Introductory Framework for Measurement, Reporting and Verification for Cooking Energy Initiatives

Photo credit: Amod K. Pokhrel, Dhiraj Pokhrel, LEADERS Nepal, for the Clean Cooking Alliance

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Berkeley Air Monitoring Group
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Note: This is a living document that will be updated regularly to reflect the changing needs of country governments working to conduct measurement, reporting, and verification for clean cooking programs that advance their national climate goals.

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I. Introduction

A. Document Purpose

Measurement, Reporting, and Verification (MRV) is a key component of any emissions reduction program, whether it is designed to contribute to a Nationally Determined Contribution (NDC) target or create tradable assets under the Article 6 framework. Particularly in the latter context, MRV is the engine that generates value. If emissions reductions are not properly estimated and documented, their value as a source of climate funding may not be fully realized. The goal of this document is to provide an introduction to MRV requirements and approaches as they apply to cooking energy interventions.

In the lead-up to COP26, 67 nations included the cooking sector in their NDCs, either with distinct aims and targets or as part of broader renewable energy, energy efficiency, and/or forestry goals. This development is not surprising, as cooking energy interventions have been shown to be among the most cost-effective emissions reductions approaches[1] while also offering health, gender, and livelihoods co-benefits.

The MRV frameworks for improved cookstove (ICS) projects and many other approaches to reducing harmful emissions from household energy differ from those of other sectors due to the distributed nature of the interventions involved. The purpose of this guide is to offer an introductory overview of these MRV frameworks. Companion documents including a guide to developing implementation plans for clean cooking programs will soon be available, and follow-on documents are planned to provide more technical guidance as well as further case studies and resources.

About the Authors

This report was jointly developed by the Clean Cooking Alliance (CCA) and Berkeley Air Monitoring Group (Berkeley Air). CCA is the convener of a consortium, whose mandate is to provide practical guidance to countries intending to include clean cooking programs in their NDCs. Berkeley Air is a member of the consortium, which is also supported by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, the Climate and Clean Air Coalition, and the U.S. Environmental Protection Agency. The consortium aims to operate in harmony with actors in the broader environment supporting the implementation of NDCs, including the NDC Partnership, UN Development Programme (UNDP), the Gold Standard Foundation, the Africa NDC Hub, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and the International Renewable Energy Agency (IRENA).

[1] https://www.sciencedirect.com/science/article/abs/pii/S2590332221002967

B. Intended audience

This guide is intended for any professionals involved in the planning or execution of programs that aim to reduce climate-harming emissions through transitions to cleaner cooking energy. The intended audience also includes those seeking to finance such programs.

II. Background

MRV frameworks for cooking energy interventions are currently still in the early stages of development. The Paris Agreement provides flexibility to member nations regarding not only the goals they set as part of their NDCs, but also the manner in which they choose to report progress. Initially, key performance indicators may be a sufficient reporting framework to demonstrate that progress is being made towards NDC commitments. Over time, however, more robust approaches may be required or become desirable.

Article 6 of the Paris Agreement provides for market mechanisms: Art 6.2 covers cooperative approaches, such as agreements between high income and low-and-middle-income countries; Art 6.4 outlines a mitigation mechanism to address trade in carbon offsets between non-governmental entities, and Art 6.8 guides non-market approaches. At the COP26 meeting, the Parties adopted several decisions to operationalize carbon markets under Article 6:

- Art 6.2: guidance for bilateral or multilateral agreements to create Internationally Transferrable Mitigation Outcomes (ITMOs), including crediting mechanism, and linking to emission trading systems;
- Art 6.4: rules, modalities, and procedures for a multilateral crediting mechanism (to be known as “A6.4M”), which will be a successor to the Clean Development Mechanism (CDM), empanelled under the prior Kyoto Protocol; and
- Art 6.8: agreement to create a work program.

