Comprehensive Lowered Emission Assessment and Reporting (CLEAR) Methodology for Cooking Energy Transitions

Developed by the Clean Cooking and Climate Consortium (4C)

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1. INTRODUCTION

This methodology is a comprehensive carbon project methodology specifically designed for crediting emissions reductions from cooking projects. It is applicable for all cooking energy transition scenarios for which the technologies meet the performance applicability criteria noted below.

Background: This methodology originated in response to stakeholder feedback at a side event at the 2022 Clean Cooking Forum focused on field monitoring, responding to a stated need for a new rigorous clean cooking carbon methodology with a harmonized approach, that would increase quality, transparency, and consistency across the clean cooking carbon project ecosystem. It has been developed by the clean cooking sector, for the clean cooking sector, through a process facilitated by the Clean Cooking and Climate Consortium (4C). The methodology was developed in close collaboration with more than 250 key stakeholders including the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, voluntary standards bodies, project proponents, researchers, carbon buyers, and others.

Relevance: This methodology differs from other available cooking methodologies in a number of key ways. It is the first and only methodology to cover all cooking transition scenarios, eliminating the need for multiple methodologies. Moreover, it has been developed as a public good available for use by any standards body or bilateral/multilateral agreement, and is intended to become the standard methodology for cookstove projects under Articles 6.2 and 6.4 of the Paris Agreement, and across the voluntary carbon market, increasing consistency across the clean cooking carbon landscape.

It incorporates the latest science on key parameters, increasing the requirements for substantiating input parameters that make the most difference in estimating emission reductions, and incentivizes direct measurement approaches for determining fuel consumption. For projects with approximately 50,000 or more households, direct measurement for project fuel consumption is required. All other projects are encouraged to choose direct measurement where feasible. At the same time, default values and caps are designed to be sufficiently conservative such that credits substantiated using defaults should be viewed as equally robust as those derived using direct measurement methods. As such, by using this methodology, clean cooking carbon projects will generate the most realistic emission reduction estimates to date and reduce integrity risks.

Approach: The methodology takes a total accounting approach, defining emissions reductions as total project emissions subtracted from total baseline emissions. Both baseline and project emissions must account for fuel consumption, renewability, emissions factors (including where applicable a 6 : 1 wood to charcoal conversion rate), and upstream emissions. Projects are encouraged to have direct measurements conducted by an independent third party.

Project proponents determine their own criteria for what constitutes a user v. non-user (uptake) and must consistently apply those definitions for all project accounting. Uptake caps for non-metered projects are based on whether the project provides after-sales support and educational/behavior change activities.

Project proponents must use a conservative global default value for baseline fuel consumption or measure it via Kitchen Performance Tests (KPTs). These measurements have both geographic caps and thresholds above which values are flagged for more intensive verifier review. Projects must monitor and adjust for potential shifts in baseline technology and fuel mixes over time.

The methodology references the most up-to-date estimations of fraction of non-renewable biomass (fNRB) at the national and subnational level, and disallows the use of the Clean Development Mechanism (CDM) TOOL30, which historically allowed for wide variability in fNRB calculations, and unrealistically high values.

Cookstove performance degradation over time is addressed through the inclusion of each cookstove vintage in fuel efficiency monitoring samples. All projects shall apply a 5% deduction to address certain risks that cannot be feasibly measured at the project level or for which there is insufficient data to support a more granular estimate. These include leakage and the risk of non-permanence, although the latter is also covered to some extent through the fNRB parameter.

The methodology addresses rebound and stacking by incentivizing direct fuel consumption measurements (through KPTs), which capture both, and applying conservative caps for displacing baseline fuel consumption when usage is measured primarily through surveys. Potential Hawthorne effects are addressed through a 10% discount applied to the maximum allowed average fuel savings when fuel consumption is measured through a KPT alone without sensors.

The methodology addresses uncertainty through a combination of conservative defaults and direct measurement and by requiring transparency and justification for all parameter inputs, assumptions, and decisions. This is done by requiring all project parameters utilized to be listed on the Project Information Cover Sheet at the time of project design and updated at the time of each issuance.

The methodology will soon be complemented by a calculator tool that facilitates emission reduction calculations and flags values outside of expected ranges for more intensive verifier review. Sampling guidance for surveys, stove use monitors (SUMs), KPTs, and Controlled Cooking Tests (CCTs); as well as guidance for conducting baseline and project surveys, KPTs, CCTs, and SUMs, are all expected in August 2024.

Once finalized, the methodology will be available via an interactive online platform, to make its application easier and more convenient. A related carbon data platform will provide access to free, reliable, and disaggregated data on key parameters used for estimating emissions reductions, expected in late 2024.

2. DEFINITIONS

Additionality: The project activity goes beyond what would occur due to enforced legal or regulatory requirements and would not have occurred in the absence of the incentives from the carbon credits.

Charcoal: A fuel produced by partially burning wood in a low-oxygen environment. The black substance that results is made up mostly of carbon and has higher energy density than the wood. Charcoal is often produced unsustainably.

Controlled Cooking Test (CCT): A test that measures stove performance in comparison to traditional cooking methods when a cook prepares a pre-determined local meal. It is designed to assess stove performance in a controlled setting using local fuels, pots, and practices.

Displacement: The displacement of baseline cooking technologies and fuels by use of the project cookstove.

Emission factor: The quantity of a pollutant released to the atmosphere relative to an activity associated with the release of that pollutant. Emission factors are usually expressed as the quantity of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant. In the context of cookstove carbon projects, emission factors measure the average mass of carbon dioxide equivalent (CO_2e) released to the atmosphere per energy unit of cooking fuel (e.g., tons per TJ).

Fraction of Non-Renewable Biomass (fNRB): Geographically-specific parameter that estimates the percentage of wood that is harvested beyond the landscape's natural rate of regeneration meaning that the wood is not a carbon neutral fuel.

Fuelwood: Strictly unprocessed solid biomass burned for energy. Does not include charcoal, briquettes, or pellets (see Woodfuel for related terms).

Household: An individual residential unit and all the individuals living together and sharing cooking facilities and energy resources within that dwelling as their usual place of residence.

Kitchen Performance Test (KPT): Field–based procedure to quantify fuel consumption under typical household and stove usage conditions. It involves daily measurements of the amount of fuel used across several days in the user's kitchen.

Leakage: Leakage occurs in carbon crediting programs when there is a net change in anthropogenic GHG emissions that occur outside the project boundary, and which are attributable to the project activity.

Metered cookstove project: Cookstove projects that continuously measure fuel or energy consumption directly on all project cookstoves through data loggers, including for electric cookstoves, liquified petroleum gas (LPG), ethanol, and biogas, or through fuel sales.

Net Calorific Value of fuel: The total quantity of heat released during combustion when all water formed by the combustion reaction remains in the vapor state.

Non-metered cookstove project: Cookstove projects that do not meter all project cookstoves in all households through data loggers or fuel sales.

Non-permanence: The risk that the emission reductions achieved by a project will not persist and may be released into the atmosphere.

Off-grid renewable energy: Renewable energy that is generated independently of the national or regional electrical grid, for example by community- or household-level solar, micro-hydro, or wind installations.

Rebound effect: Increased usage of a product or service resulting from an improvement in its efficiency, potentially negating some or all of the expected emissions reductions. In cookstove carbon projects, this effect could occur if households are able to increase how much they cook with the same amount of fuel after the introduction of a project cookstove. Rebound is also often linked to suppressed demand, where the project cookstove meets previously unmet cooking needs (see Suppressed Demand).

Renewable biomass: A by-product, residue, or waste stream from agriculture, forestry, and related industries that would not be used as a fuel or feedstock in the absence of the project activity, or biomass that originates from plantations that operate sustainably where all project and leakage emissions associated with the biomass cultivation are accounted for.

Stove stacking: Simultaneous use of multiple cooking technologies and/or fuels within a household.

Stove Use Monitor (SUM): Devices that quantify cookstove usage through direct measurements of physical or chemical parameters (temperature, heat flow, light, power, motion, gas concentration, etc.) on cookstoves, kitchen technologies, and cookware, among others.

Suppressed demand: Situation where the level of access to a given good or service is insufficient – due to poverty or lack of access to infrastructure – to meet human development needs. In the context of cookstove carbon projects, accounting for suppressed demand means that the baseline scenario is based on the assumption that households use the amount of cooking fuel necessary to provide for human needs rather than a potentially lower, actual amount of fuel used for cooking.

Third-party entity: An entity that has no affiliation with the project proponent and no financial stake in the project. The independence of the entity may be demonstrated through a signed conflict of interest form in which all conflicts are disclosed (including relational, financial, competitive, and others).

Ton: As used in this methodology, a metric ton (1,000 kilograms).

Upstream emissions: In the context of cookstove carbon projects, upstream emissions represent the GHG emissions associated with the production and processing of cooking fuels. In this methodology, transportation and distribution of cooking fuels are considered negligible.

Uptake: The proportion of project households determined by the project proponent's definition of "active user". This definition must be established in the design phase and be used consistently for all calculations over the course of the crediting period. It must also be quantifiable with surveys or usage monitoring, and direct observation of cookstoves.

User: A household that cooks with the project cookstove at or above a minimum frequency defined by the project proponent.

Usage: The frequency or quantity of cooking with a given technology.

Validation and Verification Body (VVB): An accredited, independent organization that is responsible for auditing emission reductions in greenhouse gas (GHG) emissions mitigation projects to ensure conformity with relevant standards and regulations.

Wood-to-charcoal conversion factor: This factor expresses the amount of wood needed to produce a standard quantity of charcoal, typically expressed as a ratio of the mass of air-dry or oven-dry wood input per mass of charcoal output. This factor is relevant only for projects that use charcoal in the baseline and/or project scenarios. This methodology uses a 6 : 1 conversion factor.

Woodfuel: In keeping with the Unified Wood Energy Terminology by FAO, this document uses the term "woodfuel" to refer to solid fuels derived from trees or shrubs (also known collectively as woody biomass), including fuelwood and charcoal as well as processed fuels like briquettes and pellets made from sawdust or other biomass waste. At times fuelwood and charcoal may be referred to separately to distinguish them from each other and from briquettes and pellets. This distinction is important because briquettes and pellets derived from biomass waste are generally considered sustainable because their consumption does not contribute to forest degradation or deforestation. In contrast, fuelwood and charcoal are often harvested unsustainably.

3. ACRONYMS

4C	Clean Cooking and Climate Consortium
CCT	Controlled Cooking Test
CLEAR	Comprehensive Lowered Emission Assessment and Reporting Methodology for Cooking Energy Transitions
CH_4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
fNRB	Fraction of Non-Renewable Biomass
GHG	Greenhouse Gas
GWP	Global Warming Potential
ISO	International Organization for Standardization
KPT	Kitchen Performance Test
kWh	Kilowatt-hour
LPG	Liquified Petroleum Gas
MJ	Megajoule
N_2O	Nitrous oxide
SDG	Sustainable Development Goal
SUM	Stove Use Monitor
TJ	Terajoule
VVB	Validation and Verification Body

4. APPLICABILITY

This methodology can be applied to nearly all cooking energy transition scenarios implemented at the household level that result in reductions of emissions of relevant Kyoto gasses, namely carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), collectively referred to on a CO_2e basis.

