Application of the Oeko-Institut/WWF-US/ EDF methodology for assessing the quality of carbon credits

This document presents results from the application of version 3.0 of a methodology, developed by Oeko-Institut, World Wildlife Fund (WWF-US) and Environmental Defense Fund (EDF), for assessing the quality of carbon credits. The methodology is applied by Oeko-Institut with support by Carbon Limits, Greenhouse Gas Management Institute (GHGMI), INFRAS, Stockholm Environment Institute, and individual carbon market experts. This document evaluates one specific criterion or sub-criterion with respect to a specific carbon crediting program, project type, quantification methodology and/or host country, as specified in the below table. Please note that the CCQI website Site terms and Privacy Policy apply with respect to any use of the information provided in this document. Further information on the project and the methodology can be found here: www.carboncreditquality.org

Sub-criterion:	1.2 Vulnerability
Project type:	Industrial biodigesters fed with livestock manure
Date of final assessment:	31 January 2023
Score:	3

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Assessment

Relevant scoring methodology provisions

In market situations where the supply of carbon credits from already registered and implemented projects considerably exceeds the current and expected future demand for carbon credits, the purchase of carbon credits does not necessarily trigger further emission reductions. The methodology therefore evaluates for carbon credits in collapsed markets whether the projects would continue to reduce GHG emissions even without carbon credit revenues, or whether they are at risk of discontinuing GHG abatement without these revenues. In the latter case, they are classified as vulnerable projects. The methodology employs a stepwise approach for assessing the vulnerability of the respective project type or individual project:

Step 1: Evaluate whether the relevant market of the carbon credit can be characterized as collapsed (see methodology for further details). Note that currently, this situation only applies to the CDM.

Step 2: Identify potential continuation and discontinuation scenarios. If applied on the project type level a representative sample of projects can be assessed.

Step 3: Evaluate how applicable legal requirements affect the feasibility of the scenarios identified in step 2. Apply this step to both continuation and discontinuation scenarios. Remove scenarios that could not be pursued due to applicable laws and regulations. This step may be applied at project or project type level in the context of a specific host country or at the level of the carbon crediting program (see methodology for further details).

Step 4: Assess financial benefits and costs and rank the remaining scenarios in order of their financial attractiveness by performing a cost-benefit analysis of each scenario. The financial attractiveness of a project depends on whether its income exceeds the operational expenditure in the absence of carbon credits. Only OPEX and benefits are therefore considered in the analysis. Exclude costs and benefits that occur under all scenarios in a uniform manner.

Step 5: Assess whether any of the scenarios faces non-financial barriers that exclude it from being the course of action. For conducting the barrier assessment, the same approach described in section 1.1.4 is applied using an expert judgement. Remove all scenarios that face non-financial barriers and are scored at 5 or 4 from further consideration.

Step 6: Determine the most likely project scenario. The highest ranked remaining scenario is the likely course of action. If this is a continuation scenario, the project is deemed to have a low vulnerability to discontinue GHG abatement (score of 1). If the scenario is a discontinuation scenario, and it is either the only remaining scenario or any other scenarios are financially significantly less attractive, then the vulnerability is deemed to be high (score of 5). In other instances, e.g. where a continuation and discontinuation scenario may be equally plausible, no clear conclusion can be drawn on vulnerability (score of 3).

Degree of Vulnerability	Score
High Vulnerability	5
Vulnerability not conclusive	3
Low Vulnerability	1

Information sources considered

1 CDM Database for PAs and PoAs, Data accessed on 4 May 2022. Downloadable as excel spreadsheet under https://cdm.unfccc.int/Projects/projsearch.html

2 Gold Standard Impact Registry, Data accessed on 20 June 2022 https://registry.goldstandard.org/projects?q=&page=1

3 VCS registry. Data accessed on 20 June 2022 https://registry.verra.org/app/search/VCS/Registered

4 Voluntary Registry Offsets Database v5, Goldman School of Public Policy, University of California Berkeley. https://gspp.berkeley.edu/faculty-and-impact/centers/cepp/projects/berkeley-carbon-trading-project/offsets-database

