An Introduction to the Carbon Credit Protocols from: "Methodology for Improved Cook-stoves and Kitchen Regimes (2008)" Published by

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Introduction

There has been a lot of interest recently in carbon credit financing for improved stove projects. Since 2006, stove organizations have begun to receive funding from carbon credits. The Gold Standard has just published a set of protocols formalizing how stove projects can prove the lowering of emissions. Large financial institutions, like Climate Care/JP Morgan, are now participating in the relatively new market.

Many people and organizations have asked Aprovecho to explain how carbon credit financing works. We summarized the Gold Standard protocols to try to help the stove community to better understand this new and exciting opportunity that we hope will result in the dissemination of millions of improved cooking stoves. The following summary is only a general introduction to the longer and more precise protocols. Please refer to the complete document for specifics.

Carbon credit funding began with the Kyoto Protocol, an international agreement between 170 countries, that created an emissions trading market intended to reduce global warming. Stoves can be funded by the voluntary market where buyers purchase carbon credits from brokers. The worth of the voluntary credit is based on the validation process. Voluntary credits have been worth less than the credits sold through the more rigorously validated Clean Development Mechanism.

Carbon credits are traded in units of one metric ton of carbon dioxide or other equivalent green house gases not emitted or made. The international transfer of credits is regulated by the United Nations Framework Convention on Climate Change (UNFCCC). Selling carbon credits is designed to make available a cost effective way of reducing emissions globally, either by more efficient practices (using less wood for cooking in any manner) and/or investing in a cleaner technology (an improved cook stove).

Very effective, low wood use biomass cooking stoves may save approximately one ton of CO_2 per year and the cost of an inexpensive stove may well be covered by the carbon credit financing. Carbon credit brokers usually assist with the costs of testing to prove lowered emissions. The financing can include up-front funding or a slightly higher amount can be paid to the project after the emissions reduction is proved by the in-field testing.

The Gold Standard protocols are intended to create a more rigorously validated voluntary market for wood burning stoves. In short, the Gold Standard defines how to:

1.) Determine the baseline (pre-intervention) wood used for cooking/heating.
2.) Estimate the post intervention emission savings.
3.) Calculate the renewable/non renewable ratio of wood used.
4.) Perform a pre intervention and another post intervention Kitchen Survey (qualitative) and Kitchen Test (quantitative).
5.) Make sure there is statistical confidence in the results.
6.) Establish the Green House Gas reductions.

An Introduction to the Gold Standard Protocols

1.) Carbon credit funding may be available for programs or activities lead by a project coordinator introducing improved cook-stoves and practices that reduce emissions.
2.) Carbon credit funding may be available when there is a beneficial change to cook-stoves and kitchen practices used in institutions or domestic homes that result in considerably lower or zero emissions.
3.) Examples of beneficial kitchen practices are: storage and drying of fuels, improved skills when using either the traditional or improved stoves, doubling of cook-stoves as space-heaters, use of cook-stoves to boil water for sterilization.

The following conditions apply:

- Low-emission cook-stoves and kitchen practices replace relatively high-emission baseline situations.
- The project boundaries can be clearly identified, and the stoves counted in the project are not included in another voluntary market or CDM project (i.e. no double-counting takes place)
- The project is located in a single country.
- The improved cook-stoves do not number more than ten per kitchen and each have continuous useful energy outputs of less than 50kW.

Examples of project technologies are: improved biomass stoves, fossil fuel stoves, solar cookers, water purifiers and heat retention cookers, renewable-based electricity (biogas, hydro, wind, PV, etc), and other measures that reduce consumption of non-renewable biomass or other green-house emitting fuels.

A few examples of Baseline technologies are biomass stoves, dung stoves and fossil fuel stoves.

1. Project Boundaries

A. The Project Boundary is the number of household or institutional kitchens using the improved cook-stoves and/or the emission reducing measures introduced by the project.

B. The project defines regions or towns within a country, or a whole country, as the Target Area in which the project disseminates new approaches or cook stoves.

C. If woody biomass or charcoal are the baseline fuels, the Fuel Collection Area is where the wood or charcoal is produced and supplied. Where woody biomass or charcoal is not in the baseline, the Fuel Collection Area may still be relevant, for example, in cases where the transportation of a fuel causes emissions.

	Source	Gas	Included?	Justification / Explanation
Baseline	Cooking, production of fuel, and transport of fuel	CO_2	Yes	Important source of emissions
		CH_4	Yes	Important source of emissions
		N_2O	Yes	Can be significant in some fuels

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2. How to select the baseline

The baseline is how many emissions were made in the households or institutions before they began using the improved stove or the new kitchen practices.

In a project where all stoves are installed at one time, or in which conditions do not change, the project may use a *"fixed baseline"*.

