Indicative Programme, Baseline, and Monitoring Methodology for

Improved Cook-Stoves and Kitchen Regimes

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The applicability of this methodology for water treatment technologies has been completed by Carbon Bridge Pte Ltd. For information or questions related to the application of the methodology for water treatment project activities, please contact Carbon Bridge at contact@carbon-bridge.com

SECTION I: SOURCE AND APPLICABILITY

This methodology is applicable to programs or activities introducing improved cook-stoves or water treatment technology (e.g. water filters)[1] and practices to households and institutions that result in improved kitchen regimes within a distinct geographical area. The project activity is implemented by a project coordinator who acts as a project participant. The individual households and institutions will not act as project participants.

The methodology addresses the switch from cook-stoves and kitchen regimes used in institutions or domestic homes having significant green-house gas emissions to those having considerably less or zero emissions. Kitchen regimes with significant green-house gas emissions may involve the use of more than one fuel type and more than one stove type, and the switch to low emission regimes may involve a shift in the apportionment of fuel types and/or adoption of new fuels and cook-stoves and/or water treatment technology. The shift may occur in a phased manner, a program or project comprising a progressive increase over the project years in adoption of an improved fuel mix, improved stoves and/or water treatment technology.

The term "regime" is used to encompass a range of practices which determine green-house gas (GHG) emissions arising from energy use in the kitchen. Examples are humidity control through storage and drying of fuels, skills in use both of the traditional or improved stoves, doubling of cook-stoves as space-heaters, use of cook-stoves to boil water for sterilization, use of waterfilters.

The following conditions apply:

- Low-emission cook-stoves and regimes replace relatively high-emission baseline scenarios[2].
- The project boundary can be clearly identified, and the stoves or water treatment technology 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 or water treatment technology do not number more than ten per kitchen and each have continuous useful energy outputs of less than 50kW (defined as total energy delivered usefully from start to end of operation divided by time of operation)

Examples of project technologies are improved biomass stoves, fossil fuel stoves, use of stove-displacing technologies such as solar cookers, water purifiers, water filters and heat retention

[1] See Annex 3 Application of the Methodology to Water Treatment Project Activities

[2] The use of old stoves as back-up or complementary units, in parallel with the new stoves installed in the considered households, is allowed for if a mechanism is put into place to encourage the removal of the old stoves. This mechanism can be in the form of discounted emission reductions in households where the old stoves remain in use, or discounted selling prices for households surrendering their old stove when acquiring an improved stove. The project documentation must describe in detail what approach is chosen and what discounting factor is applied. The discounting factor must be significant enough to create a real incentive, the success of the mechanism put into place must be monitored, and the approach must be adjusted if proven unsuccessful. These requirements do not apply to project activities only focusing on water treatment.

cookers, renewable-based electricity (biogas, hydro, wind, PV, etc. Examples of Baseline technologies are biomass stoves, dung stoves and fossil fuel stoves.

SECTION II: BASELINE METHODOLOGY

1. Project Boundary

Projects which promote the use of improved cook-stoves or improved cooking regimes require careful definition of Project Boundary, Target Area, and Fuel Collection Area:

a. The Project Boundary is defined by the domestic or institutional kitchens of the project population using the specific models of improved cook-stoves and/or water treatment technology and the specific GHG-reducing measures introduced by the project.

b. In applying the methodology, a project will also define regions or towns within a country, or a whole country as the Target Area in which the project has a target population; this also provides an outer limit to the Project Boundary.

c. In cases where woody biomass (including charcoal) are baseline fuels, the Fuel Collection Area is the area within which this biomass is produced and supplied, or could reasonably be expected to be produced and supplied, whichever is the greater. Where woody biomass is not in the baseline, the sourcing of the fuels may still be relevant, for example in cases where transport of a fuel has emissions significance.

Emissions sources included in or excluded from the project boundary [add/delete gases and sources as needed]

It is recommended that Project proponents include all the green-house gases marked below, and assess on a project-by-project basis whether or not their measurement or estimation is feasible or their quantitative impact is significant. In cases of doubt they may be omitted, so long as the omission has a conservative result, and an estimate made of the level of conservativeness their omission implies.

Emissions occur both during use and production and transport of cooking fuels. The project proponent is obliged to provide an equivalent level of justification for quantities of green-house gas emitted from production as from use. In both cases the evaluation of emissions must be well documented and based on publicly available and verifiable data. If such data is not available (for example in the case of production of a fuel) then care must be taken to ensure a conservative result, either by

- (when they occur in the baseline) omitting those emissions or including an incontrovertibly low estimate, or
- (when they occur in the project scenario) including an incontrovertibly high estimate

	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

	Source	Gas	Included?	Justification / Explanation
Project	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

2. Procedure for selection of the most plausible baseline scenario

The baseline scenario is the one experienced by each household purchasing an improved stove, prior to installation of the new stove[3].

In many projects the improved stoves are adopted progressively through the project period. The baseline situation therefore does not occur at the same time for all stove purchasers; it occurs at a different time for each installation.

In a project where all stoves are installed at the start, or in which conditions are unchanging during the project period, the project proponent may establish a single baseline fixed in time (the pre-project situation) of the type *"fixed baseline"*. If the stoves are installed progressively, the project proponent must present a credible case to justify application of a fixed-baseline approach. If this is validated then there is no requirement for continuous monitoring of the baseline.

If baseline conditions are changing in the course of the project, then the "*evolving baseline"* approach must be adopted. With respect to monitoring methodology, it is necessary in this case that the baseline is monitored alongside the project activity.

In many developing countries the level of energy service is not sufficient to meet human development needs due to lack of financial means and/or access to modern energy infrastructure. The methodology therefore allows for a variation to the evolving baseline option, applicable if the project activity is implemented under a situation where energy services provided are insufficient to meet the needs of stakeholders. Annex 2 describes the concept of suppressed demand.

Throughout application of the methodology it is necessary to divide the project population (all stove customers) into groups or clusters, to distinguish the characteristics which determine the emission reductions of each cluster. For example, one group may be distinguished by virtue of

[3] This also applies to establishment of a new cooking regime and the situation prior to that. In general throughout this document, "improved stove" can be read as "improved stove and/or water treatment technology resulting in an improved kitchen regime and/or improved cooking regime". Furthermore, an "improved stove" and change of kitchen regime, may also refer to a fuel switch.

mixing LPG and charcoal rather than using only charcoal or only wood, another by virtue of living at a higher altitude and using their cook-stoves as space heaters rather than using them only for cooking.

The methodology requires that cluster distinctions are made carefully as a primary step, and baseline definition (fixed or evolving) as well as trends are applied individually to each cluster. The monitoring methodology requires that cluster definitions are reviewed progressively, and clusters re-populated as necessary, throughout the project.

Clusters may be combined where this is shown to lead to a conservative estimate of emission reductions.

3. Additionality

The most recent version of the UNFCCC "Tool for the Demonstration and Assessment of Additionality" is to be applied.

The project proponent must show that the project could not or would not take place without the presence of carbon finance. Possible reasons may be that the initial investment, or the on-going costs for marketing, distribution, quality control and manufacture, are not affordable to the target project population in the form of high stove prices.

4. Baseline emissions

The project proponent should carry out a Baseline Study and summarize its results in the PDD, in accordance with the procedure set out in the steps listed below.[4]:

It should be noted that surveys and tests to estimate and quantify baseline conditions are made in homes which are not using the improved stove. At the same time, surveys and tests aimed at comparing old stove and new stove conditions are best made in the same houses (though this is not a requirement as it is not always possible), to minimize variability due to external factors other than installation of a new stove. It is therefore found in many cases that data for baseline emissions can be requested from people who have just bought an improved stove, since they are usually still in a position to continue their "old stove" behaviour under quantitative test conditions. For this reason, a pilot sales record is useful both for baseline investigation and project investigation. 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 baseline conditions.

1. Determine customer groups or "clusters"

Step 1.1: Establish a pilot Sales Record
Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regimes
Step 1.3: Analyze renewability status of wood-fuels
Step 1.4: Divide pilot Sales Record into customer groups or clusters

[4] The reader is advised to look ahead to Section 5 Project Emissions which states that this procedure is also used to characterize the Project scenario.

Step 1.5: Carry out a qualitative survey (Kitchen Survey)
Step 1.6: Refine demarcation of clusters and populate Project Database

2. Calculate baseline emissions
Step 2.1: Estimate expected variation and improvement in emission reductions
Step 2.2: Specify the Units of emission reduction or fuel consumption
Step 2.3: Make quantitative measurements (Kitchen Tests)
Step 2.4: Calculate baseline

4.1 Determine customer groups or "clusters"

Step 1.1: Establish a pilot Sales Record

A pilot sales and installation operation is necessary to collect data for the baseline study. The data is as specified in the Monitoring Procedure (see below).

The purpose of the Pilot Sales record in the context of collecting data for evaluation of Baseline emissions, is to collect the names of stove purchasers who could be the subjects of surveys and tests characterizing kitchen practices prior to use of the improved stoves. This implies that the Pilot Sales are recorded at the same time or immediately prior to Surveys and Tests, since the fresh customers can best describe pre-intervention behaviour and host old-stove tests.

Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regime

Project proponents must specify the fuels and energy sources used through the year in the project kitchens, in both the baseline and project scenarios, dividing them into the following three categories:

a) Renewable and Non-Renewable Woody Biomass, which includes all wood-fuels[5].

b) Renewable energy fuels, sources or methods with zero green-house gas emissions (RE), such as some[6] agricultural residues/coppiced wood, biogas, solar cookers, heat retention cookers (excluding sustainably produced woody biomass which is covered in category (a) above)

c) Alternative fuels (AF) emitting green-house gases during production or combustion (such as fossil fuels, dung, some crop residues) defined as fuels which do not fall into the above two categories.

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[5] The term wood-fuel is is used to denote all fuels derived from woody biomass, including charcoal, in distinction from firewood or fuelwood which are understood to mean the wood in its original composition. In cases where charcoal and wood are used in the same kitchen the methodology requires they are distiguished in the equations below (ie B would become Bwd and Bcl)

[6] Agricultural residues and other biomass may give rise to significant levels of non-CO2 GHG emissions, in which case the project proponent is required to state this and allocate these fuels to the AF category.

A provisional first estimate should be made of how the fuels are mixed by the kitchens, in the sense of how they are apportioned. For example, it may be estimated that some customers use dung and wood in approximately equal measure, while others use only wood or only charcoal.

An initial assessment should also be made of other factors which determine emission reductions. This for example includes characteristics such as whether the kitchens are cooking commercially or for domestic consumption only, whether they are doubling cook-stoves as space-heaters or not, whether they are collecting fuel manually or purchasing it, whether they are storing and drying it all year it or not, and so on.

In assessing the baseline scenario and project scenario, project proponents must determine not only the fractions attributable to fuel or energy types RE and AF at the time of the proposed project start, but also must estimate/predict the future trends, by attributing year-by-year values.

The above assessment is provisional, allowing the project population to be divided into major groups each of which will then be analyzed in more detail, through Kitchen Surveys (see below) with respect to the characteristics set out here.

Step 1.3: Analyze renewability fraction of wood-fuels

The procedure is given in Section IV, Annex 1. This step can be omitted if no wood-fuels are used for cooking in the baseline or project scenarios.

Step 1. 4: Divide pilot Sales Record into major groups or clusters

Having provisionally distinguished the factors which determine emission reductions, the project proponent should divide the Sales Record into major population clusters[7] displaying distinct patterns of emission reduction performance. The project may promote more than one type of stove, targeting different demographic groups, different fuels or technology combinations may be promoted, and indeed the usage characteristics may be very different. At the same time, variations in baseline may exist, such that cluster definitions will depend on customer grouping according to distinct baseline-project conditions. It is not necessary to split the pilot Sales Record into different clusters at this stage, if no obvious major distinctions exist.

Step 1.5: Carry out a qualitative survey (Kitchen Survey)

A qualitative survey or "Kitchen Survey" (KS) should be carried out for each major group of customers (each cluster provisionally assessed)[8], randomly selected from the relevant set of customers on the pilot Sales Record, following these guidelines as to minimum sample size:

Group size < 300: Minimum sample size 30
Group size 300 to 1000: Minimum sample size 10% of group size
Group size > 1000 Minimum sample size 100

[7] Major clusters are large obvious group distinctions like biogas users, solar cooker buyers, charcoal users, firewood users, institutional kitchens

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

The KS involves observations and questionnaires undertaken by an expert survey team visiting kitchens using the improved cook-stove (and possibly also making telephone interviews[9]). These are used to develop a more precise understanding of how adoption of the improved cook-stove (ICS) effects fuel consumption[10] and GHG emissions within each major cluster. The section below on the topic of Detailed Customer Database (a part of the Monitoring Methodology) describes the type of data required from a KS. These data reflect variation of fuel consumption and factors effecting GHG emissions associated with seasons of the year. The purpose is to define clusters appropriately in order that quantitative measurements are representative. Care should be taken to investigate, and report, on the possibility that phone users are a separate cluster in comparison to non-phone users, due to differences such as income levels. See the section below on monitoring for the minimum percentage of non-phone owners amongst survey respondents.

The KS should conclude with a formal report on its findings. It will typically conclude with a set of clustering options, for further consideration during the project design process. These options indicate where cluster distinctions exist and also where a conservative approach to emission reduction evaluation allows clusters to be combined. For example, the KS might conclude that purchasers of both small and large stove models using the same fuel can be included in one small-stove cluster, since this gives a conservative result when quantitative test results for fuel savings of small stoves are applied to large stoves. The project proponent then uses the KS as a guide to decide how many quantitative tests to undertake: if only one on small stoves, leading to a combined group, there will be a loss in potential emissions reductions from large stoves, but less resources needed for the baseline study and monitoring[11].

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[9] Home visits should always be used in preference to telephone interviews to avoid mis-communications and erroneous data collection. Telephone interviews are permissible in conditions where a minimum percentage (see the section below on monitoring for the limiting value) of the survey interviews are by home visit, and the telephone interviews are done later by the same investigator, such that they benefit from experience of direct observation.

[10] For example, it may find that some customers are using the ICS for long hours to cook food products for sale outside the home, while others are using the same model ICS to cook for one family only. The effect on emissions reductions would be very different, and the KS would specify that domestic and commercial home kitchens can comprise two quite distinct clusters. A change in climatic zone may also prompt a cluster distinction, since within one project area cook-stoves may be used for space heating in one zone and not in another.

[11] The same principle applies to other factors such as fuel mixing and seasonal variation in fuel consumption. The KS may for example identify seasons of the year when fuel consumption increases (eg harvest weeks, and festive and holiday weeks) and it may then recommend multiple KTs or timing of single KTs to measure fuel consumption in low-consumption periods to ensure conservative results. In the case of fuel mixing and RE, the KS can assess the degree of typical fuel mixing and either (a) recommend that secondary fuels/RE are quantified by KTs, (b) specify the fractions to be used in the equations below, or (c) recommend that the use of secondary fuels/RE is subsumed into a "subsumed-fuel KT". A subsumed-fuel KT is one which ensures the sampled households follow their usual pattern of use of secondary fuels (for example gas cooking for very light and quick meals such breakfasts) while measuring only primary fuel consumption for the old and new stove. Its results reflect the effect of secondary fuel consumption without the need for quantification of secondary fuels. In cases where the KS assesses secondary or alternative fuels as contributing less than 50% of total cooking energy, approach (c) is legitimate. Adoption of any one of the three options here must be justified as producing a conservative result.

The KS should also indicate how sales volumes will be estimated or measured for each cluster option, and it should estimate the degree of difficulty involved and the risk of miscounting. In the face of a risk the KS would recommend combined cluster options which avoid the risk and achieve a safe conservative result, and/or other solutions[12]. The project proponent is not bound by the conclusions or recommendations of the KS, but should take account of them in the PDD and justify final clustering options as safely measurable and conservative.

The KS will also establish trends in fuel use and fuel-mixing or in regime[13] . These are projected changes year-by-year in conditions which affect emission reductions calculations. These trends are expressed as fractions in the equations below.

The KS may be extended to encompass investigations of leakage, following the section below on leakage, and of the impact of the project activity on sustainable development.

On condition that the final emission reduction estimate is conservative, it is permissible for the observations of a KS to be used as the basis for adjustment of the findings of a Kitchen Test (KT) focused on a specific cluster such that the adjusted value can be applied to another cluster.

Step 1.6 Refine demarcation of clusters and populate Project Database

The results of the KS are used to demarcate clusters freshly, which will involve review of the provisional clusters made in step two. The determination 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. Since the parameters determining emission reductions are specific to each cluster, the Project Database should contain distinct lists for each cluster, wherever this is possible; alternatively the clustering adjustments recommended by the KS and KT analysis should be presented, and in both cases the emission reductions calculations should be presented within the Project Database.. There may be some customers on the Sales Record who are not represented by the quantitative tests; these should be included in a separate list in the Project Database, with emission reductions calculated to zero; their presence is important as they will need to be continuously reviewed as potential leakage sources or as cluster returnees in cases of periodic cluster revisions.

[12] For example, sales counting of large stoves versus small stoves may be recommended as feasible and verifiable, while counting numbers of commercial cooks versus domestic may present problems, which the KS would address, by providing for example a conservative estimate of the percentage of commercial cooks, or recommending point of sale questionnaires for all customers; a final option being a combined cluster which would eliminate from emission reduction calculations, the extra fuel savings of commercial cooks over domestic cooks.

[13] An example of a regime trend in a biogas stove project may be an increasing trend in the baseline toward stabling of animals traditionally left in the fields over night, or increasing use of ponds which accumulate animal waste; this could change the baseline emission characteristics year by year.

4.2 Calculate baseline emissions

Step 2.1: Estimate expected variation and improvement in emission reductions

In anticipation of the statistical analysis required for Kitchen Tests (reading ahead to the section below is recommended) it is helpful at this stage 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 they may take is to first decide how large a confidence interval is acceptable (for example +/- 15% from the sample mean). Then they will ask for examples of Kitchen Test results from similar projects in similar circumstances, to derive a projected figure for variance in the sample, and to see what fuel consumption improvement the stove is likely to make. From these parameters they can indicate how large a sample size will give a reasonable confidence interval at 90% confidence, and indeed they may suggest trade-offs, larger samples giving narrower intervals (in general a square law applies, an interval with half the expected width requiring four times the number of households in the sample). Typically variations in cooking patterns between homes are quite marked and results in the order of 20 to 60 houses in a sample can be expected, assuming paired sampling (pre- and post-installation testing in the same houses); in the case of non-paired sampling and varied homes, samples at the higher end of this range or even larger may be required.

