Gold Standard

Making Good Better

Guidebook to Gold Standard and CDM Methodologies for Improved Cookstove Projects

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Gold Standard Foundation

Our role as a standard and certification body is to maximise the impact of climate and development activities. We design the strongest processes that amplify the impact of efforts to deliver clean energy and water, responsibly manage land and forests, and transform lives of the world's poor. We then verify those outcomes, inspiring greater confidence that drives investment to accomplish even more.

Gold Standard was established in 2003 by WWF and other international NGOs as a best practice standard to ensure projects that reduced carbon emissions under the UN's Clean Development Mechanism (CDM) also delivered on their dual mandate to foster sustainable development. Now with more than 80 NGO supporters and 1100 projects in over 70 countries, our projects have delivered billions of dollars in climate and development outcomes in local communities all around the world. Learn more about Gold Standard at www.goldstandard.org.

Abbreviations and Glossary

Abbreviation	Details
AMS-I.E	CDM small-scale methodology "Switch from non-renewable biomass for thermal applications by the user"
AMS-II.G	CDM small-scale methodology "Energy efficiency measures in thermal applications of non-renewable biomass"
GS Simplified Methodology	Gold Standard "Simplified methodology for efficient cookstoves"
TPDDTEC	Gold Standard "Technologies and practices to displace decentralized thermal energy consumption"
BFT	Baseline Field Test (Baseline kitchen performance test)
CCT	Controlled Cooking Test
DNA	Designated National Authority
EB	Executive Board
CDM	Clean Development Mechanism
EF	Emission Factor
ER	Emission Reduction
FNC	Fundación Natura Colombia
fNRB	Fraction of Non-Renewable Biomass
GACC	Global Alliance for Clean Cookstoves
GEF	Global Environment Facility
GHG	Greenhouse Gas
GS	Gold Standard
TAC	Technical Advisory Committee
IDB	Inter-American Development Bank
ICS	Improved cookstove activities
WBT	Water Boiling Test
KPT	Kitchen Performance Test
LDC	Least Developed Country
LLDC	Land-locked developing countries
LPG	Liquefied Petroleum Gas
LSC	Local Stakeholder Consultation
NCV	Net Calorific Value
PFT	Project Field Test (Project kitchen performance test)
TEO	Thermal Energy Output
SIDS	Small Island Developing States
SME	Small and Medium Enterprises
SUZ	Special Underdeveloped Zone

Useful Terms

Term	Description
Batch	A batch is defined as the population of the device of the same type commissioned at a certain calendar year. To establish the date of commissioning, the project participant may opt to group the devices and the 'batches'. The latest date of commissioning of a device within the batch shall be used at the date of commissioning for the entire batch.
Methodology	A GHG quantification methodology that defines the GHG quantification methods, project boundaries, approaches for identification of baseline, project scenarios and monitoring requirements and guidelines.
Traditional cookstoves	Traditional solid-fuel cooking solutions include cookstoves such as three-stone fires, unvented mud/clay "U" shaped stoves, basic charcoal cookstoves, and poorly vented coal cookstoves.
Improved (biomass) cookstoves (ICS)	Solid-fuel stoves that improve on traditional baseline biomass technologies in terms of fuel savings via improved fuel efficiency. Some improved cookstoves also lower particulate emissions through improved efficiency of combustion, but the critical distinction from "clean" cooking solutions is that "improved" stoves may not reach sufficiently low emissions levels to generate meaningful health benefits. Cookstoves covered by this definition include basic chimney ICS, basic portable ICS and intermediate ICS.
Basic chimney ICS	Solid-fuel cookstoves whose chimneys feature minimal to moderate improvements in thermal efficiency.
Basic portable ICS	Portable biomass cookstoves that are unvented and feature moderate improvements in thermal efficiency. This category includes minimally improved ceramic and clay cookstoves.
Intermediate ICS	A wide range of solid-fuel cookstoves with significant improvements in fuel efficiency but typically more limited health and environment outcomes in comparison to clean cooking solutions such as gasifier and modern fuel cookstoves.
Advanced (biomass) cookstoves (ACS)	Fan draft or natural draft biomass gasification cookstoves that achieve significant particulate emission reductions.
Modern cooking solutions	Petro-chemical fuel (LPG, natural gas, kerosene), electric stoves, and electromagnetic induction cookstoves.
Renewable cooking solutions	Biofuel cookstoves powered by ethanol and other plant-based liquids, oils or gels, including biogas cookstoves, solar cookers, and retained-heat cooking devices.

Guaranteeing access to clean cooking is a universal challenge, as traditional cooking methods lead to immense human costs.

1.0 Introduction

Guaranteeing access to clean cooking is a universal challenge, as traditional cooking methods lead to immense human costs. More than 3 billion people, representing over 60% of the population in developing countries and 40% of the world's total population, still rely on traditional biomass fuels such as wood, crop residues, and dung for their primary cooking needs using open fires or traditional stoves. Sub-Saharan Africa has the highest level of solid-fuel dependence globally, followed by Asia, Latin America, and Eastern Europe. Around 82% of the population in Sub-Saharan Africa relies on solid-fuels for cooking, followed by 44–71% in Asia, 19% in Eastern Europe, and 17% in Latin America[1].

Solid-fuel cooking imposes immense health, environmental, economic, and social costs on households in developing countries. In addition, burning solid-fuels contributes to global climate change by emitting greenhouse gases (GHGs) such as carbon dioxide, methane and short-lived climate pollutants (SLCPs) such as black carbon (BC). Solid-fuel cooking and related charcoal production across the developing world generate around 1.5–3.0% of global CO2 emissions[2].

Clean cooking presents an opportunity for addressing climate change. In this context carbon finance is emerging as an attractive option to help fund improved cookstove initiatives. Carbon finance is a type of payment for environmental services in which the GHG emission reductions from an activity are certified as having taken place and then purchased by governments, companies and individuals who wish to invest in a global effort to reduce GHG emissions. This flow of investment allows projects that would not normally be economically viable to take place while stimulating technology development and uptake by providing incentives to reduce GHG emissions.

In the last decade, carbon finance opportunities have proved to be a catalyst in realising clean cooking activities on the ground and transforming the improved cookstove market at a commercial level[3]. Despite challenges in the carbon market, carbon finance for improved and clean cookstoves is booming, with voluntary buyers funneling $61 million to Gold Standard certified offsets to projects that distribute clean cookstoves in 2013[4]. Organisations ranging from NGOs, donor agencies, international and national agencies, private investors and stove manufactures, have successfully infused carbon revenue into their business models for financing cookstove interventions and are aiming to distribute millions of stoves in the coming years.

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[1] 2015, World Bank, The State of the Global Clean and Improved Cooking Sector
[2] Bis 1
[3] 2015, Oliver Johnson, Hannah Wanjiru, Cassilde Muhoza, Fiona Lambe, Marie Jürisoo, Wathanyu Amatayakul and Audrey Chenevoy; From Theory to Practice of Change: Lessons from SNV's Improved Cookstoves and Fuel Projects in Cambodia, Kenya, Nepal and Rwanda, Stockholm Environment Institute
[4] 2015, World Bank, The State of the Global Clean and Improved Cooking Sector

To be able to measure and certify emission reductions from a project, an organization (a project developer) who wishes to develop a project must follow the calculations and procedures required by an applicable GHG quantification and monitoring methodology. The leading carbon market certification schemes, the Clean Development Mechanism (CDM) and Gold Standard provide such methodologies for improved cookstoves. These methodologies differ in terms of applicability criteria, baseline assessment, emission reduction calculation approaches, monitoring requirements, etc. This guidebook aims to assist project developers in evaluating and choosing the methodology that is best suited to their improved cookstove projects. It provides an overview of applicability, GHG quantification approaches and monitoring requirements for improved cookstove projects of the approved CDM and GS methodologies available at the time of writing this guidebook. It also provides a comparison of requirements, accounting approaches and resource requirements for each methodology and also gives suggestions for applying these methodologies in practice.

This guidebook is not intended to provide conclusions regarding the maximising of GHG emission reduction benefits of the cookstove activity. On the contrary, it is intended to help project developers in gaining an understanding of the key elements of currently approved CDM and Gold Standard methodologies so that they can make informed choices when developing a project funded via carbon finance. Furthermore, this guidebook is not intended to rank the improved cookstove methodologies. The selected three methodologies each valid under their respective certification schemes as indicated in Table 1 and can be applied to any improved cookstove activities, provided that the applicability conditions of the selected methodology are met. It should be noted that:

- This methodology guidebook refers to the latest version of the methodology available at the time of writing this guidebook. Since the methodologies are living documents whereby changes may occur over time, this guidebook is subject to possible future updates.
- The project developer shall refer to and confirm with the most recent version of the methodology prior to making a decision.
- This guidebook is not intended to rate the methodologies against each other.
- This guidebook is not a technical manual and does not replace the methodology requirements.

2.0 Improved Cookstove Methodologies

This guidebook presents a comparison of the three most commonly used GHG quantification and monitoring methodologies for improved cookstove activities. These methodologies are applicable to the projects applying for CDM and/or Gold Standard certification for carbon finance (Table 1).