It is applicable for nearly[1] all baseline cooking scenarios, and all cooking intervention project scenarios, both metered and non-metered, with the following caveat: project cookstoves burning wood must achieve 25% thermal efficiency or higher when tested using the International Organization for Standardization (ISO) Standard 19867-1:2018, and project cookstoves burning charcoal must achieve 30% or higher. This methodology is applicable for project activities that would not occur in the absence of revenues from carbon credit sales, which must be demonstrated by following the Additionality section.

[1] The methodology does not consider electricity used in the baseline. It is not applicable for households who primarily use electricity in the baseline scenario, and in cases where baseline electricity is used in moderate amounts, then methods need to be adapted to account for this.

1. There is no restriction on the quantity of households involved or the total emission reductions achieved.

2. Where renewable biomass is used, the project description must document biomass sources, including origin, quantities, and pre-project conditions.

3. Where biomass residues are used, the project must demonstrate that these biomass residues would not have been collected or utilized in the absence of the project but rather dumped and left to decay or burned without energy recovery, and that their use does not involve a decrease in carbon pools.

4. Project cookstoves shall be identified with a unique identifier in order to avoid double counting of emission reductions by other mitigation actions.

5. When the expected technical life of the project cookstoves is shorter than the crediting period defined by the GHG program, the project proponent shall take measures at the end of the technical life to ensure the replacement or retrofitting of the technology with a technology of comparable or better quality and efficiency, or cease to count the household as part of the project.

5. SAFEGUARDS

The project activity shall comply with the corresponding GHG Program safeguarding requirements. Projects using this methodology within bilateral/multilateral agreements shall apply recognized safeguarding requirements, and in the absence of a specific requirement, the Gold Standard Safeguarding Principles & Requirements and its related standards shall be applied.

In addition, the project activity shall comply with the Principles for Responsible Carbon Finance in Clean Cooking, which focus on integrity, transparency, fairness, and sustainability.

6. SUSTAINABLE DEVELOPMENT GOALS

The project activity shall demonstrate contributions to Sustainable Development Goals (SDGs) as indicated by the corresponding GHG Program. Projects using this methodology within bilateral/multilateral agreements shall demonstrate contributions to SDGs according to national requirements of participating countries or by using the Gold Standard SDG Impact Tool[2].

[2] https://globalgoals.goldstandard.org/sdg-impact-tools/

7. PROJECT BOUNDARY

The project boundary corresponds to the physical, geographical sites where project technologies operate including the location from which baseline and project fuels are produced or collected.

Where project devices use electricity, the project boundary includes the electricity generation system and, where applicable, also the transmission and distribution system.

Table 1. Emissions sources included in the project boundary.

Scenario	Source	Gas	Included	Justification
Baseline scenario	Thermal energy generation	CO_2	Yes	Major source of emissions
		CH_4	Yes	Can be significant for some fuels
		N_2O	Yes	Can be significant for some fuels
	Fuel production	CO_2	Yes	Major source of emissions
		CH_4	Yes	Can be significant for some fuels
		N_2O	Yes	Can be significant for some fuels
Project scenario	Thermal energy generation	CO_2	Yes	Major source of emissions
		CH_4	Yes	Can be significant for some fuels
		N_2O	Yes	Can be significant for some fuels
	Fuel production	CO_2	Yes	Major source of emissions
		CH_4	Yes	Can be significant for some fuels
		N_2O	Yes	Can be significant for some fuels
	Electricity generation, transmission and distribution	CO_2	Yes	Major source of emissions
		CH_4	Yes	Can be significant in some cases
		N_2O	Yes	Can be significant in some cases

8. BASELINE SCENARIO

The baseline shall be defined based on the existing baseline technologies and fuel consumption patterns that are being displaced by the project technology.

Step 1: The baseline scenario shall be identified and defined through the application of a baseline survey to the target population and cross-checked with relevant, recent information from credible literature or government sources.

Step 2: The baseline scenario shall be assessed for consistency with government policies and legal requirements that are systematically enforced. Any baseline scenario that does not fulfill legal requirements that are systematically enforced shall be excluded. Any baseline scenario that is not aligned with systematically enforced government policies but instead constrains their outcomes shall be excluded.

Result: The definition of the baseline shall result in one baseline scenario defined in terms of the types of cooking technologies and types of fuels applied as well as the estimated energy use on a per household or per individual basis.

Project proponents shall conduct baseline scenario surveys every two years at the same time as the project uptake and usage survey. The survey is to be conducted in comparable non-project households to detect whether there has been a statistically significant change in household cooking practices (e.g., change in frequency of cooking with the primary baseline fuel detected with a p-value of 0.05 or lower). If so, then project proponents shall update the baseline energy consumption values. If not, the baseline shall be recalculated at the start of each crediting period (every 5 years).

9. ADDITIONALITY

Project activities using this methodology shall demonstrate that the project activity would have not occurred in the absence of the support of revenues from the carbon credit sales, and that the carbon credit revenues enable project implementation.

The demonstration further must list and describe any parallel sources of funding for efficient or clean cooking in the geography of the project activity and explain why they do not apply to the project activity. Or if they do apply, consider them in the demonstration that the project activity would have not occurred in the absence of the support of revenues from the carbon credit sales.

The outcome of the additionality assessment must be cross-checked with a market penetration check. If the project technology shows a market penetration, meaning the percent of households in the target population with a functional technology that is equivalent to the project technology, greater than 20%, then it is considered common practice and is not additional. The quantification of market penetration should not include technology installed as a result of any voluntary carbon crediting activity.

Additionality shall be reassessed at the renewal of the crediting period.

10. QUANTIFICATION OF GHG EMISSION REDUCTIONS

This methodology determines both baseline and project emissions by taking an inventory approach: treating GHG from electricity, renewable fuels, and non-renewable fuels separately.

Electricity can include both grid and off-grid sources. Emissions from grid electricity are country-specific and based on the International Financial Institutions Technical Working Group on GHG Accounting (provided in Annex 2: Grid emission factors for select countries). Emissions from off-grid sources are technology-specific (provided in Annex 3: Off-grid emission factors for select technologies). The off-grid component includes both individual household systems and mini-grids using either single or multiple sources of power.

Renewable fuels include the renewable fraction of fuelwood and charcoal, waste biomass like crop residues and dung, processed biomass like briquettes and pellets from fully renewable sources, bioethanol, biogas, and solar.

Non-renewable fuels refer to the non-renewable fraction of fuelwood and charcoal, as well as fossil fuels such as LPG, coal, and kerosene.

To account for renewable and non-renewable woody biomass, the methodology utilizes fNRB.

For all projects, baseline emissions are calculated as follows:

$$BE_y = \sum_i \left(REC_{base,i} \times \left(REF_{base,i,nonCO2}\right)\right) + \sum_i \left(NREC_{base,i} \times \left(NREF_{base,i,CO2} + NREF_{base,i,nonCO2}\right)\right) + \sum_i Upstream\ emissions_{base,y} \quad (1)$$

Where:

BE_y	=	Baseline emissions during year *y*
$REC_{base,i}$	=	Consumption of renewable fuel *i* in baseline scenario (TJ)
$REF_{base,i,nonCO2}$	=	Non-CO2 emission factor for renewable baseline fuel *i* (tCO_2e/TJ)
$NREC_{base,i}$	=	Consumption of non-renewable fuel *i* in baseline scenario (TJ)
$NREF_{base,i,CO2}$	=	CO2 emission factor for non-renewable baseline fuel *i* (tCO_2e/TJ)
$NREF_{base,i,nonCO2}$	=	Non-CO2 emission factor for non-renewable baseline fuel *i* (tCO_2e/TJ)

$Upstream\ emissions_{base,y}$	=	Upstream emissions in the baseline in year *y* (tCO_2e)

For all projects, this methodology determines project emissions using the following equation, where GHG from electricity, renewable and non-renewable sources of energy are considered separately.

$$PE_y = \sum_i \left(REC_{proj,i} \times \left(REF_{proj,i,nonCO2}\right)\right) + \sum_i \left(NREC_{proj,i} \times \left(NREF_{proj,i,CO2} + NREF_{proj,i,nonCO2}\right)\right) + \sum_i Upstream\ emissions_{proj,y} + PE_{elec,y} \quad (2)$$

Where:

PE_y	=	Project emissions during year *y*
$REC_{proj,i}$	=	Consumption of renewable fuel *i* in project scenario (TJ)
$REF_{proj,i,nonCO2}$	=	Non-CO2 emission factor for renewable project fuel *i* (tCO_2e/TJ)
$NREC_{proj,i}$		Consumption of non-renewable fuel *i* in project scenario (TJ)
$NREF_{proj,i,CO2}$	=	CO2 emission factor for non-renewable project fuel *i* (tCO_2e/TJ)
$NREF_{proj,i,nonCO2}$	=	Non-CO_2 emission factor for non-renewable project fuel *i* (tCO_2e/TJ)
$Upstream\ emissions_{proj,y}$	=	Upstream emissions in the project year *y*
$PE_{elec,y}$	=	Emissions from grid and off-grid electricity used in project scenario in the year *y*

For energy sources other than electricity, use Equation (3) to convert fuel masses to fuel energy.

$$EC_i = FC_i\ x\ NCV_i, \quad (3)$$

Where:

EC_i	=	Energy consumption for fuel *i* (TJ)
FC_i	=	Fuel consumption for fuel *i* (tons)
NCV_i	=	Net calorific value for fuel *i* (TJ/tons) (see Annex 5)

Methodology parameters are calculated differently for metered and non-metered projects, and therefore are presented separately here.

For projects that are estimated to reduce energy consumption by 780 TJ/year or more (e.g., approximately equivalent to saving 50% of fuelwood in 50,000 households)[3], direct measurement for project fuel consumption is required.

10.1. METERED PROJECTS

10.1.1. Baseline Energy Consumption for Metered Projects

Metered projects may choose from two different approaches to determine renewable and non-renewable energy consumption in the baseline scenario: either measuring fuel consumption using a KPT or back-calculating the baseline from project cookstove energy consumption using specific consumption ratios of the baseline and project cookstoves for energy delivered, determined via CCTs.

10.1.1.1. Baseline KPT

This approach involves determining baseline energy consumption through its measurement by an ex-ante KPT of the baseline scenario.

For KPT-based estimates in non-Latin American countries, energy consumption values for primary fuelwood users are capped at 0.0156 TJ/capita/year (1 ton/capita/year of air-dried wood and any additional baseline fuels) and values above 0.0124 TJ/capita/year (0.8 tons/capita/year of air-dried wood and additional baseline fuels) are flagged for more intensive verifier review.

For KPT-based estimates in Latin America, energy consumption values for primary fuelwood users are capped at 0.035 TJ/capita/year (2.25 tons/capita/year of air-dried wood and any additional baseline fuels), and values above 0.023 TJ/capita/year are flagged for more intensive verifier review.

For baselines (in any region) with charcoal as the primary fuel use, the cap is set at 0.0059 TJ/capita/year (0.2 tons/capita/year of charcoal and any additional baseline fuels), and values above 0.0047 TJ/capita/year are flagged for more intensive verifier review.

For renewable energy consumption:

$$REC_{base,i} = N_{h,\Psi,y} \times H_s \times Days_y \times mEC_{base,i} \times (1 - fNRB_y) \quad (4)$$

[3] 0.5 tons of fuelwood/person x 4 persons/household x 50,000 households = 100,000 tons / year. 100,000 tons / year x 0.0156 TJ/tons = 1560 TJ/year. A project which saves 50% on the fuel consumption would result in 780 TJ/year of estimated energy savings.

