White paper

Buffer pools:

Why the carbon market needs a new approach to permanence and how insurance can help

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Executive Summary

Permanence is a key concern for carbon credit buyers and developers today. Why? Because ensuring that removed carbon stays sequestered (permanence) is critical to slow the pace of global warming, achieve net zero, and protect the integrity of climate claims. In other words, **we need to make sure that the carbon we remove stays that way—permanently**.

But carbon sequestration is rarely permanent, despite the best of efforts. Forests burn down. Insects infest and degrade biomass. And carbon storage facilities leak. To address these risks to credit permanence, buyers and developers today rely on 'buffer pools', where registries take a percentage of issued credits from each project and aggregate them into a central pool of credits to be used to compensate for a reversal, when a portion of the sequestered carbon is released back into the atmosphere. In other words, registries have created buffer pools to 'guarantee permanence'.

But can buffer pools really do what they promise? Contrary to what they say, our analysis shows that:

- **Buffer pools are in danger of collapse**, as they are likely too small to account for possible losses since they do not effectively assess the relative risks of each project or sufficiently account for natural variability.
- **Projects have likely suffered reversals that have gone undetected and uncompensated**. Because monitoring for reversal events usually ends when a project finishes issuing credits, no one is watching for reversals for the remaining decades of promised 'permanence'.
- **Buffer pools are not operated transparently**, making it difficult to tell what they actually do and whether they are effective—but transparency and auditability are key to making the voluntary carbon market (VCM) work effectively and efficiently.

Fortunately, a fix already exists. Insurance, a time-tested risk mitigation solution, and in-kind insurance[i] in particular, does what buffer pools can't: covers losses even in extreme scenarios, calculates premiums that reflect the real risk of a project, and ensures compensation in kind for 100 years, all in a transparent, auditable way.

In this report, we shed light on how exactly buffer pools work—and how they don't—as well as **how in-kind insurance can solve the challenges of buffer pools**. We describe how carbon credit registries can engage with insurance companies to implement a gradual transition from buffer pools to insurance, and thereby to actually secure the permanence that developers and buyers are seeking, and that the carbon market needs in order to mature.

How buffer pools came to be and how they work

Registries established buffer pools with good reason: carbon credits suffer reversal events that need to be addressed, and the best way to address the loss of one carbon credit is to replace it with a new carbon credit (i.e., compensation 'in-kind'). Buffer pools were an insurance-like mechanism (with important differences, which we explain below) that tried to fill a void when insurance was not available to cover carbon market risks, a laudable goal.

We urgently need a paradigm shift away from the 'what we don't know can't hurt us' approach of buffer pools to one where the retirer of a carbon credit remains responsible for ensuring that the carbon sequestered stays sequestered.

Registries require carbon credit project developers to either contribute a flat percentage of credits (e.g., 10-20%) to the registry buffer pool or to self-assess the risk of their projects using an assessment methodology and contribute a particular amount depending on the result of the assessment. Contributions are made at credit issuance. The developer may be required to re-assess the risk periodically and to adjust their contribution accordingly. Some registries refund credits if the developer says the risk has decreased. It's unclear if the self-assessments are always reviewed by third parties, and the results aren't disclosed to credit buyers.

If there is a reversal, the developer must report the event to the registry. Depending on the cause of the event and the size of the reversal the developer may have to replenish any credits that were taken from the buffer pool and is prohibited from issuing new credits until it has replenished the pool. Some registries also cancel any unused credits remaining in a project's buffer pool account at the end of the project's crediting period to account for any future reversals that may occur when the project is no longer monitoring.

The challenges we see with buffer pools

Here are some of the key challenges we see with the scheme laid out above:

Buffer pools don't appropriately adjust for risk contributions and are likely too small to cover all the losses they will experience

As noted above, some registries require a flat contribution to buffer pools, whereas others require developers to self-assess the risk profile of the project by scoring against categories on a checklist. Almost none of these assessments:

- are based on quantitative geospatial data, which provide a more granular view of the project's risk exposure,

- consider the future effects of climate change, or
- require probabilistic modeling to correctly account for the likelihood that a project may experience damage in any given year due to different risk factors.

