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Review of carbon emissions offsetting guidelines using instructional criteria

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Abstract

Purpose Carbon offsetting is one of the tools that companies can use to achieve their climate targets. The ability of a company to offset its emissions successfully depends on the availability and quality of guidance on the subject. This study explores how well existing offsetting guidelines equip corporations to achieve successful emissions offsetting.

Methods Instructional criteria were developed and used to evaluate seven guidelines. The contents of each guideline were assessed based on how they instruct a company to achieve emissions offsetting that fulfills five criteria for appropriate offsetting: target affiliation, Paris compatibility, effectiveness, prioritizing removals, and transparency.

Results and discussion The review revealed that necessary instructions enabling appropriate emissions offsetting were absent in the guidelines. Moreover, the degree of climate ambition and the role of offsetting varied between guidelines. Deficiencies in emissions offsetting guidance may increase the uncertainty of companies' succeeding in offsetting their emissions.

Conclusions Developing guidance on emissions offsetting could benefit society and corporations by increasing the certainty of achieving successful emissions offsetting. Standardizing corporate emissions offsetting could be considered as one solution for unifying the practice. The practical life-cycle implications of current ambiguity in guidelines are a direction for future research.

Keywords Offsetting · Carbon credits · Carbon neutrality · Net zero · Climate targets · Guidelines

1 Introduction

The Paris Agreement (UNFCCC — United Nations Framework Convention on Climate Change 2015) and the implementation of the United Nations (2015) Sustainable Development Goals are considered some of the most significant accomplishments of today's society. Today, various policies and voluntary commitments promote sustainability transition and the use of climate claims to communicate climate pledges to the public by actors, including companies, organizations, cities, and governments. According to Black et al. (2021), the climate pledges such as net zero commitments

already cover over 61% of the global GHG emissions, representing 68% of the global GDP and 56% of the world's population. Despite these developments, it has become evident that the current progress and measures are insufficient to combat climate change. Due to the worsened situation, simply reducing emissions is inadequate: Finding ways to remove accumulated CO₂ from the atmosphere is also necessary (IPCC 2018). According to the Scripps Institution of Oceanography, the atmospheric CO₂ levels are currently at a record high, as cited by Freedman (2022)—in April 2022, the highest average CO₂ levels ever recorded in human history were measured. Carbon offsetting has been discussed for over two decades, and its long-awaited market growth has just started during the last few years. Carbon offsetting is considered an important mechanism that enables easy access to reduce emissions and remove carbon outside the company's supply chain. Carbon offsetting is also strengthening its position in policy; for example, the European Commission (Erbach and Victoria 2021) is developing a CO₂ removal scheme to help scale and standardize carbon offsets.

Carbon credits are tradeable units representing one ton of CO₂ achieved through emissions reductions or carbon

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removal (Schneider et al. 2020). Carbon offsetting refers to an activity when a company or other actor purchases carbon credits, *retires* them, and claims the climate benefit as part of its climate action. Examples of emissions reductions include preventing deforestation and logging through forest conservation and deploying renewable energy and clean cookstoves. Carbon removal refers to activities that contribute towards decreasing atmospheric CO₂ levels, which can be achieved by using nature-based solutions or technological solutions (Broekhoff et al. 2019). The European Parliamentary Research Service (EPRS) lists forestation, soil carbon sequestration, biochar, and wetland restoration as examples of nature-based solutions. Technological solutions include enhanced weathering, bioenergy with carbon capture and storage (BECCS), and direct air capture and storage (DACCS) (Erbach and Victoria 2021).

Carbon credits can be certified by independent certification bodies or governments (Broekhoff et al. 2019; Allen et al. 2020). The role of certification bodies is to validate, verify, and generate internationally recognized carbon credits for commercialization. Carbon standards are essential in providing detailed guidance and assisting project developers in developing and quantifying carbon projects. The most significant carbon standards, according to their market share, include (1) Verra's Verified Carbon Standard (VCS), 59%; (2) the Gold Standard (GS), 17%; (3) the Climate Action Reserve (CAR), 8%; (4) the American Carbon Registry (ACR), 8%; and (5) the Clean Development Mechanism (CDM), 3% (Hamrick and Gallant 2017). In 2020, VCS issued the most significant volume of carbon credits, 67.6%, of all issued carbon credits, while the Gold Standard certified the highest number of projects, 49.4% (Chen et al. 2021). While ensuring that carbon credits are registered under internationally recognized carbon standards is considered an essential criterion, they alone cannot fully guarantee a positive climate impact.