Step 2.2: Specify the Units of emission reduction or fuel consumption

The Units of emission reduction depend on project specifics and may vary between customer groups in a single project. In many domestic improved stove projects it is suitable to make an assessment in the PDD of emission reduction per stove-year. In some cases a more convenient Unit is 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 Unit may be the meal-year. In cases of production of home-cooked foods for sale, such as tortilla production, emission reductions may be expressed per product-year or per kilogram of raw material used to make the products through a period of one year.

Step 2.3: Make quantitative measurements (Kitchen Tests)

Baseline emissions must be measured for each cluster. This is done by conducting quantitative measurements (Kitchen Tests or "KTs") of factors affecting the quantity of GHG emissions[14] in a sample of households representing each cluster. Examples of such factors are presented in the equations below, and in the section on Kitchen Survey above together with discussion as to ways of minimizing the number of KTs necessary (usually it is possible to deal with varied factors by way of one or two KTs, balancing the costs of multiple tests against the benefits of demonstrating greater emission reductions derived from the project).

[14] 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 (EFs) are not measured by KTs if IPCC defaults are used, or if alternative values are available which are shown to be more appropriate than IPCC defaults . 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 gasification stove replacing a standard stove.

The KT measurements are applied to both the baseline and project scenarios. Once both sets of data are collected, the project proponent 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 range of values within which the mean reduction lies. The more houses involved in the KTs (the larger the sample size) the better, as this will give an improved representation of the population allowing more accurate inference as to fuel savings with narrower bounds of the 90% confidence range. In addition it is recommended that paired samples are taken, that is, pre- and post-installation consumption is compared in the same houses. This may reduce variability due to external factors other than stove installation and result in a narrower 90% confidence interval than when non-paired samples are taken. This step is discussed further in the section below on calculation of emission reductions.

In the context of fuel consumption, care must be taken to ensure that:

a) the fuel consumption of the households in the tests are not in any way dependent on each other
b) the households do not include those belonging to other clusters
c) while it may be the case that the KTs reveal households whose characteristics do not match the cluster definition, and who are removed from the sample and from the relevant cluster or moved to their correct "home" in another cluster, this process must be justified fully so as to eliminate erroneous removal of individual results
d) the selection of the houses is random from the Sales Record, although it may be legitimate to randomly select from customers purchasing at a particular time, for example in a two week period leading up to the Tests, and to select from a randomly selected KS group
e) the period over which the tests is adequate (one week of pre- and one week of post-installation cooking is recommended, to avoid risks such as pre-cooking of food eaten a day or days later cold, and to include weekend cooking in the correct annual ratio to week-day cooking, although shorter tests are acceptable if conditions indicate daily repetition of a set pattern; three days is the minimum duration which should not include weekends as these are unlikely to be representative of year-round consumption)
f) pre-installation and post-installation conditions are the same. For example, the two phases should normally immediately follow each other to ensure this; if there is a time separation (for example time may be needed to learn or settle into new regime) a shift in seasons or any other change in conditions should be avoided and it should be demonstrated that conditions have not changed.

Two examples illustrate how even conditions pre- and post adoption may be promoted:

- it may be worthwhile to avoid the danger that subjects tire of the test with time, risking poor compliance, by conducting the post-adoption tests as the first stage for half the subjects, so long as pre-adoption behaviour is as easy to restore in this case as it is in the pre-then-post sequence.
- Subjects cooking according to their normal pattern in the first stage can be asked to keep a food diary and to repeat the same set of meals in the following stage (while also asking the subjects to make meals typical of the annual pattern and to avoid unusually a-typically large meals during the test period)

It can be legitimate to increase a sample size after a first test is carried out, in cases where the first set of data suggest, through statistical analysis, that a fuel reduction does occur, but the width of the confidence interval is not acceptable to the proponent. Care must be taken that further samples are randomly selected.

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, i.e. clustered random sampling), but it must be demonstrated that the tests remain representative (for example through a set of spot checks in other geographic areas, or a cross-check of these households demographic compared to the KS norm).

If seasonal changes in fuel mix (for example due to crop residue availability) or energy-demand pattern (for example due to space-heating demand in winter) are a feature of the baseline or project scenarios, either a KT must be carried out at a time of year which gives a conservative result, or a seasonal KT must collect data on a further instance in the year as appropriate, depending on the findings and recommendation of the KS.

Step 2.4: Calculate baseline

Fuel mass or 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 data on average fuel usage found by the KTs for each customer group, to calculate emission reductions.

Kitchen Tests will in practice produce data in one of three forms:

1. Primary and secondary fuel mass are each measured directly (for example, wood consumption is measured net of the LPG consumption, and LPG consumption is known in terms of bottles consumed per year). The data values can be set as constants throughout the project period or set as year by year values. Relevant equations are presented below under the heading Approach 1.

2. All cooking during the tests is done with one primary fuel and stove (without use of secondary fuels or stoves), but it is known that other fuels and/or stoves replace a portion of the cooking energy through a typical year. The data values in this case for secondary fuels would be fractions of energy or mass displaced, and could be constants throughout the project period (for example, woody biomass is used during the Kitchen Tests while it is known from the Kitchen Survey and baseline study observations that a crop residue or renewable fuel is used for a certain fraction of each year), or they could vary year by year (as in trend toward or away from fossil fuel use). Relevant equations are presented below under the heading Approach 2.

3. The KT measures fuel consumption of the primary fuel only, while the households involved are carrying on a degree of typical fuel and stove-type mixing and/or typical use of RE forms during the KT itself ("subsumed-fuel KT"). Where a secondary fuel or stove is subsumed, the quantity or fraction of secondary fuel or RE is treated as zero (AF and Xaf, Xre in the equations below) and the effect of fuel mixing is to reduce the saving made in primary fuel between baseline and project scenarios. This approach is only legitimate if it is shown that the effect on emission reduction projections and calculations is conservative. Either of the equation sets presented below under the headings Approach 1 or 2 may be used, as appropriate.

In all cases the KTs will deliver data specific to a single cluster and specific to the chosen Units of emission reduction or fuel consumption, for example per stove-year, per kitchen-year, per stove–day, per meal or per product (in the latter cases these are then combined with averaged days per year, meals/year or products per year, depending on variables such as school term lengths, food sale periods, and so on).

The KT may also be used to collect data or measurements relevant to calculation of a wider range of emissions not directly due to cooking fuel combustion but which are avoided or introduced nevertheless by the project activity. In most such cases a specialist methodology for assessing the emissions can be drawn from the stock of existing approved methodologies and applied[15].

1. Approach 1 is specific to each representative Unit of each cluster and applies values of mass for each fuel in the mix:

$BE_y = X_{nrb,bl,y} \cdot B_{bl,y} \cdot EF_{bl.bio,CO2} + \sum(AF_{bl,i,y} \cdot EF_{af,CO2,i})$
$+ \sum$(Non-CO2 emissions during cooking)
$+ \sum$(GHG emissions during production of the fuels) ……….**Eqn B.1a**

Where

BE_y = baseline emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

$X_{nrb,bl,y}$ = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the baseline scenario

$B_{bl,y}$ = the mass of woody biomass consumed during cooking in the baseline in year y (tonnes/year).

$EF_{bl.bio,co2}$ = the CO2 emission factor for use of the biomass fuel in the baseline scenario in tonnes CO2 per tonne fuel

$AF_{bl,i,y}$ = The mass of alternative fuel i in the baseline in year y in accordance with trends projected throughout the project period, in tonnes. This mass can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels (approach 3).

$EF_{af,co2,i}$ = The CO2 emission factor for use of the alternative fuel i in the baseline in tonnes of CO2 per tonne fuel

[15] An example would be avoidance of animal waste emissions in a biogas project. In general projects which introduce small-scale biogas for domestic cooking by families with access to animal waste, should be addressed using a specialist bio-digester methodology. At the same time, the effectiveness of projects in rural areas can depend on their responsiveness to the multiple needs of rural communities, and in practice biogas may be used in part by the project population (some households may not have access to animal waste or bio-digester output, or some may find their digesters under-produce so that continuing use of biomass cook-stoves is the norm). In cases where biogas provides less than 70% of the population's cooking fuel, the general improved cook-stove methodology may be useful, allowing for specialist inputs from other methodologies for emission avoidance through elimination of animal waste handling (a baseline emission), and for methane leakage from over-producing digesters (a project emission).

