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

This document presents results from the application of a methodology, developed by Oeko-Institut, World Wildlife Fund (WWF) 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:	1.3.2 Robustness of the quantification methodologies applied to determine emission reductions or removals
Project type:	Leak repair in natural gas transmission and distribution systems
Quantification methodology:	Clean Development Mechanism (CDM) AM0023, Version 04.0, and relevant tools
Assessment based on carbon crediting program documents valid as of:	15 May 2022
Date of final assessment:	31 January 2023
Score:	3

Contact
info@oeko.de
www.oeko.de

Head Office Freiburg
P. O. Box 17 71
79017 Freiburg

Street address
Merzhauser Straße 173
79100 Freiburg
Phone +49 761 45295-0

Office Berlin
Borkumstraße 2
13189 Berlin
Phone +49 30 405085-0

Office Darmstadt
Rheinstraße 95
64295 Darmstadt
Phone +49 6151 8191-0

Assessment

Relevant scoring methodology provisions

The methodology assesses the robustness of the quantification methodologies applied by the carbon crediting program to determine emission reductions or removals. The assessment of the quantification methodologies considers the degree of conservativeness in the light of the uncertainty of the emission reductions or removals. The assessment is based on the likelihood that the emission reductions or removals are under-estimated, estimated accurately, or over-estimated, as follows (see further details in the methodology):

Assessment outcome	Score
It is very likely (i.e., a probability of more than 90%) that the emission reductions or removals are underestimated, taking into account the uncertainty in quantifying the emission reductions or removals	5
It is likely (i.e., a probability of more than 66%) that the emission reductions or removals are underestimated, taking into account the uncertainty in quantifying the emission reductions or removals OR The emission reductions or removals are likely to be estimated accurately (i.e., there is about the same probability that they are underestimated or overestimated) and uncertainty in the estimates of the emission reductions or removals is low (i.e., up to ±10%)	4
The emission reductions or removals are likely to be estimated accurately (i.e., there is about the same probability that they are underestimated or overestimated) but there is medium to high uncertainty (i.e., ±10-50%) in the estimates of the emission reductions or removals OR It is likely (i.e., a probability of more than 66%) or very likely (i.e., a probability of more than 90%) that the emission reductions or removals are overestimated, taking into account the uncertainty in quantifying the emission reductions or removals, but the degree of overestimation is likely to be low (i.e., up to ±10%)	3
The emission reductions or removals are likely to be estimated accurately (i.e., there is about the same probability that they are underestimated or overestimated) but there is very high uncertainty (i.e., larger than ±50%) in the estimates of the emission reductions or removals OR It is likely (i.e., a probability of more than 66%) or very likely (i.e., a probability of more than 90%) that the emission reductions or removals are overestimated, taking into account the uncertainty in quantifying the emission reductions or removals, and the degree of overestimation is likely to be medium (±10-30%)	2
It is likely (i.e., a probability of more than 66%) or very likely (i.e., a probability of more than 90%) that the emission reductions or removals are overestimated, taking into account the uncertainty in quantifying the emission reductions or removals, and the degree of overestimation is likely to be large (i.e., larger than ±30%)	1

Information sources considered

1 CDM large-scale methodology AM0023, version 04.0.

2 Tool 02: Combined tool to identify the baseline scenario and demonstrate additionality – Version 07.0

3 Stephanie Saunier et al. (2014), Quantifying Cost-effectiveness of Systematic Leak Detection and Repair Programs Using Infrared Cameras. https://www.carbonlimits.no/project/quantifying-cost-effectiveness-of-systematic-leak-detection-ldar-using-infrared-cameras/
4 Rutherford – Sherwein et al. (2021), Closing the methane gap in US oil and natural gas production emissions inventories
5 Colorado State University (2022), Open-Source High Flow Sampler for Natural Gas Leak Quantification
6 Carbon Limits (2017), Statistical Analysis of leak detection and repair in Canada

Assessment outcome

The quantification methodology is assigned a score of 3.

