World Health Organization

CHEST
CLEAN HOUSEHOLD ENERGY SOLUTIONS TOOLKIT

Clean household energy policy and programme planning guide:

practical steps for designing and implementing transitions to clean, healthy household energy

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Preface

Billions of people rely on polluting fuels and technologies to meet their daily cooking, heating, lighting and other household energy needs. Reliance on inefficient household energy use is associated with a heavy disease burden and also contributes to poverty, environmental degradation, gender inequality, climate change and other impediments to development and well-being targeted by the Sustainable Development Goals. Increasing the adoption of clean household fuels and technologies, such as gas and electric stoves, electric lighting and central heating, is an important means for improving the health and well-being of the poorest populations while at the same time protecting the environment and climate.

Some of the primary barriers to wider adoption of clean energy are affordability, availability and accessibility. Policy-makers and planners have two basic strategies for overcoming these barriers: increasing the availability of clean energy and ensuring cleaner sources of energy sources. This guide is intended to help policy-makers and programme implementers to accelerate and extend the adoption of clean household energy solutions by providing step-by-step guidance on the application of tools and resources to develop action plans for clean household energy policies and programmes.

While much is already being done, the scale and urgency of the challenge require redoubled effort to address and overcome the barriers. Rigorous monitoring and evaluation of clean household energy programmes is necessary to ensure that interventions actually lead to health gains through sustained use of clean energy and elimination of polluting energy systems from households.

A core element of WHO's work to fulfil its mandate to address the global scourge of household air pollution is the provision of tools to extend access to clean household energy. During the World Health Assembly in 2015, ministers of health unanimously called for scaling up of the global response to exposure to air pollution and related diseases and called on WHO to provide leadership, foster partnerships and increase advocacy to mitigate the harm due to air pollution. In 2016, a road map for enhanced action was adopted by the Health Assembly, which called for greater cross-sectoral cooperation to address the health risks of air pollution by building the knowledge base, strengthening institutional capacity, improving monitoring and reporting and emphasizing global leadership and coordination.

In 2021, WHO released updated air quality guidelines, which establish levels of air pollution that must be reached to protect health. To help countries achieve those levels in and around the home, WHO developed the Clean Household Energy Solutions Toolkit (CHEST), which provides tools and resources to extend access to and use of clean household energy.

This policy guide is a further resource to extend this urgent work. It guides stakeholders through policy development, directing them to the tools and resources necessary to set their goals and priorities, assess their household energy situation, formulate clear, credible plans for action to reduce household air pollution, extend access to clean energy and protect and improve people's lives.

Dr Naoko Yamamoto
Former Assistant Director-General for Universal Health Coverage - Healthier Populations,
World Health Organization (WHO)

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Development of the publication was coordinated by Jessica Lewis, Heather Adair-Rohani and Kendra Williams, Air Quality and Health Unit, WHO.

Abbreviations and Acronyms

ABODE	Air Pollution Burden of Disease Explorer Tool
BAR-HAP	Benefits of Action to Reduce Household Air Pollution Tool
CHEST	Clean Household Energy Solutions Toolkit
CO	Carbon Monoxide
DALY	Disability-Adjusted Life Year
GHO	Global Health Observatory
HAP	Household Air Pollution
HEART	Household Energy Assessment Rapid Tool
HOMES	Household Multiple Emission Sources Tool
ISO	International Organization for Standardization
LPG	Liquefied Petroleum Gas
NCSC	National Cookstoves Steering Committee (Malawi)
PM	Particulate Matter
SDG	Sustainable Development Goal
VPT	Voluntary Performance Target
WHO	World Health Organization

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Introduction

1.1 Purpose

Exposure to household air pollution (HAP) is one of the greatest environmental risks to human health worldwide *(1)*. Policies to accelerate the adoption of clean cooking, heating and lighting are essential for reducing HAP and the enormous burden of disease it causes and for lowering climate-warming emissions and achieving other urgent societal priorities *(2)*.

The goal of this guide is to support policy-makers and implementing partners in the health, energy, environment and related sectors in bringing about a rapid transition to widescale use of clean household energy. Decision-makers who recognize this imperative confront a number of important questions. Which fuels and devices are clean for health at the point of use? Which are transitional, that help to achieve incremental but valuable health gains and are between polluting and truly clean? What policies can promote sustained use of clean household energy? How can clean household energy solutions be tailored to each country's needs? What factors should be considered in determining which policies, fuels and devices are best for a particular context?

This guide will help to answer those and other questions. It provides practical guidance on identifying, assessing, comparing and choosing policies and programmes to help households move from using polluting fuels and devices towards sustained adoption of clean energy sources and technologies at the point of use, such as electricity, liquefied petroleum gas (LPG), ethanol, biogas and certain advanced combustion biomass stoves.

"Clean fuels and technologies" are those that attain the emission rates of fine particulate matter ($PM_{2.5)}$ and carbon monoxide (CO) recommended in the WHO Air quality guidelines (2021) *(3)*. For the purposes of this document, "clean household energy policies and programmes" consist of any government measures or activities that facilitate a transition to clean cooking, heating and/or lighting. These measures include laws, legislation, decrees, regulations, subsidies, standards, tax regimes and other state-sponsored initiatives or schemes, as well as frameworks for implementing, monitoring and evaluating the various measures. The policies and programmes can consist of various mechanisms, from direct government investment in clean energy infrastructure to financial incentives and behaviour change campaigns.

This guide takes readers through a series of steps for developing an action plan for implementing clean household energy policies and programmes or for adapting existing policies and programmes to be clean for health. It provides descriptions of and links to relevant tools and technical resources that can facilitate specific tasks. The resources are designed to help policy-makers, planners and implementers to assess their situation, compare the costs and benefits of different household energy intervention options, assess their potential for improving health and determine which are likely to be most suitable for their country's context and needs.

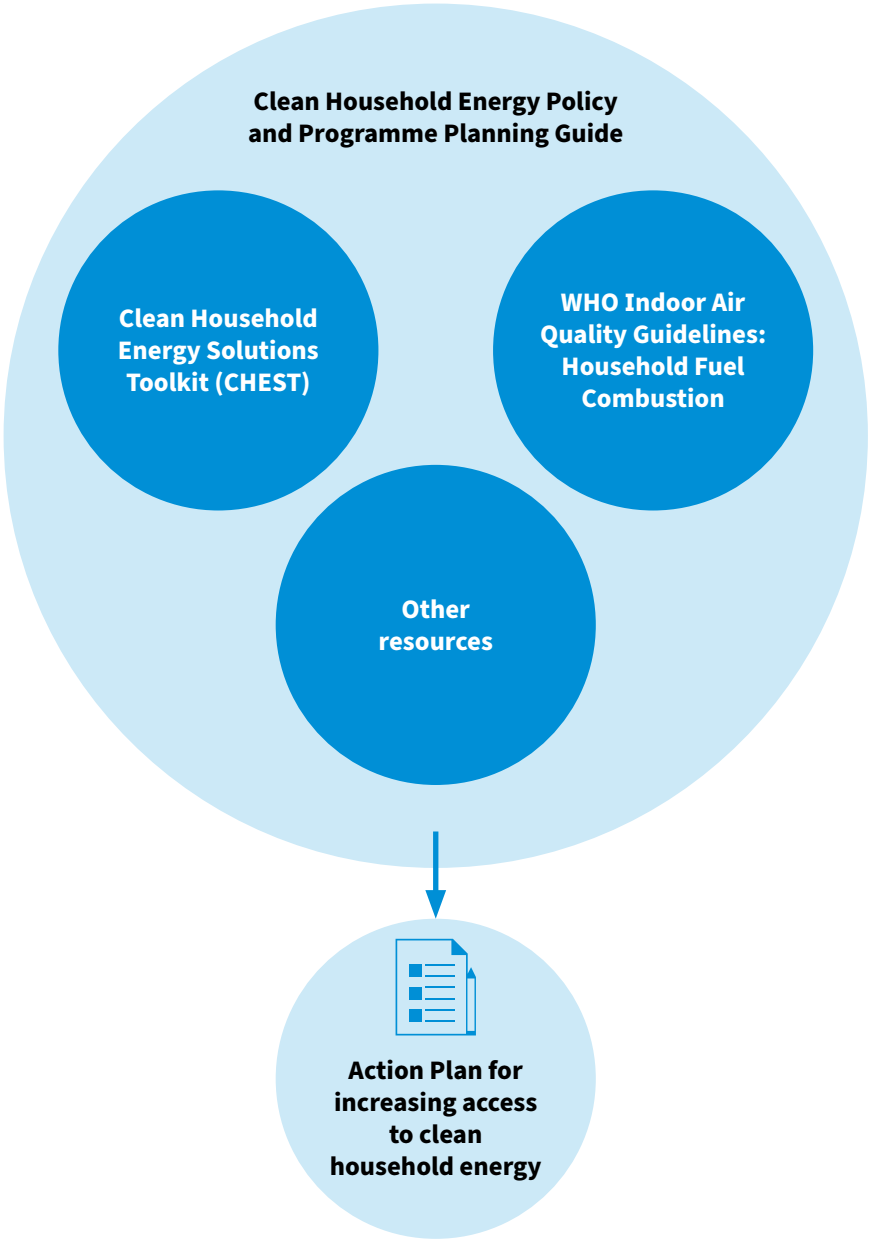
The detailed guidance in this document focuses mainly on planning policy and programme interventions rather than on their implementation. The most important outcome of use of this guide is a detailed, evidence-based **action plan** for developing, implementing and monitoring new policies and programmes or improving existing ones in order to accelerate the transition to clean household energy at scale. The action plan will list the specific steps and actors necessary for enacting a comprehensive policy to drive wider adoption and sustained use of clean household energy and ultimately improve public health outcomes.

1.2 How to use this guide

This document is intended for use with two complementary resources: the WHO Guidelines for indoor air quality: household fuel combustion ("the Guidelines") and WHO's Clean Household Energy Solutions Toolkit (CHEST). The Guidelines provide technical guidance for identifying household energy interventions that are clean for health, including detailed recommendations on use of specific fuels and performance targets for stove emissions *(4)*. CHEST comprises modules and tools to help policy-makers in implementing the recommendations in the Guidelines *(5)*.

Use of this guide is illustrated in Fig. 1. The guide provides practical steps for using the CHEST toolkit and other resources for developing or adapting household energy policies and programmes to meet the recommendations in the WHO Guidelines. It includes a wide range of tools and resources for identifying, assessing, comparing and developing clean household energy policies and technological interventions tailored for specific countries.

Figure 1. Use of this guide with other WHO resources to develop an action plan



The guide draws on a large body of public health research and scientific evidence of the impacts of HAP and on extensive reviews of current and past household energy-related policies and programmes in many countries *(6)*. It also incorporates insights from other sectors (e.g., water, sanitation and hygiene) on best practices and processes for developing effective policy interventions.

The guide is organized into four sections:

- the key principles, target audience and purpose of the guide;
- a brief overview of current global access to household energy and of the health, environmental and other impacts of HAP and a definition of what qualify as "clean household energy solutions";
- various categories of interventions, common elements of successful policies, typical barriers to expanding clean household energy and characteristics of well-designed interventions that can overcome those barriers; and
- a series of practical steps for assessing, selecting and developing a plan for implementing clean household energy policies and programmes.

The practical steps listed below form the action-oriented heart of the guide.

Step 1: Complete a situational assessment, and map stakeholders.

Step 2: Form a steering committee to design an action plan.

Step 3: Identify relevant policy and/or technological intervention options

Step 4: Analyse potential policy and/or technological interventions, and decide which to implement.

Step 5: Create and document an action plan for implementing and monitoring the selected interventions.

These steps include detailed guidance, tools and other resources for assessing and selecting the most suitable interventions for a given country or setting. They do not form a fixed "recipe" that must be followed precisely, nor do they represent the only possible means for developing effective clean household energy policies. Policy-makers and planners are encouraged to adapt the tasks and suggestions listed below as necessary to ensure the best policy for their context.

While the steps follow a logical sequence for readers starting from the beginning, they can be modified for countries that have made advances in developing policy. Likewise, the various tools, resources, case studies and templates provided in each step point towards potentially useful measures to reduce exposure to HAP and improve health, and some may be more relevant to a context or to a particular country's needs than others.

Each practical step has some common elements:

- a brief **summary** of the step, its **core objective(s)** and its **importance**;
- **tasks and tools**, with a series of sub-tasks for each step, explaining their implementation, with various tools, databases and other resources. For each tool or resource, what it does, how to use it and what outputs it provides are listed. This section also includes, where relevant, suggested templates to facilitate compilation and comparison of results from each tool and resource.
- **case studies** that show how policies and programmes have been carried out in countries, the lessons learnt and how policy-makers have used relevant WHO and other tools to develop household energy policies;
- a list of **key outcomes** from each step; and
- **takeaway messages**, which review and summarize the core purpose of each step and explain its connection to other steps.

1.3 Target audience

This document is intended for decision-makers and programme implementers in various sectors related to household energy, including:

- government officials, especially in ministries of health, energy and the environment, and in related areas (e.g., planning, infrastructure, housing, forestry, social development);
- health sector decision-makers at both national and sub-national levels;
- officials in national standards and certification agencies;
- community officials and organizations;
- members of civil society and community organizations;
- multi-sectoral groups and international agencies working on investment strategies for access to clean household energy and clean energy; and
- nongovernmental organizations involved in energy access, health and poverty alleviation.

1.4 Key principles

Following the practical steps outlined in this guide can result in a wide range of policy and programmatic choices. While certain interventions may be more appropriate in some countries and settings than in others, some universal principles should inform all decision-making to ensure wider adoption of clean household energy. They include the following imperatives:

- **Ensure that health impacts, both positive and negative, are considered in all decision-making, along with consideration of other key priorities**. Will the proposed policy or intervention improve health?
- **Prioritize actions for the most vulnerable populations, including women**. Will this policy or intervention help the poorest or otherwise most vulnerable people in the country? Are different solutions needed for different populations? Are the impacts on women and the role of women accounted for?
- **Remain evidence-based**. Does the available evidence indicate that the intervention will provide meaningful, measurable health benefits? Will the policy contribute to meeting the recommended targets for emissions and exposure in the WHO Guidelines?
- **Pursue intersectoral collaboration**. Does the policy involve stakeholders from all relevant sectors? Are any key voices missing?
- **Practise transparency**. Is information shared with and communicated to a wide set of stakeholders and relevant communities throughout the decision-making process?

- **Address common barriers**. Does the policy or intervention directly address the critical barriers to access, affordability, awareness and availability of clean household energy solutions?
- **Maximize co-benefits**. Is the policy or programme designed to maximize health, livelihoods, the environment, climate and other benefits wherever possible?
- **Emphasize action**. Is there a detailed action plan for implementing and evaluating the selected policy? Does it include interim milestones and fixed timetables? Is there clear assignment of responsibility to individuals and institutions for accomplishing discrete tasks?
- **Seek continuous improvement**. Does the design of the intervention include a framework for reviewing progress at regular intervals? Is there a plan for tracking indicators of impacts and implementation and for translating the measures into continuous action to improve or adjust the policy or programme as necessary?

Keep these anchoring principles in mind throughout decision-making to ensure that the selected interventions will contribute to measurable, meaningful progress in expanding access to clean household energy and improving health.

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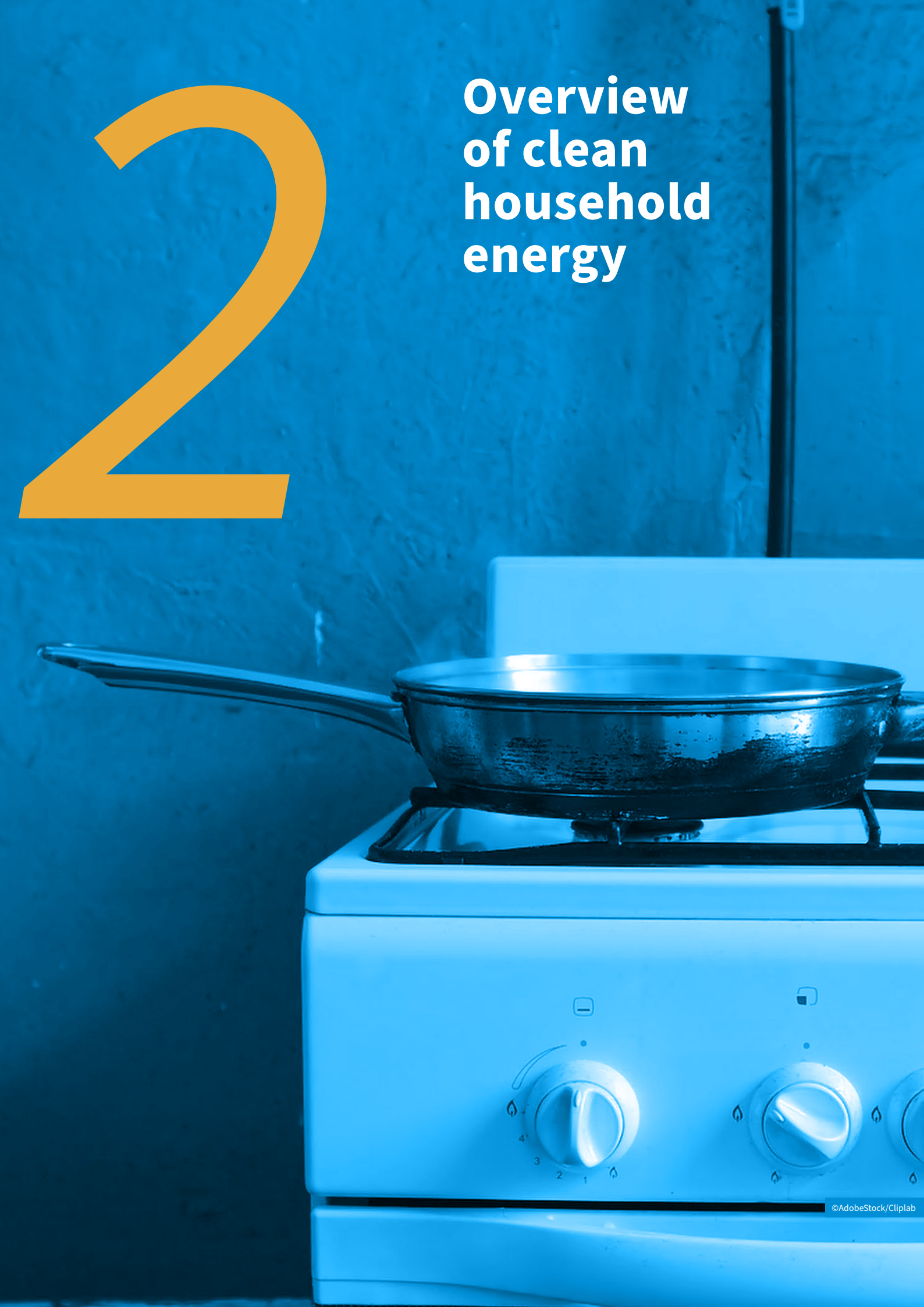
Overview of clean household energy



2.1 Why it matters

Billions of people depend on polluting energy for cooking, heating and lighting and are therefore exposed to dangerous levels of pollution in their homes *(7)*. About one third of the world's population continues to use coal, biomass, kerosene or charcoal for cooking because of lack of access to affordable clean fuels and devices *(7)*. Without action to accelerate the current rate of adoption of clean energy, roughly one third of the world's population will still primarily be using polluting cooking fuels in 2030 *(8)*.

The primary source of HAP is use of polluting fuels and devices for cooking, heating and lighting. Burning biomass and coal in inefficient stoves or open hearths produces a variety of health-damaging pollutants, most notably particulate matter ($PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO2), volatile organic compounds (VOCs) and other toxins.

Transitioning households to clean energy is an urgent public health imperative: HAP from cooking alone causes millions of premature deaths each year *(9)*. While cooking has often been the primary focus of policy-makers and programme implementers, space heating and lighting may also be significant sources of health-damaging pollution. Burning kerosene in simple wick lamps and heaters produces significant emissions of $PM_{2.5}$ and other pollutants. The technological and policy interventions discussed in this guide are also applicable for heating and lighting, as well as cooking.

Expanding access to clean household energy is also essential for achieving other urgent global and national priorities, from improving gender equity to reducing ambient air pollution to slowing climate change *(2)*.

Health and safety

HAP is associated with a wide range of diseases and adverse health outcomes. Exposure to HAP is a leading cause of stroke, heart disease, lung cancer and chronic obstructive pulmonary disease in adults and of acute lower respiratory infections (ALRI) in adults and children *(1)*. It is a leading cause of death from ALRI and neonatal risk factors such as preterm birth in children under five *(10).* Exposure to HAP is the most important risk factor for chronic obstructive pulmonary disease and lung cancer in non-smokers, and is also linked to tuberculosis, cataract and nasopharyngeal and laryngeal cancers.