If the stoves are installed over time, the project must justify using a fixed baseline.

If the baseline is changing over time, as the stoves or kitchen practices are disseminated, then the "*evolving baseline"* approach is used.

To accurately determine the baseline it is necessary to divide all stove or kitchen practices users into groups or clusters. For example, one group may mix LPG and charcoal rather than using only charcoal or only wood, another group at a higher altitude may use their cook-stoves as space heaters rather than using them only for cooking. Clusters may be combined if this leads to a conservative estimate of emissions.

Cluster groups must be determined as a part of the carbon credit funding procedure.

3. Additionality

It must be shown that the project would not take place without the presence (the addition) of carbon credit financing! The possible reasons showing why carbon credit financing is necessary may be that the initial investment or the on-going costs for marketing, distribution, quality control and manufacture are not affordable.

4. Baseline Emissions from Owners of Stoves

Data for baseline emissions can be requested from the people who have just bought an improved stove, since they are usually still in a position to continue using their old stove during the testing. *For this reason, a pilot sales record is useful both for baseline and for project analysis.* During the project itself, the same principle applies to monitoring of an evolving baseline, since surveys and tests can be requested from recent stove purchasers, to investigate the changing baseline conditions.

2. Steps to determine customer groups or clusters

Step 1: Establish a pilot Sales Record
Step 2: Determine the fuel types, fuel mix, and kitchen regimes
Step 3: Analyze the renewable status of wood-fuels
Step 4: Divide pilot Sales Records into customer groups or clusters
Step 5: Carry out a qualitative Kitchen Survey test (talking to users)
Step 6: Create accurate Project Database

3. Steps to calculate baseline emissions

Step 1: Estimate the expected variation and improvement in emission reductions
Step 2: Specify the Units of emission reduction or fuel consumption
Step 3: Make quantitative measurements during Kitchen Tests (accurate testing)
Step 4: Calculate the baseline

Step 1: Establish a pilot Sales Record

Collect the names of stove purchasers who could be the subjects of surveys and tests before they use the improved stoves. The Pilot Sales are recorded at the same time or just before the Kitchen Surveys and Kitchen Tests, so the cooks can best describe and test the oldstove behavior.

Step 2: Determine fuel types, fuel mix, and kitchen practices

The project must specify the fuels and energy sources used through the year in the project kitchens, in both the baseline (before) and (after) the new intervention. The fuels and energy sources are divided into categories.

1) Renewable and Non-Renewable Woody Biomass, which includes all wood-fuels including charcoal.

2) Renewable energy fuels, sources or methods with zero green-house gas emissions. Examples include practices such as cooking with agricultural residues/coppiced wood, biogas, solar cookers, heat retention cookers (excluding sustainably produced woody biomass which is covered in category (1) above.

3) Alternative fuels that emit green-house gases during their production or combustion (such as fossil fuels, dung, some crop residues).

An estimate should be made of how the three categories of fuels are used in the kitchens. For example, some customers may use one half dung and one half wood, while others use only wood or only charcoal.

It is necessary to determine the factors that influence how many emissions are made. This includes, for example, whether the kitchens are cooking commercially or not, whether the cook stove is also used for heating, whether fuel is collected by hand collecting or purchased, whether users are storing and drying fuels, and so on. The project also must predict the future trends year-by-year.

This first assessment divides the project population into major groups that will be analyzed in more detail, through Kitchen Surveys.

Step 3: Determine if the wood-fuels are renewable

The project must determine the extent to which the CO2 emissions of the wood-fuels are offset by re-growth in the collection area.

Options

The project may choose between options for estimation of the renewability of the wood-fuels.

The options are:

A.) Quantify the renewable biomass

1.a. Specify the geographic area from which woody biomass could be collected. This area is not only forest but any area where woody biomass is present, which includes grasslands.

1.b Use credible information sources, field surveys, or both, to determine the amount of woody biomass that is re-generating each year in this area..

1.c. Quantify the amount of non-renewable biomass drawn from the fuel collection area.

(The complete document shows how calculations are made.)

B.) Qualitative assessment

Satellite imagery, combined with field surveys, literature reviews, and expert consultations can also provide sufficient evidence of renewability of wood-fuels and can be used to create an acceptable conservative estimate.

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Field surveys can be used to identify the collection areas for population groups, and determine the

history of collection in each area. For example, interviews and field evidence may show that the collection distance is increasing and that the harvest of fuel-wood is exceeding the sustainable cut. This can apply both to manual fuel-wood collection in relatively small areas close to villages, and to urban consumption of wood or charcoal where collection areas are country-wide.

Literature studies and consultations with experts with long-standing knowledge of the areas will also provide important evidence.