Various actors, including investigative journalists, researchers, and NGOs, have found shortcomings in well-known offset projects using internationally recognized carbon standards (Kanematsu and Ishibashi 2021; Carbon Market Watch 2021; West et al. 2020; Compensate 2021). Actors who have adopted emissions offsetting as part of their climate strategy need to be aware of the quality risks associated with carbon offsetting projects. Broekhoff et al. (2019) suggest additional ways to mitigate these risks, such as conducting due diligence and seeking external experts' assistance. Actors who purchase carbon credits could also adopt a portfolio approach instead of using only one type of project for offsetting. The Carbon Offsetting guide divides offset project types into low, medium, and high-risk categories and suggests favoring low-risk project types to mitigate risks.

In addition to the quality of carbon credits, the concept of using carbon offsetting, in general, is an active topic of debate. According to Broekhoff et al. (2019), the debate and criticism around carbon offsetting are usually related to two aspects: (1) how carbon credits are used and (2) the quality of the carbon offsets. Part of the criticism is also based on a misconception that the purpose of offsets is to substitute other climate actions. Fortunately, today, various initiatives and guides have emerged, helping companies and organizations with science-based climate action and defining the role of offsets.

While many guidelines provide advice and recommendations about offsetting emissions, the practice lacks standardization, and different guidelines may provide different views on how offsets should be utilized. To ensure that companies' offsetting strategies align with the guidelines, they should be provided with clear and detailed recommendations. Shortcomings in the recommendations can negatively influence the quality of offsetting practices for those who follow the guidelines. Currently, there is a lack of scientific studies evaluating the quality of offsetting guidance for companies. This study aims to fill the research gap by investigating how well a sample of existing guidelines support appropriate corporate emissions offsetting. Finally, suggestions for future research and development in corporate emissions offsetting guidelines are given based on the study's results.

2 Methods

Guidelines for setting corporate climate targets and emissions offsetting were reviewed to accomplish the study's aim. The guidelines reviewed in this study were selected on the basis that they are publicly available, recent, targeted at corporations, and not industry or location-specific. Guidelines that concentrated solely on the quality of carbon credits or selecting offsetting projects without emphasis on offsetting as part of organizational climate targets were left out of the review. The body of guidelines is actively expanding; thus, there may exist guidelines that would fulfill the criteria for inclusion but are not included in this study. The authors consider the seven guidelines listed below to be a reasonable representation of the recent development in the field of emissions offsetting.

- PAS 2060:2014 specification for the demonstration of carbon neutrality (British Standard Institution 2014)
- Net Zero Initiative: A framework for collective carbon neutrality (Dugast 2021)
- SBTi Corporate Net-Zero Standard (Watson et al. 2021)
- Securing Climate Benefit: A Guide to Using Carbon Offsets (Broekhoff et al. 2019)

- The Oxford Principles for Net Zero Aligned Carbon Offsetting (Allen et al. 2020)
- The CarbonNeutral Protocol (Natural Capital Partners 2022): The global standard for carbon neutral programmes
- VCMI—Voluntary Carbon Market Integrity Initiative (2022): Provisional Claims Code of Practice

The authors developed criteria for assessing the instructional quality of the guidelines. From the perspective of being aligned with global emission reduction pathways, the authors consider that the implementation of emissions offsetting should, at minimum, fulfill the following five criteria:

- Target affiliation: A clearly defined corporate climate target necessitates emissions offsetting.
- Paris-compatibility: The individual company's emissions offsetting contributes towards achieving the global targets set in the Paris Agreement.
- Effectiveness: The purchased carbon credits come from projects which achieve tangible and measurable reductions in carbon emissions or removals of carbon from the atmosphere.
- Prioritizing removals: The weight of the offsetting mechanism in an entity's offsetting portfolio shifts from carbon reduction toward carbon removal over time.
- Transparency: The amount of emissions offset and the type of carbon credits used are communicated in a publicly available document.

For each guideline under review, the authors evaluated if it contained sufficient information to fulfill a criterion using a yes/no evaluation. If a guideline can fulfill all five criteria, then it is considered to support appropriate emissions offsetting. Parts unrelated to emissions offsetting were not evaluated in the guidelines.

2.1 Target affiliation

For the purchase and retirement of a carbon credit to be considered emissions offsetting, it must be done with the purpose of balancing out a quantified portion of an entity's carbon footprint. In the corporate context, a clearly defined climate target should describe the purpose and amount of the offsetting and the source of emissions. In order to assess if a guideline supports appropriate offsetting in this regard, it should be examined how it instructs companies to apply carbon offsetting in relation to a corporate target.