For non-renewable energy consumption:

$$NREC_{base,i} = N_{h,\Psi,y} \times H_s \times Days_y \times mEC_{base,i} \times fNRB_y \quad (5)$$

In both cases, for baseline energy sources $mEC_{base,i}$ other than electricity, use Equation 3 to convert fuel masses to fuel energy.

Where:

$REC_{base,i}$	=	Consumption of renewable energy for fuel *i* in baseline scenario (TJ)
$NREC_{base,i}$	=	Consumption of non-renewable energy for fuel *i* in baseline scenario (TJ)
$N_{h,\Psi,y}$	=	Number of households with project stove in use in year *y* (number)
H_s	=	Average household size (Persons per household)
$Days_y$	=	Days of the monitoring period during year *y* (Number)
$mEC_{base,i}$	=	Energy consumption of baseline fuel *i* for metered projects (TJ/person/day)
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated.
i	=	Fuel

10.1.1.2. Baseline back-calculation using specific fuel consumption ratios

This approach calculates baseline energy consumption for each technology that is displaced by determining the amount of equivalent energy required for the baseline technology(ies) to provide the same level of service as the project technology according to its metered energy consumption. This estimation is done using specific fuel consumption ratios, derived from CCTs of the baseline and project technologies. When multiple devices/fuels are used by the end user in the same premises, the proportional use shall be established from surveys or stove use monitoring, or following an approach that leads to conservative baseline emissions estimation. For example, if baseline cookstove use is estimated at 50% use of a three-stone fire, 10% use of a charcoal cookstove, and 40% use of an LPG cookstove, then the displacement of those technologies with the project technologies should be apportioned proportionately.

For back calculated estimates in non-Latin American countries, energy consumption values for primary fuelwood users are capped at 0.0156

TJ/capita/year (1 ton/capita/year of air-dried wood and any additional baseline fuels) and values above 0.0124 TJ/capita/year (0.8 tons/capita/year of air-dried wood and additional baseline fuels) are flagged for more intensive verifier review.

For back-calculated estimates in Latin America, energy consumption values for primary fuelwood users are capped at 0.035 TJ/capita/year (2.25 tons/capita/year of air-dried wood and any additional baseline fuels), and values above 0.023 TJ/capita/year are flagged for more intensive verifier review.

For baselines (in any region) with charcoal as the primary fuel use, the cap is set at 0.0059 TJ/capita/year (0.2 tons/capita/year of charcoal and any additional baseline fuels), and values above 0.0047 TJ/capita/year are flagged for more intensive verifier review.

For renewable energy consumption:

$$REC_{d-base,i} = N_{h,\Psi,y} \times H_s \times mEC_{proj,i} \times fC_{b,i} \times \left(1 - fNRB_y\right) \times \left(\frac{SC_{b,i}}{SC_{p,i,y}}\right) \qquad (6)$$

For non-renewable energy consumption:

$$NREC_{d-base,i} = N_{h,\Psi,y} \times H_s \times mEC_{proj,i} \times fCb,i \times fNRB_y \times \left(\frac{SC_{b,i}}{SC_{p,i,y}}\right) \qquad (7)$$

In both cases, for metered project energy sources other than electricity, use Equation (3) to convert fuel masses to fuel energy.

Where:

$REC_{d-base,i}$	=	Displaced consumption of renewable fuel *i* in baseline scenario (TJ)
$NREC_{d-base,i}$	=	Displaced consumption of non- renewable fuel *i* in baseline scenario (TJ)
$N_{h,\Psi,y}$	=	Number of households with project stove in use in year *y* (number)
H_s	=	Average household size (Persons per household)
$mEC_{proj,i}$	=	Energy consumption of project fuel *i* for metered projects (TJ/person/year)
$fC_{b,i}$	=	Proportion of cooking conducted on baseline technology *i*. (percentage).
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for

		fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated.
$SC_{b,i}$	=	Specific energy consumption of a baseline cooking technology *i* to cook a given amount of food (MJ/kg food)
$SC_{p,i,y}$	=	Specific energy consumption of a project cooking technology *i* to cook a given amount of food (MJ/kg food)
NCV_i	=	Net calorific value of fuel *i* (TJ/tons)

10.1.2. Project Energy Consumption for Metered Projects

There are two options for calculating energy consumption in the project scenario for metered projects: estimating energy consumption of all cookstoves in use during the project scenario using metered data and the KPT, and direct measurement of only the project technology energy consumption, through data loggers and/or sales data.

10.1.2.1. Project KPT

This approach for determining renewable and non-renewable energy consumption in the project scenario requires (a) metering energy for the project cookstove and (b) quantifying the energy consumption of other non-project technologies based on a KPT.

If the baseline was calculated using a KPT, this approach must be used for calculating project energy consumption.

For the full project scenario, including metered project stove and KPT data for other stoves:

$$REC_{proj,i} = \Psi_{metered,y} \times N_{h,y} \times H_s \times Days_y \times \left(1 - fNRB_y\right)\left(mEC_{proj,i} + ECproj,i\right) \qquad (8)$$

and:

$$NREC_{proj,i} = \Psi_{metered,y} \times N_{h,y} \times H_s \times Days_y \times \left(fNRB_y\right)\left(mEC_{proj,i} + ECproj,i\right) \qquad (9)$$

In both cases, for metered project energy sources $mEC_{proj,i}$ other than electricity, apply Equation (3) to convert fuel masses to fuel energy.

For determining energy consumption from electric technologies apply Equations (13) and (14).

Where:

$REC_{proj,i}$	=	Consumption of renewable fuel *i* in project scenario (TJ)
$NREC_{proj,i}$	=	Consumption of non-renewable fuel *i* in project scenario (TJ)
$\Psi_{metered,y}$	=	Uptake: fraction of households with a project cookstove in use during year *y*, estimated from metered data
N_h	=	Number of households in project in year *y* (Number)
H_s	=	Average household size (Persons per household)
$Days_y$	=	Days of the monitoring period during year *y* (Number)
$mEC_{proj,i}$	=	Energy consumption of project fuel *i* for metered projects (TJ/person/day)
$EC_{proj,i}$	=	Energy consumption of fuels used in the project scenario *i* (TJ/person/day)
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated.

10.1.2.2. Direct, metered measurement of energy consumption of project technology

The metered renewable and non-renewable energy consumption in the project scenario is determined by metering energy for the project technology.

If the baseline energy consumption is estimated by back-calculating the displaced baseline fuel consumption based on specific consumption and displacement rates, then this approach must be used for calculating project energy consumption. Other, non-project cookstoves that may be in use in the project scenario are not included here, as the baseline fuel consumption only includes that which is displaced by the project cookstove.

For the metered project cookstove:

$$REC_{proj,i} = \Psi_{metered,y} \times N_h \times H_s \times Days_y \times mEC_{proj,i} \times \left(1 - fNRB_y\right) \quad (10)$$

and:

$$NREC_{proj,i} = \Psi_{metered,y} \times N_h \times H_s \times Days_y \times mEC_{proj,i} \times fNRB_y \qquad (11)$$

In both cases, for energy sources other than electricity, use Equation (3) to convert fuel masses to fuel energy.

Where:

$REC_{proj,i}$	=	Consumption of renewable fuel *i* in project scenario (TJ)
$NREC_{proj,i}$	=	Consumption of non-renewable fuel *i* in project scenario (TJ)
$\Psi_{metered,y}$	=	Uptake: fraction of households with a project cookstove in use during year *y*, estimated from metered data
N_h	=	Number of households (Number)
H_s	=	Average household size (Persons per household)
$Days_y$	=	Days of the monitoring period during year *y* (Number)
$mEC_{proj,i}$	=	Energy consumption of project fuel *i* for metered projects (TJ/person/day)
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated..

Note on electricity consumption:
If the project cookstove uses electricity, coming from either the national grid $(EC_{projgrid})$ or an off-grid system(s) $(EC_{proj,offgrid})$ using renewable or non-renewable energy sources, its consumption must be calculated using Equation (12), and either Equation (13) or Equation (14).

$$PE_{elec,y} = 10^{-6}[(EC_{proj,grid,y} \times EF_{proj,grid} \times (1 + TDL_y)) + (EC_{proj,offgrid,y} \times \sum_i f_i \times EF_{proj,offgrid,i})] \qquad (12)$$

Where:

$PE_{elec,y}$	=	CO_2e emissions from electric energy consumption in year *y* (tons/year)
$EC_{proj,grid,y}$	=	Grid electricity consumption for cooking (measured in kWh/year)
$EF_{proj,grid}$	=	Grid emission factor. This is a country-specific value provided in Annex 2: Grid emission factors for select countries (gCO_2e/kWh)

$EC_{proj,offgrid,y}$	=	Off-grid electricity consumption for cooking (measured in kWh/year)
f_i	=	Fraction of off-grid electricity provided by source *i*
$EF_{proj,offgrid,i}$	=	Off-grid emission factor for source *i*. This is a technology-specific value provided in Annex 3: Off-grid emission factors for select technologies (gCO_2e/kWh)
TDL_y	=	Average technical transmission and distribution losses for providing electricity in year *y*
10^{-6}		Unit conversion for grams CO_2e to tons CO_2e (tons/grams)

Electricity consumption can be either measured, using calibrated equipment like a plug-in power meter, from all project electric cookstoves (j) (Equation (13)), or using a representative sample of project cookstoves and determining the active cookstove number (Equation (14)).

$$EC_{proj,grid,y} \text{ or } EC_{proj,offgrid,y} = \sum_j EC_{proj,grid,j,y} \text{ or } \sum_j EC_{proj,offgrid,j,y} \tag{13}$$

Where:

j	=	Subscript for project electric cookstoves

$$EC_{proj,grid,y} \text{ or } EC_{proj,offgrid,y} = EC_{proj,grid,avg,y} \times N_{h,\Psi,y} \text{ or } EC_{proj,offgrid,avg,y} \times N_{h,\Psi,y} \tag{14}$$

Where:

$EC_{proj,grid,avg,y}$	=	Average grid electricity consumed for cooking in year *y*
$EC_{proj,offgrid,avg,y}$	=	Average off-grid electricity consumed for cooking in year *y*
$N_{h,\Psi,y}$	=	Number of households with project stove in use in year *y* (number)

10.2. NON-METERED PROJECTS

10.2.1. Baseline Energy Consumption for Non-Metered Projects

Non-metered projects may choose from two different approaches to determine energy consumption (both renewable and non-renewable) in the baseline scenario: measuring fuel consumption using a KPT or using a global default.

10.2.1.1. KPT

Projects may determine non-metered renewable and non-renewable fuel consumption by conducting an ex-ante KPT of the baseline scenario.

For KPT-based estimates in non-Latin American countries, energy consumption values for primary fuelwood users are capped at 0.0156 TJ/capita/year (1 ton/capita/year of air-dried wood and any additional baseline fuels) and values above 0.0124 TJ/capita/year (0.8 tons/capita/year of air-dried wood and additional baseline fuels) are flagged for more intensive verifier review.