Activities that fall under articles 6.2 and 6.4 will require robust measurement, reporting and verification approaches. A6.4M is mandated to manage the transition of existing CDM projects to the new mechanism. CDM activities can transition to the A6.4M upon approval by the host country (request by 2023, approval by 2025), if they comply with A6.4M rules. (Projects registered after 01/01/2013 are grandfathered, and the credits generated from these projects can be counted towards the country’s first NDC.) The A6.4M rules, including MRV requirements, are under development. While they are likely to build from existing CDM and voluntary market methodologies, and also to include ISO standards, there is not yet consensus around the requirements and best practices for MRV under the Paris Agreement.

III. General MRV Principles

A. Overview

All MRV frameworks and approaches applied should be transparent, conservative, and scientifically sound. While this document does not provide specific monitoring methodologies, these principles are inherent in the general approaches described. Adhering to these principles is fundamental to providing reasonable estimates, and thus ensuring the credibility of the assets generated as well as the overall emissions trading mechanisms.

MRV systems for cooking energy interventions require a different approach than for other sectors, as the emissions result from many distributed point sources in homes (i.e. from three-stone wood fires, charcoal stoves, wood-burning stoves with chimneys and even kerosene lamps or cookers.) Furthermore, the fuel and stove use patterns in homes can vary substantially across region, user characteristics, and time. While these complexities require unique considerations, efficient and smart approaches for the measurements and assumptions needed to calculate carbon dioxide-equivalent[2] (CO_2e) reductions are available. Our goal in this section is to provide an overview of those approaches to offer a general indication of what is required to create a robust cooking energy monitoring system.

This effort is aided by the fact that cooking energy programs have been successfully integrated into carbon markets for several decades, and the corresponding methodologies used to quantify their carbon reductions are available to inform MRV frameworks. The following approaches are largely informed by two methodologies that have been widely used to quantify the impacts on emissions of cooking energy interventions. "AMS-II.G.: Energy efficiency measures in thermal applications of non-renewable biomass" (AMS-IIG)[3] was developed by the Clean Development Mechanism under the Kyoto Protocol and is currently in its 12th version, published December 14, 2020. The other foundational document, "Technologies and Practices to Displace Decentralized Thermal Energy Consumption" (TPDDTEC) is a methodology currently available in its fourth version (revised July 10, 2021) from the Gold Standard for Global Goals (GS4GG). The Gold Standard is a standard-setting body founded by the World Wildlife Fund and other NGOs to set standards for climate and development interventions. Other relevant resources consulted in the development of these MRV recommendations include the testing guidance developed by ISO Technical Committee 285 on Clean Cookstoves and Clean Cooking Solutions[4] as well as methods from adjacent sectors.

This section is organized to first outline how emission reductions are calculated and how the key inputs for those calculations can be estimated and then to provide guidance on considerations for upstream emissions from processed fuels; and how to account for changes in emissions reductions over time. The following section provides information on sampling approaches.

B. Estimating Direct Emissions Reductions

Emissions estimation calculations follow the general principle of determining the differences in emissions generated by a baseline scenario versus emissions from a project scenario.

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[2] CO_2 equivalent is a metric that normalizes the warming potential of different greenhouse pollutants to that of an equivalent amount of carbon dioxide, and thus allows for combining multiple emission species (e.g. CO_2, CH_4, N_2O) into one metric.

[3] https://cdm.unfccc.int/methodologies/DB/10PELMPDW951SVSW1B2NRCQEBAX96C

[4] https://www.iso.org/committee/4857971.html

Fundamentally, the emissions estimates for each scenario involve multiplying estimates of the GHG emission factor[5] for the scenario's fuel-technology combinations, by fuel consumption estimates, by the fraction of the biomass used that is not renewable. To provide a thorough accounting of the emissions reductions, however, the complete calculation involves additional terms for leakage[6], for frequency of usage of various technologies within a home, for changes in performance over time, and for the energy density of the fuels.

There are multiple valid strategies for estimating the inputs that are used to generate the scenario emission estimates.

