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WEBINAR

Methodology to Estimate and Verify Averted Mortality and Disability Adjusted Life Years (ADALYs) from Cleaner Household Air

INTRODUCTION

Objective of developing the methodology

Background/Problem Statement

- Around 3 billion people cook and heat their homes using solid fuels (i.e. wood, charcoal, coal, dung, crop wastes) on open fires or traditional stoves
- Household air pollution (HAP) is the single largest environmental health risk, estimated to cause 4.3 million premature deaths each year
- Majority of these preventable deaths occur in low- and middle-income countries (LMICs)
  - 25% of all deaths from stroke,
  - 15% of deaths from ischemic heart disease, (IHD)
  - 17% of deaths from lung cancer, and

  more than 33% of all deaths from chronic obstructive pulmonary disease (COPD)

Objective of the methodology

- Payment for health benefit outcomes under results-based financing presents tremendous potential to incentivize implementation of projects that reduce HAP
- To enable finance to flow at scale, we need a monitoring and evaluation (M&E) framework that demonstrates that the benefits have actually been achieved
- The Gold Standard methodology to estimate and verify averted mortality and Disability adjusted life years from cleaner household air aims to provide a robust framework to demonstrate health benefits from cleaner cooking/heating/lighting technologies

Acknowledgment (METHODOLOGY)

- **Funders**
  - Goldman Sachs, World Bank, Department of Foreign Affairs and Trade (Australian Aid) and World Vision-Australia

Goldman Sachs

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World Vision

Australian Aid

- **Partners**
  - C Quest Capital
- **Contributors**
  - Expert working group members
  - Working group convened by the World Bank
  - Prof. Kirk Smith and his team for developing the HAPIT
  - Global Alliance for Clean Cookstove

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ACKNOWLEDGEMENT

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Capacity Building on ADALYs Methodology

- World Bank Group under Efficient Clean Cooking & Heating Program (P156948) funded the capacity building initiative *"Capacity Building On Gold Standard Methodology To Estimate And Verify Averted Mortality And Disability Adjusted Life Years (ADALYs) from Cleaner Household Air"*

- The objective of the project was to provide the enabling infrastructure and build capacity of potential project developers and auditors to help fully utilize the ADALYs methodology

SPECIFIC TASKS:

- The integration of the ADALYs methodology into **Cookstove Impact Quantification Tool** and **Household Air Pollution Intervention Tool (**HAPIT)

- The development of guidance material for potential projects in the form of Technical reference manual, online tutorial and online webinars

- Capacity development of project developers and auditors with regards to the ADALY's methodology and HAPIT through four capacity building workshops

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Regional Training Workshops

The Regional capacity building workshops were held in –

Chennai, India (25th and 26th May, 2017)

Lima, Peru (8th and 9th June, 2017)

Accra, Ghana (14th and 15th July, 2017)

Bangkok, Thailand (25th and 26th July, 2017)

Attendees included –

- Project developers
- Government agencies
- Auditors
- Monitoring and testing experts
- Academicians etc.

METHODOLOGY OVERVIEW

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Methodology overview

- This methodology uses exposure to fine particulate matter (PM2.5) as the best indicator of household air pollution
- PM 2.5 is considered to be the dominant contributor to disease burden from air pollution
- PM2.5 exposure causes negative health impacts, such as cardiovascular disease, respiratory disease, and lung cancer resulting in premature death
- The methodology focuses on measurements of personal exposure of primary cook

Eligibility requirements

- Projects that lead to verifiable reduction in PM2.5 exposure levels via a change in household energy use and/or emissions for cooking, heating, lighting
- Introduce cleaner cooking devices, fuels, or practices

Cooking devices

- Clean cookstoves - biomass, biogas, ethanol based, electricity, LPG,PNG based, solar and alcohol fuel cookstoves,
- Space and water heaters (solar and otherwise),
- Heat retention cookers,
- Solar cookers and
- Safe water supply and treatment technologies

Clean Fuels

- Electricity, LPG, piped natural gas (PNG), biogas, solar and alcohol fuels

Practices

- Improved application of eligible technologies such a shift from solid fuel or kerosene to biogas, etc.).

