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Carbon credits as a mechanism for municipal climate finance: evaluating the practice of double claiming mitigation outcomes

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As governments, corporations, and other organizations around the world continue to set and work toward greenhouse gas (GHG) mitigation goals, carbon markets will play an increasingly important role. Specifically, the voluntary carbon market (VCM) is poised to grow as corporations use carbon credits to offset their emissions and make claims of carbon neutrality. However, there is debate regarding best practices for claiming mitigation outcomes tied to VCM credits. One side argues that any carbon credit needs to be coupled with a corresponding adjustment, which functions to ensure the mitigation outcome is only accounted for by the carbon credit claimant. The other side argues that the practice of double claiming should be allowed when carbon credit project developers and claimants are different reporting entities, such as corporations and governments. This paper contributes to this debate by considering the potential for municipalities to develop carbon credit projects and raise money for local GHG reduction efforts. Many municipalities around the world have already developed climate action plans which identify locally relevant GHG reduction measures; however, there are few examples of municipalities leveraging the VCM as a climate finance mechanism. Here, an illustrative example with the City of Flagstaff, AZ demonstrates how the practice of double claiming mitigation outcomes can enable the transfer of climate finance from corporations with GHG reduction targets to municipalities with underfunded climate action plans.

KEYWORDS
climate action plan, climate finance gap, greenhouse gas accounting, greenhouse gas reduction, market mechanism, municipal sustainability, voluntary carbon market

Introduction

Global ambition to accelerate the clean energy transition and reduce greenhouse gas (GHG) emissions remains high and widespread. As of September 2025, 137 countries had set long-term net zero emissions targets covering 74% of global carbon emissions (Net Zero Tracker, 2025). Yet, the consumption of fossil fuels, the largest driver of global GHG emissions, rose to the highest levels ever recorded in 2024 (IEA, 2025). A key barrier to translating climate ambition into climate action is the commitment of both public and private financial resources. The United Nations defines climate finance as any "local, national or transnational financing—drawn from public, private and alternative sources of financing—that seeks to support mitigation and adaptation actions that will address climate change" (UNFCCC, 2023). Annual totals

of global climate finance have grown steadily over the past decade, however investment in both mitigation and adaptation measures will need to increase at least seven-fold by 2030 to achieve international climate goals (Naran et al., 2022).

Recognizing that national ambition to mitigate climate change will not be enough, municipalities and local governments around the world have stepped up and made their own climate commitments (Kuramochi et al., 2020). Local communities are well positioned to oversee climate action measures, considering their close proximity and direct relationship with much of the infrastructure, energy systems, and citizens that contribute to key sources of emissions (Dale et al., 2020). Municipalities have deployed a variety of traditional and innovate finance arrangements to bring much needed capital into climate action efforts including green bonds, energy performance contracting, and crowdfunding (Ulpiani et al., 2023). However, an underexplored climate finance mechanism for municipalities is the voluntary carbon market (VCM).

The VCM allows GHG mitigation project developers to quantify mitigation outcomes and sell carbon credits to entities interested in making emission reduction claims (hereafter referred to as claimants). In recent years, the VCM has been subject to increasing scrutiny and debate around the quality of carbon credits and efficacy of the market in general (Blum, 2020; Kreibich and Hermwille, 2021; Trencher et al., 2024). Concerns regarding the VCM largely revolve around overestimation of emissions reductions, lack of additionality, weak verification standards, and potential greenwashing by corporations. In response to concerns over carbon credit integrity, organizations like the Integrity Council for Voluntary Carbon Markets (ICVCM) and the Voluntary Carbon Markets Integrity Initiative (VCMI) have established stricter standards, transparency guidelines, and best practices to enhance trust and credibility in the market (ICVCM, 2024; VCMI, 2024). Carbon market proponents argue that despite recent controversy, the VCM offers a crucial mechanism for mobilizing climate finance as the world moves toward net-zero GHG emissions (Miltenberger et al., 2021; Streck, 2021).