Table 1: GHGs Quantification and monitoring methodology for Improved Cookstove projects

Methodology	Version	Applicability
Simplified methodology for efficient cookstoves	1.0	Gold Standard
AMS-II.G: Energy efficiency measures in thermal applications of non-renewable biomass (AMS II.G)	7.0	CDM and GS
Technologies and practices to displace decentralized thermal energy consumption (TPDDTEC)	2.0	Gold Standard

All methodologies have the following key components in common:

- Scope and applicability
- Project Boundaries
- Baseline and project scenario
- Quantification of GHG emission reductions
- Monitoring methodology and requirements

The following sections provide detailed information on these key elements.

3.0 Scope and Applicability

This section provides insights on the following questions:

- What are the different types of projects eligible for quantifying GHG emission reductions under each cookstove methodology?
- Which methodology among these three is suitable to technology/fuel and fuel switch situations?
- How many cookstoves can be included in an activity under each methodology?

The applicability section defines the primary scope of a particular methodology. It outlines applicability conditions that shall be met by the potential project in order to apply the selected methodology. From the outset, the project developer shall evaluate project eligibility by reviewing the scope and applicability requirements of the potential methodology.

3.1 Scope of the Methodology

The scopes of the three methodologies are summarised in Table 2. In general, the methodologies under discussion cover technologies and measures that include:

- Project activity involving introduction of improved cookstoves
- Retrofitting of existing cookstoves
- Fuel switch situation

As summarised in Table 2, a project that involves the introduction of improved cookstoves is eligible under all three methodologies while a project that involves retrofitting existing cookstoves is not eligible under the GS Simplified Methodology and the projects that involve fuel switch situations are not eligible under AMS II.G[5].

[5] The CDM Methodologies allow fuel-switching activities e.g. AMS-I.E, AMS-III.B.

Table 2: Scope of improved cookstove methodologies

Scope (Technology/Measures)	GS Simplified Methodology	AMS II.G	TPDDTEC
Improved cookstove	Yes[1]	Yes[1]	Yes
Fuel Switch	Yes[2]	No[3]	Yes
Retrofitting of existing cook-stoves	No	Yes	Yes
Non-domestic Premises	No	Yes	Yes[4]

1. Introduction of single-pot or multi-pot portable or in-situ cookstoves with rated efficiency of at least 20%. It refers to only firewood burning stoves.
2. Only fuel switch from non-renewable to renewable biomass for firewood burning stoves is eligible under this methodology.
3. The CDM methodologies which allow fuel switch project activities are e.g. AMS-I.E, AMS-III.B.
4. Industrial/institutional cook-stoves (e.g. schools, hospitals, etc.) and residential institutional, industrial, or commercial facilities

Box 1: Fuel switch

A fuel switch situation comprises of switching from one fuel to another with or without changing the technology, such as transitioning from a non-renewable biomass fuel like firewood or charcoal to a renewable biomass fuel sourced from sustainably harvested forests or agricultural residues, like rice or coffee husks. Switching from high GHG emitting fuels to relatively lower GHG emitting fuels or even non-GHG emitting technologies includes the switch from fuels like kerosene, charcoal or firewood to ethanol, biogas, LPG or solar.

3.2 Applicability Conditions

A potential project shall meet pre-defined applicability conditions as outlined in each methodology. A summary of applicability conditions for eligible scope/conditions is provided in Table 3. The TPDDTEC methodology allows the widest range of project types in the cooking regime, while the GS Simplified Methodology has very limited applicability conditions—i.e., only projects that involve firewood cookstoves or fuel switch from non-renewable to renewable firewood are allowed. The CDM methodology, AMS II.G, allows biomass fired stoves that include firewood, charcoal and biomass fuel mix situations.

The fuel switch projects moving from the non-renewable biomass to fossil fuels like LPG and coal are eligible under the TPDDTEC methodology. However, the emission reductions

can only be claimed against the energy efficiency improvement component. Under CDM, there are other methodologies like AMS-I.E, AMS-III.B, which allow fuel switch projects.

Table 3: Applicability conditions for eligible scope

Technology /scope		GS Simplified Methodology	AMS II.G	TPDDTEC
Improved cookstove, owen and dryers	**Fuel type/technology**			
	Firewood	Yes	Yes	Yes
	Charcoal	No	Yes	Yes
	Fuelmix	No	Yes	Yes
	Solar	No	No	Yes
	Biogas	No	No	Yes
	Plant oil based stoves	No	No	Yes
	Heat retention cookers	No	No	Yes
	Fossil fuel stoves	No	No	Yes[1]
Fuel switch	**Potential fuel switch scenarios**			
	Non-renewable to renewable biomass	Yes	No	Yes
	Non-renewable biomass to fossil fuel	No	No	Yes
	High GHG emitting fossil fuels to lower GHG emitting fossil fuels (e.g., kerosene to LPG)	No	No	Yes
	Fossil fuel to non-GHG emitting fuels (e.g., ethanol, biogas, solar)	No	No	Yes
Retrofitting	Existing biomass stoves/ovens/ dryers	No	Yes	Yes
	Existing fossil fuel stoves/ovens/dryers	No	No	Yes

Notes:
In the case of projects that introduce fossil fuel stoves like LPG, Coal, etc., based improved stoves, the emission reductions associated with differences in carbon content between a non-renewable fuel and fossil fuel shall NOT be eligible for Gold Standard certification.

In addition to the applicability conditions mentioned in Table 3, the TPDDTEC methodology also has a cap on the maximum thermal output for the project technology included in the project activity. The maximum energy output of the eligible improved cookstove shall not be more than 150kW per unit. An example to demonstrate how the energy output shall be estimated is provided in Box 2.

Box 2: How to estimate energy output?

In order to estimate the energy output of project cookstove, the following approach can be used:

Step 1: Estimate the energy consumption in kWh

Energy consumption (in kWh/stove/day) = Stove fuel consumption * Energy in one tonne of wood (in kWh)

The energy in wood fuel has an NCV of 0.0156 TJ/t which must first be converted into kWh by multiplying by 277778. This figure is then multiplied by the stove fuel consumption of 0.004 t/stove/day to give an estimated energy consumption of 17.33kWh/day.

Step 2: Estimate energy output

Energy output (in kW) = Energy consumption (kWh) / Estimated daily use (in hours)

If the estimated daily use is 3 hours, the estimated fuel consumption will be 17.33 / 3 = 5.78 kW

Step 3: Estimate the useful thermal energy output

Useful energy output (kW) = Estimated fuel consumption * Thermal efficiency of the stove (%)

Assuming that the thermal efficiency of the cookstove is 28%, the useful output will be 5.78 kW * 28% = 1.62 kW. This is the energy output that acts upon the stove and is therefore able to be used for cooking.

Both Gold Standard methodologies also set additional requirements to enhance the project design and ensure transparency among participants involved in the project development and operation. The additional requirements are summarised in Table 4.

Table 4: Additional requirements for Gold Standard methodologies

Requirements	Description
Double counting	Project developers shall ensure that project devices are not counted more than once and are not included in more than one project. Avoidance of double counting of emission reductions can be achieved via unique identifications of the devices and end-user locations (e.g. programme logo). Note that double counting is also applicable for AMS II.G methodology.
Incentive mechanism to discontinue the use of baseline technology	Project developers shall provide a clear description of the chosen approach to encourage the removal of the baseline technology and the success of the mechanism that has to be monitored. If an old technology remains in use in parallel with the improved technology (e.g. the removal and continued non-use of three stone fires and other easily constructed traditional devices is in many cases unlikely and impractical to monitor), corresponding emissions must of course be accounted for as part of the project emissions.
Ownership of carbon credits	See Figure 1: Carbon Credit Ownership The individual households and institutions do not act as project participants under Gold Standard methodologies. The project developer shall proactively inform the end-users and notify when they cannot claim emission reductions from the project. The project developer can use various methods to inform the end-users. For example, leaflets distributed with the products alerting end-users to the waiving of their carbon rights in exchange for discounted cost of cookstove (Fig. 1). Another example is using a waiver form signed by end-users.
Indoor Air Quality (only applicable for projects applying TPDDTEC methodology and where project activities make use of a new biomass feedstock)	Project developers shall ensure that indoor air pollution levels are not worsened when compared to the baseline. GHGs emitted by the project fuel/stove combination shall be estimated with adequate precision.

Notes:

1. TPDDTEC methodology allows a range of technology such as cookstove, biodigesters, water filter etc. However, the requirements mentioned in the table above are primarily limited to cookstove only.
2. Monitoring of auxiliary use is required in all three metodologies. Further details are provided in the relevant sections in this document.

Figure 1: An example leaflet to explain the carbon credit ownership
Credit: Ecoact

3.3 Number of Maximum Cookstoves

During the project planning stages, it is critical to assess the maximum number of improved cookstoves that can be included in a project under different methodologies. For example, the GS Simplified Methodology caps the maximum number of emission reductions that can be claimed per year at 10,000 tCO_2. The project developer can use the automated emission reduction calculation tool available for the GS Simplified Methodology to estimate the potential emission reduction and corresponding to maximum cookstoves that would be eligible for this methodology.

AMS.II G allows up to the number of improved stoves that correspond to the maximum energy saving level of 180GWh$_{th}$. Box 3 outlines the approach to determine the energy savings and shows how a project developer can assess the maximum number of stoves that can be included.

