Methods for assessing carbon offset quality
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1. UC's offset criteria

UC's minimum offset quality criteria and other offset priorities are laid out in UC's offset procurement policy.[1] This policy was developed in consultation with UC faculty, students, and staff over five years of engagement including through town halls, individual and group meetings, and comment periods.

UC defines its **minimum criteria** for quality offsets as credits that:

- are likely to represent no more than their actual climate benefit,
- have low risk of environmental or social harm especially in marginalized communities, and
- involve technologies that are scalable in line with reducing global emissions to no more than net zero by mid-century as outlined in the *IPCC special report on Global Warming of 1.5C*.

2. Summary of methods for assessing offset quality

Offset quality can be assessed at a project or project type level. A *project type* is any set of projects that meet specific objective criteria. This can be all projects that use a specific offset protocol, or it can be a subset of projects using a specific protocol by objective characteristics such as location, size, or technology. Credits from project types are considered real and additional if total credits generated by that type are unlikely to exceed the true climate benefit across the whole portfolio of projects.

UC uses *over/under crediting analyses* to review the quality of credits generated by individual projects and project types.[2] This analysis recognizes that methods used to calculate emissions reductions may over-credit in some ways and under-credit in other ways. Credits are considered real and additional if sources of over-crediting, such as the participation of non-additional projects for a project type, or a non-conservative baseline for an individual project, is counterbalanced in full by sources of under-crediting, treating uncertainty conservatively. Conservative means that estimates of the climate benefit of a project, or portfolio of projects for a project type, are more likely to under-credit than over-credit. Large uncertainties require higher levels of conservativeness.

Over/under crediting analyses should take into account:

[1] The offset procurement policy was added to UC's Sustainable Practices Policy in March 2022, after a comprehensive, UC-wide review (see sections III.C.2. and V.C.9.)

[2] See this article for one example of a comprehensive over/under crediting analysis: Gill-Wiehl, A., Kammen, D., & Haya, B. (2023). *Cooking the books: Pervasive over-crediting from cookstoves offset methodologies* [Preprint]. In Review. https://doi.org/10.21203/rs.3.rs-2606020/v1

Additionality – would the credited reductions have occurred without the offset program or the University's climate protection policy?
Baselines – what would likely have happened without the offset program or the University's climate protection policy? The baseline is the scenario against which credited reductions/removals are estimated.
Leakage – do projects affect emissions outside of project accounting boundaries? Are any increases in emissions adequately avoided or accounted for?
Durability – is the risk that any stored carbon will be released back into the atmosphere over a forty year period managed and fully accounted for?
Methods for estimating reductions/removals – otherwise, are the methods used to estimate emissions reductions/removals conservative and aligned with the latest science?

Project types undergo a two-step review process.
(1) Comprehensive over/under crediting assessment, seeking types of projects that are categorically deemed quality.
(2) Each assessment is then peer reviewed by at least two reviewers similar to informal peer reviews before journal submission; reviewers must be independent

Comprehensive project type assessments should start with a review of relevant literature on offset quality that has already been published (see Repository of Articles on Offset Quality as a start). If a rigorous and up-to-date article has been published with a full over-under crediting analysis taking into account the list of factors described above, no further analysis is needed. Comprehensive project type assessments should be performed by a team with the necessary interdisciplinary and sector expertise for the particular project type and location, including in carbon accounting and sectoral culture and factors affecting project implementation decisions.

3. Detailed methods for assessing offset quality

3.1 Additionality

Projects are considered additional if it is likely that the reductions would not have occurred were it not for offsets or for UC's climate protection policy.

Additionality has been the largest challenge with offset quality to date. Offset programs use two methods for screening for project additionality. The United Nation's Clean Development Mechanism (CDM), the world's largest carbon offset program, assesses additionality on a project-by-project basis. Each project developer must demonstrate, and third-party verifiers must verify, that the project is either not cost effective on its own and/or has barriers that prohibit implementation without offsets. Research has found high rates of non-additionality which can be traced to weaknesses in the program's methods of assessing additionality.[3] Financial assessments involve multiple assumptions that can be strategically chosen to show that cost effective projects are not cost effective, and while most projects experience challenges, it can be difficult for third-party

[3] Haya, B. (2010). *Carbon Offsetting: An Efficient Way to Reduce Emissions or to Avoid Reducing Emissions? An Investigation and Analysis of Offsetting Design and Practice in India and China* [(Doctoral dissertation) Energy & Resources Group, University of California]. https://escholarship.org/content/qt7jk7v95t/qt7jk7v95t.pdf; Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., & Spalding-Fecher, R. (2016). *How additional is the Clean Development Mechanism?* https://ec.europa.eu/clima/system/files/2017-04/clean_dev_mechanism_en.pdf

verifiers to identify which would have prevented projects from going forward. This method for assessing project additionality is still commonly used.