Flat contributions or contributions that do not appropriately assess for risk result in adverse selection, meaning good projects are unfairly penalized, while risky projects are not penalized enough – in fact, flat contributions may incentivize the creation of projects that do not deliver any climate benefits at all, and instead only risk causing reputational damage.

Auto insurance is a good way to demonstrate the downsides of adverse selection: if an insurer charged a driver with a terrible safety record the same premium as one with an impeccable record, this would not just unfairly penalize the good driver. It could also incentivize the bad driver to drive carelessly, since that driver wouldn't pay a higher premium no matter how poorly they drive. For example, Renoster's survey of 385 IFM and REDD+ projects shows that nearly half of the projects surveyed are exposed to high and medium fire risk—yet flat buffer pool contributions do not, by design, sufficiently take into account those different exposures to fire risk.

In addition, **a buffer pool contribution that is calculated at credit issuance cannot realistically reflect the risk to the project in 20 or 40 or 100 years, because the risk profile of that project will change with the environment and climate** around it. There is a growing chorus of voices about the insufficiency of buffer pools, which reveal the danger of trying to estimate a contribution today to cover a risk for 100 years—a lesson scientists have learned in the past when trying to calculate long-term Canadian wildfire risk.[ii]

Case study: Canadian wildfire predictions fall far short

Scientists predicted in 1991, using multiple models, that the average burned area of Canadian forests would be 2.9 million hectares by 2040.[iii] As of today, 16 years *before* 2040, the average burned area of Canadian forests is 4.0 million hectares.[iv]

Even if the buffer pool contributions were 100% accurate, and we know that they aren't, statistically speaking, 50% of the time the portfolio of risks (i.e., the projects in the buffer pool) will perform worse than expected. This is why the industry standard in insurance is that insurance companies must plan for the outcome of their insured portfolio to perform better than expected 50% of the time and worse than expected 50% of the time (and, unlike the buffer pool, insurers must put aside capital to cover for those worse outcomes, which we explain further below). **The fact that the projects in the buffer pool are of different types and different geographies – *i.e.*, diversified – isn't enough to protect it, as diversification only spreads risk up to a point. After that point, each new risk added to a risk pool simply adds more risk without bringing any further benefit.** (The stock market is a good example of this—it is diversified, but that doesn't make it immune to large losses). If there is a massive loss event which wipes out a buffer pool, the only way that that buffer

pool could continue to fulfill its promise to protect against reversal risks from other projects is if it were to be fully replenished – and that replenishment would come from the risk capital set aside by the registry to cover for such an event, **except that there is no such risk capital backstopping the registry buffer pools**.

Why should buyers care? Because **there is a real possibility that buffer pools could collapse, because the contributions are not sized properly to account for different risks, climate change and natural variability**.

Buffer pools are a black box and monitoring for reversals is insufficient

After finding little data from the registries on whether buffer pool credits have actually been used to compensate for reversals, the CarbonPool team did its own analysis. What we found aligned with the findings at other institutions, including the University of California, Berkeley.

CarbonPool's internal analysis of buffer pool reversals

Using satellite biomass data and observed fire activity for more than 10 projects, we uncovered significant damage to portions of each assessed project's area/biomass due to fire, deforestation, or other factors. However, after reviewing the project verification reports, it appears that **no credits have been struck from the buffer pool to compensate for these reversals**.

The University of California, Berkeley's findings

A University of California, Berkeley study reached similar conclusions as the CarbonPool team, showing that **only 8 out of over 9,000 projects** have reported reversals covered by their registries' buffer pools, and only 12 projects have reported reversals not covered by their buffer pools. The remaining projects do not report any numbers related to their use of buffer pools.[v] Given the level of risks present to carbon credit projects, **it is extremely statistically unlikely for just 20 total projects out of 9,000 (i.e., 0.2%) to have experienced a reversal**. In any event, this data should not be hard to find.

Further, we note that the **registries' reliance on self-reporting for reversals may present a conflict of interest for developers**, since those who report reversals may also be prohibited from issuing further credits and generating revenue that they need until they replenish the buffer pool. And after the project is done issuing credits, it's not clear who, if anyone, is monitoring the projects for reversals – even though some registries promise that the buffer pool will cover reversals for up to 100 years. Verra announced in 2022 that they are working on a long-term monitoring solution, which is welcome news, since an independent source to monitor for reversals would be ideal. But the solution is still a few years away. In the meantime, no one is checking to see if reversals have occurred once the crediting period ends for most registries, so no one is

compensating for any reversals that might have occurred but haven't been reported.