Step 4: Divide the pilot Sales Record into major groups

The project divides the Sales Record into major population groups with different patterns of emission reductions. It is not necessary to split the pilot Sales Record into different groups if no obvious major distinctions exist.

Step 5: Perform a qualitative Kitchen Survey (KS)

A "Kitchen Survey" should be carried out for each major group of customers. The major clusters are large obvious group differences like biogas users, solar cooker buyers, charcoal users, firewood users, and institutional kitchens.

The guidelines of minimum sample size for the Kitchen Survey are:

Group size less than 300: Minimum sample size 30
Group size 300 to 1000: Minimum sample size 10% of group size
Group size more than 1000: Minimum sample size 100

These sample size guidelines apply to all stove user groups including institutions using large stoves.

The Kitchen Survey involves observations and questionnaires undertaken by an expert survey team visiting kitchens using the improved cook-stove (and possibly also making telephone interviews). The survey is used to develop a more precise understanding of how adoption of the improved cook-stove effects fuel consumption and GHG emissions within each major cluster. The Kitchen Survey should conclude with a formal report on its findings. Home visits should always be used in preference to telephone interviews to avoid errors.

Step 6: Improve the clusters using results from the Kitchen Survey and to create a more accurate Project Database

The creation of clusters allows individual sales in the Sales Record to be sorted properly in the Project Database. The Project Database is simply the sales record re-organized for calculation of emission reductions. The Project Database should contain distinct lists for each cluster, wherever this is possible;

Calculate the baseline emissions

Step 1: Estimate the expected variation and improvement in emission reductions

To achieve the statistical significance required for Kitchen Tests it is necessary to estimate the size of samples necessary to achieve useful results from the Kitchen Tests. *An expert statistician should be asked to do this.*

One approach is first to decide how large a confidence interval is acceptable (for example +/- 15% from the sample mean). Examples of Kitchen Test results from similar projects in similar circumstances, can be used to estimate a projected figure for variance in the sample, and to see what fuel consumption improvement the stove is likely to make.

From these parameters the statistician can indicate how large a sample size will give a reasonable confidence interval at 90% confidence.

20 to 60 houses in a sample can be expected, assuming paired sampling (testing in the same houses before and after the new stove is installed). When testing is done without paired sampling (testing in different houses where households using the old and new stove are compared) larger numbers of tests are often required to achieve statistical confidence.

Step 2: Specify the Units of emission reduction or fuel consumption

In many improved stove projects emission reductions are calculated per year of stove use. In some cases it is more to use the kitchen-year that is the emissions reductions from a combination of devices, fuels and practices providing the meals for an average family throughout a year. In other cases, such as in school kitchens, the calculations can be based on the meal-year. In cases of production of home-cooked foods for sale, such as tortilla production, emission reductions may be calculated per product-year or per kilogram of raw material used to make the products through a period of one year.

Step 3: Make quantitative measurements (Kitchen Tests) (KT)

Baseline emissions must be measured for each cluster. This is done by conducting Kitchen Tests in a sample of households representing each cluster. Usually it is possible to deal with the important factors affecting Green House Gas emissions by conducting one or two Kitchen Tests, balancing the costs of multiple tests against the benefits of demonstrating greater emission reductions produced by the project.

The primary factor is often fuel consumption, but other factors such as cooking practice, fuel handling, and emission factors may also be relevant. Emission factors are not usually measured in Kitchen Tests if IPCC defaults are used, or if alternative values are available which are shown to be more appropriate than IPCC defaults. (See below.) On the other hand, some projects may specifically seek to change the emission factor – this could be the case where a new stove introduces a significantly different combustion technology, such as a fan stove, replacing a standard stove.

The IPCC defaults are available in a database that can be found at http://www.ipcc-nggip.iges.or.jp/EFDB/main.php. Under the "Find EF" link, one can search by the IPCC Source/Sink category under the topic Energy – Fuel Combustion Activities – Residential and then choosing the proper fuel, for example in the Biomass category. Emission factors are reported as mass of pollutant per energy of fuel consumed. Therefore,

*Mass Emissions = Mass Fuel Consumed * Calorific Value of Fuel * Emission Factor*

Then the mass of emissions is multiplied by the Global Warming Potential of each gas to convert to the mass of CO2 equivalent savings.

The Kitchen Test results are applied to both the baseline (before) and project results (after the new stove or kitchen practices are being used). Once both sets of data are collected, the project is required to provide an expert statistical analysis of the GHG emission reductions of each household to determine at a 90% confidence level (or better).

The more houses involved in the KTs (the larger the sample size) the better. It is recommended that paired samples are taken. The pre- and post-installation wood consumption is compared in the same houses. This may reduce variability due to external factors other than stove installation and result in fewer households needed in the testing to reach the 90% confidence level.