- May also include technologies such as solar lighting that lead to additional PM2.5 exposure reductions

Eligibility

- Safe water supply and treatment technologies are only eligible if in the baseline situation solid fuels are burned to treat drinking water e.g. boiling water

- Other interventions
  - Check with the GS Secretariat

Fossil Fuel NOT ELIGIBLE

- Projects that involve a fuel switch to coal, charcoal, or kerosene
- Projects leading to greater efficiency in use of coal or kerosene compared to the baseline

Exceptions

- Efficient use of charcoal compared to the baseline is eligible
- Use of modern fuels (e.g. LPG and electricity derived from fossil fuels) can substantially reduce $PM_{2.5}$ exposures and are eligible for this methodology

Specific Eligibility Criteria

Additional conditions

- For clean cookstoves and heating stoves
  - Minimum 20% thermal efficiency of the project cookstove
  - Inclusion of incentive mechanism(s) to discourage the parallel use of baseline technology
  - Provide evaluation criteria to avoid double counting of same project technology in other activities

Methodological Approach

- Quantification of Health benefits from reductions in $PM_{2.5}$ exposures
- Quantify using published exposure-response relations that link PM2.5 levels to five major diseases:
  - Stroke
  - Ischemic heart disease
  - Chronic obstructive pulmonary disease (COPD)
  - Lung cancer, and
  - Acute lower respiratory infection (pneumonia)

- Averted DALYs (ADALYs, alternatively called DALYs averted) and averted mortality are the metrics used to quantify the health benefit of reduced $PM_{2.5}$ exposures
- Disability-Adjusted Life Years (DALYs) include both years of life lost due to early death and years of healthy life lost due to onset of disease

Methodological Approach

This methodology requires two step process.

- Field monitoring of PM2.5 exposure levels
- HAPIT uses epidemiologically derived exposure-response functions to convert the monitored change in exposure to ADALYs

Step -1 Monitor personal PM2.5 exposures

Field monitoring of PM2.5 exposures before and after the project technology is introduced

↓

Step -2 Convert monitored PM2.5 exposures to ADALYs

Using a web-based computer model HAPIT (Household Air Pollution Intervention Tool.

↓

Averted Disability-Adjusted Life Years (ADALYs)

Other requirements

- **Carbon monoxide (CO) monitoring for charcoal-based interventions**
  - Mmandatory room area monitoring of CO is required in all households undergoing PM2.5 PEM
  - At minimum 24 hours monitoring in sample households undergoing $PM_{2.5}$ PEM
  - If 24 hour average CO concentration exceeds the 7 mg/m^3 (WHO Guidelines) in a fraction of monitored households, the same fraction of project households in the total project population will no longer be eligible for claiming ADALYs
- **Re-assessment of baseline personal exposures**
  - If projects lasting longer than five years, a new round of baseline surveys and baseline personal exposure monitoring shall be conducted every five years)

MONITORING REQUIREMENTS

Overview: Monitoring Parameters

Monitoring parameters

Parameter	Source
• Personal exposure to $PM_{2.5}$ before and after the intervention	Baseline PEM Project PEM
• Household size • Number of adults per household and children <5 • Baseline technology type and fuels being used • Primary cook details	Baseline household survey
• Household size • Number of adults per household and children <5 • Types and extent of fuels used • Project stove use • Any changes within project boundary • Percentage of population using polluting fuel	Project household survey
• Project technology usage rate	Usage survey
• Number of targeted households	Project Database
• CO level for charcoal-based interventions only	CO monitoring

Household Survey: Baseline Survey

Why?

- Information on baseline cooking practices
- Information about the "target population" characteristics, baseline fuel consumption, baseline technology use, seasonal variations in baseline technology and fuel use
- Group the target population into representative ''baseline scenario(s)" based on fuel and technology use patterns.

- Baseline scenario 1 – domestic 3 stone fired using wood fuel
- Baseline scenario 2 - domestic traditional stoves using charcoal

When?

- Prior to distribution of the project technology
- Repeated at crediting period renewal

Household Survey: Baseline Survey

How?