2.2 Paris compatibility

In the Paris Agreement, governments worldwide agreed to avoid dangerous climate change by limiting global warming

to below 2 °C and pursuing efforts to limit it to 1.5 °C. Achieving these goals requires that global emissions reach their peak as soon as possible and are balanced with emissions removals in the second half of the century. In other words, rapid reductions in global emissions are necessary. Companies should prioritize reducing emissions in their Scope 1, 2, and 3 over emissions offsetting. To assess if a guideline supports Paris-compatible offsetting, it is examined how it instructs offsetting in relation to reducing emissions within a company's value chain.

2.3 Effectiveness

The effects of emissions offsetting varies based on the project from which the carbon credits are sourced. A guideline should support companies in selecting carbon credits with low uncertainty to enable appropriate emissions offsetting.

A carbon credit has a low uncertainty when it is the result of a project that is likely to achieve the emissions reductions or removals it promises. Being certified for high quality by a standardizing body does not ensure that a carbon credit has low uncertainty since there is evidently significant variation in the results of even certified offsetting projects. In order to assess if a guideline supports effective offsetting, it is examined how it aids companies to minimize uncertainty of emissions offsetting by instructing risk assessment of offset projects.

2.4 Prioritizing removals

According to IPCC, all pathways limiting global warming to 1.5 °C with limited or no overshoot require carbon dioxide removal (CDR) on the order of 100–1000 GtCO₂ over the twenty-first century (IPCC 2018). The evidence for the need for CDR is reinforced by Fuss et al. (2018), where an analysis of the results of different published integrated assessment models (IAMs) found that scenarios achieving 1.5 °C by 2050 included the extensive deployment of CDR. The analysis presented in UNEP (2017) related to preventing the rise in global average temperature from rising above 2 °C requires negative emissions from CDR to reach 10 GtCO₂ by mid-century and 20 GtCO₂ by 2100. Over time, as more emissions reductions are achieved globally, the more difficult further mitigations become, the more the importance of implementing CDR measures grows. As companies and organizations offsetting their emissions play an essential role in increasing the global implementation of CDR, the need for this transformation should also be reflected by offsetting guidelines. In order to assess if a guideline supports offsetting that is aligned with the necessary development in CDR, it is examined to see how the guideline instructs using carbon removal credits for offsetting in a temporal framework.

2.5 Transparency

Carbon credit use should be transparent to minimize the risk of being used for greenwashing purposes. Transparent communication places a company's offsetting under public scrutiny, which can accelerate development in the area through easier identification of inappropriate practices. A further benefit of transparent communication is that it enables companies to benchmark their offsetting practices according to other companies' actions. In order to assess if a guideline supports transparent offsetting, it is examined to see if instructions for communicating emissions offsetting are present.

3 Results

Each guideline under review is introduced via a brief summary of its contents in this chapter. Following the introduction, it is described if the guideline fulfills the criteria defined in chapter 2. Finally, the results are summarized in Table 1 at the end of the chapter.

3.1 PAS 2060

PAS 2060 specifies requirements to be met by entities seeking to demonstrate carbon neutrality. Although PAS 2060 was published in 2014 before the Paris Agreement was established, it was selected to be included in the guidelines to be reviewed due to being internationally recognized and widely adapted in setting climate goals and working to achieve them (Birkenberg and Birner 2018; Zhou 2020; Gaurangi et al. 2022; Rayer et al. 2022). The specification provides standard definitions and a method to validate entities' actions toward becoming carbon neutral. The standard defines carbon neutrality as a "condition in which during a

specified period there has been no net increase in the global emission of greenhouse gases to the atmosphere due to the greenhouse gas emissions associated with the subject during the same period." While companies and organizations can use the specification, it applies to other entities such as governments, communities, or individuals. At its core, PAS 2060 defines a process that an entity can follow to demonstrate current or future carbon neutrality. The process consists of one or more application periods whose length is determined by the assessing entity. Emission reductions taking place up to three years before the first period can be considered to enable the declaration of carbon neutrality. At the end of the first application period, achievement of carbon neutrality may be declared based on historic reductions or offsetting all emissions by the entity. If the achievement is not declared at the end of the first period, the process then moves into the second period, where a carbon footprint management plan is developed and implemented, and the carbon footprint is remeasured after reduction measures have taken place. Unabated emissions at the end of the second period can be declared residual emissions and balanced out through emissions offsetting. The process can continue over more than two periods, with all subsequent periods following the structure of the second period. The achievement of carbon neutrality can be declared at the end of any period when the requirements are met.