For KPT-based estimates in Latin America, energy consumption values for primary fuelwood users are capped at 0.035 TJ/capita/year (2.25 tons/capita/year of air-dried wood and any additional baseline fuels), and values above 0.023 TJ/capita/year are flagged for more intensive verifier review.

For baselines (in any region) with charcoal as the primary fuel use, the cap is set at 0.0059 TJ/capita/year (0.2 tons/capita/year of charcoal and any additional baseline fuels), and values above 0.0047 TJ/capita/year are flagged for more intensive verifier review.

$$REC_{base,i} = N_{h,\Psi,y} \times H_s \times Days_{,y} \times nmEC_{base,i} \times \left(1 - fNRB_y\right) \quad (15)$$

and:

$$NREC_{base,i} = N_{h,\Psi,y} \times H_s \times Days_y \times nmEC_{base,i} \times fNRB_y \quad (16)$$

In both cases, for baseline energy sources other than electricity, use Equation (3) to convert fuel masses to fuel energy.

$REC_{base,i}$	=	Consumption of renewable fuel *i* in baseline scenario (TJ)
$NREC_{base,i}$	=	Consumption of non-renewable fuel *i* in baseline scenario (TJ)
$N_{h,\Psi,y}$	=	Number of households with project stove in use in year *y* (number)

H_s	=	Average household size (Persons per household)
$Days_y$	=	Days of the monitoring period during year *y* (Number)
$nmEC_{base,i}$	=	Energy consumption of baseline fuel *i* for non-metered projects (TJ/person/day)
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated..

10.2.1.2. Global default

Alternatively, projects may determine non-metered renewable and non-renewable energy consumption in the baseline scenario by using a global default for fuelwood or charcoal consumption. These defaults can only be applied for projects where the baseline is predominantly wood or charcoal (more than 75% of the cooking as determined via surveys).

The global default for baseline fuelwood consumption is 0.0012 TJ delivered/capita/year[4] (0.5 tons/capita/year of air-dried wood), and 0.00075 TJ/delivered/capita/year[5] (0.1 tons/capita/year) for charcoal. When fuels other than wood or charcoal are in the respective baselines, their energy use must be accounted for in the 0.0012 and 0.00075 TJ delivered/capita/year, respectively.[6] These values reflect the minimum level of energy services required for cooking.

10.2.2. Project Energy Consumption for Non-Metered Projects.

For projects that are not directly and continuously metered, the methodology considers adoption as a function of uptake and usage rates, and addresses stacking through conservative assumptions of baseline cookstove displacement, or through the use of KTPs.

Uptake is whether a project household is considered a user or non-user. Project proponents determine their own criteria for what constitutes a user v. non-user, and they must consistently use those categories as they have defined them for all project accounting, and the assessment of the criteria must be done using survey questions or usage monitoring, and project

[4] 0.5 tons of air-dried fuel wood with 0.0156 TJ/tons NCV, and thermal efficiency of 15%.

[5] 0.1 tons of charcoal fuel wood with 29.5 TJ/tons NCV, and thermal efficiency of 25%.

[6] The additional energy is accounted for assuming 15% thermal efficiency for unimproved baseline wood cookstoves, 25% thermal efficiency for unimproved charcoal cookstoves, and 50% for gas and liquid fueled cookstoves. For example, if surveys indicate in the baseline that 80% of cooking is done on wood cookstoves and 20% on LPG cookstoves, then the baseline energy consumption would be as follows: Wood consumption: 0.8*0.0012 TJ delivered/capita/year / 0.15 = 0.0091 TJ/cap/year of wood energy; LPG 0.2*0.0012 TJ delivered/capita/year / 0.50 = 0.00048 TJ/cap/year of LPG energy.

cookstove observation. Further, uptake is capped at 90% for projects that incorporate after-sales support and educational/behavior change activities and at 75% for all other projects.

Non-metered projects may choose from four different approaches to determine energy consumption in the project scenario, which include assessing usage and displacement rates. These approaches involve various combinations of surveys, CCTs, usage sensors, and KPTs. For projects that are estimated to reduce energy consumption by 780 TJ/year or more (e.g., approximately equivalent to saving 50% of fuelwood in 50,000 households)[7], direct measurement for project fuel consumption is required.

10.2.2.1. KPT

Two of the approaches to calculating non-metered renewable and non-renewable energy consumption in the project scenario rely on estimates from KPTs.

Where projects measure fuel consumption through KPTs, complemented by usage surveys, maximum average fuel savings are capped at 90% of the KPT estimate.

Projects may also complement KPTs and surveys with SUMs measurements. If the SUMs demonstrate continued use of the project cookstove, or if continued average daily household fuel consumption is demonstrated through longer-term fuel consumption measurements (6-months or more) following the KPT period, maximum average fuel savings are not capped. If the use events on the project stove or fuel consumption per day show a statistically significant shift down during the post-KPT SUMs monitoring period ($p < 0.05$ using a one-way or one-tailed test of significance), then the project stove fuel consumption estimate must be adjusted such that the fuel savings is 90% of that indicated by the KPT (see *Stove Use Monitoring* in Section 11: *Monitoring Requirements*).

These approaches involve determining non-metered renewable and non-renewable project fuel consumption through a representative sample with direct measurements of fuel using KPT following the below equations.

$$REC_{proj,i} = \Psi_{Survey,y} \times N_h \times H_s \times Days_y \times nmEC_{proj,i} \times \left(1 - fNRB_y\right) \qquad (17)$$

and:

[7] 0.5 tons of fuelwood/person x 4 persons/household x 50,000 households = 100,000 tons/year. 100,000 tons / year x 0.0156 TJ/tons = 1560 TJ/year. A project which saves 50% on the fuel consumption would result in 780 TJ/year of estimated energy savings.

$$NREC_{proj,i} = \Psi_{Survey,y} \times N_h \times H_s \times Days_y \times nmEC_{proj,i} \times fNRB_y \quad (18)$$

In both cases, for energy sources other than electricity, use Equation (3) to convert fuel masses to fuel energy.

Note on electricity consumption:

Electricity consumption should be determined using a plug-in power meter during the KPT and calculated as follows.

$$EC_{proj,elec,y} = \Psi_{Survey,y} \times N_h \times H_s \times Days_y \times nmEC_{proj,elec} \quad (19)$$

Where:

$REC_{proj,i}$	=	Consumption of renewable fuel *i* in project scenario (TJ)
$NREC_{proj,i}$	=	Consumption of non-renewable fuel *i* in project scenario (TJ)
$\Psi_{Survey,y}$	=	Uptake of project cookstoves during year *y* taken from survey (Percentage)
N_h	=	Number of households (Number)
H_s	=	Average household size (Persons per household)
$Days_y$	=	Days of the monitoring period during year *y* (Number)
$nmEC_{proj,i}$	=	Energy consumption of project fuel *i* for non-metered projects (TJ/person/day)
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated..
i	=	Fuel
$nmEC_{proj,elect}$	=	Electricity consumption in project (kWh/person/year)
NCV_i	=	Net calorific value of fuel *i* (TJ/tons)
$EC_{proj,elec,y}$	=	Consumption of electricity in project scenario (TJ)

In the specific case of non-metered electricity use in the project scenario, project emissions must be calculated taking into account the average electricity consumption measured by the KPT including the use of a plug-in power meter and its corresponding emission factor.

$$PE_{elec,y} = EC_{proj,elect,y} \times EF_{proj,elect} \times (1 + TDL_y) \times 10^{-6} \quad (20)$$

$PE_{elec,y}$	=	CO_2e emissions from non-metered electric technologies in the project scenario (tons CO_2e).
$EC_{proj,elect,y}$	=	Electricity consumption for cooking (kWh/year)
$EF_{proj,elect}$	=	Electricity system emission factor ((gCO_2e/kWh))

TDL_y	=	Average technical transmission and distribution losses for providing electricity in year *y* (expressed as a fraction between zero and one).
10^{-6}		Converts from grams CO_2e to tons CO_2e

Depending on the electricity source $EF_{proj,elect}$ should be determined for the grid system ($EF_{proj,grid}$) or off-grid system(s) ($EF_{proj,offgrid}$).

10.2.2.2. Specific consumption ratios + usage survey based options

The methodology includes two approaches to calculating non-metered renewable and non-renewable energy consumption in the project scenario by using specific consumption ratios from CCTs, and comparing the CCT-determined specific consumption ratio of the baseline and project scenarios to estimate project cookstove fuel consumption.

Where projects use the CCT to estimate project cookstove fuel consumption, and base usage rates on surveys alone, the average baseline cookstove displacement is capped at 40%.

Projects may also use the CCT to estimate project cookstove fuel consumption, and base usage on surveys plus SUMs on the project cookstove in a representative sample of households. If the SUMs demonstrate at least two cooking events per day of at least 20 minutes each, baseline cookstove displacement is capped at 60%. If not, baseline cookstove displacement is capped at 40%.

$$REC_{proj,i} = \Psi_{survey,y} \times \left(1 - U_{p,y,i}\right) \times N_h \times H_s \times nmEC_{base,i} \times \left(1 - fNRB_y\right) \times \left(\frac{SC_{p,i,y}}{SC_{b,i,y}}\right) \qquad (21)$$

and:

$$NREC_{proj,i} = \Psi_{survey,y} \times (1 - U_{p,y,i}) \times N_h \times H_s \times nmEC_{base,i} \times fNRB_y \times \left(\frac{SC_{p,i,y}}{SC_{b,i,y}}\right) \qquad (22)$$

In both cases, for baseline energy sources $nmEC_{base,i}$, other than electricity, use Equation (3) to convert fuel masses to fuel energy.

Where:

$REC_{proj,i}$	=	Consumption of renewable fuel *i* in project scenario (TJ)
$NREC_{proj,i}$	=	Consumption of non-renewable fuel *i* in project scenario (TJ)
$\Psi_{Survey,y}$	=	Uptake of project cookstoves during year *y* taken from survey. (Percentage)
$U_{p,y,i}$		Usage rate of active project cookstoves during year *y*. (Percentage) determined by surveys. The maximum displacement of the baseline stove(s) is 40% (sum of $U_{p,y,i}$ across displaced baseline stoves is 0.4) when surveys are used to determine percent usage. If SUMs monitoring demonstrates two or more usage events per day of at least 20 minutes each, baseline cookstove displacement is capped at 60% (sum of $U_{p,y,i}$ across displaced baseline stoves is 0.6)
N_h	=	Number of households (Number)
H_s	=	Average household size (Persons per household)
$nmEC_{base,i}$		Energy consumption of baseline fuel *i* for non-metered projects (TJ/person/year)
$fNRB_y$	=	Fraction of non-renewable woody biomass fuel consumed during year *y*. This parameter is only applicable for fuelwood, charcoal, and other solid biomass fuels that are not fully renewable. When these fuels are not used this parameter is eliminated.
$SC_{b,i,y}$	=	Specific energy consumption of a baseline cooking technology to cook a given amount of food (MJ/kg food)
$SC_{p,i,y}$	=	Specific energy consumption of a project cooking technology to cook a given amount of food (MJ/kg food)

10.3. UPSTREAM EMISSIONS

Upstream emissions ($Upstream\ emissions_y$) in both the baseline and project scenarios are calculated as follows:

$$Upstream\ emissions_{i,y} = EC_{i,y} \times EF_{i,upstream} \quad (23)$$

Where:

EC_i	=	Energy consumption for a fuel *i* in the project or baseline scenario in year *y* (TJ/year)
$EF_{i,upstream}$	=	Upstream emission factor for fuel *i* (tCO_2/TJ)

Upstream emissions from electricity generation are included in the grid/off-grid emission factors which are presented in Annexes 2 and 3.

