Climate Stewards Seal of Approval

Methodology for the calculation of savings in CO_2e resulting from the use of Improved Cookstoves and Fireless Cookers

Contents

1. Introduction

Our analysis of the potential for carbon savings from an Improved Cookstove or Fireless Cooker project is based on two methodologies:

- the UNFCCC methodology given in AMS-II.G.: Energy efficiency measures in thermal applications of non-renewable biomass – Version 11.1,[1]
- and the Gold Standard "Technologies and Practices to Displace Decentralized Thermal Energy Consumption".[2]

Because projects based on either improved cookstoves or fireless cookers aim to reduce fuelwood consumption this methodolgy is appropriate for calculating savings based on those reductions. Where there are differences between requirements for an improved cookstove project and a fireless cooker project these will be noted with either ***[IC]*** for improved cookstoves or ***[FC]*** for fireless cookers.

This methodology may be used in any cookstove or fireless cooker project where:

[IC] A single type of improved cookstove is being used to replace a traditional 3-stone or open fire, or unimproved charcoal cookstove.

[1] https://cdm.unfccc.int/methodologies/DB/ZI2M2X5P7ZLRGFO37YBVDYOW62UHQP

[2] https://globalgoals.goldstandard.org/407-ee-ics-technologies-and-practices-to-displace-decentrilized-thermal-energy-tpddtec-consumption/

*[**FC**]* A fireless cooker is being used to reduce the amount of fuel used by any existing fire/stove being used by a household.

A Seal of Approval project may introduce either improved cookstoves **or** fireless cookers, but not both.

[IC] If, within a project, different types of stove are going to be introduced in the project scenario (i.e. different households will receive different stoves) then either the methodology shall be applied to each stove type based on the number of households that will receive that type of cookstove; or the least efficient stove shall be used as the basis for all of the calculations.

Where households currently use multiple fires and/or unimproved stoves then it must be clear which are being replaced by the improved cookstove.

If the calculation of carbon emissions savings is retrospective for a project that is already up and running, then data on fuel usage and savings where available must be used rather than relative stove efficiencies. If such data is not available, then historic fuel usage information shall be sought and found by interviewing cookstove project participants.

2. Calculation Method

2.1. Baseline scenario

In order to calculate emissions in the baseline scenario (and hence potential savings in the project scenario) it is necessary to know the quantity of fuel used annually by the household for cooking.

Fuel usage for space heating is explicitly excluded from the calculations as, typically, in the project scenario the improved cookstove, due to its construction, increased efficiency and insulation will not provide the same level of space heating as a 3-stone or open fire. And for fireless cookers the original stove will be used less, thus providing less heating. It should also be noted that there may be increased fuel usage for space heating via other methods and that this needs to be factored in to the project design to account for any potential rebound effect. Appendix 1 details the questions to be asked in a typical baseline survey.

2.2. Data required in the baseline

- Efficiency of current (3-stone or open) fire or unimproved charcoal stove – literature review would suggest that 10% is typical.[3]
- ***[IC]*** Efficiency of improved stove – manufacturer's or designer's data (minimum 20% and above to be expected).
- ***[FC]*** Anticipated percentage fuel wood saving from switching to a fireless cooker. (Including an indication of whether the fire will be damped down after food has been moved to the fireless cooker.)
- Emissions factor for wood – see below.
- Fractional non-renewability[4] – via the CDM[5] unless local data is available or there is a good reason not to use the CDM value.

[3] https://www.permaculture.co.uk/articles/cooking-efficiently-3-stone-fires-biomass-hobs, https://www.aljazeera.com/indepth/opinion/2013/04/201342412829127536.html

[4] The proportion of a country's biomass that is considered non-renewable, that is, it won't be replaced once cut down. This figure is used to account for the fact that some fuelwood is renewable whether the gatherer/purchaser is aware that the fuelwood comes from a sustainable source, or not.

[5] https://cdm.unfccc.int/DNA/fNRB/index.html

- Household consumption tonnes/year in the baseline scenario – by historical data, survey, minimum service level (i.e. what is the minimum used per person, typically set at 0.5 tonnes[6]), or field test (currently outside the CS SoA area of expertise) – see also section 2.4. Fuel Measurements.
- Usage rate – do households continue to use the cookstoves/fireless cookers that they have been given? It would be normal to start off assuming that 100% of households will use their stove – see Section 2.5. Cookstove Usage and Drop-Off.
- ***[IC]*** Efficiency loss of stoves – assume 1% per year (or via lit review, or designer's data).

2.3. Calculation of savings

Once the data from the baseline survey is known, the estimated emissions saving can be calculated based on two equations.