In the context of PAS 2060, the reason for any emissions offsetting is clearly defined as the ability to declare the achievement of carbon-neutral status. As instructed by the specification, any offsetting must happen via credits representing genuine, additional GHG emissions reductions elsewhere. The responsibility of choosing credits that meet this requirement is left to the user of the specification, as no recommendations for credit or project types are given. Documenting carbon offsetting usage is required, but there

Table 1 Summary of results

	PAS 2060 (British Standard Institution 2014)	Net Zero Initiative (Dugast 2021)	SBTi Corporate Net-Zero Standard (Watson et al. 2021)	Securing Climate Benefit: A guide to Using Carbon Offsets (Broekhoff et al. 2019)	The Oxford Principles for Net Zero Aligned Carbon Offsetting (Allen et al. 2020)	The CarbonNeutral Protocol (Natural Capital Partners 2022)	VCMI: Claims Code of Practice (VCMI 2022)
Target affiliation	✓	✓	✓	✓	✓*	✓	✓
Paris compatibility		✓	✓		✓		✓
Effectiveness				✓	✓**		
Preference for removals		✓	✓		✓	✓	✓
Transparency							✓

*Refers to initiatives: Climate Action 100+, LEED, Net Zero Asset Owners Alliance, Oxford Martin Principles for Climate-Conscious Investment, RE100, Science Based Targets initiative, and The Investor Agenda

**Refers to Broekhoff et al. (2019) for a summary of best practices regarding the purchase of carbon credits

are no requirements for public communication. Notably, PAS 2060 allows achieving carbon neutrality solely via offsetting, without any requirement for emissions reductions within the entity's value chain. The specification only considers the use of carbon reductions for offsetting purposes, as there are no mentions of carbon removals. This guideline for offsetting can be regarded as outdated, as it is not properly aligned with the goals of the Paris Agreement, which require drastic emissions reductions in corporate value chains and implementing CDR.

3.2 The net zero initiative

The Net Zero Initiative framework for collective carbon neutrality (NZI) guides organizations to contribute towards global carbon neutrality. The framework discusses the difficulty of defining and implementing *net zero* at the level of sub-planetary actors, such as companies and organizations. For example, it is argued that it is uncertain if actors reaching their individual climate targets finally result in a global balance in CO₂ emissions and removals. NZI abandons the notion of a *net zero* or *neutral* company, instead proposing independent indicators for measuring a company's climate performance against the global carbon neutrality target. The indicators are related to three pillars: emissions reductions within the company's value chain (pillar A), reducing others' emissions (pillar B), and removing CO₂ from the atmosphere (pillar C). Rather than setting a definitive climate target for the company or a part of it, targets are set for the individual pillars. The framework does not detail setting targets for pillar A, instead referring to other works on the matter. The current framework does not provide recommendations for setting targets for pillar B. For pillar C, the framework recommends setting targets based on the need for carbon sequestration in a given area so that the effort expected from the company is proportional to its responsibility for climate change. Detailed instructions for calculating a company's target trajectory for carbon removals are presented in the framework.

Since NZI considers that a company cannot be carbon neutral or net zero, and thus there is no need to *cancel* a company's carbon footprint, it is not sensible to talk about offsetting emissions in the context of the framework. The mechanisms other instances consider offsetting are not discarded; instead, they are considered instruments for societal contribution. Financing carbon reductions and carbon removals taking place outside the company's value chain are recommended in the framework, but currently, setting targets is instructed only for carbon removal. The guide recommends a company calculate its need for developing carbon removals based on an emissions reduction trajectory

consistent with a 1.5 °C or 2 °C target. Successful application of this development requires increasing carbon removals within and outside the value chain while simultaneously reducing emissions from Scopes 1, 2, and 3 significantly. As a result of the development, the company will achieve a balance of internal emissions and removals by 2050. Regarding transparency about using carbon credits, NZI refers to Allen et al. (2020) but provides no further instructions for reporting practices.