With increased attention to the quality and integrity of voluntary carbon credits, there is broad agreement that the quantification of mitigation outcomes must be backed up by transparent and credible calculation methodologies (Streck et al., 2023). However, there is debate around how carbon credit project developers and claimants should account for mitigation outcomes. Some argue that mitigation outcomes should be claimed only once by the claimant (Brander et al., 2022; Schneider et al., 2019). In this case, the carbon credit project developer would need to make an upward adjustment to their own GHG emissions inventory to counterbalance the transferred mitigation outcome. Others contend that when the project developer and claimant are different reporting entities, such as governments and corporations, both should be allowed to claim the mitigation outcome in their respective GHG emissions reporting (Ebert, 2022; Moura Costa, 2022). The outcome of this debate has significant implications for growth of the VCM and its effectiveness as a climate finance mechanism.

Here, we bring a novel perspective to the debate around double claiming VCM mitigation outcomes by investigating the scenario of municipalities as carbon credit project developers. First, we provide an overview of the VCM double claiming debate. Second, we discuss the potential for municipalities to develop carbon credit projects based on climate action measures. Third, we use the City of Flagstaff, AZ as an example to illustrate how the accounting of mitigation outcomes could be tied to VCM transactions. Lastly, we outline possible limitations and provide closing thoughts around the debate of double claiming and the potential for carbon markets to act as a mechanism for municipal climate finance.

The voluntary carbon market and the double claiming debate

Market mechanisms have played an important role in mobilizing climate finance since the adoption of the Kyoto Protocol in 1997 (Spilker and Nugent, 2022). This landmark international treaty established the Clean Development Mechanism (CDM), a global market mechanism where GHG mitigation outcomes could be commodified and traded as carbon credits. Many different carbon markets exist across the world today and each can be categorized as either a compliance market or voluntary market. Contrary to compliance markets where rules and regulations around allowable emissions are mandated by a governmental or intergovernmental body, the VCM is not enforced or managed by any governmental body. Instead, the VCM exists to facilitate the exchange of carbon credits between GHG mitigation project developers and organizations making efforts to achieve emissions reduction goals. For example, corporations working to achieve a carbon neutrality goal, also called net-zero emissions targets, often rely on carbon credits from the VCM to offset some of their emissions (Kreibich, 2024).

A defining feature of the VCM is the transfer of carbon credits from the developing world to developed countries. The CDM was originally designed to encourage the transfer of climate finance from developed to developing countries through the sale of certified emission reduction credits (Gillenwater and Seres, 2011). Global carbon markets have grown and evolved substantially since the onset of the CDM, yet most VCM projects are still located in developing countries across Asia, South America, the Caribbean, and Africa. Only 29% of projects that produced credits in 2023 and 2024 were located in North America and Europe (Forest Trends' Ecosystem Marketplace, 2025).

Because carbon credit project developers and claimants often reside in different countries, clear accounting rules are required to uphold environmental integrity and prevent double claiming. Within the context of Article 6 of the Paris Agreement, which establishes the framework for an international voluntary carbon market, double claiming is avoided through corresponding adjustments, which require any country authorizing the transfer of an Internationally Transferred Mitigation Outcome (ITMO) to add the transferred mitigation outcome back to its national emissions balance so it is not counted toward the host country's climate target (Schneider et al., 2019). This ensures the mitigation outcome is only accounted for once by the country purchasing the credits. Notably, Article 6 includes a mechanism referred to as mitigation contributions, which allows for international support of mitigation activities without authorizing an ITMO; as a result, the entity providing support does not obtain a claim to the resulting mitigation outcomes (Fallon and Jee, 2024). However, when mitigation outcomes are transferred between countries, corresponding adjustments ensure that emissions reductions are counted only once and that national emissions balances remain consistent with the global total. This mechanism is necessary when similar reporting entities in the same GHG accounting system, such as two countries, engage in a carbon credit transaction.