Non-CO2 emissions during cooking

$$= \sum (B_{bl,y} \cdot EF_{bl.bio,non\text{-}co2,i}) + \sum(AF_{bl,i,y} \cdot EF_{af,i,non\text{-}co2\ gas\ i}) \ldots \textbf{Eqn B.1b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \cdot B_{bl,y} \cdot EF_{bio,prod,co2} + \sum(AF_{bl,i,y} \cdot EF_{af,prod,co2,i}) + \sum (B_{bl,y} \cdot EF_{bio,prod,non\text{-}co2\ gas\ i}) + \sum(AF_{bl,i,y} \cdot EF_{af,i,prod,non\text{-}co2\ gas\ i}) \ldots \textbf{Eqn B.1c}$$

Where

$EF_{bl.bio,non\text{-}co2,i}$ = Emission factor for GHG gas i in the baseline scenario in units of tonnes gas per tonne wood-fuel

$EF_{af,i,non\text{-}co2\ gas\ i}$ = Non-CO2 Emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel

$EF_{bio,prod,co2}$ = CO2 Emission factor for wood-fuel during production in tonnes gas per tonnes fuel

$EF_{af,prod,co2,i}$ = CO2 Emission factor for fuel i during production in tonnes gas per tonnes fuel

$EF_{bio,prod,non\text{-}co2\ gas\ i}$ = Non-CO2 Emission factor for wood-fuel during production in tonnes gas per tonne fuel

$EF_{af,i,prod,non\text{-}co2\ gas\ i}$ = Non-CO2 Emission factor alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel

2. Approach 2 is specific to each representative Unit of each cluster and quantifies mass of only one major fuel, attributing fractions of energy delivered by the other fuels. For illustration woody biomass is selected as the major fuel:

$$BE_y = X_{nrb,bl,y} \cdot B_{gross,bl} \cdot (1 - \sum X_{re,bl,i,y} - \sum X_{af,bl,i,y}) \cdot EF_{bl.bio,co2} + \sum(X_{af,bl,i,y} \cdot (CEU / \varepsilon_{af,bl,i}) \cdot EF_{af,co2,,i(ebasis)}) + \sum(\text{Non-CO2 emissions during cooking}) + \sum(\text{GHG emissions during production of the fuels}) \ldots\ldots\ldots \textbf{Eqn B.2a}$$

Non-CO2 emissions during cooking

$$= \sum (B_{gross,bl} \cdot (1 - \sum X_{re,bl,i,y} - \sum X_{af,bl,i,y}) \cdot EF_{bl.bio,non\text{-}co2,i}) + \sum(X_{af,bl,i,y} \cdot (CEU / \varepsilon_{af,bl,i}) \cdot EF_{af,i,non\text{-}co2\ gas\ i\ (ebasis)}) \ldots\ldots \textbf{Eqn B.2b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \cdot B_{gross,bl} \cdot (1 - \sum X_{re,bl,i,y} - \sum X_{af,bl,i,y}) \cdot EF_{bio,prod,co2} + \sum(X_{af,bl,i,y} \cdot (CEU / \varepsilon_{af,bl,i}) \cdot EF_{af,prod,co2,i}) + \sum (B_{gross,bl} \cdot (1 - \sum X_{re,bl,i,y} - \sum X_{af,bl,i,y}) \cdot EF_{bio,prod,non\text{-}co2,i}) + \sum(X_{af,bl,i,y} \cdot (CEU / \varepsilon_{af,bl,i}) \cdot EF_{af,prod,non\text{-}co2,i}) \ldots\ldots\ldots \textbf{Eqn B.2c}$$

Where

$B_{gross,bl}$ = the annual mass of woody biomass consumed during cooking in the baseline (in tonnes wood per year) in conditions where no other fuel is used for cooking (ie this mass provides the gross amount of energy utilized for cooking)

$X_{re,bl,i,y}$ = percentage of woody biomass combustion avoided due to a renewable energy form[16] i identified as part of the baseline scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2.

$X_{af,bl,i,y}$ = percentage of woody biomass avoided due to alternative fuels i (such as fossil fuels and dung) identified as part of the baseline scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels (approach 3). Otherwise this percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2.

$EF_{af,co2,i(ebasis)}$ = The CO2 emission factor for use of the alternative fuel i in the baseline in tonnes of CO2 per GJ fuel

$CEU = B_{gross,bl} \cdot NCV_{bio} \cdot \varepsilon_{tradbiomass}$ = The cooking energy utilized, in GJ….**Eqn B.2d**

Where

NCV_{bio} = Net calorific value of woody biomass in MJ/kg or GJ/tonne

$\varepsilon_{tradbiomass}$ = efficiency of a traditional biomass stove in the baseline scenario (measured by baseline study or default 20%) / alternative fuel stove efficiency (in absence of specific baseline data the default values of 20% for traditional biomass cook-stoves and 50% for fossil fuel stoves may be taken)

$\varepsilon_{af,bl,i}$ = efficiency of the stove burning alternative fuel i in the baseline scenario (measured by baseline study or default 50% for fossil fuels)

5. Project emissions

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

The PDD projection should calculate emissions on the basis of an assumed life for each installation. The effects of aging and non-usage need not be detailed as they subsume under an estimated number of sales and expiry time. The equations presented here reflect the projection.

[16] See Step 1.2 above for a definition of renewable energy as denoted by RE. Under this definition Xre is never (1-Xnrb) as it does not apply to woody biomass. If sustainable biomass is used Xnrb is zero or if it is mixed with unsustainable biomass, the combination is expressed as an adjusted value of Xnrb. An example of application of Xre would be replacement of a primary fuel by a zero-emission fuel or energy source for a particular portion of the year or to displace a portion of cooking energy required. For example if solar cookers, biogas, or agricultural waste/coppiced wood deemed as having zero emissions displaced the full cooking load for 3 months of each year, Xre would be 3/12; if they displaced only half the cooking load for this portion of the year it would be 1/8.

The monitoring plan described in a PDD should however show how these factors are measured and included in emission reduction calculations. .

Data relating to project emissions[17] are collected following the baseline procedure described above, with the focus this time on characterizing the kitchen regime after installation of the improved stove. The KS and KTs are applied to improved stove users (and improved practice as introduced by the project) as well as to traditional stove users and cooks following pre-intervention practices.

1. Approach 1 is specific to each representative Unit of each cluster and applies values of mass for each fuel in the mix:

$$PE_y = X_{nrb,pj,y} \cdot B_{pj,y} \cdot EF_{pj.bio,CO2} + \sum(AF_{pj,i,y} \cdot EF_{af,CO2,i})$$
$$+ \sum(\text{Non-CO2 emissions during cooking})$$
$$+ \sum(\text{GHG emissions during production of the fuels}) \ \ldots\ldots \textbf{Eqn P.1a}$$

Where (noting that parameters common to baseline equations are not repeated):

$X_{nrb,pj,y}$ = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the project scenario

PE_y = project emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

$B_{pj,y}$ = the mass of woody biomass consumed during cooking in the project each year (in tonnes/year).

$AF_{pj,i,y}$ = The mass of alternative fuel i in the project in year y in accordance with trends projected throughout the project period, in tonnes. This mass can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels.

Non-CO2 emissions during cooking

$$= \sum (B_{pj,y} \cdot EF_{pj.bio,non\text{-}co2,i}) + \sum(AF_{pj,i,y} \cdot EF_{af,i,non\text{-}co2\ gas\ i}) \ \ldots\ldots \textbf{Eqn P.1b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \cdot B_{pj,y} \cdot EF_{bio,prod,co2}$$
$$+ \sum(AF_{pj,i,y} \cdot EF_{af,prod,co2,i})$$
$$+ \sum (B_{pj,y} \cdot EF_{bio,prod,non\text{-}co2\ gas\ i})$$
$$+ \sum(AF_{pj,i,y} \cdot EF_{af,i,prod,non\text{-}co2\ gas\ i}) \ \ldots\ldots\ldots \textbf{Eqn P.1c}$$

2. Approach 2 is specific to each representative Unit of each cluster and quantifies mass of only one major fuel, attributing fractions of energy delivered by the other fuels. For illustration woody biomass is selected as the major fuel:

[17] In the case of biogas stoves emissions due to physical leakage of gas should be estimated following a specialist approved methodology. The leakage is then treated as a project emission additional to the equations presented here.

$$PE_y = X_{nrb} \cdot B_{gross,pj} \cdot (1 - \sum X_{re,pj,i,y} - \sum X_{af,pj,i,y}) \cdot EF_{pj.bio,co2}$$
$$+ \sum (X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,co2,,i(ebasis)})$$
$$+ \sum(\text{Non-CO2 emissions during cooking})$$
$$+ \sum(\text{GHG emissions during production of the fuels}) \text{ ....} \textbf{Eqn P.2a}$$

Non-CO2 emissions during cooking

$$= \sum (B_{gross,pj} \cdot (1 - \sum X_{re,pj,i,y} - \sum X_{af,pj,i,y}) \cdot EF_{pj.bio,non\text{-}co2,i})$$
$$+ \sum (X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,i,non\text{-}co2\ gas\ i}) \text{ ....} \textbf{Eqn P.2b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \cdot B_{gross,pj} \cdot (1 - \sum X_{re,pj,i,y} - \sum X_{af,pj,i,y}) \cdot EF_{bio,prod,co2}$$
$$+ \sum(X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,prod,co2,i})$$
$$+ \sum (B_{gross,pj} \cdot (1 - \sum X_{re,pj,i,y} - \sum X_{af,pj,i,y}) \cdot EF_{bio,prod,non\text{-}co2,i})$$
$$+ \sum(X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,prod,non\text{-}co2,i}) \text{ ......} \textbf{Eqn P.2c}$$

Where (noting that parameters common to baseline equations are not repeated):

$B_{gross,pj}$ = the annual mass of woody biomass consumed during cooking in the project (in tonnes wood per year) in conditions where no other fuel is used for cooking (ie this mass provides the gross amount of energy utilized for cooking)

$X_{re,pj,i,\,y}$ = percentage of woody biomass combustion avoided due to a renewable energy form[18] i identified as part of the project scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2.