5 Warnecke, C.; Day, T.; Schneider, L.; Cames, M.; Healy, S.; Harthan, R.; Tewari, R.; Höhne, N. (2017): Vulnerability of CDM projects for Discontinuation of Mitigation Activities: Assessment of Project Vulnerability and Options to Support Continued Mitigation. NewClimate Institute; Oeko-Institut. DEHSt (ed.). Berlin, 2017. Online available at https://www.dehst.de/SharedDocs/downloads/EN/project-mechanisms/vulnerability-of-CDM.pdf?__blob=publicationFile&v=3, last accessed on 6 Nov 2020.

Assessment outcome

The project type is assigned a score of 3.

Justification of assessment

Step 1: Per the guidance in the methodology the CDM market is collapsed. There are currently 28 registered projects under the CDM. All other markets relevant for this assessment (ACR, CAR, GS and VCS) are considered functioning.

Step 2: The following continuation or discontinuation scenarios have been identified:

- Scenario 1: Mitigation activity continues as originally designed and implemented, and at the same scale.
- Scenario 2: Mitigation activity continues but overall emissions reductions of the activity will be at a smaller scale. Due to the discontinuation of the maintenance of pre-treatment skids and carbon filters that neutralize hydrogen sulphide and control siloxanes the equipment will eventually cease to function, because without pre-conditioning, harmful constituents of the biogas will likely cause severe damages to power generating engines. Consequently, project owners are forced to revert to flaring the biogas instead of using it for power generation.
- Scenario 3: Mitigation activity continues but at a smaller scale as project owners will cease to operate pre-conditioning equipment. They will continue to use the anaerobic digester as a system to manage the manure but will revert to flaring the biogas instead of using it for power generation.

- Scenario 4: Mitigation activity discontinues as project owners will stop using and dismantle the anaerobic digester and revert to other practices of manure management such as solid storage, uncovered anaerobic lagoon, pit storage, composting or deep bedding.

Step 3: Many countries encourage the efficient use of manure and have adopted policies and regulations that incentivize and govern manure management practices by farmers. Further, storage and use of manure is associated with environmental harms making it a subject to regulation in many countries over the world, including it utilization. An assessment of the manure policy frameworks of 34 developing countries in 2014 showed that 30 countries have policies related to manure management. Further, 18 countries have policies in place in relation to digestion.[1]

In China for example, the *Guiding Opinions on Promoting the Land Application of Livestock Manure and Strengthening the Pollution Control according to Law* adopted in 2019 contain targets for manure utilization of 80% in 2025 and 90% in 2030.[2] While targets do not constitute a legal requirement, it is plausible that regulation might be legislated in the coming years to support their achievement. It is therefore deemed plausible that the project type could be legally required.

The adoption of new regulations might influence the feasibility of scenarios 3 or 4 in individual countries if they would not be compatible with manure management obligations prescribed by these regulations. The assessment of the project type did however not identify evidence that would exclude these scenarios on a global level. The assessment therefore proceeds with step 4.

Step 4: As the assessment is conducted on the project type level, the relationship between revenues other than from carbon credits and operational expenditures (OPEX) was analyzed for a sample of projects. The sample was constructed as follows:

- The project databases of the Clean Development Mechanism (CDM), Gold Standard (GS) and Verra's Verified Carbon Standard (VCS)[3] were searched for projects of industrial biodigesters fed with livestock manure, since these are the only programmes that offer registrations for this project type.
- For the projects identified in each of the registries a search was performed whether they provide the necessary detailed information on their financial viability that is required for performing the assessment. In particular, the assessment requires the following data:
    - A time series of revenues other than from carbon credits over the operational period of the project