Members of households that rely on polluting fuels and devices are also at a higher risk of burns, musculoskeletal injuries and accidents *(3)*. A large fraction of the severe burns and injuries that occur in low- and middle-income countries are linked to use of polluting household energy *(11)*. Ingestion of kerosene is the leading cause of poisoning in childhood *(3)*.

HAP that leaks outdoors is a significant source of ambient air pollution around the world, resulting in health risks for everyone, regardless of the type of fuel used in individual households *(12–14)*.

Climate

Use of polluting household energy is a significant source of climate-warming pollutants. Incomplete combustion of biomass and fossil fuels in simple stoves, open fires or wick lamps produces short-lived climate pollutants such as methane and black carbon, as well as volatile organic compounds that contribute to the formation of ozone, another powerful warming agent. Household combustion of polluting fuels for cooking, heating and lighting contributes more than 50% of global anthropogenic emissions of black carbon (fine particles in soot emitted from incomplete combustion of fuels) *(15, 16)*. Black carbon is one of the largest contributors to climate change after carbon dioxide, and a major driver of glacier retreat in high mountain areas and polar regions *(17)*. About 30% of the wood used in stoves for cooking and heating globally is not sustainably harvested, resulting in one billion tonnes of carbon dioxide-equivalent emissions per year *(18)*.

Gender, time and livelihoods

Women and girls bear the brunt of the risks to health and safety associated with use of polluting household energy around the world. In many countries, the tasks of gathering and processing fuel, cooking meals and tending the hearth are performed primarily by women and children *(2)*. These activities deprive them of time for rest or other activities, expose them to higher levels of HAP and increase their risks of burns, scalds, poisoning, repetitive stress injuries and other adverse health outcomes *(3, 11)*. When they gather or procure local fuels, women and girls are also subject to increased risks of physical injury and violence. Their energy-related tasks prevent many girls from attending school and keep many women from pursuing opportunities to improve their livelihoods in ways that could help raise themselves and their families out of poverty. Lack of access to clean lighting also limits other opportunities for health and development, like studying and engaging in crafts and trades *(2)*.

WHO is responsible for tracking and reporting on progress toward Sustainable Development Goal (SDG) 7: "ensure access to affordable, reliable, sustainable and modern energy for all" (Box 1).

2021 SDG7 Tracking Report. *https://trackingsdg7.esmap.org/data/files/download-documents/2021_tracking_sdg7_report.pdf*

BOX 1. SUSTAINABLE DEVELOPMENT GOAL 7: ENSURE ACCESS TO AFFORDABLE, RELIABLE, SUSTAINABLE AND MODERN ENERGY FOR ALL

Adoption of SDG 7 in 2015 responded to widespread recognition that achieving universal clean household energy access is essential to ensure progress in meeting the global Sustainable Development Agenda, as it will lift enormous health burdens, save millions of lives and reduce climate-warming pollution. To achieve SDG 7, nearly three billion people must gain access to clean cooking solutions and one billion must gain access to electricity by 2030. This will require a coordinated global, regional and national effort to address the critical barriers of access, affordability and availability of clean household energy solutions. Awareness of the multiple links between SDG 7 and other SDGs is essential to drive policy and action. WHO is also tracking progress on indicators of the achievement of SDGs 3 (health), 11 (cities) and 13 (climate). The United Nations High-level Dialogue on Energy, convened under the auspices of the United Nations General Assembly in September 2021, produced a road map to accelerate implementation of SDG 7 and support the Paris Climate Agreement. The global road map set as targets for 2030 the achievement of universal access to electricity and clean cooking solutions and tripling global renewable energy capacity.

2.2 WHO Guidelines for indoor air quality: Household fuel combustion

The WHO Guidelines for indoor air quality: Household fuel combustion *(4)* offer clear, practical recommendations for ensuring that programmes to increase access to clean household energy actually result in substantial health gains *(2)*. The Guidelines are based on an extensive review of the literature to ensure a tool for effective policy-making and planning in energy and health.

The Guidelines define criteria to be met by household combustion devices in order to be considered truly "clean" for health, including health-based emissions rate targets for fine particulate matter ($PM_{2.5}$) and CO emissions from household fuel and device combinations *(11)*. (For summaries of these definitions, see WHO's "Defining clean fuels and technologies" webpage *(21)*.)

The Guidelines also include specific recommendations for governments to accelerate the transition to clean fuels and technologies and to prioritize transitional options in contexts where intermediate steps are necessary *(4)*. The Guidelines emphasize the importance of addressing all uses of energy, including heating and lighting, in order to protect health. (*For more information, see reference 4.*)

2.3 Definition of clean household energy solutions

Clean household energy solutions for cooking, heating or lighting are those that result in cleaner air. They come in many forms, but what they all have in common is that they produce levels of pollutants below the concentrations and emissions targets recommended in the Guidelines. Fuels and technologies that meet the targets for rates of emission of $PM_{2.5}$ and CO defined in the Guidelines are considered clean for health at the point of use. (See step 3 for more details of definitions of "clean", "transitional" and "polluting" devices for cooking, heating and lighting.) For more information, see also WHO's "Defining clean fuels and technologies" webpage *(21)*.

These Guidelines define clean fuels for **cooking** as solar, electricity, biogas, LPG, natural gas and alcohol fuels (i.e., ethanol); stoves and devices in which these fuels are used are also considered clean. Biomass stoves are classified as clean if they meet the emission rate targets in the Guidelines.

Clean fuels and technologies for **heating** include central heating (regardless of the energy source); heat pumps; manufactured space heaters, traditional space heaters, manufactured cookstoves or traditional cookstoves powered by electricity, piped natural gas, LPG, biogas and alcohol/ethanol; and solid fuel stoves or space heaters that meet the emission rate targets in the Guidelines as described for cooking fuels and technologies.

Lighting technologies are defined as clean according to the energy source. Clean fuels and technologies for lighting include electricity (including solar panels); solar- or battery-powered torches, mobiles or lanterns; biogas lamps; and LPG lamps.

2.4 Overview of the Clean Household Energy Solutions Toolkit (CHEST)

WHO's Clean Household Energy Solutions Toolkit (CHEST) was designed to help countries develop and implement policies and programmes to achieve the targets set in the WHO Guidelines for indoor air quality: household fuel combustion *(4)*. CHEST comprises tools for assessing the current state of household energy use, exposure to air pollution and associated health impacts; it also includes tools that can be used to design household energy policies and programmes. (See Annex 2 for more information on the CHEST theory of change.)

Each of CHEST's six modules helps users to take a specific action:

- understanding the current household energy situation and stakeholders;
- setting national standards;
- designing interventions to address energy needs;
- monitoring and evaluating the implementation and impact of clean household energy interventions;
- engaging the health community; and
- raising wider awareness about the importance of reducing HAP.

This guide offers practical steps for using the tools in CHEST, and other resources, in an integrated process for developing a clean household energy policy or programme.

3

Importance of policies and programmes for clean household energy

3.1 Types of policies and programmes

A complex web of social, technological, economic and behavioural factors are behind any decision to purchase or use a particular fuel or technology for household cooking, heating or lighting. Policies to accelerate and expand the use of clean household energy therefore include various strategies and mechanisms, from subsidies to make energy solutions more affordable to performance standards that require manufacturers to make devices that emit less pollution.

Most household energy policies fall into the following categories:

- financial
- regulatory
- direct investment
- research and development
- awareness-raising and behaviour change campaigns
- trade
- codes and standards

The aim of some policies is to increase the availability and affordability of clean household energy by reforming national fuel subsidies and regulatory frameworks or by providing incentives for consumers to help overcome the upfront costs of clean technologies. Other policy measures are designed to build markets for clean fuels and technologies, by fostering innovations in financing and new business models for household stove designers and distributors, or through investment to boost the manufacturing capacity of a particular industrial sector. Other approaches involve direct investment in infrastructure (e.g., electricity grid expansion) or in research and development or establishment of national performance standards to shift entire industries towards producing and selling cleaner fuels and devices. (For more detail on different types of policies and relevant examples, see step 3 and Table 1.)

Table 1. Types of household energy policies and programmes

Policy or programme type	Description and examples
Financial	Financial measures are taxes and tax credits, subsidies, voucher programmes, tariffs and other policies that influence the cost of clean energy solutions.
Trade	Trade policies consist of instruments that affect the flow of goods between countries, such as import tariffs or quotas and export restrictions. Examples include imposing, adjusting or removing import tariffs on fuels and equipment.
Research and development	These policies fund and otherwise support research and development of new clean energy household technologies and business models and improve and bolster existing markets and supply chains.
Regulatory	Regulatory policies can include restrictions or outright bans on specific fuels or technologies, measures to label devices according to their performance and environmental regulations, such as air quality limits.
Direct investment	Direct investment is government expenditure to increase access to clean energy by extending the relevant infrastructure, such as the electricity grid, and supply and distribution networks for fuels and devices, such as LPG cylinders and stoves.
Codes or standards	Testing, certification and labelling programmes allow consumers to select the products that meet or exceed certain standards. By setting national standards for stoves, heaters, lighting and other household energy devices, countries specify minimum performance requirements for energy efficiency and safety and maximum limits on emissions rates.
Information and behaviour change campaigns	Information campaigns seek to raise awareness about the health risks of polluting fuels and devices and the benefits of clean energy solutions and to induce changes in the way people purchase and/or use fuels and technologies.

Adapted from reference *6*.

The **WHO Household Energy Policy Repository** (Box 2) contains a compilation of policies for promoting clean or cleaner household energy from various countries in all six WHO regions *(6)*. The repository shows a varied policy landscape, including countries in which polluting fuels are still used for cooking, heating or lighting.

Household energy policy repository. https://www.who.int/tools/household-energy-policy-repository

Box 2. The Household Energy Policy Repository

The WHO Household Energy Policy Repository is a comprehensive database of household energy policies implemented since 2010 in more than 30 countries. The Repository serves as a clearing-house for policies, regulations and legislation regarding household energy use at national, regional and local levels. It includes information on their implementation, monitoring, evaluation and independent impact assessments. The Repository is a valuable resource for planners interested in learning how certain policies and programmes have been implemented in other countries and how such measures might be adapted to their own contexts.

The Repository can be searched for policies by type (see section 3.1) and summarizes their key features and their intended outcomes, lists implementing agencies and provides links to relevant documents. The database also includes a description of each policy and information on the target population, policy or programme goals, costs and evidence of impact and of the effectiveness of the interventions (when available).

3.2 Common Elements Of Successful Policies And Programmes

Most effective household energy policies and programmes have common elements. While many types of interventions can increase access to clean household energy, the most successful measures, with the highest impact usually have the following characteristics and components:

Inter-sectoral collaboration: Extending access to clean household energy requires concerted action and commitment from many sectors, including health, energy, environment and finance, the private sector and civil society. Strategies must therefore overcome "siloed" practices that tend to keep sectors from communicating, collaborating and sharing ideas and experience. Effective programmes usually have a clear leader (e.g., a government agency) and clear delineation of responsibilities. They are also characterized by strong coordination among actors, transparent decision-making and a commitment to share information and engage with a wide group of stakeholders, relevant sectors and communities.

National champions: Individuals in positions of influence – such as political leaders, government officials, media figures and high-profile entrepreneurs – can stress the importance of clean household energy and rally people around a collective project to reduce HAP. Identification of such champions in key government ministries, who can explain the important links between clean household energy and achieving national priorities for health, the climate and sustainable development, can raise broad support for ambitious policies.

Complementarity: Effective household energy policies often build on other policies or programmes or complement policy measures in other sectors or societal goals (e.g., social welfare programmes) by projecting existing targets, operational plans or financing mechanisms towards new work to expand clean energy access.

Quantifiable, measurable indicators: Indicators help track progress towards policy goals. Indicators that can be tracked with regularly collected, harmonized data are essential for determining whether an intervention is effective. (An example is SDG 7.1.2: "percentage of population with primary reliance on clean fuels".)

High-level political support: Support from the leaders of key government agencies is essential for securing adequate resources to sustain policy interventions over the time necessary to ensure lasting change.

Health sector participation: Members of the health sector can contribute their perspectives to the design, implementation and monitoring of policies and can play important roles in ensuring adoption of clean household energy.

3.3 Common barriers and how policies and programmes can address them

Despite increasing awareness and robust evidence of the health toll exacted by continued, widespread reliance on polluting household energy, billions of people still lack access to clean, affordable alternatives for cooking, heating and lighting. At the current rate of adoption of clean household energy, the world will fall well short of the SDG 7 goal of universal access by 2030 unless new policies, programmes and international partnerships are implemented to accelerate the transition *(7, 8)*.

Drawing on decades of experience and research, investigators have identified several recurring barriers to wider adoption of clean household energy. It is important that policy-makers who are developing new initiatives understand those obstacles and learn from the failures and successes of past programmes and interventions in different countries, in both urban and rural settings.

Poverty is one of the most significant barriers to the switch to cleaner energy for millions of households. Therefore, programmes and policies that help people to purchase clean energy fuels and devices through subsidies and access to loans, credits and other financing tools are some of the most effective ways of accelerating adoption of clean energy. The high initial cost of switching fuels can prevent many households from benefitting from clean fuels and technologies. Widely available fuels such as wood, dung and crop residues can often be gathered for free or procured at comparatively low cost. Many clean or cleaner household energy fuels and devices – including LPG stoves, LPG cylinders and refills, improved biomass stoves, solar LED lighting systems, ethanol stoves – are too expensive for low-income households. Fuel subsidies are sometimes mistargeted and fail to reach the populations who would benefit most.

How to address it: Subsidies to lower the initial cost of purchasing new devices or the recurring costs of fuel purchases can be targeted to the lowest-income households, ensuring that the clean energy transition is equitable and inclusive and delivers the highest health benefits at a societal level. Existing subsidies for polluting fuels such as coal, kerosene or charcoal, which hinder the transition to cleaner fuels, can be reformed or eliminated.

Stove-fuel stacking consists of parallel use of several types of fuel and devices by a single household. This widespread practice – which is common across cultures, geographical settings and socioeconomic contexts – can slow the full transition to clean household energy, as many people continue to use polluting devices even after they have purchased or adopted cleaner technologies, for a variety of reasons. A particular energy technology might provide some benefits, such as convenience and efficiency, to certain users, but may still not meet all of their needs or preferences. For instance, even after gaining access to LPG fuel, a household might continue to burn wood in a traditional biomass stove to cook certain meals or to heat living spaces. If a polluting fuel and/or device is used at the same time as a newly adopted clean one, the exposure of household members to health-damaging pollutants can remain unacceptably high. Even occasional continued use of polluting fuels and devices can significantly erode the health benefits of interventions. Becoming clean means not only promoting the adoption of cleaner energy but also prioritizing the abandonment of polluting energy *(19, 20)*.

How to address it: For clean energy devices to be adopted and used exclusively, they must meet the full spectrum of household energy needs, or households must have access to several types of clean devices that together meet all their needs. Effective policies must include understanding of stove-fuel stacking and the complex reality of how people actually use energy in their homes. To ensure meaningful health gains, policy-makers must pursue multi-pronged strategies for a complete transition away from polluting stoves and fuels.

Sustained use: Initial adoption is not enough; for health benefits to be attained, use of clean energy solutions must be sustained over time. If a household purchases a clean cooking device but fails to use it regularly and exclusively, few health and other benefits will be realized.

How to address it: Programmes should include measures to support users and help them to resolve any problems that arise in using new fuels and devices, especially in the first year. A rigorous monitoring and evaluation programme can verify whether clean fuels and devices are used over long periods and identify ways to improve long-term uptake. A programme should evaluate usage over 2–5 years after initial uptake of a solution.

Perceptions: User perceptions of both familiar and novel energy devices can discourage adoption of clean energy solutions. For example, persistent fears about the safety of LPG stoves and cylinders or perceptions of inadequate performance of past generations of "improved" biomass stoves can make some users reluctant to invest in newer cooking devices.

How to address it: Product design and marketing must be informed by qualitative research and survey data on user preferences and perceptions. Targeted awareness-raising campaigns can help address consumers' concerns about the performance and features of novel energy solutions. Community engagement campaigns could involve locally influential figures who could shape opinions and spread information about clean energy solutions.

Behaviour change: When a household transitions to clean energy devices, some changes in behaviour may be required. Interventions that fail to take social and cultural practices into account or which require dramatic or sudden departures from long-established behaviour in household energy use are unlikely to foster a durable, long-term transition to cleaner energy.

How to address it: Achieving the shifts in behaviour that must accompany adoption of certain new fuels and/or devices requires detailed understanding of the cultural context, household preferences and priorities in a given setting or locality and persistent, repeated follow-up of users after the intervention.

Scalability, supply chains and market ecosystem: In many rural areas, households have limited access to LPG distributors or to reliable electricity, or there may be few retailers who sell LPG, biogas, alcohol or efficient biomass stoves. Lack of a consistent supply for a given technology or fuel is another prevalent obstacle. If, for example, LPG cylinder refills or replacement parts for LPG stoves are available only intermittently, households are less likely to sustain their use of this clean cooking solution. In some settings, there may simply be no supply chain for clean fuels and technologies.

How to address it: Building the market ecosystem for clean energy solutions takes time, investment and policy support. Direct investment and subsidies can help address weak market ecosystems and ensure continued supply and delivery of fuels and devices in rural areas, or support may be provided for local enterprises for the repair and maintenance of stoves and other devices, for example.

People planning clean household energy interventions do not have the luxury of focusing narrowly on one type of user or a single sector or supply chain. Policies and programmes that address needs at both household level (e.g., user needs, perceptions and sensitivity to price) and the wider structural level (e.g., supply chain and distribution infrastructure) are likely to be the most successful in bringing about a widescale transition. Interventions that address issues of both supply and demand – including production and manufacture, distribution and retail infrastructure and initial and continued availability of fuel on the one hand, and factors such as price, user needs and cultural preferences on the other – will be more effective than those that target only one component.

Similarly, interventions that address both *adoption* of clean energy and *abandonment* of polluting energy will result in far greater improvements in health than those that focus more narrowly on increasing the rate of distribution of clean devices. The messy reality of stove-fuel stacking demands that policy-makers and planners embrace exclusive use of clean household energy as a long-term objective that is not only desirable but is essential for maximizing health and other developmental gains.

In addition to these large structural and systemic barriers to uptake of clean household energy, policy-makers and programme implementers should be mindful of specific challenges they might encounter in the design, development and implementation of clean household energy measures, which include the following.

Lack of access to high-quality data. Lack of availability or scarcity of data on the fuels and technologies used in different countries can impede efforts to track progress. To fully understand the household energy situation, detailed survey data are necessary on both primary cooking fuel and secondary fuels and on the actual devices in which fuels are used for cooking, heating and lighting in households.

Potential solution: The design and use of relevant household surveys can ensure more detailed understanding of the household fuel situation. WHO/World Bank Core Questions on Household Energy Use are a useful resource for updating existing or creating new surveys. (See step 5 and Box 3.) Additionally, low-cost, lightweight sensors for monitoring personal exposures and kitchen concentrations of household air pollutants are becoming increasingly accessible and can increase the availability of data on air quality. Performing direct measurements of air quality in households can be logistically challenging and costly, but planners can consult a robust body of scientific evidence on in-situ emissions and exposure for specific fuels and devices.

Box 3. WHO and World Bank core questions on household energy use

WHO, in cooperation with the World Bank, developed a set of core questions on household energy use for cooking, heating and lighting. The questions – part of CHEST module 4: monitoring and evaluation – are designed to be integrated into national surveys or censuses in order to assess household energy use and track progress toward increasing use of clean fuels and technologies. They cover primary and secondary fuels and technologies used for cooking, heating and lighting; cost and availability; time spent using devices and collecting fuel; availability of electricity; household members responsible for cooking and collecting fuel; and many other topics.

These core questions are more comprehensive than the household energy component of most national surveys, which typically include only the primary fuels used for cooking. Integration of these questions into the monitoring and evaluation plan will ensure a more comprehensive understanding of household energy use, including fuel stacking (use of multiple fuels and devices in parallel), of exposure to pollution in the home and of the factors that influence the adoption and sustained use of clean household energy.

WHO collaborated with government institutions and research entities to test and pilot the core questions in six countries (Belize, Cameroon, Costa Rica, Ghana, Honduras and Peru). To facilitate their inclusion in national surveys, the core questions on household energy use are available in three formats, including those for common national surveys such as the United Nations Children's Fund Multiple Indicator Cluster Surveys and the Demographic and Health Surveys of the US Agency for International Development.