$X_{af,pj,i,y}$ = percentage of woody biomass combustion avoided due to alternative fuels i (such as fossil fuels and dung) identified as part of the project scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2. This percentage can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels and it is shown that the effect is a conservative estimate of emission reductions.

$EF_{af,co2j,i(ebasis)}$ = The CO2 emission factor for use of the alternative fuel i in the project in tonnes of CO2 per GJ fuel

CEU = The cooking energy utilized, in GJ, as calculated above in Eqn B.2d

[18] The explanation given in the footnote above for Xre,bl applies in this case also.

6. Leakage

The project proponent should assess each of the following forms of leakage and present in the PDD an estimate for each case, together with a justification:

a) Some users of the efficient stoves respond to the fuel savings associated with higher-efficiency stoves by increasing consumption of fuels with GHG emission characteristics by retaining some use of inefficient stoves, to the extent that project emissions are higher than those calculated from the assumption that cooking energy is constant. This is sometimes referred to as the 'rebound' effect.

b) The project activity stimulates increased use of a high emission fuel either for cooking or for other purposes outside the project boundary (as would be the case for example if efficient cooking stimulated an increase in NRB consumption - possibly because the NRB fuel becomes cheaper due to the project activity).

c) By virtue of promotion and marketing of a new model and type of stove with high efficiency, the project stimulates substitution of a cooking fuel or stove type with relatively high emissions by households who commonly using a cooking fuel or stove type with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.

d) The project population compensates for loss of the space heating effect of inefficient cook-stoves by adopting some other form of heating or by retaining some use of inefficient stoves.

e) The traditional stoves displaced are re-used outside the boundary in a manner suggesting more usage than would have occurred in the absence of the project.

f) Significant emissions from transportation or construction involved in the project activity, including emissions associated with production/transport of the efficient stoves themselves, or production/transport of project fuels (for example briquette manufacture and supply may be energy-intensive).

g) The non-renewable biomass saved under the project activity is used by non-project households/users who previously used renewable energy sources.

h) The non-renewable biomass saved under the project activity is used to justify the baseline of other project activities.

In all cases these leakage risks should be assessed in the context of suppressed demand and satisfied level of service; if relevant conditions as defined in Annex 2 are demonstrated to apply, the leakage may not exist or may be diminished.

PDDs should contain projections of leakage based on data collection in the baseline KS's and general observation. Leakage should be included in the monitoring plan for the project using methods appropriate to the degree of risk. Risk (a) requires that Monitoring KS's and KT's include provision for relevant data collection (the standard Monitoring KT can be used to measure relative CEU as well as fuel consumption).

Leakage risks deemed very low can be neglected altogether so long as the case for their insignificance is substantiated. For example, in many projects risk (e) could be neglected on the grounds that the very low commercial value of traditional stoves in the specific baseline indicates that their release will make no difference to consumption

The leakage risk may already be taken care of by the hierarchy of steps which comprise the methodology, in which case it need not be quantified as a leakage:

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

Leakage is either calculated as a quantity of emission reductions or assessed as a risk. In the former case the quantity of Leakage is assessed and then subtracted from the baseline-project emission difference. In the latter case Leakage is estimated as a percentage of the baseline-project emission difference, then subtracted from the baseline-project emission difference.

Leakage assessments should be specific to each cluster.

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7. Emission reductions

The overall reductions of GHG induced by the project are calculated as follows:

$ER_y = \sum BE_{i,y} - \sum PE_{i,y} - \sum LE_{i,y}$ …….**Eqn ER.1a**

Where:

ER_y = Emission reduction in total project population in year y (tCO_2e/yr)
$BE_{i,y}$ = Baseline emissions of cluster i in year y (tCO_2e/yr)
$PE_{i,y}$ = Project emissions of cluster i in year y (tCO_2e/yr)
$LE_{i,y}$ = Leakage of cluster i in year y (tCO_2e/yr)

Within each cluster the emissions are calculated thus:

$BE_{i,y} = N_{i,y} \, . \, PE_y$ …….**Eqn ER.1b**
$PE_{i,y} = N_{i,y} \, . \, BE_y$ ……..**Eqn ER.1c**

Where PE_y and BE_y are calculated as set out in equations 1 to 4 above, and:

$N_{i,y}$ = the number of Units in cluster i

It is legitimate to derive emission reduction values on a per Unit basis directly from the KT tests, and modify the mode of calculation of project emission reductions (and of baseline and project emissions) accordingly, in cases where this results in the most transparent and clear mode of calculation, and where this is consistent with the calculations above.

The best approach to calculation of emission reductions from sampling will depend on whether paired kitchen data is available or not. As discussed in the section on Kitchen Tests, paired sampling should be used where possible, as this will often result in narrower error bounds.

If paired sampling has been used for the Kitchen Tests, it is legitimate to derive a value for emission reduction for each individual kitchen in the sample tested. That is, the values of BE and PE are not found for each cluster, but instead are found for each kitchen, giving an emission reduction value for each kitchen. An expert statistical analysis is then required to determine at a 90% confidence level (or better) the range of values within which the mean emission reduction per kitchen lies, 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 from the sample. An expert statistical analysis is then necessary to determine at a 90% confidence level (or better) a range of values within which the mean difference between BEs and PEs lies, with respect to the whole population of interest. A suitable analysis can be done using the appropriate independent two-sample t-test.

In each case the recommended t-test is robust to potential non-normality in the sample so long as sample size is sufficient and the data satisfy the assumption of independence.

The lower bound of the confidence interval represents the value of emission reduction which should be used[19] for all sales for the cluster in question, with 90% confidence that it will be exceeded in reality.

8. Data and Parameters not monitored

(a) Evolving baseline option in cases where emission factors are constants[20]:

Data / Parameter:	$EF_{bl.bio,co2}$
Data unit:	tCO2/t_biomass
Description:	CO2 emission factor arising from use of wood-fuel in baseline scenario
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{pj.bio,co2}$
Data unit:	tCO2/t_biomass
Description:	CO2 emission factor arising from use of wood-fuel in project scenario
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{af,co2}$
Data unit:	tCO2/t_fuel
Description:	CO2 emission factor arising from use of alternative fuel
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

[19] To calculate the lower bound it is legitimate to choose a one-sided confidence interval. The lower bound will have a higher value than when a two-sided confidence interval is chosen.

[20] The project proponent may choose to set the EFs in both the baseline and project scenarios as constants throughout the project period, except in cases where there is evidence of significant changes taking place during the project period. In such cases, the EFs are monitored.

Data / Parameter:	$EF_{bl.bio,non-co2}$
Data unit:	tCO2/t_biomass
Description:	Non-CO2 emission factor arising from use of wood-fuel in baseline scenario
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{pj.bio,non-co2}$
Data unit:	tCO2/t_biomass
Description:	Non-CO2 emission factor arising from use of wood-fuel in project scenario
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{af, non-co2}$
Data unit:	tCO2/t_fuel
Description:	Non-CO2 emission factor arising from use of alternative fuel
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{bio,prod,co2}$
Data unit:	tCO2/t_fuel
Description:	CO2 emission factor arising from production of wood-fuel
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{af,prod,co2}$
Data unit:	tCO2/t_fuel
Description:	Non-CO2 emission factor arising from production of alternative fuel
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{bio,prod,non-co2}$
Data unit:	tCO2/t_biomass
Description:	Non-CO2 emission factor arising from production of wood-fuel
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

Data / Parameter:	$EF_{af,prod,non-co2}$
Data unit:	tCO2/t_fuel
Description:	Non-CO2 emission factor arising from production of alternative fuel
Source of data:	IPCC defaults or project-relevant measurement reports
Any comment:	

(b) Fixed baseline option: The baseline parameters listed in III.3 are not monitored.

SECTION III: MONITORING METHODOLOGY

1. Monitoring Procedure

The Monitoring Procedure mirrors the Procedure set out in sections II.4-6 above.

A Total Sales Record, Detailed Customer Database, and Project Database are maintained continuously, while periodic KS's and KTs are required to measure or estimate parameter values and review and revise the cluster lists held in the Project Database; emission reduction calculations are carried out on the basis of the KT results most applicable to each stove according to its age. For clusters with evolving baselines, the KS's and/or KTs include investigation of pre-intervention conditions.

A. The monitoring tasks undertaken continuously are:

1. Maintenance of a Total Sales Record.

The Project Co-ordinator is responsible to assist the project implementing body or bodies (generally Stove Distributors, Manufacturers making sales to retailers, and Retailers) to maintain and make available accurate records. The Project Coordinator is responsible to collate a composite electronic Sales record and keep paper records also.