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[1] Teenstra et a. (2014) Global Assessment of Manure Management Policies and Practices; Wageningen Livestock Research
https://edepot.wur.nl/335445

[2] Wei et al. (2021) Policies and regulations for manure management for sustainable livestock production in China: A review; Frontiers of Agricultural Science and Engineering; Volume 8; Issue 1; pages 45-57
https://journal.hep.com.cn/fase/EN/10.15302/J-FASE-2020369

[3] However, as the Gold Standard Impact Registry (Source 2) and the Verra Registry for the Verified Carbon Standard (Source 3) do not allow for filtering their entries by this project type, the UC Berkeley Voluntary Registry Offsets Database v5 (Source 4) was used in an initial step to identify the respective projects registered under the GS and VCS respectively.

    - A time series of OPEX over the operational period of the project

- For the CDM, there are currently 28 projects registered. Furthermore, there are five GS and 27 VCS projects falling within our definition of this project type, yielding in total 60 projects of relevance.
- A review of key project information for each of the 60 projects showed that 21 CDM projects and one GS project provide the financial information required for performing the assessment.[4] Therefore, these 22 projects form the input for the data sample constructed for the assessment.
- All projects provide this information in a separate excel spreadsheet, which was downloaded for each project.

For constructing the data sample, the following information was directly retrieved from each excel spreadsheet for each project and transferred in a central excel spreadsheet created for conducting the analysis:

- The project ID
- The project start date
- The host country
- The host country region
- The currency and its unit used by the project proponent to present financial information (e.g., "10,000 RMB")

In addition to this basic information, for each project the revenues other than carbon credits and the OPEX were considered. All projects provide this information as a time series over the full operational period of the project. However, while some projects indicate the actual years for the time series (2007, 2008, 2009, etc.) others only indicate the respective period (period 1, period 2, period 3, etc.). Consequently, this information was harmonized. The construction period was not considered for the assessment.

For each project, the information provided was reviewed in detail to identify the correct values for revenues and OPEX. Projects accrue revenues from both selling the digester's effluent as a fertilizer and saving energy expenditures if the generated biogas is used on-site. Although this is not true for every project, OPEX generally comprise VAT, urban and rural construction taxes, education surcharges, management fees, insurances, and land lease costs. Since these expenditures would presumably cease by the time the mitigation activity ceases, they were considered for the analysis where available.

Finally, the costs and revenues were compared for each project in each period. The results of the assessment are shown in table 1 below. Green shaded cells indicate that the revenues other than carbon credit revenues exceed OPEX in the relevant period, while red shaded cells indicate the opposite.

[4] All VCS projects had to be excluded from the analysis as the VCS registry generally does not provide project registration documents with detailed financial information.

Based on the outcome of this calculation, projects are assigned to different groups of projects with similar patterns in the relationship between revenues and costs (see table 2). For each group, a statement is made whether the likely course of action for this group of projects is to continue or discontinue the mitigation activity.

For groups 1 and 2, consisting of 20 out of the 22 projects, there is a high likelihood that project owners will continue the mitigation activity even without revenues from carbon credits. For these projects revenues exceed OPEX in all or most periods.

For groups 3 and 4, comprising two projects, the discontinuation of the activity appears to be the most likely course of action after the revenue from carbon credits has stopped. For these projects, OPEX exceed revenues during the last periods of operation (CDM 5088) or for the whole life of the project (CDM 5672).