Justification of assessment

Project type

This assessment refers to the project type "Leak repair in natural gas transmission and distribution systems" which is characterized as follows:

"Implementation of a system to inspect, measure and repair leaks of above ground components of natural gas transmission and distribution systems. In the baseline scenario, advanced leak detection and repair is not be performed on all infrastructure and leaks. The project type reduces emissions by reducing the amount of methane leaking into the atmosphere."

Applicability criteria

The methodology is applicable to project activities that reduce physical leaks in components through the introduction of an advanced leak detection & repair (LDAR). The methodology can be applied on various segments of natural gas value chain provided that it is demonstrated that advanced LDAR has not taken place on the emission sources included in the project boundary in the recent years.

The methodology is not applicable to:

- "Physical leaks that are detected and repaired under a conventional LDAR program;
- Physical leaks that can be repaired by tightening/re-greasing or by similar measures;
- Physical leaks that are identified on components where the latest scheduled maintenance or replacement was not done before the starting date of a project activity as documented through maintenance logs, maintenance schedules, maintenance guidelines, worker logbooks, or other similar sources;
- Reductions in process venting;
- Reductions in natural gas or refinery gas combustion by process heaters or boilers, engines and thermal oxidizers."

The methodology is applicable across the natural gas value chain, from upstream to downstream operations.

The applicability conditions of the methodology are overall appropriate.

Selection of emission sources for calculating emission reductions or removals

The emission sources for calculating emission reductions include methane-leaking components which are detected through the introduction of the advanced LDAR program and meet the requirements for being included as part of the project, i.e.:

- Leaks that are not repaired as part of the conventional LDAR program;
- Leaks from components that are not listed in the maintenance reports as part of the current leaks;
- Leaks that are not repairable by low-cost methods (tightening, regreasing, etc.); and
- Leaks that need to be repaired due to current regulations and legislation.

The project proponents should carry out a baseline survey of a representative sample of leaks from all types of leaking components. The results are extrapolated to the entire project boundary in order to (a) estimate baseline emissions ex-ante and (b) determine emission sources that could be potentially included in the project activity.

The selection of the emission sources to be included is generally appropriate.

Determination of baseline emissions

For the detected leaks that meet the criteria to be included in the project activity, there are two options for the calculation of baseline emissions:

- **Option 1.** Applying default emission factors developed by the American Petroleum Institute (API). Emissions should be calculated by multiplying the CH_4 fraction in the natural gas or refinery gas with the appropriate emission factors and then summing up all components that are included in the calculation of baseline emissions.

- **Option 2:** Measuring the flow rates of the detected leaks through the use of Hi-Flow Samplers, calibrated bag or other suitable flow measurement technology.

In addition, baseline emissions are capped at the baseline emission level of the first crediting year.

UE1: Capping of baseline emissions to the first year's results

Capping baseline emissions to the estimates from the first year of the crediting period is likely to contribute to underestimating emissions reductions, because in cases where more leaks are identified, repaired, and added to the project activity in the later years of the project, those additional repairs would effectively not be counted towards baseline emissions. This potential underestimation could be irrelevant for some of the projects, i.e., those which do not go beyond the leak-repairs included in the first year of the crediting period.

UE2: Use of default emission factors

In cases where Option 1 (use of API default emission factors) is chosen, the emission reductions are likely to be underestimated, since the API emission factors database provides figures at the lower end of the plausible range. In practice, the actual emission factors could be considerably higher (Sources 3 and 4). It should be noted, however, that the majority of projects under this methodology use Option 2.

U1: Measurement of leak rates

The measurement equipment that is used to quantify the leak rates ($F_{CH4,j}$) under Option 2 can be associated with high uncertainties. The methodology requires the lower end of the uncertainty of measurement to be applied when calculating baseline emissions. In principle, this is a conservative approach and could contribute to underestimating emission reductions. In practice, however, the uncertainty of the most widely used high volume samplers is likely to be higher than claimed by manufacturers, particularly in cases where measurements are carried out on gases with a lower methane content and higher impurities. This could contribute to overestimation of emission reductions. Overall, it is therefore not clear whether this parameter would consistently be ***overestimated or underestimated***. This element thus contributes to uncertainty in estimating the emission reductions.