The first equation is used for improved cookstoves (not fireless cookers) and simply relates stove efficiency in the baseline scenario to efficiency in the project scenario. If data has already been gathered from monitoring that would show the quantitative reduction in fuel usage then this shall be used directly with Equation 2 instead of using Equation 1 to estimate the reduced consumption.

The second equation is for converting fuel to CO_2e. It is a straightforward calculation with the equation used based on the equation from the Gold Standard methodology, "Technologies and Practices to Displace Decentralized Thermal Energy Consumption".[7,8]

2.3.1 Efficiency – Equation 1

$$B_{savings} = B_{old} \times (1 - \eta_{old}/\eta_{new})$$

Where:

- B_{old} Quantity of woody biomass used in the absence of the project activity in tonnes per model and cohort of ICS
- η_{old} Efficiency of the baseline system(s) being replaced
- η_{new} Efficiency of the system being deployed as part of the project activity

2.3.2 Emissions – Equation 2

$$E = B \times ((f_{NRB} \times EF_{CO2}) + EF_{non\text{-}CO2}) \times NCV$$

Where:

- E emissions in tCO_2e.
- B fuel consumed in tonnes.
- f_{NRB} fraction of biomass that is non-renewable, based on CDM published list of country defaults.[9]

[6] https://globalgoals.goldstandard.org/407-ee-ics-technologies-and-practices-to-displace-decentrilized-thermal-energy-tpddtec-consumption/ – pg. 23.

[7] See "Technologies and Practices to Displace Decentralized Thermal Energy Consumption" version 3.1, August 2017, Gold Standard, pg 19ff. Available at https://globalgoals.goldstandard.org/407-ee-ics-technologies-and-practices-to-displace-decentrilized-thermal-energy-tpddtec-consumption/

[8] VCS don't currently offer a comparable methodology for thermal energy but do allow the use of CDM methodologies. CDM's methodology "AMS-II.G.: Energy efficiency measures in thermal applications of non-renewable biomass --- Version 11.1" available at https://cdm.unfccc.int/methodologies/DB/ZI2M2X5P7ZLRGFO37YBVDYOW62UHQP is for the replacement of fossil fuels but offers a similar equation to the Gold Standard methodology.

[9] https://cdm.unfccc.int/DNA/fNRB/index.html

- EF_{CO2} emissions factor for the CO_2 released when wood/charcoal is burnt. Under the Gold Standard methodology, the biomass fraction figure is applied only to this emissions factor. From the IPCC[10] data for wood fuel/charcoal – EF_{CO2} = 112 tCO_2/TJ.
- $EF_{non\text{-}CO2}$ emissions factor for non-CO_2 components of a fuel. The Gold Standard methodology incldes both Methane and Nitrous Oxide. The Emissions Factors for charcoal and wood are slightly different:
    - $EF_{CH4\text{-}WOOD}$ = 0.3 tCO_2/TJ × GWP[11] of 21 = 6.3 tCO_2e/TJ
    - $EF_{N2O\text{-}WOOD}$ = 0.004 tCO_2/TJ × GWP of 310 = 1.24 tCO_2e/TJ
    - $EF_{CH4\text{-}CHARCOAL}$ = 0.2 tCO_2/TJ × GWP[12] of 21 = 4.2 tCO_2e/TJ
    - $EF_{N2O\text{-}CHARCOAL}$ = 0.001 tCO_2/TJ × GWP of 310 = 0.31 tCO_2e/TJ
- NCV Net Calorific Value of fuel used, based on conservative IPCC data.[13]
    - NCV = 0.0156 TJ/tonne for wood fuel
    - NCV = 0.0295 TJ/tonne for charcoal

2.4. Fuel Measurements

In order to gather data on household consumption it is necessary to measure as accurately as possible how much fuel individual households are using.

Survey staff shall ask households to make a pile of fuelwood/charcoal that is indicative of the quantity they would use in a typical week (excluding space heating). The surveyor shall then weigh the wood/charcoal using scales and a sling/container of known weight. The weight in kilograms shall then be recorded.

If possible, the surveyor should return at the end of the week and weigh any fuel that is left over with this figure being subtracted from the original weight to give total quantity used in the week.

At one and four months the weighing exercise shall be repeated to establish actual reductions. The surveys are carried out at one and four months, firstly to make sure the stove is being used, and secondly, by four months the novelty will have worn off and the household will likely have established a more regular pattern of usage.

