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# Clean cookstoves and clean cooking solutions — Guidelines for social impact assessment

*Fourneaux et foyers de cuisson propres — Lignes directrices pour l'évaluation de l'impact social*



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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 285, *Clean cookstoves and clean cooking solutions*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

# Introduction

This document provides guidance for assessing social impacts. It illustrates social impacts deriving from improved cooking and inspires the implementation of such assessments. This document is not exclusive nor comprehensive but provides a solid basis for an assessment. It is important to note that these guidelines are limited by the fact that social impact assessments have been carried out over a limited time and in limited number. Therefore, the guidelines can be considered in evolution.

By social impacts, it is meant consequences to human populations (which can be viewed as harmful or beneficial by those impacted) of any public or private actions related to the adoption of improved cooking solutions that alter and affect the ways in which people live, work, play, relate to one another and organize to meet their needs as members of society (men, women, boys, girls, all ages and all genders). The term also includes cultural impacts involving changes to cooking habits, norms, values and beliefs that guide and rationalize their cognition of themselves and their society[98].

The social impacts this document currently reflects are socio-economic impacts (e.g. gender impacts, employment, entrepreneurship, economic impacts, time use and perception of well-being), health impacts (e.g. accidents and safety, exposure to smoke and resulting health effects, and food security) and environmental impacts. The impact hypotheses however might appear rather linear, even though in reality they are not. This simplified presentation is for illustrative purposes.

This document is a companion to the International Standard for harmonised laboratory testing (ISO 19867) (describing procedures to analyse and characterize the performance of a technology under laboratory conditions) and to the International Standard for field testing methods (ISO 19869) (describing procedures to analyse and characterize the performance of the entire cooking energy system including user behaviour and cooking location in real settings). This document describes procedures to analyse and characterize the impacts people experience after improving their cooking energy system.

Impacts result from the adoption and consistent use of the improved cooking energy system; guidance on assessing adoption and use is provided in ISO 19869.

Stove and fuel stacking is a common practice in which households use various stoves and fuels for specific purposes and cooking tasks. Households commonly adopt an improved cookstove as one cooking tool among others that can accommodate several cooking methods and fuels. This practice can limit or change the intended impacts of a cooking intervention.

This document refers to a solution called “improved cooking energy system” or “improved cookstove”. The term “improved” was chosen as it is generic and inclusive: it includes fuel saving and efficiency, usability, durability, etc. In contrast, the term “clean cookstoves” or “clean cooking solution” does not encompass all issues that are trying to be resolved in the sector. For instance, it does not address efficiency/fuel savings nor include significant social impacts that are, at times, the determining decision factors (besides smoke reduction, comfort, time saving, etc.) that move households to decide to buy and use technologies and change their cooking habits. Therefore, this document uses the term “improved.”

Furthermore, a cookstove alone does not change the cooking reality of families and does not generate all intended impacts. Therefore, this document considers the entire “cooking energy system,” which is a term that reflects and acknowledges the following impact-influencing factors: fuel properties, user behaviour, cooking practice, cooking location and ventilation as well as cooking utensils. Working towards including all these factors will provide the expected benefits.

# Clean cookstoves and clean cooking solutions — Guidelines for social impact assessment

## 1 Scope

This document provides a guidance to evaluate and assess the social impact of improved cooking energy systems.

This document is an informative document, which provides orientation in terms of:

— considerations for stakeholders involved in the cooking sector;

— background information regarding various social impacts resulting from cooking systems;

— example results chains illustrating the simplified and aspirational causal linkages related to energy transitions; and

— descriptive tools and methods to measure direct and indirect social impacts.

The target group for this document is any stakeholder interested in evaluating the impacts of improved cooking, such as: researchers, development organisations, non-governmental organisations, government bodies private sector companies, and donor or investors.

## 2 Normative references

There are no normative references in this document.

## 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**agency**
ability to define one's goals and act upon them

[SOURCE: ISO/TR 21276:2018, 3.6.2]

**3.2**
**baseline**
status of a market or a community prior to introduction of improved cooking energy systems, described by measurements and metadata derived from the field

[SOURCE: ISO/TR 21276:2018, 3.3.1, modified — The phrase "community or cooking system" has been replaced by "community", and "prior to intervention" has been replaced by "prior to introduction of improved cooking energy systems".]

**3.3**
**cooking system**
combination of *cookstove* (3.5), fuel, cooking equipment, cooking environment (including ventilation), and user behaviour, which all influence the quality of the cooking energy service provided

[SOURCE: ISO/TR 21276:2018, 3.5.4, modified — The phrase "and user behaviour, which all influence the quality of the cooking energy service provided" has been added.]

**3.4**
**cooking time**
total time of cooking a dish; it is the time difference between finishing time minus starting time of cooking (in minutes)

[SOURCE: Reference [19] modified — The formula $\Delta t = t_f - t_i$ was translated into the phrase "total time of cooking a dish; it is the time difference between finishing time minus starting time of cooking (in minutes)", with $t_i$ being start time and $t_f$ being finish time of cooking (minutes).]

**3.5**
**cookstove**
appliance primarily employed for the cooking of food, but which can also be employed for space or water heating, or other purposes

[SOURCE: ISO/TR 21276:2018, 3.1.7]

**3.6**
**DALY**
disability-adjusted life year
loss of the equivalent of one year of full health

Note 1 to entry: DALYs for a disease or health condition are the sum of the years of life lost to due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population.

[SOURCE: Reference [112] modified — Note 1 to entry was originally part of the definition.]

**3.7**
**economic impact**
net change in an economic activity associated with an industry, event or policy in an existing regional economy

Note 1 to entry: These changes are most often viewed in terms of business output, value added, wealth, personal income or jobs.

[SOURCE: ISO/TR 21276:2018, 3.6.3, modified — The phrase "net change, either positive or negative, in an economic activity" has been replaced by "net change in an economic activity", and "including industrial output, value added, wealth, personal income, jobs and resources" has been replaced by "associated with an industry, event or policy in an existing regional economy". Note 1 to entry was originally part of the definition.]

**3.8**
**employment**
occupation for which people are paid either in cash or in kind

Note 1 to entry: Persons who during a specified brief period, (a) performed some work for wage or salary in cash or in kind, (b) had a formal attachment to their job but were temporarily not at work during the reference period, (c) performed some work for profit or family gain in cash or in kind, (d) were with an enterprise such as a business, farm or service but who were temporarily not at work during the reference period for any specific reason.

[SOURCE: ISO/TR 21276:2018, 3.6.4, modified — Note 1 to entry was added.]

**3.9**
**empowerment**
process of expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them

Note 1 to entry: Empowerment is comprised of the following dimensions: resources, *agency* (3.1) and achievements. Resources is defined as the necessary skills and information; achievement is defined as the outcomes of the empowerment process.

[SOURCE: ISO/TR 21276:2018, 3.6.5, modified — Note 1 to entry was added.]

**3.10**
**entrepreneur**
person who seeks to generate value through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets

[SOURCE: ISO/TR 21276:2018, 3.6.6]

**3.11**
**environmental impact**
positive, neutral or negative effect on the social or material environment in a given area resulting from a change

[SOURCE: ISO/TR 21276:2018, 3.6.7]

**3.12**
**exposure**
contact of an organism with chemical, biological or physical influences

Note 1 to entry: This contact can occur via mouth (e.g. by food), the respiratory system or skin.

[SOURCE: ISO/TR 21276:2018, 3.4.4, modified — The phrase "physical or biological agent at levels above those normally found in the organism's environment" has been replaced by "biological or physical influences" and Note 1 to entry was added.]

**3.13**
**food security**
point in time, when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life

[SOURCE: ISO/TR 21276:2018, 3.6.8, modified — The term "condition" was replaced by "point in time" and "for an active and healthy life" was added.]

**3.14**
**gender**
socially constructed roles and responsibilities of women and men in society and the power relations that exist between them

Note 1 to entry: The concept of gender also includes the expectations held about the characteristics, aptitudes and likely behaviours of both women and men (femininity and masculinity). Gender roles and expectations are learned. They can change over time and they vary within and between cultures. Systems of social differentiation such as political status, class, ethnicity, physical and mental disability, age and more, modify gender roles [105].

Note 2 to entry: The concept of gender is vital because, applied to social analysis, it reveals how women's and men's roles and relationships are largely socially constructed. In most societies, there are differences and inequalities between women and men in decision-making opportunities, responsibilities assigned, activities undertaken, and access to and control over resources.

[SOURCE: ISO/TR 21276:2018, 3.6.9, modified — The phrase "culturally and socially constructed" has been replaced by "socially constructed" and "of different sexes that exist in families, societies and cultures, and the power relations that exist between different sexes" has been replaced by "of women

and men in society and the power relations that exist between them". Notes 1 and 2 to entry were added.]

**3.15**
**HIC**
high income country
economy with a gross national income per capita of 13 206 USD or more

[SOURCE: Reference [44] modified — The abbreviation "GNI" has been replaced by "economy with a gross national income".]

**3.16**
**HAP**
**household air pollution**
presence of air pollutants including solid particles or gases in air in both indoor and outdoor environments of living spaces

[SOURCE: ISO 19869:2019, 3.4.9]

**3.17**
**improved cookstove**
*cookstove* (3.5) proposed for a geographic region or target community, which has been shown to outperform a *baseline* (3.2) with respect to primary criteria including emission factors, fuel consumption, thermal efficiency, durability and/or safety

[SOURCE: ISO/TR 21276:2018, 3.1.9]

**3.18**
**livelihood**
capabilities, assets, income and activities required to obtain the necessities of life

Note 1 to entry: People pursue a variety of livelihood outcomes [such as more income, increased *well-being* (3.28), reduced vulnerability, improved *food security* (3.13)] through various livelihood strategies. Livelihood strategies aim to build or contribute to an individual's livelihood assets- comprised of human capital, natural capital, financial capital, physical capital, social capital, and political capital.

[SOURCE: ISO/TR 21276:2018, 3.6.11, modified — Note 1 to entry was added.]

**3.19**
**LMICs**
low and middle income countries
economies with a gross national income per capita of less than 13 205 USD

[SOURCE: Reference [120] modified — The abbreviation "GNI" has been replaced by "economies with a gross national income".]

**3.20**
**$PM_{2,5}$**
particulate matter with diameter of 2,5 micrometres (µm) or less

[SOURCE: ISO/TR 21276:2018, 3.4.8, modified — The phrase "fine particulate matter such that the aerodynamic equivalent diameter of the particles is less than or equal to 2,5 µm" has been replaced by "particulate matter with diameter of 2,5 micrometres (µm) or less".]

**3.21**
**quality of life**
individuals' objective and perceived position in life in the context of culture and value systems in which they live, including personal security, physical and mental health, education and skills, environmental quality, social connections, civic engagement and governance, as well as recreational and leisure time

[SOURCE: ISO/TR 21276:2018, 3.6.12, modified — The phrase "and in relation to their goals, expectations, standards and concerns, and the sum of the above as expressed in their community"

has been replaced by “including personal security, physical and mental health, education and skills, environmental quality, social connections, civic engagement and governance, as well as recreational and leisure time”.]