All sales records should comprise the following data:
- Date of Sale
- Location of sale
- Mode of use: resale/onward retailing, institutional, other (assumed domestic)
- Model/type of stoves purchased
- Number of stoves purchased
- Name and telephone number:
  - Required for all bulk purchasers, ie retailers and institutional users
  - Domestic end users: as many as possible
- Address:
  - Required for all bulk purchasers and institutional users
  - Domestic end users: as many as possible

2. Maintenance of a Detailed Customer Database, and Monitoring KS's

The project co-ordinator will place the results of Kitchen Surveys into a Detailed Customer Database (DCD). The DCD is initially filled with the results of the Baseline KS (and may be supplemented with additional data collected during the baseline Kitchen Tests); it is then further populated by data collected during the course of the project by Monitoring KS's and Monitoring KTs. Monitoring KS's are conducted each quarter (3 month period) of the project, to ensure that data is collected at all times of the year such that seasonal variation is captured.

The sample size for a Monitoring KS, repeated each 3 months, is not less than 25 customers (or 10% of cluster size if this is less than 250). The purpose and guidelines are described in the Baseline Procedure in section II.4; households are randomly selected from the Sales Record of the relevant period (in this case purchases made in the previous and/or current quarter). The purpose is to update cluster definitions such that the Monitoring KTs remain representative, and the calculations of emission reductions are based on a correctly organized Project Database. The repeated KS's serve to monitor an evolving baseline. Results of the monitoring KS's should be included in monitoring reports[21].

It is recommended that all the data in the DCD is derived from interviews in the homes of the customers, rather than by telephone, so that the observations of the interviewer will help to avoid mis-communications. To accommodate conditions where this is practically difficult, the largest possible ratio should be achieved, not falling below 50% of the data in the DCD being derived from interviews in the homes of the customers. Home interviews should take place before telephone interviews in order to assure the quality of interviews conducted by telephone.

The data collected is specific to the characteristics of each project and each cluster, and should be freshly defined for each project to fulfill the aim of the KS as expressed above. .As an example, the data per domestic respondent could be:

a) Mobile telephone number and/or address with land-line telephone number

New stove:

b) Type of stoves and fuels used by customer including this new one
c) Place of use, location
d) Application of new stove-fuel combination: commercial food production, domestic, institutional, etc
e) Fuel mix used typically through the year: specify different types of fuel used and fractions of total fuel use, noting variations in the mix at different parts of year, duration of each period, and reasons for variation (specify whether space-heating is a seasonal requirement and how it is done). If possible note quantities of each fuel per period of the year.
f) Sources of fuels used with new stove (purchased or hand-collected, etc) and prices paid or effort made (eg walking distances, persons collecting, opportunity cost)
g) Frequency of cooking per day and per week (if possible specify reasons for infrequent cooking: eg due to out-eating, cooking to eat cold/warmed later)
h) Number of adults and of children under 10, eating
i) Allocation of the questions/information above separately, to separate seasons of the year

Previous stove (omitted in cases where baseline information not required):

Questions as above adjusted for previous stove-fuel combination

Care should be taken that a number of customers on the record are non-telephone owners to ensure representativeness of different socio-economic groups, this number being in proportion to the number of customers found or estimated to be non-telephone owners.

[21] Projects generating baseline information for application to retrospective emission reductions do not need to add retrospective monitoring KS's to a baseline KS.

3. Continuous updating of the Project Database

The Project Database is derived from the Total Sales Record, dividing the purchasers into groups according to the most recent definition of clusters, and listing under separate headings any sales which do not fall into the cluster categories. The Project Database should include a description of the conclusions of KS's and KTs with regard to clustering, factors effecting emission reductions, and adjustments for emission reduction calculations and it should include within it the emission reduction calculations for the project. The Project Co-ordinator is responsible for this task.

4. Calculation of emission reductions

Emission reductions should be calculated using the results of the most recent Monitoring KS's and KTs as set out below in the section on Periodic Monitoring. The surveys and tests will provide updated values for NRB fraction, Leakage, and also values for Usage, Age, and New-stove factors, always specific to a cluster. The Age factor is particular to stove vintages and is used to adjust the fuel savings performance and any other relevant factors applied in the emission reduction equation. The Usage factor is also particular to stove vintage and adjusts the emission reduction value for each age group. The updated NRB and Leakage values adjust all emission reduction results for the year monitored. Updated values of baseline parameters are used in the emission reduction equations.

B. The monitoring tasks undertaken periodically will be:

1. The NRB fraction should be re-assessed, not less frequently than bi-annually.

2. Leakage estimates identified in the PDD should be surveyed, and an investigation made into the possibility of new leakage effects, not less frequently than bi-annually.

3. A Usage Survey should be undertaken not less frequently than bi-annually (every two years) for sales made in the first year of the project, to establish the drop-off rates in stove usage (or new regime application) over time. The sample size is as defined for the baseline KS, selected randomly from users having made their purchase in the first year of the project.

4. An "Aging-Stove KT" should be undertaken not less frequently than bi-annually for sales made in the first year, to measure fuel reduction performance and other relevant factors [22] in successive years of stoves of Age x years, Age y years, and so on. A linear extrapolation is applied to all stoves of intermediate age and extended age, when calculating overall project GHG reductions. The mean performance of the aging stoves can be applied to the lower bound of the fuel savings as determined in the baseline study; it is therefore not necessary to apply a lower bound adjustment to the aging stove test data. The sample size should be such that a sufficient number of aging stoves are considered to ensure that the typical levels and types of degradation are represented. It is not necessary to measure baseline fuel use[23] and the

[22] If IPCC defaults are not used, testing of emission factors (EFs) of ageing stoves is only required if there is evidence of a risk of significant changes from the baseline EFs and if this risk points to possible over-estimation of emission reductions

[23] The question of whether the baseline is fixed or evolving and requires re-measurement or not is fully separate from the aging stove KT.

tests therefore only involve measurements of the performance of the improved stove. The mean fuel use of the aging stoves is to be ratio-ed to the mean fuel use of the stoves as measured in the baseline study; this ratio is then multiplied by the lower bound of the baseline fuel savings to yield the fuel savings of the aging stoves. The use of a Control Cooking Test (CCT) to be conducted on both the new stoves and the aging stoves, possibly in a centralized facility, can be approved if it can be shown that results from such an approach are correlated with a KT approach.

5. Baseline Monitoring KT. If the KS reveals that baseline parameters of the type measured by KTs may have changed significantly, or if the KS is not adequate to update evolving baseline conditions, and no New-Stove KT is taking place to perform this function, then a Baseline Monitoring KT should be carried out not less frequently than bi-annually amongst new customers to update baseline parameters.

6. A "New-Stove KT" to measure fuel consumption should take place for new models and designs when they are launched, and will be repeated not less frequently than bi-annually. The sample size is as defined by the Baseline Procedure in section II.4. This KT may also be used to measure evolving baseline parameters amongst new customers, to act as the Baseline Monitoring KT[24].

7. The wider social and economic impact of the project should be investigated biannually and an assessment made of its contribution, positive or otherwise, to sustainable development in the area.

2. 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.

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

3. Data and Parameters monitored

(a) Evolving baseline option:

Data / Parameter:	Xnrb,bl,y
Data unit:	Fraction
Description:	Non-renewability status of woody biomass fuel in year y in baseline scenario
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Xnrb,pj,y
Data unit:	Fraction
Description:	Non-renewability of woody biomass fuel in year y in project scenario
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Xre,bl,y
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to renewable energy form in year y in baseline
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Xre,pj,y
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to renewable energy form in year y in project
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Xaf,bl,y
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to alternative fuels in year y in baseline
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Xaf,pj,y
Data unit:	Fraction
Description:	Woody biomass combustion avoided due to alternative fuels in year y in project
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Leakage
Data unit:	t_CO2e per year
Description:	Potential GHG emissions outside project boundary caused by project activity
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	$B_{bl,y}$
Data unit:	t_biomass/unit-year
Description:	Mass of woody biomass combusted in the baseline in year y
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	$AF_{bl,i,y}$
Data unit:	t_fuel/unit-year
Description:	The mass of alternative fuel i combusted in the baseline in year y
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	$B_{pj,,y}$
Data unit:	t_biomass/unit-year
Description:	Mass of woody biomass combusted in the project in year y
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	$AF_{pj,i,y}$
Data unit:	t_fuel/unit-year
Description:	Mass of alternative fuel i combusted in the project in year y
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual

QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Usage in year y
Data unit:	Fraction
Description:	Percentage of stoves of age x remaining in use in year y
Source of data:	Survey
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Age
Data unit:	Fraction
Description:	Adjustment to values of $B_{pj,,y}$ and $AF_{pj,i,y}$ for stoves of age x
Source of data:	Survey
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	New Stove
Data unit:	Fraction
Description:	Adjustment to values of $B_{pj,,y}$ and $AF_{pj,i,y}$ for new stove models
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

(b) Fixed baseline option: The monitoring of the baseline parameters listed above is not mandatory.

SECTION IV: ANNEXES

Annex 1: Renewability of woody biomass fuels

In projects where woody biomass is a component of either the baseline or project scenario, project proponents must specify the extent to which the CO2 emissions of that biomass are not offset by re-growth in the collection area.