10.4. LEAKAGE (LE)

All projects shall apply a 5% deduction to address certain risks that cannot be feasibly measured at the project level or for which there is insufficient data to support a more granular estimate. These include leakage and the risk of non-permanence, although the latter is also covered to some extent through the fNRB parameter.

10.5. EMISSIONS REDUCTIONS (ER)

$$ER = (BE_y - PE_y)(1 - LE_y) \quad (27)$$

Where:

ER_y	=	Emissions reduction during year *y* ($tonCO_2e$)
BE_y	=	Baseline emissions during year *y* ($tonCO_2e$)
PE_y	=	Project emissions during year *y* ($tonCO_2e$)
LE_y	=	Leakage emissions during year *y* (Percentage)

11. MONITORING REQUIREMENTS

Monitoring activity schedule

Activity	Prior to validation	Prior to first verification	Annual	Every two years
Emission reduction estimation	X			
Baseline studies				
Baseline scenario survey **See Evolving Baseline section below*	X			X*
Baseline energy consumption measurement **Only required when a shift in baseline technology use patterns has been observed* *** May be continuous in the case of metered projects*		X		X*,**
Project studies				
Uptake and usage monitoring (survey or SUMs) * May be continuous in the case of metered projects			X*	
Project energy consumption measurement *May be continuous in the case of metered projects		X		X*
Ongoing monitoring tasks				
Maintenance of total sales and service records, and project databases	Continuous			

Evolving baselines

- Project proponents shall conduct baseline scenario surveys every two years at the same time as the project uptake and usage survey. The survey is to be conducted in comparable non-project households to detect whether there has been a statistically significant change in household cooking practices (e.g., change in frequency of cooking with the primary baseline fuel detected with a p-value of 0.05 or lower).

- If so, then project proponents shall update the baseline energy consumption values. If not, the baseline shall be recalculated at the start of each crediting period (every 5 years).

Seasonality

- Project proponents shall provide a description of seasonality at the project location(s) (e.g., wet/dry, cold/warm, temporality during the year, etc.) and the observed impacts on cooking practices and cooking energy use.
- Projects shall demonstrate that sampling is done to account for seasonality in such a way that it captures seasonal factors that may affect fuel consumption over the year, or
- Projects shall demonstrate that sampling is done in a way that ensures that the results are conservative, given seasonal variability (e.g., undertake measurement in the season where the least emissions reductions are expected).

Stove Use Monitoring

- This methodology considers SUMs to include sensors that use continuous monitoring of temperature, infrared light, fuel consumption, or other metric that can be used as a proxy for usage.
- Stove use monitoring must be done continuously for at least six months per monitoring period to account for seasonality.
- The algorithm for estimating cookstove use events must be clearly presented and public, along with at least 50 anonymized real-time data streams showing the raw cookstove use data (e.g., real-time temperature traces over time) with clearly demarcated usage events.
- The same algorithm must be used for the duration of the project.
- Sampling must meet the 90/10 precision guidelines.
- For non-metered projects using the KPT and stove use monitoring (see Section 10.2.2.1 KPT), the average of the stove use events per day during the full 6-month monitoring period must be compared to those measured during the KPT to determine if there is a statistically significant difference. If SUMs data is incomplete or missing, it must be omitted from the analysis.

12. METHODOLOGY PARAMETERS

When the project proponents apply for crediting period renewal, all methodological parameters shall be reassessed as per the latest version of the methodology available at the time of renewal.

Parameters are presented in alphabetical order, in separate sections for ex-ante and monitored parameters.

12.1. Ex-ante parameters

Data/Parameter	$EF_{i,upstream}$	
Unit	tCO_2e/TJ	
Description	Upstream emission factor for fuel *i* in baseline/project scenario	
Type of parameter	X	Ex-ante
		Monitored
Source of data	See Annex 4	
Value applied	See Annex 4	
Frequency of monitoring	N/A	
Description of measurement methods	N/A	
QA/QC procedures		
Purpose of data	Calculation of upstream emissions in baseline and project scenarios	
Comments	Upstream emissions for fuelwood are considered as zero	

Data/Parameter	$EF_{proj,grid}$	
Unit	gCO_2e/kWh	
Description	Grid emission factor	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Country-specific values from the International Financial Institution’s Technical Working Group	
Value applied	See Annex 2	
Frequency of monitoring	N/A	

Description of measurement methods	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of project emissions
Comments	-

Data/Parameter	$EF_{proj,offgrid,i}$	
Unit	gCO_2e/kWh	
Description	Off-grid emission factor for source *i*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Mini-grid Emission Tool from SEforAll	
Value applied	See Annex 3	
Frequency of monitoring	N/A	
Description of measurement methods	N/A	
QA/QC procedures	N/A	
Purpose of data	Calculation of baseline and project emissions	
Comments	-	

Data/Parameter	$fNRB_y$	
Unit	Fraction	
Description	Fraction of non-renewable woody biomass fuel during year *y*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	National or sub-national default values from the UNFCCC-supported MoFuSS model. Sub-national values are appropriate for projects concentrated in specific regions. National values are appropriate for projects that are evenly spread throughout a country; or Customized project area (not aligned with national or subnational boundaries) using online MoFuSS interface.	
Value applied		

Frequency of monitoring	Determined once ex-ante
Description of measurement methods	
QA/QC procedures	
Purpose of data	Calculation of baseline and project emissions
Comments	This parameter is only considered when woody biomass is used in either baseline or project scenario. Updated at crediting period renewal

Data/Parameter	H_s	
Unit	Persons/household	
Description	Average household size	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Survey	
Value applied	-	
Frequency of monitoring	N/A	
Description of measurement methods	Baseline survey	
QA/QC procedures	The minimum sample size for the survey must reach the minimum confidence and precision of 90/10. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value.	
Purpose of data	Calculation of baseline and project emissions	
Comments	-	

Data/Parameter	NCV_i	
Unit	TJ/tons	
Description	Net calorific value of fuel *i*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories	
Value applied	See Annex 5 "Default point of use emission factors and net calorific values"	

Frequency of monitoring	N/A
Description of measurement methods	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of baseline and project emissions
Comments	Not applicable for electricity as energy source in baseline or project scenario

Data/Parameter	$NREF_{base,i,CO2}$
Unit	tCO_2e/TJ
Description	CO_2 emission factor for non-renewable baseline fuel *i*
Type of parameter	X Ex-ante
	Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories
Value applied	See Annex 5 “Default point of use emission factors and net calorific values”
Frequency of monitoring	N/A
Description of measurement methods	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Comments	-

Data/Parameter	$NREF_{base,i,nonCO2}$
Unit	tCO_2e/TJ
Description	Non-CO_2 emission factor for non-renewable baseline fuel *i*
Type of parameter	X Ex-ante
	Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories
Value applied	See Annex 5 “Default point of use emission factors and net calorific values”
Frequency of monitoring	N/A

Description of measurement methods	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emissions
Comments	-

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Data/Parameter	$NREF_{proj,i,CO2}$	
Unit	tCO_2e/TJ	
Description	CO_2 emission factor for non-renewable project fuel *i*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories	
Value applied	See Annex 5 “Default point of use emission factors and net calorific values”	
Frequency of monitoring	N/A	
Description of measurement methods	N/A	
QA/QC procedures		
Purpose of data	Calculation of project emissions	
Comments	-	

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Data/Parameter	$NREF_{proj,i,nonCO2}$	
Unit	tCO_2e/TJ	
Description	Non-CO_2 emission factor for non-renewable project fuel *i*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories	
Value applied	See Annex 5 “Default point of use emission factors and net calorific values”	
Frequency of monitoring	N/A	
Description of measurement methods	N/A	

QA/QC procedures	
Purpose of data	Calculation of project emissions
Comments	-

Data/Parameter	$REF_{base,i,nonCO2}$	
Unit	tCO_2e/TJ	
Description	Non-CO_2 emission factor for renewable baseline fuel *i*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories	
Value applied	See Annex 5 “Default point of use emission factors and net calorific values”	
Frequency of monitoring	N/A	
Description of measurement methods	N/A	
QA/QC procedures	N/A	
Purpose of data	Calculation of baseline emissions	
Comments		

Data/Parameter	$REF_{proj,i,nonCO2}$	
Unit	tCO_2e/TJ	
Description	Non-CO_2 emission factor for renewable project fuel *i*	
Type of parameter	X	Ex-ante
		Monitored
Source of data	Default value from the latest version of the IPCC Guidelines for National GHG Inventories	
Value applied	See Annex 5 “Default point of use emission factors and net calorific values”	
Frequency of monitoring	N/A	
Description of measurement methods	N/A	
QA/QC procedures	N/A	
Purpose of data	Calculation of project emissions	
Comments		

Data/Parameter	TDL_y
Unit	Fraction
Description	Average technical transmission and distribution losses for providing electricity in year *y*
Type of parameter	X Ex-ante
	Monitored
Source of data	Determined using the latest version of CDM TOOL05
Value applied	-
Frequency of monitoring	Once per monitoring period
Description of measurement methods	N/A
QA/QC procedures	N/A
Purpose of data	Calculation project emissions
Comments	-

12.2. Monitored parameters

Data/Parameter	$Days_y$
Unit	Number
Description	Days project technology in households period during year *y*
Type of parameter	Ex-ante
	X Monitored
Source of data	Project database
Value applied	-
Frequency of monitoring	Annually
Description of measurement methods	-
QA/QC procedures	-
Purpose of data	Calculation of baseline and project emissions
Comments	-

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Data/Parameter	$EC_{proj,elect,y}$
Unit	kWh/year
Description	Electricity consumption for cooking (kWh/year)
Type of parameter	Ex-ante X Monitored
Source of data	KPT during project scenario
Value applied	Result from KPT
Frequency of monitoring	Every two years during project fuel consumption test
Description of measurement methods	A representative sample with built-in or external data loggers may be used during kitchen performance testing, where they conform with industry standards and are calibrated according to relevant national requirements.
QA/QC procedures	When a sample of project devices is used, the sampling approach must achieve a confidence level and precision of at least 90/10. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculation of project emissions
Comments	Projects in which built-in monitors are not included on every device shall ensure that project households receiving monitored devices are randomly distributed among the overall target population.

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Data/Parameter	$EC_{proj,grid,avg,y}$
Unit	kWh/year
Description	Average grid electricity consumed for cooking in year y
Type of parameter	Ex-ante X Monitored
Source of data	Metered electricity consumption logger or meter
Value applied	Result from metering or logging
Frequency of monitoring	Measured continuously or during project fuel consumption test
Description of measurement methods	Measured continuously on all project devices Or

	A representative sample with built-in or external data loggers may be used, where they conform with industry standards and are calibrated according to relevant national requirements.
QA/QC procedures	When a sample of project devices is used, the sampling approach must achieve a confidence level and precision of at least 90/10. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculation of project emissions
Comments	Projects in which built-in monitors are not included on every device shall ensure that project households receiving monitored devices are randomly distributed among the overall target population.