By contrast, when reporting entities within different GHG accounting systems engage in a carbon credit transaction, such as a

corporation and a government, the issue of double claiming is more complicated. Governmental and corporate GHG inventories are never summed together because they are inherently overlapping as a result of fundamentally distinct GHG accounting protocols. Corporate GHG inventories attribute emissions based on a framework of scopes, delineating the inventory by direct emissions (Scope 1), indirect emissions from purchased electricity (Scope 2), and all other indirect emissions from upstream and downstream value chain activities (Scope 3) (WBCSD and WRI, 2015). Regional governments and municipalities follow a different GHG accounting approach, which consolidates emissions within geographic boundaries (IPCC, 2006; WBCSD and WRI, 2021). Sub-national entities will often use the framework of scopes to categorize GHG emissions, but the attribution of emissions is based on geographic boundaries and sectors, which is distinctly different from corporate GHG accounting. While these accounting approaches support internal tracking, planning, and voluntary climate claims, they operate independently of national GHG inventories and the international reporting frameworks used to assess progress under the Paris Agreement. This results in structural double counting of the same emissions across corporate, sub-national, and national GHG inventories. One example of this structural double counting is the overlapping of municipal and corporate GHG accounting boundaries (Figure 1).

The debate on double claiming revolves around whether an ITMO can be counted toward both a host country's Nationally Determined Contribution (NDC) under the Paris agreement and the claimant's corporate climate target (Streck et al., 2023). In one camp, proponents of corresponding adjustments argue that double claiming should be avoided in all VCM transactions to ensure that emission reductions are only counted once, thereby maintaining the integrity of climate commitments and incentivizing host countries to adopt more ambitious policies rather than relying on voluntary market activities (Brander et al., 2022). In the other camp, opponents of corresponding adjustments between different reporting entities argue that strict prohibition of double claiming could discourage private investment in mitigation projects, create administrative burdens, and limit the flow of climate finance (Ebert, 2022; Moura Costa, 2022).

Notably, the debate around double claiming and corresponding adjustments is focused on carbon credits transactions that involve an ITMO. This assumption is reasonable, given most of the current supply of VCM credits originate in developing countries while demand for purchasing these credits largely comes from developed countries. However, this assumption fails to account for domestic VCM transactions. When a project developer and claimant reside in the same country, there is no concern of the mitigation outcome being claimed twice by two different countries toward their NDCs, as the outcome is not transferred internationally and remains within the country of origin. Assuming the claimant is a corporation, they may use the mitigation outcome to support a voluntary carbon neutrality claim, while the emissions reduction may also be reflected in the host country's national GHG inventory. In this case, the mitigation outcome is claimed once within each relevant GHG accounting system: once for national accounting and once for corporate accounting. This perspective on double claiming is examined further in the following section by considering municipalities as carbon credit project developers.

Municipalities as carbon credit project developers

Municipalities are at the forefront of the low-carbon energy transition. Cities around the world currently account for about 70% of global GHG emissions, which could increase as the share of global population living in cities is expected to grow from 55% in 2018 to 68% in 2050 (Ahn et al., 2023). Recognizing the impact of urban GHG emissions, many municipalities around the world have developed climate actions plans (CAPs) which identify a diverse array of mitigation actions and interventions to combat climate change. Municipal CAPs span mitigation strategies such as sustainable transport, reduced building energy consumption, improved waste management, improved governance, and sustainable consumption practices (Seto et al., 2021).

There are limited examples of municipalities financing climate action measures using the VCM as a funding mechanism. The City of