**3.22**
**results chain**
causal chain
description of steps that can result from an intervention, defined as inputs, activities, outputs, outcomes (direct results) and impacts (indirect results)

[SOURCE: Reference [21] modified — The phrase “The causal sequence for a development intervention that stipulates the necessary sequence to achieve desired objectives beginning with inputs, moving through activities and outputs, and culminating in outcomes, impacts, and feedback.” has been replaced by “description of steps that can result from an intervention, defined as inputs, activities, outputs, outcomes (direct results), and impacts (indirect results)”.]

**3.23**
**self efficacy**
belief that one will be able to accomplish the things he/she sets out to do

[SOURCE: Reference [52] modified — The phrase “beliefs have the potential to influence imagery outcomes and can show if an intervention has had an effect.” has been replaced by “belief that one will be able to accomplish the things he/she sets out to do”.]

**3.24**
**social impact**
positive and negative consequences of any actions to improve cooking that can alter or affect the ways in which people live

[SOURCE: ISO/TR 21276:2018, 3.6.13]

**3.25**
**stacking**
common practice in which households use various stoves and fuels for specific purposes and cooking tasks

[SOURCE: ISO/TR 21276:2018, 3.5.13, modified — The original term was "stove stacking" and the phrase “practice of a household using more than one cookstove” was replaced by “common practice in which households use various stoves and fuels for specific purposes and cooking tasks”.]

**3.26**
**stakeholder**
organization, government, company, researcher, user and/or community involved in *cooking system* (3.3) research, design, development, production, sale, promotion, regulation and/or use

[SOURCE: ISO/TR 21276:2018, 3.6.14, modified — The phrase “those involved in the development of clean cookstoves” was replaced by “organization, government, company, researcher, user and/or community involved in cooking system research, design, development, production, sale, promotion, regulation, and/or use”.]

**3.27**
**time use**
time spent on fuel procurement and preparation, food preparation, cooking, cleaning, and stove tending, as well as shifts in time and activity patterns, including among household members

Note 1 to entry: This includes both perceived changes and actual measured shifts in how people spend their time.

Note 2 to entry: Adapted from ISO/TR 21276:2018, 3.3.24.

**3.28**
**well-being**
dynamic process that gives people a sense of how their lives are going as a result of the interaction between their circumstances, activities and psychological resources or 'mental capital'

Note 1 to entry: It includes objective and subjective factors.

Note 2 to entry: Adapted from ISO/TR 21276:2018, 3.6.17 and Reference [100].

# 4 Impacts

## 4.1 General

Around the world, three billion people rely on open fires and traditional cookstoves and fuels to cook food and to light and heat their homes – causing serious environmental and health problems [110]. Over four million people globally die each year from exposure to household air pollution caused by cooking fires [110]. Scaling the adoption of clean and efficient cookstoves and fuels is imperative to ending energy poverty. Increasing access to and the adoption and consistent use of clean and efficient cookstoves and fuels has the potential to contribute to the achievement of UN Sustainable Development Goals (SDGs) related to poverty eradication, food security, health and well-being, education, gender equality, economic growth, reducing inequalities, sustainable cities, environmental protection, and climate change mitigation[101,97]. Stakeholders can consider including an assessment of adoption and usage as a central component of their impact evaluations (for guidance, see ISO 19869).

## 4.2 Gender impacts

Stakeholders can consider the potential positive, negative or neutral gender impacts to individuals and households from the adoption of an alternative cooking energy system, given that women and girls generally perform an overwhelming majority of the cooking tasks, and in most contexts, are responsible for managing household energy, including collecting or purchasing fuel. These impacts can concern health, safety, economic circumstance, education, household energy, time use and/or quality of life. Knowing that these factors overwhelmingly impact the lives of women and children, a gender analysis can be undertaken to capture gender and power dynamics in a given context or intervention. (See Table 1 for gender analysis and implementation resources and Table 2 for guidance on gender impact assessment.)

NOTE 1 It is important to consider different roles and responsibilities played by women, men and children in and outside the household that could be affected by cookstove interventions. For instance, women often shoulder the burden of caregiver responsibilities. Roles can also be viewed across the entire cooking value chain (including design, production, marketing, sales, distribution and use). Assessing both the extent and quality of these roles is important (such as access and control/ownership of resources, the ease of access to credit and loans, leadership, and decision-making opportunities, paid and unpaid labour, domestic duties and care, etc.).

NOTE 2 The assessment can consider any policies that are enacted to ensure or foster gender equality and a conducive working environment for women (such as issues of maternity and paternity leave, flexible working hours, consideration of work/life balance, equal salary/wages, opportunities for training, mentorship, and promotion, sexual harassment policies, health care, etc.).

NOTE 3 The assessment can consider the gendered household, social, and economic impacts of alternative cooking energy system adoption (such as household finances, time use, gender norms and workload, health, the impacts of drudgery, injuries, accidents, harassment, and the risk of violence).

## 4.3 Socioeconomic impacts

### 4.3.1 Household finance, employment and enterprise

Stakeholders can consider the potential positive, negative or neutral economic impacts to individuals and households from the adoption of alternative cooking energy systems. Possible impacts include

household economic shifts from reduced fuel expenditure or changes in income-generating opportunities.

NOTE 1 Changes in the money spent on fuel is a common direct impact resulting from the adoption and use of improved stoves in some contexts. Not only do the prices of various fuels differ (including free fuelwood), but depending on the fuel efficiency of the cookstove, less or more fuel can also be required [3]. (See Table 3 for resources on economic impact assessment.)

NOTE 2 Shifts in fuel expenditures are also dependent on how consistently the family uses the improved cooking energy system, whether they are using it correctly, and whether they are using it in place of other cooking energy system or in combination with other cooking technologies[13].

NOTE 3 While more efficient cooking can reduce fuel costs, such advantages could be offset by the added costs or investment required for the purchase of new cookstoves, including the burden of credit/finance. For instance, the adoption of new cookstove technologies and fuels can greatly shift household costs in terms of cash flow and time.

EXAMPLE If a family borrows money to buy a liquefied petroleum gas (LPG) stove to replace or supplement a cookstove that burns collected wood fuel, they could experience a reduction in their cash resources in order to pay back the credit and refill their LPG cylinder but also an increase in time for productive or leisure activities, as they no longer have to collect as much wood.

NOTE 4 Product design, production, distribution and after-sales service of cooking energy systems can encourage new skills and retraining, as well as the potential creation of businesses, entrepreneurship and employment opportunities.

NOTE 5 The adoption of alternative cooking energy systems could negatively impact the livelihoods of people involved in the distribution of existing stoves and fuels. This could include job losses, lower profit margins or disruptive effects of importing products. The opportunity to access, use and manage credit can be considered.

NOTE 6 It is also important to consider skills and knowledge gained as well as traditional or indigenous knowledge lost because of the introduction of alternative cooking energy systems. These can relate to technical skills related to cooking or the production and use of fuel, as well as knowledge related to health and environmental impacts of cooking practices. The extent and quality of training activities can also be considered.

### 4.3.2 Time use

Stakeholders can consider that in LMICs, household members typically spend long days balancing a variety of responsibilities that are integral to the family's survival. Cooking and related fuel collection and preparation tasks are commonly integrated into long days of unpaid care work, such as caring for children, tending to animals and crops, fetching water, washing clothes and other cleaning tasks. In general, while not universally true, these responsibilities and their impacts fall most heavily on women and female children.

Stakeholders can consider the ways in which changes in cooking technology, fuel or practices (alone or in combination) impact household time use, whether through time savings, increased time expenditures, or balance-neutral transference of time among activities and/or household members. (See Table 4 on methods for collecting time use data.)

NOTE 1 Cooking-related activities and fuel-related activities are sometimes performed by distinct household members, with the division often determined by gender and/or age[96].

NOTE 2 These activities often occur on quite separate time scales, with cooking performed at least once per day year-round, while fuel procurement could be undertaken less frequently, and patterns could vary significantly across seasons. The frequency and duration of these activities are affected by very different factors, and how time is allocated and prioritized can vary at different times of the year.

EXAMPLE 1 Fuel collection can be a function of forest cover, whereas cooking time can be a function of food preparation (like pre-soaking beans). During agricultural harvesting seasons, women could have less time for fuel collection due to increased farming responsibilities and could need to collect more fuel before this time period to have a sufficient stock.

NOTE 3 Who experiences the impacts and to what degree (if at all) depends on who is performing the cooking-related activities, and this is often determined by gender and age. Although most (but not all) improved cookstoves and fuel combinations provide some efficiency gains, it is possible for new stoves and/or fuels to not result in increased cooking capacity, increased cooking power, or less onerous tending/maintenance requirements; in fact, the opposite could be true, and time use can increase. Further, even where benefits do occur, they are not guaranteed to generate time savings because these are largely dependent on user behaviour. In some cases, cooking energy transitions result in more available fuel, which causes households to cook more than they did previously due to suppressed demand.

Stakeholders can consider the entire meal creation process, including fuel procurement and preparation, food preparation, cooking, and cleaning of pots and stove, recognizing that trade-offs in time requirements can occur among these activities. There is a distinction between "cooking time," defined as the time during which the cook actively engages with the food while it is cooking and "stove usage," which refers to the total time the stove is lit/operating. Both "cooking time" and "stove usage" occur within the larger framework of the meal creation process, which starts with fuel procurement and preparation and concludes with the cleaning of the pots, stove, and other utensils.

Stakeholders can consider the full range of time shifts associated with adoption of improved cooking technologies. Time and activity shifts include changes in time patterns within the cooking activity as well as changes in the use of non-cooking time associated with adoption of improved cooking technologies, including the use of any time savings.

EXAMPLE 2 A family could move from a technology that is slow-cooking but has low fuel-tending requirements, to one that cooks quickly but needs more frequent tending. In this case, the cook could no longer be able to multitask after the stove is lit, and could need to chop vegetables ahead of time, so the shorter cooking time is offset by the need to prepare food before lighting the stoves.

NOTE 4 Time and activity shifts could be experienced by one or more household members simultaneously, either separately or in an interdependent manner. For example, gains in cookstove efficiency could result in shorter fuel collection times for one family member and shorter cooking time for another. How time shifts from one household member to another is often determined by gender dynamics within the household.

NOTE 5 Use of time savings could include engagement in productive activities, child-care, leisure and sleep. The time savings could be used for more or less pleasant/drudgerous non-cooking activities; for example, less cooking time resulting in more labour-intensive agricultural responsibilities.

Stakeholders can consider that cultural perceptions of time are not uniform; time-savings are not universally valued or even viewed as an asset in some settings. Furthermore, the valuation of time saving often varies according to gender dynamics, with women and girls' time often less valued.

NOTE 6 Regardless of whether actual time savings are achieved, household members could perceive time-related benefits from cooking system changes.

EXAMPLE 3 Changes in stove tending requirements could allow multi-tasking, which creates a perception of time efficiency/savings.

NOTE 7 Cooking and fuel collection activities are not a universally negative experience for those who perform them.