Second generation offset protocols, like those under California's offset program and many protocols generating credits on today's voluntary offset market, use a "standardized" approach to assessing additionality. Under this approach, offset registries create eligibility criteria that restrict offsetting to project types that are not common practice; any project meeting the eligibility criteria is allowed to participate and generate credits. Ideally protocols would prevent over-crediting across the entire portfolio of projects using methods similar to our over/under crediting analysis—taking into account that some credited reductions may be non-additional, but that conservativeness in emissions reduction calculations can counterbalance that over-crediting. In our own assessments of protocols using the standardized approach, we have found that protocol developers sometimes choose conservative methods for estimating project benefits but commonly do not quantitatively assess whether sources of under-crediting counterbalance crediting from non-additional projects that choose to participate and from other sources of over-crediting.[4]

Methods for independently assessing additionality will vary per project and project type. Additionality is rarely black and white; most often there is some uncertainty, and sometimes a lot of uncertainty, in whether a project is additional, or the proportion of participating projects that are non-additional.

Here we elaborate on some key additionality assessment methods and issues. As with other elements of these guidelines, these additionality assessment guidelines will continue to evolve as we gain experience and as methods are published by other groups.

3.1.1 Methods for assessing additionality at a project type level:

Project type additionality analyses will vary by the project type and is best performed by individuals who know the industry well in the locations where the credited projects are taking place, including the factors that commonly influence decisions to implement the project types being credited, and common practice in the industry.

Project types are most likely to be additional if climate change mitigation is the sole reason to perform the project. Project types are also likely to be additional if they have been implemented at very low rates or not at all prior to eligibility under an offset protocol, and if offset income significantly improves project financial returns, such as is more common with projects that reduce methane and other high potency gases than with projects that only reduce CO_2.

Evaluators of additionality for project types should use their expert judgment to conservatively assess the proportion of participating projects that are non-additional.[5] Assessments can involve, among other things, review of published articles including gray literature; in depth assessments of individual projects following the methods for assessing the additionality of individual projects below; input from sectoral/ technological/ regional experts; and analysis of project implementation trends over time in which an increase in implementation should be seen in response to the adoption of offset protocols and increases in offset prices.

[4] Haya, B., Cullenward, D., Strong, A. L., Grubert, E., Heilmayr, R., Sivas, D. A., & Wara, M. (2020). Managing uncertainty in carbon offsets: Insights from California's standardized approach. *Climate Policy*, 1–15. https://doi.org/10.1080/14693062.2020.1781035

[5] For an example of such an analysis, see: Haya, B., Cullenward, D., Strong, A. L., Grubert, E., Heilmayr, R., Sivas, D. A., & Wara, M. (2020). Managing uncertainty in carbon offsets: Insights from California's standardized approach. *Climate Policy*, 1–15. https://doi.org/10.1080/14693062.2020.1781035

3.1.2 When a project has multiple revenue sources

Additionality can be particularly tricky to assess if there are multiple sources of supportive revenues, such as government incentives, philanthropic funding, or multiple sources of payments for environmental services. Additionality in the context of multiple funding sources can be addressed in several ways, depending on the specific project, context:

1. The other revenues are considered in the same manner as product sales revenues, and the offset project is considered to be additional only if it is very likely that the project would not have gone forward without the offset program or UC's climate protection policy.
2. Payment stacking: when there are multiple sources of climate-driven funding, to avoid double counting, responsibility can be claimed in proportion to the supportive funds provided. For example, if philanthropy and carbon offsets both contribute half of the needed funding, each can claim responsibility for half of the resulting reductions. Offset credits would only be generated for half of the GHG benefit estimated for the project or the two funding sources would each receive half of the credits.
3. If the offset project is run by a non-profit or business devoted to climate mitigation projects, and if the offset income is sufficient to have provided the total incentive funds needed by the project to move forward, an offset project could be considered additional even if the project was also supported, or even primarily supported, but other support revenue. Offset funds would be fully invested in future climate mitigation projects of at least similar GHG benefits. A potential con of this approach is the timing of credit generation and the impact of those funds–credits would be generated for past non-additional activities, and the impact of those offset credits is to enable other future activities with similar GHG impact. A benefit of this approach is that a combination of initial philanthropy and a steady stream of offsets revenues can enable an organization or business to be viable. An inherent challenge of offsets as an incentive system is that credits are generated for reductions only after they occur, and so do not provide the upfront capital needed to get a project off the ground. This approach to additionality could overcome that fundamental challenge resulting in real additional climate benefits over time. Examples of this approach could be a cookstoves business that needs upfront funds to get going but then can expand as offset funds come in, or a conservation organization that would reinvest offset funds proportionally in more land easements or purchases. Of course a drawback of this approach is that credits are effectively generated ex-ante and additional reductions happen over time as the offset funds are invested in new projects.

3.2 Baselines

Offset projects measure their emissions/carbon impact against estimates of the emissions/removals that would have taken place without the offset program. All or most offset protocols calculate the project effect, and number of credits generated, as the difference between the estimated emissions or removals in the project scenario, minus the emissions/removal in the defined baseline scenario. Additionality is related to baselines; if the project is non-additional, the baseline *is* the project and the project has no impact.

Like additionality, baselines assessments are also often very uncertain, since it is impossible to directly measure a scenario that never happened. Studies of offset quality have found that some protocols have defined baselines in a way that exaggerates climate impacts, for example studies have found significant exaggeration of baseline emissions and therefore credit generation from "clean

coal" CDM projects,[6] US improved forest management projects,[7] and international reduced deforestation projects (REDD+).[8] Critical case studies of the baselines of individual offset projects have also been published.[9]

Assessments of protocol baselines will be specific to the project type, and can draw from published literature, market and technology trends, and sector-specific knowledge to assess the accuracy and conservativeness of the methods used to estimate baseline emissions. Assessments of baselines and additionality should take into account adverse selection and information asymmetries. Adverse selection can occur when offset protocols define baselines as the average, or more conservative than average, across the portfolio of *possible* projects, but because the financial benefits are greatest for those projects that need to make the smallest change to participate, such as non-additional projects, so that the actual pool of participating projects is dominated by those with the least real GHG impact.

3.3 Leakage

A project meant to reduce emissions can cause *leakage* when it causes emissions to increase outside of project accounting boundaries.

The most common form of leakage is market leakage. An offset project that reduces emissions by decreasing production of a product can lead to an increase in production, and associated emissions increases, elsewhere to meet demand for that product. For example, improved forest management projects that increase carbon on participating lands by reducing timber harvesting can lead to increased timber harvesting elsewhere to meet timber demand. Protocols should be designed to minimize the risk of leakage as possible and otherwise account for it conservatively.

Assessments of market leakage accounting can focus on leakage timing and leakage rates. California Air Resources Board's U.S. Forest offset protocol commonly credits a large reduction in timber harvesting in the first year of a project, but deducts the associated leakage evenly over 100 years leading to significant over-crediting at the start of the project.[10] This has led to significant over-crediting in the first decades of many projects. Assessments should also compare the leakage rates used by the protocol with published studies of leakage rates for the commodity and region.

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[6] Lazarus, M., & Chandler, C. (2011). *Coal Power in the CDM: Issues and Options*. https://www.sei.org/publications/coal-power-in-the-cdm-issues-and-options/

[7] Badgley, G., Freeman, J., Hamman, J. J., Haya, B., Trugman, A. T., Anderegg, W. R. L., & Cullenward, D. (2021). Systematic over-crediting in California's forest carbon offsets program. *Global Change Biology*, gcb.15943. https://doi.org/10.1111/gcb.15943; Coffield, S. R., Vo, C. D., Wang, J. A., Badgley, G., Goulden, M. L., Cullenward, D., Anderegg, W. R. L., & Randerson, J. T. (2022). Using remote sensing to quantify the additional climate benefits of California forest carbon offset projects. *Global Change Biology*, gcb.16380. https://doi.org/10.1111/gcb.16380; Stapp, J., Nolte, C., Potts, M., Baumann, M., Haya, B. K., & Butsic, V. (2023). Little evidence of management change in California's forest offset program. *Communications Earth & Environment*, *4*(1), 331. https://doi.org/10.1038/s43247-023-00984-2

