and growth.

2.2.2.7 Key Activities

Key activities are the essential actions a company must take to operate successfully. These include production, marketing, sales, and customer service (Murray & Scuotto, 2015). The BMC helps businesses identify and prioritize these activities to ensure they are aligned with their strategic goals.

2.2.2.8 Key Partnerships

Key partnerships involve collaborations with external entities that help the company achieve its objectives (Murray & Scuotto, 2015). This can include suppliers, distributors, technology partners, and other strategic alliances. Effective partnerships can enhance capabilities, reduce risks, and accelerate growth.

2.2.2.9 Cost Structure

The cost structure outlines the major costs involved in operating the business. This includes fixed and variable costs, such as salaries, rent, production costs, and marketing expenses (Murray & Scuotto, 2015). Understanding the cost structure helps businesses manage expenses and improve profitability.

The BMC offers several advantages for entrepreneurs and established businesses. First, the BMC provides a comprehensive holistic overview of the business model, facilitating a better understanding of how different components interact and impact overall performance (Murray & Scuotto, 2015). Second, the visual and modular format of the BMC allows for easy adjustments and iterations, making it ideal for businesses operating in dynamic and competitive environments. Third, the BMC helps businesses stay focused on delivering value to their customers through emphasizing customer segments, relationships, and channels. Lastly, it ensures that all aspects of the business model are aligned with the company's strategic goals and value proposition (Murray & Scuotto, 2015).

2.3 Business Model Innovation

Business model innovation (BMI) is an emerging field that has increasingly concerned various scholars and practitioners. How an organization creates and captures value by making novel core changes to key elements or architecture of an existing BM is referred to as BMI (Huang & Ichikohji, 2023). It is deemed as an innovative replacement or complementary and is most relevant to the way an organization restructures its business. BMI also considers how successfully the business is implemented. Organizations applying BMI have higher potential to adapt to rapid changes in market conditions and thereby overcome business environment volatility (Huang & Ichikohji, 2023). This concept extends beyond traditional product and process innovation by emphasizing the holistic redesign of a company's value creation, delivery, and capture mechanisms (Clauss, 2017).

To effectively measure and implement BMI, it is crucial to understand the various dimensions and sub-constructs that comprise this multifaceted concept. BMI is often conceptualized through three primary dimensions: value creation, value proposition, and value capture. Each of these dimensions encompasses several sub-constructs that can be measured and assessed to gauge the extent and impact of innovation within a business model (Clauss, 2017). Table 2 provides a detailed breakdown of these dimensions and their respective sub-constructs, highlighting key items that are identified as most relevant to the current project.

Table 2: Measuring BMI

(Adapted from: Clauss, 2017**)**

Dimension	Sub-construct	Item
Value Creation Innovation	New capabilities	• Employees constantly receive training to develop new competences. • Employees have up-to-date knowledge and capabilities. • Constantly reflect on which new competencies need to be established to adapt to changing market requirements.
Value Proposition Innovation	New Offerings	• Products or services are very innovative in relation to our competitors.
	New Customers and Markets	• Regularly take opportunities that arise in new or growing markets.
Value Capture Innovation	New Revenue Models	• Recently developed new revenue opportunities • Do not rely on the durability of existing revenue sources.

2.4 Humanitarian Innovation

Among the growing body of literature that investigates various aspects of humanitarian innovation (HI), some articles define this concept without specifically contextualizing it to being 'humanitarian' (Bruder & Baar, 2024). However, the largest donor, the United States Agency for International Development (USAID), refers to this kind of innovation as 'novel business or

organizational models, operational or production processes, or products or services that lead to substantial improvements (not incremental “next steps”) in addressing humanitarian challenges.’ This can be perceived as the only definition that integrates humanitarian and development approaches. Innovative business strategies to bring HIs to scale can be categorized as a kind of humanitarian BMI (Bruder & Baar, 2024). It is worth mentioning that BMI is the least abundant type of innovation in the available academic literature on HI (Bruder & Baar, 2024). Moreover, there is quite limited or almost no literature on humanitarian BMI in WaSH applications that integrate carbon credits.

Despite the limited academic research body in business modelling in HI, there are efforts that practitioners are exerting to contribute to this emerging research area. Figure 6 provides a visualization of the humanitarian business model canvas (HIBMC) that was developed by Something Meaningful Consulting, which is a humanitarian and sustainability consultancy (Baizan, 2022). There are several key differences between the HIBMC and the BMC provided in section 2.2.2. These are reflected in the HIBMC focus on humanitarian and social impact rather than commercial-oriented goals. The HIBMC explicitly includes sections for defining the problem being addressed and the solution being offered, highlighting the importance of problem-solving in humanitarian contexts. Moreover, the impact section emphasizes the value offered to people experiencing the problem, focusing on the social impact rather than just customer value. The HIBMC also differentiates between users (those experiencing the problem) and clients (those willing to pay to address the problem), acknowledging the dual focus on beneficiaries and funders in humanitarian efforts. In addition, the traditional BMC's "Unique Value Proposition" is reframed as "Unique Selling Point" in the HIBMC, emphasizing what makes the solution non-replicable and distinct in the context of humanitarian aid. The HIBMC further includes a section for "Negative Externalities," asking how the solution impacts the environment, partners, and users, which is crucial for ensuring ethical considerations in humanitarian projects. While the traditional BMC may focus on key performance indicators related to financial success, the HIBMC includes "Success Metrics" to ensure that the model delivers all dimensions of value, including social impact. Considering the visual representation, the traditional BMC is structured around nine building blocks, while the HIBMC adapts these elements to include additional or modified sections to better suit humanitarian and social innovation contexts, such as problem definition, impact, and negative externalities.

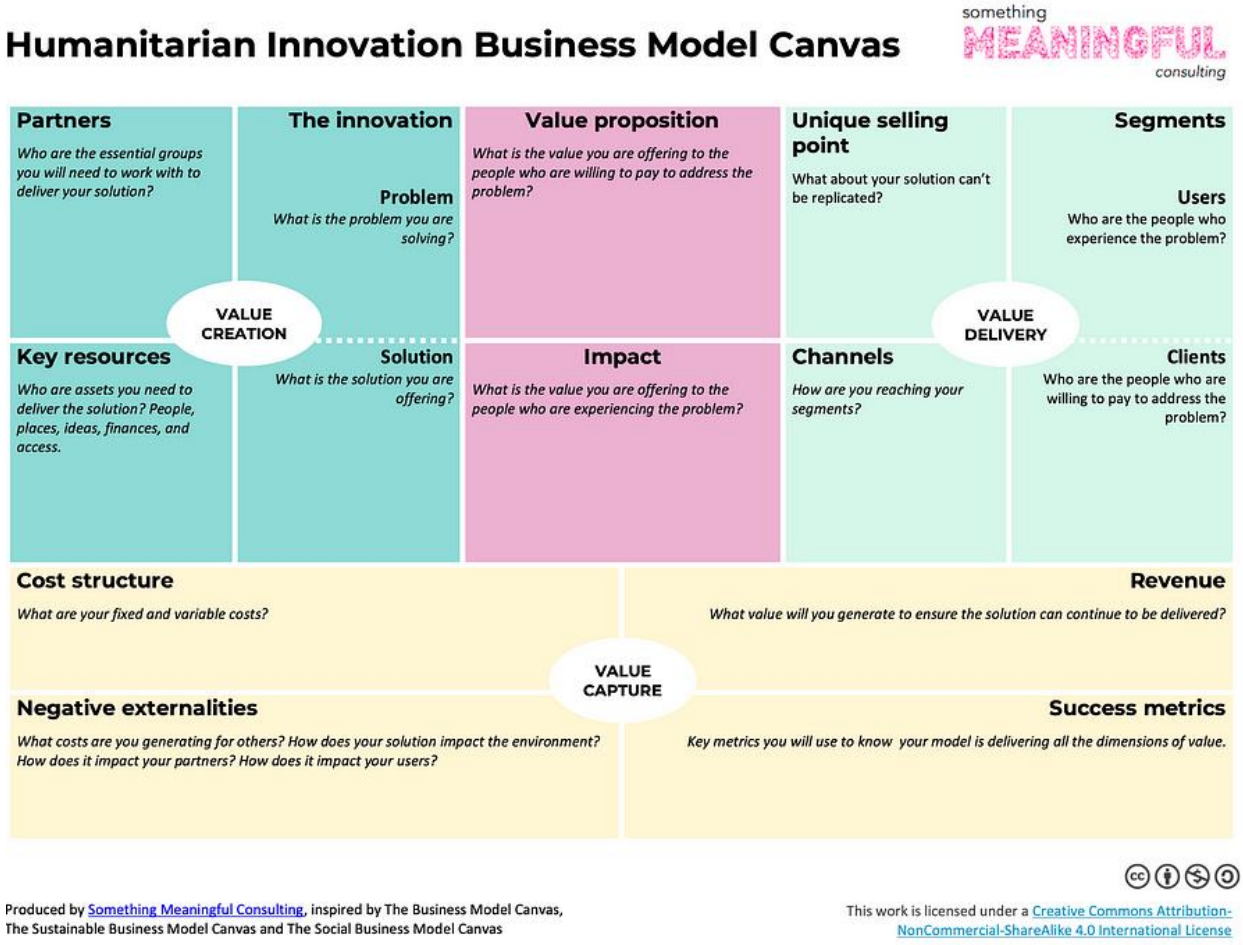

Figure 6: Humanitarian innovation business model canvas (HIBMC)

(Source: Baizan, 2022)

2.5 Business Models Conceptual Framework

Generally, a conceptual framework aims to describe existing practice, prescribe future practice, and define key terms and fundamental issues (Lambert, 2008). For the current study, the Business Model Conceptual Framework (BMCF) developed by Lambert (2008) was followed, as it is a generic framework for developing any kind of BM. This allows for a high level of flexibility where the framework can be tailored to any kind and application of BM. Thus, with the diversified and multifaceted nature of this study, this framework was found to be a good fit. As presented in Figure 7, the five main levels involved in the BMCF are:

1. Definition of business modelling (as mentioned in section 2.2)
2. Objectives of business modelling
3. Qualitative characteristics, and elements
4. Recognition and measurement
5. Business model representation

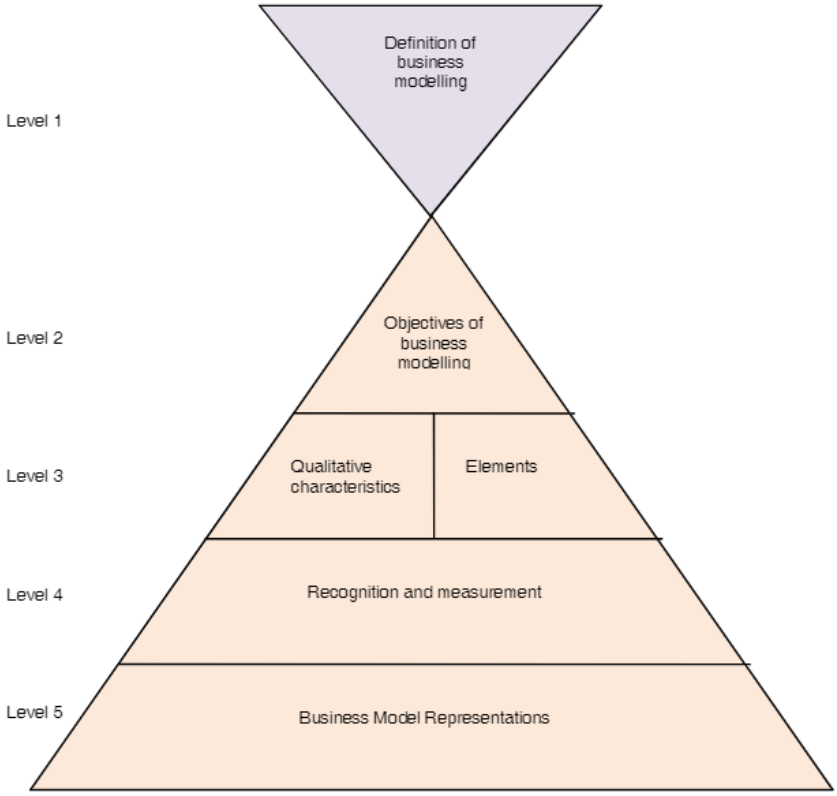

Figure 7: Business Model Conceptual Framework (BMCF)

(Source: Lambert, 2008)

Figure 8 provides further information on how the BMCF is operationalized and contextualized to this research.

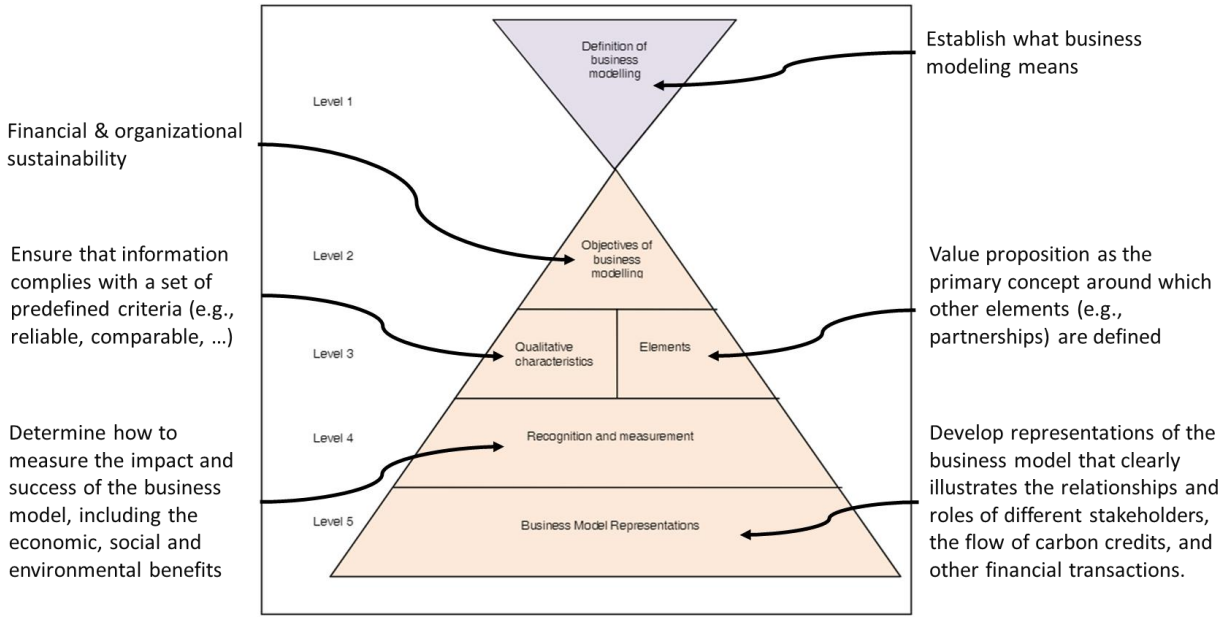

Figure 8: Operationalizing the Business Model Conceptual Framework (BMCF) within the scope of this study

3 Research Design

This research is designed following the systematic approach provided by Verschuren and Doorewaard (2010). This book states that there are two types of research: theory-oriented and practice-oriented research. As defined by Verschuren and Doorewaard (2010), practice-oriented research aims to offer insights and data that can support an effective intervention aimed at altering a real existing situation. Interventions occur when corporate and non-profit organizations, as well as local, regional, national, or international governments, execute policies that they have created. Thus, this study is considered a practice-oriented, and thereby the relevant approach in design and execution was followed as presented in this chapter. The chapter thoroughly presents the methodological framework through which the study was performed. Moreover, the main concepts involved in this research are defined. The research strategy, materials and their accessing method, and data analysis are also provided in detail. Lastly, the ethical considerations and study limitations are presented.