EXAMPLE 4 Preparing family meals could be personally satisfying to the cook, just as collecting fuel could be an opportunity for groups to socialize.

### 4.3.3 Well-being

Stakeholders can consider how well-being is impacted by (1) access to improved cooking energy system, and (2) involvement in the cooking energy value chain. Well-being is a combination of objective factors (quality of life and material conditions) and subjective factors (positive emotions and moods,

the absence of negative emotions, satisfaction with life, fulfilment and general positive functioning)[14]. (See Table 5 for tools for measuring well-being.)

NOTE 1 Stakeholders can consider consumers' perception of benefits of improved cooking. Perceived benefits can differ amongst women and men in the household, regardless of who is using the stove on a regular basis. Perceived benefits can include reduced cooking time, reduced fuel expenditures, a cleaner kitchen, and pride in ownership of new products (or having status from being part of the value chain for an aspirational product). A change in the taste of food could be a perceived drawback.

NOTE 2 Stakeholders can consider cookstove users' perception of changes in drudgery because of cookstove use, recognizing that improved cookstoves can decrease or increase perceived drudgery. Individuals could find they can reduce the length and frequency of fuel collection trips. Alternatively, users could perceive an increase in drudgery associated with fuel processing, such as the need to chop wood into smaller pieces to fit their improved cookstove, or the need to feed their improved cookstove more frequently.

## 4.4 Health impacts

### 4.4.1 Accidents and safety

Stakeholders can consider the health impacts of cooking energy system use with respect to accidents and safety. This subclause outlines key health risk factors and assessment recommendations associated with traditional cooking methods and fuels beyond those attributed to exposure to household air pollution (discussed in 5.2). Further guidance on conducting safety assessments on cooking technologies and fuels in the field can be found in ISO 19869:2019.

#### 4.4.1.1 Burns

Stakeholders can consider the risk of cooking-related burn injuries. Household use of traditional cookstoves is associated with several environmental and health problems, including a significant number of burn injuries each year. Those who survive burn injury frequently live with chronic disability, which can have extensive psychological and social effects and impact their ability to work.

NOTE 1 An estimated 90 %[23] of the 265,000 total deaths[113] occurring worldwide from burn injuries each year occur in LMICs. In 2004, an estimated 11 million people globally had burns severe enough to necessitate medical attention and, in LMICs alone, 10,5 million DALYs were lost [115]. Children, especially toddlers from birth to four years of age, experience a disproportionately high number of burns. Studies have shown this age group to account for nearly half of all childhood burns[79] and, when considering all age groups, up to a third of total burns[2].

NOTE 2 Many of the advances made in HICs that have improved the functional recovery of burn victims have yet to make impacts in LMICs. As a result, the burden of burn injury remains particularly high in these regions, especially the Indian subcontinent and Sub-Saharan Africa. Notably, the mortality rate in LMICs is more than twelve times higher than that of HICs [55]. Whereas burns in HICs have surveillance and epidemiological data, clearly defined and successful prevention and protection strategies, and strong treatment facilities, LMICs have little infrastructure to handle burn injuries on a wide scale. There is low quality and quantity of data describing cookstove-related burn injuries in LMICs, limiting the development of effective prevention and treatment strategies. It is possible that the problem of cookstove-related burn injuries is greater in magnitude than currently reported. Since most LMICs do not have national burn surveillance systems to report burn injury rates, it is widely agreed by sector experts and the World Health Organization (WHO) that burn injury estimates for LMICs are significantly underestimated[23].

NOTE 3 Risk for burn injuries resulting from household cooking is disproportionately high for young children and women. Children face a high risk due to a combination of the amount of time spent around household cooking, their inherent limited awareness of fire dangers, and their natural curiosity and impulsiveness. The differences in body proportions put children at an even higher risk for burns, as their skin is thinner than that of adults and they have a body surface area to body mass ratio three times that of adults[89].

NOTE 4 In the majority of LMICs, women are at a higher risk than men for burn injuries because of their primary responsibility for cooking duties. In some regions, it is common for women to wear loose-fitting clothing while cooking, which increases the risk for burn injuries.

NOTE 5 The use of liquid fuels like kerosene for cooking carries specific risk factors for burn injuries including:

— fuel leakage onto surrounding materials or clothing;

— explosion of malfunctioning stoves; and

— instability of stoves and risks of tipping[23].

#### 4.4.1.2 Poisoning from liquid fuels

Stakeholders can consider the risk of poisoning from liquid fuels. The use of liquid fuels such as kerosene and, to a lesser degree, ethanol, for cooking and lighting remains widespread in LMICs. Ingestion of these fuels is a significant source of paediatric poisoning in households that rely on these fuels.

NOTE 1 The ingestion of kerosene results in gastro-intestinal symptoms, respiratory distress and, in rare cases, damage to the central nervous system. Severity and recovery are closely related to the amount of liquid ingested and how quickly treatment was administered.

NOTE 2 Rural communities of lower socio-economic status experience higher risk for and incidence of kerosene poisoning due to higher dependence on the fuel as an energy source. Poisoning is most common among young children, who are curious about their surroundings but unable to identify the hazards of liquid fuels like kerosene.

NOTE 3 Both kerosene and ethanol are visually similar to water and are frequently purchased and stored in milk or soft drink bottles, which makes it harder to distinguish between fuel and beverages and significantly increases risk of injury or harm[23].

NOTE 4 The lack of population-based data makes estimating the overall burden of liquid-fuel poisoning challenging, but in LMICs it remains the most common source of poisoning among children[23]. Possibly due to ethanol's lower prevalence as a household fuel, its risk of ingestion is less well documented than that of other fuels.

#### 4.4.1.3 Other accidents

Stakeholders can consider the risk of accidents and violence during fuel collection. In regions where households rely heavily on gathered biomass for most of their energy needs, procuring fuel to meet household cooking needs is a significant and time-consuming responsibility that can have health, safety and security implications, especially, but not exclusively, for women and children.

NOTE 1 Those responsible for fuelwood collection, especially women and children, are exposed to potentially dangerous environments where they are vulnerable to accident and injury.

EXAMPLE 1 Collectors could suffer back or other strains from long treks carrying fuel, snake or insect bites, and/or machete wounds from cutting tree limbs, etc.

NOTE 2 Fuel collectors can be the target of violence, including verbal and physical attacks. Gender-based violence, including sexual assault and rape, is especially of concern in conflict and refugee situations. Attacks could be motivated by competition for scarce biomass resources and/or by broader societal conflicts.

EXAMPLE 2 A study supported by the World Food Programme (WFP) in Uganda's Nakivale refugee camp reported that incidents occurred as often as on a bi-weekly basis[11]. A study conducted in 2014 in the same refugee camp reported that 41 % of households suffered from incidents of assault during fuelwood collection in the past six months[95]. Incidents reported included the confiscation of fuelwood (23 %), beating (20 %), bodily injury (12 %), assault (10 %), attempted rape (5 %) and rape (4 %)[95].

NOTE 3 The risk of injury, accident and violence is greater as distance to the biomass supply source increases. Increasing deforestation often necessitates longer journeys to collection areas, thereby increasing risk of assault.

### 4.4.2 Exposure to emissions from cooking energy systems

Stakeholders can consider the established and suggested health effects of exposure to pollutants present in smoke from cooking fires. The burning of solid fuels for cooking results in high levels of household air pollution (HAP). As a result, household members are exposed to health-damaging



 

pollutants, including but not limited to particulate matter (PM), carbon monoxide (CO), nitrous oxides, sulphur oxides, and hundreds of volatile organic compounds (VOCs).

NOTE 1 Women are often the primary cooks and as such are chronically exposed to HAP.

NOTE 2 Children are commonly present during cooking activities and therefore, negatively impacted by HAP during critical periods of their cognitive and physical development.

NOTE 3 While for a number of years smoke from cooking fires was commonly referred to as indoor air pollution, recently researchers have adopted the term "HAP" as a more inclusive term to encompass not only the indoor smoke, but also the smoke in the outdoor air nearby the household.

#### 4.4.2.1 Mechanism by which cooking energy systems impact human health

Stakeholders can consider the pathway (illustrated in Figure 1) by which cooking impacts health. Reducing exposure to these harmful pollutants—especially $PM_{2,5}$ and CO—is critical to achieving health benefits.

NOTE 1 Incomplete combustion of dirty fuels for cooking (and/or lighting and/or heating) emits pollutants into the local environment. These pollutants accumulate in and around the living space, where family members are exposed to them. Breathing allows a certain quantity of the pollutants to enter the body (i.e. dose), causing illness.

NOTE 2 Exposure to fine particulates, such as $PM_{2,5}$, is hazardous, as they penetrate deep into the human lung.

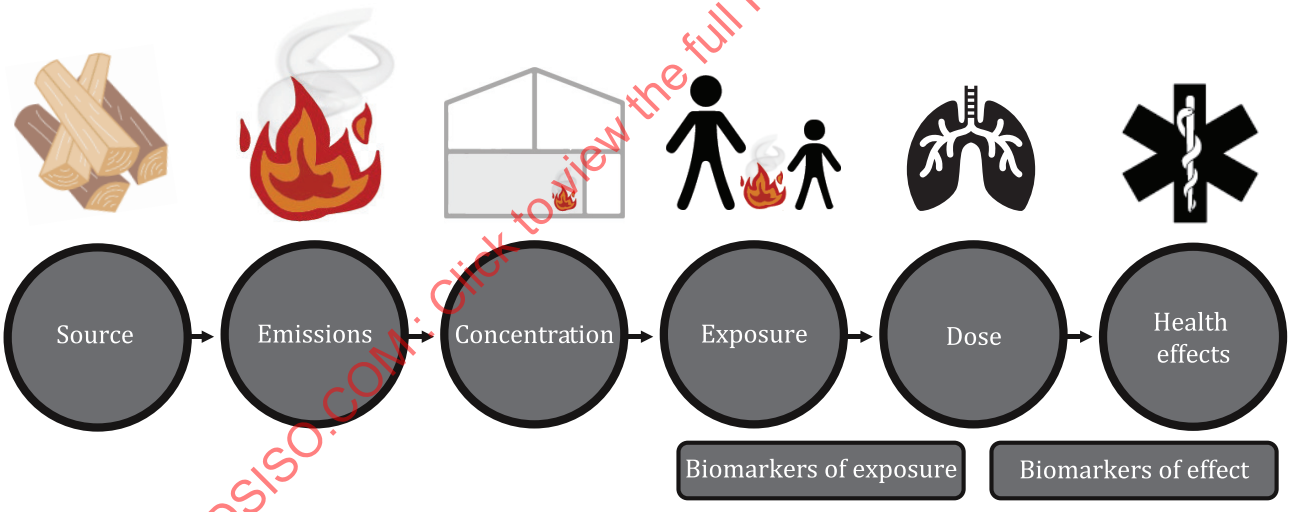


**Figure 1 — Results chain depicting environmental health pathway for household air pollution[92]**

NOTE 2 According to the WHO, the annual guideline for chronic exposures to $PM_{2,5}$ is 5 µg/m$^3$. This used to be daily exposure level of $PM_{2,5}$ on a daily basis averaged over a 24-hour period is 10 µg/m$^3$, based on Reference [116]. Concentrations in poorly ventilated households during a cooking event can reach levels up to one hundred times this level.