The following resources accompany the core questions on household energy use in CHEST module 4:

- *The* **Measuring Energy Access Guidebook** *provides explanations for each of the core questions, gives guidance on calculating key indicators from the data collected and advice for training field workers to administer the questionnaire.*
- *The* **Pictorial Guide for Administering the Core Questions** *provides detailed descriptions and pictures of different fuels and devices used for cooking, heating and lighting to help survey enumerators select appropriate responses when administering the core questions.*

Core Questions on Household Energy Use. https://www.who.int/tools/core-questions-for-household-energy-use

CHEST Module 4: Monitoring and Evaluation. https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-4-monitoring-and-evaluation

Measuring Energy Access Guidebook. https://www.who.int/publications/i/item/WHO-HEP-ECH-AQH-2021.9

Resource constraints. Lack of political commitment, inadequate funding and high staff turnover are perennial challenges for both starting and sustaining new policy development or programme implementation.

Potential solution: A case for increased funding can be made with use of detailed cost–benefit analyses made with the Benefits of Action to Reduce Household Air Pollution (BAR-HAP) tool developed by WHO. (See step 4 and Box 4 for more details on this tool.) Training resources can also ensure that new staff are brought up to date on key issues in air pollution and health. Detailed record-keeping to document decisions and progress ensures continuity in the event of staff turnover. It may also be possible to leverage sources of funding and/or established programme infrastructure from initiatives in other sectors (e.g., water, sanitation or housing), including data collection (e.g., indicators of bulk fuel import and distribution and detailed data on distributor sales and electricity meter data). (See step 1 and the HEART tool for guidance on identifying such programmes.)

Benefits of Action to Reduce Household Air Pollution (BAR-HAP) Tool, manual and instructional videos.
https://www.who.int/tools/benefits-of-action-to-reduce-household-air-pollution-tool

CHEST module 2: Identification of technological and policy interventions.
https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-2-identification-technological-and-policy-interventions

Box 4. The "Benefits of Action to Reduce Household Air Pollution (BAR-HAP)" tool

WHO's BAR-HAP tool, part of CHEST module 2: Identification of technological and policy interventions, can be used to calculate the public and private costs and benefits that would result from transitions to cleaner cooking options. The tool quantifies the net health and economic benefits of different policy action(s) for facilitating specific technology transition(s). BAR-HAP allows users to select a type of transition (or multiple transitions) from more polluting options (e.g., biomass, kerosene) to clean or transitional fuels and technologies, including improved biomass, improved charcoal, biogas, LPG, ethanol and electric stoves. Users can select one of five policy instruments to facilitate transitions to cleaner cooking: subsidy for stoves, subsidy for fuel (biomass pellets, LPG, electricity, ethanol), stove financing (spreading payments for the new technology over time), behaviour change campaigns and a ban on polluting fuels or technologies.

Key decisions to be made when modelling scenarios in BAR-HAP are:

- *scope (will the programme target rural areas, urban areas or the whole country?),*
- *percentage of the population that will be targeted in the intervention,*
- *percentage of the price of stoves and/or fuel that will be subsidized and*
- *percentage of cooking that the target population is anticipated to do on the cleaner stove.*

The tool calculates different types of costs and benefits, including the cost to the government of implementing the programme, the costs to individuals (e.g., fuel refills, stove purchase, maintenance, time spent learning how to use the new technology) and benefits in the form of societal health, private health, time saved from fuel collection, climate impacts (e.g., avoided climate-warming pollution) and other environmental benefits from reducing unsustainable fuelwood harvesting.

BAR-HAP incorporates the latest data on fuel use, health and background information on countries; users need only select the country and specify the type of transition to generate estimates. The default data settings can be modified if relevant local data are available.

Lack of coordination. Inadequate coordination and communication among government agencies, national and international institutions and private sector actors has long been a common barrier to achieving wider adoption of clean household energy. Household energy – especially for cooking – may fall outside the mandates of individual ministries or agencies. In many instances, household energy has become an "orphaned" issue, with no single sector assuming primary responsibility for advancing policies to address it. In some cases, different government agencies or stakeholders even pursue divergent solutions. Lack of clarity on which ministries are directly responsible for household energy can restrict efforts to launch, advance or update interventions.

Potential solution: Mapping all the key stakeholders in household energy can help to ensure that all relevant actors are engaged and share information. The HEART template offers guidance on stakeholder mapping. (See steps 1 and 2 below.) Defining which agencies and sectors (including health, energy, environment, finance and social development) are responsible for specific elements of clean household energy programmes and policy interventions is critical for effective coordination. Convening working groups or steering committees that include representatives of all key stakeholder groups can overcome this common pitfall and ensure that roles are clearly assigned and core objectives are aligned.

Lack of political commitment. Little awareness among high-level decision-makers and leaders of key government agencies of the many severe health, environmental and economic impacts of HAP can mean that household energy policies and programmes do not attract the necessary resources. Without a sustained focus on HAP, household energy initiatives and schemes may struggle to obtain adequate funding and personnel. Successful programmes also require long-term, sustained effort beyond the term of a single government administration or electoral cycle.

Potential solution: Well-substantiated, evidence-based cases for investment in clean household energy can help political leaders to understand the scope of the opportunity and prioritize it. Awareness-raising campaigns through social media, traditional media, digital channels and videos can increase the salience of the issue for decision-makers. Similar campaigns that target the general public can also increase demand for and attention to the issue, thus helping to catalyse political commitment and support.

These considerations should be kept in mind in implementing the practical steps described below. The tools and resources described can help to address these and other challenges for design and implementation.

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4 Practical steps

The remainder of this policy guide presents a series of steps that culminate in creation of an action plan to expand clean household energy. By following the practical steps described below (Fig. 2), policy-makers and planners can identify the interventions that are most likely to accelerate adoption of clean household energy in their country, region or municipality.

The tasks and resources described may be more relevant for some settings or countries than others, depending on their status in the broader energy transition. The steps and tools outlined can be adapted and applied as necessary to particular national or sub-national contexts.

Figure. 2. Five practical steps for developing clean household energy policies and programmes

Step 1

Complete a situational assessment and stakeholder mapping

A situational assessment provides an overview of the fuels and devices currently used, the markets and supply chains and relevant policies and programmes in different sectors. A map of key stakeholders ensures that all relevant voices are identified for engagement in policy development. The outputs indicate the household energy baseline and are a starting point for developing new policies and programmes to expand access to clean household energy.

Step 2

Form a steering committee to design an action plan

The steering committee comprises representatives of the key stakeholder groups identified in step 1. This body will set priorities to guide the policy or programme, establish a timetable and working process and initiate identification, evaluation and selection of new policies or programmes.

Step 3

Identify relevant policy and/or technological interventions

The steering committee will develop a short list of potential policy measures and identify the clean fuels and devices that are available and appropriate in the country or setting.

Step 4

Analyse potential policy and/or technology interventions, and decide which to implement

The steering committee weighs the options identified in step 3 and selects which ones to implement. First, it assesses each potential policy measure on the short list from step 3, with det^ailed analyses of the interventions' costs, benefits, impacts, risks and opportunities. It then chooses the policy and technology measures to be recommended to decision-makers and selects the intervention(s) for implementation.

Step 5

Create and document an action plan for implementing and monitoring the selected intervention(s)

The primary outcome of the process is a detailed road map for implementation of the selected policy and/or technology intervention(s) that includes a timetable, interim goals and clear assignment of responsibilities. A plan is also made for monitoring and evaluation, including an organized approach for collecting data to track both implementation of the intervention and its impact on health and other priorities. This will ensure continuous improvement of the policy over time.

Step 1. Complete a situational assessment and stakeholder mapping

Assessment of the current household energy "landscape" and identification of key stakeholders are critical first steps in the policy and programme development process described in this guide. This step involves conducting an overview of the current situation of household energy in the country and mapping key actors in all the sectors that influence clean household energy use and adoption. Detailed knowledge of the types of fuels available in the country will be required to decide which clean fuels and technologies to promote. Likewise, data on current use of polluting fuels is important for developing strategies to encourage transitions to cleaner options. Identification of all the critical stakeholders will ensure that individuals and organizations with important experience, resources, mandates and ideas to contribute are fully engaged in developing the action plan for implementing the chosen interventions.

Objectives:

- Conduct a comprehensive review of household energy use, existing fuel supplies and distribution infrastructure, exposure to HAP and the associated impacts on health, gender, the environment and other aspects in the country.
- Identify existing policies or programmes related to household energy, air pollution and health.
- Identify and map stakeholders working on issues related to household energy in the energy, environment, health, finance, social development, private industry, civil society and other relevant sectors.

Why it is important:

Creating an enabling environment for widescale adoption of clean household energy solutions requires concerted action in many sectors. A wide array of public and private stakeholders working on health, energy, gender, economic development, climate, environment and other areas must be engaged in developing policy and programmes to ensure durable, effective interventions.

A **situational assessment** of the current status of household energy use and policy in the country, comprising infrastructure for fuel distribution, all relevant laws and regulations and existing policies or programmes in health, energy or other relevant sectors, is essential for expanding access to clean household energy. Robust understanding of previous policies and relevant enablers and barriers will be the foundation for new policies. In countries that are already accelerating the transition to clean household energy, this exercise will be useful for identifying opportunities for strengthening existing policies or programmes. The situational assessment will help identify the types of clean fuels that could feasibly be promoted, avenues for promoting wider use of those fuels based on existing user practices and preferences, and the populations to whom such promotion should be targeted. This assessment will also help build an evidence-based case for securing high-level government support for policy measures and provide a baseline for monitoring the impacts and outcomes of new or expanded interventions.

Stakeholder mapping is critically important for several reasons. Household energy and HAP are issues that involve many sectors, from health to housing, finance and the environment. Successful policy-making must involve stakeholders from all those sectors to ensure that relevant voices are heard and that policy "siloes" are broken down. Stakeholder mapping also promotes consistent messaging for all sectors, resulting in plans that are more feasible, based on guidance from those who will be directly involved in their implementation. A priority early in policy development is clear assignment of responsibilities to participants and to the institutional actors they represent. All this requires detailed stakeholder mapping.

Tasks and tools

Task 1.1. Convene a workshop to plan a situational assessment and mapping of stakeholders.

- Organize an initial meeting of implementers or specialists who will lead data collection and research with stakeholders.
- Develop a plan for collecting data and drafting a summary of the findings.
- Discuss methods for collecting data, assignment of responsibilities, addressing potential obstacles and other planning tasks.

Task 1.2. Perform a situational assessment of the current household energy context.

Establish baseline information on the current use, availability and impacts of clean and polluting household fuels used for cooking, heating and lighting (and other uses) in the country through interviews and computer-based desk research on various subject areas (see Box 5 for details of WHO's Household Energy Assessment Rapid Tool [HEART], which provides a template and guidance for conducting such research), including:

- local data on the burden of disease and the health impacts of HAP;
- fuels and technologies currently used for cooking, heating and lighting and the emission rates of the devices used in the country;
- the infrastructure for and availability of household fuels and technologies in the country, including supply chain and industrial capacity;
- relevant policies, programmes or regulatory frameworks that support – or could be adapted to incorporate – clean energy objectives (e.g., social welfare, development, poverty alleviation programmes);
- demographic information on the users of different fuels and technologies in different parts of the country and data on how usage varies by sub-national region;
- data on the time spent cooking and gathering fuel, who performs those tasks and gender roles related to fuel gathering and use; and
- socioeconomic, behavioural and cultural factors that influence adoption of clean household energy locally.

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Household Energy Assessment Rapid Tool (HEART) template.
https://www.who.int/tools/household-energy-assessment-rapid-tool-templates

CHEST module 1: Stakeholder mapping and situational assessment.
https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-1

Box 5. Household Energy Assessment Rapid Tool (HEART)

Summary: WHO's Household Energy Assessment Rapid Tool (HEART) is part of CHEST module 1: Stakeholder mapping and situational assessment. HEART can be used to make a rapid assessment of current household energy use (particularly for cooking, heating and lighting), the extent of HAP and its impacts on health, and related policies and programmes. HEART also facilitates identification of key stakeholders, barriers to expanding access to clean household fuels and devices and opportunities for greater intersectoral cooperation.

How to use it: The template consists of a set of questions and prompts to guide the collection of information. The questions are to be completed by energy and/or environmental health specialists on the basis of interviews with key informants and computer-based desk research. The recommended data collection method is noted for each section. The HEART template recommends the desirable qualifications of the individuals who complete it and detailed instructions on use of the tool.

Outputs: Completion of the HEART template results in a comprehensive report that can be referred to throughout the remaining practical steps in this guide. The stakeholder mapping component will guide formation of the steering committee in step 2, which will include representatives from the stakeholder groups identified. The situational assessment made with HEART will help guide the identification and selection of appropriate policy and/or technology interventions in steps 3 and 4, respectively. The situational assessment could be used, for example, in identifying the clean fuels that could be promoted in the country, planning how to promote them according to existing fuel use and determining who should be targeted for promotion efforts.

The HEART report helps planners, policy-makers and implementers to orient themselves with respect to the status of their country in the transition to clean household energy. The action plan produced in step 5 will serve as a road map to guide the country towards universal clean household energy use.

RESOURCES:

The resources and databases listed below should be used to obtain information for completing the **situational assessment** component of the HEART template.

WHO Global Health Observatory (GHO) Air Pollution Data Portal
The GHO is a comprehensive database of health-related statistics for WHO's 194 Member States. It contains data on more than 1000 indicators on health topics, including environmental health, noncommunicable diseases and risk factors, child health, maternal and reproductive health and water and sanitation. The data for compiling a situational assessment for the HEART report, such as maternal mortality rates and urban/rural populations, can be found in the GHO.

For indicators of the burden of disease and exposure to HAP, consult the **Air pollution data portal**, which is part of the GHO and is referenced in CHEST module 1: Stakeholder mapping and situational assessment. The portal contains numerous data resources on air quality and health, including many indicators of morbidity and mortality attributable to exposure to household and ambient air pollution at national, rural and urban levels, broken down by age group and gender. Other indicators reported on the GHO include information on exposure to HAP, such as the populations that rely primarily on clean and on polluting fuels or technologies for cooking (including an indicator for data reported for SDG indicator 7.1.2 on the percentage of the population that relies primarily on clean fuels and technologies). It also provides estimates of primary reliance on fuels and technologies by fuel type. The GHO enables comparison of data for other health indicators (e.g., deaths and disability-adjusted life years [DALYs] due to malaria, tuberculosis and inadequate sanitation) with the

burden of disease due to air pollution. Such information can help contextualize the extent of ill health caused by HAP.

The CHEST module 1 also includes links to:

- The **WHO Household Energy Database**, which is a compilation of nationally representative statistics from surveys and censuses on household energy use from more than 1400 surveys, with data on fuels and technologies used for cooking, heating and lighting. The Household Energy Database is used to derive data for making national estimates of the use of polluting household energy sources. It also forms the basis for further assessment of the burden of disease attributable to HAP. This database is a unique resource that can be used to monitor progress in the transition to cleaner fuels and stoves. (https://www.who.int/data/gho/data/themes/air-pollution/who-household-energy-db).
- The **WHO Global Database of Household Air Pollution Measurements**, which contains measurements of HAP from studies conducted around the world. The database summarizes HAP measurements (primarily of PM and CO) from published studies, including basic information on the study designs. The database currently includes nearly 200 studies from dozens of countries. Most of the data are the concentrations of pollutants in kitchens, with some data on outdoor levels and personal exposure. This database can be used to estimate baseline or expected levels of pollutants in actual households from measurements made in comparable settings in the region or other parts of the country. The database is regularly updated to integrate new data (https://www.who.int/data/gho/data/themes/air-pollution/hap-measurement-db).
- The **WHO Ambient Air Pollution Database**, which includes annual mean ground concentrations (in $\mu g/m^3$) of $PM_{2.5}$ and PM_{10} in ambient air in many cities around the world (https://www.who.int/data/gho/data/themes/air-pollution/who-air-quality-database).
- The **WHO Source Apportionment Database for Particulate Matter** is a systematic collection of data on the sources that contribute to ambient levels of PM from studies conducted in over 50 countries. It includes information on the percentages of ambient levels of PM that originate from domestic fuel burning and from natural sources, traffic, industry and other sources of human origin (https://www.who.int/data/gho/data/themes/air-pollution/source-apportionment-db).
- The **WHO Health Effects from Liquid and Gaseous Fuels Database** contains studies identified in a systematic review that investigated the health effects of liquid and gaseous fuels for household cooking, heating, and lighting across low-, middle- and high-income countries (https://www.who.int/data/gho/data/themes/air-pollution/health-effects-of-liquid-and-gaseous-fuels-database).

Task 1.3. Map stakeholders engaged in household energy-related work.

- Using HEART, make a comprehensive list of all relevant entities and actors working on issues related to household energy, including the following:
  - government agencies and ministries (e.g., health, energy, environment, housing) at national, sub-national, state or province and/ municipal levels;
  - nongovernmental organizations (e.g., national, regional and international nongovernmental organizations working on expanding access to clean cooking, heating or lighting);
  - cooperation agencies (e.g., World Bank, Deutsche Gesellschaft für Internationale Zusammenarbeit, regional development banks);
  - international agencies (e.g., WHO, United Nations Children's Fund);
  - research and academic institutions;
  - health sector members (e.g., physicians, community health workers);
  - community service organizations;
  - civil society and philanthropic foundations;
  - industry actors (e.g., LPG distributors, solar lighting/LED retailers and manufacturing companies);
  - financial sector (e.g., investment funds, commercial banks);
  - media (e.g., television networks, radio channels, newspaper consortiums, journalists' associations); and
  - relevant advocacy groups.
- Collect information on the scope of the work of these stakeholders, their connections and opportunities for improving coordination, communication and alignment among them.

RESOURCE:

Household Energy Assessment Rapid Tool (HEART): See summary in box 5.

Task 1.4. Convene a second workshop to review the findings of the situational assessment and stakeholder mapping, and invite feedback.

- Convene key stakeholders for a second consultation meeting, to present preliminary findings from the situational assessment and stakeholder mapping, verify collected information, identify any missing information and make a list of opportunities and barriers for increasing access to clean fuels and technologies.

Task 1.5: Finalize a report on the findings of the situational assessment and stakeholder mapping.

- Prepare a report that includes the findings of the situational assessment and stakeholder mapping and a discussion of possible barriers to increasing adoption of clean fuels and technologies and opportunities for increasing access.

Key outcomes:

A report, generated using the WHO's HEART template, on the current state of access to household energy access, exposure to HAP and the associated health impacts, existing household energy policies and programmes, key stakeholders and their roles and opportunities for increasing access to clean household energy (See https://www.who.int/tools/household-energy-assessment-rapid-tool-templates for examples of completed reports.)

Takeaway message:

A situational assessment is a prerequisite for devising any household energy policy. Detailed understanding of existing programmes and policies ensures that the new interventions build on past and current work to increase access to clean household energy. Stakeholder mapping facilitates formation of a steering committee in step 2.

CASE STUDY 1

Using HEART in the WHO Region of the Americas

The Pan American Health Organization – the specialized health agency for the Americas that also serves as the WHO Regional Office for the Americas – applied the HEART template in Honduras, Mexico, Panama, Paraguay and Peru between 2018 and 2019. In each country, a focal point in each of three ministries (health, energy and environment) filled in the template as a team. For most of the focal points, the exercise was the first time that the health sector had formally discussed the issue of access to clean energy for cooking with representatives from the energy and environment sectors. Bringing different ministries together to complete the HEART template provided an opportunity to consider how each could contribute to improving access to clean cooking fuels. Preparation of the reports indicated the current state of access to energy, the key barriers and opportunities and means for increasing access. The reports serve as a road map for each country, as they are locally relevant, developed by the stakeholders themselves. Another benefit of the collaboration was integration of the health sector perspective into discussions on energy policy, since historically energy had not been a high priority for the health sector in those countries.

Use of the HEART template made it possible to identify tailored strategies to increase access to clean household energy that were appropriate for each country. In Honduras, the suggestions included promoting the use of LPG and electricity for cooking in urban areas and improved cookstoves in rural areas, recognizing the limitations of access to electricity and LPG in those areas and the availability of free biomass. In Mexico, the roadmap called for redirecting resources from subsidies from electricity to LPG in rural areas and for eliminating use of firewood for cooking in urban areas. In Panama, the HEART findings showed that the LPG subsidy was not reaching the poorest households in some parts of the country, indicating that focused strategies were necessary for those areas. In Paraguay, the strategy focused on promoting a widescale transition to cooking with electricity, as there was near-universal access to the electrical grid, abundant renewable electricity and the possibility of providing a targeted subsidy for electricity to the poorest households. In Peru, the process resulted in a recommendation to increase the existing LPG subsidy so that more households could afford to use LPG exclusively.