Fuel Consumption

Fuel consumption can generally be estimated from surveys (participant estimates), directly weighing fuel, or use of sensors that track fuel consumption. Commonly used tests include the laboratory Water Boiling Test (WBT) and the Controlled Cooking Test (CCT) and Kitchen Performance Test (KPT), both performed in the field. Fuels which are regularly purchased or metered may also be estimated via transaction records or sensors that track quantity of the fuel used. While surveys are typically less expensive options, self-reported estimates of fuel use can be inaccurate and unreliable. Direct measures of fuel consumption, such as weighing fuel in homes over time with the kitchen performance test, or monitoring fuel use with meters provide better estimates, but require more resources and technical capacity. Examples to estimate fuel consumption can be found at https://cleancooking.org/research-evidence-learning/standards-testing/protocols/ and https://www.iso.org/standard/66521.html.

Emission Factors

It is common to use default emission factors for CO2, N2O, and CH4 for the residential use of various fuels. These defaults are typically from the Intergovernmental Panel on Climate Change Guidelines for National Greenhouse Gas Inventories[7], which provides default emission factors for various sectors and activities, including residential fuel combustion. While sector specific, these defaults are not technology specific (e.g. there are not separate emission factors for a three-stove-fire compared to an advanced forced draft wood stove). Technology or region-specific emission factors can also be applied, if sufficient evidence for the choice exists in the literature or if a local emissions study is conducted. Importantly, emission factors for electricity generation also exist (default and grid-specific), and can be applied when electric cooking is a program component.

[5] An emission factor is a quantity of a pollutant released per a given activity rate (e.g. 1.5 kilograms of CO2 released per 1 kilogram of wood burned).

[6] For a project activity, the net change of GHGs emissions that occur outside the project boundary, and that are measurable and attributable to the project activity.

[7] https://www.ipcc-nggip.iges.or.jp/public/gl/guidelin/ch1ref3.pdf

Renewability of Biomass

Renewable biomass consumption is considered to have no net CO2 release into the atmosphere, because the CO2 is taken up by new growth. Biomass that is used but not harvested in a renewable manner results in a net release of CO2e into the atmosphere and is known as the fraction of non-renewable biomass (fNRB). fNRB can be estimated by simple calculations or more complex modeling. Default fNRB estimates can be used from the literature, or studies can be conducted to establish the fNRB for a country or program area.

C. Estimating Upstream Emissions

In addition to the emissions arising at the point-of-use, some fuels also have substantive emissions associated with their feedstock production, transportation, processing, and distribution. These upstream emissions need to be included to accurately account for the overall mitigation being attributed to a given program. In the case of cooking energy programs, the main fuels of interest for their upstream emissions are charcoal, ethanol, LPG, biogas, and electricity. Fuelwood does not generally not have meaningful upstream emissions, unless there is substantial processing and transport involved, which can be the case with pellets or other highly processed wood-based fuels.

Generally, the approaches used to estimate upstream emissions rely on default emission scaling and/or emission factors. For example, the Clean Development Mechanism methodology for cooking energy devices (AMS–II.G.) stipulates that a default assumption may be made that 1 kg of charcoal requires approximately 6 kg of wood to produce. In such cases, the charcoal mass is converted into wood equivalent, and then the wood emission factors are applied. Similar scenarios arise for the other fuels, and there are resources available[8] to provide reasonable assumptions for their upstream emissions.

D. Estimating Reductions Over Lifetime

As noted previously, cookstove emissions measurements are conducted by determining a baseline scenario and then comparing that to the project scenario over time.