NOTE 3 According to the WHO, the annual guideline for chronic exposures to CO is 4 µg/m$^3$. This used to be acceptable exposure to CO averaged over a 24-hour period as 7 mg/m$^3$, based on Reference [116]. CO is a gas produced from the partial oxidation of carbon-containing compounds and has both acute and chronic health impacts. Such partial oxidation occurs in incomplete combustion of solid fuels, and CO forms when there is not enough oxygen to produce carbon dioxide ($CO_2$).

#### 4.4.2.2 Contribution of household air pollution to the global burden of disease

Stakeholders can consider the established global burden of disease, as well as further suggested health effects, from exposure to household air pollution. (See Table A.1 for more details on established and suggested health impacts of HAP.)

NOTE 1 The global burden of disease comparative risk assessment identified exposure to HAP as among the greatest health risk factors around the world. In total, it accounts for 5 % of the global burden of disease expressed in DALYs[58] and an estimated 4,3 million premature deaths annually[115]. Exposure to HAP has been definitively linked to acute lower-respiratory infections (ALRIs), chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD), stroke and lung cancer[58]. ALRIs, which include pneumonia and other respiratory infections, are the leading global cause of mortality for children under the age of five[4], [110].

NOTE 2 The development of integrated exposure-response (IER) curves for the 2010 Global Burden of Disease report models estimates of health risks at a variety of concentrations of $PM_{2,5}$ using studies of outdoor air pollution, second-hand smoke, HAP and active smoking. IER curves have been developed for paediatric ALRIs and four adult health outcomes (IHD, stroke, lung cancer and COPD). Due to the strong evidence base for these health effects, they are considered established and counted in the global burden of disease.

NOTE 3 Exposure to HAP is responsible for approximately 4,3 million premature deaths annually, with a distribution as follows:

— 12 % from pneumonia;

— 34 % from stroke;

— 26 % from ischemic heart disease;

— 22 % from COPD; and

— 6 % from lung cancer[110].

NOTE 4 Household solid fuel use is associated with high rates of non-pulmonary health effects, including, for example, cardiovascular disease, cataracts, low birth weight and tuberculosis. However, the evidence linking these health outcomes to exposure to household smoke is not yet sufficient to include them in the primary health effects counted in the global burden of disease.

# 5 Measuring impacts

## 5.1 Measures, metrics and assessment methodologies – Gender impacts

**Table 1 — Methods for conducting gender analysis and integrating gender into projects**

| Method name | Indicator/content | Source |
|---|---|---|
| Scaling Adoption of Clean Cooking Solutions through Women's Empowerment[85] | The Alliance Resource Guide is a tool for a wide variety of sector stakeholders — including practitioners (private sector players, community-based organisations (CBOs), NGOs, etc.), donors, policymakers, multinational corporations, investors and academic institutions — to increase their understanding of why women are critical to clean cooking solutions, how to ensure they are included in every value chain segment, and to tell the story of women's empowerment in the clean cooking sector. | Clean Cooking Alliance (CCA) (formerly known as the Global Alliance for Clean Cookstoves) |
| Integrating Gender Considerations into Energy Operations[40] | This briefing note discusses the key elements of the gender-energy topic and provides specific examples of how to integrate gender considerations in energy policy dialogue and the project cycle. It draws on recent experience within the World Bank and elsewhere in mainstreaming gender in energy projects, and looks at three key areas: assessment, action, and monitoring and evaluation. The primary objective is to provide World Bank task teams a brief overview of the key issues, resources and tools to help integrate gender considerations into energy sector operations.<br>This note is complemented by an online compendium of gender resources, including sample questionnaires, terms of reference, and screening guidance. | The World Bank, Energy Sector Management Assistance Program (ESMAP) |
| Mainstreaming Gender into Energy Projects: A Practical Handbook[60] | This handbook on mainstreaming gender in energy projects provides guidance, practical tools and examples for energy projects that show how to undertake gender mainstreaming systematically. The handbook provides guidance on:<br>— how to assess the gender situation in an energy project;<br>— what gender interventions can be undertaken as part of project activities;<br>— how to build capacities and institutionalise gender mainstreaming practices within implementing organisations and partners; and<br>— how to measure and monitor the progress made on gender aspects of energy projects. | ENERGIA |
| **Gender Analysis, Assessment, and Audit Manual & Toolkit[107]** | This toolkit provides instructions on how to conduct gender-analysis studies, assessments and audits. It provides useful approaches and tools for gender-analysis studies, including guidance on operationalizing a study from start to finish. It also includes tools for baseline studies, agriculture and economic growth-oriented gender analyses, value-chain and market assessments, and others that can be incorporated into other studies. | ACDI/VOCA |
| **Gender Awareness and Development Manual: Resource Material for Gender Trainers[8]** | This set of training tools and exercises was developed to train and equip staff at all levels of responsibility within an organization by providing the knowledge and tools to integrate gender issues throughout their work. The modules are designed to initiate discussion and provide a context for staff to develop future planning in gender mainstreaming. | United Nations Development Programme (UNDP) |

**Table 1** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| **Harvard Gender Analysis Framework**[36] | Developed by the Women in Development (WID) office at the U.S. Agency for International Development (USAID), this resource makes an economic case for allocating resources to women (as well as men) and helps planners to design more efficient projects. The framework presents a matrix for collecting and analysing gender data with the following four components:<br>a) the **activity profile** identifies who does what on a daily basis (differentiating productive and reproductive activities);<br>b) the **access and control profile** identifies how resources are used to carry out the work identified in the activity profile, as well as access to and control over their use by gender;<br>c) the **analysis of influencing** factors charts factors that influence gender differences in the aforementioned profiles; and<br>d) a **project-cycle analysis** that demonstrates how to examine a project or intervention considering gender-disaggregated information. | International Labour Organization |
| **Integrating Gender throughout a Project Life Cycle 2,0**[41] | To conduct effective, responsible development work, incorporating gender at all stages of a project's life cycle is critical. As such, this document provides guidance on how to use a gender lens in program design, implementation and evaluation. It includes technical sections, best practices and case studies that address capacity development and gender outcomes. | Land O'Lakes International Development |
| **Socio-Economic and Gender Analysis Field Handbook**[25] | This handbook is written for a range of development professionals who work directly with local communities in developing countries. The guide supports community engagement though participatory development planning. The tools in this handbook will help development agents to:<br>— identify key development patterns;<br>— understand various livelihood strategies; and<br>— build consensus and community buy-in for development priorities and action plans. | Food and Agriculture Organisation (FAO) |

**Table 2 — Methods for collecting gender impact data**

| Method name | Indicator/content | Source |
|---|---|---|
| Social Impact Enterprise Survey[69] | This social impact survey is meant to be conducted with individual clean cooking enterprises on an annual basis. The goal of this survey is to capture some of the output level social impact data, such as how many men and women the company directly employs and how many men and women, they engage in various roles throughout their value chain. The survey captures data related to the following indicators: | CCA and the International Center for Research on Women (ICRW) |

**Table 2** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| | — number of employees (full-time and part-time; full-time only; part-time only) (disaggregated by sex);<br>— number of full-time management employees (disaggregated by sex);<br>— number of employees who serve in various roles throughout the value change (i.e. as product designers; as producers/ manufacturers; as wholesale distributors; as retail distributors; in after-sales service) (disaggregated by sex);<br>— number of employees who live in urban/rural locations (disaggregated by sex);<br>— average wage paid to full-time and part-time employees over the last month (disaggregated by sex);<br>— average wage paid to management employees over the last month (disaggregated by sex); and<br>— percentage of the organization that is owned by women. | |
| Social Impact: Employee/ Entrepreneur Survey[25] | This social impact survey is meant to be conducted with employees/ entrepreneurs soon after they have been hired/become affiliated with the clean cooking enterprise and then again after they have been with the enterprise for some time. For the baseline survey, the goal is to ask the employees/ entrepreneurs to reflect on life **before** they became employed/affiliated with the enterprise (these questions and modules are labeled "pre" in red). A similar, follow-up survey can then be conducted after six months to one year with the same employee/entrepreneur; this time, the focus will be on their life **now** that they have been working with the clean cooking enterprise for six months to one year (these questions and modules are labeled "post" in red).<br>The survey covers the following areas of impact:<br>— income,<br>— access to financial services,<br>— access to credit,<br>— training: business and technical skills,<br>— training: empowerment and leadership skills,<br>— mentoring,<br>— access to networks,<br>— agency:<br>— self-confidence,<br>— voice/communication skills,<br>— status,<br>— decision-making and control over resources/ assets. | CCA & ICRW |

**Table 2** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| Social Impact: Customer Survey[26] | This social impact survey is meant to be conducted with customers soon after they have purchased the clean cooking product and then again after they have been using the clean cooking product for some time. For the baseline survey, the goal is to ask customers to reflect on life **before** they acquired the clean cooking product (these questions and modules are labeled "pre" in red). A similar, follow-up survey can then be conducted after six months to one year with the same customers; this time, the focus will be on their life **after** the purchase, now that they have been using the clean cooking product for six months to one year (these questions and modules are labeled "post" in red).<br>The survey covers the following areas of impact:<br>— household finances:<br>— fuel expenditure,<br>— income through productive use of the cookstove,<br>— time use:<br>— time spent on fuel collection,<br>— time spent on cooking,<br>— household social and economic well-being:<br>— status within the family/community,<br>— workload:<br>— safety/protection,<br>— drudgery. | CCA &ICRW |
| Integrating Gender Considerations into Energy Operations[40] | This briefing note discusses the key elements of the gender-energy topic and provides specific examples of how to integrate gender considerations in energy policy dialogue and the project cycle. It draws on recent experience within the World Bank and elsewhere in mainstreaming gender in energy projects, and looks at three key areas: assessment, action, and monitoring and evaluation. The primary objective is to provide World Bank task teams a brief overview of the key issues, resources, and tools to help integrate gender considerations into energy sector operations.<br>This note is complemented by an online compendium of gender resources, including sample questionnaires, terms of reference and screening guidance. | The World Bank, ESMAP |
| Intervention Guide for the Women's Empowerment in Agriculture Index (WEAI): Practitioners' Guide to Selecting and Designing WEAI Interventions[42] | The WEAI Guide instructs donors and implementers of agricultural market development programs about how best to use the WEAI survey results to improve their programs. The guide helps practitioners to employ market-systems and gender-responsive approaches to selecting and designing evidence-based interventions tailored to the domains of empowerment prioritized in the WEAI. Implementers and managers of Feed the Future projects will find this guide particularly useful, but other local stakeholders, donors and implementers working in livelihoods and gender could also benefit from this resource. | USAID and ACDI/VOCA |

