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Digital Innovation and Sustainability: Advancing Voluntary Carbon Offsets

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Abstract.

Achieving the environmental objectives established by the United Nations in the 2030 Sustainable Development Goals (SDGs) will undoubtedly be a complex and demanding task. One of the most pressing challenges is the reduction of carbon dioxide (CO_2) emissions, which are the primary contributors to the intensification of the greenhouse effect and, consequently, global climate change. The rise in global temperatures, melting polar ice caps, and extreme weather events are all directly linked to elevated CO_2 concentrations in the atmosphere. In response to this urgent issue, both public and private institutions worldwide are adopting innovative methodologies that aim to integrate economic profitability with long-term environmental sustainability.

These efforts include implementing cleaner production technologies, investing in renewable energy sources, enhancing energy efficiency, and optimizing supply chains to minimize their carbon footprint. Increasingly, companies are incorporating sustainability criteria into their core business strategies, with many committing to science-based targets and transparent reporting mechanisms. A growing number of corporations are also joining global climate initiatives and coalitions, pledging to reach net-zero emissions by 2050. This alignment of business operations with climate goals is not only essential for mitigating environmental risks but also for ensuring competitiveness and resilience in a rapidly changing global economy. The transition to a low-carbon future requires bold leadership, cross-sector collaboration, and sustained commitment at every level of society.

Each year increase number of this. Carbon credits can help companies to meet their climate-change goals. The involvement of all citizens will be an essential factor to get this challenge. For this, the Voluntary offsetting market is created. Companies and citizens will pay for their emissions based on their carbon footprint. Investment in climate-related activities to combat climate change should reach more than 5 trillion by 2030. Based on the framework described above, digital technologies should play an important role. Digital applications and digital environments have begun to emerge. That can be defined as a voluntary digital market where people and organizations can calculate and offset or sell their CO2 footprint according to their needs. There is a lot of work yet. The voluntary offsetting market needs to be transparent and credible. Compliance standards, which should be a keystone of this market, are scarce or nonexistent. The purpose is not easy. Technology can help to reach this goal. Appear a lot of digital marketplaces trading CO2 offsetting every day. We search into these websites, comparing their most essential characteristics.

Keywords: Technology and Sustainability, C02 offsetting, marketplaces

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1 Introduction

It is widely accepted that society is increasingly aware of environmental challenges (Thompson & Harris, 2021). Public and private institutions are researching and applying innovative methodologies to create an ecosystem that can bring together profitability and sustainability (Valls-Val & Bovea, 2021; Thompson, 2021). Another keystone to cope with the environmental challenge is the citizen's role. According to the United Nations (UNFCC, 2021), it will also be essential to have the involvement of all citizens to achieve the environmental objectives determined by the United Nations in their 2030 GDS goals. The ecological challenge is complex and has many facets, but one of the most important is C02 emissions. CO2 emissions are the leading causes of the greenhouse effect on the planet. Today, the results of these emissions are highly relevant to all world economies. Global warming of the earth is mainly due to these emissions that provoke devastating climatic events with an enormous economic impact (Bjelle et al., 2021). Extreme weather won't be the only climate-related threat to supply chains in the years ahead. One consequence worries many: as demand increases for materials with low emissions intensity, such as green steel, production capacity may not expand quickly enough to keep pace, at least in the short term. For example, McKinsey analysis suggests that shortages of high-quality iron ore could constrain the production of zero-emissions steel (Bowcott et al., 2021). Environmental concerts are affecting both the planet and each person. It is urgent to limit C02 emissions to overcome the climate imperative. In the last Conference of the Parties Held, COP-26 in Glasgow (Growing Concerns for COP26, 2021), there has been a significant advance exploring the mechanisms that can generate and favour a Voluntary Emissions Offset trade. For instance, large industrial companies must seek efficiencies in their operational processes to reduce their carbon footprint. A growing number of companies are pledging to help stop climate change by reducing their greenhouse gas emissions as much as they can. But with the current development of technology, it is almost impossible for many businesses to eliminate their emissions or even lessen them as quickly as they might like. The challenge is especially tough for organisations that aim to achieve net-zero emissions, which means removing as much greenhouse gas from the air as they put in. This situation pushes the creation of carbon credits to offset emissions they can't get rid of by other means, compensating in that way their CO2 emissions (Blaufelder et al., 2021). The COP26 has been treated in-depth on establishing a fair trade of rights for their compensation. But it is not enough only with the contribution of large companies. It is necessary that each individual, at a particular level, can offset their carbon footprint. The first step should be calculating each person's Carbon Footprint (Geneidy et al., 2021).