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Step 2: Form a steering committee to design an action plan

Household energy is a multi-sectoral issue, encompassing energy, health, environment, climate, livelihoods and economic development. Solutions to ease the heavy societal burdens of HAP rely on collaborative work among these sectors and among governments, civil society, international cooperation agencies and private industry.

To chart a path forward on the transition to clean household energy, a team should be formed of people who understand the possibilities and anticipate possible pitfalls. The steering committee should thus be composed of individuals representing all key sectors and stakeholders with the relevant expertise to select and design effective clean household energy policies.

Objectives:

- From the list of stakeholders identified in step 1, establish a national steering committee with representatives from all relevant sectors, agencies, affected communities and institutions.
- Establish a smaller working group composed of steering committee members and external specialists and stakeholders as necessary to conduct technical analyses and spearhead implementation.
- Outline the priorities, and set short-term and long-term goals to guide consideration of different policies and programmes, such as elimination of the use of polluting fuels to reduce maternal and infant mortality from HAP, deforestation and climate-warming emissions.
- Clearly define the roles and responsibilities of each member of the steering committee in a document outlining their terms of reference.
- Determine which ministry, agency or organization will lead policy and programme development.
- Integrate and define the supportive roles of other ministries, organizations and stakeholders in plans for implementing the policy or programme.

Why it is important:

Household energy is a multisectoral issue requiring coordination among stakeholders to maximize the impact and ensure synergy. as the capacities of each sector can be more fully harnessed through cooperation and communication. A diverse, inclusive, committed, well-informed team of representatives of key sectors, with substantive participation by decision-makers in key government agencies, is essential for successful policy development.

Tasks and tools:

Task 2.1. Identify and secure participation from key stakeholders on a multi-sectoral steering committee.

- Consider forming two working groups within the steering committee, to facilitate and expedite its work:
  - an operational sub-committee consisting of 8–15 people that meets more frequently and performs most data collection, analysis and other technical tasks; and
  - a larger, high-level decision-making committee that meets two to four times a year to review progress, identify priorities, make decisions on policy assessment and selection and communicate with decision-makers.

- Review the results of stakeholder and policy mapping performed in step 1 to identify collaborators for both the steering committee and the operational sub-committee.
- Prepare a concept note and an invitation for recruiting steering committee members, and secure their participation.

RESOURCE:

HEART template (See Table 2 for an example list. Use Template A in Annex H to complete your own table). The report generated using HEART includes a comprehensive list of all relevant stakeholders.

Considerations in selecting a steering committee are outlined in Box 6.

Box 6. Considerations for selecting steering committee participants

Considerations for the perspectives and backgrounds to be represented:

- Ensure that all relevant stakeholders are represented. They might include representatives from the energy, health, environment, education, social welfare and/or financial sectors, as well as private industry, civil society, academic research institutions, power utilities and others.
- Ensure that decision-makers from relevant government ministries and implementing organizations and agencies are represented.
- Seek to achieve gender balance on the committee or, at a minimum, strong representation of women and women's organizations and stakeholder groups.
- Engage participants from the health sector (e.g., health ministry, health providers and practitioners).
- Engage and invite participation from government authorities and officials at sub-national and municipal levels (e.g., governors, mayors).

Considerations for the expertise of participants:

- How clean and polluting household energy use affect health, the environment, the climate and livelihoods.
- The current national energy infrastructure, plans for improvement and any limitations.
- National or sub-national finance and opportunities to implement taxation or subsidy schemes.
- Available national statistical data on health and energy.
- Conducting and interpreting health risk assessments with available data, tools and resources.
- Conducting cost–benefit and cost–effectiveness analyses.
- The methods and processes used to obtain and communicate the results of monitoring and evaluation.
- Coordinating and participating in inter-sectoral collaborations.
- The gender dimensions of household energy use and women's roles as primary users of household fuels and device.

Task 2.2. Define the roles and responsibilities of steering committee members.

- Determine the agency that will be responsible for leading policy or programme development.
- Identify focal points and other contacts in institutions not directly represented on the steering committee who might serve as external technical advisors (e.g., staff from other government ministries, nongovernmental organizations, international development agencies, academic research centres).
- Define the decision-making authority of the steering committee leadership (e.g., chairperson or executive committee) and the decision-making process (e.g., how decisions will made, e.g., by consensus, majority vote, etc.).
- Identify and appoint a steering committee chairperson.
- Define and record the roles and responsibilities of each steering committee member. (See Table 2 for an example list. Use Template A in Annex H to complete your own table).

Table 2. Example list of steering committee members and their roles

Name	Affiliation	Job title	Sector	Role on committee	Contact information
	Ministry of Health	Director or focal point for environmental health	Health	Co-chair	e-mail; telephone
	Ministry of Energy	Lead specialist in energy importation	Energy	Co-chair	
	Ministry of Environment	Environmental health officer	Environment	Lead, HEART assessment	
	Ministry of Finance	Chief Economist	Finance	Lead, budget development	
	Planning commission	Secretary of Planning and Development	Planning	Lead, action plan	
	Local university	Epidemiologist	Impact assessment	Lead, BAR-HAP analyses	
	Clean Cooking Alliance	Implementation expert	Non-governmental health organizations	Interface with non-governmental and civil society organizations	
	World Bank	Health economist	Multilateral institution	Adviser on finance, monitoring and evaluation	
	Energy sector management assistance programme	Energy specialist, gender and energy programme	Energy	Adviser on gender and equity	
	Climate and Clean Air Coalition	Climate expert	Climate	Adviser on climate change impacts	

Note: See Template A in Annex H for a blank version of this table.

Task 2.3. Set terms of reference that include goals, a timetable and the process for the steering committee's work.

- Decide on a clear set of priorities in access to clean household energy for the country or setting. Consider listing the three top priorities, such as whether the policy or programme should focus on cooking, heating or lighting (or a combination); how the policy or programme will prioritize health in relation to other social, environmental and economic priorities (e.g., gender equity, climate mitigation, livelihood generation).
- Achieve consensus on the goals of the policy or programme (e.g., achieve adoption of clean cooking by 50% of households within 10 years).
- Commit to developing a detailed action plan. (See also step 5.)
- Prepare terms of reference for the process, purpose and responsibilities of the steering committee. (See Box 7.)

Box 7. Preparing terms of reference for the steering committee

To function effectively, the steering committee requires strong leadership, adequate resources, regular meetings and clear communication among its members. Early in the process, the steering committee members should define their roles, responsibilities and joint purpose in formal terms of reference, which address the following questions:

- What core values will guide the steering committee's work?
- What is the role of each member of the steering committee?
- What will be the key outcomes of the committee's work, and how will they advance creation of a detailed action plan?
- What in-kind support is available and what, if any, additional resources will be necessary to facilitate the steering committee's work?
- How will the steering committee achieve steps 3–5 of this guide? What is the timeframe for completing the necessary activities?
- How will the steering committee communicate internally and with the wider group of stakeholders? How will the steering committee's work be documented? How will information be shared?
- How will the steering committee ensure that it achieves gender balance and is inclusive of the perspectives of users of household energy and of vulnerable groups and communities?
- How will it communicate with and solicit feedback and questions from policy-makers and government ministries?

Task 2.4. Seek and secure strong government support.

- Make a clear, compelling case for action to expand clean household energy access in order to secure high-level government and political support. (Clearly specify how a clean household energy policy or programme is expected to achieve the desired outcomes.)
- To generate support, consider drawing on publications and summaries of the major benefits of clean household energy, including health, livelihood and time savings, environmental and climate benefits and others. (For some resources, see CHEST module 6: https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-6-communication-and-raising-awareness)
- Engage government leaders who are not members of the steering committee but whose support will be instrumental for implementing the action plan (e.g., for securing financial and other resources); request feedback on the steering committee's list of priorities.
- Revise and finalize the list of priorities and terms of reference for the steering committee on the basis of feedback from key decision-makers and authorities. (These will be reviewed again in step 5.)

RESOURCE:

Benefits of Action to Reduce Household Air Pollution (BAR-HAP), part of CHEST module 2: Identification of technological and policy interventions, can be used to estimate the benefits for health, the economy, the environment and the climate of supporting a transition to cleaner household energy. This information can make the case to government leaders for financial and other support for the steering committee's work (Box 8). BAR-HAP can also be used without running a full transition scenario in order to show the current state of household energy use and health and other impacts in the country, as a means of demonstrating the costs of inaction or maintaining the status quo. (See step 4 and Box 4 for more detail on the use of BAR-HAP for comparing interventions.)

Box 8. Generating support: resources for building a case for action on clean household energy

The publications and resources listed below can be consulted for country-specific and general information on the health and other impacts of HAP, in order to build the case to political leaders and decision-makers for action to expand clean household energy and to secure support for the steering committee's work and mandate.

- **WHO Air pollution data portal**. See task 1.2 for details. (https://www.who.int/data/gho/data/themes/air-pollution).
- **BreatheLife Campaign**. Part of CHEST module 6: Communication and awareness-raising. The aim of the campaign is to mobilize communities to reduce the impact of air pollution on health and the climate. It includes brochures, graphics and videos that can be used to educate people about the threat that air pollution poses to health. (https://breathelife2030.org).
- **WHO video series on air pollution and health**. These videos, also part of CHEST module 6, contain interviews with experts about air pollution and its negative effect on health. (https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health/videos/mosaic).
- **Burning opportunity: Clean household energy for health, sustainable development and the well-being of women and children** *(2)*. This global report presents extensive data on the widespread use of polluting household fuels for cooking, heating and lighting and documents its damaging effects on human health, safety and well-being, especially for women and children. (https://www.who.int/publications/i/item/9789241565233).
- **Health and Energy Platform of Action (HEPA)**. HEPA is a multi-stakeholder platform for ministries of health and of energy, intergovernmental and nongovernmental organizations, private sector entities, philanthropic foundations and academic institutions. Convened by WHO, the United Nations Department of Economic and Social Affairs, the United Nations Development Programme and the World Bank, in cooperation with the International Renewable Energy Agency, the platform is designed to increase engagement in health and energy priorities and leadership for action by strengthening cooperation between the health and energy sectors, mobilizing political commitment and conducting advocacy and outreach. With an initial focus on clean cooking and electrification of health-care facilities, HEPA will increase the scale of results required to achieve SDG 3 on health, SDG 7 on energy and SDGs on gender (goal 5) and climate (goal 13). (https://www.who.int/initiatives/health-and-energy-platform-of-action).

Key outcomes:

- list of steering committee members and their roles;
- terms of reference for operation of the steering committee, including:
  - designation of lead agency and chairperson;
  - explanation of decision-making processes;
  - agreed systems for communicating and documenting the committee's proceedings and decisions; and
  - a timetable for the committee's work, with key products and outcomes;

- a statement of priorities agreed by consensus of steering committee members and external stakeholders (e.g., focus on maternal health);
- selected goals for household energy policy (e.g., at least 80% of the population cooks primarily with clean fuels or devices within 10 years); and
- key messages for decision-makers in securing high-level political commitment and the necessary resources.

Takeaway message:

Increasing access to clean fuels requires coordinated action. The steering committee is the primary means of choosing and designing clean household energy policies or programmes. All the other tasks described in this guide, including the essential tasks of assessing and selecting policy or programme options in collaboration with national decision-makers (step 4) and developing a detailed policy action plan (step 5), are performed or overseen by this core body.

CASE STUDY 2

Forming a household energy working group in Kenya

Recognizing the importance of inter-ministerial partnerships for increasing access to clean household energy, the Government of Kenya set up a technical working group on climate change, health and energy to foster cross-sectoral coordination for a transition to clean household energy and to develop and implement an evidence-based action plan to reduce HAP.

The group is coordinated by the Ministry of Health and implemented jointly with the Ministry of Energy and Petroleum and the Ministry of the Environment and Natural Resources. Representation from these ministries provides the diverse expertise necessary to draft and implement a comprehensive household energy action plan, with input from specialists in carbon financing (Ministry of the Environment); technical assistance, capacity-building and investment in energy technologies and fuels (Ministry of Energy); and health effects of household energy interventions (Ministry of Health). The working group has obviated overlapping mandates and ensured standardization of messaging on household energy.

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Step 3. Identify relevant policy and/or technological interventions.

A country or municipality might pursue many possible interventions to promote use of clean household energy, from financial tools to behaviour change campaigns to performance standards to infrastructure investment. In this step, the steering committee first identifies potentially appropriate interventions, including the expansion of existing household energy policies or programmes, and then narrows down the list to the options that are most likely to be feasible and appropriate for the county's context and goals.

The list of interventions drawn up in step 3 will be evaluated in more detail in step 4. Readers may wish to read step 4 before the initial narrowing-down in step 3 to ensure that the shortlist of options selected for further evaluation is likely to meet the assessment criteria in step 4.

Objectives:

- Review potential policy and technological interventions that are appropriate and relevant according to the recommendations from the situational assessment (in step 1) and priorities identified by the steering committee (in step 2).
- Identify existing policies or programmes that could be strengthened (from step 1) or new ones that could be implemented to increase access to clean household energy.
- Describe the key characteristics of the technologies and policies identified.
- Create a short list of possible interventions to be further evaluated in step 4.

Why it is important:

Some policy approaches to expanding clean household energy will inevitably be more appropriate to a particular country's context than others. By exploring the various types of policies and programmes and learning how measures have been implemented in other countries, the steering committee will gain insight into which interventions are most likely to meet the priorities in their country or context. This will also ensure better understanding of the clean or transitional fuels and technologies that are already available (or could be made available) at scale in the country. It is necessary to consider both the type of technology or fuel that will be promoted as well as the policy measures to facilitate access and use.

It is important to narrow down the list of all possible clean household energy interventions to those that are most relevant for the country in order to ensure that only those most likely to achieve the objectives are extensively evaluated in step 4.

Overview of policy interventions

Many types of policies and programmes can encourage wider use of clean household energy, which are based on various approaches and instruments and operate at various scales. What they have in common is that they are undertaken by governments that impose, induce, incentivize or otherwise facilitate their adoption for clean household energy for cooking, heating and/or lighting.

The actions may be formal laws, decrees or orders, regulations, state-sponsored programmes, initiatives or other schemes. They might cover all aspects of the country's energy sector or focus on particular sectors (e.g., the residential or housing sector) or specific fuels and/or technologies. They may be components of larger initiatives to improve the health or well-being of certain groups of people (e.g., programmes for maternal or child health, poverty alleviation).

The types of policies that could be considered to expand clean household energy access and use are summarized in Table 1 in section 3.1.

Overview of technologies

WHO classifies household energy fuels and technologies as "clean", "transitional" or "polluting" according to the WHO Guidelines *(4)* (Table 3). Fuels and technologies are currently classified as "clean" for health on the basis of the measured emissions of fine particulate matter ($PM_{2.5}$) and carbon monoxide (CO). Fuel and technology combinations are classified as clean if they achieve:

- either the annual average air quality guideline level (AQG, 5 µg/m^3) or the interim target-1 level (IT1, 35 µg/m^3) for $PM_{2.5}$; and
- either the 24-hour average air quality guideline level (AQG, 4 mg/m^3) or the interim target-1 level (IT1, 7 mg/m^3) for CO.

(These classifications may be updated to reflect new evidence; current information can be found on the WHO's "Defining clean fuels and technologies" webpage *(21)*. (https://www who int/tools/clean-household-energy-solutions-toolkit/module-7-defining- clean).

Table 3. WHO categorization of ISO voluntary performance targets for emission tiers as clean, transitional or polluting

ISO VPT TIER	WHO CATEGORY FOR CO	WHO CATEGORY FOR $PM_{2.5}$
5	Clean	Clean
4	Transitional	Clean
3	Transitional	Transitional
2	Polluting	Polluting
1	Polluting	Polluting
0	Polluting	Polluting

ISO, International Organization for Standardization; VPT, voluntary performance target

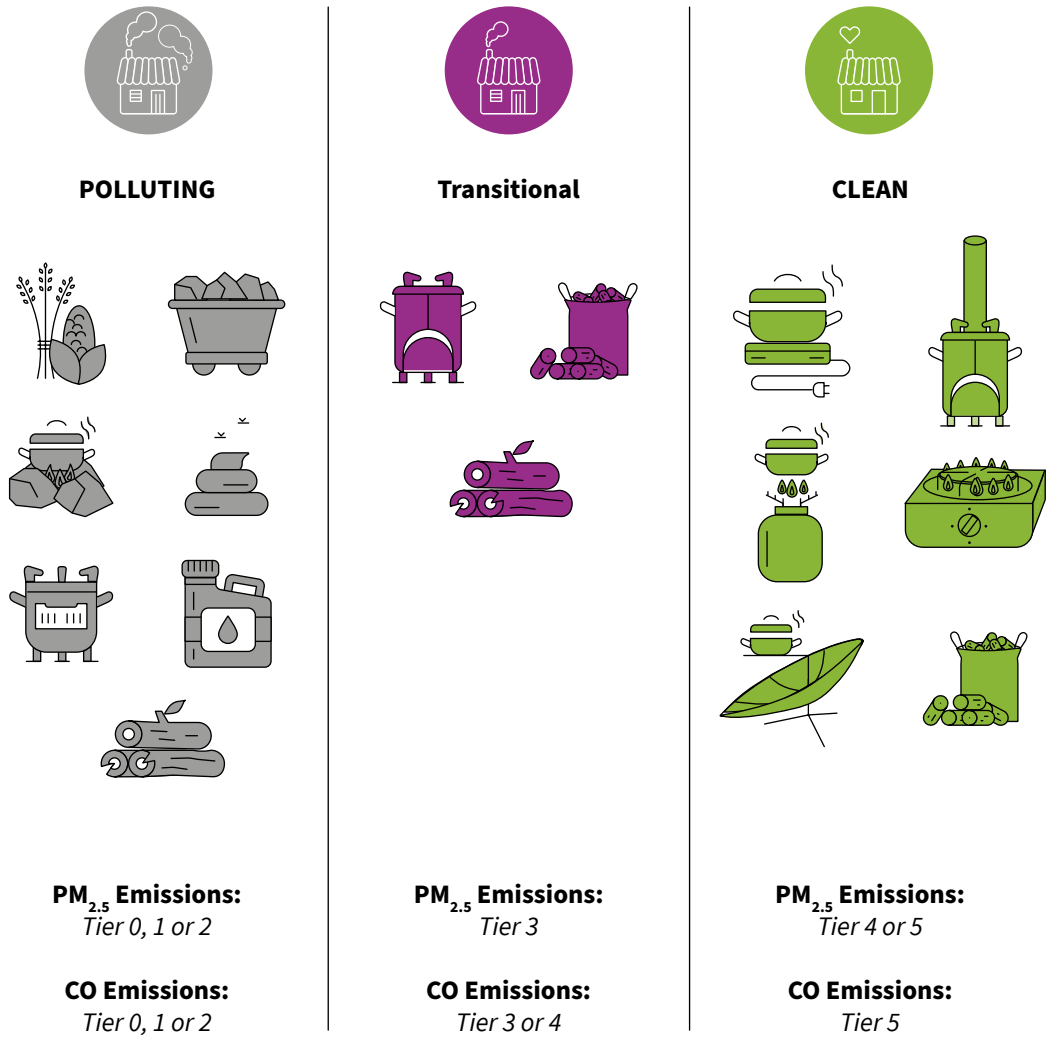
Through international consensus, the International Organization for Standardization (ISO) developed standards for clean cookstoves and clean cooking solutions *(22)* to support countries in setting national Voluntary Performance Targets (VPTs). VPTs comprise five tiered targets, tier 0 being the poorest performance (e.g., open fires and simple biomass fuel stoves) and tiers 1–5 indicating increasingly better performance. The VPT tiers are aligned with the guideline values and interim target levels for $PM_{2.5}$ and CO in the WHO Guidelines to minimize health risks *(3)*. The ISO standards provide a framework for assessing the performance of stoves and fuels that may be developed, marketed and used as people move from traditional solid fuels and kerosene to cleaner alternatives. (For more information on the ISO VPTs, see: https://www.iso.org/standard/73935.html).

Clean:

WHO defines as "clean" those fuels and technologies that attain the interim targets for fine particulate matter ($PM_{2.5}$) and carbon monoxide (CO) levels included in the 2021 WHO Global Air Quality Guidelines *(3)* and the respective guideline values in the WHO Air quality guidelines: global update 2005 *(23)* and the 2010 Guidelines for indoor air quality: selected pollutants *(24)*. Fuel and technology combinations that achieve the interim target-1 level (35 µg/m^3) for $PM_{2.5}$ and the 24-h average interim target-1 level (7 mg/m^3) for CO in the WHO Global air quality guidelines *(3)* are classified as "clean". Certain fuels are assumed to be clean for health at the point of use because they emit low levels of health-damaging pollutants, regardless of the performance of the device in which they are used. Therefore, solar, electric, biogas, natural gas, LPG and alcohol fuels (including ethanol) are considered clean for health at the point of use on the basis of their household emissions of $PM_{2.5}$ and CO.