**Table 2** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| Understanding and Measuring Women's Economic Empowerment[30] | This brief report lays out fundamental concepts including a definition of women's economic empowerment: a measurement framework that can guide the design, implementation and evaluation of programs to economically empower women. In addition to a set of illustrative indicators that can serve as concrete examples for developing meaningful metrics for success. | ICRW |
| Measuring Women's Economic Empowerment[63] | This brief summarizes recommended measures to assess intermediate, direct and final outcomes of women's economic empowerment programs. Outcomes of interest are women's increased productivity, income and well-being. This brief is a companion to the Roadmap to Promoting Women's Economic Empowerment report and focuses on what to measure. A full database of relevant indicators can also be found in the related Indicator Database. | UN Foundation and ExxonMobil |
| Compendium of Gender Scales[17] | This compendium makes gender scales readily accessible to practitioners interested in assessing gender-related attitudes and beliefs and evaluating their interventions.<br>This compendium consists of the following eight scales:<br>— couple communication on sex,<br>— women's empowerment,<br>— gender beliefs,<br>— gender equitable men,<br>— gender norm attitudes,<br>— gender relations,<br>— household decision making,<br>— sexual relationship power. | FHI 360 (C-Change Project) |

## 5.2 Measures, metrics and assessment methodologies – Household finance, employment and enterprise

**Table 3 — Methods for collecting economic impact data**

| Method name | Indicator/content | Source |
|---|---|---|
| Social Impact: Enterprise Survey[69] | This social impact survey is meant to be conducted with individual clean cooking enterprises on an annual basis. The goal of this survey is to capture some of the output level social impact data, such as how many men and women the company directly employs and how many men and women they engage in various roles throughout their value chain. The survey captures data related to the following indicators: | CCA & ICRW |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| | — number of employees (full-time and part-time; full-time only; part-time only) (disaggregated by sex);<br>— number of full-time management employees (disaggregated by sex);<br>— number of employees who serve in various roles throughout the value change (i.e. as product designers; as producers/ manufacturers; as wholesale distributors; as retail distributors; in after-sales service) (disaggregated by sex);<br>— number of employees who live in urban/rural locations (disaggregated by sex);<br>— average wage paid to full-time and part-time employees over the last month (disaggregated by sex);<br>— average wage paid to management employees over the last month (disaggregated by sex); and<br>— percentage of the organization that is owned by women. | |
| Social Impact: Employee/ Entrepreneur Survey[25] | This social impact survey is meant to be conducted with employees/entrepreneurs soon after they have been hired/become affiliated with the clean cooking enterprise and then again after they have been with the enterprise for some time. For the baseline survey, the goal is to ask the employees/ entrepreneurs to reflect on life **before** they became employed/affiliated with the enterprise (these questions and modules are labeled "pre" in red). A similar, follow-up survey can then be conducted after six months to one year with the same employee/entrepreneur; this time, the focus will be on their life **now** that they have been working with the clean cooking enterprise for six months to one year (these questions and modules are labeled "post" in red).<br>The survey covers the following areas of impact:<br>— income,<br>— access to financial services,<br>— access to credit,<br>— training: business and technical skills,<br>— training: empowerment/leadership skills,<br>— mentoring,<br>— access to networks,<br>— agency:<br>— self-confidence,<br>— voice/communication skills,<br>— status,<br>— decision-making and control over resources/assets. | CCA &ICRW |
| Impact Reporting and Investing Standards (IRIS) Metrics[43] | IRIS is the catalogue of generally accepted performance metrics that leading impact investors use to measure social, environmental and financial success. | Global Impact Investment Network (GIIN) |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| | — IRIS is a free, online catalogue for selecting performance metrics, including metrics for financial performance, including standard financial reporting metrics such as current assets and financial liabilities;<br>— operational performance, including metrics to assess your investees' governance policies, employment practices, and the social and environmental impact of their day-to-day business activities;<br>— product performance, including metrics that describe and quantify the social and environmental benefits of the products, services, and unique processes offered by your investees;<br>— sector performance, including metrics that describe and quantify impact, in particular social and environmental sectors, including agriculture, financial services and healthcare; and<br>— social and environmental objective performance, including metrics that describe and quantify progress towards specific impact objectives such as employment generation or sustainable land use. | |
| **Access to credit** | | |
| Global Findex Questionnaire[99] | Developed by the Bill and Melinda Gates Foundation, the Global Findex Questionnaire tracks how adults save, borrow, make payments and manage risk across 140 economies. Acknowledging the variety of formal and informal financial services available in the developing world, Findex defines account ownership as having an account with either a financial institution (including banks, credit unions, cooperatives and/or microfinance institutions) or a mobile money provider.<br>Selected questions: | World Bank |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| | — An account can be used to save money, to make or receive payments, or to receive wages or financial help. Do you, either by yourself or together with someone else, currently have an account at any of the following places: a bank [a credit union, cooperative, microfinance institution] or another type of formal financial institution?<br>— In the past 12 months, has money been **deposited** into your personal account(s)? This includes cash or electronic deposits, or any time money is put into your account(s) by yourself, an employer, or another person or institution.<br>— In the past 12 months, have you ever made a transaction with money **from your account** at a bank or another type of formal financial institution using a **mobile phone**? This can include using a mobile phone to make payments, buy things, or to send or receive money.<br>— In the past 12 months, have you, personally, saved or set aside any money for any of the following reasons? How about …? (Read A-C): (A) To start, operate, or grow a business or farm; (B) For old age; (C) For education or school fees.<br>— In the past 12 months, have you, by yourself or together with someone else, borrowed any money from any of the following sources? (Read A-D): (A) Have you borrowed from a bank, [insert all financial institutions], or another type of formal financial institution? This does not include credit cards. (B) Have you borrowed from a store by using instalment credit or buying on credit? (C) Have you borrowed from family, relatives or friends? (D) Have you borrowed from another private lender (for example, a/an [insert country-specific examples of private lenders, i.e. loan shark, payday lender or pawn shop])? | |
| Women's Empowerment in Agriculture Index (WEAI)[119] | The WEAI was initially developed in 2012 as a tool to reflect changes in women's empowerment that might result from the US government's Feed the Future Initiative, which commissioned the development of the WEAI. However, the WEAI has also been used by a variety of organizations to assess the state of empowerment and gender parity in agriculture, including the impact of credit.<br>Selected questions:<br>Module G3 (B): Access to credit: "Next I'd like to ask about your household's experience with borrowing money or other items in the past 12 months."<br>— Would you or anyone in your household be able to take a loan or borrow cash/in-kind from [SOURCE] if you wanted to?<br>— Has anyone in your household taken any loans or borrowed cash/in-kind from [SOURCE] in the past 12 months?<br>— Who made the decision to borrow from [SOURCE]?<br>— Who makes the decision about what to do with the money/ item borrowed from [SOURCE]? | International Food Policy Research Institute (IFPRI) |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| | List of sources: NGOs; informal lender; formal lender (bank, financial institution); friends or relatives; group-based micro-finance or lending including village savings and loan associations (VSLAs), savings and credit co-operative societies (SACCOs), and merry-go-rounds; or any other context-specific lending source. | |
| **Access to networks/social cohesion** | | |
| WEAI Group Membership Module (G4)[64] | The WEAI also assess individuals' involvement in community groups, including formal and informal systems. Membership in economic or social groups can be important means of establishing networking connections within communities.<br>Selected questions:<br>"Now I'm going to ask you about groups in the community. These can be either formal or informal and customary groups."<br>Is there a [GROUP] in your community?<br>Are you an active member of this [GROUP]?<br>List of groups: Agricultural/livestock/fisheries producers' group (including marketing groups); water users' group; forest users' group; credit or microfinance group (including SACCOs, merry-go-rounds, and VSLAs); mutual help or insurance group (including burial societies); trade and business association; civic groups (improving community) or charitable group (helping others); local government; religious group; other [women's/men's] group (only if it does not fit into one of the other categories); or other. | IFPRI |
| World Bank Integrated Questionnaire for the Measurement of Social Capital[32] | The World Bank developed this questionnaire to assess the relationship between social capital and poverty. This tool aims to document survival and mobility strategies of the poor, including exploring social relations between households and within communities, as well as with markets, states and NGOs.<br>Selected questions:<br>Of all these groups to which you or members of your household belong, which one is the most important to your household?<br>_____ [Name of group]<br>Thinking about the members of this group, are most of them of the same....<br>— Religion? (Yes/No)<br>— Gender? (Yes/No)<br>— Ethnic or linguistic background/race/caste/tribe? (Yes/No)<br>— Occupation? (Yes/No)<br>— Educational background or level? (Yes/No)<br>If you suddenly needed to borrow a small amount of money [rural: enough to pay for expenses for your household for one week; urban: equal to about one week's wages], are there people beyond your immediate household and close relatives to whom you could turn and who would be willing and able to provide this money? (Answer choices: definitely; probably; unsure; probably not; definitely not.) | The World Bank |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| Interpersonal Support Evaluation List[16] | To understand the role social support networks play in reducing the impacts of stress, the authors developed questions to assess emotional and familial support outside of the household. The tool uses a Likert scale to measure the access individuals have to interpersonal support for various life situations: 1. Definitely false 2. Probably false 3. Probably true 4. Definitely true.<br>Assessment statements:<br>1) If I wanted to go on a trip for a day (for example, to the country or mountains), I would have a hard time finding someone to go with me.<br>2) I feel that there is no one I can share my most private worries and fears with.<br>3) If I were sick, I could easily find someone to help me with my daily chores.<br>4) There is someone I can turn to for advice about handling problems with my family.<br>5) If I decide one afternoon that I would like to go to a movie that evening, I could easily find someone to go with me.<br>6) When I need suggestions on how to deal with a personal problem, I know someone I can turn to.<br>7) I don't often get invited to do things with others.<br>8) If I had to go out of town for a few weeks, it would be difficult to find someone who would look after my house or apartment (the plants, pets, garden, etc.).<br>9) If I wanted to have lunch with someone, I could easily find someone to join me.<br>10) If I was stranded 10 miles from home, there is someone I could call who could come and get me.<br>11) If a family crisis arose, it would be difficult to find someone who could give me good advice about how to handle it.<br>12) If I needed some help in moving to a new house or apartment, I would have a hard time finding someone to help me.<br>Scoring:<br>Items 1, 2, 7, 8, 11, 12 are reverse scored.<br>Items 2, 4, 6, 11 make up the appraisal support subscale<br>Items 1, 5, 7, 9 make up the belonging support subscale<br>Items, 3, 8, 10, 12 make up the tangible support subscale.<br>All scores are kept continuous. | Cohen, Sheldon et al., (1985) NATO Advanced Science Institutes (ASI) Series D |
| **Communications** | | |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| WEAI Group Membership Module[119] | The purpose of this module is to evaluate men's and women's potential for leadership and influence in the communities where they live. The tool uses a Likert scale to measure leadership: 1. No, not at all comfortable; 2. Yes, but with a great deal of difficulty; 3. Yes, but with a little difficulty; 4. Yes, fairly comfortable; 5. Yes, very comfortable.<br>Selected statements:<br>— Do you feel comfortable speaking up in public to help decide on infrastructure (like small wells, roads, water supplies) to be built in your community?<br>— Do you feel comfortable speaking up in public to ensure proper payment of wages for public works or other similar programs?<br>— Do you feel comfortable speaking up in public to protest the misbehaviour of authorities or elected officials? | IFPRI |
| Self-Perceived Communication Competence Scale (SPCC)[62] | This tool was developed by researchers to determine self-perceived communication competence, focusing on attitude change, credibility, interpersonal attraction, communication anxiety, and apprehension. It presents twelve communication situations for which participants are asked to score their own competence on a scale 0 to 100, where 0 = completely incompetent and 100 = competent.<br>Assessment statements:<br>_____1) Present a talk to a group of strangers.<br>_____2) Talk with an acquaintance.<br>_____3) Talk in a large meeting of friends.<br>_____4) Talk in a small group of strangers.<br>_____5) Talk with a friend.<br>_____6) Talk in a large meeting of acquaintances.<br>_____7) Talk with a stranger.<br>_____8) Present a talk to a group of friends.<br>_____9) Talk in a small group of acquaintances.<br>_____10) Talk in a large meeting of strangers.<br>_____11) Talk in a small group of friends.<br>_____12) Present a talk to a group of acquaintances. | McCroskey, James C. & McCroskey, Linda L (1998) Communication Research Reports |
| **Fuel expenditure** | | |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| Energy Policies and Multitopic Household Surveys Guidelines for Questionnaire Design in Living Standards Measurement Studies (LSMS)[67] | LSMS surveys include questions designed to measure the fuels and electricity sources available to households, energy quantities consumed, and associated household cost and expenditures.<br>Selected questions:<br>F01: During the last 30 days, has your household used [for each fuel]?<br>F02: What is the typical unit of measure [for each fuel]?<br>F03: What is the approximate weight or volume of a typical unit of [for each fuel]?<br>F04: How many units of [for each fuel] has your household used in the last 30 days?<br>F05: How many of these units of [for each fuel] did your household purchase in the last 30 days?<br>F06: What is the typical price your household pays per unit of [for each fuel]?<br>F07: What was the total cost of all the units of [for each fuel] that your household purchased in the last 30 days?<br>F08: How much time did all members of your household spend collecting [for each biomass fuel] in the last 30 days? Include time spent purchasing and collecting, as well as round-trip travel.<br>F09: What is the one-way distance members of your household typically travel to collect [for each biomass fuel]?<br>F10: What percentage of [for each fuel] was used for the following purposes? | The World Bank, ESMAP |
| Comparative Cooking Costs in Developing Countries[10] | This model is designed to help policy makers understand the economic tradeoffs between cooking technologies and fuels at the household level in order to encourage adoption of improved cooking solutions. The tool uses a series of quantitative data questions to compare cost benefit between traditional biomass and energy efficient stoves.<br>Variables needed to calculate change in fuel expenditure:<br>— cost of the stove;<br>— lifetime of the stove;<br>— efficiency of the stove;<br>— price of fuels used burned by the stove including wood or other biomass fuels;<br>— fuel collection hours for biomass fuels;<br>— quantity of fuel consumed in the household per month; and<br>— average wage of agricultural workers.<br>Similar information can be found in World Bank's Household Cookstoves, Environment, Health and Climate Change report[38] | Energy for Development and Poverty Reduction Blog |
| **Household economic stability** | | |