This can be done following the EB 23 Annex 18 definition of "renewable biomass" (by inversion) and by collecting evidence through field survey, existing literature and resource/population mapping studies. Depending on the depth and quality of information available on biomass supply and growth in the collection area, a quantitative approach may or may not be possible. If it is, the quantitative approach below should be adopted, otherwise the qualitative approach should be adopted. A combination of both approaches is recommended with conservative estimations.

Options

Project proponents may choose between one of two options for estimation of the non-renewability fraction Xnrb,y. The options are:

a. Adoption of the approach described in sections A1.1 and A1.2 below

b. On condition that it can be shown that option (a) is not practical due to undue difficulty in collection area estimation, and that the conservativeness of this modification is demonstrated, it is legitimate to aggregate all reachable wood-fuel collection areas and apply, using option (a) with this adjustment only, a single fraction for all collection areas in the country.

A1.1 Quantify non-renewable biomass

1.a. Specify the geographic area from which woody biomass fuel is or could be reasonably be expected to be collected by or for the project population, and adopt whichever is the larger. This is termed the Fuel Collection Area or Reachable Collection Area (A). This area is not only forest but any area where woody biomass is present, effectively a combination of forest and so-called "invisible forest" which includes grasslands.

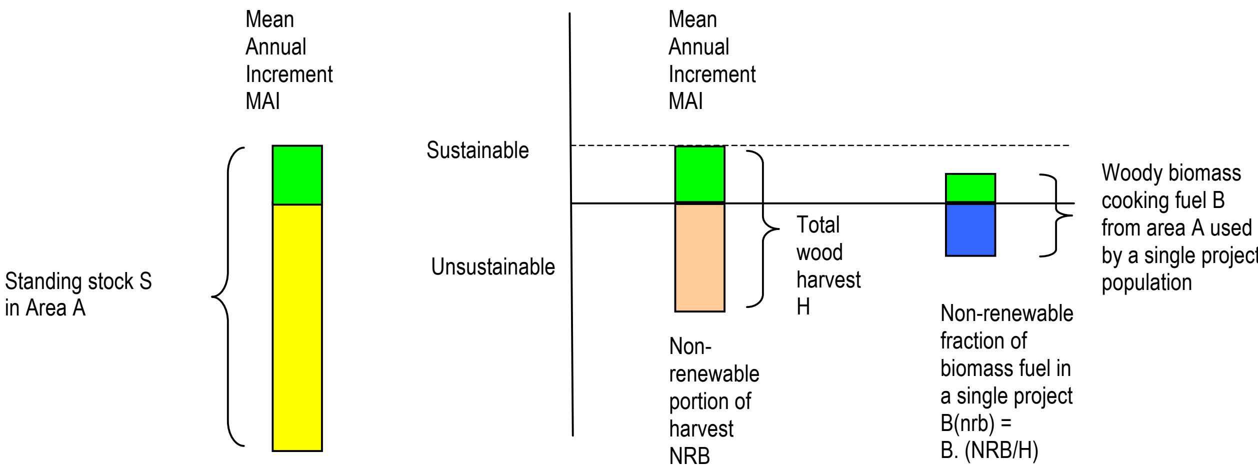
1.b Use credible information sources, field surveys, or both, to ascertain the amount of woody biomass that is re-generating each year in this area. This is the Mean Annual Increment (MAI).

1.c. Quantify the amount of non-renewable biomass (NRB) drawn from the fuel collection area (A) as follows:

$$NRB = H - MAI$$

where

H = the annual harvest of woody biomass, including forest clearance, timber extraction, consumption of wood-fuels, drawn from fuel collection area A
MAI = sum of mean annual increments of the wood species, or “re=growth” in area A
NRB = non-renewing biomass or excess harvest over and above re-growth, which is the amount of woody biomass removed with attendant CO2 emissions which are not absorbed by re-growth



The diagram illustrates sustainable and unsustainable woody biomass extracted from fuel collection area A. MAI is a percentage of the total standing stock S, and NRB is the harvest taken from area A net of MAI. The fraction of the harvest which is non-renewable is NRB/H.

1.d. Ascertain the fraction of extracted woody biomass that is non-renewable, denoted Xnrb. If a quantity of woody biomass supplied from fuel collection area A is used as a fuel in cook-stoves, the fraction Xnrb is assumed to be non-renewable with CO2 emissions that are not reabsorbed by re-growth:

$$Xnrb = (NRB/H)$$

This fraction should be assessed for the different types of Reachable Collection Area, for example forest and grassland. If it is not possible to take a quantitative approach in all area types, it should be taken wherever possible, and a qualitative approach taken for the other area types.

A1.2 Qualitative assessment

Satellite imagery, combined with field surveys, pertinent literature reviews, and expert consultations can also provide sufficient evidence of non-renewability and lead to an acceptable conservative estimate of the NRB fraction.

Satellite imagery can be used to link population centres where there exists a demand for biomass fuel, with their associated reachable biomass harvesting areas (software doing this is under development and already in use to ascertain non-renewability in this way).

Field surveys can identify reachable collection areas for population groups, and ascertain the history of collection in each area. For example, interviews and field evidence may show that over recent years 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 involving walking distances, and to urban consumption or wood or charcoal where collection areas are country-wide.

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

A qualitative assessment should conclude with an estimate of NRB fraction, using a combination of the above sources of information to substantiate the conclusion.

This proposed methodology for estimating NRB 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.

Such proposals would need to consider the following elements:
- Methodologies must be demonstrably conservative, ensuring a high probability that over-crediting of emissions reductions will not occur
- Datasets required by the methodology must be reliably obtained from proposed sampling methods
- Use of generic datasets must be clearly justified and adjusted for local relevance
- Methodologies ought to be practical and simple enough for widespread usage

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

Annex 2 Suppressed demand and satisfactory level of service

It is sometimes the case that in the baseline scenario the population (or a cluster within the population) experiences poverty-related under-cooking and consequently under-nourishment due to limited access to cooking fuel. The project activity corrects this by virtue of introducing more fuel-efficient cooking devices. The amount of energy delivered usefully (the 'cooking energy utilized' or CEU) becomes more in the project scenario than it was in the baseline scenario, as the cluster members achieve a satisfactory level of service.

A similar situation can arise in cold climates with respect to the space-heating. The cluster population may experience such low comfort levels in cold weather that it cannot achieve reasonable standards of human development. If a project introduces a new stove-fuel combination allowing improved access to energy then it can be the case that the total kitchen energy CEU (including cooking needs and space-heating effects) is more in the project than in the baseline[25], the project having achieved a satisfactory level of service.

Such cases should first be analysed in terms of rising standards of living, in which case they are addressed in the methodology as baseline trends. In the extreme case a rising-standard-of-living argument could justify replacement of a biomass baseline with a proxy of 100% fossil fuel (Xaf would be set to 100% in the equations above) and a project-level of satisfactory service used to estimate CEU. The existence of such trends, if they increase the emission reduction calculated, must be justified with evidence.

In cases where a rising standard of living is not directly apparent in the population cluster examined, the project proponent may nevertheless provide a plausible argument that the project-level value of CEU is the appropriate value to act as a baseline for calculation of emission reductions. These are cases where the rising standard of living of peers is not being realized by the cluster in question and is therefore suppressed.

The underlying principle of the suppressed demand argument is:

Where a group of people are deprived of a reasonable level of human development in comparison to their peers, and the opportunity to achieve a satisfactory level of service is available through carbon financing calculated from the baseline level of service of their peers or from the project level of service achievable, then the appropriate adjustment to baseline can be made.

This principle implies that the equations presented above for emission reduction calculation must be adapted for cases of suppressed demand on a case-by-case basis.

One possible case is that efficiency of the cooking system in the baseline does not change, but the delivered energy is equal to the project delivered energy, so giving rise to a hypothetical amount of fuel (of the same type as in the baseline). In the project scenario, the efficiency is as measured in reality and the fuel amount is as measured. Evidence here would be required that the project

[25] The possibility also exists for a falling value of CEU, such as would be the case when a switch from an inefficient stove to an efficient one results in less space heating than experienced before. This case is addressed as a leakage risk.

level was satisfactory but not excessive and that the previous level was unsatisfactory according to essential-needs benchmarks.

Another case is that the hypothetical baseline is set to a proxy fuel-stove combination based on the standard of living achieved by peers. This may be appropriate in some cases where project scenarios are renewable energy scenarios. The project scenario, in some cases, may also be taken as a proxy fuel-stove combination.

Annex 3 Application of the Methodology to Water Treatment Project Activities

V.02 of this methodology has been updated[26] to allow the eligibility of project activities that reduce the amount of fuelwood consumed by changing kitchen practice from water boiling as a purification technique to the introduction of new zero emission technology that treats water (eg gravity household water filters).

The baseline scenario is the existing kitchen practice of boiling water to treat water for consumption on stoves using high emission fuels including non-renewable biomass and fossil fuels.