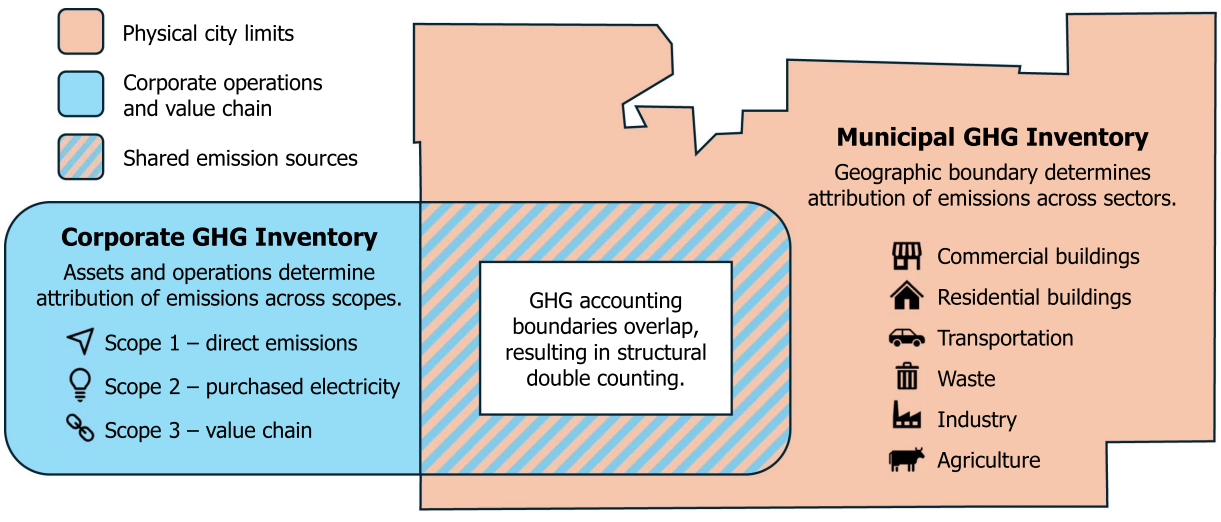


FIGURE 1
Structural double counting between municipal and corporate reporting entities leads to GHG emissions from shared activities being reported by each entity.

Johannesburg, South Africa registered a project on the VCM to improve the public transportation system through expanding bus lanes, purchasing more fuel-efficient busses, and improved transit management. The project was validated by Verra and is currently generating around 39,829 metric tons of CO_2e reduction credits per year (City of Johannesburg: Transportation Department, 2020). Another project in Christchurch, New Zealand aims to mitigate 40,000 metric tons of CO_2 per year by capturing methane from a local landfill, treating it, and substituting LPG fuel consumption at a nearby swimming pool facility (Christchurch City Council, 2020). These city-based carbon credit projects, however, are few and far between. Of the 2,562 registered projects on the Verra VCS registry (the most popular voluntary registry for carbon credits) as of November 2025, only 10 have a municipality identified as the project developer (Verra, 2025).

The limited number of cities and municipalities acting as carbon credit project developers is not for lack of proposed GHG mitigation measures. The Global Covenant of Mayors reports that 7,179 cities and local governments around the world have identified 191,200 GHG mitigation actions (Global Covenant of Mayors for Climate and Energy, 2023). Municipal climate action plans focus heavily on reducing fossil fuel consumption and accelerating the clean energy transition, including the electrification of public transportation fleets, energy efficiency measures in commercial and residential buildings, and the deployment of renewable energy (Deetjen et al., 2018). These measures are geared toward decarbonization of urban infrastructure, which is long lived and influences patterns of behavior, energy consumption, and carbon lock-in—a concept used to describe future pathways which remain dependent on fossil fuel energy systems (Seto et al., 2021). Addressing carbon lock-in and reducing urban dependance on fossil fuel energy systems is a central theme in municipal climate action planning.

In spite of the breadth and depth of municipal climate action planning, cities around the world do not have enough financial resources to implement projects at the necessary scale and pace to meet global GHG reduction targets (Negreiros et al., 2021). New and innovative financing strategies will likely play an important role in municipal efforts to reduce GHG emissions and build climate-resilient urban infrastructure. The VCM offers one potential pathway for cities and municipalities to address the climate finance gap. In the next section, we explore this further using an illustrative example with the City of Flagstaff, AZ.

An illustrative example with the city of Flagstaff

Flagstaff, AZ is a community of approximately 76,000 located in Northern Arizona. In 2021 Flagstaff committed to achieving carbon neutrality by 2030, with specific goals to reduce emissions, build out carbon dioxide removal, and improve community resilience (City of Flagstaff, 2022). The City of Flagstaff's Carbon Neutrality Plan (CNP) outlines many specific GHG mitigation measures including residential energy efficiency upgrades, incentives for alternative modes of transportation, and deployment of solar energy. Like many communities, implementing climate action measures depends on securing the required financing. By developing proposed mitigation measures as carbon credit projects, the City of Flagstaff could unlock new sources of finance through the VCM.