Measurement of the Baseline

Existing methodologies offer multiple ways to determine baseline emission scenarios. They must be ambitious, must be improvements over the business as usual scenario (BAU), and should be re-determined once an emissions reduction strategy gains widespread adoption, such that it becomes the new business as usual. Three general approaches can be used to estimate the baseline scenario in line with the aforementioned principles: assume the best available (and

[8] Example resources: https://cleancooking.org/reports-and-tools/fuel-analysis-comparison-integration-tool-facit/, https://ghgprotocol.org/life-cycle-databases,

economically feasible) technologies are being used, use top-performing technologies as benchmarks, or adjust historical historical emissions estimates conservatively

Stove Aging

Consideration should be given to changes in emissions reductions over time for a given stove, due to reasons such as component decay or failure or transition to other stoves. TPDDTEC and AMS.II-G both provide guidelines on incorporating stove aging into the emissions reduction calculations. TPDDTEC requires Water Boiling Tests (WBT)[9] be conducted by independent entities every year for each year of the cookstove project under analysis, and each batch must comply with rules about how precise the stove's efficiency estimates must be. AMS.II-G also requires adherence to precision rules, but it is on a by-batch basis of cookstoves, rather than on a by-year basis.

Emission Measurement Considerations

Both field and laboratory-based WBTs are acceptable under the guidelines, though the tested stoves must be representative of typical usage for the group of stoves. The flexibility given by the methodology is appropriate, and designers of MRV plans should consider the logistics involved in conducting these sampling campaigns. If stoves are mobile, they may be brought to laboratories for analysis by experienced lab technicians, using well-characterized instrumentation. If the stoves are built-in or transport is challenging, trained lab technicians may go to the field to conduct the tests. Analysis of the combustion efficiency data from the WBTs provides changes in efficiency over time, which can then be incorporated into emissions reduction calculations. AMS.II-G requires testing by batches of stoves, rather than by year installed, thus providing more flexibility and lower sampling requirements.

IV. Sampling Approaches

Given the distributed nature and variability in emissions from cooking technologies, tracking and measuring each one of them is not practical. Therefore, strategies to sample target populations are critical for providing representative and/or conservative inputs for calculating emission reductions achieved by cooking energy programs.

Sample Selection

Testing concepts and methodologies described in previous sections must be applied thoughtfully to ensure that the data translate to useful and accurate results. For example, homes selected for sampling should be representative of the target population over key units, such as regional location, types of fuels and stoves used, fuel use patterns, seasonality, population density (urban/peri-urban/rural), and activities in the regions such as occupation and

[9] The Water Boiling Test is a standardized laboratory test for which a stove's thermal efficiency is determined while heating water.

transportation. Extrapolation of results to different regions or fuel/stove combinations that may have other baseline scenarios should be avoided or justified rigorously.

Sample Size

Sample sizes have been discussed in previous sections as well, and should be determined considering the project goals, existing data that can be used to estimate precision rule adherence, and new data that can be incorporated for precision rule calculation as it is collected for the MRV. Precision rules are guidelines used to ensure that the data are sufficiently representative of the sample population and that there is a common understanding of data quality expectations for a variety of projects in different settings. 90/10 precision rules are used in various methodologies, and in order to adhere to the rule, a data set (e.g. kilograms of fuel used per household per day) must have its 90 percent confidence interval within +/- 10% of the average (TPDDTEC). When the data are widely spread, the confidence interval is larger than if it is narrowly spread, so more samples would be needed to adhere to the rule, even for data with the same mean. This variability, or spread of the data is often presented as a coefficient of variance (COV, defined as the variance of the data divided by the mean of the data). The COV may then be used to estimate sample sizes to adhere to a given precision rule calculation. When collecting cooking energy-related data in homes, it is common to find substantial variability from household to household due to many differences in cooking practices, preferences and behavior.

V. Case Studies

A. Nepal Case Study- Electric cooking

Background

Nepal's long-term low greenhouse gas (GHG) development strategy, to be completed in 2021, aims to reach net-zero GHG emission by 2050. Nepal's 2019 National Climate Policy calls for the production and use of renewable energy, including that of hydroelectricity and energy efficient technologies. Nepal's enhanced NDC targets in the cooking sector include the bold electric cooking goal to "use primarily electric cooking (EC) in 25% of households by 2030".