Whereas the fuels and technologies mentioned above are always categorized as clean, solid fuels and technologies that use solid fuels (e.g., charcoal and biomass) may be considered clean, transitional or polluting according to the emissions levels (see Fig. 3). These fuel–technology combinations are considered clean if they achieve the $PM_{2.5}$ and CO emission rate targets specified in the WHO Guidelines for indoor air quality: household fuel combustion (4) and hence meet at least the interim targets in the 2021 Global air quality guidelines (3). The WHO Guidelines1 for indoor air quality: household fuel combustion (4) were designed to help countries achieve the guideline and interim target values specified for $PM_{2.5}$ and for CO in the 2005 Air quality guidelines: global update and the 2010 Guidelines for indoor air quality: selected pollutants. On the basis of new evidence on the health-damaging impacts of even lower levels of air pollutants, the 2021 Global air quality guidelines provided new recommendations for the levels of $PM_{2.5}$ and CO necessary to protect health but maintained the interim targets from the previous guidelines and converted them into new interim target values, i.e., interim target-4. In the light of these updates, the 2014 Guidelines for indoor air quality: household fuel combustion can still be used to achieve the 2021 interim targets. These interim targets serve as a useful benchmark for progressing towards the lower guideline values and achieving meaningful health benefits for the population. Although the vast majority of solid fuel-burning devices in use around the world are polluting, a few have been categorized as clean or transitional (see reference 3 for a list of clean and transitional solid fuel-burning devices).

Figure 3. Differences between clean, transitional and polluting fuels and devices



On the basis of the ISO VPTs for cookstoves or context-specific emission rate targets calculated in the WHO Performance Target (PT) model (Annex 3), a stove that achieves tier 4 or tier 5 for $PM_{2.5}$ emissions and tier 5 for CO emissions is classified as clean for health (see Table 3). The Clean Cooking Alliance's "Clean cooking catalog" lists the results of laboratory tests of stoves and fuels, which can be consulted to determine tiers with the ISO VPTs *(22)*.

Cooking: Clean fuels and technologies for cooking include:

- solar
- electric
- biogas
- LPG
- alcohol fuels (e.g., ethanol)
- biomass stoves that meet the target emission rates in the WHO Guidelines (equivalent to tier 4 or 5 for $PM_{2.5}$ emissions and tier 5 for CO emissions from the ISO VPTs). (https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean)

Heating: Clean fuels and technologies for heating include:

- central heating (regardless of the energy source)
- heat pumps (electric-powered)
- manufactured space heaters, traditional space heaters, manufactured cookstoves or traditional cookstoves (if they require electricity, piped natural gas, LPG, biogas or alcohol/ethanol)
- manufactured or traditional solid fuel stoves or space heaters that meet the emission rate targets in the Guidelines as described for cooking fuels and technologies (i.e., ISO VPT tier 4 or 5 for $PM_{2.5}$ emissions and tier 5 for CO emissions).

Lighting: Lighting technologies are defined as clean according to the energy source. Clean fuels and technologies for lighting include:

- electricity (including solar panels)
- solar-powered lanterns or torches
- rechargeable mobile phones, torches or lanterns
- battery-powered torches or lanterns
- biogas lamps
- LPG lamps

Transitional:

WHO defines transitional fuels and technologies as those with emission rates that exceed the targets recommended in the WHO Guidelines but that still reduce health risks relative to other options *(3, 21)*. Transitional technologies are not fully clean for health, but their use provides some health benefit.

The interim targets in the WHO Global air quality guidelines are intended as incremental steps in progressive reduction of air pollution in highly polluted settings. They are intended to promote a reduction in the concentrations of pollutants that have serious health consequences to concentrations that, if achieved, would significantly reduce the risks of acute and chronic effects *(3)*.

Although they may not be considered fully clean, some "advanced" biomass stoves can merit consideration for reducing the risks of people exposed to high levels of HAP, particularly in remote communities with little or no distribution infrastructure for clean fuels or electricity. Truly "advanced" biomass stoves have features such as secondary combustion, insulated combustion chambers and fans, which can dramatically improve combustion efficiency and significantly lower the emissions of health-damaging pollutants.

While not all "advanced" biomass stoves meet the WHO Guidelines' thresholds for "clean", in settings where biomass fuels are widely available and clean fuels are not, low-emission stoves can be used as a transitional technology to provide meaningful health benefits on the pathway to truly clean energy sources *(3)*. Interventions to promote adoption of fully clean fuels and technologies should be prioritized when possible, and transitional options should be considered only if clean options are not available (Box 9).

Cooking: Transitional cooking fuels and devices include improved charcoal stoves and improved biomass stoves (chimney, natural draft, forced draft, forced draft with biomass pellets) with an emission rate meeting ISO VPT Tier 3 for $PM_{2.5}$ and Tier 3 or 4 for CO.

Heating: Transitional heating devices are manufactured space heaters, traditional space heaters, manufactured cookstoves, or traditional cookstoves that meet Tiers 3 or 4 for CO emissions and Tier 3 for $PM_{2.5}$ emissions (according to the ISO VPTs).

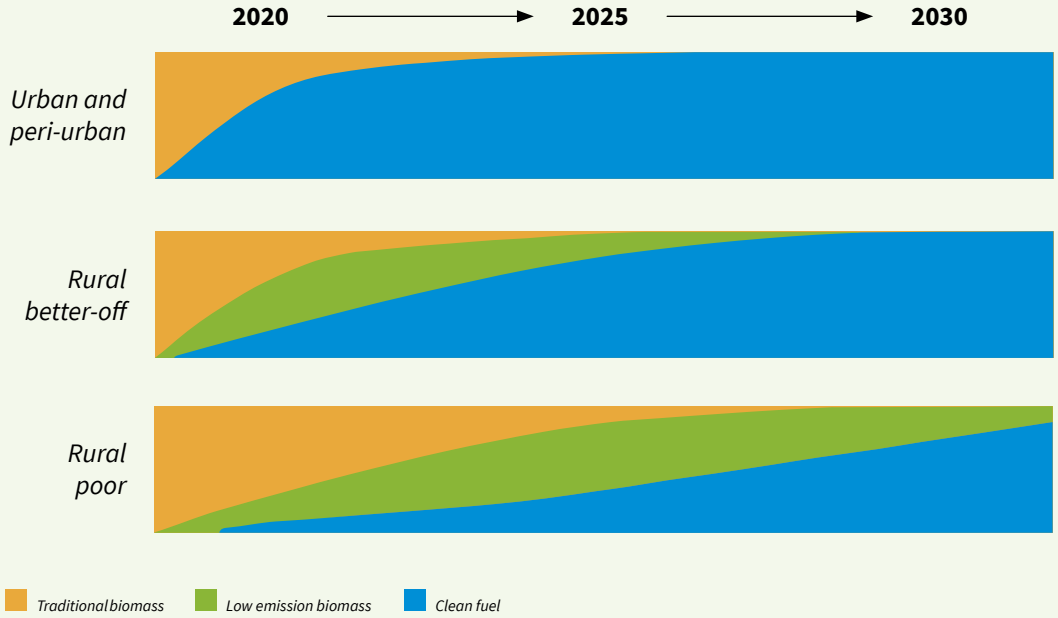
Lighting: There are no transitional lighting options.

Box 9. Recommendation 2 of the WHO Indoor air quality guidelines: Household fuel combustion on policy during transition

Recommendation 2. Policy during transition to technologies and fuels that meet WHO air quality guidelines

For settings and situations in which "intermediate steps are necessary", the guidelines recommend that governments prioritize transition fuels and technologies that offer substantial health benefits in order to meet the air quality guidelines and emission rates targets specified in the Guidelines. When solid fuel technology continues to be necessary, the lowest emission options – consistent with meeting household needs, safety and costs – should be developed and promoted. For those households that have to rely in the interim on improved solid fuel stoves, assessment should also be made of what can be done as soon as possible to prepare the start or increasing use of clean fuels. Fig. 4 shows hypothetical scenarios for rates of transition in three different groups.

Figure 4. Hypothetical scenarios for rates of transition from predominant use of traditional solid fuel for cooking to low-emission, improved solid fuel stoves, clean fuels and/or electricity in three socially and geographically defined groups



Adapted from WHO Guidelines for indoor air quality: Household fuel combustion *(4)*.

Polluting:

Polluting fuels and technologies pose a risk to health at the point of use. The WHO Guidelines discourage use of kerosene and of unprocessed or so-called “raw” coal in the home, as these fuels are considered polluting.

Cooking: Polluting cooking fuels and technologies include kerosene stoves and devices that burn unprocessed coal. Inefficient technologies in which other fuels, such as wood, charcoal and dung, are used are classified as polluting if they rate tier 0, 1 or 2 for $PM_{2.5}$ or CO emissions.

Heating: Polluting heating devices include moveable heating pans and open-fire or three-stone stoves. Biomass heating devices are classified as polluting if they rate tier 0, 1 or 2 for $PM_{2.5}$ or CO emissions.2 Analyses are under way to assess the emissions, performance and health risks of kerosene heaters, as the emissions may vary.

Lighting: Polluting sources of light include gasoline lamps, kerosene or paraffin lamps, oil lamps, candles and open fires.

Box 10 describes the cleanest forms of household energy for health and the climate.

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Box 10. Cleanest forms of household energy for health and the climate

WHO calls for use of the cleanest possible options for health and does not advocate for the use of any specific type of fuel or technology. The clean options listed above are all considered clean for health. Although this guide focuses on the health impacts of pollutant emissions at the point of use, zero-emission energy sources, such as renewably generated electricity, are both clean for health and also, in most cases, are likely to produce the least amount of greenhouse gases and climate-warming pollution.

While LPG is considered clean for health as a fuel for cooking and heating, it is a fossil fuel. Burning LPG produces climate-warming carbon dioxide, and leakage of LPG at any point in its supply chain, from extraction to delivery to consumers, adds methane, a potent greenhouse gas, to the atmosphere. The large health benefits of use of fuels like LPG must, however, be considered with their impact on the climate and the risks that climate change poses to human health.

The net impact on the climate depends in part on whether the wood fuel to be replaced by clean fuels like LPG is sourced renewably and on the combustion efficiency of the biomass-burning stove (27). Evidence suggests that, when emissions of black carbon and other short-lived climate pollutants from biomass combustion are taken into account, large-scale transitions from biomass to LPG in low- and middle-income countries will probably result in a net reduction in climate-warming pollution (28).

Renewable electricity technologies and battery storage are becoming increasingly affordable, presenting an unprecedented opportunity for investing in new energy systems that are clean for both the climate and health, to help millions of households change from polluting energy to renewable electricity. For communities and regions that are connected to an electric grid, transitioning to electric devices for cooking, heating and lighting may be feasible, leading to widespread adoption of household energy that is clean for both health and the climate. For households that are not connected to the grid, stand-alone renewably powered micro-grids or roof-mounted solar home systems are possible solutions for fuelling household lighting and certain appliances, including highly efficient electric cooking devices, such as pressure cookers, that consume modest amounts of energy (29).

Although the price of solar systems, batteries and other sources of renewable electricity is falling steadily, the initial costs of purchasing and installing them remain far higher than can be afforded many low-income households and communities. Without government policies to expand the electricity grid, subsidize micro-grids or defray the initial cost of electric devices, solutions that are clean for both health and the climate may not be as affordable as stoves fuelled by other options, such as LPG, alcohol fuels, biogas or natural gas. Furthermore, electric devices are a viable solution only if there is a sufficient, reliable, affordable supply of electricity (30).

As more countries adopt decarbonization plans and include reform of their fossil fuel subsidies as part of their agenda for climate change action, however, the opportunity for aligning climate and health goals through investments in low-carbon electrification will increase. As noted in the WHO Manifesto for a healthy recovery from COVID-19 in May 2020:

> *"Energy infrastructure decisions taken now will be locked in for decades to come. Factoring in the full economic and social consequences, and taking decisions in the public health interest, will tend to favour renewable energy sources, leading to cleaner environments and healthier people." (31)*

In its special report on climate change and health prepared for COP26 in Glasgow, Scotland, in 2021, WHO recommended that governments "fast-track the transition to clean cooking and heating fuels and technologies and help reliably electrify households while extending renewable energy." (28). These recommendations reflect the growing understanding that, while LPG is a clean fuel for health today, it might one day be viewed as an intermediate solution before universal electrification of household energy, a future that is fully clean for both health and climate.

Tasks and tools:

Task 3.1. Identify clean or transitional fuels and/or technologies that are available (or could be made available) for cooking, heating and/or lighting, and describe their characteristics.

- Consult the HEART report generated in step 1 for an overview of the available fuels, fuel use patterns and their costs in the country or setting, and information on the broader market characteristics and supply and distribution infrastructure.
- Drawing on the results of the HEART assessment and other data sources, identify feasible technologies for consideration. The objective is to expand the availability of clean or transitional fuels or technologies that already exist in the country or to introduce new fuels or technologies that could be made available on a wide scale.
- See Table 4 for an example on how to compile the characteristics of the cooking or heating technology and fuel combinations under consideration (including cost information). These classifications are illustrative examples only – The table should be completed using data for particular stoves and fuels. Use Template B in Annex H to complete your own summary table of fuel and technology considerations. (Note: Tier classifications apply only to cooking and heating devices.)

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Table 4. Example summary of the technology and fuel combinations under consideration

	Technology/Fuel Combinations	Cost	WHO classification for PM & CO (clean, transitional, polluting)	Efficiency Tier	$PM_{2.5}$ Tier	CO Tier	Safety Tier	Durability Tier
Cooking	LPG	$ $	Clean	N/A				
	Electric	$ $ $	Clean					
	Forced air gasifier stove	$ $	Clean	4	4	5	5	4
	Pellet stove	$ $ $	Clean	5	5	5	4	4
	Forced draft cookstove	$	Transitional	3	3	4	4	4
	Fan-assisted gasifier stove	$	Transitional	3	3	3	5	4
Heating	Natural gas heater	$ $	Clean	N/A				
	Electric heater	$ $ $	Clean					
	Forced air gasifier stove	$ $	Clean	4	4	5	5	4
	Forced draft stove with fan	$	Transitional	3	3	3	5	4
Lighting	Electricity	$ $	Clean	N/A				
	Solar	$ $ $	Clean					
	Rechargeable flashlights	$	Clean					

Note: There are no transitional lighting options; all fuels and technologies under consideration for lighting should be clean. See Template B in Annex H for a blank version of this table.

Only clean transitional technologies should be considered and included in this table; devices that burn polluting fuels such as coal and kerosene should not be considered. Tier ratings typically apply only to solid-fuel stoves. Tier ratings need not be assessed for clean fuels and technologies such as LPG, natural gas, ethanol, solar, electric and biogas, all of which are classified as clean.

The following resources may be consulted for further information on fuel and technology characteristics and classifications:

- WHO Guidelines on indoor air quality: household fuel combustion (section 2.2). (https://www.who.int/publications/i/item/9789241548878).
- WHO website on "Defining clean fuels and technologies" (https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-7-defining-clean) to determine which of the stoves and fuels under consideration are classified as clean, transitional or polluting.
- Clean Cooking Alliance's Clean cooking catalog (Box 11).

Box 11. The Clean cooking catalog

The Clean cooking catalog, developed by the Clean Cooking Alliance and referenced in CHEST module 2, is a regularly updated global database on cookstoves, fuels, fuel products and performance. Users can look up a stove (or a similar model) and find information on its emissions, efficiency and safety. Users can also search for products according to design characteristics, geography and test performance. Information on the various tier classifications of biomass stoves can also be found. Information on stove models, including test results, can be uploaded directly to the catalog.

Clean cooking catalog. http://catalog.cleancookstoves.org/

Task 3.2. Identify relevant policies or programmes for expanding adoption and use of the clean and/or transitional fuels and technologies identified in Task 3.1.

- Review relevant examples of policies to promote clean or transitional cooking, heating and/or lighting and their evaluations on the Household Energy Policy Repository website.
  - Search the Repository for policy examples by type (e.g., regulatory, financial, infrastructure investment), location (country or WHO region), end use (e.g., cooking, heating, lighting), technology or fuel type, scope (i.e., national, regional, local), year of implementation and other factors of interest.
  - If specific polluting fuels and/or devices (e.g., coal, kerosene, biomass in inefficient devices) are used widely for cooking in the country, search the Repository for policies for promoting transitions away from those fuels or devices (e.g., policies designed to shift households from primary dependence on biomass for cooking to LPG or electric cooking devices).
  - Likewise, if a change to clean or transitional fuels and technologies for heating and/or lighting has been identified as a priority, search the Repository for relevant policies (e.g., policies to help households shift from burning kerosene for lighting).
  - Consult the policy evaluations in the Repository and WHO policy briefs on clean cooking subsidies and household heating (https://householdenergypolicies.org/resources) for information on the effectiveness of policies under consideration and their suitability for adaptation to the country's context *(6)*.

- Interview decision-makers and technical experts in other countries to learn about their experience in designing and implementing household energy policies and programmes. (See Box 12.)
  - Identify decision-makers to be interviewed by finding relevant policies in the Household Energy Policy Repository and the contacts of the ministries responsible for monitoring and evaluating them.
  - Conduct interviews and compile relevant lessons and suggestions as qualitative data to complement the analyses and assessments that will be performed in step 4.

Box 12. Guide for communicating with decision-makers in other countries

Conversations with individuals responsible for designing, implementing, monitoring and evaluating past or current household energy policy interventions can provide valuable insights to the steering committee. The list below provides some sample questions and topics to be covered in interviews. Some of the questions may not be relevant for the country's context or in view of the priorities identified in earlier steps.

- What were the specific targets and objectives of the policy or programme? Were they achieved? If the policy or programme is ongoing, how are you tracking progress towards the goals?
- Did you focus on cooking, heating, lighting or some combination? How did you prioritize certain household energy end uses?
- If the policy addresses cooking, did you focus exclusively on promoting or extending clean cooking fuels and technologies, or did you include transitional options? How did you make that decision?
- Did you address scaling up adoption and use of fuels and technologies that were already available, or did you seek to introduce new clean fuels and technologies? How did you make that decision?
- Into what category does the policy fall (e.g., regulatory, financial, direct investment, behaviour change, trade, codes and standards)? Why did you choose that particular policy type, mechanism or instrument?
- What factors led you to choose this policy approach over others? Did you use models or technical tools to estimate costs and benefits of interventions under consideration? Which types of costs and benefits did you estimate, and which weighed most heavily in your assessment?
- Which ministries and/or organizations were responsible for leading policy implementation? How did you assign responsibilities? How effective was that assignment?
- What other stakeholders were involved in designing the policy?
- Was there high-level government support for clean household energy action at the start of policy selection, or did you have to build that support by outreach and sharing evidence? How did you gain their support?
- Can you describe the respective roles of the private sector, academic and research institutions, nongovernmental organizations and civil society groups in the design and/or implementation of the policy or programme or in raising public awareness about it?
- How long did it take to design, develop and implement the policy or programme? What obstacles were encountered? How did you overcome those obstacles?
- What were the sources of funding? How did you obtain the funding? Was the level of funding adequate to maintain the policy or programme?
- Do you think the policy has worked as intended? If not, why? If it did, what were the key factors of success?
- Have you revised or updated the policy or programme since its initial launch? If so, in what way, and why?
- If relevant, what have been the impacts of the policy on health? On the climate? How did you measure and track those impacts? Was your approach to monitoring and evaluation effective?
- What advice would you give to people starting to identify and select clean household energy interventions? What do you wish you had known or anticipated before you began work on your policy or programme?

- Consider developing national performance standards for cooking devices as a policy option.
  - Review global stove standard guidance and, if relevant, examples of standards from the country or region to determine how they might be adapted to local conditions or needs. (See Annex 3 for available tools and resources related to setting national performance standards for cooking devices.)

- Summarize relevant policies or programmes to be considered for expanding adoption of the clean cooking, heating and/or lighting solutions listed in Table 5 (Template C).
  - Draw on the Repository, stakeholder interviews and a review of existing policies or programmes identified in the situational assessment (HEART report) in step 1.
  - Solicit input on potential policies from stakeholders representing relevant communities and household energy users.
  - See Table 5 as an example for compiling a short list of cooking policies or programmes for consideration. Use Template C in Annex H to complete your own summary table. (The list will be used later to complete Table 6 under task 3.3, Template D in Annex H).

Table 5. Example summary of cooking, heating and lighting policies under consideration

Policy	Policy type	Related fuel and technology	Scale, scope	Clean or transitional	Notes
LPG subsidy	Financial	LPG and LPG stoves	National	Clean	
Pellet stove programme in municipalities with poor air quality	Financial; regulatory	Natural draft pellet stoves	Local	Transitional	
Electric grid extension	Direct investment	Electric stoves	Sub-national	Clean	

Note: Those listed are provided as illustrative examples only. See Template C in Annex H for a blank version of this table.