- Household survey guidelines (Annex 2 of the ADALYs methodology)

Key considerations

- Consent from participating households; guaranteeing data privacy, low risk from the equipment, non-responsibility for loss or damage to the equipment, and the ability to withdraw from the study at any time without penalty
- Personal identifiers such as name, household number, address, etc. should not be entered into the database that will be available for analysis.
- Households should be identified in the database only by ID numbers, with the code linking these numbers to personal identifiers kept locked away by the project field manager
- No photos should be taken in which individuals can be identified (without prior consent)

Household Survey: Project Survey

- **Why?**
  - Information on year-to-year trends in end user characteristics such as technology use, type of fuel use, kitchen characteristics and seasonal variations
  - Identify changes over time in a Project Scenario
- **When?**
  - Annually, after six months of start of use of the new technology in the households
- **How?**
  - Household survey guidelines (Annex – 2 of the ADALYs methodology)
- **Key considerations**
  - Same as for baseline survey

Project Survey Guidelines

Approach for project household survey

- Annual project surveys are conducted with end users representative of each Project Scenario (i.e. those using the project devices)

Minimum sample size:

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

Further Information

Annex 1.1

- Objectives of Surveys and Sample Questions

Usage Survey

- **Why?**
  - To determine the fraction of users who have stopped using the project technology completely i.e. drop off
- **When?**
  - Annually or more frequently, and in all cases on time for any request of issuance
- **How?**
  - Survey or Continuous Stove Monitors (CSMs)
  - Survey
    - Minimum total sample size required for usage surveys is 100, with at least 30 samples for project technologies of each age being credited
    - Simple random or any other commonly used sampling approach such as stratified random sampling
  - Continuous Stove Monitors (CSMs)
    - Minimum 100 households for at least 90 days, with at least 30 samples for project technologies of each age being credited

Usage Survey Guidelines

Measuring stove use

- Survey

In-person visit to collect information in sample households via

  - Interview with the main cook
  - Kitchen observation
  - Photos of the cooking area

- Continuous Stove Monitors (CSMs):
  - Annex 3 Stove use monitoring guidelines

Usage survey requirements and guidelines are available on the GS website, and meth applicants should refer to those guidelines to meet the usage requirements.

How is PEM Characterized?

Personal exposure: The average concentration of a pollutant to which an individual or population is exposed to over a specific period of time, accounting for their movements into and out of polluted microenvironments for example, kitchens, rooms, etc.

- This methodology sets forth techniques for characterizing $PM_{2.5}$ exposure from residential fuel combustion
- Exposure is not necessarily correlated with stove $PM_{2.5}$ emissions or indoor concentrations
- Because human activity follows a diurnal pattern that may vary on different days, exposure should be monitored continuously for at least a 48-hour period
- If longer periods are chosen, they should be done in multiples of 24 hours after the first 48 hours

Exposure measures must meet the 90/30 precision rule

PEM: Baseline Scenario

- Baseline PEM of $PM_{2.5}$ establishes the baseline exposure before the project technology is in use

- PEM is only required in a sample of households in the target population (at least 30 and meeting the 90/30 rule)

- The samples should:
  - Be conducted on the primary cook for at least 48 continuous hours to capture diurnal and inter-day variation
  - Be conducted during the season that is most representative of the full year
  - Exclude households in which the main cook smokes or which do not represent the conditions of the majority of the community

PEM: Project Scenario

- To account for households that are not suitable for inclusion in PEM, the initial monitoring sample size should be larger than the sample size required for PEM to account for drop out or exclusion
- The sampled households should still be using the project technology
- PEM shall be carried out for at least 48 continuous hours in each household
- Light scattering measurements shall be adjusted to scale to gravimetric equivalent concentrations

PEM: Monitoring Guidelines

- PEM shall be conducted every other year (biannual), at a minimum. For the years in which no PEM is conducted, PEM values from the prior year shall be used along with the usage rate from the current year.
- 40% of issuable ADALYs calculated in the off-years will be held in reserve pending exposure measurements in the following year. In the following year, the ADALYs shall be re-estimated for the year when no PEM was monitored using the average PEM value of prior and subsequent years when PEM was carried out.
- The actual value of the usage rate in the off-year shall be used for re-estimation.
- The difference in ADALYs re-estimated and issued in off-year will be awarded back to the project.