3.3 Science-based targets initiative corporate net-zero standard

The SBTi Corporate Net-Zero Standard guides corporations to set climate targets aligned with the Paris Agreement's pathways. The standard instructs corporations to achieve a net zero status, which is defined to be achieved when value chain emissions are reduced to the point required by global 1.5 °C pathways. The impact of any residual emissions is neutralized by permanently removing an equivalent volume of CO₂ from the atmosphere. Key elements of the standard include setting near-term (5–10 years) and long-term (by 2050) targets for reducing emissions within a company's value chain, neutralizing residual emissions and practicing beyond value chain mitigation. The standard presents sector-specific long-term targets that specify the amount of emissions reductions that should be reached by 2050. These range from an 80% reduction in the forests, land, and agriculture (FLAG) sector to a 98% reduction in service buildings. Companies operating outside the fields of sector-specific targets should follow a cross-sector pathway, which is constructed to achieve a 90% reduction in global CO₂ emissions. The requirements set by the standard do not expect a company to achieve a 100% reduction in emissions. This means that emissions offsetting is expected to be part of all companies' climate targets.

Offsetting is discussed very briefly in the SBTi standard. The only instruction regarding offsetting is that it must be done for residual emissions through permanent removal and storage of CO₂. Contribution towards societal net zero is recommended beyond value chain mitigation, which can be done by securing and enhancing carbon sinks. The purchase of credits from REDD+ projects and investing in nascent GHG removal technologies are given as examples of ways to participate in mitigation outside the value chain. Still, no instructions are provided for selecting credits that contain minimal uncertainty in the results they promise to deliver. It is not specified how much a company should utilize carbon offsets or beyond value chain mitigation during its journey to a net zero target. No instructions related to communicating emissions offsetting are given in the standard.

3.4 Securing climate benefit: a guide to using carbon offsetting

The guide written by Broekhoff et al. (2019) is targeted toward companies and organizations who seek to understand carbon offsets and how to use them in voluntary GHG reduction strategies. In the guide, the lifecycle of a carbon offset is explained in detail. Instructions are given for the most critical steps of emissions offsetting: selecting suitable credits, ways to acquire them, linking into corporate climate targets, and ensuring that the credits are high quality. Rather than simply recommending the potential credit buyer buy credits certified by a third party, the guide prompts the buyer to ask specific questions to ensure a project's quality during credit selection. Specific strategies are also presented for avoiding lower-quality offset credits. Annex 1 of the guide includes a table that presents relative quality risks related to 21 types of offset projects.

Broekhoff et al. (2019) instruct how a potential emissions offset user can minimize the uncertainty related to a carbon credit resulting from real, measurable emissions reductions or carbon removal. A basic framework also depicts the relationship between emissions offsetting and corporate climate targets. While the guide details avoiding risks related to individual offsetting projects, it does not instruct corporations on how an offsetting portfolio should be composed. In other words, no recommendations are given for how much offsetting should be achieved through emissions reductions and carbon removals at a given time. Furthermore, no instructions are provided for communicating offset use.

3.5 The Oxford principles for net zero aligned carbon offsetting

Allen et al. (2020) present a set of principles designed to help non-state actors design and deliver rigorous net zero commitments by participating in voluntary carbon markets. The principles that should enable rigorous offsetting of an actor's emissions include minimizing the need for offsetting by prioritizing cutting emissions in Scopes 1, 2, and 3, gradually shifting to carbon removal offsetting with long-lived storage and supporting the development of net zero aligned offsetting.

The focus of Allen et al. (2020) is not on providing instructions on practically implementing and using carbon offsets. The paper guides the reader to consult Broekhoff et al. (2019) for best practices regarding purchasing offsets. Allen et al. (2020) prescribe core ideas for approaching offsetting in a way aligned with the Paris Agreement's goals. The connection between an actor's specific climate targets and the need for offsetting is recognized, and references are provided to other works instructing the target setting. Notably, the guide acknowledges the need for shifting offsetting

toward carbon removal and explains mechanisms by which offset users can enable a system-wide transition toward this requirement. One of these mechanisms is said to be market signaling, i.e., organizations publicizing their adoption of the Oxford Offsetting principles and, through that, motivating investment and project creation. The importance of transparency in offsetting is clearly recognized, but no instructions for communicating offset use are delivered.