Task 3.3. Identify the most relevant policy and technology interventions for further consideration and comparison in step 4.

- Review the lists of intervention options drawn up in task 3.1 (fuels and technologies, Table 4, Template B in Annex H) and task 3.2 (policies, Table 5, Template C in Annex H).
- Drawing on those lists, make a shorter list of three to ten potential combinations of policy and technology for cooking, heating and/or lighting that could be considered for use in the country (or sub-national or municipal authority).
- Consult the situational assessment conducted in step 1 and the priorities established in step 2 to determine the policies and technologies that are most relevant and promising for achieving the country's objectives. It may also be helpful to consult Box 13. Decision guide, to become familiar with the criteria by which the final list of interventions will be assessed. This can help ensure that the options selected in this step are likely to perform well during further evaluation in step 4.

Box 13. Decision guide

For each of the categories below, assign a rating of high, medium or low for the intervention under consideration.

Feasibility

Assess the feasibility of the intervention according to the following factors.

- Is the fuel or device widely available?
- Can the stove or device be manufactured locally or in the country, or must it be imported?
- Is the infrastructure for storing, transporting and distributing the fuel or device in place and widely developed?
- Is the market for the fuel or device well established throughout the country or in its early stages of development?
- Is there a user base? How large is it?
- Have there been pilot programmes or previous small-scale deployments of the fuel or device?
- Is there sufficient technical competence and expertise for installing and maintaining it? How much training or new investment will be necessary?
- Is the intervention consistent with national or sub-national legal frameworks and mandates? Will laws, regulations or sector-wide policies require modification or significant revision?
- Are there any technical or logistical limitations to use of the intervention at scale? (e.g., are there enough facilities to bottle and store LPG?)
- How complex will it be to administer, track and evaluate the policy or programme, and how easy will it be to harmonize it with other relevant programmes?
- Are any externalities or adverse effects on other sectors, programmes or governmental priorities anticipated to result from this intervention?

Adoptability:

Assess the adoptability of the intervention according to the following factors, as appropriate, and any others that are important in the local context.

- To what extent does the technology meet local needs, and to what extent is it aligned with user preferences, both nationally and in specific locations?
- Over what period could the device be expected to function properly? How often would it have to be repaired or replaced?
- Are the supply chain and technical capacity in place for repairs and maintenance (e.g., replacement of parts and cylinders)?
- How likely is it that users will engage in fuel or device stacking (use of multiple devices in parallel) with this intervention?
- How likely are users to continue to use the new fuel or technology after initial adoption?
- How will the intervention address or be aligned with cultural factors and behaviour? Will significant behaviour change be required on the part of household members?
- Is the intervention somewhat familiar to users, or is it a completely new technology for a significant segment of the target population?
- How does the intervention address or overcome structural barriers due to social inequity (e.g., lack of access to banking services, information technology, electricity and welfare programmes)?

Impacts:

Assess the cumulative or overall beneficial impacts of the intervention.

- What is the likely impact on health and burden of disease (overall mortality and morbidity, DALYs, maternal and child mortality, incidence of major noncommunicable diseases, acute lower respiratory infections, etc.)?
- What is the likely impact on safety (incidence of injuries during fuel collection, burns, poisonings, risk of violence, etc.)?
- What is the estimated impact on air quality (levels of exposure to HAP, kitchen concentrations of HAP, contributions to ambient air pollution)?
- What is the estimated reduction of emissions of greenhouse gases and short-lived climate pollutants (climate impact)?
- What are the other environmental impacts (e.g., effects on deforestation, water supply and quality)?
- What are the estimated impacts on household members' time spent processing and gathering fuel, cooking, etc.?
- What are the likely impacts on livelihoods and household incomes (productivity)?
- How many households or people are likely to be affected by the intervention or to participate in the programme?
- What is the potential reach of the programme (e.g., numbers of participating individuals and households) over time? Is it likely to be durable through any political transitions?
- Is the intervention likely to have equitable outcomes? Will the costs and benefits be evenly distributed among different groups, ethnicities and segments of the population (low-income, urban/rural, women, children, elderly, disabled)?
- Will the intervention extend access to clean energy for particularly vulnerable or marginalized groups? Is the policy or programme likely to benefit women and children?
- Is the intervention designed to maximize both health and climate benefits?
- Can the intervention be rigorously monitored and evaluated? Are there any challenges with regard to data availability or collection for indicators?

Costs:

Assess the overall cost of the intervention, including the categories and considerations below.

- What are the estimated direct and indirect costs to households?
- What is the estimated total cost of administering the programme to the government? What is the estimated cost to the government per household?
- What will be the likely fiscal impact on the budget of the agency administering the policy or programme?
- Are the costs likely to outweigh the benefits (on the basis of BAR-HAP analysis in task 4.1)?
- What are the existing or potential new sources of funding?
- What is the likely cost in time for users to learn how to use and maintain the technology?

- Compile the options in Template D (Annex H). See Table 6 for an example. Factors to be considered include:
  - whether the fuel or technology will meet the needs of the target population and the likelihood of its widescale uptake and sustained use;
  - the cost of the fuel or technology and its affordability for low-income households;
  - the availability of the fuel or technology;
  - the fiscal implications for relevant government entities and their budgetary constraints;
  - whether the infrastructure for supply and distribution is in place or could be established; and
  - whether the fuel or technology is the cleanest option in terms of health, climate and other impacts.

This list of three to ten tailored options is the key output from step 3; each option will be further analysed, and a final list of programme and policy interventions will be selected in step 4.

Table 6. Example short list of interventions for consideration

Fuel type/ or technology targeted	Policy or programme	Cooking, heating or lighting	Scale or scope	Already widely used in country or new?
LPG stoves	Fuel subsidy	Cooking	National	Yes
Biomass pellet stoves	Behaviour change campaign	Cooking	Rural population	New
Solar lantern programme with ban on kerosene for lighting	Subsidy; regulatory scheme	Lighting	National	Yes

Note: Those listed are provided as illustrative examples only. See Template D in Annex H for a blank version of this table.

Key outcome:

A consolidated list of up to 10 appropriate policy and technology intervention options (e.g., financial incentives, distribution programmes, regulations) that could feasibly be scaled up for a rapid, large-scale transition to clean household energy.

Takeaway messages:

A smaller set of compelling, feasible options was identified from a longer list of possible policy and technological interventions. This is an essential step for selecting a policy or programme to implement (step 4) and creating an action plan with concrete, realistic targets (step 5).

The case study below provides a hypothetical example of completion of steps 3 and 4.

CASE STUDY 3

Hypothetical example of steps 3 and 4

Should the national government subsidize LPG stoves and fuel or household electricity connections and electric cooking devices? Or a mix of the two? Or should it focus on transitioning more households to improved biomass stoves?

The members of the steering committee found themselves torn between these options; however, they agreed that, in order to find the best path forward to extend access to clean household energy in their country of nearly 30 million people, they would need more information. To launch their search for policies to be recommended to government leaders, they review the findings of the situational assessment (**step 1**) prepared by a team of specialists on the current state of use of and access to household energy in the country. That report showed that they should focus on cooking rather than heating or lighting, as food was still cooked primarily with wood in traditional stoves in about 60% of households in the country. Their reliance on polluting cooking fuels was by far the largest source of health-damaging HAP in the country, which posed significant health risks, especially for women and children. The committee therefore reached consensus that shifting from polluting biomass to cleaner cooking solutions in as many households as possible, as fast as possible was likely to yield the greatest health benefits. But which fuels and technologies should they promote?

Drawing on the report drafted with the WHO HEART template (**step 1**) and reviewing their list of priorities (**step 2**), which included reducing maternal and child mortality and morbidity rates, the committee narrowed their focus to three types of fuels and technologies: LPG, electricity and/or improved biomass stoves [**task 3.1**]. They formed an operational sub-committee of 10 members of the steering committee to identify and analyse interventions to promote these options.

The sub-committee then searched the WHO Household Energy Policy Repository to find examples of policies and programmes in other countries for increasing access to these fuels and devices. Conversations with stakeholders, including members of the health sector and community organizations representing vulnerable groups, also yielded valuable insights [**task 3.2**]. The steering committee then concluded that subsidies for stoves would be necessary to drive widespread adoption of the improved technology and to achieve the desired health benefits. Their earlier discussion of the HEART report and conversations with policy-makers in other countries in their region, however, indicated that subsidies alone would be insufficient to promote widescale use and equitable transition, and investment to expand the supply and distribution infrastructure for clean fuels and behaviour change campaigns would also be required.

Their deliberations resulted in a list of seven policy interventions for further study [**task 3.3**]:

Fuel type, technology	Policy or programme	Cooking, heating or lighting	Scale or scope	Already widely used or new?
Advanced or improved biomass stoves	Stove subsidy	Cooking	National	Limited use
LPG stoves	Stove subsidy	Cooking	National	Used
LPG stoves	Stove subsidy	Cooking	Rural	Used
LPG stoves	Stove subsidy	Cooking	Urban	Used
LPG and electric stoves	Stove subsidy	Cooking	Rural	Used
LPG and electric stoves	Stove and fuel subsidies	Cooking	Rural	Used
LPG and electric stoves	Stove subsidy and behaviour change campaign	Cooking	Rural	Used

*The committee then addressed the core question: Which policy pathway would yield the greatest return on investment in terms of economic, environmental, climate and health benefits? To narrow down the options to three policies to present to the leaders of their low- to middle-income country, the sub-committee applied the BAR-HAP tool to estimate the costs and benefits of each option [**Task 4.1**]. They knew they would need compelling evidence to convince the government to invest limited financial resources into one of these options, among many other competing policy demands. The results are shown in the table below.*

Technology or policy*	Total benefits per year (private and social) (US$)	Health benefits: reductions in morbidity and mortality (YLL/year)	Total time savings (hours per year)	Climate benefits (full; tonnes of climate-forcing pollutants reduced/year)
Biomass to natural draft improved cook stove, 65% stove subsidy	3 134 599	138.1	7 218 232	110 975
Biomass to LPG, 70% stove subsidy	193 381 907	14 536.6	181 323 037	4 880 575
Biomass to LPG (rural), 70% stove subsidy	185 312 192	14 085.1	169 619 216	4 565 549
Biomass to 75% LPG + 25% electricity (rural), 70% LPG stove subsidy, 85% electric stove subsidy	206 090 574	15 482.5	186 157 089	5 406 419
Biomass to 75% LPG + 25% electricity (rural), 25% fuel subsidy, 70% LPG stove subsidy, 85% electric stove subsidy	259 232 550	20 055.3	231 242 010	6 715 786
Biomass to 75% LPG + 25% electricity (rural), BCC + 70% LPG stove subsidy, 85% electric stove subsidy	230 902 809	17 351.1	208 631 636	6 049 077
Biomass to 75% LPG + 25% electricity (rural), BCC + 70% LPG stove subsidy, 85% electric stove subsidy, 60% usage rate	308 298 364	24 126	260 789 545	7 561 346

*** To be completed with the technology and/or policy options compiled in task 3.3 and listed above. See Template E in Annex H for a blank version of this table.**

CASE STUDY 3

	Environmental savings (kg unsustainable wood harvest avoided/year)	Total costs per year (government and private) (US$)	Government cost (US$/year)	Private cost (US$/year)	Social net benefits (net present value) (US$)
	37 311 174	246 986	1 058 462	-811 476	83 664 755
	1 497 554 367	62 609 903	11 583 542	51 026 360	3 536 042 313
	1 400 892 027	58 535 212	10 802 440	47 732 772	3 424 282 316
	1 386 865 944	45 517 580	13 699 517	31 818 063	4 323 394 338
	1 722 523 946	116 529 842	89 531 919	26 997 923	4 665 593 967
	1 557 929 979	54 262 428	18 080 454	36 181 974	4 759 333 579
	1 947 412 474	60 540 540	18 080 454	42 460 086	6 624 460 210

The sub-committee concluded from the BAR-HAP comparison that they should not provide a subsidy for improved biomass stoves, as this policy yielded by far the least health and other benefits. They instead narrowed their choice to transitions to LPG and/or electricity.

In exploring transitions to LPG, the clean fuel most widely available in their country, the team calculated the subsidies to meet various percentages of stove costs. They found that a 70% stove subsidy provided much more health benefits than a 60% subsidy, with only a small increase in cost. Increasing the subsidy to 85% increased the benefits substantially but also sharply increased the cost. After discussing the country's fiscal situation, the sub-committee decided that the cost of providing an 85% stove subsidy would be too high and decided to pursue a 70% stove subsidy.

Next, the team decided which part of the country's population should be targeted. Their baseline assessment indicated that most of the households that used traditional biomass fuels were in rural areas and that nearly 60% of the country's urban population already used LPG as their primary cooking fuel. Providing a subsidy in urban areas would therefore be an additional cost with minimal additional benefit, as the government would be subsidizing LPG for many households that were already using it. Targeting only rural areas would save money while achieving significant net benefits.

*As renewably generated electricity is the best choice for both health and the climate (see **Box 10**), the team explored scenarios that encourage a transition to electric stoves. After adjustment of the electric stove subsidy to account for the fact that they cost more than LPG stoves, the benefits of a subsidy for both LPG and electric stoves were found to be greater than those for an LPG stove alone, and the total cost was actually lower.*

The sub-committee also modelled scenarios with the addition of other interventions, such as a fuel subsidy or a behaviour change campaign, to a subsidy for LPG and electric stoves. Adding in a 25% fuel subsidy increased the benefits only slightly and at much greater cost. Adding a behaviour change campaign significantly increased the benefits, with only a small increase in costs. The team therefore concluded that the combination of a campaign and a subsidy for LPG and electric stoves was a cost–effective option. They also found that the benefit of the scenario would be even greater if the campaign successfully increased use of the clean stoves.

*The sub-committee then used the decision guide (**Box 13**) to assess all of the policies under consideration, including those modelled in BAR-HAP and potential infrastructural investments that could not be modelled with BAR-HAP (**task 4.2**). This exercise identified trade-offs, especially between cost, feasibility and impact. The full steering committee then reviewed the answers to the decision guide, reviewed their priorities (from **step 2**) and drew up a list of three policy options (**task 4.3**):*

1. *Target 75% of current biomass users in rural areas to transition to LPG with a 70% stove subsidy, target 25% of current biomass users in rural areas to transition to electricity with an 85% stove subsidy and conduct a behaviour change campaign;*
2. *Target 75% of current biomass users in rural areas to transition to LPG with a 70% stove subsidy and to target 25% of current biomass users in rural areas to transition to electricity with an 85% stove subsidy; or*
3. *Target 100% of current biomass users in rural areas to transition to LPG with a 70% stove subsidy. In a discussion of their country's fiscal situation, they acknowledged that an expensive new programme may be received with scepticism by government. As the higher-cost options also yielded the greatest benefits, however, they decided to frame the programmes not only as worthwhile for improving health but also as a smart long-term investment, especially for the well-being and productivity of the youngest inhabitants of their country, where half of the population was under the age of 30, and also as a major step in the country's climate change action agenda.*

CASE STUDY 3

*The steering committee then met with key decision-makers from the ministries of energy, health, environment, power and finance and with other senior government leaders to discuss the three options (**task 4.4**). They reached an agreement to implement LPG and electricity subsidies with a behaviour change campaign, with direct investment in LPG distribution and electricity infrastructure. Various reasons were given for this choice. While LPG was the most widely available, viable clean fuel option in the country, electricity was the fuel most likely to be a widescale, durable platform for both environmental and health benefits in the long term. Extending the electricity grid and encouraging an initial shift to electric cooking would also lay the groundwork for future programmes to promote larger shifts to electric technologies.*

*Once consensus was reached and the final intervention package agreed upon, the steering committee prepared an action plan for the intervention (**step 5**).*

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Step 4. Analyse potential policy and/or technological interventions, and decide which to implement

In this step, the list of policy options developed in step 3 is narrowed down to up to three interventions, from which the final intervention to expand clean household energy adoption is selected. Step 3 involved identifying the most relevant interventions, while step 4 involves choosing which to implement. The steering committee analyses and compares the interventions on the short list developed in step 3, evaluates their feasibility and weighs their costs and benefits for health, the environment and other priorities.

Objectives:

- Analyse and compare the policy and/or technological interventions identified for consideration in step 3.
- Choose one or more interventions to implement.
- Present a final set of proposed intervention(s) to decision-makers, and secure support for their implementation.

Why it is important:

In this step, different policy and technological interventions are compared, and their performance on a range of criteria is weighed: emissions reductions, increased health and safety, cost, feasibility, climate and environmental impacts and other factors and projected outcomes. This detailed assessment ensures that the intervention(s) selected will achieve the goals and priorities agreed by the steering committee in step 2.

Tasks and tools:

Task 4.1. Assess and compare costs, benefits and impacts on HAP emissions, exposure and health outcomes from proposed ***cooking-related interventions****.*

As the assessment tools discussed below were designed to evaluate cooking policies and technologies, this task applies only to interventions related to cooking. For interventions related to heating or lighting, see task 4.2.

- Use the BAR-HAP tool to estimate the costs and benefits expected for each of the cooking policy and technological interventions in Table 6 (Template D) from step 3.
  - Enter the information for each scenario according to the prompts in the tool and the BAR-HAP manual. (See Box 4 for details of the BAR-HAP tool and how to access it.)

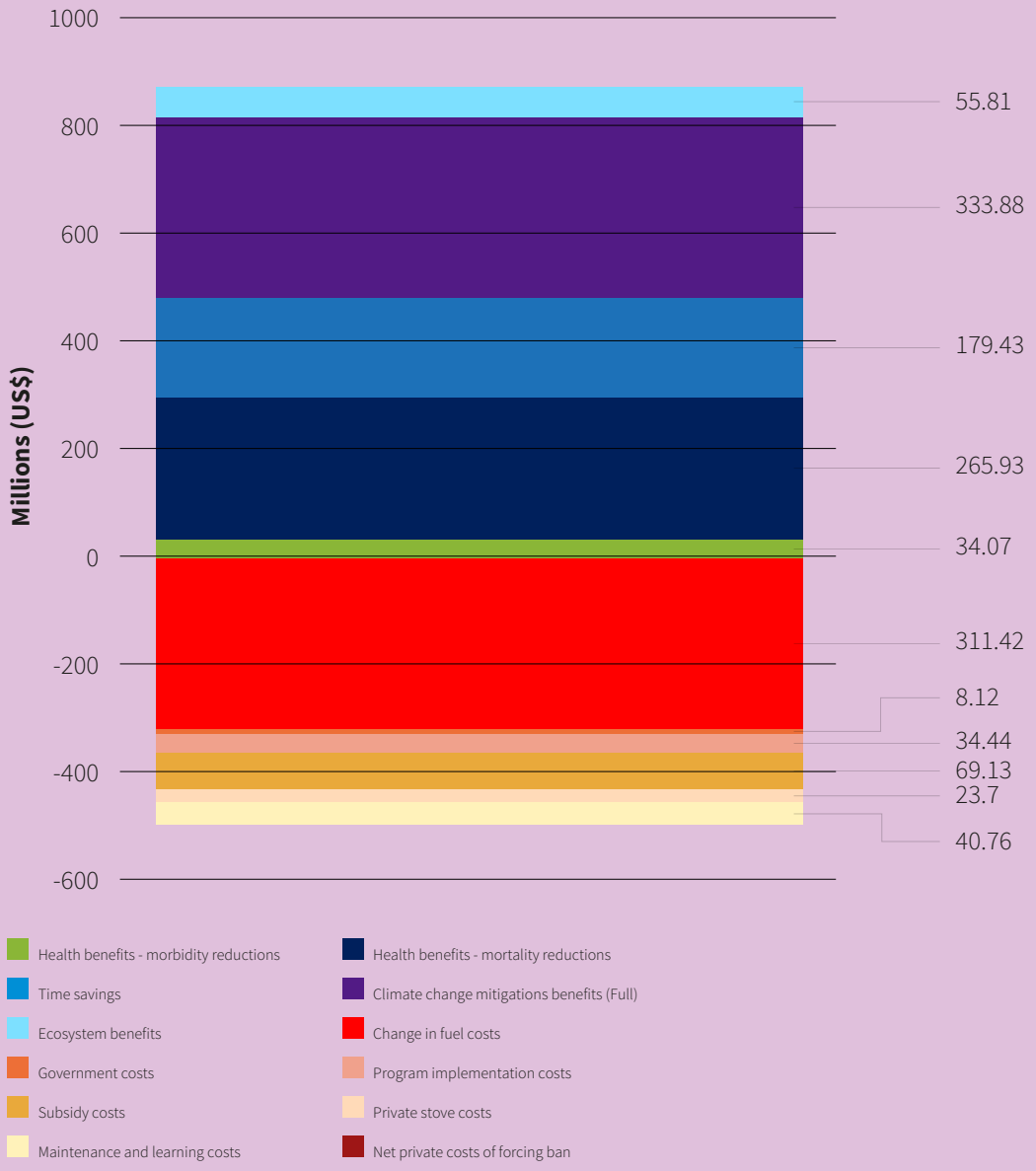
- Use Template E (Annex H) to summarize the results for each scenario. See Table in Case Study 3 for an example.
- Optional: Consider using the Household Multiple Emission Sources (HOMES) and ABODE tools to complete additional analyses. These advanced modelling tools provide estimates of changes in personal exposure to fine particulate matter due to household energy interventions and estimates of the averted deaths and DALYs due to the intervention. (See Annex 4 for more information on these tools.) The steering committee might have to engage outside consultants with relevant expertise to assist in performing analyses with these tools and/or interpreting the results.