Data/Parameter	$EC_{proj,i}$	
Unit	TJ/person/year	
Description	Energy consumption of fuels used in the project scenario *i* (TJ/person/day)	
Type of parameter		Ex-ante
	X	Monitored
Source of data	KPT during project scenario	
Value applied	Result from KPT	
Frequency of monitoring	Every two years	
Description of measurement methods	Representative sample using a KPT	
QA/QC procedures	The study must achieve confidence and precision of at least 90/10 for the target parameter of average daily fuel consumption per person. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.	
Purpose of data	Calculate project emissions	
Comments		

Data/Parameter	$EC_{proj,offgrid,avg,y}$	
Unit	kWh/year	
Description	Average grid electricity consumed for cooking in year *y*	
Type of parameter		Ex-ante
	X	Monitored
Source of data	Metered electricity consumption logger or meter	
Value applied	Result from metering or logging	
Frequency of monitoring	Measured continuously or during project fuel consumption test	
Description of measurement methods	Measured continuously on all project devices Or A representative sample with built-in or external data loggers may be used, where they conform with industry standards and are calibrated according to relevant national requirements.	
QA/QC procedures	When a sample of project devices is used, the sampling approach must achieve a confidence level and precision of at least 90/10. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.	
Purpose of data	Calculation of project emissions	
Comments	Projects in which built-in monitors are not included on every device shall ensure that project households receiving monitored devices are randomly distributed among the overall target population.	

Data/Parameter	$fC_{b,i}$	
Unit	Percentage	
Description	Proportion of cooking conducted on baseline technology *i*	
Type of parameter		Ex-ante
	X	Monitored
Source of data	Project uptake and usage survey	
Value applied	Survey results	
Frequency of monitoring	Annual	

Description of measurement methods	Survey questions on stove usage The survey must ask to identify all the cooking devices present in the household. Then, for the project cookstove and each other cooking device present in the household, ask "How many times did you cook using [cooking device] yesterday?" to determine the number of usage events per day per device.
QA/QC procedures	The minimum sample size for the survey must be determined to achieve 90/10 confidence precision for the average number of cooking events per day per household.
Purpose of data	Estimate the displacement of the baseline stove(s)
Comments	

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Data/Parameter	f_i
Unit	
Description	Fraction of off-grid electricity provided by source *i*
Type of parameter	Ex-ante
	X Monitored
Source of data	Project uptake and usage survey
Value applied	Survey results
Frequency of monitoring	Annual
Description of measurement methods	Survey questions on electricity generation, which asks what proportion of electricity is provided by off-grid sources in comparison to on grid sources.
QA/QC procedures	The minimum sample size for the survey must be determined to achieve 90/10 confidence precision for the average number of cooking events per day per household.
Purpose of data	Apportioning fraction of electricity use for off and on grid emission factors.
Comments	

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Data/Parameter	$mEC_{base.i}$
Unit	TJ/person/year
Description	Energy consumption of baseline fuel *i* for metered projects
Type of parameter	Ex-ante
	X Monitored
Source of data	KPT or back-calculate the baseline from project cookstove energy consumption

Value applied	-
Frequency of monitoring	KPT: At baseline and if/when significant changes are determined in the baseline fuel mix of the project area. Back-calculation: Continuous
Description of measurement methods	Projects that choose the KPT approach to determine fuel consumption in the baseline scenario must collect data from a representative sample of households and follow the KPT protocol. Projects that choose to back-calculate the baseline, must calculate baseline energy consumption for each technology that is displaced by determining the amount of equivalent energy required for the baseline technology(ies) to provide the same level of service as the project technology according to its metered energy consumption. This estimation is done using specific fuel consumption ratios, derived from CCTs of the baseline and project technologies. When multiple devices/fuels are used by the end user in the same premises, the proportional use shall be established from surveys or stove use monitoring, or following an approach that leads to conservative baseline emissions estimation.
QA/QC procedures	The study must achieve confidence and precision of at least 90/10 for the target parameter of average daily fuel consumption per person. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for baseline emissions is that which tends to underestimate emissions. For both KPT-based and back-calculated fuel estimates in non-Latin American countries, energy consumption values for fuelwood are capped at 0.0156 TJ/capita/year (1 t/capita/year of air-dried wood), and values above 0.0124 TJ/capita/year (0.8 tons/capita/year of air-dried wood) are flagged for more intensive verifier review. For both KPT-based and back-calculated fuel estimates in Latin America, fuel consumption values

	for fuelwood are capped at 0.035 TJ/capita/year (2.25 tons/capita/year of (air-dried wood), and values above 0.023 TJ/capita/year (1.5 ton/capita/year of air-dried wood) are flagged for more intensive verifier review. For baselines (in any region) with charcoal as the primary fuel use, the cap is set at 0.0059 TJ/capita/year (0.2 tons/capita/year), and values above 0.0047 TJ/capita/year are flagged for verifier review.
Purpose of data	Calculation of baseline emissions
Comments	-

Data/Parameter	$mEC_{proj,elect}$
Unit	kWh/year
Description	Electricity consumption in project scenario
Type of parameter	Ex-ante
	X Monitored
Source of data	Metered electricity use
Value applied	-
Frequency of monitoring	Continuous and aggregated annually
Description of measurement methods	All project technologies are monitored continuously. If not, then a representative sample must be taken. Plug-in or built-in data loggers may be used, where they conform with industry standards and are calibrated according to relevant national requirements.
QA/QC procedures	The sampling approach must achieve a confidence level and precision of at least 90/10 for the target parameter of energy use per person per day. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculation of project emissions
Comments	Projects in which built-in monitors are not included on every device shall ensure that project households receiving monitored devices are randomly distributed among the overall target population.

Data/Parameter	$mEC_{proj,i}$
Unit	TJ/person/day
Description	Energy consumption of project fuel *i* for metered projects
Type of parameter	Ex-ante
	X Monitored
Source of data	Energy or fuel loggers for a sample of cookstoves
Value applied	-
Frequency of monitoring	Continuous and aggregated annually
Description of measurement methods	All project technologies are monitored continuously. If not, then a representative sample must be taken. Plug-in or built-in data loggers may be used, where they conform with industry standards and are calibrated according to relevant national requirements.
QA/QC procedures	The sampling approach must achieve a confidence level and precision of at least 90/10 for the target parameter of fuel use per person per day. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculation of project emissions
Comments	Projects in which built-in monitors are not included on every device shall ensure that project households receiving monitored devices are randomly distributed among the overall target population.

Data/Parameter	N_h
Unit	Number
Description	Number of households in project in year *y*
Type of parameter	Ex-ante
	X Monitored
Source of data	Project database
Value applied	-
Frequency of monitoring	Continuous, every time that new project devices are distributed in any household

Description of measurement methods	Date of commissioning of project device must be recorded
QA/QC procedures	Transparent reporting
Purpose of data	Calculation of baseline and project emissions
Comments	The number of households must be recorded in a database or similar to ensure transparency

Data/Parameter	$N_{h,\Psi,y}$	
Unit	Number	
Description	Number of households with project stove in use in year *y*	
Type of parameter		Ex-ante
	X	Monitored
Source of data	Project database and usage and uptake survey or SUMs monitoring	
Value applied	-	
Frequency of monitoring	Annual	
Description of measurement methods	Household surveys and stove use monitoring.	
QA/QC procedures	Sampling must be conducted to meet the 90/10 precision guideline.	
Purpose of data	Scale the emission reduction estimates to the applicable number of households with stoves in use.	
Comments	For projects with meters on all project stoves, the number is directly measured and not the result of a sample.	

Data/Parameter	$nmEC_{proj,elect}$	
Unit	TJ/person/year	
Description	Energy consumption of electric project technologies the project scenario *i* (TJ/person/day)	
Type of parameter		Ex-ante
	X	Monitored
Source of data	KPT during project scenario	
Value applied	Result from KPT	
Frequency of monitoring	Every two years	

Description of measurement methods	Projects that choose the KPT approach to determine fuel consumption in the project scenario must collect data from a representative sample of households and follow the KPT protocol. Plug-in or built-in data loggers may be used, where they conform with industry standards and are calibrated according to relevant national requirements.
QA/QC procedures	The study must achieve confidence and precision of at least 90/10 for the target parameter of average daily fuel consumption per person. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculate project emissions
Comments	

Data/Parameter	$nmEC_{proj,i}$	
Unit	TJ/person/year	
Description	Energy consumption of project fuel *i* for non-metered projects (TJ/person/day)	
Type of parameter		Ex-ante
	X	Monitored
Source of data	KPT during project scenario	
Value applied	Result from KPT	
Frequency of monitoring	Every two years	
Description of measurement methods	Projects that choose the KPT approach to determine fuel consumption in the project scenario must collect data from a representative sample of households and follow the KPT protocol. Where projects measure fuel consumption through KPTs, complemented by usage surveys, maximum average fuel savings are capped at 90% of the KPT estimate, with project stove energy consumption increased to meet this requirement.	

	Projects may also measure fuel consumption through KPTs, complemented with SUMs on the project cookstove. If the SUMs demonstrate continued use of the project cookstove following the KPT period, maximum average fuel savings are not capped. If the use events per day on the project stove show a statistically significant shift down during the post-KPT SUMs monitoring period ($p < 0.05$ using a one-way or one-tailed test of significance), then the project stove fuel consumption estimate must be adjusted such that the fuel savings is 90% of that indicated by the KP
QA/QC procedures	The study must achieve confidence and precision of at least 90/10 for the target parameter of average daily fuel consumption per person. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculation of project emissions
Comments	

Data/Parameter	$SC_{b,i}$	
Unit	MJ fuel energy / kg food	
Description	Specific energy consumption of a baseline cooking technology to cook a given amount of food	
Type of parameter		Ex-ante
	X	Monitored
Source of data	CCT protocol	
Value applied	Mean value from test results, if 90/10 precision guideline is met	
Frequency of monitoring	Before validation	
Description of measurement methods	Provided in the CCT protocol	
QA/QC procedures	Requirements per the CCT protocol. Additionally: - A minimum of 15 CCTs by 5 different cooks (3 repeats per cook) must be conducted per stove.	

	- The CCTs must be alternated between the baseline and project stoves to limit potential bias in increased cook efficiency over repeats.
Purpose of data	Calculation of fuel savings and/or back-calculation of baseline fuel consumption.
Comments	-

Data/Parameter	$SC_{p,i,y}$	
Unit	MJ fuel energy / kg food	
Description	Specific energy consumption of a project cooking technology *i* in year *y* to cook a given amount of food	
Type of parameter		Ex-ante
	X	Monitored
Source of data	CCT protocol	
Value applied	Mean value from test results, if 90/10 precision guideline is met. The conservative 90% confidence bound if it is not met shall be applied.	
Frequency of monitoring	Before validation	
Description of measurement methods	Provided in the CCT protocol	
QA/QC procedures	Requirements provided in the CCT protocol. Additionally: - A minimum of 15 CCTs by 5 different cooks (3 repeats per cook) must be conducted per stove. - The CCTs must be alternated between the baseline and project stoves to limit potential bias in increased cook efficiency over repeats.	
Purpose of data	Calculation of fuel savings and/or back-calculation of baseline fuel consumption.	
Comments	-	

Data/Parameter	$U_{p,i,y}$	
Unit	Percentage	
Description	Usage rate of active project cookstove *i* during year *y*	
Type of parameter		Ex-ante
	X	Monitored
Source of data	Surveys	
Value applied	Result using inputs from surveys.	