3.1 Research Framework

The first step in the adopted approach is to identify the research framework based on seven main steps as shown in the following sections.

3.1.1 Research Objective

As mentioned in section 1.3, the main objective of this study is to investigate the feasibility of incorporating carbon credits into a novel and sustainable business model for solar-powered water systems.

3.1.2 Research Object

The central focus of this study is the potential integration of carbon credits into a sustainable business model for solarized public water systems in Lebanon. This encompasses examining the feasibility and sustainability of using carbon credits as a financial component within this specific context. Thus, the study only involves systems in Lebanon as the case study.

3.1.3 Nature of Research Perspective

Since the solarization of public water systems is already taking place in Lebanon as a solution to the implications of the multi-layered crisis on water provision, this research focuses on how these systems can operate sustainably and efficiently through an innovative business model. Thus, this research looks from a design perspective, in the sense that it should help the decision making and implementation of the project progress in the right direction.

3.1.4 Sources

This research is conducted based on primary and secondary data sources. Table 3 provides an overview of the primary and secondary data sources that were used throughout this study.

Table 3: Sources of research perspective

Key Concepts	Sources	
	Primary	**Secondary**
Solarization of Water Systems	-	Project design documents, case studies and grey literature on similar projects globally implemented.
Carbon Markets and Carbon Offset	-	Documents from carbon offset standards, official documents from UNFCCC[1] related to CDM and Article 6 of the Paris Agreement, review documents on the relevance of different standards to the system under study.
BMI	Designed business models for similar projects by the Red Cross, focus group with NLRC, interview with potential investor	Academic literature on business model development, sustainable business models for humanitarian projects, BMI, and stakeholder analysis to identify the key actors within the business models.

3.1.5 Research Framework

After defining the sources, steps five and six involve formulating the research framework with a schematic presentation which is essential to provide an overview of the activities to be performed throughout the research project. As shown in Figure 9 , the research is conducted through the following phases:

(A) Analyzing the literature and documents for the concepts as provided in Table 3.
(B) The abovementioned analysis result in developing a concrete conceptual model for this research as well as the identification of the offset methodology that is most suitable for the study.
(C) Through the conceptual model and the methodology selected, the feasibility of the project to acquire carbon credits, as well as potential business models' development and comparison is carried out.
(D) Lastly, the main conclusion of the project is a recommendation for the most suitable business model.

[1] UNFCCC: United Nations Framework Convention on Climate Change

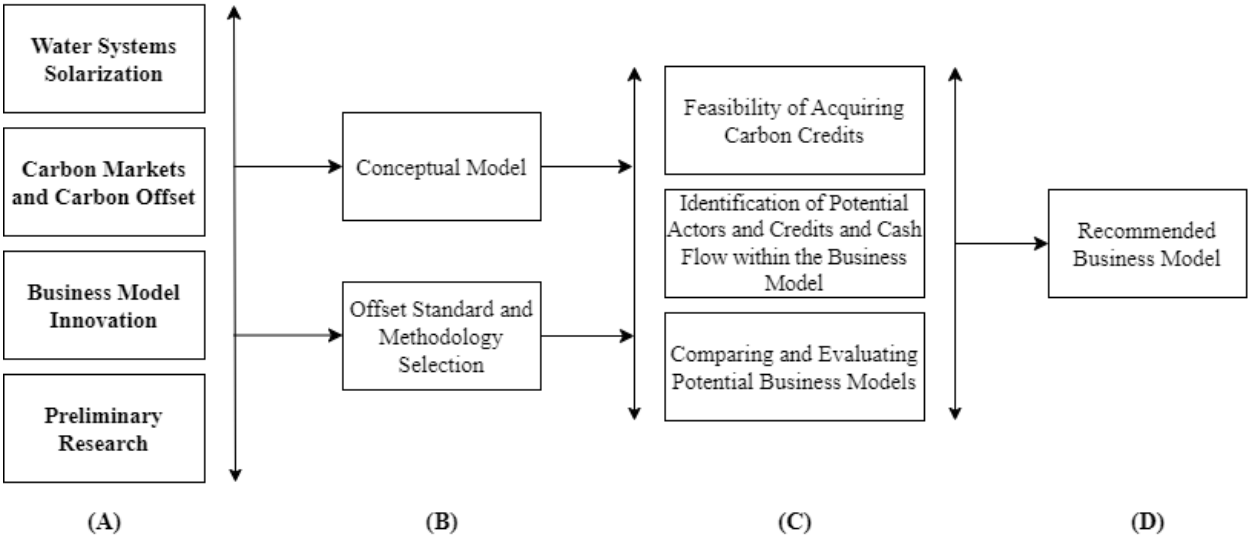

Figure 9: Research Framework[2]

3.1.6 Iteration

With the current givens for this research, there is no need for iterations or changes to be made.

3.2 Research Questions

For this research, the main question and sub-questions were formulated as shown in section 1.4.

3.3 Defining Concepts

Aligning with the scope of this study, the key concepts (shown in Table 3) are defined as follows:

Solarization of Water Systems: this mainly focuses on public water systems being powered by solar energy for pumping.

Carbon Markets and Carbon Emissions Reduction: expanding on the main definitions that were provided in section 2.1.1, the focus of this study is on the VCM and its relevant standards and methodologies that are suitable to be used for this case.

Business Model Innovation: this combines the notion of BMI as defined in section 2.2, while also taking into consideration the nature of the project being carried out by a humanitarian organization (i.e., LRC and NLRC).

3.4 Research Strategy

This research adopts a depth approach, where the focus is in thoroughly analyzing the available data and developing a business model for the context of Lebanon. This implies the adoption of small-scale approach that results in knowledge that can be generalized to a limited extent. In other words, this can be considered as a case study. However, this approach enables the achievement of elaboration, complexity, and soundness of the results, and thereby minimizing the risk of uncertainties. This work can be considered of mixed nature since the data that was collected and

[2] Double-headed vertical arrows stand for the ‘confrontation' and the horizontal single-headed one stands for 'from this will be concluded or deduced that'

provided as results for the different research questions involve quantitative and qualitative data. Furthermore, it can be deemed as a mix of empirical and desk research since some data was provided for the specific project under investigation while other data was collected from the available literature.

3.4.1 Research Unit Definition and Selection

The main research units for this study includes the five solarized pumping stations in Lebanon, namely: Debbabiyeh, Chackdouf, Alma, Halba Akkar, and Hawaych Akkar. All these pumping stations are located in the two northern-most districts in Lebanon Akkar and North Lebanon (also known as Liban-Nord in French) as shown in Figure 10.

Figure 10: Lebanon's map with the districts' names

(Source: GISGeography, 2024)

The abovementioned research units were selected as these are the locations of the already solarized pumps that are directly funded by the NLRC, for which the technical and business feasibility is assessed through this research using the data shown in Table 4. It is good to note that Lebanon has around 270 locations operated by the LRC. However, no data about these locations is available for the current study.

Table 4: Available data about the research units

Location	Pump Power (HP)	Power Requirement (kW)	Cost (USD)
Alma	50	70.3	95,000
Chaqdouf	3.5	5.1	9,412
Debbabiye	25	44.3	47,000
Halba & Howeysh Akkar	4	7.6	28,000

3.4.2 Research Boundaries

Setting clear research boundaries is essential to maintain focus and manageability in the study. The boundaries of the current research can be defined as follows:

- **Geography**: the research only focuses on Lebanon as the case study.
- **Scope**: the research only focuses on the integration of carbon credits within a business model for solarized public water systems, without considering other aspects that are not related to carbon credits (e.g., water system management or alternative renewable energy financing mechanisms).
- **Data availability**: various assumptions had to be made, especially while calculating the carbon offset from solarization, due to data availability constraints. This adds to the uncertainty of results and limitations of the study.
- **Stakeholders**: for developing the business models, focus group discussion was used as a source of data collection. The kind of stakeholders that could be reached was limited to representatives from the NLRC who had expertise in business development and WaSH interventions.
- **Time**: this research was completed and finalized in July, 2024, which puts constraints on the data collection and data analysis and thereby the results of the study.

3.5 Research Material and Accessing Method

To operationalize the abovementioned main concepts, research materials and their accessing method are essential to define (Vershuren & Doorewaard, 2010). Building on what was provided in Table 3, this section provides more insights on how the different sources were accessed. Since the research questions have different natures, both data and knowledge sources are necessary for answering these questions. The main types of sources can be identified as follows:

- **Reality**: through continuous consultation and direct communication with the NLRC regarding the project design and feedback about the proposed models
- **Documents**: available documentation on similar projects, methodologies for offset calculation, similar implemented humanitarian projects
- **Literature**: framework for developing and comparing business models, review papers on these frameworks, relevant theories (e.g., BMI)

The accessing methods for these data and knowledge sources includes search method and content analysis. First, search was conducted in an effective way using relevant keywords on reliable data

bases. For instance, Scopus is the main database for academic literature, while standards like Verra and Gold Standard databases were used to access relevant project documents. Following this, the content of the acquired documents and literature was qualitatively analyzed. Reality data was also accessed through content analysis. Table 5 provides further information on the required information, source, and sourcing method for each research question.

Table 5: Research Material and Accessing Method

Research Question	Required information	Source	Accessing Method
What standards, processes, participant roles, and integrity criteria govern carbon projects throughout their lifecycle?	Existing crediting standards and methodologies, carbon credits certification process, most relevant credit quality criteria, status quo of the international carbon market	Documents	Search method & content analysis
What is the technical feasibility of acquiring carbon credits for Lebanon's solarized public water pumping systems in terms of GHG emissions reduction and credits' integrity?	Data for offset calculation (activity data and emission factors), relevant data for assessing the potential credits' quality	Reality	Content analysis
		Literature	Search method & content analysis
		Documents	Search method & content analysis
What are the potential business models integrating carbon credits for solarized public water systems, and what are their associated benefits and risks in terms of stakeholder roles and cash flow?	Business innovation theories, frameworks for business models development and evaluation, stakeholder theories	Literature	Search method & content analysis
	Business models used in similar projects by other humanitarian organizations	Documents	Search method & content analysis
	Data and information from the relevant stakeholders NLRC on their perception of the different identified potential business models	Reality (i.e., focus group)	Content analysis

3.6 Data Analysis

This section presents the methodology that was followed for interpreting the data and information acquired based on the abovementioned methodology. The validation of findings and the analytical framework for the study are also presented.

3.6.1 Method of Data Analysis

A mixed-methods approach involving both qualitative and quantitative strategies was adopted in this research. The qualitative analysis includes a thorough review of literature, documents, and project reports to establish a robust foundation for the study. This process involves content analysis

to examine the textual data and derive relevant information related to carbon market mechanisms, certification processes, quality criteria, and potential business models. To select the most suitable model, a focus group with the NLRC was conducted to gather their perceptions and feedback on the proposed business models, following the design recommended by Krueger & Leader (2002). The focus group comprised five participants from the NLRC. The discussion began with a presentation of the project's context, key concepts of carbon markets, and the main outcomes from the technical and financial feasibility assessments. Responses were collected through printouts and transcriptions of the session's recording.

As recommended by Krueger & Leader (2002), the analysis of the feedback and responses from the participants considered:

- The difference between the real/ scientific meaning of the **words** and terms used by participants and the participants meant by these words.
- **Context** of the discussion where a certain comment was provided by a participant.
- Internal consistency, where participants might change or even reverse their positions after interaction with others. Thus, the flow of the conversation was traced to determine clues that might explain the change.
- Among the participants, some topics are discussed more than others (i.e., **extensiveness**), and some comments are made more often than others (i.e., **frequency**). Special attention was given to these topics, as they could be more important or of special interest to participants.
- When participants discuss a topic with deep feelings or special **intensity**, they tend to change their tone and speed of speech sometimes. In this case, transcripts alone might not be sufficient to inform about the strength of the participants' interests. Thus, recordings were also used in the data analysis.

For the focus group and the interview with an interested investor in the project, qualitative analysis in the form of thematic coding was used to identify the key risks and benefits associated with each proposed business model. The coding was color-coded: risks highlighted in red, benefits in green, and other significant information in yellow. Additionally, a quantitative method of frequency analysis was conducted to identify the key factors to be considered in developing the business model based on participants' opinions.

The outcome of the analysis of findings from the focus group, the interview, and the literature review resulted in the development of two business models. These models reflect and incorporate the findings to the greatest extent possible.

3.6.2 Method of Validation

To validate the findings of the performed qualitative and quantitative analysis, triangulation with available literature was used. In addition, the relevance and compliance of the collected data and its analysis with the concepts defined in section 3.3 was continuously checked. This ensures the reliability of the findings and thereby supports the development of a robust innovative business model that integrates carbon credits as a sustainable financial solution for solarized public water

systems. Moreover, validation of the results involved weekly review and consultation with the NLRC to further support the validity of the findings.

3.6.3 Analytical Framework

Based on the analysis explained above, Figure 11 and Figure 12 provide visual representation of the study's scope and analytical framework, respectively.