MONITORING INSTRUMENTS

PEM monitoring instruments

PEM

Gravimetric PEM pump

SKC AirChek 5000 pump

Casella Apex pump

PEM monitoring instruments

PEM

Gravimetric PEM sampler

SKC Personal Modular Impactor (PMI)

Gravimetric PEM cyclone

SCC1.062 (Triplex) Personal Sampling Cyclone

Integrated Gravimetric

RTI MicroPEM

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Overview of monitoring instruments

CO monitoring

SKC Drager diffusion tube

LASCAR

Overview of monitoring instruments

PEM (Optical measurement) and CO

Optical system

PATS +

Continuous Stove Monitors (CSMs)

Maxim iButton

Infrared thermocouple

kSUMs

Nexleaf StoveTrace

SWEETSense

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Household Air Pollution Intervention Tool (HAPIT)

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HAPIT: Household Air Pollution Intervention Tool

- **An easy-to-use tool to estimate the health benefits of household energy interventions in many countries and in some sub-national geographies**

- **Benefits by default are estimated for countries**
  - Based on the best available health effects evidence from the Global Burden of Disease
  - HAPIT estimates the approximate morbidity and premature mortality reductions for user-created scenarios
  - As the evidence improves, these estimates of deaths and DALYs averted will change

Information required for HAPIT)

Requirements

S.No	Name of the parameter	Monitoring Frequency	Monitoring method
1.	Country or province/state where project is located	-	-
2.	Baseline PM 2.5 exposure	One time	Baseline PE monitoring
3.	Project PM 2.5 exposure	Biennial	Project PE monitoring
4.	Number of targeted households	Continuous	Project Sales record
5.	Number of people per household	Annual	Project monitoring survey
6.	Percentage of population using polluting fuels	Annual	Project monitoring survey
7.	Number of children per household age under 5 years	Annual	Project monitoring survey
8.	Fraction of targeted households using intervention (usage rate)	Annual	Usage survey or CSMs

Available at https://householdenergy.shinyapps.io/hapit3/

How to Use HAPIT

HAPIT is currently available at householdenergy.shinyapps.io/hapit3.

HAPIT v3.1

- Overview
- Inputs
- Health Impacts
- Documentation
- Downloads

Navigation

Introduction

Welcome to HAPIT!

HAPIT estimates health changes due to interventions designed to lower exposures to household air pollution (HAP) of household members currently using unclean fuels (wood, dung, coal, kerosene, and others). These interventions could be due to cleaner burning stoves, cleaner fuels, providing chimneys or other ventilation changes, movement of the traditional hearth to a different location, motivating changes in behavior, or a combination of the above. HAPIT does not currently estimate changes in health due to changes in community or regional changes in air pollution from household interventions that would not be measured in normal household exposure measurements. With some care in entering input parameters, it can be used for evaluating other interventions to reduce HAP, including those for lighting and spaceheating.

Meaningful use of HAPIT requires field work at the intervention dissemination site to demonstrate pollution exposures before and after the intervention in a representative sample of households. As each country's health and HAP situation is different, HAPIT currently contains the background data necessary to conduct analysis in **104 countries, 31 provinces of China, and 29 states of Mexico.**

Select a Country

Select a Country

Nepal

Country Select

Background information

Nepal Background SES & Demographic Statistics

Population (millions)	<5 Population (millions)	Average HH Size	Dirty Fuel Use (%)	GDP USD
27.8	2.9	5	74	401

Deaths | DALYs | YLLs | YLDs

Nepal Annual disease data

Disease	Age	Year	Mean	Lower Bound	Upper Bound
Lung Cancer	All Ages	2013	943	659	1571

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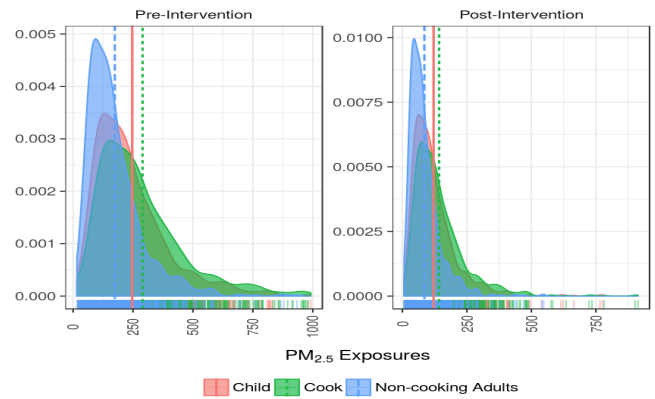
How to Use HAPIT