**Table 3** *(continued)*

| Method name | Indicator/content | Source |
|---|---|---|
| Personal Financial Situation Index[27] | Gallup's Personal Financial Situation Index captures a respondent's perception of their current financial situation relative to their past financial situation. It also captures their perceptions regarding whether their current financial situation will be stable over time.<br>Selected question:<br>"We are interested in how people's financial situation may have changed. Would you say that you are financially better off now than you were a year ago, or are you financially worse off now? Now looking ahead, do you expect that at this time next year you will be financially better off than now, or worse off?" | Gallup |

## 5.3 Measures, metrics and assessment methodologies – Time use

Stakeholders can utilize a combination of technical, quantitative and qualitative data collection methods in order to obtain the most accurate assessment of time savings, including both perceived and measured change in time use[94]. Evaluations can also examine potential unintended negative consequences that might hinder or negate the overall time-savings benefits. When measuring time spent on meal preparation, stakeholders can consider:

a) time spent on fuel-specific activities, including time spent procuring/collecting fuel and preparing it (e.g. any required drying or processing);

b) time spent on cooking-specific activities, including:

- food preparation;
- cooking time/duration;
- capacity of the stove to cook multiple foods/dishes simultaneously (which impacts total cooking time/duration);
- intensity of stove tending/fire management (and resulting ability to attend to other activities while cooking, or not);
- cleaning of pots, counters, and walls (based on how dirty the stove gets them); and
- in-home stove maintenance, such as cleaning the chimney and/or combustion chamber.

Table 4 presents various time use data collection methods, identifying the type of data obtained through the method, level of research control, benefits and limitations.

NOTE 1 The cooking sector faces challenges reconciling the complex interconnected nature of basic human activities, including cooking, in rural households with the marketing needs of a global market-based scale up of improved cookstoves and fuels. Currently there is not a simple integrated approach for measuring the time savings implications of a cooking energy system with greater fuel efficiency, cooking power, or capacity. Tools and methodologies to measure changes in time use and perceptions of time use range from very controlled lab-based approaches that gather limited quantitative data about the potential of the technology to reduce cooking time, to open ended qualitative data from real users in real world setting about actual context-specific experiences and outcomes, and everything in between. Some of these methodologies quantify actual changes in time per task by instrumenting stoves or making systematic observations, whereas others measure perceived changes in time use and dig more deeply into the causes and implications of changes. The relative role of perceived changes in time versus actual measured outcomes is significant; existing research suggests that cooks commonly over-report cooking time generally and use of new or improved cooking energy systems specifically. Regardless of the approach taken, results could show increases or decreases in time use associated with changes in cooking technology, fuel and/or practices.

NOTE 2 Standardized measurement approaches for cooking task time provide objective and comparable product information while integrated field methods promise a more holistic and realistic understanding of time-related outcomes and longer-term impacts.

EXAMPLE Cookstove promoters can base claims of faster cooking on actual measurements of context-specific cooking tasks.

**Table 4 — Methods for collecting time use data**

| Method | Indicator/content | Level of control | Benefits | Limitations |
|---|---|---|---|---|
| Structured household surveys | Estimated time spent on cooking, fuel collection, or related tasks<br><br>Basic data on cooking and household management patterns | Real-world conditions but structured information | Context specific data that can be easily aggregated for overview<br><br>Collecting short recall data at regular intervals can limit some recall bias | Highly dependent on asking the "right" questions<br><br>Subject to recall and reporting bias |
| Semi-structured interview | Investigates all time-related aspects of cooking, fuel collection, and related tasks as well as factors shaping household and personal time choices | Real-word conditions with unstructured information | Rich and complete context-specific data<br><br>Collecting short recall data at regular intervals can limit some recall bias | Subject to recall and reporting bias<br><br>Data collection and analysis both very resource-intensive |
| Focus groups | Identifies cooking, fuel collection, and related tasks and relative time-intensity of each as well as factors shaping time-related choices | Real-word conditions with unstructured information<br><br>Group dynamic unfolds in real-time | Detailed context-specific information about personal and group feelings, perceptions, and opinions | Peer pressure could shape answers and dissenting/minority opinions could be lost |
| Self-reported time/ activity | Time spent per activity | Real-word conditions with unstructured information | Rich context specific data | Subject to recall and reporting bias<br><br>Diaries/logs/matrices can be more accurate but subject to compliance problems |
| Observation | Time spent per activity | Can be applied during controlled cooking tests or without any controls in a household | Very direct specific measurement of key time-related indicators | Resource intensive and subject to Hawthorn effect |
| Stove use monitoring system | Duration of stove usage and number of cooking event per day | Instrument data can be collected during controlled cooking tests or in real-world uncontrolled situations | Objective measure of stove usage across all situations | No insight into causes of time shifts or ultimate impacts on households<br><br>Can only track the time the stove is lit, not necessarily the time the cook is present in the kitchen/ tending the stove |

**Table 4** *(continued)*

| Method | Indicator/content | Level of control | Benefits | Limitations |
|---|---|---|---|---|
| Personal CO or PM exposure monitors | Levels of personal exposure to pollutant over time | Instrument data can be collected during controlled cooking tests or in real-world uncontrolled situations | Objective measure of effects of cooking on household members<br><br>Provides indication of duration of active cooking time during which exposures are greatest | Resource intensive<br><br>Subject to non-compliance<br><br>Subject to confounding due to other sources of pollution or changes in kitchen ventilation |
| Controlled cooking test | Time per cooking task | Controlled test with context-specific pots, foods and fuel | Data on the mechanics of changes in cooking time due to changes in stoves or fuels | Resource intensive<br><br>Less comparable across contexts and still not context-specific enough to definitively measure impacts |
| Water boiling test (WBT) | Time to boil | Lab-based test that is strictly controlled | Standard across all situations, makes comparisons possible | Few insights into actual context-specific impacts |

## 5.4 Measures, metrics and assessment methodologies – Well-being

Stakeholders can consider the tools presented in Table 5 as means of measuring well-being. Questions from these tools can be mixed and matched, along with other questions as needed, to create surveys customized to the relevant context.

**Table 5 — Tools for measuring well-being[1]**

NOTE 1 Data can be aggregated across multiple enterprises.

| Method name | Indicator/content | Source |
|---|---|---|
| WHO Quality of Life (WHOQOL)[117] | The WHOQOL is a quality of life assessment developed by the WHOQOL Group with fifteen international field centres, simultaneously, in an attempt to develop a quality of life assessment that would be applicable cross-culturally. | WHO |
| Organisation for Economic Co-operation and Development (OECD)'s Guidelines on Measuring Subjective Well-being[68] | These guidelines provide international recommendations on collecting, publishing and analysing subjective well-being data. They provide guidance on collecting information on people's evaluations and experiences of life, as well as on collecting "eudaimonic" measures of psychological well-being. They identify approaches for measuring the various dimensions of subjective well-being, and provide guidance for reporting on such measures. The guidelines also include several prototype survey modules on subjective well-being that national and international agencies can use in their surveys. | Organisation for Economic Co-operation and Development |
| Ryff Scales of Psychological Well-Being[88] | This instrument focuses on measuring multiple facets of psychological well-being, including self-acceptance, the establishment of quality ties to others, a sense of autonomy in thought and action, the ability to manage complex environments to suit personal needs and values, the pursuit of meaningful goals and a sense of purpose in life, and continued growth and development as a person. | Ryff, Carol D. et al (2007) accessed at Stanford University SPARQtools |

**Table 5** *(continued)*

| | | |
|---|---|---|
| The Adult Hope Scale[93] | This scale is a 12-item measure of a respondent's level of hope. In particular, the scale is divided into two subscales that comprise Snyder's cognitive model of hope: (1) agency (i.e. goal-directed energy) and (2) pathways (i.e. planning to accomplish goals). | Snyder, C. R. et al (1991) accessed at Fetzer Institute |
| The General Self Efficacy Scale (GSE)[86] | The GSE is a 10-item psychometric scale that is designed to assess optimistic self-beliefs to cope with a variety of difficult demands in life. | Schwarzer, R., & Jerusalem, M. (1995) accessed at the Free University of Berlin |
| Rosenberg Self Esteem Scale[78] | This is a 10-item scale that measures global self-worth by measuring both positive and negative feelings about the self. The scale is believed to be unidimensional. All items are answered using a 4-point Likert scale format ranging from strongly agree to strongly disagree. | Rosenberg, M. (1965) accessed at Fetzer Institute |

## 5.5 Measures, metrics and assessment methodologies – Accidents and safety

### 5.5.1 Notes on assessments of burns

Stakeholders can assess burns using both quantitative and qualitative methods. Questionnaires can be used to assess the frequency and severity of burns in target populations. In some circumstances, it is possible to observe scars and deformities. Perceptions of risk of burns, especially by mothers for children, can be assessed through qualitative methods. Studies can also assess the levels at which prevention information has been retained by household members.