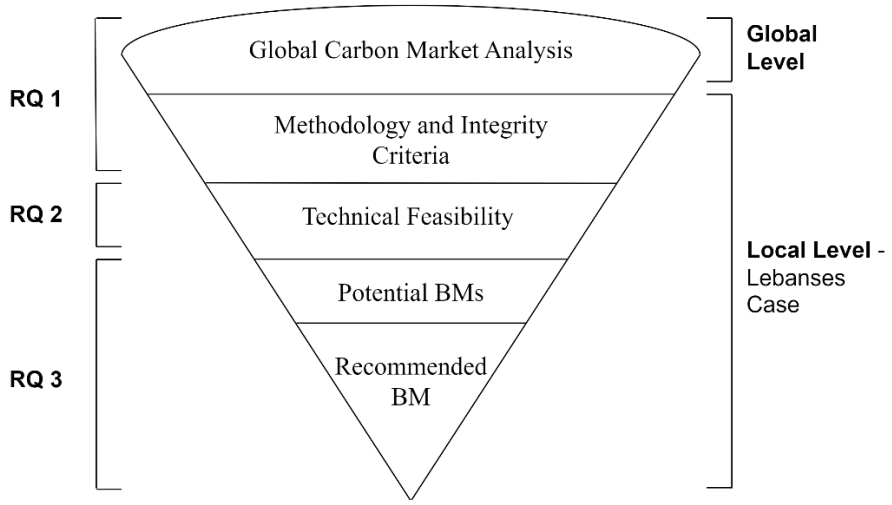

Figure 11: Level and scope of study per sub-research question (BM: Business Model)

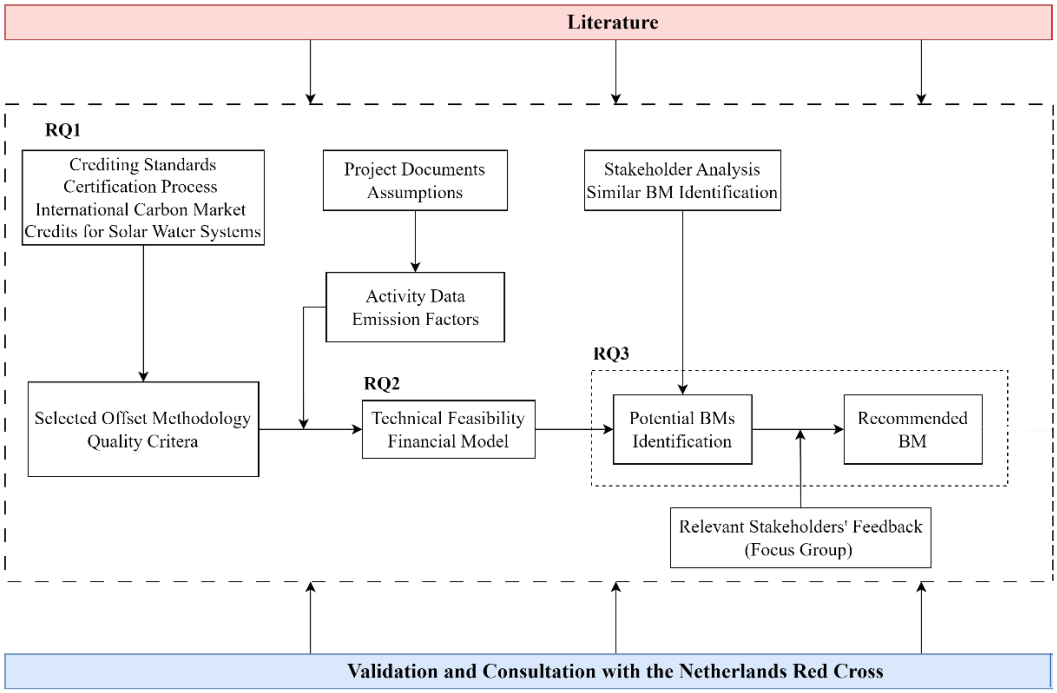

Figure 12: Schematic representation of the analytical framework (BM: Business Model)

3.7 Ethical Considerations

This research was conducted in adherence to ethical standards. First, data storage was secured through restricting access to authorized members of the research team and the NLRC. Moreover, all participants in the focus group and the interview were well-informed about the purpose of the research, the nature of their contribution, and how the data gathered was going to be used. Verbal consent was obtained to ensure that participation is voluntary and informed. Lastly, findings of this research are reported accurately and transparently.

3.8 Limitations

Besides the time limitation, data availability and access to a wide range of stakeholders form a major limitation for this research. Regarding the pumping systems under investigation, not all the required data for calculating the carbon offset is available. Thus, assumptions had to be made based on the available relevant literature. This compromises the accuracy of the technical feasibility results. However, all the assumptions were well-educated based on literature to provide results with the highest accuracy possible. Moreover, access to stakeholders relevant to this case is limited to the network reachable through the NLRC, which is also a limiting factor for the feedback received about the potential business models. Hence, the recommended business models might not be reflecting the views of a wide range of stakeholders.

From a broader lens in the context of humanitarian missions, the market-based approach of the project presents its own set of challenges. Market-based mechanisms like carbon credits often rely on indirect methods of incentivizing participation and may not fully address the needs and priorities of local communities. This contrasts with commons-based approaches, which emphasize direct support and engagement with communities. The World Bank's extensive experience in providing financing directly to communities highlights the effectiveness of such approaches in ensuring that financial support aligns with local needs and conditions (WB, 2013). Market-based mechanisms may therefore be less effective in capturing and responding to the demands of local stakeholders compared to direct, community-centered financing strategies.

4 Results and Findings

This chapter presents the key findings of each research sub question. First, more details about carbon markets, standard setting agencies, carbon project cycle and integrity criteria are provided. Following that, the key outcomes of the technical feasibility assessment is provided to inform the business model development. Lastly, the implementation of the BMCF is detailed and the key outcomes from primary data collection is provided to result in the proposal of the recommended business model.

4.1 Processes, participant roles, and integrity criteria that govern carbon projects

Carbon standards are organizations that set the guidelines and practices for generating carbon credits from climate mitigation initiatives (Millenium Water Alliance, 2024). These standards are applied to the structured process through which carbon credits are granted. This approach emphasizes the sustainable development goals (SDGs) and the mitigation of social and environmental impacts. It involves the development and adherence to specified "methodologies" that explain the calculation of emission reductions or removals for various projects (Millenium Water Alliance, 2024). To guarantee transparency, accountability and integrity in climate mitigation projects, the certification of carbon credits is a rigorous and intricate process that entails numerous steps, costs, and related risks.

4.1.1 The Carbon Certification Process (Project Cycle)

The carbon certification process starts once the project developer/implementer makes the decision to participate in the carbon market.

4.1.1.1 Project Documentation and Stakeholder Consultation

To involve all pertinent parties, including the local government and community, a stakeholder consultation process must take place during project planning (Millenium Water Alliance, 2024). In addition to addressing stakeholder feedback, concerns, and recommendations, the project team must show how the project complies with the carbon standard's safeguards criteria. In compliance with the selected methodology, the team must also create a monitoring plan, define the baseline scenario, and prove additionality. A Project Design Document (PDD) and sometimes other supporting documents (such as a report on local stakeholder consultation or a spreadsheet for calculating emission reductions) then serve as a summary of all the abovementioned aspects (Millenium Water Alliance, 2024).

For a WaSH project, the PDD has the narrative of a project that has the main aim of reducing, removing or avoiding GHG emissions while providing access to safe drinking water and improved health (Millenium Water Alliance, 2024). These associated positive impacts are referred to as “co-benefits”. Carbon certification is commonly added to an already-existing intervention, and not every activity should be included in a PDD. The registered PDD(s) may only cover specific elements of the intervention as a whole. Establishing reliable monitoring and support systems—including a comprehensive input and complaint mechanism—is advised in order to gather data for specialized reporting at the PDD level (Millenium Water Alliance, 2024).

The typical duration of this step is six to twelve months and has external costs of approximately 30,000 – 50,000 USD (Millenium Water Alliance, 2024).

4.1.1.2 Validation and Registration

When the project team prepares and finalized the PDD, it gets submitted to the selected Carbon Standard to be reviewed (Millenium Water Alliance, 2024). Moreover, the PDD gets validated against the rules and principles of the Carbon Standard and methodology for the eligibility of the project, baseline scenario, and monitoring plan. This validation is carried out by an independent third party verifier referred to as the Validation and Verification Body (VVB). It should be noted that this step may require the VVB to conduct a site visit to the project. Once the final validation report is received, a final review is conducted by the Carbon Standard as a last check prior to the formal confirmation of the project's registration (Millenium Water Alliance, 2024).

The typical duration of this step is six to twelve months and has external costs of approximately 20,000 – 40,000 USD (Millenium Water Alliance, 2024).

4.1.1.3 Monitoring and Reporting

As defined in the PDD's monitoring plan, the project team collects the monitoring data. Input and complaints from relevant stakeholders must be simultaneously collected and addressed. At the end of the specified monitoring period, the actual emission reductions achieved are communicated through the monitoring report and emission reduction calculation table prepared and submitted by the project team (Millenium Water Alliance, 2024).

The typical duration of this step is one to two years and has external costs of approximately 10,000 USD (Millenium Water Alliance, 2024).

4.1.1.4 Verification and Issuance

This step involves the verification of the carbon credit claims against the registered monitored plan (from step 2) as well as the rules and principles of the carbon standard and methodology. This is carried out by the VVB verifying the documentation (as explained in step 3) submitted by the project team (Millenium Water Alliance, 2024). Like step 2, this step might require a visit from the VVB to the project. Once the final verification report is received, a final review is conducted by the Carbon Standard as a last check prior to the formal confirmation of the credits' issuance.

The typical duration of this step is six to twelve months and has external costs of approximately 15,000- 30,000 USD (Millenium Water Alliance, 2024).

4.1.1.5 Transaction

Interested buyers can buy the carbon credits upon their issuance. For the credits to be monetized (i.e., sold), it can take years. This depends on various factors, including the capacity of the carbon credit trader, type of project, demand for carbon credits and price expectations (Millenium Water Alliance, 2024). By delivering notices for "retired"[3] credits, these rules ensure that each issued carbon credit is utilized only once by keeping track of them in a registry.

[3] Carbon credits are retired when they are purchased and claimed by a buyer.

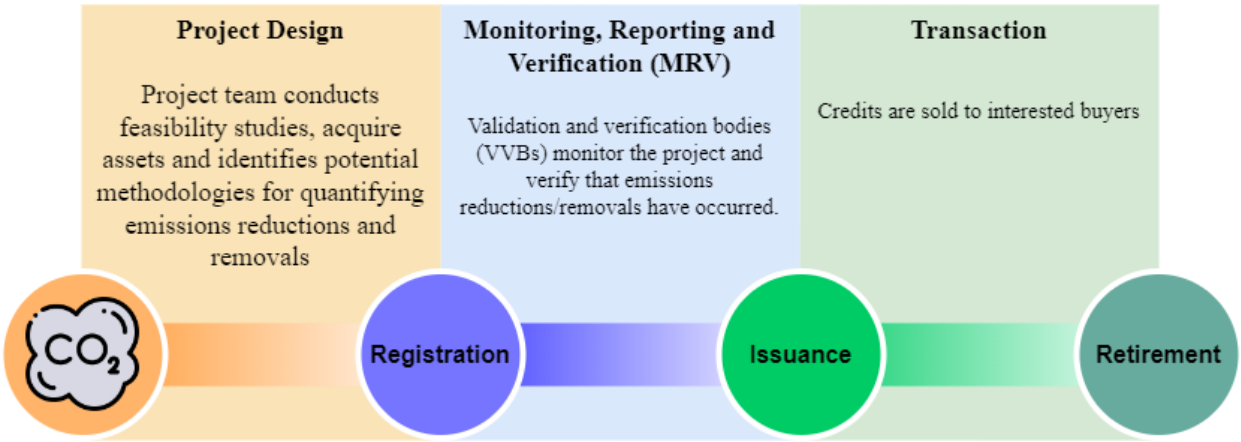

Figure 13: Carbon project certification process

4.1.2 Participants in a Carbon Project

4.1.2.1 Project Implementer (Owner)

Carbon project implementers, also known as project owners, are at the core of the carbon project, since they play a key role in managing and overseeing the implementation of the project. The implementer could be a governmental agency, non-governmental organization (NGO), community-based groups or private sector, and they have the responsibility to ensure that all stakeholders (i.e., end users and project participants) are well informed about the project activities (Millenium Water Alliance, 2024). To ensure inclusive participation throughout the project, the implementer is tasked to organize stakeholder consultations during the design phase and setting up procedures for continuous feedback and grievances. Establishing precise contracts with project participants that outline who owns the carbon credits is also essential.

4.1.2.2 Project Developer

It is a common practice that the project implementer works in collaboration with a carbon project developer, which is a company that specializes in developing and registering carbon projects. This kind of organization may be non-profit or for profit (Millenium Water Alliance, 2024). While a project implementer may create their own internal capacity for carbon project registration, certain developers may also take on the role of project implementer directly. A contract that specifies the ownership of the carbon credits is one of the things that formalizes the relationship between the developer of the carbon project and the project implementer (Millenium Water Alliance, 2024). These are known as Emission Reductions Payment Agreements (ERPAs).

4.1.2.3 Third-party Auditor

The carbon project developer and the project implementer work together to choose a suitable carbon standard and methodology for the project. The technical approach is specified by the methodology, whereas the selected carbon standard establishes the rules, principles, and procedures for producing carbon credits. A validation and verification body (VVB), a third-party auditor recognized by the carbon standard, is chosen to handle the project's validation and verification (Millenium Water Alliance, 2024). The required technical services are supplied by these auditors, which are usually private businesses.

4.1.2.4 Retailers/Traders and Buyers

Carbon credits have to be sold after they are issued. Retailers and traders buy credits from projects and resell them to the buyers. It is common that carbon project developers work as retailers as well. Credits are kept in registries by traders for potential future sales.

4.1.3 Methodology

Each carbon standard's "methodologies" specify the meticulous procedure used to generate carbon credits. These methods include scope, baseline emissions, and monitoring requirements and explain how to compute emission reductions or removals for particular projects. When new approaches are required, stakeholders can create methodologies by collaborating with standards. Certain standards, like the Gold Standard, may accept methodology from other standards.

This project focuses on carbon credits for solar water panels used to generate electricity for pumping water. Thus, the most relevant methodologies for calculating emissions reductions in renewable energy interventions within the WaSH sector were evaluated. The three methodologies considered were:

A. Gold Standard Methodology for Emission Reductions from Safe Drinking Water Supply (The Gold Standard Foundation, 2021)
B. CDM AMS.I.F: Renewable Electricity Generation for Captive Use and Mini Grid (Version 5.0) (UNFCCC, 2022a)
C. CDM AMS.I.B: Mechanical Energy for the User with or without Electrical Energy (Version 13.0) (UNFCCC, 2022b)

4.1.3.1 Gold Standard Methodology for Safe Drinking Water Supply

The Gold Standard methodology is applicable to projects introducing new or rehabilitated zero or low-emission technologies to supply safe drinking water. The primary goal under this methodology is to reduce or avoid greenhouse gas emissions from boiling unsafe drinking water and to ensure the water is safe for consumption at the point of entry into project households or institutions.

The eligibility criteria for this methodology includes that the baseline scenario must involve users boiling water in the absence of the project. Thus, it was concluded that this methodology is not applicable to the project, as the solarization projects involve changing the fuel source for pumping water from existing boreholes rather than changing water quality (i.e., the project is fuel switch and not water treatment).

4.1.3.2 CDM AMS.I.F: Renewable Electricity Generation for Captive Use and Mini Grid

This CDM methodology addresses electricity generation for captive use and mini grids, particularly for grid-connected systems. Eligible projects for this methodology involve electricity generation for grid-connected systems. Since the project is off-grid and involves direct installation of solar panels at pumping locations to generate electricity solely for water pumping, it was concluded that this methodology is not applicable.

4.1.3.3 CDM AMS.I.B: Mechanical Energy for the User with or without Electrical Energy

This methodology focuses on generating mechanical energy, with or without electrical energy, to meet project objectives. This is highly relevant to the project as it involves generating mechanical

energy to pump water using electrical energy from solar panels. A similar project issued credits under the VCS standard successfully used this methodology for solar pumping in irrigation, further validating its applicability to the current project under study.

4.1.3.4 Selected Methodology

Given the abovementioned comparison, CDM AMS.I.B was selected as the appropriate methodology for calculating emissions reductions. It is worth noting that this methodology is validated by and can be registered under either the Gold Standard or the VCS standard.

4.1.4 Standard

Due to their extensive utilization and recognition by buyers, The Gold Standard and Verra VCS stand out among the VCM. In particular, the Gold Standard has issued 20.1% of credits, and VCS has issued 68.5% of credits (Millenium Water Alliance, 2024). This demonstrates their important roles in the issuing of carbon credits and the trust of buyers. Moreover, these are the most relevant standards to renewable energy interventions in the WaSH sector (Millenium Water Alliance, 2024).