There is no cap on the maximum number of stoves, emission reductions or energy savings that can be included under the TPDDTEC methodology.

Box 3: How to calculate energy savings?

In order to check the maximum number of improved cookstoves that can be included in a project within the energy threshold i.e., 180 GWh$_{th}$ of AMS-II.G, the following stepwise approach can be applied:

Step 1: Estimate the maximum quantity of biomass saved corresponding to 180 GWH$_{th}$
The maximum fuel saving is estimated as the threshold value i.e., 180GWh/Net Calorific Value of the project fuel (in GWh/t)

Step 2: Estimate the maximum number of cookstoves
It is estimated that maximum number of cookstoves is the maximum quantity of biomass saved / annual fuel savings per stove (fuel savings for the stove can be determined through KPTs, CCTs or baseline default value and baseline/project stove efficiencies).

For example
The maximum quantity of biomass saved (in case of firewood) = 180 / 0.004333 = 41,538 ton where (0.004333 GWh/t is the NCV of firewood/firewood waste). Assuming that annual fuel savings per stove are 2.8 t/year, the maximum number of stoves = 41,538 / 2.8 = 14,835 stoves

4.0 Project Boundary

This section provides insights on the following questions:

- What is included in the project boundary for different methodologies?
- Which GHG emission sources are included in the project boundary?

4.1 Geographic Boundary

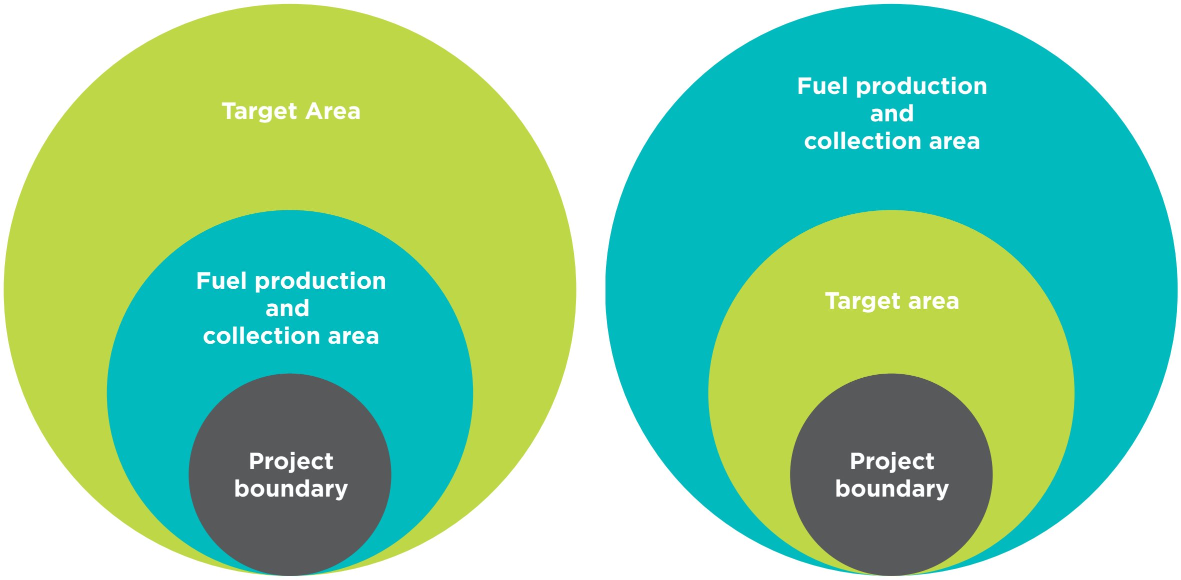
All cookstove methodologies require a physical delineation of the project boundary. For AMS-II.G, the physical, geographical site of the efficient cookstoves that utilise biomass are part of the project boundary, while for GS methodologies the fuel production and collection area shall also be included in the project boundary. The fuel production and collection area is the area within which the fuel is produced, collected and supplied. In addition, GS methodologies require project developers to clearly define the “Target Area” and “Target Population” to determine the outer boundary of the project. Doing so defines the area where the usage of baseline fuel consumption pattern shall be assessed to determine the baseline (Box 4).

Box 4: The Project Target Area and fuel collection and production area

The target area is the region(s) where the considered baseline scenario(s) are deemed to be uniform across political borders. This area could be within a single country, or across multiple adjacent countries. The target area provides an outer limit to the project boundary in which the project has a target population.

In cases where woody biomass (including charcoal) is the baseline fuel or where the project activity introduces the use of a new biomass feedstock into the project situation, the fuel production and collection area is the area within which this woody or new biomass is produced, collected and supplied.

In a project’s boundary, the target, fuel production and collection area might be identical. However, there may be cases where the project boundary is different to the target area and fuel production/collection area. Two examples are illustrated in Figure 2. Please note that the examples are not exhaustive, since there might be other configurations. For example, the fuel production/collection area may be located outside of the project boundary and target area.



Example 1:
The project target population is rural households across the entirety of Uganda (target area), however the improved cookstoves have been distributed in only one of the four regions (project boundary). The fuel (firewood) is sourced from two of the four regions (fuel production/ collection area).

Example 2:
The project target population is urban households in Mozambique (target area), however the improved cookstoves have been distributed in the capital Maputo only (project boundary). The charcoal for your project comes from all over the country (fuel production/collection area).

Figure 2: Examples for the delineation of project boundary, target area and fuel production/collection area under TPDDTEC

4.2 GHGs Emission Sources

It is important to understand which GHG emissions and emission sources in the baseline and project scenario are included in the project boundary. There is a significant difference between AMS-II.G and the GS methodologies in terms of the GHG emissions and sources included in the project boundary. GS methodologies account for both CO2 and non-CO2 GHGs, i.e., methane (CH4) and nitrous oxide (N2O) emissions, in the baseline and project scenario, while the AMS II.G only accounts for CO2 emissions. Since the fuel production, collection and transportation for GS methodologies are part of the project boundary, the respective emissions shall be accounted for in the baseline and project scenario. A summary of emissions and its sources are presented in Tables 5 and 6.

Table 5: GHG emissions included in each methodology

GHGs	GS Simplified Methodology	AMS II.G	TPDDTEC
Carbon dioxide (CO_2)	Included	Included	Included
Methane (CH_4)	Included	Excluded	Included
Nitrous Oxide (N_2O)	Included	Excluded	Included

In all cases, sources can be conservatively ignored in the baseline, while all sources shall be included for the project scenario, unless arguably negligible or inapplicable to the individual project. The project developer must ensure that the calculation of GHG emission reductions from the project is conservative.

Table 6: Emission sources included in each methodology

Emission sources in baseline and project scenario	GS Simplified Methodology	AMS II.G	TPDDTEC
Fuel consumption	Included	Included	Included
Fuel production	Included	Excluded	Included
Fuel transportation	Included	Excluded	Included

5.0 Baseline and Project Scenario Identification

The following sections provide a concise overview of emission reductions accounting approaches for different improved cookstove methodologies. It includes explanations of how the baseline, project scenario, emission reductions, and leakage are dealt with by the different methodologies. This section provides insights on the following questions:

- How are the baseline and project scenarios identified?
- How is the validity of the baseline determined?

5.1 Baseline Scenario Identification

A baseline scenario represents the typical pre-project fuel consumption patterns in a population that is targeted for improved cookstoves. The methodologies outline different approaches for selecting the appropriate baseline scenario. The CDM methodology, AMS-II.G, assumes that in the absence of the project activity, a mix of fossil fuels, such as kerosene, LPG, and coal as the alternatives to solid fossil fuel and would have been used by default to satisfy cooking requirements. For the GS Simplified Methodology, the baseline scenario is the consumption of non-renewable firewood to meet thermal energy requirements for household cooking. The baseline scenario under TPDDTEC is the typical baseline fuel consumption patterns in target population. The project developer may identify multiple baseline scenarios that are applicable in relation to the different project technologies in the activity, depending on local fuel and technology use patterns. For example, one baseline scenario may represent rural end-users predominantly using inefficient wood stoves, while the second baseline scenario may represent a target population predominantly using inefficient charcoal stoves.

Furthermore, the TPDDTEC methodology allows various combinations of baseline and project scenarios. For example, different improved wood stove models in the project activity could be compared to the same wood baseline scenario, and different improved charcoal stove models in the project activity could be compared to the same charcoal baseline scenario. The baseline scenario must be adequately described with all relevant technologies included. It is not legitimate to compare the project to only the most inefficient technology being used in the baseline.

In many projects, the project technology is adopted progressively through the crediting period of the project. The baseline situation therefore does not occur at the same time for all technology purchasers.

Box 5: TPDDTEC Methodology: +/-5% rule

The TPDDTEC methodology allows for project technologies with similar design and performance characteristics to be included under a single project scenario. For example, improved cookstoves can be considered similar if they are based on the same fundamental combustion technology and their respective thermal efficiencies or specific consumptions do not differ by more than +/-5% in absolute terms. Similarly, comparable project technologies may share the same monitoring procedures. Project technologies with significantly different performance characteristics (e.g. fuel consumption characteristics in the case of stoves) are treated as independent project scenarios and hence monitored and credited separately.