	The maximum displacement of the baseline stove(s) is 40% (sum of $U_{p,y,i}$ across displaced baseline stoves is 0.4) when surveys are used to determine percent usage. If SUMs monitoring demonstrates two or more usage events per day of at least 20 minutes each, baseline cookstove displacement is capped at 60% (sum of $U_{p,y,i}$ across displaced baseline stoves is 0.6).
Frequency of monitoring	Annual
Description of measurement methods	The survey must ask to identify all the cooking devices present in the household. Then, for the project cookstove and each other cooking device present in the household, ask “How many times did you cook using [cooking device] yesterday?” to determine the number of usage events per day per device. For SUMs, see requirements on “SUMs Usage” in Annex 6 “*Guidance on adoption and usage*”.
QA/QC procedures	The minimum sample size for the survey must be determined to achieve 90/10 confidence precision for the average number of cooking events per day per household. If the target precision is missed, the project proponent may take the conservative bound of the confidence interval as the parameter value. The conservative bound for baseline emissions is that which tends to underestimate emissions, whereas the conservative bound for project emissions is that which tends to overestimate emissions.
Purpose of data	Calculation of baseline and project emissions
Comments	

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Data/Parameter	$\Psi_{Metered,y}$	
Unit	Percentage	
Description	Uptake: fraction of households with a project cookstove in use during year *y*, estimated from metered data.	
Type of parameter		Ex-ante
	X	Monitored
Source of data	Metered fuel consumption	
Value applied	Percentage of user households from metered data	

Frequency of monitoring	Continuous
Description of measurement methods	Measured fuel consumption by metered approach indicates usage of project stove in a household. If no fuel consumption is measured, then the household would be considered a non-user. Uptake is capped at 90% for projects that incorporate after-sales support and educational/behavior change activities and at 75% for all other projects.
QA/QC procedures	If a sample, then the 90/10 precision guideline must be applied.
Purpose of data	Calculation of baseline and project emissions
Comments	Project proponents can determine their own criteria for what constitutes a user v. non-user, but they must consistently use those categories as they have defined them for all project accounting.

Data/Parameter	$\Psi_{Survey,y}$	
Unit	Percentage	
Description	Uptake of project cookstoves during year *y* taken from survey	
Type of parameter		Ex-ante
	X	Monitored
Source of data	Surveys	
Value applied	Survey result	
Frequency of monitoring	Annual	
Description of measurement methods	The project proponent establishes the definition of a user and therefore the survey response that indicates whether or not a project cookstove has been adopted.	
QA/QC procedures	The minimum sample size for the survey must be determined to achieve 90/10 confidence precision for the proportion of devices in operation. Uptake is capped at 90% for projects that incorporate after-sales support and educational/behavior change activities and at 75% for all other projects.	
Purpose of data	Calculation of baseline and project emissions	
Comments	Project proponents can determine their own criteria for what constitutes a user v. non-user, but they must consistently use those categories as they have defined them for all project accounting.	

13. ANNEXES

Annex 1: Sampling size calculations

The table below describes the recommended sampling methods depending on the project conditions and capabilities for sampling and/or surveys. NOTE: 4C will publish sampling guidance specific to this methodology for surveys, SUMs, KPTs, and CCTs in August 2024.

Table 2. Sampling methods

Sampling Method	Characteristics
Simple Random Sampling	• Easy to understand. • This approach is particularly advantageous when assuming population homogeneity, such as within the same climate zone or socio-economic circumstances. • It can often be costly. • Not applied if the population covers a large geographical area.
Stratified Random Sampling	• Improves the precision of the estimate if there are differences between the groups or strata. By dividing the population into strata and then sampling from each stratum proportionally, a more accurate estimate of the overall population can be obtained. • Applied for heterogeneous population but identifying suitable stratification factors to divide the population may not be obvious. Stratification factors should be selected to reflect significant differences in the population regarding the parameter of interest. • The process of stratified sampling can be more intricate and require additional calculations compared to simple random sampling

To perform sample size calculations, it is necessary to make estimates of the parameters of interest. This can be achieved by:

1. Referring to the results of previous studies.
2. In the absence of previous studies, conducting a preliminary pilot sample and using that sample to calculate estimates.
3. Using estimates based on the researchers' own experiences.

4. While sample size calculations must be performed for each parameter, multiple parameters may be measured from the same sample to reduce the overall monitoring burden.

The following equations outline the sampling plan that must be followed, along with the type of project.

Simple Random Sampling

- Sample size determination for mean parameter following the equation:

$$n \geq \frac{1.645^2 N \times V}{(N-1) \times 0.1^2 + 1.645^2 \times V}$$

$$V = \left(\frac{SD}{mean}\right)^2$$

Where:

n	=	Sample size
N	=	Total number of households
SD	=	Expected standard deviation
mean	=	Expected mean, depends on similar studies or country
1.645	=	Represents the 90% confidence required
0.1	=	Represents the 10% relative precision

- Sample size determination for proportion parameter:

The equation for a 90/10 confidence/precision to give the required sample size is:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1) \times 0.1^2 \times p^2 + 1.645^2 \times p(1-p)}$$

Where:

n	=	Sample size for households
N	=	Total number of households
p	=	Expected proportion of the parameter of interest
1.645	=	Represents the 90% confidence required
0.1	=	Represents the 10% relative precision

The result “n" represents the number of households with data available for analysis. If it is anticipated that a certain proportion of the sampled households will respond, adjust this number accordingly by dividing “n" by the anticipated proportion.

The expected proportion shall not be more than 1, and a conservative range to apply could be between 0.5 to 0.7.

Then, the equation for 95/10 confidence/precision to give the required sample size is:

$$n \geq \frac{1.96^2 N \times p(1-p)}{(N-1) \times 0.1^2 \times p^2 + 1.96^2 \times p(1-p)}$$

Where:

n	=	Sample size
N	=	Total number of households
p	=	Expected proportion of cookstoves would be operating
1.96	=	Represents the 95% confidence required
0.1	=	Represents the 10% relative precision

Stratified Random Sampling

When the project covers a large geographical area, stratified random sampling may be applied. It consists of dividing the area into different districts where it is more likely that cookstoves will continue to function compared to others. The number of districts (k) should cover the total number of households, and each district will convert in a population with estimate proportion and surveyed separately.

- Total sample size determination for proportion parameter is:

$$n \geq \frac{1.645^2 \times NV}{(N-1) \times 0.1^2 + 1.645^2 \times V}$$

$$V = \frac{SD^2}{\underline{p}^2}$$

Where:

n	=	Sample size
N	=	Total number of households
V	=	Overall variance
1.645	=	Represents the 90% confidence required
0.1	=	Represents the 10% relative precision
SD	=	Standard deviation
$\underline{p}$		Overall proportion

Then, standard deviation is based on g_i and proportion p_i.

$$SD = \sum_{i=1}^{k} \frac{g_i \times p_i(1-p_i)}{N}$$

Where:

SD	=	Sample size for each *i* district
g_i	=	Number of the households with cookstove in *i* district
$p_i(1-p_i)$	=	Variance of a proportion
N	=	Total number of households

The overall proportion is based on the number of households in district and the proportion of cookstoves, respectively.

$$\underline{p} = \sum_{i=1}^{k} \frac{(g_i + p_i)}{N}$$

Where:

$\underline{p}$	=	Overall proportion
g_i	=	Number of the households with cookstove in *i* district
p_i	=	Proportion of cookstove of *i* district
N	=	Total number of households

To decide on the number of households in the sample that come from each district we could use proportional allocation, where the proportion from different districts are the same as the proportion in the population.

So:

$$n_i = \frac{g_i}{N} \times n$$

Where:

n_i	=	Sample size for each *i* district
g_i	=	Number of the households with cookstove in *i* district
N	=	Total number of households

Sample size determination for mean parameter following the equation:

$$n \geq \frac{1.645^2 \times NV}{(N-1) \times 0.1^2 + 1.645^2 \times V}$$

$$V = \left(\frac{SD_{overall}}{mean}\right)^2$$

Where:

SD	=	Is the overall standard deviation
$Mean$	=	Is the overall mean

The overall standard deviation is:

$$SD_{overall} = \sqrt{\frac{\sum_{i=1}^{k} g_i \times SD_i^2}{N}}$$

Where:

$SD_{overall}$	=	Weighted overall standard deviation
SD_i	=	Standard deviation of the *i* district
g_i	=	Number of the households with cookstove in *i* district
N	=	Total number of households

The overall mean is:

$$mean = \sum_{i=1}^{k} \frac{(g_i + m_i)}{N}$$

Where:

$mean$	=	Weighted overall mean
g_i	=	Number of the households with cookstove in *i* district
m_i	=	Mean of cookstove of *i* district
N	=	Total number of households

Annex 2: Grid emission factors for select countries

Country / Territory / Island	gCO2/kWh	Country / Territory / Island	gCO2/kWh	Country / Territory / Island	gCO2/kWh
Afghanistan	193	Gabon	533	Palau	497
Algeria	397	Gambia	591	Panama	230
Angola	748	Ghana	276	Papua New Guinea	315
Bangladesh	412	Guam	428	Paraguay	0
Belize	183	Guatemala	427	Peru	252
Benin	576	Guinea	460	Philippines	525
Bhutan	0	Guinea-Bissau	577	Rwanda	416
Bolivia, Plurinational State of	393	Guyana	616	Samoa	434
Botswana	1070	Haiti	765	Sao Tomé & Principe	565
Brazil	150	Honduras	359	Senegal	656
Burkina Faso	539	India	608	Seychelles	479
Burundi	197	Indonesia	675	Sierra Leone	246
Cambodia	588	Jamaica	498	Solomon Islands	563
Cameroon	354	Kenya	274	Somalia	582
Cape Verde	505	Kiribati	530	South Africa	786
Central African Republic	77	Lao People's Democratic Republic	555	South Sudan	704
Chad	581	Lebanon	567	Sri Lanka	506
Chile	235	Liberia	374	Sudan	398
China (PRC and Hong Kong)	485	Libya	493	Suriname	565
Colombia	208	Madagascar	567	Tajikistan	106
Comoros	589	Malawi	243	Tanzania, United Republic of	336
Congo, Democratic Republic of	0	Mali	623	Thailand	351
Congo, Republic of	405	Mauritania	513	Timor-Leste	589
Costa Rica	39	Mauritius	543	Togo	597
Côte d'Ivoire	314	Mexico	359	Tonga	533
Cuba	391	Micronesia	557	Tunisia	348
Djibouti	575	Morocco	547	Turkmenistan	676
Dominica	433	Mozambique	111	Tuvalu	497
Dominican Republic	426	Myanmar	407	Uganda	116
Ecuador	280	Namibia	139	Uruguay	65
Egypt	406	Nauru	521	Uzbekistan	467
El Salvador	275	Nepal	0	Vanatu	504
Equatorial Guinea	361	Nicaragua	372	Venezuela, Bolivarian Republic of	368
Eritrea	704	Niger	718	Viet Nam	381
Eswatini	0	Nigeria	358	Yemen	615
Ethiopia	0	Pakistan	386	Zambia	197
Fiji	334	Palestinian Authority	517	Zimbabwe	880

These emission factors are estimated by the International Financial Institution's Technical Working Group (IFI-TWG) on GHG Accounting. The IFI-TWG uses the Combined Margin (CM) grid emission factor for Electricity Consumption. CM is a weighted average of each country's Operating Margin (33%) and Build Margin (67%). Operating Margin is the cohort of existing power plants that are most likely to be brought online to meet an additional unit of demand. Build Margin is the cohort of power plants expected to come online based on a country-specific assessment of planned and expected new generation capacity.