Finally, we believe that, **given the current state of our climate and the intense scrutiny of carbon credits, auditable, transparent reporting about carbon credits and reversals is critical**. And national regulators seem to agree, given the increasingly stringent reporting requirements on the use of carbon offsets taking effect in many parts of the world.

The quality of buffer pools is unclear

Based on publicly available data and our own analysis described above, it also appears that credits from projects that have been discredited, such as this project that has since been deforested, may still form part of the buffer pool. This means that **credits that are supposed to be used to compensate for reversals may have themselves been reversed**. The buyers we speak to are keenly interested in credit quality and avoiding reputational risk. We expect that these **discerning buyers will not be satisfied with the fact that buffer pool compensation can include compensation in the form of credits from all kinds of carbon credit projects**, whether those projects are avoidance or removal projects or whether they are additional, prevent leakage, and are based on sound baselines. (At least one major registry we reviewed even allows developers to contribute any type of credit they want to the buffer pool, without regard to its quality.)

In short

The current state of buffer pools is precarious: buffer pools are likely insufficient, they fail to monitor or account for many credit reversals, and the quality of the credits in the buffer pools themselves are questionable.

How in-kind insurance can compensate for reversal risk and secure permanence

Insurance has been a common risk transfer mechanism for centuries. **And it will work here, too.** How, and why?

In-kind insurance can secure permanence for 40 or 100 years, in yearly increments

No product manufacturer guarantees their products for anything close to 100 years in the modern world, and neither should carbon credit project developers—again, because it's impossible to predict with any accuracy what the world will look like a century from now. **Insurers, however, have long experience in insuring the same assets for 100 years, but in annual increments**. Think of your home insurance, which insures against risks to the same home year after year, with premiums adjusted if you make claims or if the area where your home is located is declared a flood zone. Annual insurance

contracts mean that someone will need to be responsible for maintaining the yearly insurance. In our view, this should be the entity that retires the credit (i.e., claims its benefit), but this could also be the project developer. Annual insurance also means that the insurance company will re-evaluate the risk of the project every year as part of its pricing process and will take into account whether reversals have occurred in its assessment.

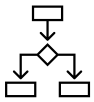
When a reversal happens, it will be compensated in-kind, with an unused carbon credit from the insurer's own pool of carbon credits. What's more, the insured party will know exactly what has been reversed and with what it has been compensated – all in an auditable, contractual transaction.

Insurance companies are tightly regulated enterprises that must be able to pay their claims

It's the business of insurance companies, and the regulators who supervise them, **to ensure that they have enough resources to pay their claims**, even in worst case scenarios.

Insurers are subject to strict regulation and both their senior management and board of directors must be vetted by a regulator to ensure that they have the appropriate level of expertise—especially in 'setting reserves,' *i.e.,* calculating the amount to be set aside to pay claims.

As we mentioned above, insurance companies expect the outcome of their portfolio to be worse than expected 50% of the time. Insurers are also required by regulation to be able to pay claims in all but the most extreme cases (those that are expected to occur once every 200 years or even less frequently). Therefore, when an insurer calculates how much money they need to set aside to cover a claim, they calculate the amount based on the statistical probabilities of experiencing a loss, and increase this amount by putting aside their own risk capital to cover the worst-case outcomes—an 'additional risk buffer', if you will. Since insurers are putting their own capital at risk, **they have a very strong incentive to calculate risk correctly**.



Insurance premiums reflect each project's individual risk profile, creating a quantitative, unbiased tool for risk selection for carbon credit buyers

The cost of insuring a carbon credit project in an area that is prone to wildfires should be higher than one that isn't, just like insuring a house built in a flood zone should be more expensive compared to one that's not. A project's insurance premium, coupled with scientific, quantitative assessments of a project's actual carbon sequestration—such as Renoster's quantitative, expert-designed and vetted Gemini Rubric (which was developed by forestry scientists with deep knowledge of carbon crediting methodologies based on years of experience and review of over 200 projects)—would certainly **help buyers to differentiate between VCM projects of differing quality**.