CASE STUDY 4

Use of the BAR-HAP tool to analyse the costs and benefits of household energy transitions in Nepal

A team of researchers and government representatives entered data for Nepal into the BAR-HAP tool to calculate the costs and benefits that would result from transitioning all households from using traditional firewood stoves to LPG. The largest category of benefits from this transition would be mitigation of effects on the climate, followed by avoided mortality, household time savings, other ecosystem benefits and avoided morbidity (Fig. 5). The largest costs would be for the stoves (borne by both the Government and users), programme implementation costs for stove distribution and technology maintenance costs. In this scenario, the total benefits outweigh the costs.

Figure 5. Costs and benefits of a liquified petroleum gas stove subsidy in Nepal from WHO's BAR-HAP tool



Source: reference *25*.
Breakdown of total present value of costs and benefits (in US$) of a 70% stove subsidy to induce a shift from traditional biomass stoves to LPG stoves https://doi.org/10.1371/journal.pone.0245729.g004 https://doi.org/10.1371/journal.pone.0245729

Task 4.2. Evaluate the policy/programme and technology intervention options under consideration using the Decision guide.

- Review the results of analyses conducted in earlier tasks and their associated tables:
  - Table 4 (Template B, Annex H) summarizing characteristics of fuels/technologies under consideration (task 3.1)
  - Table 6 (Template D, Annex H) on interventions under consideration (task 3.3)
  - Template E in Annex H comparing results from BAR-HAP analyses of emissions, exposure and health impacts for different cooking interventions (task 4.1). See the Table in Case Study 3 for an example.

- To supplement this information, review the information collected from:
  - the HEART situational assessment (task 1.1)
  - Household Energy Policy Repository examples (task 3.2)
  - lessons from discussions with policy-makers in other countries (task 3.5)
  - optional advanced analysis of cooking interventions using HOMES and ABODE models (See Annex 4).

- Draw on these results and analyses to answer the questions in the decision guide in Box 13 in narrative form for up to five of the most promising interventions under consideration from the short list in Table 6 (Template D, Annex H).

The **Decision Guide** in Box 13 is intended to help evaluate the list of interventions developed in step 3 and assessed in step 4. Use it to make a final list of up to three leading policy and technology options, drawing on the results of the analyses mentioned above. This resource applies equally to cooking, heating and lighting interventions and is relevant to the energy end uses on which the steering committee has chosen to focus. The questions will help the steering committee to move from analysis and assessment towards selection. Rather than ranking interventions numerically, the decision guide elicits brief descriptions of the strengths, weaknesses and overall suitability of a given intervention on the basis of a range of criteria. This entails applying the detailed understanding of the costs, benefits, risks and probable impacts developed in steps 1–4 and determining which interventions align most closely with the priorities and broad goals outlined in step 2.

For each of the interventions under consideration, use the Decision guide to draft an evaluation. For each of the four criteria – feasibility, adoptability, impacts and costs – describe in narrative form the suitability, merits and drawbacks of the proposed intervention, and then assign each intervention an overall rating of **high, medium or low** for each category.

Note that some of the criteria (such as estimated emissions reductions) are measurable or quantifiable, whereas others (such as feasibility, which can encompass legal viability, political viability and long-term durability) may require more subjective or qualitative evaluation.

Task 4.3. Review the evidence, and choose the three preferred interventions.

- Once the operational sub-committee has compiled narratives in the Decision guide (Box 12) for each of the three preferred interventions, review the narratives with the full steering committee to assess potential trade-offs (e.g., between cost, feasibility and impact), and arrive at a consensus on the relative weighting of different criteria in order to agree upon clear preferences. (It may be helpful to review the "Common elements of successful policies and programmes" discussed in section 3.2.)
- Identify the three preferred interventions to be proposed for wide-scale implementation, with detailed explanations of the reasons for their selection, anticipated benefits and potential risks. This proposal will be made in a workshop with relevant government authorities and agencies in task 4.4.
- Review and finalize the priorities decided in step 2, and determine whether they have changed after identification and narrowing down of policy options and whether new constraints and opportunities (e.g., national health or climate objectives or poverty alleviation initiatives) have emerged or been clarified since the steering committee began its work.
- Revise estimates of the available funds, and determine whether additional or new sources of funding have been identified or whether savings in other health or societal costs could offset the price.

- Rank the proposed interventions as first, second and third choices. Use Template F in Annex H to summarize the three interventions proposed by the steering committee. Fill out separate tables for cooking, heating and lighting as desired or appropriate. See Table 7 for an example.

Table 7. Three policy and/or technological interventions to be proposed

INTERVENTION	CATEGORY	IMPLEMENTING AGENCY	BENEFITS	RISKS	REASONS FOR SELECTION
(describe proposed intervention)	*(e.g., financial, regulatory, trade, behaviour change campaign)*	*(e.g., Ministry of Health, Energy, Environment)*	*(e.g., BAR-HAP results with monetary values for all benefits, lives saved/year, total costs)*	*(e.g., concerns or probable barriers to feasibility, adoptability, cost)*	*(Brief summary of two or three justifications for selection, trade-offs considered, benefits, impacts, risks)*
1 (first choice)					
2 (second choice)					
3 (third choice)					

Task 4.4. Conduct a workshop with decision-makers and key stakeholders to present the three preferred interventions, and formally select the intervention(s) to be implemented.

- Present the three policy and/or technological interventions selected for consideration in task 4.3 to decision-makers and other key stakeholders.
- Determine which of the three will be implemented. (Details of implementation will be addressed in step 5.)
- Secure high-level support from key government ministries and stakeholder organizations for implementation of the selected intervention(s). Publicize their endorsement and commitment in a formal announcement and in the media to increase accountability and public awareness.

Key outcomes:

- Detailed summary and comparison of costs, benefits and impacts of leading clean household energy interventions under consideration.
- Selection of up to three interventions to be presented to key decision-makers, with explanations of why they were chosen as most suitable for the country context and goals identified in step 2 and how they will accelerate progress towards wider adoption of clean household energy.
- Final selection of the technology and policy intervention(s) to be implemented by decision-makers.

Takeaway messages:

In this step, the steering committee selects a policy or programme to be implemented after comparisons of the health, economic, climate and other outcomes of the three preferred interventions and identification of that or those most closely aligned with the priorities and goals set in earlier steps.

Once this critical decision has been made, the steering committee is ready to develop a detailed action plan (step 5) to accomplish its objectives.

Step 5. Create and document an action plan for implementing and monitoring the selected interventions

Policy development culminates in formulation of an action plan, the most important outcome of this policy planning guide. It lays out in detail exactly who will do what, by when. By setting a clear timetable for each task and assigning responsibility, the plan will provide a step-by-step guide to implement, monitor and evaluate the chosen intervention(s).

Objectives:

- Draft a detailed action plan for implementing the policy and/or technological intervention(s) chosen in step 4.
- Develop a detailed plan for monitoring and evaluating the implementation and effectiveness of the chosen intervention(s) on a range of outcomes.

Why it is important:

This step is based on work done in the previous steps and brings all those outputs together into a coherent plan for action. This requires a number of decisions that are essential to successful implementation, including:

- identifying the lead implementing agency (which might be different from the agency or organization leading the steering committee);
- defining the role of each actor;
- establishing a realistic timetable;
- clarifying what resources are required and how to obtain them;
- establishing a robust mechanism for monitoring and evaluating the selected policy and/or programme;
- planning communication and outreach to key stakeholders and the community; and
- assessing the capacity-building that will be required to instrumentalize the action plan.

Assessment of existing policies, stating priorities and adopting ambitious targets are all important, but little can be achieved without a credible plan for concrete action. An important part of the plan is monitoring and evaluation of progress in clean household energy adoption as a result of the intervention(s). As the real-world effects of a policy may differ from those intended, measuring the impact is essential to understanding the cost–effectiveness and sustainability of an intervention and its alignment with the priorities and objectives identified by the steering committee in step 2.

Measuring and tracking health and other outcomes also indicates whether and how the policy and/or technological intervention should be adjusted or updated over time in order to achieve its goals. Monitoring implementation of an intervention also helps to interpret outcomes. Monitoring is essential to ensure that the intervention is being implemented as intended and, if it is but is not achieving the desired outcomes, whether the design of the programme or the policy should be adjusted.

Tasks and tools

The tasks listed below will fulfil the essential elements of the action plan, and their outputs can then be assembled into a comprehensive action plan. Thus, the tasks listed in this step are a template for drafting the action plan. The structure and specific sections of the action plan should, however, be determined according to the country context and the particular features of the selected intervention(s).

Task 5.1. Summarize the proposed policy and/or technological intervention(s) and its objectives.

- Outline the elements of the intervention, including scale (e.g., projected number of households or people reached); relevant implementing agencies or national or sub-national actors; cost; timeframe for implementation and projected duration of any resulting programmes or schemes; required legislative action or changes to existing regulatory frameworks. List the objectives of the intervention(s) selected in step 4.

- Identify clear, concrete targets for the intervention (e.g., reduce maternal and infant mortality from exposure to HAP by 25% by 2030; transition five million households away from using kerosene for lighting). Review the goals set by the steering committee in task 2.3 if necessary to ensure that the statement of objectives is specific to the selected intervention.

Task 5.2. List the tasks required to implement the policy or programme.

- List the tasks that must be completed to implement the policy or programme selected in step 4. For each task, include:
  - amount of time required to complete the task;
  - individuals and/or entities responsible for performing the task. Assign responsibility to specific ministries or agencies, and designate a focal point.
  - potential staffing or personnel requirements, including capacity-building or training that may be required to complete the task, and who will provide the training (i.e., local or external technical experts). Capacity-building may be necessary for implementing agencies or other programme implementers, such as fuel distributors (who may, for example, have to process new vouchers from consumers), energy device manufacturers (who might have to ensure that their products meet new standards), health-care providers (who might educate communities about the programme) and others. CHEST module 5 provides resources for engaging the health community.
  - barriers that are likely to be encountered during implementation of the task and how they can be addressed (e.g., frequent turnover or periodic departures of key administrative personnel in government agencies).

- Consider adding tasks for raising public awareness (e.g., inform the public about the new interventions, encourage users to enrol in the new programme and/or use the new clean technology exclusively). CHEST module 6 provides resources for communication and awareness-raising.

Note: *If* development of *performance standards is one of the interventions selected in* step *4 and summarized in* task *5.1 above, the action plan should include consultation of the resources listed in Annex* 3.

Task 5.3. Set 1-year, 3-year and 5-year goals.

- Break down the objectives listed in task 5.1 into interim targets that can be achieved realistically within 1, 3 and 5 years.
- List the goals in the form of desired, concrete outcomes (e.g., 50% reduction in the number of households that rely primarily on polluting cooking fuels or devices).

Task 5.4. Draft a monitoring and evaluation plan.

- Identify indicators to track implementation of the policy or programme and its impacts on priority outcomes such as health, environment, climate and livelihoods. The indicators should be designed to allow reporting on progress towards the goals identified in task 5.3. (See Annex 5 for examples of implementation and impact indicators.)
- Develop survey questions to track indicators. This may be done by updating or refining questions

from existing national surveys with standard questions, such as the WHO and World Bank Core questions on household energy use (Box 13), or by writing new questions.
- Develop a plan for collecting the relevant data, which may already be collected or can be obtained by integrating questions into existing data collection or planning new data collection. (See Annex 5 for examples of other factors to be considered.)
- Develop a plan for training data collectors.
- Develop a plan for analysing the data. (See Annex 5 for examples of the components of an analysis plan.)
- Develop a plan for raising awareness about the efficacy of the intervention(s) and for communicating the results. The results of monitoring and evaluation might have to be distilled into messages for public dissemination, emphasizing positive results to encourage sustained commitment and/or using negative results to call for increased investment and effort. The results should be communicated to relevant policy-makers for improving the programme or policy.

Resources:

- ***National household surveys*** (i.e., questions on Multiple Indicator Cluster Surveys, Demographic and Health Surveys and national censuses). WHO has spearheaded a collaboration to improve global household surveys such as the United Nations Children's Fund's Multiple Indicator Cluster Survey and US Agency for International Development's Demographic and Health Surveys by developing, field testing and refining new questions about household energy use. The surveys now include versions of the WHO and World Bank core questions on household energy use for monitoring 7.1.2 (primary reliance on clean fuels and technology). (https://mics.unicef.org/surveys; https://dhsprogram.com/).
- ***Catalogue of methods: Evaluating household energy and health interventions***, part of CHEST module 4, describes methods and tools available for measuring: (i) stove performance; (ii) the impact of household energy interventions on access, adoption and use of clean household energy; (iii) levels of pollution and personal exposure; (iv) health, safety and convenience; and (v) time, socio-economic, equity and other outcomes *(26)*. It also describes methods for evaluating larger environmental, economic and market-based impacts. (https://www.who.int/tools/clean-household-energy-solutions-toolkit/module-4-monitoring-and-evaluation).
- ***Multi-tier framework surveys***. The Multi-tier Framework survey is a global baseline survey of household access to electricity and clean cooking, launched in 2015 by the Energy Sector Management Assistance Program. The survey records access to technologies or fuels in six tiers, from tier 0 (no access) to tier 6 (full access). (https://mtfenergyaccess.esmap.org).

Task 5.5. Establish a detailed timetable with specific benchmarks.

- Set target dates for completion of the tasks in task 5.2 (related to policy or programme implementation) and task 5.4 (related to monitoring and evaluation) according to the estimates of the time required to complete each task.
- Determine how to assess progress towards and/or completion of the tasks with concrete benchmarks.
- If several interventions and targets have been chosen, indicate whether they should be implemented in parallel or in sequence, which are priorities for immediate implementation and which can be deferred to a later phase.

Task 5.6. Draft a budget, and make plans for obtaining the required funds.

- List the resources available to support the work, and identify new sources of funding.
- Develop a detailed budget for implementing the intervention(s) and for monitoring and evaluation (See Annex 6 for example budget template).

Box 14 describes means for obtaining funding for programmes to increase access to clean household energy.

Box 14. Obtaining funding for development, implementation, monitoring and evaluation of household energy policies

Finding and securing adequate funding for new programmes is a perennial challenge, especially in fiscally constrained government ministries. While specific sources and mechanisms for securing funding for clean household energy will differ by context, some general strategies that may be considered for obtaining funding for designing, implementing, monitoring and evaluating household energy programmes are:

- *levying taxes or fees on large commercial energy consumers and companies;*
- *reallocating existing energy subsidies (i.e., shifting subsidies for kerosene to subsidies for clean fuels) or improving targeting of energy subsidies to the poorest households;*
- *incorporating energy subsidies into existing programmes (i.e., earmarking conditional cash transfers for clean energy purchases);*
- *using carbon finance markets (e.g., gold-standard certified carbon credits for reducing emissions of black carbon and short-lived climate pollutants);*
- *using the Green Climate Fund (financing for climate mitigation projects) and other climate-focused initiatives that can provide grants or loans for programmes to deliver health and climate "co-benefits" by reducing pollution;*
- *obtaining grants from international organizations such as the World Bank's Clean Cooking Fund, the Clean Cooking Alliance's Spark Fund, the Climate and Clean Air Coalition's Household Energy Initiative and the Organization of the Petroleum Exporting Countries' Fund for International Development Grants Program;*
- *obtaining grants or loans from bilateral and multilateral development aid organizations. commercial and cooperative banks, impact investors, private foundations and philanthropies (e.g., the Bill & Melinda Gates Foundation);*
- *leveraging funding from national and sub-national government budgets and national public banks for social development, health and other government programmes with health objectives similar to those of a clean household energy programme; and*
- *offsetting costs with the health and other societal savings achieved by the intervention.*

Task 5.7. Compile the outputs from tasks 5.1–5.6 into a draft action plan for implementing the intervention(s) and for monitoring and evaluating progress towards the 1-year, 3-year and 5-year goals.

- Produce an action plan with lists of tasks, a timetable, benchmarks and a list of responsible agencies and focal points for each task. (This involves compiling and synthesizing the information collected in response to each of the preceding tasks into a single document.)
- Indicate a lead for implementation. (This may be different from the institution or agency that leads the steering committee).

Task 5.8. Obtain support from relevant government agencies and other key stakeholders for the draft action plan.

- Convene a meeting to present the draft action plan and solicit feedback from stakeholders. Consult all the ministries, agencies and organizations that are essential for implementation of the intervention; secure their input and endorsement for key elements of the draft action plan, especially its objectives, tasks and 1-year, 3-year and 5-year goals. (Other participants may include manufacturers and fuel distributors, retailers, consumers, civil society groups involved in programme implementation.)
- Collect any additional information required (e.g., more input from community groups, women's organizations and other representatives of household energy users) for the action plan.
- After consultation with stakeholders, revise the objectives and the 1-year, 3-year and 5-year goals, as appropriate.
- Incorporate feedback into the action plan, and update the monitoring and evaluation plan.
- Publish and widely circulate the final action plan.

Key outcomes:

A comprehensive action plan that includes:

- objectives;
- a detailed timetable for implementing the chosen intervention(s);
- a set of interim 1-year, 3-year and 5-year goals;
- a monitoring and evaluation plan;
- a budget;
- plans for training and capacity-building;
- plans for communicating and raising public awareness about the intervention(s); and
- assignment of responsibilities for discrete elements of the action plan and for overall leadership of implementation.

Takeaway messages:

In step 3, the steering committee identified possible policy and technology options; in step 4, the committee evaluated those options and made decisions about which to implement. In step 5, the entire process culminates in the production of an action plan. The plan includes clear delineation of roles and responsibilities, a statement of short-term, medium-term and long-term goals and a plan for monitoring and evaluation to determine whether the policy is achieving its intended results and to drive continuous improvement and investment over time.

CASE STUDY 5

Malawi action plan for setting cookstove standards

To promote clean household energy, stakeholders in Malawi formed a national cookstoves steering committee (NCSC), which includes representatives of various sectors, including academia, government, nongovernmental organizations, media and international development partners. In July 2019, members of the NCSC attended a workshop on development of national cookstove standards. At that time, Malawi had published three cookstove standards and one standard for charcoal and charcoal briquettes. While the standards were a promising start, they had become outdated and were not aligned with the International Organization for Standardization (ISO) international cookstove standards. With support from the Malawi Energy Regulatory Authority, the NCSC devised an action plan to update the country's stove standards.

Having determined their policy intervention, the NCSC drew up an action plan with short-, medium- and long-term goals for development and implementation of national standards for cookstoves and fuels and designated a focal point for each task. The short-term goals include reviewing the evidence and existing standards to identify content relevant for Malawi's standards by the NCSC. The medium-term goals include adapting the ISO standards to the Malawi context and applying durability and safety testing protocols (by the Malawi Bureau of Standards), as well as developing regulations on biomass energy (by the Department of Energy Affairs). The long-term goals are for the Ministry of Natural Resources, Energy and Mining to publish the standards, and for the Department of Energy Affairs to prepare an Act for enactment by Parliament to institutionalize implementation of the voluntary domesticated ISO standards.

In 2019, the NCSC gained a commitment from the Ministry of Energy to publish the newly established cookstove standards. In 2020, the NCSC created a voluntary endorsement label for stoves that met the new standards: "Cleaner cooking for Malawi". In 2021, the NCSC and the Ministry of Energy created Malawi's Clean Cooking Compact, with the goal of achieving access to clean cooking for all households and institutions and eliminating the use of open fires by 2030.

Malawi's NCSC plans to continue testing stoves according to ISO protocols, further developing national laboratory capacity for testing cookstoves and working towards achieving the long-term action plan goals. By developing a concrete action plan and engaging the support of various agencies and stakeholders, Malawi has made meaningful progress towards the development and implementation of national cookstove standards.