5.1.1 Baseline Validity

In a project targeting households where all cookstoves are installed at the start, the baseline is considered by default fixed in time during the considered crediting period for all the three methodologies.

It therefore does not require continuous monitoring. However, whenever the project proponent applies for a renewal of the crediting period, the baseline must be reassessed following the applicable rules for renewal of the crediting period.

5.2 Project Scenario Identification

A project scenario is defined by *the fuel consumption patterns of end-users within a target population* that adopt a project technology. The TPDDTEC methodology allows for different types of efficient cookstoves to be installed in a single project activity, creating multiple project scenarios. As mentioned above, different project scenarios can be credited against the same baseline scenario if it is deemed applicable. For example, the same baseline scenario for inefficient wood stoves could be compared to separate project scenarios for two or more different improved wood stove models in the project activity.

Box 6: TPDDTEC methodology: How to add additional baseline and project scenarios?

Project proponents must consider distinct baseline and project scenarios when the project activity targets end-user populations that consume significantly different fuels or when different technologies are considered in a given project. For example, end-users cooking predominantly with wood are significantly different from end-users cooking predominantly with charcoal, and would thus warrant a different baseline scenario. Ideally, all expected baseline and project scenarios shall be defined in the project documentation in time for validation and registration review. However, it is possible that during the crediting period a new stove model is included in the project activity, which warrants a new project scenario. The TPDDTEC allows adding additional baseline and project scenarios to a project activity at any time during the crediting period. This can only be applied upon approval of a request for design changes, as per Gold Standard rules. Emission reductions cannot be credited for a new project scenario, or in relation to a new baseline scenario, until the respective project studies or baseline studies have been conducted.

6.0 Quantification of GHG Emission Reductions

This section provides answers to the following key questions:

- How are the emission reductions estimated?
- What is the fundamental difference between the CDM and Gold Standard methodologies?
- What are the different methods used to estimate emission reductions?
- What are the monitoring requirements for different methods?
- How does the leakage assessment differ in these methodologies?

Emission reductions are determined by comparing fuel consumption in a project scenario to the applicable baseline scenario. Fundamentally, all the three methodologies follow the same principles for emission reduction calculations. The emission reductions are a product of the amount of woody biomass saved, number of operational devices, operational days, the fraction that is considered non-renewable biomass, the net calorific value (NCV) of the biomass, and an emission factor for the fuel avoided. Figure 3 illustrates the dif-

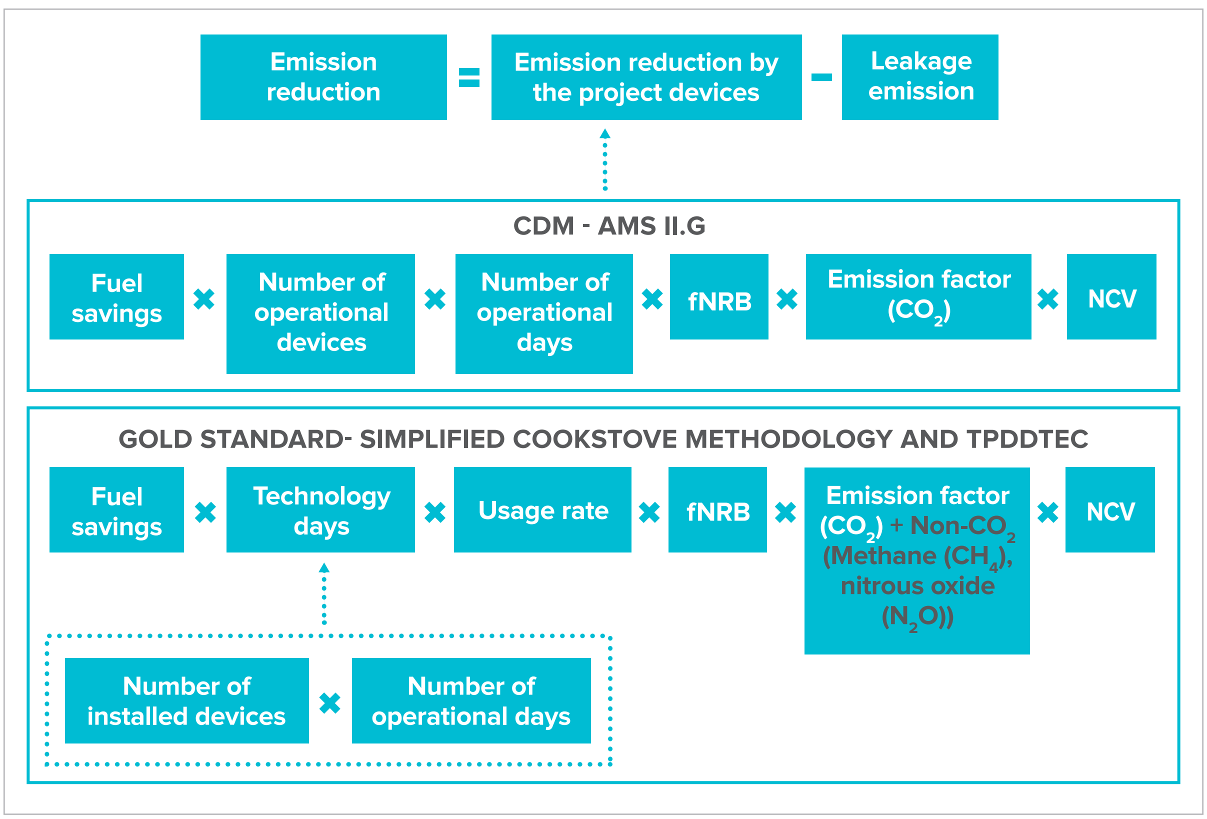


Figure 3: Parameters for estimation of emission reductions at project level

ferences and similarities between CDM and Gold Standard methodologies in a simplistic way. There are several parameters of interest for the estimation of emission reductions at a project level as depicted in Figure 3. The following sections provide further insight into the relevant parameters for different methodologies. Where applicable, the relevance of the parameters for the specified methodology has been highlighted. However, it is recommended to refer to the methodology itself to ensure the applicability and relevance.

6.1 Fuel Savings

The "fuel saving" criteria, defined as the reduction in fuel consumption following the introduction of an improved cookstove (either through efficiency gains or fuel switching), is one of the primary parameters of interest for quantifying emission reductions. The three methodologies have common as well as some distinct fuel consumption estimation methods. The CDM methodology, AMS-II. G, offers four different options: (i) Thermal Energy Output (TEO), (ii) Kitchen performance test (KPT), (iii) Water boiling test (WBT) and (iv) Controlled cooking test CCT. The GS methodology, TPDDTEC[6] only allows KPT or the recently approved combination of KPT and WBT[7], while the GS Simplified Methodology allows to use WBT and KPT method for fuel consumption estimation. A summary of eligible methods for fuel saving applicable under each methodology is provided in Table 7.

Table 7: Fuel consumption estimation methods

Option	Method	GS Simplified Methodology	AMS II.G	TPDDTEC
1	Thermal Energy Output (TEO)	No	Yes	No
2	Water boiling test (WBT)	Yes	Yes	No
3	Controlled cooking test (CCT)	No	Yes	No
4	Kitchen performance test (KPT)	Yes	Yes	Yes
5	Kitchen performance test and water boiling test	No	No	Yes

There are a number of tradeoffs related to accuracy versus degree of complexity and costs involved for fuel consumption estimation methods as depicted in Fig. 4. Fuel consumption can be driven by several factors (e.g., geography, climate, and cooking practices), making it highly difficult to apply an adequate one-size-fits-all estimation approach (Lee et.al., 2013). The user shall select the method considering the requirements and complexities involved. For example, the WBT method is the simplest method because it is cheaper and easier to implement, however, it does not always accurately represent household cooking conditions. To further assist the developers, a comparison of the three primary test methods is provided in Annex 2.

[6] A baseline KPT is not necessary if a default efficiency is applied to baseline stoves. In this case the only test needed is a project stove KPT. This is a "SINGLE SAMPLE" KPT.