Implementation

Several initiatives are underway to support rapid and widespread increases in the availability and use of electricity for cooking, along with the promotion of electric cooking technologies and user behaviors. These programs aim to build on Nepal's existing electricity infrastructure, which is primarily generated from hydropower, making it a clean and renewable energy resource. Further, as much as 90% of the population already have access to electricity[10] (although many connections require upgrading to accommodate electric cooking devices safely).

[10] https://mof.gov.np/uploads/document/file/Economic%20Survey%202019_20201125024153.pdf

The most active project is currently being implemented with funding from the Green Climate Fund in Nepal's Terai region, where connection rates are higher than in other areas. The GCF initiative, entitled "Mitigating GHG emission through modern, efficient and climate friendly clean cooking solutions" (CCS), focuses on creating awareness of and expanding access to electricity for cooking, using both household and policy approaches. The project targets installing 500,000 electric stoves as well as other clean or transitional cooking technologies using a mix of market mechanisms, results-based financing for de-risking and scaling up of investments, and institutional capacity building for local government authorities. CSC aims to reduce or avoid 3.54 million tCO2e from buildings, cities, industries and appliances.

Another initiative supporting Nepal's electric cooking target is the Nepal Electric Cooking Initiative (NECI). The Nepal Electric Cooking Initiative (NECI) has four primary objectives: support effective utilization of surplus renewably-sourced electricity; reduce reliance on imported liquified petroleum gas (LPG) and unsustainably harvested firewood for cooking, and achieve sales of induction stoves, infrared stoves, and electric pressure cookers resulting in 500,000 households adopting electric cooking within five years; and establish a sustainable market for electric cooking devices across the country beyond the lifetime of the program. Through the promotion of electric cooking solutions, NECI aims to reduce 3.04 million tCO2e (direct) and 6.46 million tCO2e (indirect). The health co-benefits from the project are expected to result in a reduction of 8,400 Disability-Adjusted Life Years (DALYs) during the project lifetime.

Measurement, Reporting and Verification

The CSC initiative will follow the CDM AMS.II-G methodology for quantifying progress towards their tCO2e target. Installation of electric cooking devices will be tracked using management information systems set up with the local government entities that receive capacity building support through the project. MIS data will be sex-disaggregated in order to provided data on the gender co-benefits of the program. The Nepal Living Standard Survey and other data collection activities regularly conducted by the Government of Nepal will be used to track the portion of the population adopting clean cooking solutions. The initiative will also conduct its own baseline, midterm and endline evaluations to inform on many of the initiative's sub-aims. Finally, new and existing cookstove performance testing capacity will be developed in order to ensure that all promoted technologies meet the targeted ISO standards.

Progress towards, and verification of CO2e mitigation in the NECI initiative will be monitored via baseline (year 1), midline (year 3), and end-line (year 5). The monitoring will consist of household surveys, which will include direct measurements of wood and electricity, as well as logs of LPG consumption via receipts or sales records. Smart sensing devices will be employed to measure usage where feasible. The sampling strategies will be designed to capture the variability across major user groups and geographies. Sample sizes will be guided by 90/10 precision rules as presented in the CDM methodology AMS-II.G. Customer and sales records from enterprises participating in the NECI will be used to scale the CO2e savings per home for the project-wide mitigation estimate. In addition, program activities will be continuously monitored to ensure adherence to the best business practices and initiative guidelines. For example, a part of the total incentives claimed by the market aggregators will be only released after the MRV component of the project has verified the sale.

B. Case Study of Ghana-Switzerland Bilateral Agreement

Background

Expanding the adoption of market-based cleaner cooking solutions is one of Ghana's climate goals, as demonstrated by their NDC target of scaling-up access and adoption of 2 million efficient cook stoves by 2030. Co-benefits are expected to include the avoided degradation of 39,500 hectares of woodland, as well as reduced household air pollution and smoke related respiratory and eye diseases. Economic co-benefits would include reduced household cooking fuel expenditure and job creation through the manufacture and sale of the efficient stoves.