3.6 The CarbonNeutral Protocol

The CarbonNeutral Protocol is a framework designed to help businesses and organizations to develop programs for achieving a carbon neutral status. The framework applies to entities, products, and activities and consists of five steps: (1) defining the subject, (2) measuring its GHG emissions, (3) setting targets for emissions reductions, (4) delivering reductions, and (5) communicating the process. Step 4 includes internal emissions reductions from a subject's Scopes 1, 2, and 3, as well as offsetting through the purchase of carbon credits. A subject is considered to have reached a carbon neutral status when it has offset an amount equivalent to the sum of its own Scopes 1, 2, and 3 emissions. Carbon neutrality is considered only an interim status, with the eventual goal of achieving a net zero status. In the framework context, the difference between carbon neutrality and net zero is that net zero requires all offsets to be emissions removals. In contrast, both reductions and removals can be used to achieve carbon neutrality. In order to receive a certification for carbon neutrality, credits used for emissions offsetting must be legally attributable, achieve measurable and permanent results, and be independently verified and unique. Twelve standards that ensure that credits fulfill the set criteria are listed in the protocol. Two types of projects, namely, certain hydroelectric and HFC-23 destruction projects, are expressly excluded from those that can be used to reach a carbon neutrality certification, even if they are certified by the approved bodies.

As reaching the goals of the Paris Agreement requires drastic reductions in corporate value chains, it is questionable how well The CarbonNeutral Protocol serves the pursuit of global carbon neutrality. Technically, a corporation following the protocol can earn the right to call itself carbon neutral or net zero based solely on offsetting, as reducing emissions inside the value chain is not an obligation for reaching these goals. There are many uncertainties related to emissions offsetting; thus, offsetting a ton of emissions cannot be considered an equivalent effort towards controlling climate change as reducing a ton of emissions from a company's Scopes 1, 2, and 3. Since offsetting a ton of emissions often requires less effort and money than implementing a ton of internal emissions reductions, awarding a company a carbon neutral or net zero status based solely on offsetting

may reduce the company's incentive to implement emissions reductions inside the value chain. While the importance of moving toward carbon removals in offsetting is explained in the protocol, it is evident that the Paris Agreement's goals are not achievable by relying solely on carbon removal offsetting. Furthermore, while the protocol advocates the use of quality certified credits, a credit having a certification does not ensure that it is produced by a project that achieves promised results. No instructions are provided for the user of the protocol for assessing risks of offset projects. Guidance for communicating offset use is absent in the framework.

3.7 VCMi provisional claims code of practice

The purpose of the VCMi Provisional Claims Code of Practice is to guide companies and other non-state actors to make credible voluntary use of carbon credits as part of their net zero commitments. According to the code, there are four steps for making a credible claim: (1) meeting the prerequisites, (2) identifying claims to be made, (3) purchasing high-quality credits, and (4) reporting transparently on using carbon credits. To meet the prerequisites of the first step, a company must commit publicly to science-aligned emissions reduction targets, which means setting interim targets and a long-term goal of reaching net zero emissions no later than 2050. According to the code, achieving a net zero status for most companies means reducing emissions by at least 90% to 95% across all emissions scopes and balancing out remaining unabated emissions by permanent removals. A company must also provide information about plans for achieving the targets, maintain a publicly available GHG emissions inventory, and publicly state that the company's advocacy activities are consistent with the Paris Agreement's goals. The second step includes identifying if the claims to be made apply to the whole enterprise or a specific brand, product, or service and demonstrating that their emissions and ongoing decarbonization plans are consistent with the claim. Only an entire enterprise can achieve a net zero status. In contrast, products, brands, and services can achieve a carbon-neutral status through emissions reductions in their life cycles and offsetting unabated emissions. Additionally, all claims require *beyond value chain mitigation* through the purchase of carbon credits. The third step includes purchasing carbon credits that meet certain quality criteria, such as being governed by a standard-setting body, having high environmental quality, and resulting from activities that are compatible with human rights. The fourth and final step is publicly reporting all information required to demonstrate that prerequisites and claim requirements have been met and details about using carbon credits.

The emissions offsetting practices instructed by the VCMi Provisional Claims Code of Practice are rigorously connected to corporate climate targets and aligned with the

Paris Agreement's goals. The code's guidelines reflect the necessity of shifting towards carbon removal offsetting. The importance of transparent communication is recognized, and instructions are given on how to report carbon credit use. An extensive list of quality requirements for carbon credits is present in the guide, which requires the offsetting entity to pay more attention to a project's details than simply relying on third-party certification. However, few directions are given for choosing project types that meet these requirements.