[7] For further details see "Revision to the TPDDTEC methodology" GS TAC rule update (18/12/2015) available at http://www.goldstandard.org/articles/tac-rule-updates

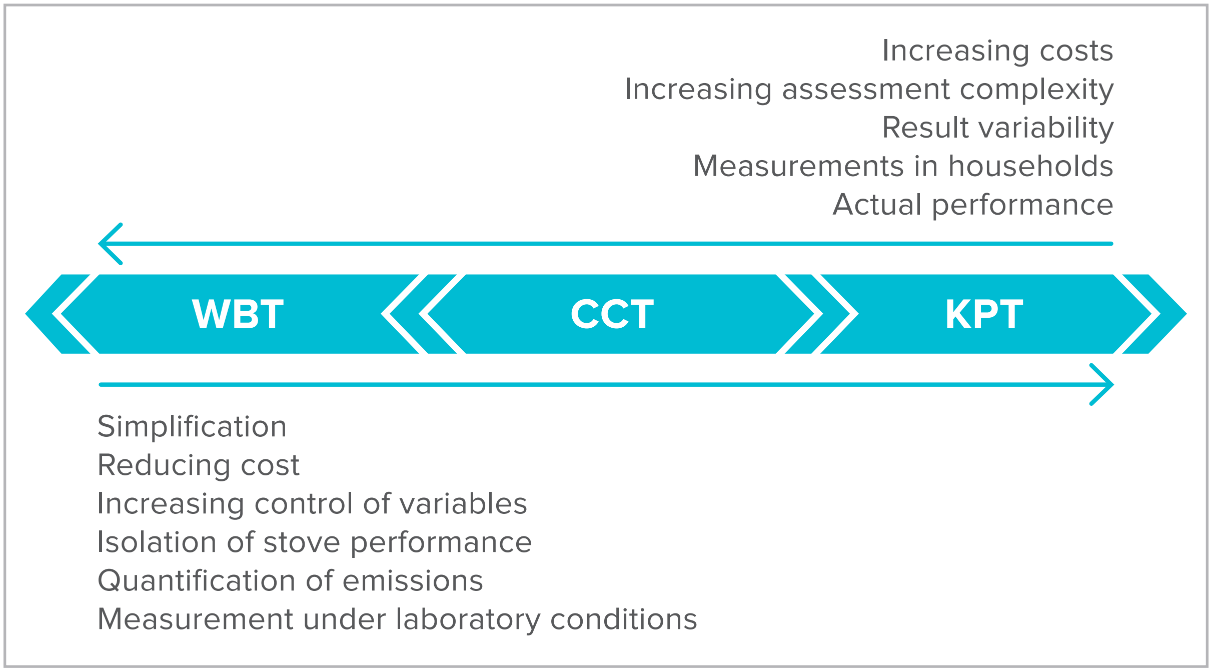


Figure 4: Relative benefits and tradeoffs of fuel consumption estimation methods

Source: Adapted from Lee et al., (2013)

Furthermore, each of these methods require additional input parameters to estimate the fuel savings due to implementation of the project cookstoves. Table 8 provides the details of these methods, corresponding requirements and how the values for these parameters are estimated. It does not include the common parameters like NCV and emission factors, which are discussed in detail in the following section. Note that the description/notification/terminology in different methodologies may vary for some parameters.

Table 8: Fuel saving estimation methods

Option	Method	Input parameter required	Method	Source/How
1	Thermal Energy Output (TEO)	Number of hours of utilization	Monitoring	Survey
		Rated thermal capacity of project device	Measurement	Manufacturer specification
		Efficiency of the baseline devices	Default	Three stone fire or conventional device, not charcoal stove (0.10)
				Other device (0.2)
			Measurement	
		Efficiency of the project device	Measurement	Certificate by national standard body or
				Appropriate certifying body/ agency or
				Manufacturer specification, or
				Sample test
2	Water boiling test (WBT)	Baseline fuel consumption	Default	0.5 tonnes/capita per year
			Survey	Following sampling and surveys for CDM project activities and programme of activities
			Historical	Literature or published reports relevant to project boundary
		Efficiency of the baseline devices	Default	Three stone fire or conventional device, not charcoal stove (0.10)
				Other device (0.2)
			Measurement	Efficiency tests
		Efficiency of the project device	Measurement	Certificate by national standard body or
				Appropriate certifying body/ agency or
				Manufacturer specification, or
				Sample test
		Project fuel consumption	Survey	Sample surveys, that are solely based on questionnaires or interviews
			Measurement	Measurement campaigns at representative households
3	Kitchen performance test (KPT)	Baseline fuel consumption	Default	0.5 tonnes/capita per year
			Measurement	Baseline kitchen performance test (Baseline KPT)
		Project fuel consumption	Measurement	Project kitchen performance test (Project KPT)

4	Controlled cooking test (CCT)	Specific fuel consumption or fuel consumption rate of the baseline stove	Measurement	Controlled cooking test following CCT protocol
		Specific fuel consumption or fuel consumption rate of the project stove	Measurement	Controlled cooking test following CCT protocol
5	Kitchen performance test and water boiling test	Baseline fuel consumption	Measurement	Baseline Kitchen performance test (Baseline KPT)
		Project fuel consumption	Measurement	Project kitchen performance test (project KPT)
		Efficiency of the project device	Measurement	Lab or field test following Water boiling test (WBT) protocol

6.2 Baseline Fuel Consumption

The baseline fuel consumption is the quantity of fuel that is consumed prior to the improved cookstove, i.e., baseline scenario or pre-project scenario. The project developer can choose from a range of options available for baseline fuel consumption estimation according to the applicable methodology. A brief description of each option is presented in Table 9.

Table 9: Baseline fuel consumption estimation methods

Estimation method	Description
Default value (0.5 tonnes/capita per year)	CDM and Gold Standard methodologies provide the default woody biomass consumption values for baseline fuel consumption. To estimate the fuel consumption at the household level, the default value is multiplied with the family size, determined through surveys. The GS methodologies allow for applying default values for baseline scenarios where the firewood is the only baseline fuel[i]. The default value is applicable to the project located across the regions of the world. This is the simplest approach, however, in some cases it could be lower in comparison to the actual fuel consumption level in the project boundary. The developer shall carefully assess the local cooking practices prior to applying the default values, since in most cases the baseline fuel consumption level is fixed for the entire crediting period. Only the TPDDTEC methodology provides flexibility in updating the baseline (default value) at any time during the crediting period. To update the default baseline, the developer shall carry out the baseline Kitchen Performance Tests (KPT) in households where the baseline technology is still in use in the project area. In addition, the PP shall establish that the selected sample households exhibit the same socio-economic circumstances as the households that have already received the improved devices in the project activity.

Survey method	AMS II.G and GS Simplified Methodology allow for the determination of the average annual consumption of woody biomass per device (tonnes/year) via a sample survey conducted in the target population following the latest version of "Guidelines for sampling and surveys for CDM project activities and programme of activities". The guidelines describe common types of sampling approaches with examples and also includes a sample size calculator toolto assist project developers. The GS Simplified Methodology only provides the guidelines for minimum sample size required for simple random sampling approach and the survey template to collect the required information. However, for other sampling approaches, the developer can refer to "Guidelines for sampling and surveys for CDM project activities and programme of activities"
Historical data	AMS II.G and GS Simplified Methodology also allow sourcing of the baseline fuel consumption values from relevant published literature. To apply this method, the developer shall justify the relevance of historical values with the target population. Please refer to TPDDTEC V2.0 Footnote 24, Page 19 for suppressed demand cases for micro and small scale activity, where historical data from credible literature such as a credible and validated report from a survey by a third party can be used if baseline fuel in only fuelwood.
Baseline Kitchen performance test (KPT)	AMS II.G and GS methodologies allow the baseline Kitchen Performance Test (baseline field tests (BFT)) to measure the fuel consumption level in a sample household. It is a field test based method that measures the real fuel consumption level in a representative sample of target households for each defined baseline scenario (in the absence of the project technology). The KPT is carried out in accordance with national standards (if available) or international standards or guidelines (e.g. the KPT procedures specified by the partnership for clean indoor air (PCIA). The TPDDTEC methodology also provides simplified guidelines for project developer to carry out the KPTs how to determine the sample size and assess the result. Please refer to Annex 4: Kitchen Performance Test of TPDDETC methodology, page 46.
Specific fuel consumption (tonnes fuel/unit output or tonnes fuel/hour)	The specific fuel consumption (SFC) or fuel consumption rate of the baseline stoves is determined following the Controlled Cooking Test (CCT) protocol that primarily compare the performance of an improved stove to a traditional stove in a standardized cooking task. The specific fuel consumption or fuel consumption rate of the baseline devices is fuel consumption per quantity of item/s processed (e.g. food cooked) or fuel consumption per hour, respectively. The developer shall refer to national (if available) or international standards or guidelines for CCT.
The TPDDTEC methodology caps the baseline wood fuel consumption at 0.5 t/capita/year estimated using 10% default efficiency for suppressed demand situation and case of single sample test. All relevant cookstove national/international protocols are available at the Global Alliance for Clean Cookstove (GACC) website at the following link: http://cleancookstoves.org/technology-and-fuels/testing/protocols.html	

6.3 Project Fuel Consumption

The project fuel consumption is the quantity of fuel that is consumed after installation of the improved cookstove in the project scenario. The fuel consumption is monitored and/or adjusted for performance degradation of the project technology over the crediting period. A brief description of each option and monitoring requirements are presented below in Table 10. Note that the fuel consumption estimation methods summarised below are not alternatives to each other in all cases. The developers are to select one of the options and corresponding estimation method summarised in Table 10. For example, the survey method and measurement method summarised in Table 10 are alternative methods only for option 2: Water Boiling Test (WBT).