Insurance is transparent

Insurers' balance sheets and reserves (*i.e.*, how much they set aside to pay claims) are audited by external auditors and actuaries, and must be disclosed

to their regulators annually, so it is easy to determine the quality and value of the assets used to pay claims in case of a reversal. **Black boxes aren't allowed in insurance**, because insurance plays such a critical role in the risk mitigation strategies of individuals and companies; **this should also be the case for reversal risk for carbon credits, given what is at stake**.

Figure 1. Buffer pools versus in-kind insurance: a quick comparison

	Buffer pools	In-kind insurance
Enough credits to cover for a single catastrophic event?	Likely	Yes
Enough credits to cover for multiple catastrophic events?	Unlikely	Yes
Buffer mechanism supervised by an independent regulator?	No	Yes
In-kind compensation for reversal events	Yes	Yes
Annual risk assessment of projects, taking into account whether reversals have occurred?	Not after crediting period ends	Yes

What next, and why now?

If you're reading this article, it's probably because you believe that getting the VCM right is critical to achieving net zero. VCM participants are engaged in any number of initiatives, be it the ICVCM and its CCP initiative, VCMI Claims Guidance, Verra and its ABACUS initiative or rating agencies like Renoster, BeZero and Sylvera, to improve the quality of carbon credits and demystify the process of buying them. Buyers in turn are laser-focused on the risks and benefits of carbon credit projects, and their own reputations, and can hardly justify receiving buffer pool compensation that is unclear and paid with poor quality or even reversed credits, if at all.

We invite carbon credit registries to engage with carbon credit insurers and all relevant stakeholders to build the mechanisms necessary to make in-kind carbon credit insurance a viable alternative to buffer pools.

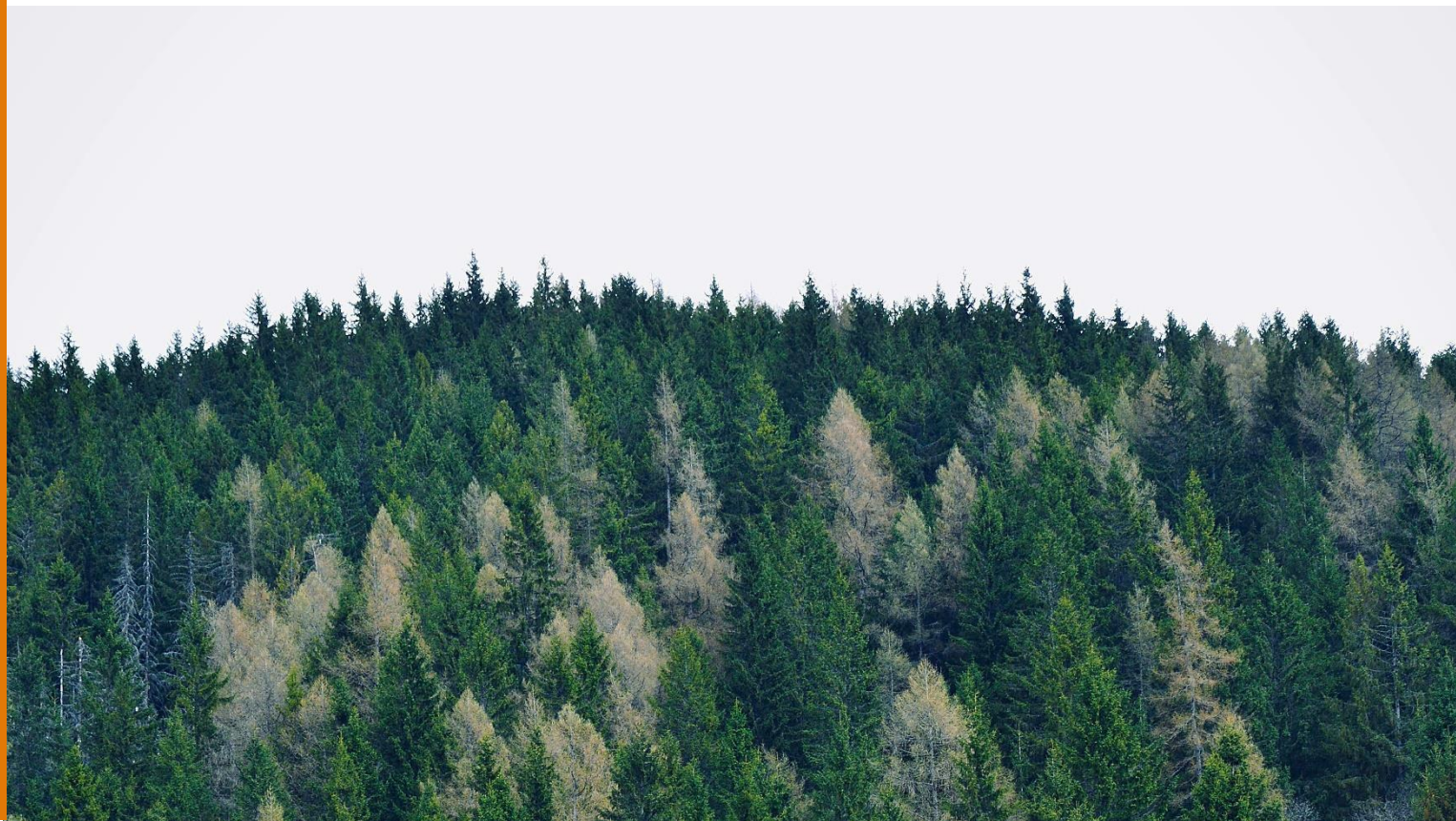
Specifically:

- Registries, insurers, rating agencies, and other key market participants should **engage in a structured dialogue** to discuss how buffer pools can be transitioned to insurance.
- **Insurers should be prepared to share details** of how an insurance solution in lieu of a buffer pool can work—CarbonPool has prepared such a proposal to share with registries interested in piloting an insurance alternative.
- Registries that already contemplate insurance in lieu of buffer pool contributions (like ACR) **should in particular be prepared to specify what they seek in insurance coverage and to allow some pilot insurance contracts** with measurable milestones to determine effectiveness.

There will undoubtedly be challenges: for one, insurers don't yet have the underwriting capacity to take over all the projects that need to cover for reversal risk. **But insurance is part of every mature market in the world, and the VCM should be no different**—particularly as investors, developers and buyers alike are seeking to mitigate and transfer risk. CarbonPool has developed an in-kind reversal insurance product which we believe is uniquely well-suited to the challenge of replacing buffer pools, though other insurance products and solutions also exist—ultimately the market will determine which solutions are best fit for purpose. It will take time and work, but the time to act is now, **and we stand ready to work with clients, registries and other VCM participants to implement better solutions to achieve the outcome that we are all striving to achieve**.

The bottom line

The time to introduce a regulated, transparent mechanism for mitigating against reversal risk that actually does what it promises to do is now – on its own merits, but also before the buffer pools, created with smart and good intentions, become the subject of loud and damaging media criticism.



Endnotes

[i] In-kind insurance refers to insurance products where claims are paid 'in-kind' in carbon credits rather than in cash.

[ii] See, e.g., https://www.frontiersin.org/articles/10.3389/ffgc.2022.930426/full; https://www.biorxiv.org/content/10.1101/2024.03.28.587000v1; https://carbonplan.org/blog/carb-buffer-decline.

[iii] Flannigan, Mike & Wagner, C.E.. (1991). Climate change and wildfire in Canada. Canadian Journal of Forest Research. 21. 66-72. 10.1139/x91-010.

iv Canadian National Fire Database (CNFDB), 2024; Curasi, Salvatore & Melton, Joe & Arora, Vivek & Humphreys, Elyn & Whaley, Cynthia. (2024). Canada's wildfire future: climate change below a 2°C global target avoids large increases in burned area by the end of the century. 10.21203/rs.3.rs-4364877/v1.

[v] Haya, B.K, Abayo, A., So, I.S., Elias, M. (2024, May). Voluntary Registry Offsets Database v11, Berkeley Carbon Trading Project, University of California, Berkeley.