This scenario highlights the importance of the debate around double claiming mitigation outcomes. Proponents of applying corresponding adjustments to all VCM transactions would argue that if the City of Flagstaff developed a mitigation measure as a carbon credit project and secured finance from a corporate claimant through the VCM, then the city would need to forfeit the mitigation outcome and adjust their municipal GHG inventory accordingly. However, as discussed earlier, the project developer and claimant in this case represent different reporting entities. Corporate and municipal emissions are never summed together to represent total emissions of a system. Moreover, when the corporation and municipality reside in the same country, there is no international transfer of mitigation outcome and no risk of double claiming for multiple NDCs. In this case, the VCM functions as a mechanism to transfer finance from a well-resourced claimant to an under-resourced project developer, leading to increased investment in municipal GHG mitigation.

When carbon credit claimants account for mitigation outcomes, distinguishing claims as either within or beyond the value chain is a key part of best practices (SBTi, 2024). A company's value chain is covered by its Scope 1, 2, and 3 emissions. These are GHG emissions that a company has either direct or indirect influence over. Emissions beyond the value chain encompass all other global emissions. Today, most carbon credits represent beyond value chain mitigation for claimants. However, municipalities like the City of Flagstaff have the potential to provide both within and beyond value chain mitigation for claimants.

This scenario is illustrated with a hypothetical example of the City of Flagstaff developing a commercial composting program as a carbon credit project. Research shows that diversion of food waste and other organics from the landfill leads to reduced GHG emissions (Morrigan, 2011; Seng et al., 2013; Yoshida et al., 2012). Aerobic decomposition is the process by which organic waste is converted into compost, producing less methane compared to anerobic decomposition in landfills (Lou and Nair, 2009; Morris et al., 2013; Pérez et al., 2023). Further, composting creates a valuable soil amendment that can enhance carbon sequestration and reduce the need for synthetic fertilizers (Wang et al., 2022). In 2023, emissions from solid waste management in Flagstaff were estimated to be 94,071 $MTCO_2e$ (City of Flagstaff Sustainability Office, 2024). We assume that mixed organic waste constitutes 33.7% of total waste generation in Flagstaff, which is consistent with national averages (US EPA, 2018). Using the US EPA's Waste Reduction Model (WARM; US EPA, 2023) and assuming that 50% of organic waste is diverted from the landfill to composting, annual solid waste emissions are estimated to fall to 76,367 $MTCO_2e$, a 19% reduction and annual mitigation outcome of 17,704 $MTCO_2e$.

Next, we assume that a company operating within the City of Flagstaff purchases all carbon credits associated with the commercial composting program. The company generates waste that is managed by the city and accounts for associated Scope 3 emissions in its GHG inventory. For the purposes of this example, we assume that the company contributes 1% of total waste generation in Flagstaff. Accordingly, the company's baseline Scope 3 emissions from waste generation in Flagstaff are estimated to be 941 $MTCO_2e$ per year. The implementation of commercial composting is estimated to reduce these annual emissions to 764 $MTCO_2e$. This represents a reduction of 177 $MTCO_2e$ within the company's value chain. This mitigation outcome is reflected in the company's Scope 3 GHG inventory. The remaining emission reductions associated with the composting program, 17,527 $MTCO_2e$, are reported as beyond value chain mitigation for the company (Figure 2).