Table 10: Project fuel consumption estimation methods

Estimation method	Description
Survey method	AMS II.G allows a developer to determine the project fuel consumption solely based on questionnaires or interviews on the condition that the baseline stoves have been completely decommissioned and only efficient project stove(s) are exclusively used in the project households. If more than one device, or another device that consumes woody biomass, are in use in project households, then the sample survey needs to distinguish the quantity of biomass used by the project device and the other devices that use biomass.
	Monitoring requirements: The surveys are carried out during the first year of the crediting period and fuel consumption is adjusted for efficiency loss for the remaining crediting period. If the life span of the improved cookstove is less than the crediting period, then either the cookstove shall be replaced after the lifespan has ended or emission reductions can only be claimed until the end of lifespan of the cookstove.
Measurement method	AMS II.G also allows a developer to determine the project fuel consumption based on measurement campaigns carried out at representative households.
	Monitoring requirements: The measurement campaign is carried out during the first year of the crediting period. Fuel consumption values are adjusted for efficiency loss for the remaining crediting period, following the same approach as provided above for survey methods.
Project KPT	AMS II.G and TPDDTEC allow the project KPT (project performance field tests (PFT)) to measure the fuel consumption level at the sample households. It is a field test based method that measures the real fuel consumption level in a representative sample of target households for each defined project scenario (with the improved cookstove).
	Monitoring requirements: The 1st project KPT is carried out in the first year of commissioning of improved cookstoves following the KPT protocol as mentioned above for the baseline KPT. The AMS II.G requires annual monitoring while the TPDDTEC allows biennial project KPT updates.
Specific fuel consumption	For AMS II.G, project specific fuel consumption or fuel consumption rate of the project cookstoves is determined in representative households in the same way as for the baseline cookstove following the CCT protocol, as discussed above.
	Monitoring requirements: Specific fuel consumption or fuel consumption rates are updated annually following the CCT protocols.

6.4 Efficiency and Efficiency Loss

The project's baseline and cookstove efficiency are required to estimate the fuel consumption level as summarised in the table above. The AMS.IIG provides options to measure or use the default efficiency values for two categories of baseline stoves:

i. 10% for three stone fire using firewood or conventional device with no improved combustion air supply or flue gas ventilation, that is without a grate or a chimney, and

ii. 20% for other type of devices.

Alternatively, the efficiency level can be determined using the WBT protocol or referring to relevant literature values. The baseline stove efficiency is determined prior to project implementation and remains fixed for the entire crediting period.

The AMS II.G allows project developers to have the project stove efficiency certified by a national standards body or an appropriate certifying agent recognized by that body. Alternatively, manufacturer specification can be used. The project stove efficiency can also be measured by carrying out the test using the WBT protocol measured by sample testing. In both cases, sourced or measured by the developer, the efficiency test results shall meet precision requirement, i.e., 90/10. The developer shall always confirm the compliance with the manufacturer or certifying body prior to distribution of project stoves.

Unlike for the baseline stove, the project stove performance is adjusted to account for efficiency loss during the monitoring period for AMS II.G and GS Simplified Methodology. AMS II.G provides several options to account for efficiency loss, such as using the default value or annual testing to monitor the efficiency loss in a representative sample. Alternatively, no decrease in efficiency of the improved device can be claimed, if justified on a technical basis by the manufacturer or certification agency. This option shall be identified with due care and consideration for the follow-up requirements as it will remain fixed for the entire crediting period at the time of registration.

GS Simplified Methodology provides two options:

i. Default efficiency loss

ii. Annual monitoring of efficiency loss

Although AMS II.G and GS Simplified Methodology both provide the default values, the application and default values are different. For example, AMS II.G assumes a linear efficiency loss across the project lifespan and assumes a terminal project stove efficiency of 20%. If the lifespan of the project device is five years and the project device has an efficiency of 30% at installation, then an annual efficiency loss of 2% shall be applied. To adopt the de-

fault value option, the life span of the project stove, based on manufacturer's specification, shall be documented at the time of registration. The GS Simplified Methodology provides the default annual efficiency loss as 1%, i.e., 0.99. Though it doesn't account for the lifespan of the cookstove, it requires monitoring of the cookstove conditions annually through monitoring surveys. The cookstove database is adjusted in equal proportion to the fraction of sampled households where the cookstoves are not in working condition. New cookstoves are added back to the database as and when they are replaced.

6.5 Rated Thermal Capacity

AMS.II G provides a simplified method: Thermal Energy Output (TEO). It requires the rated thermal capacity of the project cookstove along with other parameters to estimate the fuel savings. The manufacturer's specification is used for the rated capacity of the project cookstoves. It is fixed from the start of the project.

6.6 Emission Factors

AMS II.G provides the default emission factor based on projected fossil fuels for similar users, while the GS Simplified Methodology provides default CO_2 and Non-CO_2 emission factors for firewood. The TPDDTEC methodology primarily relies on IPCC default factors, which express emissions as a function of the energy content of fuels consumed. It also provides a range of options like literature or project relevant measurements provided the defined criteria for project specific measurement are met.

AMS II.G allows a developer to claim emission reductions for reducing CO_2 emissions only for projected fossil fuel. The emission factor of the projected fossil fuel likely to be used by similar users is estimated based on a weighted average of a mix of present and future fuels. It consists of a solid fossil fuel (lowest in the ladder of fuel choices), a liquid fossil fuel (represents a progression over solid fuel in the ladder of fuel use choices) and a gaseous fuel (represents a progression over liquid fuel in the ladder of fuel use choices). The weighted average value of 81.6 (t CO_2/TJ) represents a mix of 50% coal, 25% kerosene, and 25% LPG fuel.

Contrary to AMS II.G, the GS methodologies emission factors are based on the assumption that the actual baseline fuel would be used in the absence of the project activity. In addition, both GS methodologies allow a developer to claim emission reductions from non-CO_2 GHGs, i.e., methane and nitrous oxide (CH_4 and N_2O) as well as emissions produced during fuel production. The non-CO_2 GHGs are applied to the total biomass savings of the improved stove, not only non-renewable biomass, because the non-CO_2 GHGs emission result from combustion of both renewable and non-renewable biomass cannot be reabsorbed and balanced by renewable biomass growth. Using the Gold Standard methodologies, the combined effect of the additional accounting of CH_4 and N_2O emissions from biomass combustion, plus the use of real conditions for the baseline (instead of fossil fuel values as in AMS II.G) can influence the emission reductions significantly in comparison to AMS II.G[8,9]

6.7 Fraction of Non-Renewable Biomass (fNRB)

Fraction of non-renewable biomass (fNRB) is the fraction of woody biomass saved by the project activity that can be established as non-renewable biomass. It is a key parameter for all the three methodologies. Guidelines for assessment methods are defined in each methodology. The TPDDTEC methodology allows both qualitative and quantitative methods; however, quantitative assessment is the most preferable approach. Furthermore, the TPDDTEC and GS Simplified Methodology accept the fNRB values estimated using the guidelines provided in AMS II.G. The developer can estimate the project specific or sub-national/national values using these guidelines.

To assist developers, the CDM Executive Board (CDM EB) has approved the national level default fNRB values for several countries. However, the default values are only allowed to be used if it is endorsed by the host country's Designated National Authority (DNA). In cases where it is not endorsed or developed by the CDM EB, the developer can

[8] Blunck, M., Griebenow, C., Rammelt, M. and Zimm, C. (2011). Carbon Markets for Improved Cooking Stoves: A GIZ Guide for Project Operators. Revised Edition - January 2011. GIZ-HERA.
[9] Carrie M. Lee, Chelsea Chandler, Michael Lazarus, Francis X. Johnson (2013). Assessing the Climate Impacts of Cookstove Projects: Issues in Emissions Accounting. Stockholm Environment Institute, Working Paper 2013-01

estimate and get it validated by the Designated Operating Entity. Although GS methodologies allow a developer to use fNRB default values without formal DNA endorsement, they require the project developer to get endorsement form relevant stakeholders (Box 7). Please refer to the CDM website for the latest information on endorsed fNRB value (https://cdm.unfccc.int/DNA/fNRB/index.html).

The fNRB values are selected or estimated prior to project registration and either fixed for the entire crediting period, or they can be updated annually for AMS II.G, while the GS Simplified and TPDDTEC methodology provide the flexibility to reassess and update it any time prior to the end of the crediting period.

Box 7: How can project developer use the default fNRB values that are approved by CDM EB but not yet endorsed by the host country DNAs?

The CDM EB has approved the default fNRB values (https://cdm.unfccc.int/DNA/fNRB/index.html) for several countries, however not all host country DNAs have approved the respective country specific default values. The developer may still use such default fNRB values for Gold Standard methodologies. The developer shall carry out stakeholder consultation to collect feedback from relevant stakeholders. If the comments raised during the public consultation can be replied satisfactorily and validated by the DOE, the developer can use the default values. The developer shall identify the relevant stakeholders that includes the host country DNA, other ministry/department of forestry, other active NGOs, and other relevant agencies.

6.8 Other Parameters

6.8.1 Number of Hours of Utilization

The number of hours of project stove utilisation are required for the TEO method. The number of hours of utilisation are estimated biennially through surveys in the sample households of the project population.

6.8.2 Net Calorific Value (NCV)

AMS II.G and TPDDTEC use the IPCC default value i.e., 0.015 TJ/tonne for firewood. AMS II.G requires that the NCV for other fuels like charcoal or briquette is measured annually. TPDDTEC allows to source NCV value for other fuels from project relevant literature or from project specific measurement, however, the values are fixed for entire crediting period. Since the GS Simplified Methodology only allows fuelwood cookstoves, the NCV has already been accounted for in default emission factors provided in the methodology.

7.0 Monitoring Methodology and Requirements

In addition to the monitoring parameters relevant to fuel saving estimation methods discussed above, there are common and distinct additional monitoring requirements for each methodology. In the following sections, these requirements are discussed in detail.