OE1: Duration for which detected leaks are assumed to continue to leak in the baseline scenario

The methodology prescribes that baseline emissions from a specific leak or component are included in the calculations until whichever of the following occurs first:

(a) “The equipment concerned is replaced for a non-leak related reason (i.e. it breaks down); or

(b) The end of the last crediting period of the overall project activity; or

(c) The maximum period for which a specific leak can be accounted towards emission reductions is over. This maximum period is seven years (in the case that a renewable crediting period is chosen) or the end of the crediting period (in the case that a non-renewable crediting period is chosen).”

These assumptions are intended to introduce conservative approaches but, in reality, do not prevent overestimation of the baseline emissions. The methodology implicitly assumes that a leak may remain unrepaired for up to 7 years. In our assessment, this is not a plausible assumption for all leaks. Typically, all components undergo some sort of maintenance, and some leaks could be detected even under conventional methods within few years from the start of the crediting period.

U2 / OE2: Lack of monitoring of line pressure

The methodology does not require frequent monitoring of line pressure throughout the monitoring period. Leak rates, however, depend strongly on the gas pressure of the respective lines. In some components, the pressure can vary significantly over time. Not considering the line pressure in the determination of leak rates thus introduces uncertainty, which could lead to overestimation or underestimation of baseline emissions (U2).

In addition, the lack of provisions for monitoring the line pressure could also create a perverse incentive for project proponents to increase the line pressure during the baseline surveys or to select measurement samples from components operating under higher pressure than average. It is unclear how large this risk is; however, where this happens, it could lead to significant overestimation of the baseline emissions (OE2).

OE3: Criteria to include/exclude leak points

While the methodology defines the criteria for inclusion of a leak under the baseline emissions, the criteria are not detailed enough to objectively conclude whether or not a particular leak is eligible for inclusion. This is particularly the case for those leak points that are in the “grey zone”, i.e., which might in some cases also be detected without LDAR equipment. For example, the methodology does not exclude super-emitting leaks from baseline emissions, while in practice it is unlikely that these would remain undetected for significant time. This constitutes a risk for overestimation of baseline emissions, though the magnitude of this risk is difficult to judge.

Determination of project emissions

Similar to the determination of baseline emissions, project emissions can be estimated using Option 1 (use of default factors) or Option 2 (direct measurement). The methodology requires that the option used for determination of baseline emissions must also be used to calculate project emissions.

The methodology provides the following approaches for estimating project emissions:

- "If a repair of a physical leak ceases to function, it is conservatively assumed that the leak resumed either:
  (a) At the same flow rate that was measured prior to its repair when using only leak detection equipment.
  (a) At the newly measured leak rate if the leak is re-measured using leak measurement equipment at the time of monitoring (in case of Option 2);
  (b) At the flow rate specified by the API Compendium (in case of Option 1).
- It is further assumed that the leak resumed at the day when the leak was last checked and confirmed not to leak and that it continued to leak for the entire time since that date. Thus, leaks where the repair failed should be included in the project emissions."

UE3: Assumption that leak resumed after the last check

If a new leak is detected at a component that was identified to be leaking in the baseline survey and that was subsequently repaired, the methodology assumes that the new leak would have occurred at the day following the last no-leak check. This is a conservative assumption given that the leak may have occurred at any time between the previous check and the check where the leak is detected. This assumption may thus lead to ***underestimation of emission reductions***.

Determination of leakage emissions

The methodology states that "no significant leakage is expected to occur in these types of projects."