Table 1 and table 2 do not only indicate that scenario 1 is financially beneficial in almost all cases but also allow comparing its likelihood of being the course of action with the likelihood of the other scenarios identified above. Scenario 2, where the maintenance of pre-treatment skids and carbon filters will be discontinued, may well result in higher profits in the short run through lower maintenance expenditures. However, as an incomplete maintenance will likely lead to a malfunction of the preconditioning equipment and eventually to defective power generating engines, scenario 2 must account for the cease of power generation in the long run. Thus, the likelihood of this scenario depends on how farm owners perceive the time value of money, i.e., whether they prefer 1) lower OPEX and thereby higher profits in the short run, in expense of a default of revenues (or cost savings) from power generation in the long run – or 2) a virtually constant stream of OPEX and revenues over a long period of time, usually resulting in equally constant profits (see table 1). However, as for most projects the financial analysis shows a considerably higher revenue stream from power generation when compared to available savings from ceasing maintenance, there should be a strong incentive for decisionmakers to continue maintenance in the usual manner (scenario 1). This only holds under the assumption that there are no non-financial barriers which prevent this scenario to materialize (see step 5).

As findings from Warnecke et al. (2017) suggest, the scenarios 3 and 4 are not likely to yield higher profits than those displayed in table 1. Following interviews with project stakeholders and an analysis of 15 PDDs, the authors report negative financial benefits for the decision to revert to flaring the biogas (scenario 3) and neutral financial outcomes for discontinuing the emission reductions by switching back to anaerobic treatment of manure (scenario 4), which inevitably results in the release of biogas. Although the study only analyzed projects in three countries (Mexico, Brazil and Thailand), there is no indication that, when assessed on a general level, the financial attractiveness of either of the two scenarios would increase to the point where it could compete with scenario 1. Therefore, from a financial point of view, scenario 1 is considered the most likely course of action.

Table 1 **Difference between revenues other than from carbon credits and OPEX for selected projects of the project type *Industrial biodigesters fed with livestock manure*[5]**

ID	Year	Country	Cur.	Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
CDM																								
452	2005	AM	EUR	100,000	0.59	2.22	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54	2.54
1301	2005	CN	USD	100,000	0.45	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.42	2.62	2.62	2.62	2.62	2.62					
1891	2007	CN	RMB	1,000,000	5.74	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66
3488	2007	CN	RMB	1,000,000	1.62	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36	3.36					
3716	2007	CN	RMB	1,000,000	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.01	4.01										
3851	2007	CN	RMB	1,000,000	0.64	1.19	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74					
3984	2008	BR	BRL	10,000	1.62	1.17	1.62	1.17	1.62	1.17	1.62	1.17	1.62	1.17	1.62	1.17	1.62	1.17	1.62					
4228	2008	CN	RMB	1,000,000	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
4398	2008	CN	RMB	1,000,000	1.83	1.93	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29						
4471	2008	CN	RMB	1,000,000	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.34					
5088	2008	MX	USD	100,000	0.80	0.56	0.49	0.41	0.33	0.25	0.17	0.07	-0.02	-0.12										
5105	2009	VN	USD	100,000	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56										
5672	2009	MX	USD	100,000	-0.93	-0.93	-0.94	-0.94	-0.95	-0.95	-0.95	-0.96	-0.96	-0.97	-0.97	-0.97	-0.98	-0.98	-0.99	-0.99	-1.00	-1.00	-1.01	-1.01
5708	2010	CN	RMB	1,000,000	0.51	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22	2.22					
5710	2009	CN	RMB	1,000,000	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26	2.26						
6277	2011	CN	RMB	1,000,000	3.67	3.67	2.14	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02					
7314	2010	CN	RMB	1,000,000	3.44	3.44	3.44	3.44	3.34	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	2.69	1.05	1.05	1.05	1.05	1.05
8935	2009	IN	INR	1,000,000	-9.62	-4.63	-2.14	0.60	3.62	6.94	10.60	14.62	19.04	23.90	29.25	35.13	41.60	48.72	56.55	65.16	74.64	85.06	96.52	109.13
9046	2008	TH	THB	100,000	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71										
9107	2010	CN	RMB	1,000,000	5.25	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48	15.48
9478	2011	RS	EUR	100,000	-7.20	19.68	24.28	23.65	22.98	22.28	21.52	20.89	20.23	19.55	18.92	18.26	17.58	16.88	16.15					
GS																								
11238	2020	CN	RMB	1,000,000	17.02	17.02	17.02	13.35	12.93	12.93	12.93	12.93	12.93	12.93	12.93	12.93	12.93	12.93	12.93					

Source: Own calculation based on information provided by project documents.