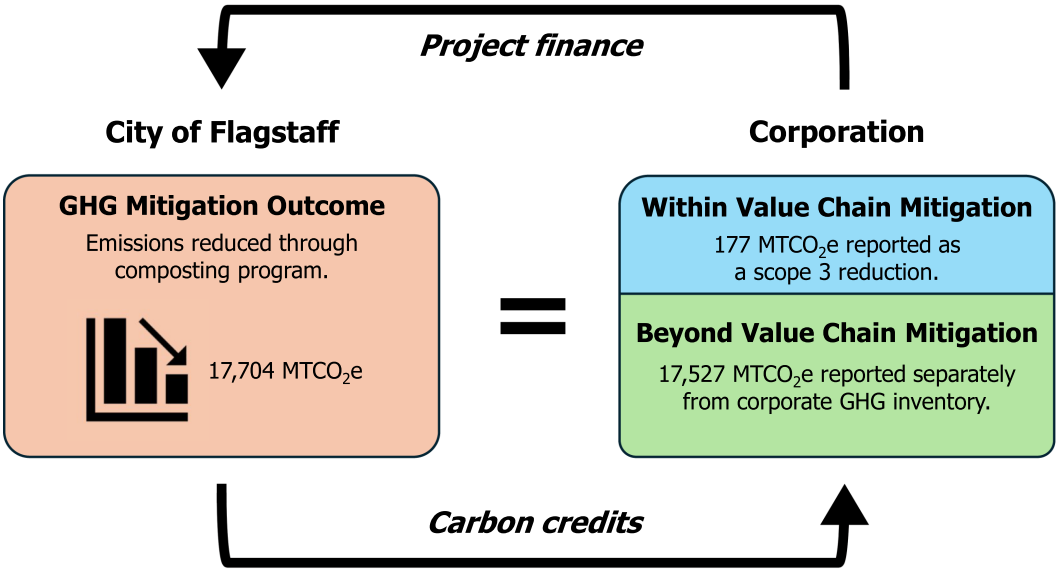


FIGURE 2
Double claiming of mitigation outcomes by municipal and corporate reporting entities (box sizes are not to scale).

In this case, the City of Flagstaff and the company both report GHG emission reductions of 17,704 $MTCO_2e$. The mitigation outcome is claimed twice, however there is no clear violation of environmental integrity. The company will realize a small portion of the mitigation outcome within its Scope 3 inventory, where GHG accounting boundaries overlap. The remainder of the mitigation outcome is reported as beyond value chain mitigation, drawing a clear distinction between the corporate GHG inventory and external mitigation efforts. Rather than compromise environmental integrity, double claiming in this scenario incentivizes partnerships between municipalities and companies in their shared efforts to mitigate GHG emissions.

This approach has several potential benefits for the VCM. First, the close relationship between project developer and claimant is more conducive to accountability. The corporation in this example operates within the municipality, making the verification of mitigation outcomes easier than a carbon credit project located in a distant international location. Second, the clear distinction between within and beyond value chain mitigation allows for companies to showcase where they are realizing emissions reductions within their value chain vs. financing external mitigation outcomes. Lastly, this approach engenders a stakeholder relationship between the corporation and the municipality. The carbon credit transaction supports a shared mission to reduce emissions in the community.

Opportunities and limitations for municipal carbon credit projects

When municipalities are faced with limitations to climate finance, the VCM offers an alternative source of funding to implement GHG mitigation projects. However, there are several practical limitations and unknows. Carbon credit purchases within the VCM commonly take place on a registry or marketplace, such as Verra, the American Carbon Registry, and Gold Standard. This approach to carbon credit procurement is effective at channeling finance to existing projects. However, projects that involve new technologies, innovative design, and urban infrastructure often require significant upfront capital. Carbon credit contracts based on offtake agreements have emerged in recent years to provide required up front capital and manage investment risk (Oyewunmi and Haddad, 2024). In simplified terms, a carbon offtake agreement creates a long-term contract between the project developer and claimant, where the claimant provides an initial investment to support the carbon removal/reduction project in return for a pre-determined stream of carbon credits in future years.

While carbon offtake agreements offer a promising contract structure, they are relatively new to the VCM and provide few data points to suggest that they alone would suffice as the legal basis for a long-term arrangement between a municipality and corporation for the delivery of carbon credits. Public Private Partnerships (PPPs) could provide a more proven administrative framework. PPPs bring corporations and governments together to invest in public services and improve management of public resources. PPPs are already used to promote sustainable development in many countries around the world (The World Bank, 2022). The United Nations also promotes PPPs as a tool to work toward the sustainable development goals (Wang and Ma, 2021). A common trait of all PPPs is the delivery of public goods and/or services. Because GHG mitigation is a universal public good, municipal climate action efforts are an ideal fit for PPPs.