4 Discussion

Emissions offsetting is recognized as a necessary part of climate action when it comes to preventing catastrophic global warming. In order for offsetting to provide climate benefits, corporations should be equipped with the knowledge on how to offset their emissions properly. To date, there has been a lack of critical approach towards how guidelines instruct emissions offsetting. Offsetting guidelines are continuously evolving; already existing guidelines are being revised, and new guidelines are constantly emerging. There are also various factors, such as tightening climate and environmental policy, that can impact the guidelines as they are partly designed to reflect the global policy and contribute towards international environmental and climate targets such as the Paris Agreement. Currently, it is challenging to estimate which guidelines will eventually become widely adopted. Even though this study assessed a limited number of guidelines, it managed to identify shortcomings in offsetting instructions of several widely known and adopted guidelines. In addition, this study developed methodology and criteria that can also be used for guidelines that were left outside the scope of this study.

While analyzing different guidelines during this study, it became evident that they provide divergent recommendations or suggestions for offsetting emissions that can be interpreted in various ways. A suggestion for future research direction is to assess how following different guidelines on the individual company level impacts the climate ambition and the extent of required action. Moreover, it would be important to assess from a life-cycle perspective how following the guidelines affects company's emissions and other environmental impacts. Even though offsets themselves are not allowed to be included in an organizations' carbon footprint, the way emissions offsetting is implemented can impact the footprint. For example, PAS 2060, SBTi Corporate Net-Zero Standard, and Net Zero Initiative all instruct using emissions offsetting in a different manner. Following one guideline may encourage towards different action than another one, impacting the end results in the company's environmental strategies.

A recommended development would be to standardize corporate carbon offsetting. Currently, companies carry the responsibility of finding, selecting, interpreting, and applying an offsetting guideline. A constantly expanding body of guidelines may complicate decision making and thus also hinder the adoption of best offsetting practices. Standardizing the emissions offsetting process could help to reduce the burden of decision making, while providing a single platform for developing the offsetting practice.

5 Conclusions

An examination of seven guidelines revealed that many existing emissions offsetting guidelines do not provide complete knowledge for corporations to offset their emissions successfully. This may place increased responsibility on companies in finding the correct information and may lead to raised uncertainty in the impacts of emissions offsetting. For the benefit of society and corporations, it is recommended to develop communication and guidance related to offsetting corporate emissions. The practical life-cycle implications of inconsistencies in corporate climate action guidelines remain a subject for future research. Standardizing the corporate emissions offsetting process should be considered to reduce uncertainty in achieving successful offsetting.

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Data availability Data sharing does not apply to this article as no datasets were generated or analyzed during the current study.

Declarations

Conflict of interest The authors declare no competing interests.

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References

- Allen M et al (2020) The Oxford principles for net zero aligned carbon offsetting. University of Oxford. https://www.sustainabilityexchange.ac.uk/files/oxford_offsetting_principles.pdf. Accessed 27 May 2022
- Birkenberg A, Birner R (2018) The world's first carbon neutral coffee: lessons on certification and innovation from a pioneer case in Costa Rica. *J Clean Prod* 10:485–501. <https://doi.org/10.1016/j.jclepro.2018.03.226>
- Black R, Cullen K, Fay B, Hale T, Lang J, Mahmood S, Smith SM (2021) Taking stock: a global assessment of net zero targets. Energy and Climate Intelligence Unit and Oxford Net Zero
- Broekhoff D, Gillenwater M, Colbert-Sangree T, Cage P (2019) Securing climate benefit: a guide to using carbon offsets. Stockholm Environment Institute and Greenhouse Gas Management Institute. <https://doi.org/10.1038/s41558-021-01245-w>. Accessed 27 May 2022
- British Standard Institution (BSI) (2014) PAS 2060—Specification for the demonstration of carbon neutrality. British Standard Institution, UK
- Carbon Market Watch (2021) Two shades of green: how hot air forest credits are being used to avoid carbon taxes in Colombia. Policy briefing. https://carbonmarketwatch.org/wp-content/uploads/2021/06/Two-shades-of-green_EN_WEB.pdf. Accessed 28 Jun 2022
- Chen S, Marbough D, Moore S, Stern K (2021) Voluntary carbon offsets: an empirical market study. Available at SSRN: <https://ssrn.com/abstract=981914> or <https://doi.org/10.2139/ssrn.3981914>
- Compensate (2021) Compensate white paper: reforming the voluntary carbon market. <https://www.compensate.com/reforming-the-voluntary-carbon-market>. Accessed 28 Jun 2022
- Dugast C (2021) Net Zero Initiative 2020–2021 Final report. Carbone 4. https://www.carbone4.com/files/Net_Zero_Initiative_Final_Report_2021_2021.pdf. Accessed 29 Jun 2022
- Erbach G, Victoria G (2021) European Parliamentary Research Service. Carbon dioxide removal - Nature-based and technological solutions. [https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689336/EPRS_BRI\(2021\)689336_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/689336/EPRS_BRI(2021)689336_EN.pdf). Accessed 27 May 2022
- Freedman A (2022) April sets record for highest CO2 levels in human history. Axios Generate. <https://www.axios.com/2022/05/04/april-sets-record-highest-co2-levels>. Accessed 24 May 2022
- Fuss S, Lamb W, Callaghan M, Hilaire J, Creutzig F, Amann P, Beringer P, de Oliveira Garcia W, Hartmann J, Khanna T, Luderer G, Nemet G, Rogelj J, Smith P, Vicente J, Wilcox J, del Mar Zamora Dominguez M, Minx J (2018) Negative emissions -part 2: costs, potentials and side-effects. *Environ Res Lett* 13(6):063002. <https://doi.org/10.1088/1748-9326/aabf9f>
- Gaurangi S, Chau H-W, Tariq M, Muttill M, Ng A (2022) Achieving sustainability and carbon neutrality in higher education institutions: a review. *Sustainability* 14(1):222. <https://doi.org/10.3390/su14010222>
- Hamrick K, Gallant M (2017) Unlocking potential state of the voluntary carbon markets 2017. www.forest-trends.org/documents/files/doc_5591.pdf. Accessed 5 Jul 2022
- IPCC (2018) Summary for policymakers. In: Masson-Delmotte V, Zhai P, Pörtner H-O, Roberts D, Skea J, Shukla PR, Pirani A, Moufouma-Okia W, Péan C, Pidcock R, Connors S, Matthews JBR, Chen Y, Zhou X, Gomis MI, Lonnoy E, Maycock T, Tignor M, Waterfield T (eds) *Global Warming of 1.5 °C*. An IPCC Special Report on the impacts of global warming of 1.5