[5] For illustration purposes, the table only incorporates the first 20 years of the projects' operation period. For those few projects which envisage a longer operation period it was assured that there is no trend reversal.

Table 2 **Assessment of vulnerability for project sample**

Group	Project IDs	#	Description	Likely course of action
1	452, 1301, 1891, 3488, 3716, 3851, 3984, 4228, 4398, 4471, 5105, 5708, 5710, 6277, 7314, 9046, 9107, GS 11238	18	Revenues exceed OPEX during all periods of project operation. Continuing the activity is therefore the most likely scenario for these projects.	Continue the activity
2	8935, 9478	2	Revenues exceed OPEX during all periods of project operation except for the first periods.[6] As revenues exceed OPEX for all following periods, it is likely that the activity will be continued.	Continue the activity
3	5088	1	OPEX exceed revenues for two years at the end of the project's operational period. This is because energy savings (the only income indicated for this project except CER revenues) are projected to remain constant over time whereas OPEX are estimated to rise each year. Also including CER revenues for their calculations, the project proponents assume a significant profit over the whole life of the project. Thus, carbon credits may be the decisive factor for the project's continuation.	Discontinue the activity
4	5672	1	OPEX exceed revenues for the whole life of the project. This is reversed however by the time the project proponents also consider CER revenues for their calculations. Here, carbon credits are deemed the make-or-break factor for the entire project.	Discontinue the activity

Source: Own compilation.

[6] This is due to the low initial sales values (8935) or due to the fact that there are only two months of revenue generation in the first year of the project (9478).

Step 5: Warnecke et al. (2017) emphasize the role of the project's ownership structure as a potential non-financial barrier for continuing the mitigation activity as described in scenario 1. If the project is owned by the same entity which owns the farm, or its stakeholders, the risk of ceasing the mitigation activity remains low (as concluded in step 4). The opposite holds true for project arrangements where the project owners are third parties. In these cases, the split ownership structure proved to be a major barrier for continuing the activity in Mexico and Brazil. In such project arrangements the responsibility for the operation of biodigesters usually falls on the project owners, which in turn leaves the farm owners without the technical knowledge and skills to operate the equipment. Thus, once the project has ended and the third party has left, the farm operators would soon be unable to continue the operation of the biodigesters.

According to Warnecke et al. (2017), the high risk-perception of farmers towards investments not related to their main business case, poses another potential barrier to the continuation of the mitigation activity. Depending on the quality of the equipment, some components (e.g., primitive generators) need to be replaced on a regular basis. Even if the farm operator may be in a financial situation which allows them to afford the replacement, they may still be unwilling to do so due to their risk aversion towards this kind of asset.

For both barriers the study makes a distinction of the farm size. Generally, larger farms would be more capable of having access to skilled personnel and acquiring the knowledge required for the continuous use of the equipment. They would also utilize more sophisticated components which would rather require partial replacements instead of regularly substituting the whole component. Smaller farms would usually not be able to afford those components of higher quality, however.

As Warnecke et al. (2017) emphasize that projects in Thailand typically do not face the barriers described above, the prospect of scenario 1 being the most likely course of action cannot be excluded on a global level. Assessing the project type in the context of a particular country may lead to a divergent conclusion, however.

Step 6: The most likely scenario for the project type is a continuation scenario, as for most of the assessed projects the revenues from power generation exceed operational expenditures. Moreover, as identified in step 2, there may be circumstances under which the project owners are compelled to continue operation due to new or enforced legal requirements. Nonetheless, country-specific barriers opposing the continuation (such as in Brazil and Mexico) may exist. Thus, the vulnerability analysis is inconclusive, and the project type is assigned a score of 3 under the CDM.