A pioneering agreement facilitated by the UNDevelopment Programme (UNDP) and signed in 2020 between Ghana and Switzerland aims to support these goals.[11] The agreement outlines their cooperation approach under the Paris Agreement and intent to design a framework for ITMO projects in Ghana. Under the ITMO agreement, Switzerland will agree to buy a certain volume of emission reductions – ITMOs – from Ghana. This commitment from Switzerland, ahead of time (although conditional upon independent verification of results, ex-post) acts as an incentive for project developers in Ghana to finance projects that deliver mitigation outcomes, such as installing a renewable energy facility.

Implementation: Ghana National Clean Energy Access Programme (NCEP)

The ITMO agreement supports Ghana's National Clean Energy Access Programme (NCEP), which is the primary implementation mechanism. Expanding the adoption of market-based cleaner cooking solutions is one of three strategies prioritized to achieve a conditional target of a 30% reduction in CO2e, which is additional to the 15% unconditional commitment, to be derived primarily from developing natural gas for electricity generation and prioritizing reforestation/afforestation of degraded lands. Under the agreement, Switzerland will buy credits for 5 years but the benefits of the supported NCEP activities are expected to continue well beyond the time horizon of the agreement, creating a defacto investment in Ghana's energy sector that will facilitate expanding ambition in their future NDCs. Further the NCEP is designed to produce many development co-benefits, including improvements to livelihoods, health, and communities, among others.

Measurement, Reporting and Verification

The Ghana-Switzerland agreement is still in its infancy, but UNDP has recognized the "the need for robust monitoring, reporting and verification (MRV) systems that are essential to avoid

[11] Advancing the Paris Agreement Through Cooperative Approaches: The Ghana-Switzerland Case Study, UNDP

double counting and maintain the environmental integrity of markets." UNDP offers technical assistance for an integrated MRV system and registry to track each unit of emission reduction.

VI. Role of Key Performance Indicators

When clean cooking programs make up a portion of a country's unconditional commitment under the Paris Agreement, they may be reported on in terms of programmatic indicators rather than in emissions reductions. Key performance indicators (KPIs) are simple measures that demonstrate the progress achieved towards the NDC targets. Monitoring KPI progress in the short-term allows countries to build the infrastructure to formally estimate CO2e reductions in the longer term.

KPIs may be informed by data that are already collected in existing national surveys or inventories, such as the national census, or the Demographic and Health Surveys conducted regularly in many low and middle income countries. Or these existing data collection tools may be updated to include KPI metrics. The World Health Organization offers "Harmonized survey questions for monitoring household energy use and SDG indicators 7.1.1 and 7.1.2"[12] developed in conjunction with the Energy Sector Management Assistance Program and the World Bank. The World Bank's Multi-Tier Framework survey[13] may also prove useful in this context.

Examples of common KPIs for cooking energy programs include:

- Percent of population with access to modern cooking energy services;
- Percent or number of households using clean fuels (e.g., electricity, ethanol, solar, LPG, biogas, etc.); and/or
- Percent or number of households using high performance biomass stoves (defined with international testing standards).

VII. Ongoing MRV Support

Global climate goals cannot be achieved without reductions in emissions from cooking, and climate mitigation efforts are a key way to expand clean cooking opportunities to millions of families who don't currently have access to modern cooking energy. Measurement, reporting, and verification is a key component of any emissions reduction program; if emissions reductions are not properly estimated and documented, their value as a source of climate funding may not be fully realized. And finally, MRV for cooking energy interventions can be uniquely challenging.

Designing and implementing an MRV system, or integrating cooking energy programs into a national monitoring framework requires building and maintaining capacities and infrastructure. Countries opting to undertake this activity will be aided by capacity building and technical support resources.