- **Verra VCS**: also known as the "Verified Carbon Standard ", Verra VCS is a leading voluntary carbon offset standard. It offers a robust framework for carbon offset project development, verification, and certification (Carbonibus, 2023). Projects must adhere to certain standards and requirements, such as additionality, permanence, and transparency, to be approved by Verra VCS. It provides a large variety of project kinds, such as forestry, agriculture, and renewable energy. Verra VCS is a reliable option for organizations aiming to reduce their carbon footprint since it is renowned in the carbon market for its reliability and integrity.
- **Gold Standard**: Established in 2003, the Gold Standard sets certification criteria for carbon offset initiatives. Its strict standards and excellent integrity are well known in the market (Carbonibus, 2023). Strict environmental, social, and economic standards must be met by Gold Standard projects for them to be real and additional in reducing emissions. In addition, the standard fosters sustainable development and supports the United Nations accomplish its SDGs. A comprehensive verification process is implemented for Gold Standard projects to guarantee the accuracy and credibility of their emissions reductions. Gold Standard offers a reliable and accountable structure for carbon offset initiatives.

The factors included in comparing both standards are the average market prices from 2021 to 2023, how demanding the certification process is, the need for third-party verifier and the cost of certification. First, VCS had higher average market prices in 2021, 2022 and 2023 compared to the Gold Standard (Procton, 2024). Second, the certification process is less demanding under the VCS as shown in Figure 14. Each 'process' shown in the figure indicates a key step in the requirements/processes for both standards before the project can proceed. This is a crucial factor for this project, since the Red Cross is considering taking over the role of the project developer, which means that it is advantageous to work with a standard that is less time- and resource-consuming. Third, the VCS requires third-party verification, which can be more costly and time-consuming compared to the streamlined verification process offered by the Gold Standard. Lastly, costs and fees should be considered. The VCS has a tiered fee structure based on project size (Verra, 2023), while Gold Standard has a flat fee structure (Carbonibus, 2023).

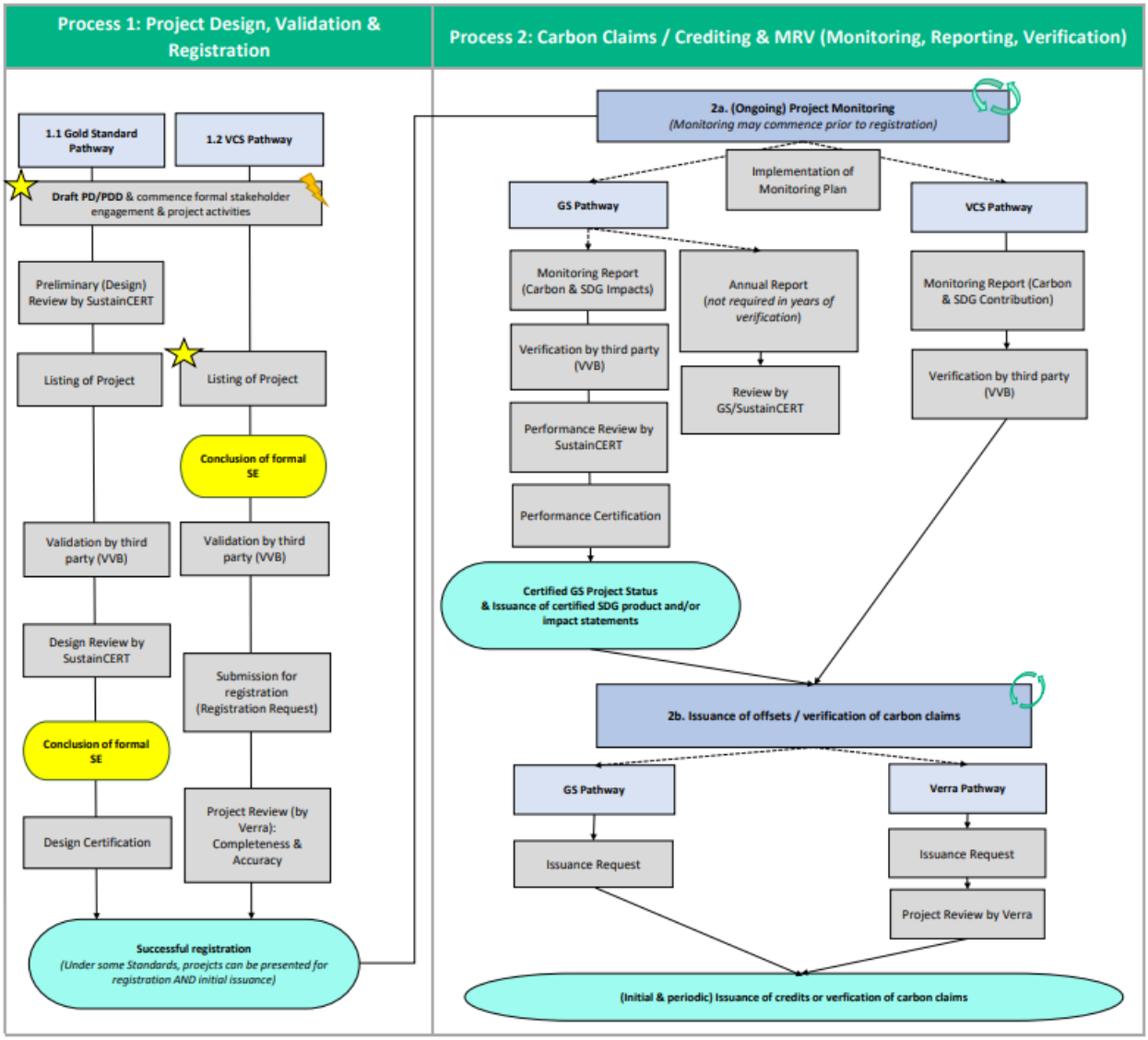

Figure 14: Flowchart comparing the registration process, certification requirements, and payment structure of the Gold Standard vs VCS

(Source: Millenium Water Alliance, 2024)

Table 6: Gold Standard vs VCS

Standard	Gold Standard	VCS
Average market prices	Lower	Higher
Certification process	Lengthier	Less demanding
Verification	Streamlined	Third-party (could be more costly and time consuming)
Certification Costs	Flat fee	Tiered structure

Based on the abovementioned comparison, and given that the project is small scale, the VCS appears to be the more attractive standard for the project's certification. Based on the guidelines

of the VCS standard, the crediting period[4] was be selected to be 21 years. This is the maximum period for renewable energy projects under the VCS, and it is in the form of 7 years renewed twice (i.e., 7x3) (Verra, 2024b).

4.1.5 Integrity criteria

The principles demonstrated in Figure 4 can be summarized in the following five most significant quality criteria.

4.1.5.1 Additionality

Additionality refers to a project's necessity for carbon credit revenues to proceed (Broekhoff et al., 2019b). It is assessed by crediting programs during project approval. A project is deemed additional if it would not occur without the expected carbon credit revenue. Determining additionality involves comparing the project to its baseline scenario, which predicts the future behavior of stakeholders without carbon revenue incentives. If the project and its baseline are indistinguishable, the project is not additional. The quality of carbon credits hinges on additionality. Issuing credits to non-additional projects exacerbates climate change, as total emissions would be lower if the purchaser reduced their emissions instead. Moreover, evaluating additionality can be challenging (Broekhoff et al., 2019b). For instance, legal requirements or profitable investments in certain projects might proceed without carbon credits. For a project to be deemed additional, the expectation of carbon credit revenue must decisively influence its implementation. Determining additionality is predictive and requires establishing a hypothetical scenario without carbon credits, informed by factors like future prices.

In summary, additionality ensures that carbon credit revenues are crucial for project implementation, maintaining the integrity and effectiveness of carbon credits in mitigating climate change. The assessment process involves predictive comparisons to baseline scenarios and addresses legal and financial considerations within a unified framework.

4.1.5.2 Not overestimated

To prevent overestimation of a carbon offset project’s effects, it is crucial that emissions avoided or removed are not exaggerated. Monitoring and data verification by accredited verifiers are necessary before credit issuance. Overestimation can occur through inflated baseline emissions or underestimated project emissions, including indirect effects on GHG emissions (leakage)(Broekhoff et al., 2019b). For example, if a project developer reports avoiding 100 tons of CO2 instead of the actual 50 tons, half the credits would be ineffective in mitigating climate change. GHG credits can be overestimated if baseline emissions are overestimated. Baseline emissions vary in accuracy depending on the project type. Methane capture from landfills, for instance, has clearer baseline emissions than grid-connected solar power projects. Projects often avoid but do not eliminate GHG emissions. Overestimation also occurs when actual emissions after project implementation are underestimated (Broekhoff et al., 2019b). Moreover, projects can have unintended effects on GHG emissions. If quantification methods fail to account for these

[4] The time frame for which carbon dioxide removals or GHG emission reductions produced by the project are eligible for verified carbon units (VCU) issuance is known as the project crediting period. To guarantee that modifications to a project's baseline scenario and regulatory surplus are taken into account throughout the project lifecycle, project crediting periods must be renewed on a regular basis.

indirect effects, total avoided GHG emissions are overestimated. To control overestimation, it is essential to monitor and verify a project's performance ex post. Measurement and data collection should be scientifically sound and methodologically robust. Rigorous verification, often through audits of data samples, ensures that reported data are accurate and do not overstate avoided GHG emissions.

4.1.5.3 Permanent

GHG emissions have long-lasting effects, with around 25% of emitted CO_2 remaining in the atmosphere for hundreds to thousands of years. Therefore, offset credits must be linked to similarly permanent GHG reductions (Broekhoff et al., 2019b). If a GHG reduction is reversed, it fails to compensate for the emissions. Most carbon offset projects have negligible risks of reversal. However, projects storing carbon in unstable reservoirs, such as forestry projects, are at higher risk. For instance, carbon stored in trees can be re-emitted if a fire occurs, negating the initial reduction. A common misconception is that "permanent" carbon offsets last less than hundreds or thousands of years. Many programs consider carbon offsets permanent if they last 100 years or less, balancing technical needs with practical insurance against reversals. However, scientifically, permanence requires an indefinite guarantee against reversals (Broekhoff et al., 2019b).

4.1.5.4 Not claimed by another entity

Carbon credits can worsen climate change if more than one party claims the same avoided emissions or enhanced removals, leading to greater total emissions. For instance, if two companies each claim the same 100 tons of avoided CO_2 emissions, they would collectively claim 200 tons avoided, while the actual reduction is only 100 tons. Double counting can occur in three ways:

4.1.5.4.1 Double Issuance:

This occurs when more than one carbon credit is issued for the same avoided ton of GHG emissions (Broekhoff et al., 2019b). For example, a single project may mistakenly receive two credits from the same program for one ton of avoided emissions. A more common scenario is when two different programs issue credits to the same project, unaware that it is registered with both. Another subtle risk involves different projects each claiming to have avoided the same ton of emissions, resulting in credits issued by the same or different programs (Broekhoff et al., 2019b). For instance, both the producer and consumer of biofuels may claim avoided emissions from the same fuel.

4.1.5.4.2 Double Use:

This happens if two parties count the same carbon credit towards their emission reduction or removal targets. The most likely scenario is a seller representing a credit as retired to a buyer, then selling the same credit again to another buyer (Broekhoff et al., 2019b). To prevent this, carbon crediting programs must record the purpose of any credit retirement in a registry, identify beneficiaries of retirements, and make this information publicly accessible. Current practices on information disclosure vary across programs.

4.1.5.4.3 Double Claiming:

Double claiming occurs when carbon credits for avoided emissions or removals are claimed by both the project and another entity, such as a government or private company, against their own targets (Broekhoff et al., 2019b). For example, an energy efficiency project might receive carbon

credits for avoided emissions at a power plant covered by an emission target. Both the project and the power plant could claim the same avoided emissions. This issue is significant under the Paris Agreement.

For the solarization project in Lebanon, only additionality is considered in the feasibility assessment, since it is the most relevant integrity criterion for WaSH interventions (Millenium Water Alliance, 2024).

Takeaway

The key takeaways from examining the process, participant roles and integrity criteria relevant to the development of the business models include:

- CDM AMS.I.B was selected as the appropriate methodology for calculating emissions reductions.
- The standard used for this project is the Verra VCS with a crediting period of 21 years (7x3).
- Only additionality was assessed for the credits' integrity.

4.2 Technical Feasibility

4.2.1 Emissions Reduction and Financial Feasibility

As mentioned above in the methodology chapter, data from five locations of those solarized in Lebanon was available for this research. Using this data, along with a few assumptions about the diesel consumption and generator efficiency, the annual reductions were calculated to be 259 ton CO_2e based on the selected CDM methodology[5]. Compared to common practice, that is well below the threshold of 50,000 ton CO_2e emission reductions that the project should achieve to be financially feasible (Millenium Water Alliance, 2024). Thus, the scale of the five project was identified as a key limiting factor. Accordingly, an assessment was conducted for a larger project involving 270 solarized water pumping locations under the LRC.

Given the lack of specific data regarding the size of these 270 systems, two key parameters were identified for assumptions: the generator efficiency and the size distribution of the systems. Three scenarios were developed based on these parameters: a best-case scenario, a worst-case scenario, and an average scenario. The detailed assumptions for the three scenarios are shown in Table 7.

[5] Detailed calculations and assumptions are available here: https://docs.google.com/spreadsheets/d/121qQgZSuOfQ-cLGQUR0H342H9jxXjtzv/edit?usp=sharing&ouid=104515518382688967559&rtpof=true&sd=true

Table 7: Assumptions in building the scenarios

Scenario no.		1	2	3
Size of grouped systems	Large scale (50 hp)	20 %	20 %	60 %
	Medium scale (25 hp)	20 %	60 %	20 %
	Small scale (3.5 hp)	60 %	20 %	20 %
Generator efficiency		40 %	30 %	25 %
Emission reductions (ton CO_2e/year)		14,442	30,433	45,610
Investment Cost (million USD)		9.19	13.25	18.44

To calculate the cash flow throughout the whole 21-year crediting period of the project (i.e., 7 years renewed twice), the project external costs for the carbon certification process during the whole crediting period were assumed to be as shown in Table 8.

Table 8: Carbon project certification external costs

(Source: Millenium Water Alliance, 2024)

Step in the carbon certification project cycle	Cycle duration	External costs (USD)
Project Documentation	Every 7 years (revalidation cycle)	40,000
Validation and Registration	Every 7 years (revalidation cycle)	30,000
Verification and Issuance	Every 7 years (revalidation cycle)	20,000
Monitoring and Reporting	Annually	10,000
VVB Annual Fee	Annually	2,500

Finally, the cash flow was calculated assuming selling the carbon price to range from 5 to 10 USD/VCC (Millenium Water Alliance, 2024) in the three scenarios. In 2023, price of RE credits was 3.97 USD (Procton, 2024). In 2022, projects working towards the SDGs demonstrated a price premium at 86% higher prices than projects not associated with SDGs (Procton, 2024). Based on these statistics, the carbon price in the “average” scenario is assumed to have a price premium (3.97x1.86) being 7.4 USD/VCC. It should be noted that this calculation only includes the carbon certification external costs and does not include the solar systems installation and maintenance costs. Moreover, this calculation is limited since it does not account for any economic indicators (e.g., inflation rate).