NOTE 1 Some stakeholders find it useful to analyse cooking-related risk factors associated with burn injuries in LMICs according to the WHO's methodology as follows:

a) personal risks:
   - attempts to put out fires,
   - loose-fitting and flammable clothing worn during cooking,
   - children playing near cookstoves,
   - insufficient knowledge about safe cookstove usage practices,

b) cooking equipment:
   - instability of pots and stoves,
   - usage of ground level stoves,
   - lack of enclosure of open flames due to cookstove design and construction,
   - combustibility of fuel sources,

c) cooking environment:
   - confined spaces,
   - cooking equipment within the reach of children,
   - flammable fuels and substances stored near open cooking flames[23].

NOTE 2 In many LMICs there is currently little infrastructure in place from which to draw local information regarding burns. As a result, including questions about the long-term incidence of burns within the baseline survey to establish a level of incidence within the target population is needed to assess the impacts of interventions on this health outcome. Serious events are likely to be well remembered, implying that recall periods are long.

NOTE 3 Stakeholders can consult the WHO Review on Household Fuel Combustion and Burns and Poisoning[111].

NOTE 4 ISO/TC 285 has provided guidance for safety assessment of stoves in the field (for reference, see 19869:2019).

### 5.5.2 Notes on assessments of poisoning

Stakeholders can assess poisoning events using quantitative and qualitative methods. Survey questions can identify incidents of poisoning, including circumstances and outcomes (e.g. health care sought and health outcome). Perception of risks can also be assessed using qualitative methods. Stakeholders can also assess the level of education surrounding poisoning for liquid-fuel users, especially if educational components have been integrated into stakeholder activities. Stakeholders can also monitor household uptake of risk-reducing interventions like child-resistant containers, distinctive colouring of liquid fuels, and safer storage of liquid fuels.

NOTE 1 Since it is unlikely that comprehensive local information regarding rates of poisonings exist for target populations, including events of poisonings within the baseline survey will be important to establish a level of incidence within the target population. This is required to assess the impacts of interventions on this health outcome. Serious events are likely to be well remembered implying that recall periods are long.

NOTE 2 Stakeholders can consult the WHO Review on Household Fuel Combustion and Burns and Poisoning.

### 5.5.3 Notes on assessment of other accidents and risks

Stakeholders can determine who in the household is responsible for fuel collection within the target community to assess the risks related to fuel collection in a target area. Although in many cases women and children are primarily responsible for the collection, it is not uncommon for men to collect fuelwood. In these cases, men are therefore also at risk for accidents and violence.

Stakeholders can collect evidence and data on accidents and violence in an appropriate manner, recognizing that this information is socially sensitive. Stakeholders can consider employing empirical means of measuring accidents and violence in fuel collection. At this point, evidence and data covering accidents and violence associated with fuel collection are largely anecdotal. No health-based framework for this investigation is known to the authors; therefore, an anthropology- or gender-based framework could be most useful.

Stakeholders can also note that fuel collection tasks could be carried out at the same time as other chores outside the home. Fuel collectors could view the collection task in a positive or neutral light due to social or other benefits that they provide despite the risk of injury, accident, or violence.

NOTE Stakeholders working in humanitarian settings could find it useful to consult the humanitarian online library[39], which offers a research index of cooking assessments conducted with displaced populations, including several related to fuel collection, accidents, and gender-based violence.

## 5.6 Measures, metrics and assessment methodologies – Exposure to smoke

### 5.6.1 General

Stakeholders seeking to describe health effects and the impacts of interventions must tailor the methods and tools utilized to desired outcomes and audiences.

EXAMPLE 1 An accessible approach is to conduct descriptive studies of self-reported symptoms related to cooking tasks, which can be valuable for stakeholders and target populations, but which will not generate quantitative evidence of health impacts.

EXAMPLE 2 Qualified research professionals can collect health data using more sophisticated study designs and technical methods to generate quantitative evidence of health impacts.

EXAMPLE 3 Following a standard protocol (under development) it could be possible to effectively address a health policy audience by quantifying health impacts in terms of DALYs, a composite unit utilized by health and development entities globally to measure the burden of disease to evaluate the effectiveness of health-related interventions.

Stakeholders seeking to assess health impacts related to cooking could consider three non-exclusive approaches:

a) self-reported health outcomes;

b) technical measurements of stove emissions, HAP, and/or personal exposure; and

c) modeling estimated averted DALYs.

NOTE 1 Stakeholders seeking guidance on selecting appropriate methods for assessing health impacts could consult Reference [108].

NOTE 2 Stakeholders could find it valuable to consult Reference [54], a catalogue of sensors and monitoring technologies.

NOTE 3 Technical assessment of health risks associated with chronic exposure to household air pollution is a specialized field that requires the close adherence to specific, prescriptive protocols. This is research to be conducted by experienced professionals.

### 5.6.2 Self-reported health outcomes

Stakeholders can utilize quantitative and qualitative methods to assess self-reported health symptoms, which could indicate some smoke-related diseases. Surveys and interviews conducted with principal cooks, primarily women, can be used to assess symptoms associated with cooking, such as cough, headache and irritated eyes. Open-ended questions can be incorporated to further explore perceptions of well-being.

NOTE 1 Perceived improvement in health and well-being can contribute to motivations for adoption and sustained usage of cleaner cookstoves and fuels.

### 5.6.3 Technical measurements to assess health impacts from exposure to smoke

Technical measurements of pollutants that commonly result from incomplete combustion, such as PM and CO can be used as a proxy for health impacts of cooking with unimproved technologies and fuels. These pollutants are most commonly measured at the community level (ambient), inside homes as HAP, or in the breathing zone of individual family members (personal exposure). Of these, personal exposure is the most accurate metric for assessing direct individual health impacts and can be used to estimate the health impacts of exposure using integrated exposure-response curves for several health outcomes (e.g. ALRI, COPD, IHD, stroke and lung cancer). Nonetheless, measurements of HAP and ambient air pollution, although still subject to the time-location variability of cooks, can be used to estimate health impacts.

NOTE 1 The measurement of HAP and/or personal exposure to HAP has been established as a widely accepted proxy for measuring actual health outcomes. Multiple tools and methods exist for measuring HAP, and somewhat fewer for exposure [71]. The WHO offers indoor air quality guidelines[111], including a subsection dedicated to exposure to HAP[35].

NOTE 2 Estimates of health impacts from exposure to smoke include only outcomes with known IER curves, resulting in significant suggested health impacts that are not included in the calculation.

### 5.6.4 Calculating averted DALYs

Stakeholders interested in specifically determining the health impact of an intervention can consider calculating averted disability-adjusted life years (aDALYs), a composite unit widely recognized by health and development entities globally to measure disease burden or risk factors to evaluate interventions.

EXAMPLE Stakeholders engaged in activities designed to replace traditional cooking systems with improved options could use aDALY estimates to demonstrate their relative cost-effectiveness compared to other public health initiatives and attract investors.

NOTE 1 Efforts are underway to develop a standardized approach to quantifying aDALYs from interventions that reduce household air pollution. Stakeholders would be responsible for establishing a baseline with specific air pollution and demographic information and then measure the changes or differences in households with improved cooking energy systems through additional measurements. Studies using this type of approach have been successfully piloted.

Stakeholders can consider the household air pollution intervention tool (HAPIT) to generate aDALY estimates[35].

NOTE 2 HAPIT is a web-based tool that allows users to estimate their impact on the burden of disease. The tool requires stakeholders to input parameters from the intervention program, including data on targeted households, intervention lifetime, and intervention cost, as well as field data, such as exposures to $PM_{2,5}$ and usage data, to calculate the health impacts of the intervention in aDALYs.

NOTE 3 HAPIT utilizes existing HAP exposure-response relationships for established health effects as well as national health, demographic, energy, and economic data. The tool is therefore reliant on the accuracy of these national databases and their representativeness of the study area. This methodology is similar to that utilized to calculate the Global Burden of Disease.

NOTE 4 It is expected that HAPIT will be replaced by the air pollution burden of disease explorer (ABODE)[1].

# Annex A
(informative)

# Background material

## A.1 Illustrative causal linkages related to household finance, employment and enterprise

Figure A.1 illustrates the results chain by which adoption of improved cooking energy systems can have gendered impacts on household social and economic well-being.