For accurate measurement of fuel consumption care must be taken to ensure that:

a) The fuel consumption of the households in the tests is not in any way dependent on each other.

b) The households are not included in other clusters.

c) Removing a household from a cluster must be justifiable.

d) The selection of the houses from the Sales Record is random.

e) One week of pre- and one week of post installation cooking is recommended.

f) Pre-installation and post-installation conditions must be the same. For example, the two test phases should immediately follow each other. If there is a pause between pre and post intervention testing make sure no change in season, etc. has occurred. Do not tire out the participants.

It can be legitimate to randomly select within a smaller population than the full Sales Record to make sure tests are feasible in practical terms (for example focusing on one area so that the test houses are not too spread out geographically. But then it must be demonstrated that the tests remain representative.

If seasonal changes in fuel mix (for example due to crop residue availability) or energy-demand patterns (for example due to a space-heating demand in winter) occur the KT must be carried out at a time of year which gives a conservative result. A KT done during a dry or wet season for instance might collect data in both seasons depending on the findings and recommendation of the KS.

Step 4: Calculate the baseline GHG emissions

The fuel mass or the energy content is converted to GHG emissions using emission factors.

It is required that wherever possible the emission factor values used are ones measured in actual baseline and project conditions or in similar conditions.

When such are not available, relevant IPCC defaults may be used.

The emissions factors are multiplied by the average fuel use found by the before and after KTs for each customer group, to calculate emission reductions.

Kitchen Tests will produce different kinds of data:

1. The amount of primary and secondary fuel mass are each measured directly (for example, wood consumption is measured, and LPG consumption is known in terms of bottles consumed per year).

2. All cooking during the tests is done with one primary fuel and stove but it is known that other fuels and/or stoves replace a portion of the cooking energy through a typical year.

3.)The KT measures fuel consumption of the primary fuel only.

Equations are included in the full report.

5. Project emissions

An improved stove project usually involves continual installations of improved stoves over the project period. It may also accomplish all the installation work within a short start-up period.

The emissions projection should calculate emissions on the basis of the assumed life for each stove.

6. Problems in Measurements (Leakage)

The project proponent should assess each of the following problems and present an estimate for the effect of each problem:

a) Some users of the efficient stoves may increase their use of fuels with GHG emission characteristics.

b) The project increases the use of a high emission fuel either for cooking or for other purposes outside the project boundary.

c) The promotion stimulates substitution of a cooking fuel or stove type with relatively high emissions.

d) Users compensate for the loss of the space heating by adopting some other form of heating.

e) The traditional stoves displaced are re-used outside the project boundary.

f) Significant emissions are created by transportation or construction involved in the project activity.

The leakage risk may already be accounted for by:

1. Clustering (cluster distinctions and exclusions reduce risk of leakage).
2. Baseline option (requirement for monitoring of evolving baselines).
3. Long-term trends in fuel mix, and seasonal variations of fuel mix, quantified in the emissions equations.

7. Emission reduction calculations

Emission reductions are calculated from the KT tests. Paired sampling should be used where possible, as this will often result in fewer needed samples. If paired sampling has been used for the Kitchen Tests, it is legitimate to derive
The emission reduction for each individual kitchen in the sample tested. An expert statistical analysis is then required to determine at a 90% confidence level (or better) the mean pre and post results per kitchen with respect to the whole cluster population.

A suitable analysis is an approximate paired t-test performed on this pre- and post-installation data.

If paired sampling has not been used, average Baseline Emissions and Project Emissions should be calculated separately. An expert statistical analysis is then necessary.

If IPCC defaults are not used, testing of the emission factors of new stoves is only required if there is evidence that the new stove may give rise to significantly different emission factors leading to possible over-estimation of emission reductions

Quality Assurance and Quality Control

The employment of an expert 3rd party is recommended to accomplish or reinforce some or all of the monitoring tasks.

This should be done in relation to specific cross-checks, for example between production records (e.g. materials purchases, internal logs, gate checks), financial accounts, retailer records, and also through spot checks, for example wholesale customer invoices, observations of retailer activities and sales performance. The use of serial numbers on project stoves is recommended to facilitate cross-checks and prevent double-counting. These should be devised and issued in such a way that copying is prevented.

This proposed methodology for estimating Non Renewable Biomass fraction is based upon a limited body of existing work. The Gold Standard Technical Advisory Committee is prepared to review and endorse new methodologies for estimating NRB and to incorporate them into this baseline and monitoring methodology.

Proposals for new NRB methodologies should be submitted independently to the Gold

Standard TAC for consideration using the email address info@cdmgoldstandard.org and will be subject to a reduced assessment fee of 1250 USD per proposal.