7.1 Sales Record and Project Database

The objective of the sales record and project database is to provide required information about the technology, location, user, etc., for monitoring, sampling and emission reduction calculations. The GS methodologies clearly define the information required for sales record, i.e., information on sales date and installation date, location, model type of cookstoves and contact details, retailers and end-users such as name, address and telephone number (if available), and mode of use. It is required to collect information about all users except in cases where it is justifiably not feasible. It should always be 10 times greater than the survey and field test sample size, therefore comprising a large enough population for sample selection. The sales record is updated regularly to account for the new sales during the project life. AMS II.G requires monitoring of the date of commission for each device. However, maintaining sales records and project databases is not mandatory as they are implied ion details required for sampling and monitoring purposes. Further details on key parameters and their interpretation and use for GS and AMS II.G methodology is discussed in the section below.

7.1.1 Sales Date and Installation Date (Commissioning Date)

GS methodologies require the record of the sales date and installation date to be recorded (commissioning date for AMS II.G). All three methodologies allow the use of the individual cookstove installation commissioning date or conservative date for a group of stoves to be used for emissions reduction calculation. AMS II.G requires that in cases where the cookstoves are grouped in batches, the latest date of commissioning of the device shall be used as the commissioning date for the entire batch. However, GS methodologies allow for the application of conservative estimates in such cases.

7.2 Monitoring Survey

The GS methodologies require annual monitoring surveys to collect critical information on year-to-year trends in end-user characteristics, such as technology use, fuel consumption and seasonal variations. The objective is to evaluate if there are any drastic changes in cooking patterns in the target population.

7.2.1 Usage Survey

Usage assessment, i.e., estimation of the number of operational cookstoves, is a critical parameter for emission reduction estimation. Primarily, all three methodologies allow the survey method to capture the relevant information, while AMS II.G also provides an option of direct monitoring of usage. The sample size requirements are different under three methodologies as highlighted in Table 11 below.

Table 11: Usage survey

Requirements	GS Simplified Methodology	AMS-II.G	TPDDTEC
Frequency	Annual	Biennial	Annual
Method	Survey	1. Survey 2. Direct measurement	Survey
Sample selection	Sampling among the each age group of project population	Sampling among the each batch commissioned	Sampling among the each age group of project population
Accounting	Weighted average factor for overall project population	Usage discount for each batch commissioned	Weighted average factor for overall project population
Sample size	Minimum sample size for each age group • Project target population < 300: Minimum sample size 30 • Project target population 300 to 1000: Minimum sample size 10% of group size • Project target population > 1000 Minimum sample size 100	Sample size to achieve 90/10 precision	Minimum 100, with at least 30 samples for project technologies of each age being credited

7.2.2 Number of Stove Utilization Days

Since only project stove usage leads to emission reductions, it is therefore required to monitor the usage intensity of the stoves annually if the baseline and project stove are used together, which is translated into the number of project stove utilisation days. AMS II.G defines two options to monitor stove utilisation days:

i. Data loggers

The data loggers such as Stove Utilisation Monitors (SUMs) shall be used over a 90-day measurement campaign to monitor all stove usage in at least 10 randomly selected project households.

ii. Survey method

Alternatively, the surveys can be conducted in the randomly selected households to capture information on cooking habits and stove usage to determine the usage frequency of all stoves. However, the surveys may only be conducted if the use of data loggers to record the continued operation of baseline devices is demonstrated to be impractical, for example when the baseline device is the three stone fire.

During the days where both devices have been used, if the data loggers are able to detect and record the time each device has been used (e.g. in hours), the share in the total duration of utilisation will be used to attribute a fraction of this day to one or to the other device. Alternatively, if the data loggers are not able to determine the duration of the utilisation, but only the situation of the device being on or off (i.e. used or not used during that day), the share of 50:50 may be used.

The field test-based approach accounts for the fuel consumption of all stoves used by households and estimate the fuel savings at the household level by comparing the fuel consumption in the baseline and project scenario. Therefore, it is not required to estimate the baseline and project stove use separately when field tests are carried out for TPDDTEC. However, the auxiliary stove use is monitored through surveys to determine the level of use so that the developer can implement a robust incentive programme to discourage the use of auxiliary stoves. In these cases, the number of operational days are estimated using the project sales record and monitoring period.

The GS Simplified Methodology also requires the monitoring of the baseline stove use in the project scenario. The frequency of the baseline stove usage is further applied to adjust fuel quantity, like AMS II.G. The usage frequency is determined separately with each project age-group following the survey template provided in the methodology.

7.3 Monitoring Frequency

The project fuel consumption monitoring requirements have been discussed in section 6.0 and table 10. In addition, there are a few common monitoring parameters that are applicable to each method, as discussed in the section above. As summarised above, the three methodologies have different as well as common monitoring parameters and requirements. There are also differences in monitoring frequency and sample size requirements for surveys and tests. A summary of monitoring frequency for relevant parameters and sample size requirements for surveys and tests (including one time surveys and tests) are provided in Table 12 and 13, respectively. Note that the monitoring parameter requirements correspond to the methods chosen at the time of project registration. Therefore, not all parameters listed in Table 12 and 13 are applicable to all projects.

Table 12: Monitoring frequency of relevant parameters

Monitoring parameter	Monitoring frequency		
	GS Simplified Methodology	AMS-II.G	TPDDTEC
Project database/Sales record			
Total sales record/project database	Continuous	Continuous	Continuous
Survey			
Monitoring survey	Annual	Biennial	Annual
Usage survey	Annual	Biennial	Annual
• **Number of operational stove**	Annual	Biennial	Annual
• **Number of operational days**	Not required	Annual	Not required
• **Number of utilization hrs**	Not required	Biennial	Not required
Fuel characteristics and fuel consumption			
NRB assessment update	Fixed or update anytime during the crediting period	Fixed or Annual update	Fixed or update anytime during the crediting period
Net Calorific value (Fuel other than firewood)	Not required	Annual	Not required
Baseline performance field test updates	Not required	Not required	Not mandatory[1]
Project performance field test updates	Not applicable	Annual	Biennial
Project stove efficiency	Annual or default efficiency loss	Annual or alternative methods	Annual[2]
Specific fuel consumption	Not applicable	Annual	Not applicable
Leakage assessment			
Leakage assessment	Not required for individual activity however for VPAs under microscale PoA biennial or default values	Annual or biennial ex-post survey or default values	Biennial

Notes:
TPDDTEC

1. If a PP would like to update the baseline during the crediting period, the baseline performance field tests shall be carried out as per the requirements mentioned in the methodology (page 8).
2. If aging test approach for project fuel update is applied. Please refer to rule update available here.

Table 13: Sample size for surveys and tests

Parameter/data	GS Simplified Methodology	AMS-II.G	TPDDTEC
Survey			
Monitoring survey	• Population size <300: at least 30 • Population size 300 to 1000: at least 10% of group size • Population size > 1,000: at least 100	Sample size to achieve 90/10 confidence precision	• Population size <300: at least 30 • Population size 300 to 1000: at least 10% of group size • Population size > 1,000: at least 100
Usage rate	Same as for monitoring survey	Sample size to achieve 90/10 confidence precision	Minimum 100, with at least 30 samples for project technologies of each age being credited
• **Number of operational stove**	Same as for monitoring survey	Sample size to achieve 90/10 confidence precision	Same as for usage survey
• **Number of operational days**	Not required	In case of measurement campaign: At least 10 randomly selected Household for at least 90 days or In case of surveys: Sample size to achieve 90/10 confidence precision	Not required
• **Number of utilization hours**	Not required	Sample size to achieve 95/10 confidence precision	Not required

Table 14: Fuel characteristics and fuel consumption

Baseline fuel consumption (survey method)	Same as for monitoring survey	As per the survey approach	Not applicable
Baseline fuel consumption (performance test (KPT method)	• Recommended Sample size 30, and • Annual fuel saving shall meet "90/10 confidence precision	Sample size to achieve 90/10 confidence precision	• Sample size > 20, and • Annual fuel saving or emission reduction shall comply with "90/30 rule"1 • If complying with the 90/30 requirements, apply mean savings or emission reduction. If not apply lower bound to estimate overall emission reduction
Project fuel consumption (Project KPT)	Not applicable	Sample size to achieve 90/10 confidence precision	• In case of paired and independent sampling same as for baseline KPT In case of single sample test: • Sample size > 20, and • Annual project fuel consumption or emission reduction shall comply with "90/10" rule • If complying with the 90/10 requirement, apply mean project fuel consumption. If not apply upper bound to estimate overall emission reduction
Project stove efficiency	3 sample runs on at least 3 randomly selected project cookstove	• Sample size to achieve 90/10 confidence precision • 3 stoves with 3 tests each (in case of stoves produced by manufacturer with a good quality management system): accepted if Standard Deviation is small and 90/10 applying the t-distribution is met	• Comply with the 90/10 requirement confidence precision level for each age group

Efficiency loss	• In case that discount factor for efficiency loss is used, not monitored • In case that project stove efficiency is annually monitored, discount factor to account for efficiency loss is subsumed in the degrading stove efficiency	Sample size to achieve 90/10 precision • 3 stoves with 3 tests each (in case of stoves produced by manufacturer with a good quality management system): accepted if SD is small and 90/10 applying the t-distribution is met	Sample size to achieve 90/10 precision for each age group
Leakage	Same as monitoring survey, both leakage and monitoring survey can be done together	• Sample size to achieve 90/30 confidence precision	Same as monitoring survey, both leakage and monitoring survey can be done together

Notes:
TPDDTEC

1. You should take into account that for some parameters under the TPDDTEC the sample size must be greater than 20. However, the recommended sample size is least 30.
2. The baseline and project field test data must be analysed in combination to estimate the average annual emission reductions or average fuel savings per unit for each scenario. If the baseline fuel and project fuel are same (e.g. deployment of improved cook stove only), the statistical analysis can be conducted with respect to fuel savings per unit. In cases where baseline fuel and project fuel are different (different emission factors), the statistical analysis must be conducted with respect to emission savings per unit.