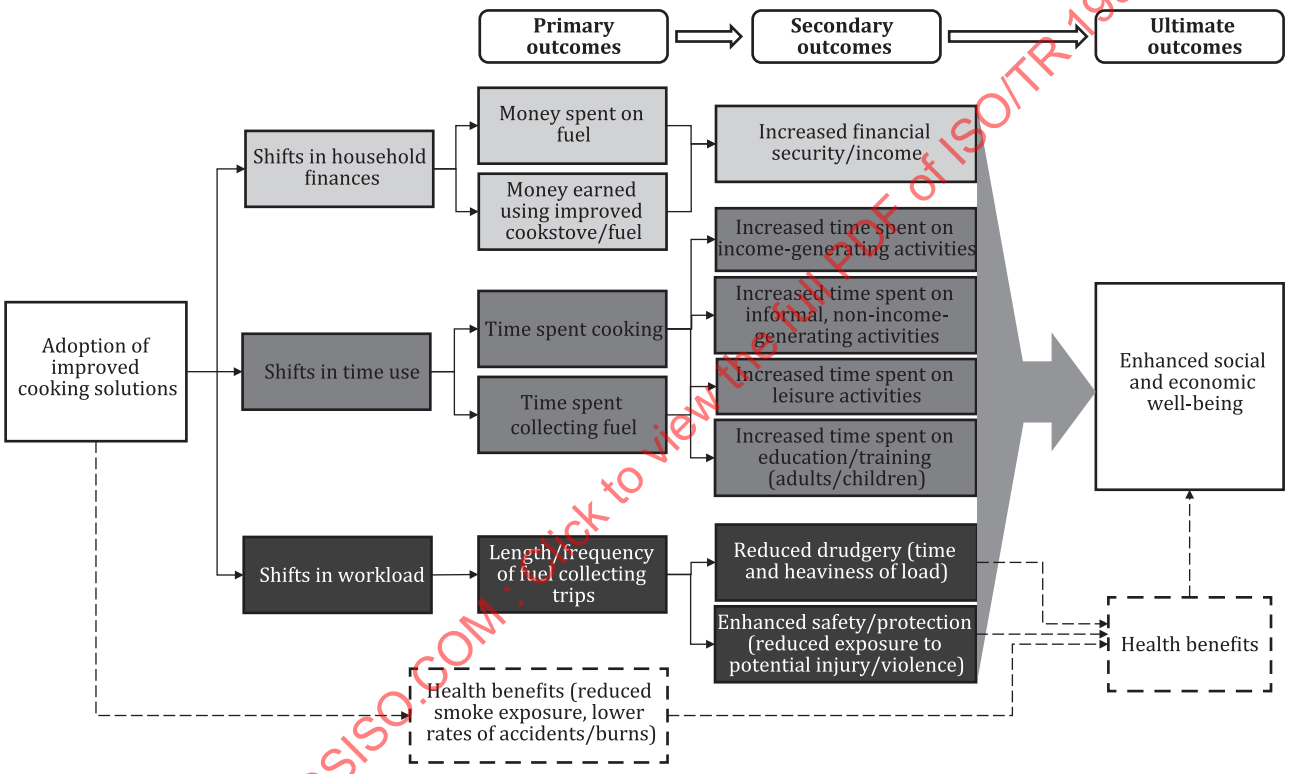


**Figure A.1 — Results chain of adoption of improved cooking energy systems**

NOTE All of the changes illustrated in the figure are particularly relevant for women, who are often the main users of the improved cooking technology and those who spend time and money collecting/purchasing necessary inputs for cooking.

## A.2 Research gaps related to time use

### A.2.1 LMIC settings

Large-scale studies across key geographies in Sub-Saharan Africa, Asia, and Latin America are needed to trace the impact of a variety of improved cookstoves and fuels along the results chain presented in Figure A.1. A key objective of these studies would be to investigate and document the relationship among the key factors that are thought to drive time-savings, such as fuel efficiency, cooking power, cookstove location, capacity and tending requirements, fuel collection and preparation, and cookstove maintenance and related cleaning. Relatively little research has been done that focuses specifically on time use as an outcome of or even as a potential barrier to adoption of improved cooking energy

systems, although there is growing recognition of the importance of this type of investigation. Evidence demonstrating which elements of the results chain lead to actual time savings can be leveraged by stakeholders to strengthen their activities. For example, this information can be used to improve the design of an improved cookstove or in marketing materials to drive purchase and use.

NOTE 1 While solid fuels are burned inefficiently for cooking and heating needs in many contexts around the world, arguably the most pressing research priority is to further explore effective ways to reduce the impacts of these practices on those who suffer from them the most, typically women and girls in poor rural households. The existing evidence base points to many undesirable health, socioeconomic, and environmental burdens and impacts suffered by those who depend on solid fuel. Within this context, cooking technologies, fuels or behaviour change strategies, whether individually or in combination, that save time and/or reduce drudgery for household members (predominantly women and girls) are both valuable and difficult to evaluate.

### A.2.2 Time use changes for individual household members

Studies are needed to explore how shifts in time use are allocated among household members (by both age and gender), such as who experiences time savings and who experiences increased time burdens, whose time is valued and by which members of the household, as well as what people do with saved time. The research would explore what shifts in time use can mean for social and economic well-being for individuals, as well as the household overall.

### A.2.3 Time use measurement instruments and protocols

Studies are needed to continue to refine measurement instruments and protocols, particularly through field validation of sensor-based data compared to both qualitative and quantitative observation and self-reported data. Standardized measurement approaches for cooking task time will provide more credible product information while integrated field methods promise a more holistic and realistic understanding of time-related outcomes and longer-term impacts.

Studies are also needed to explore the relative role of perceived changes in time versus actual measured outcomes in determining the success of cooking energy programs.

EXAMPLE Existing research suggests that cooks commonly over-report cooking time generally and use of new or improved cooking energy systems specifically [53], [84], [118]. Additional research in this area could lead to generally accepted adjustment factors for certain types of self-reported information, which would facilitate wider monitoring of time use and ultimately to improved access to innovations that ease time pressures for rural women.

## A.3 Questions and supplementary material for well-being

**The improved cooking well-being scale (to be further developed/finalized)**

This questionnaire was developed to assess the “well-being” effects of improved cooking. It is important to note that this has not been tested in the field.

**User questionnaire: well-being/quality of life perception**

Instructions: this questionnaire is intended to be given to the user(s) of the cookstove.

### A.3.1 Perception of benefits of cleaner cooking

NOTE It is often the case that within a given household, two or more different types of cookstoves are used. These questions are meant to help the survey administrator understand the impact of the newly introduced, cleaner cookstove(s) within the household.

— Q1: On a scale of 1-5, with 1 being significant worsening, 3 being no change, and 5 being significant improvement, how has your general cooking routine changed as a result of owning a cookstove?

  — A1: 1-5 rating

  - List two primary benefits of owning a stove that you see as most important [e.g. time savings, money savings, less smoke, like having new gadget in the home].
  - List two primary negatives of owning a stove that you see as most important [e.g. cost, smoke, time spent gathering or processing fuel].
- Q2: For the first benefit listed above, on a scale of 1-5 with 1 being significant worsening, 3 being no change, and 5 being significant improvement, how has your [insert primary benefit] changed as a result of owning a cookstove?
  - A2: 1-5 rating
- Q3: For the second benefit listed above, on a scale of 1-5, with 1 being significant worsening, 3 being no change, and 5 being significant improvement, how has your [insert primary benefit] changed as a result of owning a cookstove?
  - A3: 1-5 rating
- Q4: For the first negative listed above, on a scale of 1-5 with 1 being significant worsening, 3 being no change, and 5 being significant improvement, how has your [insert primary benefit] changed as a result of owning a cookstove?
  - A4: 1-5 rating
- Q4: For the second negative listed above, on a scale of 1-5 with 1 being significant worsening, 3 being no change, and 5 being significant improvement, how has your [insert primary benefit] changed as a result of owning a cookstove?
  - A5: 1-5 rating

### A.3.2 Perceived and actual change in drudgery

NOTE Here, time collecting/transporting wood, time cooking and time scrubbing soot off of pots are included as drudgery.

— Q1(a): How much time did you spend collecting/transporting wood per week before owning your cookstove?

  — A1(a): # of hours

— Q1(b): How much time do you spend collecting/transporting wood now that you own your cookstove?

  — A1(b): # of hours

— Q2(a): How much time did you spend processing wood per week before owning your cookstove?

  — A2(a): # of hours

— Q2(b): How much time do you spend processing wood now that you own your cookstove?

  — A2(b): # of hours

— Q3(a): How much time did you spend cooking per week before owning your cookstove?

  — A3(a): # of hours

— Q3(b): How much time do you spend cooking now that you own your cookstove?

  — A3(b): # of hours

— Q4(a): How much time did you spend scrubbing soot of pots/cleaning pots per week before owning your cookstove?

  — A4(a): # of hours

— Q4(b): How much time do you spend scrubbing soot of pots/cleaning pots now that you own your cookstove?

  — A4(b): # of hours

Answer for analysis: Difference between (a) time before and (b) time after. After calculating difference for each question, add them up and compare to actual time change collected in “time” section.

### A.3.3 Perception of status and power

NOTE Here, control over household finances, interest in community engagement and general feelings of being respected are used as proxies for status and power.

- Q1: On a scale of 1-5, with 1 being no control, 3 being some control, and 5 being full control:
  - a) How much control do you have over household finances in general?
    - i) Before owning a stove, how much control did you have over household finances in general?
  - b) How much control do you have over household finances as they relate to spending on food, cooking fuel and cooking supplies?
    - i) Before owning a stove, how much control did you have over household finances as they relate to spending on food, cooking fuel and cooking supplies?
  - A1: 1-5
    Answer for analysis of Q1: [a - a(i)] +[b - b(i)]
- Q2: On a scale of 1-5, with 1 being not at all interested, 3 being somewhat interested, and 5 being very interested:
  - a) How interested are you in attending community meetings and activities?
    - i) Before owning a stove, how interested were you in attending community meetings and activities?
  - b) How interested are you in taking a leadership role in community meetings, activities?
    - i) Before owning a stove, how interested were you in taking a leadership role in community meetings, activities?
  - A2: 1-5

Answer for analysis of Q2: [a - a(i)] + [b - b(i)]

- Q3: On a scale of 1-5, with 1 being not at all respected, 3 being somewhat respected, and 5 being very respected:
  - a) When you are within your home, how respected do you feel?
    - i) Before owning a stove, when you were within your home, how respected did you feel?
  - b) When you are in your community, how respected do you feel?
    - i) Before owning a stove, within your community, how respected do you feel?
  - A3: 1-5

Answer for analysis of Q3: [a - a(i)] + [b - b(i)]

### A.3.4 Perception of well-being (e.g. subjective well-being)

As referenced above in Table 5, it is suggested to use the Eudaimonic well-being scale outlined Reference [58], Annex B.

### A.3.5 Change of attitude towards change

- Q1: On a scale of 1-5, with 1 being not significantly dissatisfied, 3 being indifferent, and 5 being very satisfied:
  - How satisfied are you with the overall experience of using your old cookstove [insert locally appropriate 'old stove']?
  - How satisfied are you with the overall experience of using your new cookstove?

  - A1: 1-5 Answer for analysis = difference between satisfaction in using old and new stoves
- Q2: On a scale of 1-5, with 1 being not at all likely, 3 being somewhat likely, and 5 being very likely:
  - How likely are you to try a new stove?
  - How likely are you to try a new fuel?
  - How likely are you to try new cooking practices?
  - A2: 1-5

### A.3.6 Perception of access to fuel (addressing sense of vulnerability)

NOTE Here, the question is approached from the angle of vulnerability, with three types of vulnerability that relate to fuel use and access:

a) ability to acquire adequate amounts of fuel (either through purchase, covered above, or collection. Adequate amount of fuel in this questionnaire signifies enough fuel from the perspective of the interviewee to cook as much food as they would like, or feel is necessary for themselves and their family);

b) safety of gathering fuel; and

c) safety of cooking, from a health and injury perspective.

- Q1: On a scale of 1-5, with 1 being not confident at all, 3 being somewhat confident, and 5 being very confident, do you feel confident of your ability to acquire adequate amounts of fuel (either through purchase or collection)?
  - A1: 1-5
- Q2: On a scale of 1-5, with 1 being not at all safe, 3 being somewhat safe, and 5 being very safe, how safe do you feel collecting fuel?
  - A2: 1-5
- Q3: On a scale of 1-5, with 1 being not risky, 3 being somewhat risky, and 5 being very risky, how risky to your health do you perceive cooking to be (including from smoke or other injuries such as burns)?
  - A3: 1-5

## A.4 Established and suggested health effects of HAP