Table 9: Summary of cash-flow analysis assumptions

Scenario	1. Worst Case	2. Average	3. Best Case
Annual Emission Reduction (kton CO_2e)	14.4	30.4	45.7
Price (USD/VCU)	5	7.4	10
Solar Systems Investment Cost (million USD)	9.19	13.25	18.44
Carbon Certification Pre-investment (USD)	100,000	100,000	100,000

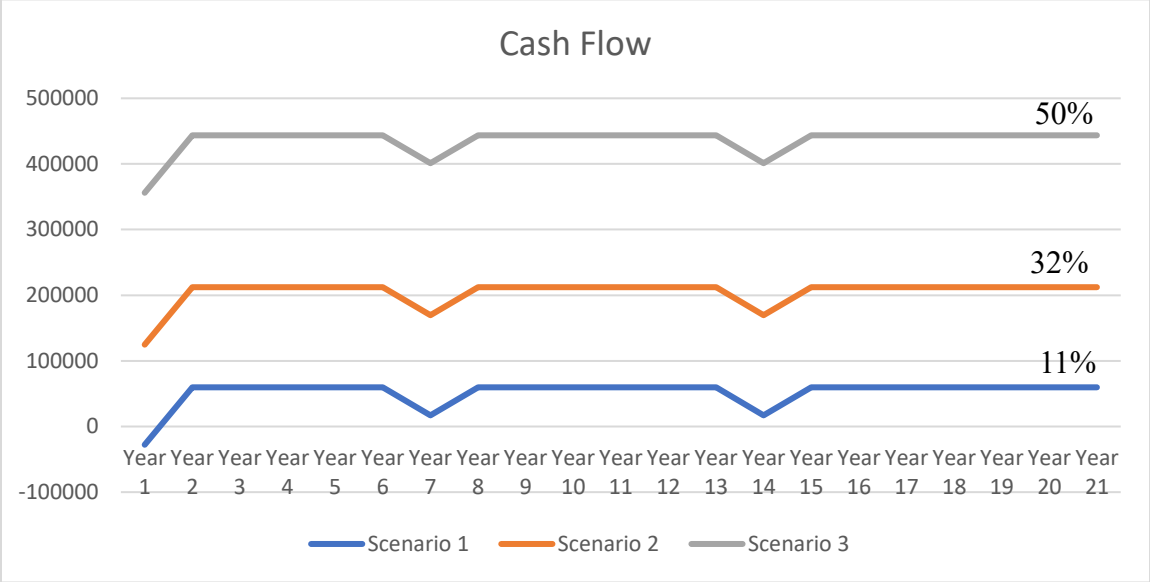

Figure 15: Cash flow analysis results

As shown in the graph, the project requires pre-investment for the carbon certification process until the credits are issued and ready for transaction. The cash flow analysis indicates that the cumulative net profit for the Red Cross from selling carbon credits would range from approximately 1,000,000 to 9,000,000 USD in total over 21 years from the worst-case scenario to the best-case scenario. Additionally, the percentages displayed on the graph represent the portion of the solar system investment costs that could be covered by revenue from selling carbon credits. In the best-case scenario, the revenue can cover 50% of the initial investment costs in addition to the carbon certification costs.

For a humanitarian organization like the Red Cross, which has various projects to fund, a project with this profit range is considered financially attractive since it requires only 50% of the project's initial costs while sustaining itself from the revenues. Despite the uncertainties in this analysis, it still provides an indication of how significantly the profit margin can vary depending on the scale of the solar systems.

4.2.2 Additionality

The additionality assessment was done following the CDM guidelines for additionality assessment. The Grouped Project[6] is deemed additional by adhering to the steps outlined in Tool 21 of the CDM "Tool for Demonstration of Additionality of Small-Scale Project Activities," version 13.1, Appendix "Provisions of Small Scale and Microscale Tools for Automatic Additionality."

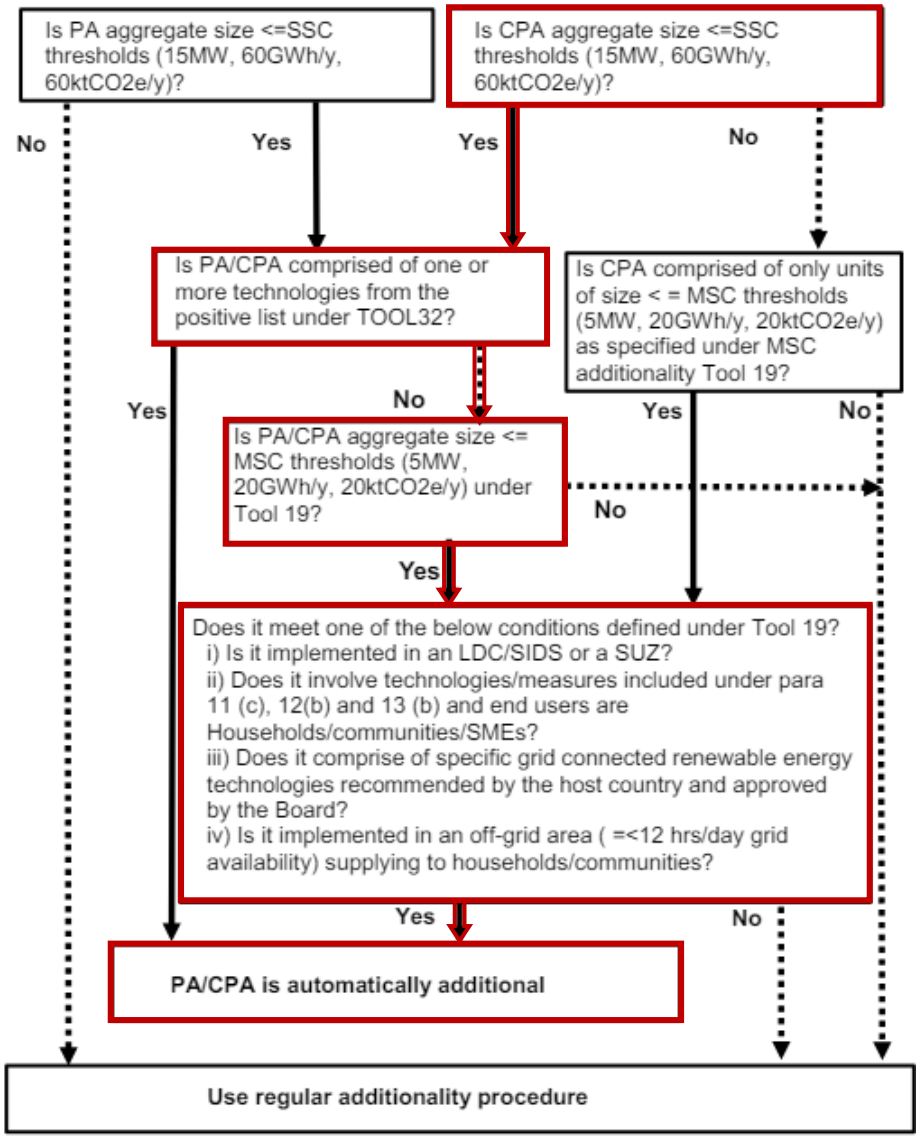

Figure 16: Criteria for automatic additionality using provisions of small-scale (SSC) or microscale (MSC) additionality tools

(Source: CDM, 2020)

[6] Multiple project activity instances are integrated into a single, unified project that adds additional instances throughout time, known as a VCS grouped project. A project proponent can avoid having to go through a thorough validation process for each additional instance added to the project by using the VCS requirements for grouped projects. As a result, projects may be subjected to upscaling over time and incur lower transaction costs (Verra, 2024a).

The flowchart above provides a step-by-step criterion for demonstrating additionality using provisions of small-scale (SSC) and microscale (MSC) additionality tools. The red arrows in the flowchart indicates the pathway used to demonstrate additionality. Each criterion in the flowchart is addressed accordingly.

Table 10: Additionality assessment justification

Criteria	Response	Justification
1. Is PA aggregate size <=SSC thresholds (15MW, 60GWh/y, 60ktCO2e/y)?	Yes	As demonstrated in Table 7, the highest aggregate size of systems in the best case is around 45 ktonCO_2e/yr, which is lower than the threshold of 60 ktonCO_2e/yr.
2. Is PA/CPA comprised of one or more technologies from the positive list under tool 32?	No	-
3. Is PA/CPA aggregate size <= MSC thresholds (5MW, 20GWh/yr, 20ktCO2e) under TOOL 19?	Yes	Each project activity instance comprising the grouped project is assumed to be less than the microscale (MSC) threshold of 5 MW based on the data from the 5 locations.
4. Does it meet one of the below conditions defined under TOOL 19? i. Is it implemented in an LDC/SIDS or a SUZ? ii. Does it involve technologies/measures included under para 11(c), 12(b) and 13(b) and end users are Households/communities/ SMEs? iii. Does it comprise of specific grid connected renewable energy technologies recommended by the host country and approved by the Board? iv. Is it implemented in off-grid area (<=12 hrs/day grid availability) supplying to households/communities?	Yes	The project activity instances meet the requirements of paragraph 11 (c) (i) of Tool 19 and belong to the sub-category: solar technologies (photovoltaic and solar thermal electricity generation) (CDM, 2022).

According to the abovementioned argument, the project is deemed to be automatically additional.

Takeaway

The key takeaways from examining the technical feasibility relevant to the development of the business models include:

- From the technical perspective, the project is eligible for acquiring carbon credits.

- The current investment scale of the NLRC, covering five locations, is too small to be financially feasible for acquiring carbon credits.
- Scenario analysis indicates a broad range of potential profit margins, suggesting that the project could be financially viable and rewarding under certain conditions (i.e., project scale, carbon market prices and the existence of donor funding).
- Notably, even in the best-case scenario, the project only covers approximately 50% of the initial investment costs. This necessitates the use of blended finance, as relying solely on the sale of carbon credits is insufficient to cover the initial capital and operational expenses in all scenarios.

4.3 Potential Business Models and Their Associated Benefits and Risks

4.3.1 Business Model Conceptual Framework

Following the Business Model Conceptual Framework (BMCF), the following levels were defined and are elaborated in the subsequent subsections.

4.3.1.1 Level 1: Definition of Business Modelling

"A business model is a structured framework outlining how an organization, along with its partners, manages the flow of resources and value."

For the project under study, the business model primarily focuses on the external relationships between the organization generating the carbon credits (i.e., the Red Cross) and its partners, including investors and donors. This model should also illustrate the cash flow dynamics among these partners.

4.3.1.2 Level 2: Objectives of Business Modelling

The primary objective of the project is to ensure the sustainability of solar systems' operations to provide safe and reliable water access to communities, thereby achieving water security and enhancing public health. To achieve this main objective, the following specific objectives are set for the business model:

1. **Sustainability**
   - Financial Sustainability: Ensure the long-term financial viability of the solar-powered water systems by integrating new funding sources such as revenue from carbon credits.
   - Environmental Sustainability: Promote the reduction of GHG emissions the generation of carbon credits.
2. **Value Creation and Delivery**
   - Enhanced Water Access: Provide reliable and sustainable access to clean water for local communities.
   - Economic Value: Generate additional revenue streams through the sale of carbon credits, supporting the project's financial sustainability.
   - Social Value: Improve the health and well-being of local communities by providing a reliable and clean water supply.

3. **Resource Management**
    - Efficient Resource Allocation: Optimize the allocation and utilization of financial, human, and technical resources to maximize the impact and efficiency of the project.
4. **Scalability and Replicability**
    - Scalability: Design the business model to be scalable, allowing for the expansion of solar-powered water systems to other regions or communities.
    - Replicability: Develop a replicable framework that can be adopted by other humanitarian projects or organizations seeking to integrate carbon credits as a financing mechanism.
5. **Stakeholder Engagement**
    - Donor Relations: Maintain strong and transparent relationships with donors, providing regular updates and impact reports to ensure continued support.
    - Partnership Development: Build and maintain strategic partnerships with certification bodies, NGOs, local governments, and technical service providers.

4.3.1.3 Level 3: Fundamentals

Given the diverse possibilities for financing the carbon credits registration and issuance process (e.g., donor or investor funding), stakeholder mapping is crucial to identify the main stakeholders involved in the project. Table 11 presents the identified stakeholders and categorizes them based on their interest and influence on the project implementation. Table 12 further elaborates this categorization.

Table 11: Stakeholder identification

	High Interest	**Low Interest**
High Influence	• Donors • Investors • Project Team (Red Cross)	• Regulatory Bodies (Verra) • Third-party Verifiers • Third-party credits consultant or project developers • Local communities
Low Influence	• Carbon Credits Buyers	-

Table 12: Elaboration on stakeholder identification

Stakeholder	Interest	Influence	Engagement Strategy
Donors	Social impact, transparency, project success	High	Impact reports, transparency in fund utilization
Investors	Financial return, project success	High	Regular financial updates, ROI reports
Project Team (Red Cross)	Successful implementation, meeting objectives	High	Collaborative decision-making, performance metrics
Local Communities	Receiving benefits, minimal disruption	High	Feedback sessions and community meetings
Carbon Credit Buyers	High-quality credits, reliable certification	Low	Quality assurance, timely certification
Regulatory Bodies (Verra)	Compliance, environmental standards	High	Ensure compliance, regular audits
Third-party Verifiers	Accurate certification, credits integrity	High	Transparent verification processes

4.3.1.3.1 Qualitative Characteristics

The four main characteristics that should be considered for business model information are comparability, understandability, relevance, and reliability (Lambert, 2008). Information needs to be relevant to the user to be valuable, directly relating to the business modeling's objective. Reliability refers to information's objectivity or verifiability. Reliability and relevance are often trade-offs. The importance of each characteristic determines what information should and shouldn't be included in the business model. Additionally, assumptions about the user's capabilities must be made to ensure they understand the business model representations. The format and level of technical language must be appropriate for the users' skill level. Comparability of data over time and between entities enhances the usefulness of business model representations (Lambert, 2008). For the model developed in this study, the following interpretations of each qualitative characteristic are defined:

1. **Relevance**
   - Stakeholder Interests: Ensure that the proposed business model aligns with the interests and motivations of the respective stakeholders (i.e., investors or donors).
   - Value Proposition: Clearly define the value proposition for each type of partner, highlighting the benefits they receive from participating in the project.
2. **Reliability**
   - Data: Ensure the reliability, accuracy and verifiability of data related to carbon credit generation and financial distributions.

3. **Understandability**
    - Stakeholder Roles: Clearly define the roles and responsibilities of each partner within the business models.
    - Clear Communication: Use clear and straightforward language to explain the business models and the flow of cash and credits.
    - Accessible Documentation: Make all relevant information, including agreements and financial reports, accessible to stakeholders.
4. **Comparability**
    - Standardized Procedures: Apply consistent procedures for all the proposed business models.
    - Aligned Goals: Ensure that the goals and objectives of each business model are consistently aligned with the overarching mission of reducing carbon emissions and providing sustainable water access.
    - Benchmark Metrics: Use standardized metrics to compare the performance and effectiveness of the different business models.
    - Best Practices: Incorporate and adapt best practices from other successful carbon credit and humanitarian projects.

4.3.1.3.2 Elements

The HIBMC was used as the main tool to identify the key elements in the carbon credits business model as shown in Figure 17.