The diagram below provides an overview of how the application of the Methodology results in emissions reductions per person per day for the water treatment project activity[27]:

Emissions Reductions

=

Baseline Emissions = Non-renewable biomass (%) x Wood-fuel used to Treat Water (T/L) x Total Treated Water (L/p/d) x Emissions Factor (tCO2/T)

-

Project Emissions = Non-renewable biomass (%) x Wood-fuel used to Treat Water (T/L) x Total Water Still Boiled (L/p/d) x Emissions Factor (tCO2/T)

-

Leakage

The equations outlined in Approach 1 of the Methodology apply for water treatment applications - the key differentiating factor is the selection of the proposed unit as litres/person/day. The amount of fuelwood required to boil 1L should be tested in order to create the amount of woody biomass consumed for the emission reduction calculations. Project units are converted into the parameter specified in the Methodology (baseline and project woody biomass consumptions -

[26] The applicability of this methodology for water treatment technologies has been completed by Carbon Bridge Pte Ltd. For information or questions related to the application of the methodology for water treatment project activities, please contact Carbon Bridge at contact@carbon-bridge.com

[27] The equation is simplified to emissions per person per day for illustrative purposes. The figure must be multiplied by the average number of household members (this will be determined by Kitchen Survey data for each cluster) and by 365 days to equal the annual emissions reductions per filter.

$B_{bl,pj,i,y}$ and $B_{pj,i,y}$) by multiplying by the amount of wood-fuel saved by stove type by the number of household members.

$B_{bl,i,y} = L_{bl,i,y}$ x W_i x 365 days x $P_{i,y}$ … for Eqn B1, B2

$B_{pj,i,y} = L_{pj,i,y}$ x W_i x 365 days x $P_{i,y}$ … for Eqn P1, P2

Where,

$L_{bl,i,y}$ = the total amount of treated water for consumption per person per day for each cluster (in litres). This is equal to the amount of raw water treated plus the amount of raw water boiled after the introduction of the water treatment technology. *This potentially takes into account a situation of suppressed demand and is capped at a maximum amount of 7.5 L/p/d (see section on Suppressed Demand below).*

$L_{pj,i,y}$ = the total amount of water still boiled per person per day for each cluster (in litres). This is equal to the amount of raw water[28] and treated water[29] that are boiled after the introduction of the water treatment technology.

W_i = amount of wood-fuel or fossil fuel (in tonnes) required to boil 1L of water on stove type i to be safe for consumption

$P_{,i,y}$ = members per household per cluster in year y[30]

All parameters above are monitored ex-post.

Suppressed demand and satisfactory level of service

Households in developing countries experience suppressed demand where they do not have a satisfactory level of service in terms of treated water available for consumption, inhibited by insufficient energy to meet their basic water treatment needs. The boiling of water requires the collection or purchase of wood-fuel and a household member to boil the water taking 20-30 minutes. These barriers result in less than the required amount of water being treated in the household and accordingly, less than the basic amount of water recommend for good health being consumed.

To account for this suppressed demand and reflect a more satisfactory level of service, the baseline is defined as the total amount of treated water for consumption per person per day. This is measured in the project activity scenario, after the introduction of the water treatment technology, as the sum of the amount of raw water treated and the amount of raw water boiled. This represents the amount of treated water per person that would be consumed removing the barriers raised by the requirement to boil. This amount of water provides households with a greater satisfactory level of service.

In order to ensure that this amount is conservative and does not exceed the definition of a satisfactory level of service, the baseline amount is capped at the level WHO states meets the "basic needs" for treated water[31]. This remains a conservative figure as the definition of peer in

[28] To prevent accounting of emission reductions from the consumption of raw water boiled for other purposes than drinking water, e.g. cooking, hot drinks.

[29] To prevent accounting of emission reductions from the consumption of treated water that is still boiled anyway.

[30] This will be determined by an expert statistical analysis of Kitchen Survey data for each cluster, ensuring that the sample is sufficiently representative of the considered cluster.

[31] This cap will be 7.5L/p/d.

relation to water should be the "developed" world global peer as access to safe water is a basic human right[32].

The baseline standard of living is captured in the Kitchen Survey, both Baseline and quarterly Monitoring, and reflected in the Kitchen Tests. This should be completed on at least a bi-annual basis as prescribed in the Methodology. Should rising standards of living result in the adoption of modern fuels to replace biomass then this would be monitored and applied as outlined in the Methodology.

Application of the Monitoring Methodology for Water Treatment Project Activities

Parameters to be monitored[33]

Description	**Data variable**	**Source of data**	**Data unit**	**Recording frequency**
Non-renewable biomass	$X_{nrb,bl,y}$ $X_{nrb,pj,y}$	Study	Fraction	Bi-annual
Leakage	$LE_{,y}$	Study	tCO2e/y	Bi-annual
Woody biomass consumed in baseline	$B_{bl,i,y}$	Kitchen Test	Tbiomass/y	Bi-annual
Woody biomass consumed in project	$B_{pj,i,y}$	Kitchen Test	Tbiomass/y	Bi-annual
Alternative fuel consumed in baseline	$AF_{bl,i,y}$	Kitchen Test	Tfuel/y	Bi-annual
Alternative fuel consumed in project	$AF_{pj,i,y}$	Kitchen Test	Tfuel/y	Bi-annual
Usage of water treatment units in place	U_y	Usage Survey	%	Bi-annual
Performance of water treatment units in place.	F_y	Performance Survey	%	Bi-annual
New Stove performance	W_i	BWBT (Kitchen Test)	kg/L	As required
Litres of treated water in the baseline	$L_{bl,i,y}$	Kitchen Test	L/p/d	Bi-annual
Litres of treated water still boiled in the PA	$L_{pj,i,y}$	Kitchen Test	L/p/d	Bi-annual
Existing stove performance	W_i	BWBT (Kitchen Test)	kg/L	Bi-annual

[32] "The human right to water is indispensable for leading a life in human dignity", The right to water (arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights), UN 2003

[33] This assumes Approach 1 is taken, therefore no Xre or Xaf. However, project participants may propose an alternative if Approach 2 is taken.

Average people per household per cluster	$P_{i,y}$	Kitchen Survey and Study	p/h	Annual
Eligible units in cluster	$N_{i,y}$	Project Database	#units/y	Annual

The Kitchen Tests should involve the following:

- Baseline Water Boiling Test (BWBT): to find the amount of wood-fuel or alternative fuel required in kg/L to bring one litre of water to boil (W_i) on stove type i and to be safe for consumption. In order for the test to be consistent across stove types this shall be completed in a laboratory. In order to reflect an evolving baseline the BWBT should be updated when new stove and fuel types are monitored. This should be monitored ex post.

- Litres/person/day ($L_{bl,i,y}$ and $L_{pj,\,i,y}$), monitored ex post:
    - The $L_{bl,i,y}$ should be monitored by Kitchen Tests to measure the number of litres of raw water that is boiled after installation of the water treatment technology and the number of litres of raw water that is treated per household over three days. The number of litres per person per day is then calculated.
    - Similarly, $L_{pj,\,i,y}$, should be monitored by Kitchen Tests to measure the number of litres of raw water that is boiled and the number of litres of treated water that is still boiled per household over three days. The number of litres per person per day of water still boiled in the project scenario is calculated.

The Monitoring Kitchen Surveys (KS) should be carried out every 3 months with at least 25 surveys for each cluster as specified in the Methodology. A random sample should be drawn from the Sales Record (from sales that occur in the previous and/or current quarter) with the purpose of updating the cluster definitions and to monitor for an evolving baseline. The Monitoring KS should be designed to comply with the Methodology and to obtain the following information:

- Type of water treatment technology, location and application/use.
- Baseline kitchen regime: to identify the baseline behaviour or pre-project activity water treatment (ie boiling, purification tablets, another type of filter, no treatment). Only households that boil water are eligible to earn emissions reductions.
- Fuel types: to identify the types of fuel that are used to boil water to determine the use of biomass both non-renewable and renewable and alternative fuels.
- Fuel mix for boiling water through the year: to specify different types of fuels used and fractions of total fuel use, noting seasonal variations in the mix, duration of each period, and reasons for variation
- Wood-fuel collection/purchase: time and effort to collect wood-fuel (eg walking distances, people collecting, opportunity cost) or cost of purchase of wood-fuel
- Fuel trends: increasing or decreasing costs of wood-fuel and collection times
- Stove type: to identify the type of stove that is used to boil water
- Household members: number of people living in the household.

Periodic Monitoring Tasks would be undertaken in accordance with the Methodology:

- Non-renewable biomass: Reassessment of X_{nrb} fraction completed every second year
- Leakage: Measurements for potential leakage effects completed every second year
- Usage survey: to assess the usage rates for water treatment units. This should be completed every second year
- Performance Survey: to check whether water treatment units continue to meet the specifications stated by the manufacturer (eg through a mechanism on a water filter that

indicates when the unit must be replaced or other way to confirm the useful life of the product is still in service). If the product meets Standards with a Guaranteed lifetime – this can become an ex-ante factor.

- Baseline Monitoring KT: this *should* be completed if either the KS reveals that baseline parameters have changed, or if the KS is not adequate to update evolving baseline conditions. This *should* be completed at least every second year where necessary.
- New-Stove-KT: to measure fuel consumption to treat one litre of water by boiling where a new stove type is being used as indicated by the Monitoring KS. A Kitchen Test, specifically a BWBT, should be completed