It should be noted that there may be seasonal variation in fuel consumption and usage, so the following must be taken into account: “Do participants also use the stove to heat their home in the winter? Do the types of fuel used vary according to the season due seasonal availability? Does the type of fuel commonly used vary according to seasonal fluctuations in household income?”[14]

This pile of fuel wood must reflect the usage of the fire/stove(s) that is to be replaced by the improved cookstove or for which fuel usage will be reduced by the introduction of a fireless cooker. The surveyor should take a picture of the pile of fuel wood for future reference. For example, if the cookstove will replace a single open fire then the fuel for one week for that one fire for all cooking

[10] http://www.ipcc.ch/meetings/session25/doc4a4b/vol2.pdf (Table 2.5 – DEFAULT EMISSION FACTORS FOR STATIONARY COMBUSTION IN THE RESIDENTIAL AND AGRICULTURE/FORESTRY/FISHING/FISHING FARMS CATEGORIES).
[11] http://unfccc.int/ghg_data/items/3825.php
[12] http://unfccc.int/ghg_data/items/3825.php
[13] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf (Table 1.2 – DEFAULT NET CALORIFIC VALUES (NCVS)).
[14] https://www.k4health.org/sites/default/files/Alternative%20Stoves%20english%20draft%20-%20without%20cd%20references.doc

needs shall be gathered and measured. If the improved cookstove is replacing an open fire and an unimproved stove the fuel for one week for the fire and the stove shall be gathered and measured.

For households that buy fuel on a daily basis, they shall be asked to show the surveyor how much fuel they use each day (excluding space heating). This fuel shall be weighed and the result multiplied by seven to give an estimated figure for one week's usage.

2.5. Usage and Drop-Off

Over time it is likely that some households will discontinue their use of the improved cookstove or fireless cooker and revert to exclusively using their old 3-stone or open fires. In calculating the cumulative emissions savings from the project, it is then necessary to know at what rate participants are abandoning their stoves and/or fireless cookers.

This is critical to the project as it will affect the overall emissions savings generated by the project and, through monitoring, will also show weaknesses in how the project is being implemented.

Usage drop-off must be minimised as much as possible – i.e. households going back to the old stoves or using the old stoves in conjunction with the new (see also rebound effect, below). Possible strategies include:

- Training events where the usage of the cookstoves/fireless cookers and their benefits are explained to potential project participants.
- Ongoing help from locally sourced and trained "Buddies" who will support households in the use of their new cookstoves or fireless cookers until their usage has become integrated into the household's lifestyle.

3. Criteria for accounting

- ***[IC]*** All improved cookstoves are being used and the "replaced" stoves are not being used in such a way as to eliminate the savings from having a cookstove.
- ***[FC]*** All fireless cookers are being used and the original stove is not continuing to be used at previous levels – i.e. fire is damped down when food is moved from the stove to the fireless cooker – households should be able to demonstrate what they do with the fire once food has been moved to the fireless cooker. Their actions shall be recorded as notes on the monitoring form.
- All cookstoves are in good condition.

4. Monitoring

Monitoring shall be carried out to make sure the cookstoves or fireless cookers are there, being used and in good condition, and that no old cooking methods have been re-introduced.

Monitoring shall occur at one and four months after installation of the new improved cookstoves/fireless cookers, and thereafter annually.

During monitoring, data will be gathered on fuel usage in order to evaluate previously estimated savings. The new data can be used to verify the initial estimates and/or calculate savings in the project scenario. Section 2.4. Fuel Measurements shall be used as the basis for monitoring fuel usage.

5. Additional Issues

There are two additional issues to be considered and during monitoring surveys the surveyor should be on the lookout for changes in improved cookstove or fireless cooker usage in the participating households.

5.1. Costs

This section relates to improved cookstoves only. Fireless cookers are of less concern because they cause a reduction in any fuel type used.

Changes in costs of fuel in the local area may affect the usage of improved cookstoves. People are less likely to use (or even pay for) an improved stove for which they need to purchase charcoal if they have access to fuelwood that is easily gathered and is free.

This could lead to users abandoning stoves or cookers and needs to be considered in monitoring and evaluation. Evidence needs to be gathered relating to continued usage of improved cookstoves or fireless cookers.

5.2. Rebound Effect

The "rebound effect" occurs when users of improved cookstoves or fireless cookers respond to fuel savings from the new technology by consuming more fuel.

Examples of when the rebound effect may occur:

- The family uses the new stove for longer, or adds extra usage (more cooking, boiling water, etc.) that didn't occur prior to the introduction of the cookstove or fireless cooker.
- Where households benefitted from the old fire or stove for space heating they may use extra fuel to compensate for what has been lost due to either the more contained heat of the improved cookstove or because the fire is extinguished when food is moved into the fireless cooker.
- The original stove may continue to be used outside of the project boundary – for example it may be passed on to a family that is not involved in the project but that had no stove.
- In the context of fireless cookers, once food has been moved from the stove/fire to the fireless cooker the fire may be allowed to continue to burn in order to cook more food, boil water or heat the home. In poorer households there may well be an ingrained "fuel saving" mentality that will mean that the fire is immediately or quickly damped down, however proof that this is being done will need to be shown.