For countries not included on this list, download the full database and use the data from Column E "Electricity Consumption".

Annex 3: Off-grid emission factors for select technologies

Generation technology	gCO_2e /kWh	Source
Petrol generator	1252	https://www.seforall.org/system/files/2021-08/SEforALL_Carbon-emissions-methodology-note.pdf
Diesel generator	1000	https://www.seforall.org/system/files/2021-08/SEforALL_Carbon-emissions-methodology-note.pdf

Annex 4: Upstream emissions from other fuels in ton/TJ[8]

Fuel	CO_2	CH_4	N_2O	CO_2e	Notes
Kerosene (assuming conv jet fuel)	8.72	0.10	0.00	11.6	a
LPG from crude oil	15.40	0.12	0.00	19.0	
LPG from natural gas	6.93	0.15	0.00	11.3	
LPG derived from a mix of crude and natural gas inputs	10.56	0.10	0.00	13.6	b
Coal mining and cleaning	0.66	0.22	0.00	7.3	
Sugarcane-based ethanol	-11.60	0.58	0.06	20.8	c, d, e
Pellets	3.81	0.01	0.00	4.4	
Charcoal (traditional kiln) - note, CO_2 should be multiplied by fNRB before adding up to CO_2e	115	2.68	0.115	190	f
Global Warming Potentials (GWPs)					
GWP from AR6	1	Fossil fuels: 29.8; Non-fossil fuels: 27.2	273		

Notes:

a Kerosene emissions are based on jet fuel from the GREET model

b Combined LPG is a weighted average using the 2021 global input mix, which was 37% crude and 63% natural gas

c CO_2 is negative because it accounts for carbon fixed during plant growth.

d CH_4 emissions are due to field burning, which is common for cane produced in many LMICs.

e Life Cycle Assessment impacts are allocated by mass assuming 20% of farmgate output goes toward ethanol

f Charcoal production emission factors are taken from six peer-reviewed studies of emissions from traditional kilns. The average conversion rate from those 6 studies is 3.7 tons of oven-dry wood per ton of charcoal. For this methodology, we use a default conversion rate of 6:1, which means that more wood, and therefore more carbon, is input to obtain the same amount of charcoal output. This would result in more carbon-pollution. We account for this, by increasing the CO2 and CH4 emission factors proportionally. Sources: Bertschi, Isaac T., Robert J. Yokelson, Darold E. Ward, Ted J. Christian, and Wei Min Hao. "Trace Gas Emissions from the Production and Use of Domestic Biofuels in Zambia Measured by Open-Path Fourier Transform Infrared Spectroscopy." Journal of Geophysical Research-Atmosphere 108 (2003): 5–1, 5–13; Lacaux, J. P., J. M. Brustet, R. Delmas, J. C. Menaut, L. Abbadie, B. Bonsang, H. Cachier, J. Baudet, M. O. Andreae, and G. Helas. "Biomass Burning in the Tropical Savannas of Ivory Coast: An Overview of the Field Experiment Fire of Savannas (FOS/DECAFE 91)." Journal of Atmospheric Chemistry 22, no. 1–2 (October 1995): 195–216. https://doi.org/10.1007/BF00708189; Smith, K. R., D. P. Pennise, P. Khummongkol, V. Chaiwong, K. Ritgeen, J. Zhang, W. Panyathanya, R. A. Rasmussen, and M. A. K. Khalil. "Greenhouse Gases from Small-Scale Combustion in Developing Countries: Charcoal Making Kilns in Thailand." Research Triangle Park, NC: US EPA, 1999; Pennise, D., K. R. Smith,

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Annex 5: Default point of use emission factors and net calorific values

Fuel	Net Calorific Value (TJ/tons)	Default CO2 Emission Factor (tons/TJ)	Default CH4 Emission Factor (tons/TJ)	Default N2O Emission Factor (tons/TJ)
Biogas[1]	0.0504	54.6	0.5	0.0015
Charcoal [(2-5)]	0.030	78.5	0.2	0.008
Kerosene[1]	0.0452	71.9	0.01	0.0006
LPG[1]	0.0522	63.1	0.005	0.0001
Wood[1]	0.0156	112.0	0.012	0.0003

Sources

[1] Gomez, Darío R., and John D. Watterson. 2006. *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. edited by S. Eggleston, L. Buendia, K. Miwa, T. Ngara, and K. Tanabe. Kamiyamaguchi Hayama, Japan: Institute for Global Environmental Strategies.

[2] Brocard, D., C. Lacaux, J. P. Lacaux, G. Kouadio, and V. Yoboue. "Emissions from the Combustion of Biofuels in Western Africa." In Biomass Burning and Global Change, edited by J. S. Levine, 1:350–60. Cambridge, MA: MIT Press, 1996.

[3] Bertschi, Isaac T., Robert J. Yokelson, Darold E. Ward, Ted J. Christian, and Wei Min Hao. "Trace Gas Emissions from the Production and Use of Domestic Biofuels in Zambia Measured by Open-Path Fourier Transform Infrared Spectroscopy." Journal of Geophysical Research-Atmosphere 108 (2003): 5–1, 5–13.

[4] Akagi, S. K., R. J. Yokelson, C. Wiedinmyer, M. J. Alvarado, J. S. Reid, T. Karl, J. D. Crounse, and P. O. Wennberg. "Emission Factors for Open and Domestic Biomass Burning for Use in Atmospheric Models." Atmospheric Chemistry and Physics 11, no. 9 (May 3, 2011): 4039–72. https://doi.org/10.5194/acp-11-4039-2011.

[5] Smith, Kirk, R. Uma, V. V. N. Kishore, K. Lata, V. Joshi, Junfeng Zhang, R. A. Rasmussen, and M. A. K. Khalil. "Greenhouse Gases From Small-Scale Combustion Devices In Developing Countries Phase IIa: Household Stoves In India." Research Triangle Park, NC: US Environmental Protection Agency, June 2000.

Notes:

- Default net calorific values and default emission factors for other fuel types (e.g., specific types of coal) can also be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, or may be justified from literature and/or testing reports.

- GWPs from the IPCC Fifth Assessment Report (AR6) should be multiplied by the emission factors to convert them to CO_2e as follows:
  - CO2: 1
  - CH_4 fossil fuels: 29.8
  - CH_4 non fossil fuels: 27.2
  - N_2O 273.
- For non-renewable emission factors ($NREF_i$), the tons CO_2e per TJ for CO_2, CH_4, and N_2O should be summed.
- For renewable emission factors (REF_i), the tons CO_2e per TJ for CH_4 and N_2O should be summed.

Annex 6: Guidance on adoption: uptake and usage

For projects that are not directly and continuously metered, the methodology considers adoption as a function of uptake and usage rates, and addresses stacking through conservative assumptions of baseline cookstove displacement, or through the use of KTPs.

Metered projects may determine uptake from surveys or metered data, and usage through metered data alone or in combination with a KPT.

Uptake: determination of user

The project proponent shall determine which households are considered active users for calculating emissions reductions. This definition must be established in the design phase and be used consistently for all calculations over the course of the crediting period. It must also be quantifiable with surveys or usage monitoring, and direct observation of project cookstoves. Further, uptake is capped at 90% for projects that incorporate after-sales support and educational/behavior change activities and at 75% for all other projects.

Definitions may include:

1. Project household has a project cookstove and provides evidence of the project cookstove's existence and functionality at the household. Fuel consumption data can be used to determine fuel consumption for metered projects.

2. Project household has a project cookstove and provides evidence of cookstove's existence and functionality at the household and reports more than the PP's a priori usage or fuel consumption threshold to be designated a user (e.g., use of more than once per month, week, or day; or fuel consumption of more than 10 MJ per month, week, or day). Fuel consumption data can be used to determine fuel consumption for metered projects.

Only data from representative samples of these users may be used to estimate emissions reductions.

Usage: metered

There are two options for calculating energy consumption in the project scenario for metered projects: estimating energy consumption of all cookstoves in use during the project scenario using metered data and the

KPT, and direct measurement of only the project technology energy consumption.

If the baseline energy consumption was calculated using a KPT, then project proponents must calculate project energy consumption by (a) metering energy for the project cookstove and (b) quantifying the energy consumption of other non-project technologies based on a KPT.

If the baseline energy consumption was estimated by back-calculating the displaced baseline fuel consumption based on specific consumption and displacement rates, then project proponents must calculate project energy consumption by metering energy for the project technology. Other, non-project cookstoves that may be in use in the project scenario are not included, as the baseline fuel consumption only includes that which is displaced by the project cookstove.

Usage: non-metered

Non-metered projects may choose from four different approaches to determine energy consumption in the project scenario, which include assessing usage and displacement rates. These approaches involve various combinations of surveys, CCTs, usage sensors, and KPTs. To address cookstove performance degradation over time, fuel efficiency monitoring samples must include each cookstove vintage.

Projects may measure fuel consumption through KPTs, complemented by surveys and SUMs measurements. If the SUMs demonstrate continued use of the project cookstove, or if continued average daily household fuel consumption is demonstrated through longer-term fuel consumption measurements (6-months or more) following the KPT period, maximum average fuel savings are not capped. If the use events on the project stove or fuel consumption per day show a statistically significant shift down during the post-KPT SUMs monitoring period ($p < 0.05$ using a one-way or one-tailed test of significance), then the project stove fuel consumption estimate must be adjusted such that the fuel savings is 90% of the value indicated by the KPT.

Where projects measure fuel consumption through KPTs, complemented by usage surveys alone (and no SUMs measurements in the post-KPT period), maximum average fuel savings are capped at 90% of the KPT estimate.

Projects may use specific consumption ratios from CCTs (comparing the CCT-determined specific consumption ratio of the baseline and project scenarios to estimate project cookstove fuel consumption) to estimate project cookstove fuel consumption, and base usage on surveys plus SUMs on the project cookstove in a representative sample of households. If the SUMs demonstrate at least two cooking events per day of at least 20 minutes each, baseline cookstove displacement estimated through surveys is capped at 60%. If SUMs monitoring estimates that mean project stove usage is less than two, 20-minute events per day, baseline cookstove as measured by the survey displacement is capped at 40%. This means the primary baseline cookstove (as indicated by reported usage rates) displacement must be adjusted down to the 40% cap.

Where projects use the CCT to estimate project cookstove fuel consumption, and base usage rates on surveys alone, average baseline cookstove displacement is capped at 40%.

Thus, the caps for the various uptake and usage rate measurement combination scenarios are as follows, with the portion shown of what maximum total credits would be if uptake and usage were 100% for each combination:

	Maximum allowed average fuel savings	
Cap on uptake	**100%** [survey+KPT+SUMs	**90%** [survey +KPT]
90% [after-sales support & BC]	0.90	0.81
75%	0.75	0.675

	Maximum allowed average baseline displacement rate	
Cap on uptake	**60%** [survey +SUMs]	**40%** [survey only]
90% [after-sales support & BC]	0.54	0.36
75%	0.45	0.3