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[12] https://cdn.who.int/media/docs/default-source/air-pollution-documents/air-quality-and-health/2_harmonized_household_energy_survey_questions-long_roster_final_nov2019.pdf?sfvrsn=f3e7c27e_5&download=true accessed Jan 17 2022.
[13] https://datacatalog.worldbank.org/search/dataset/0039986 accessed Jan 17 2022.

This MRV roadmap document and the companion guidance document on planning and implementing clean cooking programs are the initial offerings from a consortium of organizations aiming to provide targeted practical and technical support to countries who expect cooking energy interventions to play a key role in meeting their obligations under the Paris Agreement, whether as part their unconditional targets, or whether through Article 6 mechanisms, such as bilateral ITMO agreements. This overview of MRV approaches will be followed by more technical manuals that will address the details and nuance of each of the components of measuring emissions reductions generated from cooking energy programs.

In tandem with these documents, the consortium plans to hold an introductory webinar to present the current status of clean cooking commitments under the Paris Agreement. UNFCCC and CCAC focal points in countries identified as having clean cooking and/or household energy goals in their NDCs will be invited. In parallel, an informal needs assessment will be conducted among the webinar audience to gauge interest in further technical support and refine the offerings to meet the spectrum of current needs. Two activities are likely to follow the introductory webinar. First, a series of technical question and answer sessions are planned, where experts will answer submitted questions related to MRV mechanics. Second, one or more cohorts of representatives from countries at similar stages in the implementation of cooking energy initiatives will be created, allowing peer-to-peer learning and targeted technical assistance. For more information on these activities, please contact climate@cleancooking.org.

VIII. Additional MRV Resources for Cooking Energy Interventions

A. Determining fNRB

Resource	Purpose
Bailis, Robert, Rudi Drigo, Adrian Ghilardi, and Omar Masera. “The Carbon Footprint of Traditional Woodfuels.” *Nature Climate Change* 5, no. 3 (March 2015): 266–72. https://doi.org/10.1038/nclimate2491	Provides sources and methodological guidance for calculating fNRB.
Modeling Fuelwood Savings Scenarios (MoFuSS): https://www.mofuss.unam.mx/webmofuss	MoFuSS is an open-source GIS-bsed freeware model developed to evaluate potential impacts of firewood harvest and charcoal production over the landscape.

B. Survey Tools

Resource	Purpose
Borlizzi, Andrea. “Guidelines for the Incorporation of a Woodfuel Supplementary Module into Existing Household Surveys in Developing Countries,” FAO, August 2018. https://www.fao.org/3/ca6402en/ca6402en.pdf	Survey tool for estimating household wood use.

C. Co-benefit Methodologies

Resource	Purpose
"Methodology to Estimate and Verify ADALYs from Cleaner Household Air" (Gold Standard) https://www.goldstandard.org/articles/health-impacts-averted-disability-adjusted-life-years-adalys	Gold Standard methodology for measuring health impacts from cooking energy interventions.
"Quantification of Climate Related Emission Reductions of Black Carbon and Co-Emitted Species Due to the Replacement of Less Efficient Cookstoves with Improved Efficiency Cookstoves" (Gold Standard) https://globalgoals.goldstandard.org/412-ics-slcp-black-carbon-and-co-emitted-species-due-to-the-replacement-of-less-efficient-cookstoves-with-improved-efficiency-cookstoves/	Gold Standard methodology for measuring impact on short-lived climate pollutants from cooking energy interventions.
Quantifying and Measuring Climate, Health and Gender Co-Benefits from Clean Cooking Interventions: Methodologies Review (English). Washington, D.C.: World Bank Group. http://documents.worldbank.org/curated/en/436301593546281643/Quantifying-and-Measuring-Climate-Health-and-Gender-Co-Benefits-from-Clean-Cooking-Interventions-Methodologies-Review	World Bank approaches to measure health, gender, and expanded climate (black carbon) benefits for results-based financing.