HAPIT v3.1

- Overview
- Inputs
- Health Impacts
- Documentation
- Downloads

Exposure-related Inputs



Simulated $PM_{2.5}$ exposures based on user-input pre- and-post intervention exposure means and standard deviations. Pink, green, and blue bars represent distributions for children, primary cooks, and non-cooking adults, respectively. Dashed lines are the per-group means of the draws from the distributions. Vertical ticks along the x-axis are individual points making up the distribution.

Instructions. Enter your mean pre- and post-intervention $PM_{2.5}$ exposures and standard deviations. If you do not have standard deviations, click the 'Default SD' button to set the SDs to 0.70 times the input exposures. **After entering or changing values, click 'Update Exposures'.** *Do not leave any fields empty.*

Primary Cook Mean Pre-Intervention $PM_{2.5}$ Exposure[1]: 285

Std Deviation Default SD: 200

Primary Cook Mean Post-Intervention $PM_{2.5}$ Exposure[2]: 140

Std Deviation Default SD: 100

Mother-Child (< 5) Exposure Ratio[3]: 0.85 (range 0.4 – 1)

Cook to Other Adult Exposure Ratio[4]: 0.6 (range 0.4 – 1)

Update Exposures

Population Inputs

Number of Targeted HH[6]: 25000

People Per HH[7]: 5 (range 1 – 10)

Kids <5 Per HH[8]: 0.5 (range 0 – 5)

Adults Per HH[9]: 4.5 (range 0 – 5)

Intervention Inputs

% using Intervention[10]: 50 (range 0 – 100)

Intervention Useful Life[11]: 1 (range 1 – 5)

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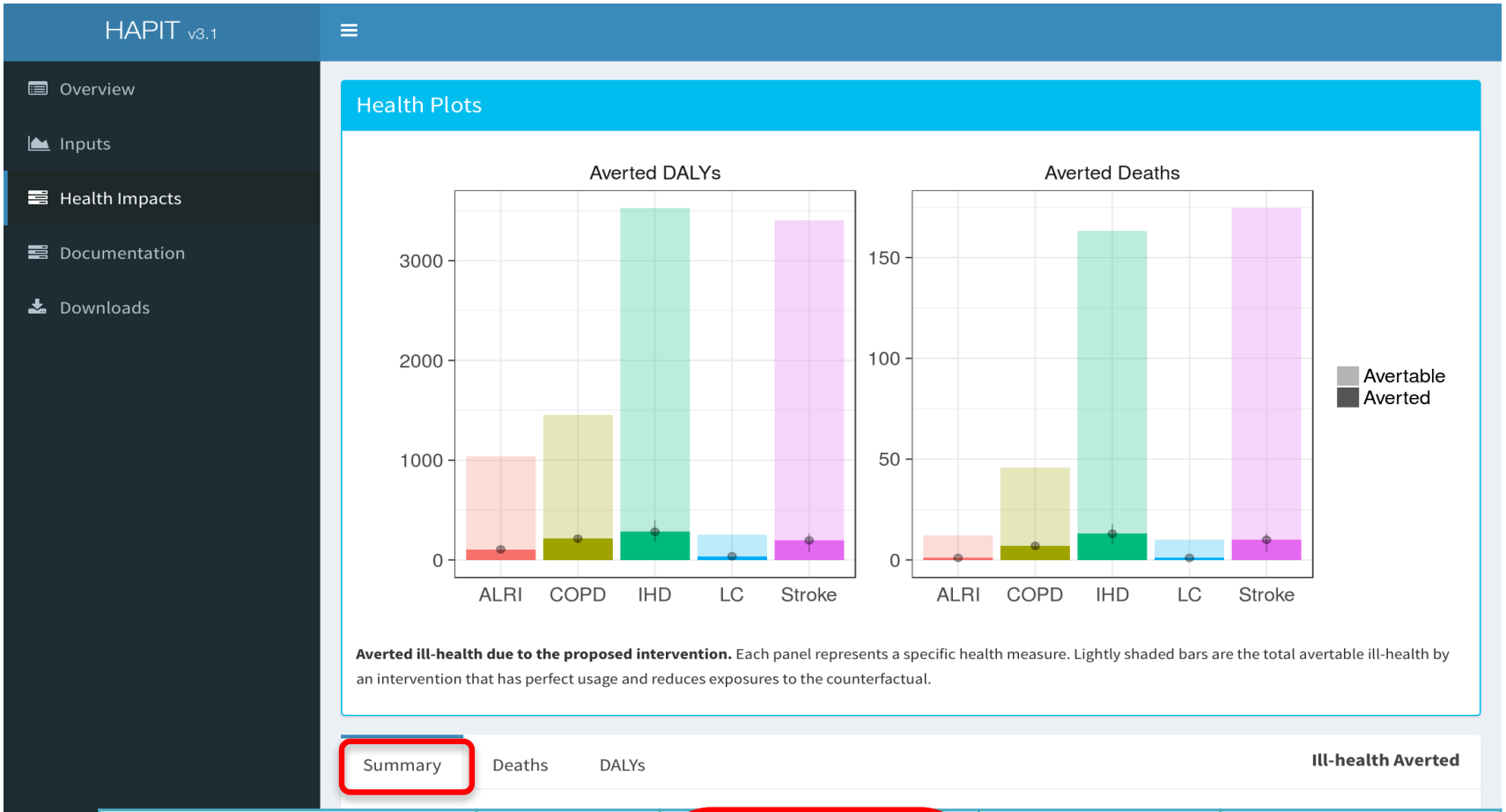
How to Use HAPIT