Virtual Power Purchase Agreements (VPPAs) offer another relevant framework with similarities to carbon credit transactions. A VPPA is a financial contract between a power producer, typically a renewable energy project, and a buyer, such as a corporation or institution, seeking to support clean energy generation (Kansal, 2019). Unlike a traditional power purchase agreement (PPA), a VPPA does not involve the physical delivery of electricity to the buyer. The buyer of a VPPA is simply purchasing an environmental attribute, in this case a renewable energy credit (REC), which allows them to demonstrate progress toward an emissions reduction goal or renewable energy procurement target (Bachus and Lim, 2023). This has many similarities to carbon credit transactions, where claimants are interested in purchasing environmental attributes in the form of mitigation outcomes. More research is required to clarify what kinds of contract structures will best support municipalities developing carbon credit projects.

Any carbon credit project needs to be structured to meet basic criteria, but it also needs to attract investors that want to finance the project. The concept of project bankability refers to the quality of a project's documentation, structure, and durability (Oyewunmi and Haddad, 2024). In essence, a project is deemed bankable if the potential financier feels confident they will receive the promised outcomes within an acceptable risk tolerance. As discussed above, many municipalities and local governments have published detailed climate action plans outlining specific measures they aspire to implement. However, additional due diligence will be required to turn these measures into bankable carbon credit projects. Project developers would need to demonstrate adherence with key quality criteria such as additionality, permanence and transparency of GHG mitigation estimates. Additionally, carbon credit projects would need to be verified by a reputable standard, such as the Verified Carbon Standard and the Gold Standard (Gold Standard, 2023; Verra, 2025). The administrative capacity of municipal staff to perform this work is unknown but likely constrained. Moreover, carbon market expertise within municipal government is likely limited. This presents potential barriers to project bankability.

Another key factor to consider when developing carbon credit projects is the price per credit. Today, pricing on the VCM is primarily driven by supply and demand for carbon credits (Gold Standard, 2024). When market dynamics are the lead factor in price setting, the actual cost to mitigate GHG emissions for a particular project becomes lost and obscured. The Gold Standard (2024) describes several alternative pricing models that could prove useful for carbon credits. A cost-based model, for example, would derive a carbon credit cost based on the actual project implementation costs. This can lead carbon credits to be much more expensive than what the market would set on its own, however a cost-based model ensures that the costs of the project will be covered. The cost-based method seems most appropriate for municipalities that want to finance climate action measures, yet it remains unclear how this would play out within the larger context of the VCM which sets prices based on market dynamics.

The cost of carbon credits can also be influenced by the inclusion of co-benefits. The sustainable development goals (SDGs) are often used as a framework to evaluate co-benefit impacts from GHG mitigation projects. Lou et al. (2022) investigated the effect of co-benefits on the price of carbon credits, looking at SDG related impacts such as enhancement of local infrastructure, improved income and employment, and access to cleaner and affordable energy. They found that, on average, carbon credit projects with the highest likelihood of delivering co-benefits had a 30.4% higher price than projects with poor co-benefit evaluation (Lou et al., 2022). This research reveals an increased willingness to pay for carbon credits when co-benefits are evaluated and communicated alongside the GHG mitigation outcomes. Further research on the specific co-benefits associated with urban energy transitions would better equip municipalities to develop carbon credit projects and communicate value to claimants.

Conclusion

Reducing global GHG emissions at the scale necessary to meet international climate goals will require rapid growth of investment in both mitigation and adaptation measures. This article describes a potential pathway to address this need by financing municipal climate action measures through the VCM. However, clarity around best practices for claiming mitigation outcomes is necessary to ensure trust and integrity in the VCM. This article contributes to the debate around double claiming by demonstrating that municipalities and corporations participating in the same VCM transaction can both reflect the mitigation outcome in their accounting without compromising environmental integrity, provided that climate claims are clearly differentiated and transparently framed. In cases where project developers and claimants are located within the same country, this approach also avoids the risk of double counting across multiple NDCs. Carbon credit projects tied to municipal climate action measures therefore offer one potential pathway for the VCM to scale as a source of climate finance, while underscoring the importance of robust guidance on credible climate claims.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

BM: Writing – original draft, Writing – review & editing. DH: Writing – original draft, Writing – review & editing. RR: Writing – original draft, Writing – review & editing. EN: Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The author(s) declared that Generative AI was not used in the creation of this manuscript.

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