<table>
<tr>
<td rowspan="2">1. Partners
• Water authorities
• Donors/investors
• VVB
• Verra registry
• Project developer

2. Key Resources
• Funding
• Project team within the Red Cross
• Technical expertise
• Technology</td>
<td rowspan="2">The Innovation
2. Problem:
• Limited access to reliable water and energy sources
• Risks of financial instability from traditional BM of humanitarian funding only relying on donor funds
3. Solution:
• Installation of solar panels to pump water
• Integration of carbon credits to fund and sustain the project</td>
<td>12. Value Proposition
High-quality carbon credits supporting humanitarian projects (co-benefits)</td>
<td>11. Unique Selling Point
providing water services while contributing to climate change mitigation through carbon credits (dual impact)</td>
<td rowspan="2">Customer Segments
1. Users: Local communities

8. Clients: carbon credits buyers</td>
</tr>
<tr>
<td>13. Impact
Enhanced access to water supply service</td>
<td>4. Channels
Communication:
• Stakeholder engagement meetings
Delivery:
• Collaboration with water authorities
• Collaboration with project developer</td>
</tr>
<tr>
<td colspan="3">3. Cost Structure
Systems costs:
• Solar systems infrastructure (solar panels purchase, installation costs, etc.)
• Maintenance
Carbon credits costs:
• Project developer
• VVB
• Registration and issuance process
• Monitoring and reporting</td>
<td colspan="2">9. Revenue
Sales of carbon credits</td>
</tr>
<tr>
<td colspan="3">10. Externalities
Positive: reduction in GHG emission</td>
<td colspan="2">14. Success Metrics
• Number of people with improved water access
• Amount of carbon credits issued and sold.
• Financial sustainability and ROI
• Environmental and social impact assessments</td>
</tr>
</table>

Figure 17: Humanitarian Innovation Business Model Canvas (HIBMC) for carbon credits for solar systems in Lebanon

4.3.2 Initial Proposals of the Business Models

Using the elements identified in the abovementioned HIBMC, four business models were proposed. The key difference between these models was in the project management, outsourcing vs in-house project developer and broker roles, and the existence of investment besides the donor pool funding. With these key factors, the **four models** were developed with different configurations as shown in Figure 18 - Figure 21. In all the proposed models, it is assumed that the Red Cross uses its pool funds from donors for the initial investment to implement the solar

systems (i.e., installation, maintenance and monitoring activities). Another common assumption is the responsibility of the LRC in the on-ground implementation of the solar systems as well as engaging with the local communities in consultation sessions and building capacity about the project. Moreover, the International Federation of Red Cross and Red Crescent Societies (IFRC) is proposed to have a guidance position where the project management team reports periodically about the progress and the IFRC ensures that the project is aligned with the overall vision and values of the organization. Further differences in the models are highlighted below. Moreover, the benefits and risks of each model that were identified during the focus group discussion with the NLRC are also demonstrated.

4.3.2.1 Proposal 1

As shown in Figure 18, this model is proposed to function as provided above. Further elaboration is mentioned in Table 13.

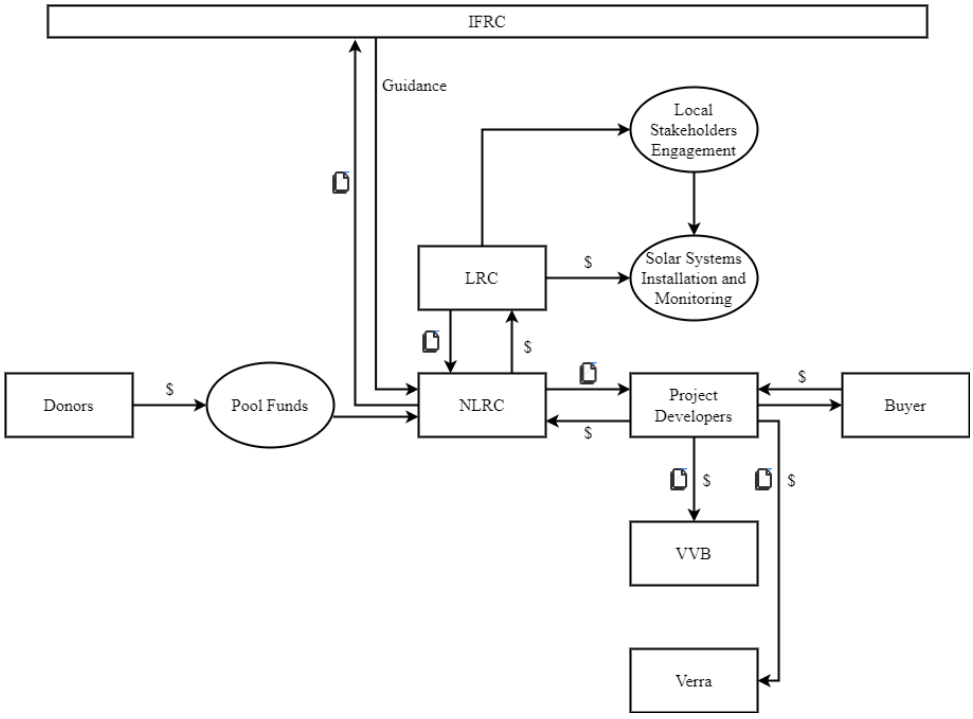

Figure 18: Business model proposal 1 [7,8]

[7] The arrow is connected directly from the project developer to the buyer since the typically project developer either acts as the broker or hires is tasked with hiring the broker.

[8] In this model, the broker is assumed to be a normal typical broker that sells the credits to an interested buyer.

Table 13: Description of roles and responsibilities in the business model proposal

Role	Description	Partner
Project Manager (PM)	- Manages the funds - Focal point	NLRC
Project Developer	Responsible for the carbon certification process and communicating with the third-party auditor (i.e., VVB) and Verra (i.e., standard setting agency)	Outsourced
Broker	Responsible for the transaction as well as the administration work required to ensure proper transaction and retirement of credits.	Outsourced

Table 14 presents the key benefits and risks associated with this model as discussed with the NLRC.

Table 14: Benefits and risks of business model proposal 1 identified during the focus group discussion with the NLRC

Benefits	Risks
- Less burden on LRC - Maximized revenues to the Red Cross due to absence of investments (i.e., no pay back required) - Could be used by the NLRC as a pilot to build capacity - More control over the process by NLRC	- More burden on the NLRC (i.e., capacity requirement) - Distant and more communication required for project developer - Administration-heavy - NLRC is the focal point while IFRC's is only limited to guidance compromises potential scalability - Having a broker is risky because it could cause less control over buyers (associated ethical risk) - If the model uses regular institutional donor funding, it would be ethically risky - Donor funding instability

4.3.2.2 Proposal 2

as shown in Figure 19, the key difference in business model 2 is that the carbon certification process is financed by an investor who also acts as a broker since they have interested buyers. This model was based on the information that the NLRC is already in contact with an interested investor, which donates/invests philanthropic funds in water systems in developing countries and has donors that are interested in buying carbon credits from water projects like the one under study.

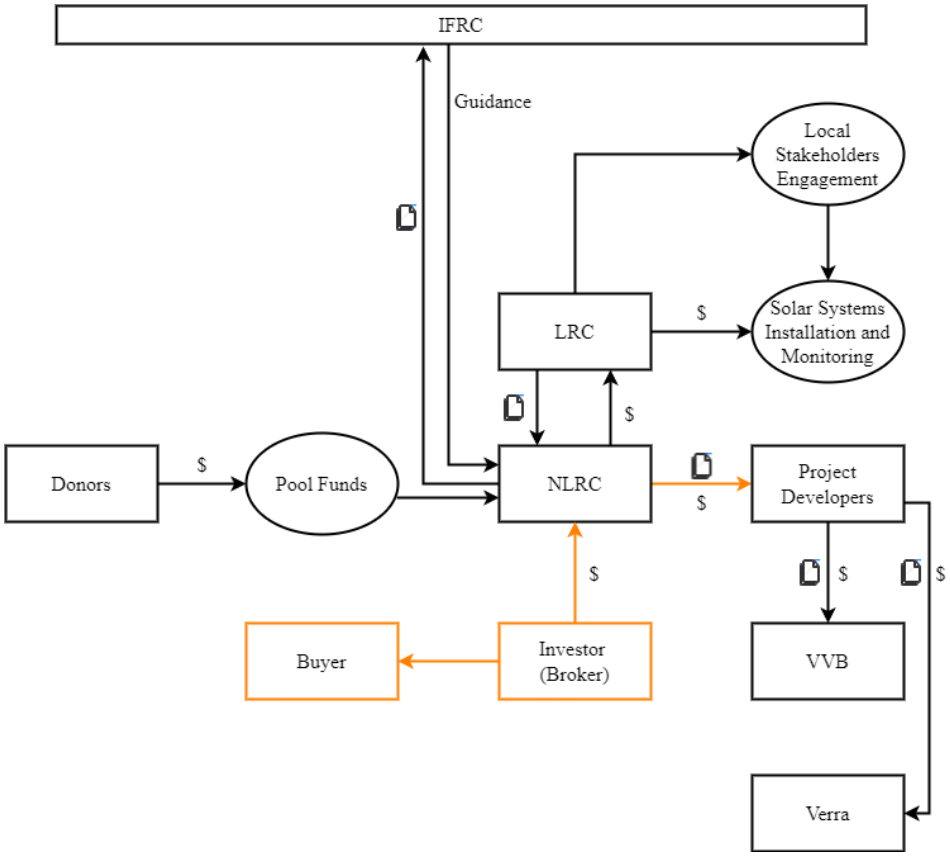

Figure 19: Business model proposal 2

Table 15 presents the key benefits and risks associated with this model as discussed with the NLRC.

Table 15: Benefits and risks of business model proposal 2 identified during the focus group discussion with the NLRC

Benefits	Risks
- Less burden on LRC - Could be used by the NLRC as a pilot to build capacity - More control over the process by NLRC - Financial risk sharing - Better control over buyers through set criteria - Less ethical risk regarding the use of donor funding since there is no need to fund carbon certification process	- More burden on the NLRC (i.e., capacity requirement) - Distant and more communication required for project developer - Administration-heavy - NLRC is the focal point while IFRC's is only limited to guidance compromises potential scalability - Having a broker remains risky because it could cause less control over buyers (associated ethical risk) - Funding instability

4.3.2.3 Proposal 3

The model shown in Figure 20 assumes that the NLRC has the responsibility of the PM, the project developer, and the broker. Thus, all the project activities are managed and carried out in-house, which is a huge burden and a huge risk as well.

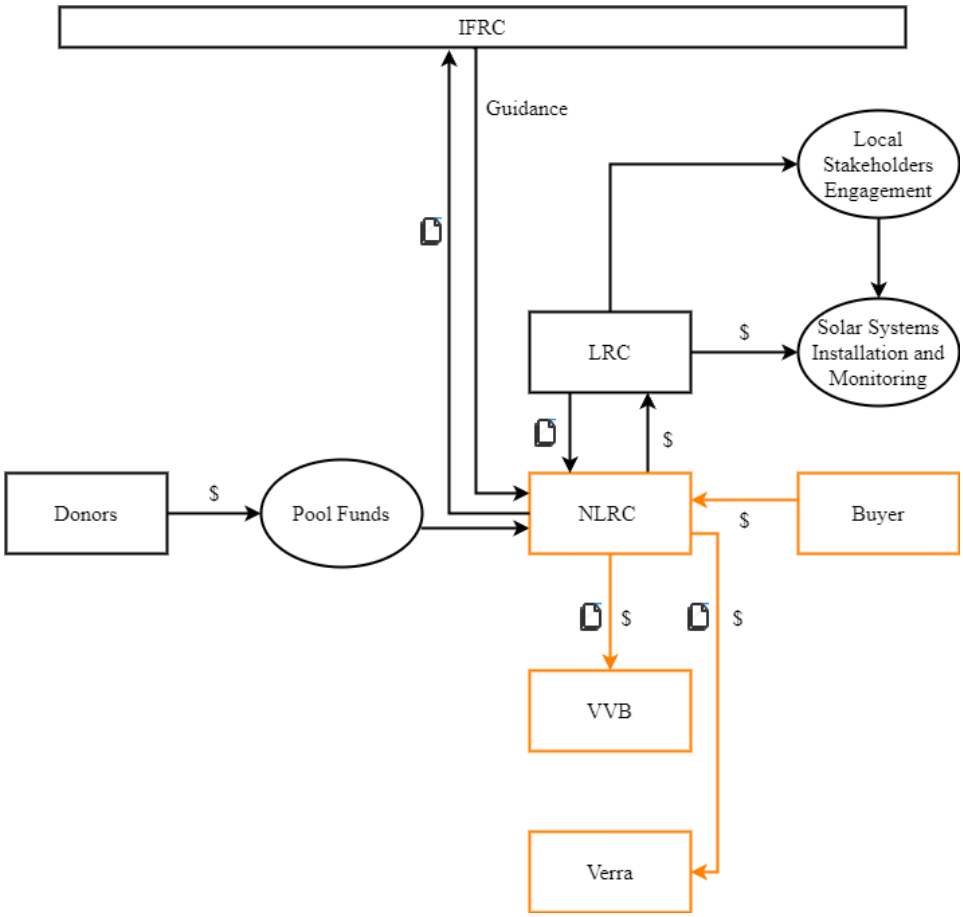

Figure 20: Business model proposal 3

Table 16 presents the key benefits and risks associated with this model as discussed with the NLRC.

Table 16: Benefits and risks of business model proposal 3 identified during the focus group discussion with the NLRC

Benefits	Risks
- Less burden on LRC - More control over the process by NLRC - Better direct control over buyers - Strategic for the NLRC. Might be the goal that the NLRC want to reach in the future - More transparent - Better control over the credits' price - Branding for the NLRC	- More burden on the NLRC (i.e., capacity requirement) - NLRC is the focal point while IFRC's is only limited to guidance compromises potential scalability - Funding instability

4.3.2.4 Proposal 4

The business model in Figure 21 is similar to the second proposed model. However, it assumes that the is a standalone entity that is chaired by the IFRC and LRC, where only the NLRC provides advisory role and technical support when needed.