UE4: Neglection of leakage emissions

LDAR projects may involve some emissions, such as emissions associated with transport of staff and equipment to various pipeline locations. These emissions are, however, considered to be very small compared to the overall emission reductions. On the other hand, LDAR projects reduce the losses of natural gas from transmission and distribution systems. This means that more gas reaches end-consumers and, overall, less natural gas needs to be explored in order to provide the same energy service to end-consumers. This in turn could reduce upstream emissions associated with exploration, processing and transmission of natural gas. This negative leakage effect is not considered in the methodology. Therefore, although the impact is small, this assumption leads to a slight underestimation of emission reductions.

Summary and conclusion

Table 1 summarizes the results of the assessment and, where possible, presents the potential impact on the quantification of emission reductions for each of the previously discussed elements.

Table 1 Relevant elements of assessment and qualitative ratings

Element	Fraction of projects affected by this element[1]	Average degree of under- or overestimation where element materializes[2]	Variability among projects where element materializes[3]
Elements likely to contribute to overestimating emission reductions or removals			
OE1: Duration for which detected leaks are assumed to continue to leak in the baseline scenario	Unknown	Medium-High	Medium
OE2: Lack of monitoring of line pressure	Low	Medium *(The impact could be higher in case of drastic change in the line pressure)*	Medium
OE3: Criteria to include/exclude leak points	Medium	Medium-High	High
Elements likely to contribute to underestimating emission reductions or removals			
UE1: Capping of baseline emissions to the first year's results	Medium *(Some projects may simply not continue expanding LDAR after year 1)*	Low	Medium

1 This parameter refers to the likely fraction of individual projects (applying the same methodology) that are affected by this element, considering the potential portfolio of projects. "Low" indicates that the element is estimated to be relevant for less than one third of the projects, "Medium" for one to two thirds of the projects, "High" for more than two third of the projects, and "All" for all of the projects. "Unknown" indicates that no information on the likely fraction of projects affected is available.

2 This parameter refers to the likely average degree / magnitude to which the element contributes to an over- or underestimation of the total emission reductions or removals for those projects for which this element materializes (i.e., the assessment shall not refer to average over- or underestimation resulting from all projects). "Low" indicates an estimated deviation of the calculated emission reductions or removals by less than 10% from the actual (unknown) emission reductions or removals, "Medium" refers to an estimated deviation of 10 to 30%, and high refers to an estimated deviation larger than 30%. "Unknown" indicates that it is likely that the element contributes to an over- or underestimation (e. g. overestimation of emission reductions in case of an omitted project emission source) but that no information is available on the degree / magnitude of over- or underestimation. Where relevant information is available, the degree of over- or underestimation resulting from the element may be expressed through a percentage range.

3 This refers to the variability with respect to the element among those projects for which the element materializes. "Low" means that the variability of the relevant element among the projects is at most ±10% based on a 95% confidence interval. For example, an emission factor may be estimated to vary between values from 18 and 22 among projects, with 20 being the mean value. "Medium" refers to a variability of at most ±30%, and "High" of more than ±30%.

UE2: Use of default emission factors (Option 1)	Low	High	Medium
UE3: Assumption that leak resumed after the last check	Medium *(This element is related to project emissions. Since some projects do not have any project emissions due to frequent checks for any leaks, this is assessed as Medium)*	Low	Low
UE4: Neglection of leakage emissions	All	Low	High
Elements with unknown impact			
U1: Measurement of leak rates under Option 2	Medium	Medium	Medium
U2: Lack of monitoring of line pressure	All	Low *(The impact could be higher in case of drastic change in the line pressure)*	High

While three elements have been identified that could contribute to overestimation of emission reductions, a number of elements could also lead to underestimation of emission reductions. Overall, there is no clear bias towards either underestimation or overestimation of emission reductions. The measurement of leak rates under Option 2 and the lack of provisions to monitor the line pressure, however, introduce significant uncertainty. Overall, the uncertainty of emission reductions is estimated to be within a range of 50%. The quantification methodology is therefore assigned an overall score of 3.