- °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. World Meteorological Organization, Geneva, Switzerland, p 32
- Kanematsu Y, Ishibashi M (2021) Indonesian carbon credit project appears to betray its purpose. <https://asia.nikkei.com/Spotlight/Environment/Climate-Change/Indonesian-carbon-credit-project-appears-to-betray-its-purpose>. Accessed 28 Jun 2022
- Natural Capital Partners (2022) The CarbonNeutral protocol. https://www.carbonneutral.com/pdfs/The_CarbonNeutral_Protocol_Jan_2022.pdf. Accessed 6 Jul 2022
- Rayer Q, Jenkins S, Walton P (2022) Defining net-zero and climate recommendations for carbon offsetting. Business and Policy Solutions to Climate Change. Palgrave Studies in Sustainable Business In Association with Future Earth. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-86803-1_2
- Schneider L, Healy S, Fallasch F, León F, Rambharos M, Schallert B, Holler J, Kizzier K, Petsonk A, Hanafi A (2020) What makes a high-quality carbon credit? World Wildlife Fund, Environmental Defense Fund and Oeko-Institut. https://files.worldwildlife.org/wwfcmprod/files/Publication/file/54su0gjuo_What_Makes_a_High_quality_Carbon_Credit.pdf?_ga=2.55045035.166619473.1670934868-1305619491.1670934867
- UNEP (2017) The Emissions Gap Report 2017. United Nations Environment Programme (UNEP), Nairobi. www.unenvironment.org/resources/emissions-gap-report
- UNFCCC — United Nations Framework Convention on Climate Change (2015) Paris Agreement. https://ec.europa.eu/clima/policies/international/negotiations/paris_en. Accessed 27 May 2022
- United Nations (2015) Sustainable development goals - the 17 goals. <https://sdgs.un.org/goals>. Accessed 27 May 2022
- VCMI — Voluntary Carbon Markets Integrity Initiative (2022) Provisional Claims Code of Practice. <https://vcmintegrity.org/wp-content/uploads/2022/06/VCMI-Provisional-Claims-Code-of-Practice.pdf>. Accessed 28 Jun 2022
- Watson E et al (2021) SBTi corporate net-zero standard version 1.0. Science based targets initiative. <https://sciencebasedtargets.org/resources/files/Net-Zero-Standard.pdf>
- West TAP, Börner J, Sills EO, Kontoleon A (2020) Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon. Proc Natl Acad Sci USA 117:24188. <https://doi.org/10.1073/pnas.2004334117>
- Zhou SW, Zhou SW (2020) Total carbon management model. Carbon Management for a Sustainable Environment. Cham: Springer International Publishing 123–160

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