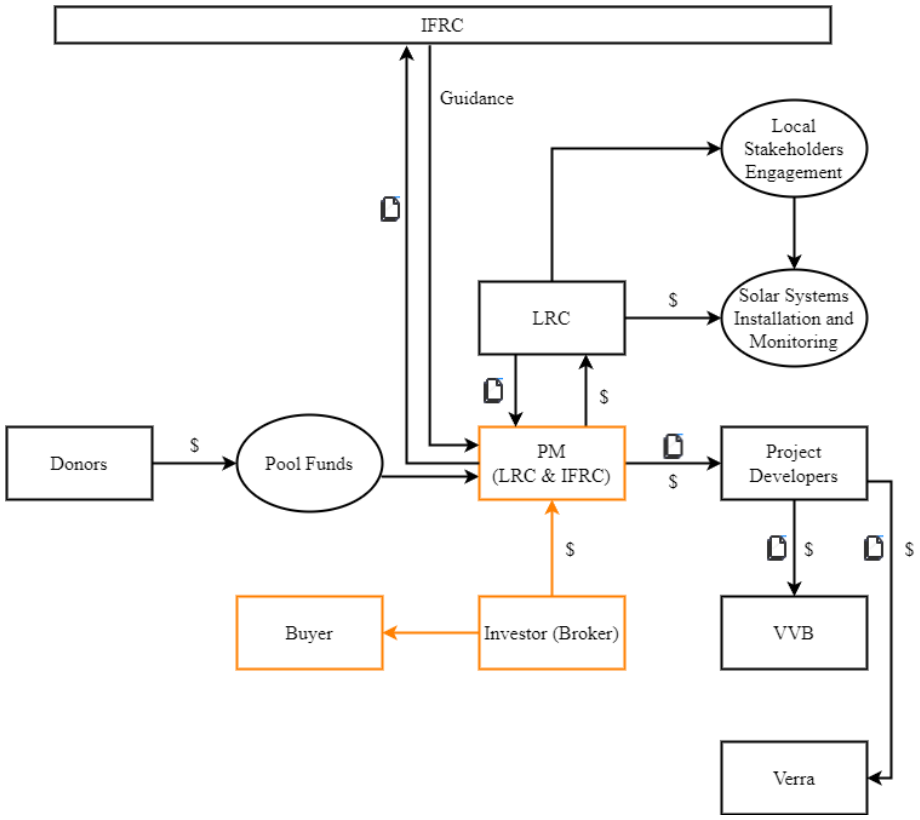

Figure 21: Business model proposal 4

Table 17 presents the key benefits and risks associated with this model as discussed with the NLRC.

Table 17: Benefits and risks of business model proposal 4 identified during the focus group discussion with the NLRC

Benefits	Risks
- Highest upscaling potential - Less risks for NLRC - Less administration-heavy - Potential for enhanced monitoring and local communication with LRC - Ownership of LRC - Better understanding of the local context in the PM body with LRC involved. - More interesting to investors (confirmed by the interview with the potential investor) - IFRC position eliminates competition on donors between national societies	- Capacity of LRC & IFRC - Willingness of NLRC to take such a limited role

Table 18 presents a comparative summary between the key identified benefits and risks presented in Tables 14-17.

Table 18: Summarized comparison between the proposed models in terms of their benefits and risks

Feature		Proposal			
		1	2	3	4
Benefit	Less burden on LRC	✓	✓	✓	
	Maximized revenues to the Red Cross	✓			
	Could be used by the NLRC as a pilot to build capacity	✓	✓		
	More control over the process by NLRC	✓	✓	✓	
	Financial risk sharing		✓		
	Better control over buyers through set criteria		✓		
	Less ethical risk regarding the use of donor funding		✓		
	Direct control over buyers			✓	
	Strategic for the NLRC			✓	
	Enhanced transparency			✓	
	Better control over the credits' price			✓	
	Branding for the NLRC			✓	
	Highest upscaling potential				✓
	Less risks for NLRC				✓
	Less administration-heavy				✓
	Potential for enhanced monitoring and local communication with LRC				✓
	Ownership of LRC				✓
	Better understanding of the local context				✓
	More interesting to investors				✓
	IFRC position eliminates competition on donors				✓
Risk	More burden on the NLRC (capacity requirement)	✓	✓	✓	
	Distant and more communication required for project developer	✓	✓		
	Administration-heavy	✓	✓		
	NLRC is the focal point while IFRC's is only limited to guidance	✓	✓	✓	
	Having a broker is risky	✓	✓		
	If the model uses regular institutional donor funding, it would be ethically risky	✓			
	Donor funding instability	✓	✓	✓	✓
	Capacity of LRC & IFRC				✓
	Willingness of NLRC to take such a limited role				✓

4.3.2.5 Key factors

Various key factors were identified and prioritized by each NLRC participant as the most significant considerations while developing the business model. These factors are summarized as follows:

1. Capacity of the organization, including LRC, NLRC and IFRC
2. Financial risk sharing
3. Transparency
4. Localization
5. Ownership of LRC
6. Burden on the organization, including LRC, NLRC and IFRC
7. Sustainability
8. Scalability
9. Ethical considerations

The frequency analysis revealed the number of occurrences of each response among the NLRC participants, as shown in Table 19. The main factors considered in developing the business model are capacity, risk sharing, ownership, and scalability.

Table 19: Frequency analysis results

Factor	Frequency
Capacity	5
Risk sharing	4
Ownership	4
Scalability	3
Localization	2
Sustainability	2
Ethical considerations	2
Transparency	1
Burden	1

Another significant outcome of the focus group discussion with the NLRC is the suggestion to propose two business models: one for the short term (referred to as the pilot model) and another for the long term (referred to as the strategic model). Table 20 shows the extent of involvement of each party in the two models, as discussed in the NLRC focus group.

Table 20: Roles of each party in the pilot and strategic models

Partner	Pilot	Strategic
NLRC	**Yes** For facilitation and support (depending in the agreement with LRC)	**Maybe** As advisor
LRC	**Yes** Implementation	**Yes** Implementation + bigger role in project management
IFRC	**Yes** Guidance	**Yes** More involvement in project management for scalability
Outsourced broker	**Yes**	**No**
Outsourced project developer	**Yes**	**No**

4.3.3 Pilot vs Strategic Business Models

Before recommending the models, an interview was conducted with the co-founder of the foundation that was deemed as interested in donating for the certification process to confirm their role. The main outcome of the interview was that the Foundation can either invest in or donate to the solar water systems through their pool funds, with the NLRC funding the certification process and bearing the associated risks. The Foundation's donors would then buy some of the credits. Another scenario is that the Foundation pre-invests in the carbon certification process and takes shares of the revenues. However, it was highlighted that it is currently more attractive to participate solely in financing the solar systems. This is mainly since the Foundation's main mission lies in securing enhanced water access, so directly financing the solar systems would have more tangible impacts and more relevant to their scope. Another notable reason is that the Foundation is not willing to share the financial risks associated with carbon certification, unless a strong business case is demonstrated.

Considering the outcomes from the NLRC focus group discussion and the interview with the Foundation, the pilot and strategic business models are proposed as shown in Figure 22 and Figure 23.

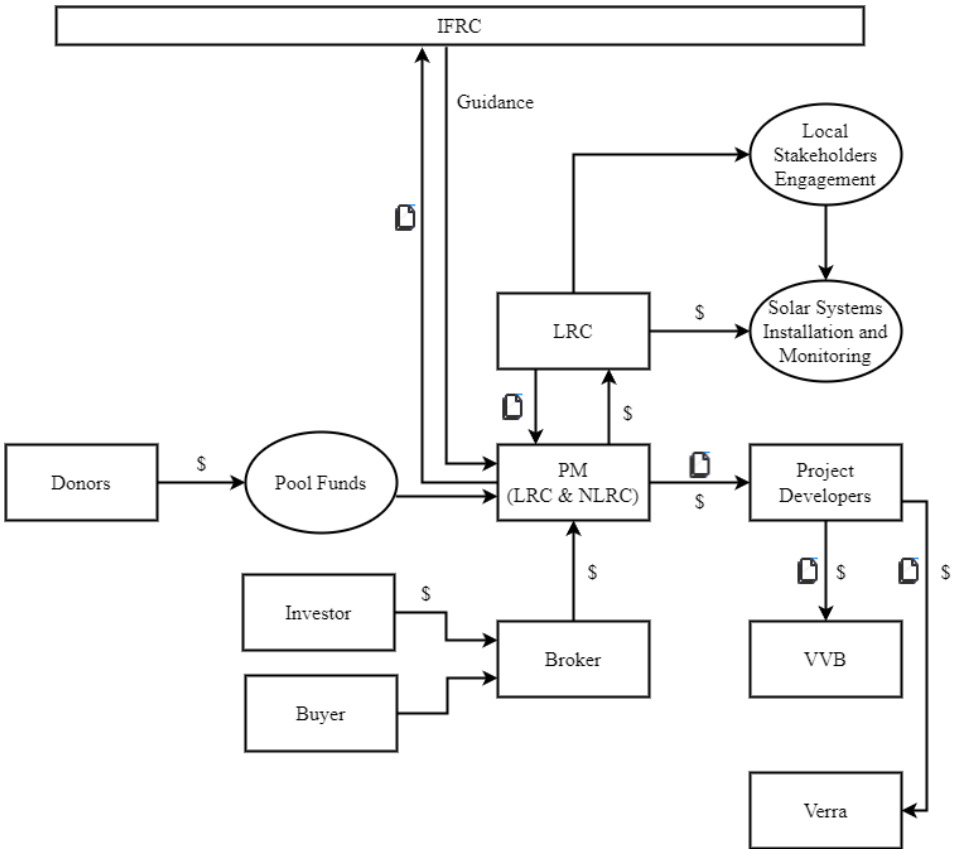

Figure 22: Pilot business model proposed for the short-term implementation

In the pilot model, it is assumed that the solar systems are financed mainly through pool funds (whether including donors from the Foundation or solely the NLRC). Additionally, investment for the carbon certification process is mobilized through the Foundation, which also acts as the broker since they facilitate the selling process by having their own donors interested in buying water-related carbon credits. An outsourced project developer ensures the facilitation and reliability of the administrative work related to carbon certification, given that the Red Cross does not currently have the in-house capacity. The involvement of the LRC in project management enhances localization and ownership, which was the second-most prioritized factor identified by the NLRC. This setup also allows for risk sharing through the involvement of an investor.

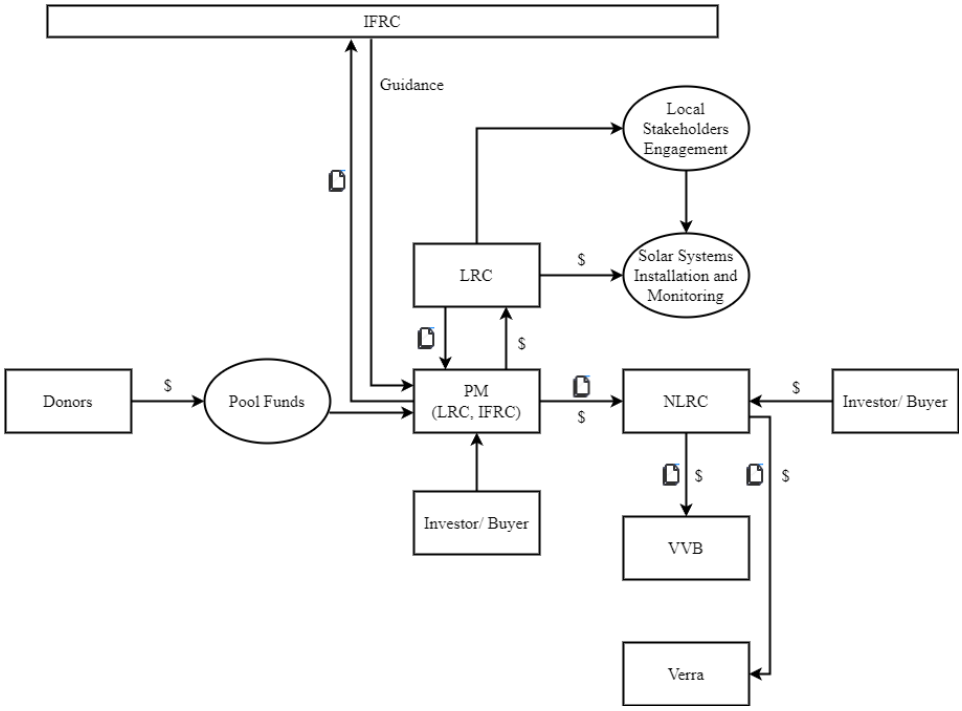

Figure 23: Strategic business model proposed for the long-term implementation

In the strategic model, the project is managed by the LRC together with the IFRC, fostering scalability as well as ownership and localization, both of which are prioritized factors by the NLRC. Moreover, the NLRC acts as both the broker and the project developer, implying that the organization will have sufficient capacity for these roles in the future. This ensures transparency and better control over project implementation, as all key actors are within the Red Cross. Like the pilot model, the strategic model includes an investor financing the carbon certification process, allowing for risk sharing and providing a more reliable source of funding. It is worth noting that this model is quite similar to the pilot one business wise, while it adopts a slightly different governance model.

Takeaway

The key takeaways regarding the proposed business model are as follows:

- Unlike for-profit organizations, humanitarian non-profit organizations prioritize factors beyond financial gain, such as ethical risks. This significantly influenced the process of developing and proposing the business models.
- There is no perfect business model. There will always be a tradeoff between various factors (e.g., risk sharing vs. financial gain). Therefore, it is ultimately the organization's decision to determine the most appropriate governance setup that balances the tradeoffs in a way that aligns with their vision and goals.
- It is recommended to implement both a pilot (short-term) and a strategic (longer-term) governance model. Both models would adopt the same business model.

5 Discussion

This section aims to interpret the findings in relation to the broader context of the project as well as reflect on the key concepts like BMI and HI. By addressing the three sub research questions, a comprehensive view that integrates all aspects of the study is created.

5.1 Project-specific Considerations

One significant challenge that could be identified is the potential for conflict with the Lebanese government. The government may perceive the project as reducing its opportunities to undertake similar initiatives that count towards its NDCs under the Paris Agreement. There is a risk that the government might view generating carbon credits for this project in the VCM as competing with its climate pledges, potentially leading to friction over resource allocation and policy priorities. After investigating the key aspects of the carbon markets under sub research question 1, also complemented with the literature review, this research suggests the need for careful communication with the government and alignment with national policies to ensure the project complements rather than conflicts with governmental objectives. Another challenge is Lebanon's political and economic instability, which presents an obstacle in attracting and retaining investors. This instability can deter investors concerned about the risks associated with project continuity and returns on investment. Therefore, establishing robust risk mitigation strategies and demonstrating the project's resilience and potential for highly impactful social and environmental returns is critical to securing investor confidence.

The integration of carbon credits into humanitarian water projects represents a niche market. This niche combines environmental sustainability with humanitarian aid, providing a unique value proposition. However, its novelty means there is limited precedents, making it both a pioneering opportunity and a challenge due to the lack of established models and practices. The project's success could pave the way for similar initiatives globally, but it requires navigating uncharted territory with careful planning and strategic innovation. Moreover, there is a significant gap in academic and practical literature on the integration of carbon credits by humanitarian organizations in water projects. This lack of existing research underscores the innovative nature of the project but also highlights the need for comprehensive documentation and dissemination of findings. By contributing new knowledge and evidence to this niche, this project can help build a body of literature that supports future initiatives.

When considering the findings of the second research sub question, it becomes evident that the technical feasibility hinges on robust calculation of the GHG emissions reduction and maintaining credits' integrity. The study highlights that the solarized public water systems in Lebanon can potentially achieve significant emissions reductions under some scenarios. Although the scenario analysis showed that only 50% of the capital needed for installing the systems could be covered under the best case, it still makes the project financially viable in the humanitarian context as it provides an additional source of funding that is reliable and sustainable throughout the crediting period. However, ensuring the integrity of these credits is crucial. This involves rigorous verification processes to maintain credibility and trust in the carbon market, which is critical for the project's success and sustainability.