7.4 Leakage

The TPDDTEC methodology requires the risk assessment of potential leakage sources including potential reuse of the baseline stoves, use/diversion of non-renewable/fossil fuel saved under the project activity by non-project population, project impact on fNRB in other emission reduction project collection area, use of other fuel/technology to compensate the loss of space heating in target population and the project impact on lower GHGs emitting technology. If the assessment reveals leakage that quantifies an increase in fuel consumption by the non-project households/users attributable to the project activity, the emission reduction calculation shall account for the quantified leakage. The project

always carries risks of potential leakage during its crediting period. Therefore, this methodology requires a biennial leakage risk assessment. Leakage risks deemed very low can be ignored as long as the case for their insignificance is substantiated.

AMS-II.G accounts for potential leakage related to the use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users. The methodology requires ex-post surveys among the end-users and the areas from which this biomass is sourced to assess the potential use of non-renewable woody biomass. If there is any increase the baseline fuel consumption, the project population shall be adjusted accordingly. Alternatively, the baseline fuel consumption can be multiplied by 0.95 to account for potential leakage without carrying out the surveys. Unlike TPDDTEC and AMS II.G, the GS Simplified Methodology does not consider leakage for an individual activity. However, if the methodology is applied for a microscale programme of activities and leakage must be considered, it offers two choices: (i) Leakage risk assessment according to TPDDTEC requirements and (ii) Multiple of the net emission reductions with a default factor of 0.95 to account the potential leakage (similar to AMS II.G).

8.0 Conclusion

In the following section, some key conclusions and takeaways resulting from the comparison of the three methodologies are summarised:

- The TPDDTEC methodology allows the widest range of project activities in the cooking regime including the technology and practices such as improved fossil fuel stoves/ovens/dryers, solar cookers, heat retention cookers and biogas stoves
- The GS Simplified Methodology has the most limited eligibility i.e., only firewood stove or a switch from non-renewable firewood to renewable firewood
- AMS-II.G does not allow any kind of fuel switch
- There are thresholds in the AMS-II.G and GS Simplified Methodologies for project scales:
    - Under AMS-II.G, energy savings shall be lower than 180 GWHth/year,
    - Under GS Simplified Methodology, a maximum of 10,000 tCO_2 emission reductions per year
- The TPDDTEC does not have any threshold for project scale, i.e., a micro, small, or large scale project can apply TPDDTEC. However, the useful energy output of the project technology for each unit shall not exceed 150 kW!
- GS methodologies requires communication about the carbon credit ownership with the end-users
- The minimum project stove efficiency is capped at 20% for AMS-II.G and GS Simplified Methodologies
- The baseline scenario is defined differently in the three methodologies:
    - AMS-II.G assumes default fuel mix situation
    - The Simplified Cookstove Methodology (only firewood) and TPDDTEC defines the baseline scenario as the typical baseline fuel consumption pattern in the target population
- AMS-II.G provides four options to determine the fuel savings (TEO, KPT, WBT, CCT).
- TPDDTEC requires the determination of fuel savings through Kitchen Performance test or a combination of KPT and WBT
- The GS Simplified Methodology requires the calculation of the fuel savings through the firewood consumed in the baseline scenario along with the baseline and project stove efficiencies
- Under CDM methodology AMS-II.G, non CO_2 GHGs emissions are not eligible for crediting, while GS methodologies allows crediting against non CO_2 GHG i.e., CH_4 and N_2O
- The TPDDTEC does not allow you to apply a default value for leakage but requests you to assess the different potential leakage sources through biennial surveys

Annex 1: Relevant Links

Gold Standard	
	www.goldstandard.org (general)
	Requirements, mandatory guidelines, legal documents, templates http://www.goldstandard.org/resources/energy-requirements GS Standalone Micro-scale Scheme Rules - Annex T http://www.goldstandard.org/sites/default/files/v2.2_annex-t.pdf GS Micro-programme Rules and Procedures - Annex U http://www.goldstandard.org/sites/default/files/v2.2_annex-u.pdf
GS TAC Rule updates	
	http://www.goldstandard.org/articles/tac-rule-updates
UNFCCC (CDM)	
	http://cdm.unfccc.int
IPCC	
	http://www.ipcc-nggip.iges.or.jp/public/2006gl/ (2006 IPCC Guidelines for National Greenhouse Gas Inventories)
GACC	
	http://cleancookstoves.org
Additionality:	
	CDM Tool for the demonstration and assessment of additionality http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-01-v7.0.0.pdf CDM SSC additionality tool http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-21-v1.pdf CDM Micro-scale additionality tool http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-19-v7.0.pdf CDM Guidelines for objective demonstration and assessment of barriers https://cdm.unfccc.int/Reference/Guidclarif/meth/meth_guid38.pdf CDM Guidelines on the assessment of investment analysis https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-27-v1.pdf CDM First-of-its-kind tool http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-23-v1.pdf Common practice http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf
Emission factors	
	http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_2_Ch2_Stationary_Combustion.pdf

fNRB	
	https://cdm.unfccc.int/DNA/fNRB/index.html
Methodologies	
	CDM methodology booklet https://cdm.unfccc.int/methodologies/documentation/meth_booklet.pdf
	AMS-II.G Energy efficiency measures in thermal applications of non-renewable biomass Version 7.0 http://cdm.unfccc.int/methodologies/DB/KZ6FQOCEEHD1V02ARWTW1W2R9G-45BX
	TPDDTEC http://www.goldstandard.org/sites/default/files/revised-tpddtec-methodology_april-2015_final-clean.pdf
	GS simplified cookstove methodology http://www.goldstandard.org/sites/default/files/documents/gs-simplified-micro-scale-cookstove-meth-2013.pdf
Net Calorific Value (NCV)	
	http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf
Sampling	
	CDM Sampling Standard http://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20151023110717966/meth_stan05.pdf
	CDM Sampling Guidelines https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20151023152925068/Meth_GC48_%28ver04.0%29.pdf
	Sample size calculator https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20150813144045237/Meth_guid48Calculator.xlsx
Test protocols: Water Boiling Test, Controlled Cooking Test, Kitchen Performance Test	
	http://cleancookstoves.org/technology-and-fuels/testing/protocols.html

Annex 2: Fuel Consumption Estimation Protocol

Fuel consumption estimation protocol			
Test method	**Description**	**Strengths**	**Weakness**
WBT	The most basic, standardised, easy method of comparing stove efficiencies under controlled laboratory conditions Assesses stove performance while completing a standard task (boiling and simmering water)	Simple method that can be performed on most stove types worldwide (standardised and replicable). Provides a preliminary understanding of stove performance, useful during design.	Reveals technical stove performance, not necessarily what can be achieved in actual households while cooking actual foods. Relies on default values for baseline cookstove biomass consumption.
CCT	Laboratory test, performed by a local cook on location or in-field in a test kitchen: Measures stove performance using actual local cooking methods as a cook prepares a typical meal intended to be representative of cooking practices of the target population participating in the project.	Stoves are assessed while performing a standard cooking task (more closely mimics actual cooking done by local users). Test design helps minimise influence of potential confounding factors and allows for conditions to be reproduced	Demonstrates what is possible under ideal conditions, but not necessarily what occurs under daily use.
KPT	Field based test that measures how much fuel is used in actual households when cooking normally over a few days. The approach using the KPT simply subtracts the quantity of woody biomass used by project participants (based on a random sample) from the amount of biomass used by a representative sample of non-participant households. Both are measured over a three-day period. Total biomass available in the household is weighed at the start and end of each day or meal to measure the weight of fuel used	Typically conducted in actual stove dissemination effort with local cooks. Best way to understand stove's impact on fuel consumption, as well as household characteristics and behaviours as it occurs in the user's household. Provides a consistent approach for estimating both baseline and project biomass consumption.	Measurements more uncertain as possible sources of error are difficult to control compared with laboratory tests.

Sources:

- Bailis R. Controlled Cooking Test (CCT). London, UK: Household Energy and Health Programme, Shell Foundation; 2004.
- Bailis R, Ogle D, MacCarty N, Still D. The Water Boiling Test (WBT). London, UK: Household Energy and Heath Programme, Shell Foundation; 2007.
- Bailis R, Smith KR, Edwards R. Kitchen Performance Test (KPT). CLondon, UK: Household Energy and Health Programme, Shell Foundation; 2007.

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