Measure	Age	Mean Averted	Min Averted	Max Averted
Averted DALYs	Child	2666	1937	3075
Averted Deaths	Child	31	23	36
Averted DALYs	Adult	8006	4750	10538
Averted Deaths	Adult	359	206	473

HAPIT Output: PDF Report / Brief

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COOKSTOVE IQ

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COOKSTOVE IQ

OBJECTIVES

- Cookstove IQ is an online solution for impact project design, monitoring and verification in Gold Standard cookstove projects.
- It standardises project data collection, calculations and reporting using a website and online database that can be accessed anywhere, and by multiple stakeholders (project owners/GS/DOEs/VVBs etc.)
- ADALYs methodology is fully integrated into Cookstove IQ (outputs from HAPIT need additional processing for project ADALYs to be certifiable)

AVAILABILITY

- Available from the Gold Standard website, and at the following link: http://cookstoveiq.goldstandard.org

COOKSTOVE IQ DEMO

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REFERENCE MANUAL and ONLINE TUTORIAL

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REFERENCE MANUAL

- The aim of the reference manual is to provide non-technical information on the methodology
- Designed in a simple to read manner with pictures and illustrations
- Includes additional information like the price of monitoring instruments and where they can be procured
- Provides contact details of agencies with expertise in monitoring and testing exposure to PM 2.5
- Best practices in monitoring Usage and PM 2.5 exposure

Objective of the online tutorial

OBJECTIVE:

- The objective of the online tutorial is to help facilitate knowledge acquisition on the GS ADALYs methodology
- The online tutorial will be in an easy to understand and non-technical format to help practitioners understand the nuances of the methodology

ACKNOWLEDGEMENT

The Energy Sector Management Assistance Program (ESMAP) is a global knowledge and technical assistance program administered by the World Bank. It provides analytical and advisory services to low- and middle-income countries to increase their know-how and institutional capacity to achieve environmentally sustainable energy solutions for poverty reduction and economic growth. ESMAP is funded by Australia, Austria, Denmark, the European Commission, Finland, France, Germany, Iceland, Japan, Lithuania, Luxemburg, the Netherlands, Norway, Rockefeller Foundation, Sweden, Switzerland, the United Kingdom, and the World Bank Group.

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Q&A

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