5.2 Organization-specific Considerations

5.2.1 Governance

As a step toward developing the business model, the focus group discussion defined the key factors to consider for the model. This paved the way to answer the third sub research question regarding comparing the different models proposed. The key factors that were identified reflect the significance of governance. Although the focus group discussions highlighted the importance of capacity as the most-commonly prioritized factor by all the participants, none of the Red Cross organizations, whether on an international level (IFRC) or local level (NLRC and LRC), currently possess the necessary capacity. Consequently, this factor could not be well-reflected in the models. However, if capacity building were to be prioritized for one organization, it is recommended to focus on the IFRC to facilitate scaling up the implementation of carbon credits among other locations and national societies. This approach also makes the initiative more attractive to investors, offering enhanced future opportunities for collaboration in similar projects.

Another option for the NLRC is to hire a project developer for the feasibility study and invest in the carbon certification process. This approach carries two risks. First, it is contingent on the feasibility study proving that the project is technically viable for acquiring carbon credits and participating in VCMs, as well as being financially feasible and profitable. This process requires pre-investment from the Red Cross without a guarantee of resulting in carbon credits. However, this is necessary for the NLRC before proceeding with the project in all the cases. Second, if the project developer invests in the certification process, it might involve giving the project implementer (i.e., Red Cross) a fixed rate (e.g., 5 USD/credit)[9], often resulting in the project developer receiving a higher revenue share. Although this reduces financial risk for the Red Cross, since the project developer bears the potential risks and the Red Cross mainly provides essential data and information, it is less financially appealing due to the reduced revenue. A detailed assessment should be conducted when all data is available about the project's scale and emission reductions, as well as valid financial model assumptions, to decide. This approach might be attractive for large-scale projects, as the flat rate could still generate additional revenue for the Red Cross. Moreover, the initial project could provide valuable insights into the project documentation and processes, aiding future capacity development within the organization to potentially undertake project development roles. An additional consideration is the role of the broker. The qualifications and certifications required by an entity or individual to become a broker should be further investigated to validate the role of the Red Cross as a broker.

5.2.2 Tradeoffs and Opportunities

Considering the key findings of all the research questions as well as the continuous consultations with the NLRC, the organization must navigate the tradeoffs and opportunities within carbon markets. It is notable that financial gain is not the major factor for the organization. Other factors like risk sharing and ethical use of donor funding are also significant, unlike for-profit organizations where financial gain is commonly the primary decision-making factor. The Red Cross is concerned with the ethical implications of participating in VCMs, given criticisms about carbon markets contributing to greenwashing and requiring further regulation. This concern is

[9] This model was mentioned during the interview with the interested investor.

significant enough that a parallel study is being conducted to investigate the ethical risks associated with the organization's participation in the VCM. Investigating this topic from a humanitarian organization's perspective provides insights into the diverse considerations involved in participating in the VCM. Despite the theoretical environmental and social benefits, critics argue that carbon markets currently do not deliver these benefits as intended (Dawes et al., 2023; ISDA, 2024; Miltenberger et al., 2021). The involvement of reputable organizations like the Red Cross, which adheres to ethical, social, and environmental values, could potentially push carbon markets towards greater integrity and set an example of how organizations can achieve financial gains while maintaining core values. The participation of the Red Cross in carbon markets presents an opportunity to address some of the criticisms leveled against these markets. By implementing a transparent, well-documented, and community-focused project, the organization can help elevate the standards of the VCM. This could contribute to a more robust and credible market that genuinely supports global decarbonization efforts.

Nonetheless, the organization should not compromise its financial gains. For example, an interested private investor was only willing to fund the solar systems rather than the carbon certification process, making this collaboration less appealing to the NLRC. The primary added value of this contribution would be for the other organization to continue investing in water-related projects in developing countries, providing an additional service to their customers who buy carbon credits and are interested in carbon credits from water projects. However, for the Red Cross, this is not appealing because they already have a well-established, diverse network of donors and potential buyers. Collaborating with this investor might compromise the organization's profit from the project, as the investor would expect a share of the revenues, whether they acted as investors in the certification process or as brokers. In summary, while the Red Cross does not prioritize financial factors over other considerations, it should not lead to easy compromises allowing another organization to profit at the Red Cross's expense.

This example illustrates the trade-offs within the business model. Collaborating with an external organization might reduce the Red Cross's profit but also lower the financial risk through risk-sharing. Another trade-off is capacity versus transparency; in-house project activities increase transparency but require higher capacity. While recommending outsourcing the project developer and broker in the pilot scenario, it is crucial to note that this requires higher administrative work and might affect transparency. Therefore, the organization must decide which trade-offs make sense based on a detailed feasibility study of capacity building needs, potential future scaling, and replication of carbon certification in other locations.

Considering the ethical use of donor funding for carbon credits might be risky, a potential solution could be using unregistered credits. This model involves the Red Cross accounting for carbon credits internally and communicating that specific project activities have led to specific amount of emission reductions without external validation or verification. These credits could then be sold to buyers at lower prices. This model could appeal to organizations unable to afford carbon certification prices and buyers satisfied with unregistered credits for offset claims. However, this approach carries significant risks, such as ethical concerns due to the lack of credibility and potential for double counting. While this model eliminates ethical risks associated with using donor

funding for carbon credits and reduces certification costs, it also eliminates the benefits of enhanced credibility and transparency provided by participation in registered markets and introduces a new set of risks.

5.3 Relation and Contribution to Existing Literature

5.3.1 Business Model Innovation

Following the BMCF and the findings of the third research sub question highlight how the project relates to BMI. In the context of integrating carbon credits into solarized public water systems in Lebanon, BMI involves several key components: new customer segments (i.e., buyers of carbon credits), a value proposition centered on high-quality carbon credits with social co-benefits, and strategic partnerships with investors and project developers. This also involves creating new revenue streams from the sale of carbon credits, which supports the financial sustainability of these systems. The innovation lies in using an environmental commodity (carbon credits) to fund humanitarian infrastructure, thereby linking environmental and social benefits. In addition, the project strengthens community resilience to energy and economic crises through reducing dependence on diesel fuel and promoting renewable energy. Enhanced access to clean water also ensures improved public health. Thus, the project not only addresses financial and environmental challenges but also delivers significant social benefits. This holistic approach ensures the project's viability and scalability, making it a model for similar initiatives in other regions.

5.3.2 Humanitarian Innovation

Another crucial concept reflected in this study is HI, which refers to the application of novel solutions to address challenges in humanitarian contexts, typically involving vulnerable populations affected by crises such as conflicts, natural disasters, or economic hardships. This type of innovation often focuses on creating significant improvements in the efficiency, effectiveness, and impact of humanitarian interventions. It can encompass new products, processes, or organizational models that better meet the needs of affected communities. In this study, HI is demonstrated through the development of sustainable business models that incorporate carbon credits to fund the solarization of public water systems in Lebanon. This approach not only addresses immediate water access issues but also ensures the long-term operability and sustainability of water supply systems by leveraging innovative financial mechanisms. This contributes to enhancing the overall resilience and sustainability of the Red Cross’s humanitarian mission.

5.3.3 Humanitarian Innovation Business Model Canvas

To identify the main elements of the proposed business model, the HIBMC was used. In the context of humanitarian innovation, this canvas is particularly effective because it differentiates between users and clients and distinguishes between value proposition and impact. Additionally, it adds more layers to the traditional BMC by clearly specifying the innovation, unique selling point, success metrics, and externalities. However, an important aspect identified in the current study is the risk associated with a humanitarian organization adopting specific business models or participating in certain markets. In the current project, it was noted that there are significant ethical risks that the organization must carefully consider before adopting the business model and deciding to participate in carbon markets. Externalities are crucial for partners in a business case to

understand how they will be impacted if they decide to collaborate with the organization on a specific project. Beside externalities, it is equally important for them to be aware of the risks on the organization itself, since this might affect the sustainability and continuity of the project. This awareness ensures that partners have a complete understanding before committing to the project. This highlights a potential gap in the HIBMC, which lies in not capturing the possible ethical risks or other similar risks that are particularly relevant to humanitarian organizations. Given that humanitarian organizations rely heavily on their reputation as a key asset, these risks are indispensable.

5.4 Resilience and Adaptability of the Proposed Business Models

A critical consideration for the proposed pilot and strategic business models is their ability to withstand external financial and economic disruptions, such as global regionalization or disruptions in monetary flows. Although both models operate under the same business model, they adopt different governance structures. This impacts their response in the face of such challenges. The pilot model, which mainly aims to build capacity, is designed with a governance approach that allows for flexibility and adaptability. This flexibility could help mitigate the risks associated with financial instability. The model's governance allows for a more decentralized approach, enabling the organization to navigate financial disruptions by leveraging local capacities and adjusting to changes in funding availability or economic conditions. On the other hand, the strategic model, with its more centralized governance, emphasizes transparency, control, and a long-term vision aligned with the NLRC's strategic goals. This governance structure allows the organization to take a leading role in managing and scaling solarization projects. The strategic model is designed to enhance stability by positioning the organization to better withstand economic fluctuations through strong oversight and strategic planning. Both models also demonstrate the ability to function in non-market contexts, which is particularly relevant in the humanitarian sector. Given that both models adopt the same business model, they can adapt to environments where traditional market mechanisms may be unreliable or absent. The pilot model's decentralized governance allows for greater adaptability in informal settings. In contrast, the strategic model's centralized governance ensures consistency and transparency, even in non-market contexts. This adaptability is crucial for maintaining the humanitarian focus, ensuring that the models can operate effectively and deliver on their objectives regardless of market conditions. The ability to function outside traditional market structures underscores the importance of considering a hierarchy of means and goals in humanitarian efforts. While both models incorporate market-based mechanisms such as carbon credits and revenue generation, their ultimate aim is to provide sustainable and equitable solutions to those in need. By ensuring that the governance structures of these models can operate within and beyond market contexts, the NLRC can better align its initiatives with humanitarian principles, ensuring their effectiveness even in the face of economic and financial challenges.

6 Conclusion

This study explored the integration of carbon credits into innovative sustainable business models for solarized public water systems in Lebanon. Reflecting on the first research sub question (What standards, processes, participant roles, and integrity criteria govern carbon projects throughout their lifecycle?), the key aspects of voluntary carbon markets were analyzed. These markets provide essential platforms for cost-effective climate actions, which can significantly contribute to reducing global carbon footprints. In response to the second research question (What is the technical feasibility of acquiring carbon credits for Lebanon's solarized public water pumping systems in terms of GHG emissions reduction and credits' integrity?), the technical feasibility assessment revealed that solarized water systems could indeed generate substantial emission reductions, and thereby qualifying for carbon credits. However, the current scale of projects funded by the NLRC in Lebanon, covering five locations, is insufficient to achieve financial viability unless there is a significant expansion. This finding underscores the need for larger-scale implementations to realize better financial outcomes and attract blended financing options that combine donor funding and carbon credit revenues. Addressing the third research question (What are the potential business models integrating carbon credits for solarized public water systems, and what are their associated benefits and risks in terms of stakeholder roles and cash flow?), several business models were proposed using the BMCF, each emphasizing different aspects of project implementation, stakeholder roles, and financial structuring. These models aim to balance financial gains while maintaining high ethical standards and transparency, which is crucial for humanitarian organizations like the Red Cross. Participation in carbon markets presents an opportunity for the Red Cross to enhance the credibility and transparency of the VCM by setting a strong example through well-documented and community-focused projects. The study concludes that integrating carbon credits into the business models of solarized public water systems offers substantial environmental and financial benefits for the Red Cross. However, the organization must carefully navigate the trade-offs between financial viability, ethical considerations, and operational transparency.

This study contributes to the existing body of literature both in theory and in practice. Theoretically, it advances the existing body of knowledge by developing a novel business model that integrates carbon credits within the humanitarian sector. This addresses the intersection of BMI and HI, providing a structured approach to tackling the financial and operational challenges faced by crisis-affected regions. By focusing on the specific case of solarized public water systems in Lebanon, the study contributes to the literature with context-specific insights that can be adapted to similar environments globally. Practically, the research offers actionable recommendations for humanitarian organizations, particularly in leveraging carbon credits as a financial mechanism to support their projects. The study's findings have direct implications for the NLRC, offering a pathway to scale solarization efforts while ensuring financial viability through carbon market participation. By bridging the gap between theory and practice, this study not only contributes to academic discourse but also provides tangible solutions that can be applied in real-world humanitarian operations.

While this study provides insights into integrating carbon credits into sustainable business models in the humanitarian context, there are limitations to the findings. One of the primary limitations is

the reliance on a relatively small dataset, which may not fully capture the variability and complexity of similar projects beyond the locations under investigation. Another limitation lies in the scope of stakeholder engagement, which was limited to the NLRC. Broader input from other humanitarian organizations, could have provided a wider perspective. This could have allowed for higher potential for replication and adaptability of the proposed models. Developing robust frameworks for BMI and HI will be essential for systematically integrating carbon credits into sustainable business models on a broader level. This approach will not only address environmental objectives but also provide a replicable model for other humanitarian organizations. Ultimately, integrating carbon credits into solarized public water systems presents a promising opportunity for the Red Cross, offering significant environmental and financial benefits while upholding the organization's commitment to ethical and transparent practices.

7 Recommendation for Future Research

Further research should focus on developing more robust frameworks for BMI and HI. These frameworks should address the unique challenges faced by humanitarian organizations and provide tailored solutions for integrating innovative business models into their operations. Criteria for evaluating and comparing different business models are also essential to help organizations identify the most effective and sustainable approaches through considering factors beside the financial benefit that are equally crucial. Moreover, there is a need for extensive research on carbon credits and carbon markets. This includes studying the mechanisms of carbon trading, the impact of different crediting standards, and the role of regulatory frameworks in ensuring market integrity. Such research can provide valuable insights into optimizing carbon market participation and maximizing the environmental and financial benefits of carbon credits.

Moreover, future research for the Red Cross should delve into comprehensive technical and financial assessments, capacity building for carbon project development, and broader surveys to evaluate the feasibility and impact of solarized public water systems on a larger scale. A detailed technical and financial assessment, including a robust investment plan, is essential for a real project implemented by the Red Cross to yield more solid and actionable results. This would involve meticulous data collection and analysis to accurately model costs, benefits, and potential risks associated with such projects. Additionally, more work is needed on understanding the qualifications necessary to become a broker and project developer within the carbon credit market. This includes identifying the skills, certifications, and regulatory requirements that might be required to navigate and succeed in this complex market. Building this capacity within the Red Cross can help streamline their involvement in carbon trading and enhance the overall efficiency and effectiveness of their projects. In addition, mapping existing as well as planned projects at the organization’s international level is crucial to determine whether building this capacity is worthwhile for the Red Cross. This survey should assess the potential for scalability and replication of successful projects across different regions and contexts. Another important area of focus is understanding how many of the Red Cross's partners are already buying carbon credits. Conducting a comprehensive survey to identify current partners involved in carbon credit transactions can provide valuable insights into the existing market landscape and potential collaborative opportunities. This information can guide strategic decisions regarding partnerships and market positioning.

By addressing these areas, both the Red Cross and academic institutions can contribute to the development of more effective, sustainable, and impactful models for integrating carbon credits into humanitarian and development projects. This collaborative effort can lead to significant advancements in both theory and practice, ultimately supporting global efforts to combat climate change and promote sustainable development.

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Appendix

Detailed calculations and assumptions for the technical assessment and cash flow analysis is available in the following link:

https://docs.google.com/spreadsheets/d/121qQgZSuOfQ-cLGQUR0H342H9jxXjtzv/edit?usp=sharing&ouid=104515518382688967559&rtpof=true&sd=true