[8] West, T. A. P., Börner, J., Sills, E. O., & Kontoleon, A. (2020). Overstated carbon emission reductions from voluntary REDD+ projects in the Brazilian Amazon. *Proceedings of the National Academy of Sciences*, *117*(39), 24188–24194. https://doi.org/10.1073/pnas.2004334117;; West, T. A. P., Wunder, S., Sills, E. O., Börner, J., Rifai, S. W., Neidermeier, A. N., Frey, G. P., & Kontoleon, A. (2023). Action needed to make carbon offsets from forest conservation work for climate change mitigation. *Science*, *381*(6660), 873–877. https://doi.org/10.1126/science.ade3535

[9] E.g. van Kooten, G. C., Bogle, T. N., & de Vries, F. P. (2014). Forest Carbon Offsets Revisited: Shedding Light on Darkwoods. *Forest Science*, *61*(6), 370–380. https://doi.org/10.5849/forsci.13-183

[10] Haya, B. (2019). *The California Air Resources Board's U.S. Forest offset protocol underestimates leakage*. University of California, Berkeley. https://gspp.berkeley.edu/assets/uploads/research/pdf/Policy_Brief-US_Forest_Projects-Leakage-Haya_4.pdf

The California U.S. Forest offset protocol uses a leakage rate far below rates from published literature.[11] Also, leakage assessments can be complex and often involve significant uncertainty.

Offset protocols should also be evaluated for other potential perverse incentives that increase emissions. Examples of perverse incentives include creating incentives for facilities to increase emissions in order to be paid to decrease them, increasing profits from higher emitting products/activities that reduce some of their emissions but that compete with lower emitting products/activities, and creating disincentives for governments to regulate emissions.[12]

3.4 Methods for estimating emissions reductions

Protocol reviewers should carefully review all methods used to estimate emissions reductions, including emissions factors used and whether they reflect the latest science, and emissions pools that are excluded from emissions accounting.

3.5 Scalability

UC is committed to only supporting offset project types that avoid locking in levels of emissions, technologies, or carbon-intensive practices that are incompatible with deep decarbonization in line with new zero by mid-century.[13] UC is committed to supporting innovation, best-available technologies, and technologies that are a part of a net zero world rather than incrementally better technologies. This assessment can involve reference to sectoral decarbonization pathways assessments if available. Also, drawing from the work of the ICVCM, UC will avoid "a technology or practice that constitutes an inefficient use of a resource, such as biomass, that might be important for climate mitigation."[14]

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[11] Haya, B. & Stewart, W. (2019). *Response to comments by the California Air Resources Board on The California Air Resources Board's U.S. Forest offset protocol underestimates leakage*. University of California, Berkeley. https://gspp.berkeley.edu/assets/uploads/research/pdf/Response_to_comments_by_ARB_on_leakage_under_forest_protocol_2.pdf

[12] Cames, M., Harthan, R. O., Füssler, J., Lazarus, M., Lee, C. M., Erickson, P., & Spalding-Fecher, R. (2016). *How additional is the Clean Development Mechanism?* https://ec.europa.eu/clima/system/files/2017-04/clean_dev_mechanism_en.pdf (see adiptic acid analysis); Haya, B., Cullenward, D., Strong, A. L., Grubert, E., Heilmayr, R., Sivas, D. A., & Wara, M. (2020). Managing uncertainty in carbon offsets: Insights from California's standardized approach. *Climate Policy*, 1–15. https://doi.org/10.1080/14693062.2020.1781035; Schneider, L., & Kollmuss, A. (2015). Perverse effects of carbon markets on HFC-23 and SF6 abatement projects in Russia. *Nature Climate Change*, *5*(12), 1061–1063. https://doi.org/10.1038/nclimate2772; Wara, M. (2014). Measuring the Clean Development Mechanism's Performance and Potential. *UCLA Law Review*, *55*, 1759–1803.

[13] This language is taken directly from Part 2 of the draft consultation report of the Integrity Council for the Voluntary Carbon Market ICVCM, which captures our intent well.

[14] See Criterion 11.1, p113 of the draft consultation report of the Integrity Council for the Voluntary Carbon Market ICVCM