When individuals and companies become aware of their greenhouse gas (GHG) emissions and the volume that should be offset, the logical next step is to establish a voluntary carbon offset market. Such a market enables entities and people who wish to mitigate their emissions to contribute financially to initiatives that reduce or remove GHGs from the atmosphere. This market operates outside of the mechanisms established by the Kyoto Protocol, emerging as a decentralized and flexible alternative. In the voluntary carbon market, non-governmental organizations (NGOs), private enterprises, and individuals can both generate and purchase offsets. These offsets often fund reforestation projects, renewable energy programs, or methane capture efforts, among others. However, as noted by Lovell (2010), a major issue persists: the absence of universally recognized and enforced international standards. This lack of standardization leads to questions about the credibility and environmental integrity of some offset projects.

The 2015 Paris Agreement represents a pivotal shift, as nearly 200 nations committed to limiting the increase in global average temperature to below 2°C above pre-industrial levels, ideally aiming for 1.5°C. Achieving this target demands substantial reductions— global emissions must fall by 50% by 2030 and reach net-zero by 2050. In alignment with this, a growing number of companies are pledging to reach net-zero emissions. According to Blaufelder et al. (2021), the number of firms with such commitments more than doubled in just one year—from 500 in 2019 to over 1,000 in 2020. Carbon credits play a vital role in helping companies meet these goals, particularly in hard-to- abate sectors where immediate emissions

reductions are difficult.

Nevertheless, for the voluntary carbon market to function effectively, several challenges must be addressed. Chief among them is the establishment of a reliable and transparent methodology for calculating carbon footprints. Without a standardized approach, it becomes difficult to determine how much a company or individual must compensate. Additionally, the allocation of compensation rights—deciding who can sell and claim offsets—requires clear governance frameworks. As highlighted by Sheather (2021), these analytical and procedural foundations are critical early steps for building trust in offset mechanisms and ensuring the integrity of compensation systems. Therefore, creating a credible and efficient voluntary carbon market must become a top priority in the global climate response strategy. By doing so, a greater number of stakeholders can be engaged, increasing the scale and impact of climate mitigation efforts worldwide.

2 Methods

Based on the framework described above, digital technologies should play an important role. Digital applications and digital environments have begun to emerge with two main objectives: (1) to calculate the carbon footprint by applying a world standard method; and (2) based on the previous calculation of the carbon footprint, to create mechanisms to offset this footprint by choosing a specific compensation reliable project inside the same digital environment that (Warburg et al., 2021). That can be defined as a voluntary digital market where people and organisations can calculate and offset or sell their CO2 footprint according to their needs. In recent years, studies on consumer behaviour when choosing and participating in these markets have allowed consumers to compensate for emissions voluntary, improving their C02 challenges(Warburg et al., 2021).

In these markets, measurement and disclosure are unavoidable; forcing digital technologies to create exchanges defining prices transparently can have benefits (Bowcott et al., 2021). Even using digital technologies to calculate and compensate carbon emissions, monetizing it in a safe and trusted environment is not easy for both individuals and organisations (Bowcott et al., 2021). Carbon offsets are produced and sold under the international climate change regime (the United Nations Kyoto Protocol) and within an expanding voluntary offset market. Companies and individuals can voluntarily trade to balance their greenhouse gas emissions. The volume of carbon produced and consumed within compliance and voluntary markets has grown dramatically in the last five years, raising several governance challenges (Lovell, 2010). Digital Marketplaces: E-commerce of Voluntary Carbon Offsetting.

A global carbon market has evolved in recent years after the United Nations Kyoto Protocol. It has significant growth potential serving countries, organisations and individual customers. However, this market has been characterized by an absence of publicly available market information and a lack of transparency (Harris, n.d.). Compliance standards, which should be a keystone of this market, are scarce or nonexistent.

According to Reuters, investment in climate-related activities to combat climate change should reach more than 5 trillion by 2030.

Given the small and fragmented nature of the retail market and the lack of centralized registration for non-CDM[1] projects, it isn't easy to estimate the size of the market. The World Bank maintain databases of non-CDM project transactions, but they are primarily incomplete due to the above reasons (World Bank, 2021). The retail market for carbon offsets is relatively small and fragmented. Many consumers and organisations are unaware of what makes complex voluntary compensation for both people and organisations. In this context, it isn't easy to achieve ambitious objectives. In recent years, taking advantage of technological advances, many marketplaces are

[1] CDM: Clean Development Mechanism

appearing. Their primary purpose is to show potential clients the projects to offset their carbon footprint. Our study analyses the current marketplaces with a qualitative methodology to determine their main

features, what motivates consumers' participation, and their ethical priorities of users' influence. We are going to review 15 websites. These sites choose the most important in the market. We search into the websites the number of users, the total of carbon offsetting, the main characteristics, their first application in this market, and other specific situations that we find out while we do the study. Then, we will make a ranking that recognizes the essential qualities of users.

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