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5 Conclusion

5. Conclusion

Continued reliance of hundreds of millions of households on polluting fuels for daily cooking, heating and lighting imposes enormous costs on individuals, communities, societies and ecosystems around the world. The good news is that clean, healthy, affordable alternatives exist. The challenge for policy-makers and other stakeholders is to improve access to cleaner alternatives for as many people as possible as rapidly as possible. Rising to this challenge at global, national and sub-national levels requires policies built on lessons from the past and on the best evidence that reflect societal goals for future sustainable development. Effective policies and programmes can help the billions of people who currently do not have access to clean cooking solutions to enjoy the benefits of electric devices, LPG, alcohol, biogas or improved biomass stoves. Well-designed interventions can also provide access to the grid for hundreds of millions of people who do not have reliable electricity or allow them install solar home-lighting systems, so that they do not have to burn kerosene to illuminate their homes.

There are many possible means to advance the transition to clean household energy, and countries are at different stages in this transition, with widely varied constraints, resources and priorities. The steps and tasks outlined in this policy and programme planning guide are therefore suggestions, derived from the diverse experiences of policy-makers and planners in many countries and contexts. They should be adapted to the specific needs and goals of each country, and some steps and tasks will be more relevant to certain readers than to others. Almost all users of this guide, however, should focus on achieving one concrete outcome from following these steps: a detailed action plan for a specific policy or programme that will significantly extend the use of clean household energy and reduce the use of polluting sources.

The steering committee implements the action plan, secures the necessary financial resources to support implementation, collects and analyses monitoring data and makes any required adjustments to policies or programmes according to those data. If the intervention is not achieving its intended outcomes, the committee could review and reconsider some of the alternatives assessed in step 4. During implementation, the committee can seek support from members of the Health and Energy Platform for Action (HEPA), a WHO-led initiative that brings together institutions working to achieve universal access to clean, sustainable energy. The steering committee could use the expertise and resources of the HEPA community through strategic partnerships.

Once the policy or programme is under way, rigorous monitoring and evaluation are essential to ensure that the intervention has the intended benefits. Monitoring also indicates whether adjustments and improvements are necessary if the intervention fails to result in the desired health and other impacts. As technologies develop and markets change, policies must be updated to take advantage of new opportunities. For instance, during the past decade, the cost of solar photovoltaic systems has decreased rapidly, making it a more affordable energy source in much of the world.

Policy interventions that expand access to clean household energy can meet many societal goals simultaneously. Clean household energy solutions save lives, time and money, and they prevent disease, reduce climate-warming pollution, expand learning and earning opportunities and drive equitable economic development. Providing clean energy thus contributes to progress on many urgent priorities at once.

With careful design, implementation and continuous evaluation, household energy policies and programmes can deliver these and other benefits for individuals and countries. This guide is intended to help countries develop road maps of their own design that they can follow to help realize these enormous opportunities.

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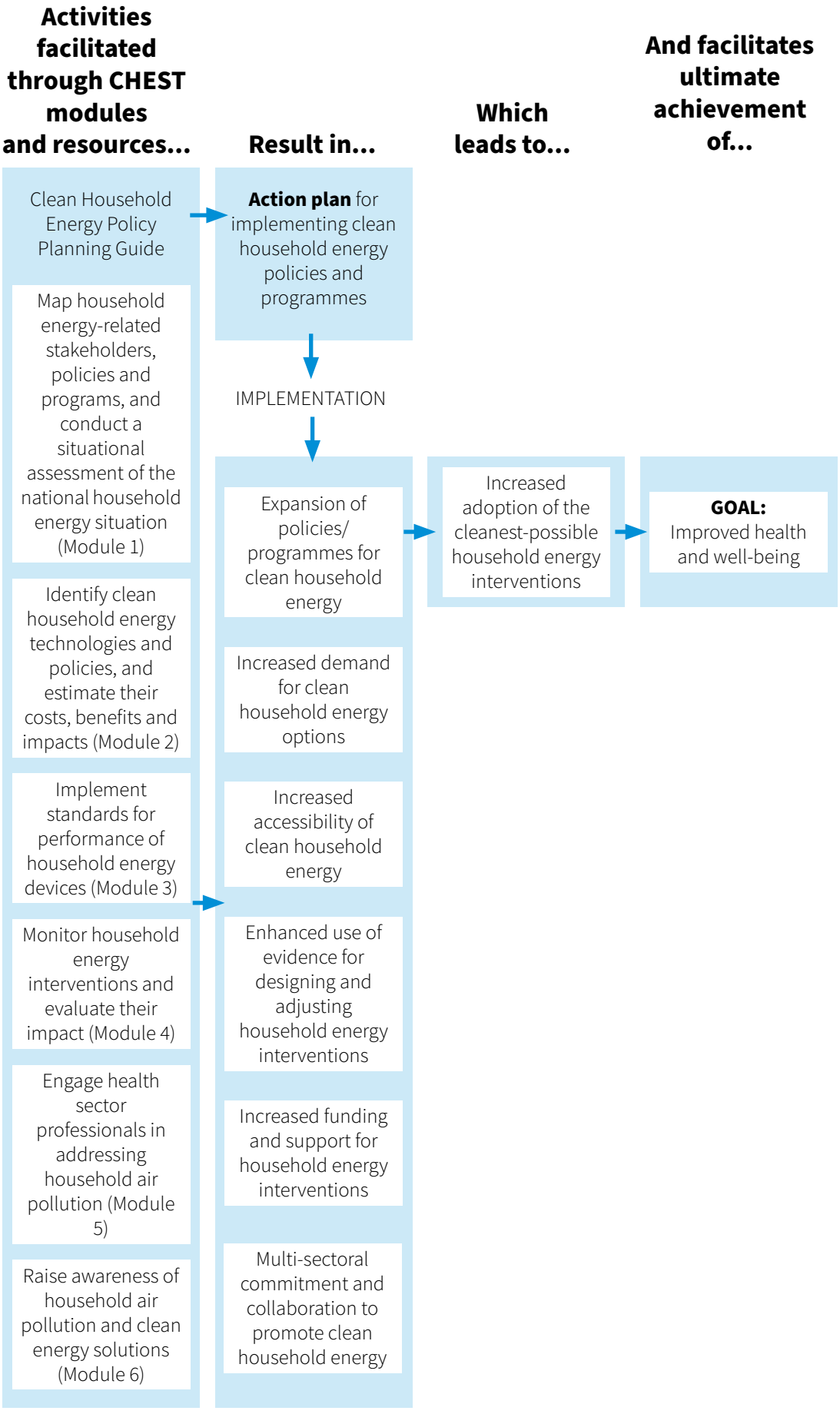
Annex A. List of expert reviewers

Donee Alexander, Clean Cooking Alliance, United States of America
Kofi Amegah, University of Cape Coast, Ghana
Rob Bailis, Stockholm Environment Institute, United States of America
Jill Baumgartner, McGill University, Canada
Verena Brinkman, Deutsche Gesellschaft für Internationale Zusammenarbeit (EnDev), Germany
Juan Jose Castillo, WHO Regional Office for the Americas, United States of America
Sandra Cavalieri, Climate & Clean Air Coalition, United States of America
Nita Chaudhuri, WHO, Switzerland
Thomas Clasen, Rollins School of Public Health, Emory University, United States of America
Simone Fehrenbach, Deutsche Gesellschaft für Internationale Zusammenarbeit (EnDev), Germany
Innocent Habimana, WHO Country Office Rwanda, Rwanda
Christa Hasenkopf, US Agency for International Development, United States of America
Julie Ipe, Clean Cooking Alliance, United States of America
Darby Jack, Columbia University, United States of America
Mazen Malkawi, WHO Regional Office for the Eastern Mediterranean, Jordan
Guy Mbayo, WHO Regional Office for Africa, Congo
Sumi Mehta, Vital Strategies, United States of America
John Mitchell, US Environmental Protection Agency, United States of America
Abraham Ortinez Alvarez, National Institute of Ecology and Climate Change of Mexico, Mexico
Helen Petach, unaffiliated, United States of America
Ajay Pillarisetti, Rollins School of Public Health, Emory University, United States of America
Alisha Pinto Noella, World Bank, United States of America
Joshua Rosenthal, US National Institutes of Health, United States of America
Manjeet Saluja, WHO Regional Office for South-East Asia, India
Devesh Shah, Self-employed Women's Association, India
Raja Ram Pote Shrestha, WHO Regional Office for South-East Asia, Nepal
Bastiaan Teune, Stichting Nederlandse Vrijwilligers (SNV), The Netherlands
Karin Troncoso, Modern Energy Cooking Services (MECS), United Kingdom
Elena Villalobos Prats, WHO, Switzerland

Annex B. CHEST theory of change



Annex C. Development of national performance standards

Relevant to step 3; see task 3.2.

National performance standards can improve the quality and safety of fuels and devices and protect the health of consumers. Rigorous, evidence-based national standards can help drive entire market sectors toward cleaner products. The development of national performance standards is one of the options for the steering committee's proposed policy or technology interventions. Several resources are featured in CHEST module 3: Guidance on standards and testing, which provides detailed guidance on methods for developing performance standards and conducting testing to determine which stoves meet the standards for certification.

RESOURCES:

- **Setting national voluntary performance targets for cookstoves (WHO, 2021)**. This document was developed to support countries in setting VPTs for cookstoves and clean cooking solutions, such as those established by the ISO. The document provides detailed guidance on the ISO laboratory testing protocols and assessing device performance using the five VPT tiers. It also discusses application of the ISO standards and VPTs in clean household energy policies (https://www.who.int/publications/i/item/9789240023987),
- **International Organization for Standardization (ISO) standards and resources:**
  - *ISO Technical Report 19867-3:2018, Voluntary performance targets for cookstoves* contains tiers of performance for rating the emissions, safety, efficiency, safety and durability of clean cooking devices. (https://www.iso.org/standard/73935.html).
  - *ISO Standard 19867-1:2018 Harmonized laboratory test protocols* provides standardized protocols for evaluating cookstove emissions, efficiency, safety and durability in the laboratory. (https://www.iso.org/standard/66519.html).
  - *ISO Standard 19869:2019 Field testing methods for cookstoves* provides guidance for assessing emissions, safety, use and other cookstove metrics in field settings. (https://www.iso.org/standard/66521.html).

- **The WHO Performance Target (PT) Model**. This tool can be used to determine locally-specific stove emissions rates for $PM_{2.5}$ and CO to achieve air quality and health outcomes associated with the ISO tiers of performance. Users enter data on average kitchen size, time spent using the device per day and air circulation characteristics, and the model produces a set of emission rates for setting $PM_{2.5}$ and CO emission tiers or targets that provide certain levels of health protection. (https://www.who.int/tools/performance-target-model).

Annex D. Optional advanced analysis for cooking technologies

Relevant to step 4

Task [optional for advanced analysis of cooking, heating, and/or lighting interventions]: Further investigate the impact of each of the interventions in Template D in Annex H (see examples in Table 6 and Case Study 3) on exposure to HAP and health outcomes through comparison of results from other tools.

This advanced analysis may be undertaken by countries that wish to obtain deeper understanding of the potential exposure and health outcomes that could result from the interventions under consideration (from Table 6 and Template D, Annex H).

By conducting this advanced analysis, users can:

- estimate specific health impacts of interventions on women, men, children and different age groups;
- understand the effects on health outcomes from reductions in ambient air pollution due to interventions that reduce indoor emissions;
- determine exposure and health impacts that could result from concurrent use of up to three different stoves, heaters or lighting devices, to account for the fact that device stacking is common globally; and
- compare the modelled impacts produced by different tools to ensure that the selected intervention(s) are consistently predicted to deliver desirable results.

RESOURCES:

- **HOMES.** Part of CHEST module 2: Identification of technological and policy interventions, the Household Multiple Emission Sources (HOMES) model (https://www.who.int/tools/household-multiple-emission-source-homes-model) can be used to estimate levels of personal exposure to and kitchen concentrations of fine particulate matter ($PM_{2.5}$) that would result from the use of up to three different stoves, space heaters or lighting devices. It also estimates how use of the devices would affect the risk for acute lower respiratory infection.
- **ABODE.** The Air pollution burden of disease explorer (ABODE) (https://householdenergy.shinyapps.io/abode/), also part of CHEST module 2, can be used to estimate the impact of an intervention on averting deaths and DALYs as a result of decreased exposures to HAP from a household energy intervention. Interventions could include transitions to cleaner technologies (i.e., cleaner burning stoves, cleaner fuels), improved ventilation, moving the traditional hearth outdoors, motivating changes in behaviour to reduce exposure or a combination. The model estimates reductions in acute lower respiratory infections, chronic obstructive pulmonary disease, ischaemic heart disease, lung cancer, stroke and type 2 diabetes mellitus that would be expected to occur from the reduction in exposure achieved by the intervention. In addition to estimating the overall number of deaths and DALYs that could be averted by the intervention, the model specifies how those effects are distributed among males, females, and children, by age, by disease and through ambient or HAP.

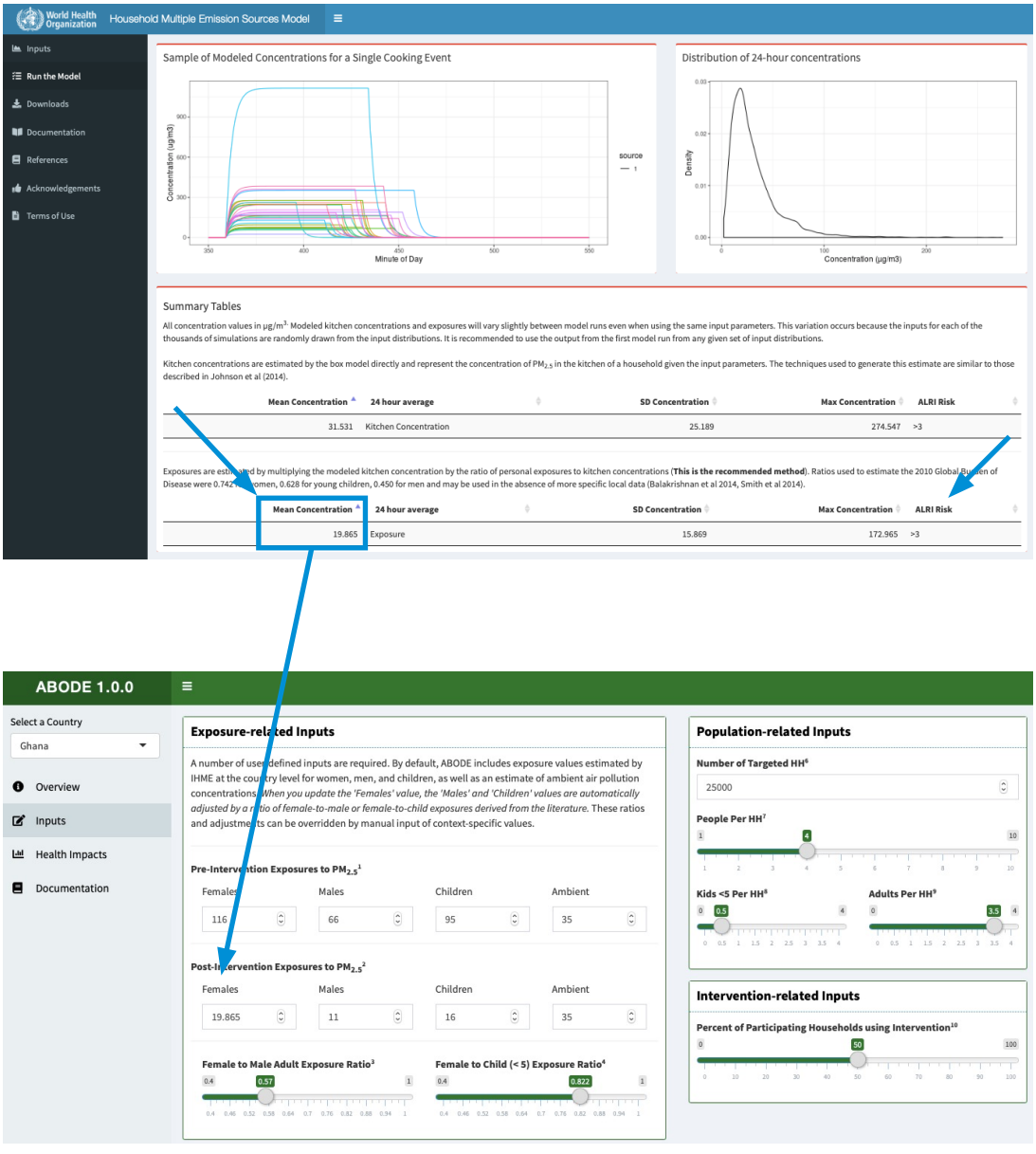
Sub-tasks:

1. Use the HOMES model (https://www.who.int/tools/household-multiple-emission-source-homes-model) to obtain estimates of kitchen concentrations of fine particulate matter, individual exposure to fine particulate matter and the risk of acute lower respiratory infections (ALRI) that would result from using the technologies under consideration. This model allows users to enter up to three different household energy devices to account for the fact that a new technology may be used with other technologies in a household. The data necessary to run the model can be obtained from the WHO database of input variable***s if local data are not available (***https://worldhealthorg.shinyapps.io/HAPmodelinputdata/***)***.

2. Use the individual exposure results from HOMES (see Fig. 4) as the value for "Post-intervention exposures to $PM_{2.5}$ (females)" in the ABODE tool (https://householdenergy.shinyapps.io/abode/).

The following flow chart indicates how to use the output value of individual exposure to fine particulate matter from the HOMES tool as an input to the ABODE tool.

(Note: The values for exposure of males and children after the intervention in ABODE are automatically adjusted after the female value is entered according to female-to-male and female-to-child ratios of exposure from the published literature.)



3. Run the ABODE tool to estimate the health impacts that would be expected as a result of the reductions in exposure due to each intervention under consideration. Default values are pre-filled for the country selected; in addition to updating the post-intervention exposure value, users may wish to update the number of targeted households and percentage of participating households using the intervention.
4. Compile results from the HOMES and ABODE tools for each intervention from Template D in Annex H (See Table 6 and table in Case Study 3 as examples). Use the table below to capture key information from the HOMES and ABODE tools after running them for each intervention under consideration. Users may add additional columns to capture the impact on specific diseases of interest, specific age groups of interest or by gender.

Optional advanced analysis: Comparison of key information from HOMES and ABODE tools

Technological Intervention	HOMES: Post-intervention 24-h average exposure to $PM_{2.5}$	HOMES: Relative risk for acute lower respiratory infection as a result of the intervention	ABODE: Total number of DALYs averted	ABODE: Total number of deaths averted

5. Compare the interventions from the estimates produced by the BAR-HAP (i.e. Template E in Annex H), HOMES and ABODE analyses to identify the best intervention options. The estimates from the tools may differ because the models use different estimates of disease burden to calculate disease reductions and incorporate different assumptions. ABODE uses data from the 2017 Global Burden of Disease Study, BAR-HAP uses WHO data as a default or data from the 2019 Global Burden of Disease Study, and HOMES uses data from the 2010 Global Burden of Disease Study. Factors to be considered when evaluating the proposed interventions include:

- Which intervention(s) show consistent health benefits in all tools? (i.e., large reductions in total numbers of deaths and DALYs avoided)
- Which intervention(s) have benefits that outweigh the costs (from BAR-HAP) and also significantly reduce personal exposure and kitchen concentrations of HAP (from HOMES)?
- Which intervention(s) have the largest impact on women and children (from ABODE)?

Annex E. Guidance for monitoring and evaluation

Relevant to step 5

Development of a monitoring and evaluation plan is discussed in task 5.4 (and at greater length in CHEST module 4). Some important tasks and decisions in creating a framework for monitoring and evaluation are listed below, with examples of key indicators.

- Select key indicators for implementation and impacts.
  - When choosing indicators to track implementation of the policy or programme, examples to consider include: the number of households that adopted the cleaner stove or fuel; the number of implementers trained; perceptions of the acceptability, appropriateness and feasibility of the intervention; fidelity of implementation (i.e., whether the programme or policy is being implemented according to plan).
  - When choosing indicators to track the impact of the policy or programme on outcomes such as health, environment and livelihood, examples to consider include: SDG 7.1.2 ("proportion of population with primary reliance on clean fuels and technologies"), percentage of households using LPG as the main cooking fuel, cases of childhood pneumonia and levels of HAP (concentrations of e.g., $PM_{2.5}$ and CO).

- Develop a plan for collecting the relevant data.
  - Map demographic and household surveys that have been conducted recently or are conducted regularly in the country or setting.
  - Decide whether to use data that are already being collected, integrate questions into ongoing data collection, or plan new data collection.
  - Determine whether data will be collected nationally or sub-nationally, and decide what type of data will be collected (e.g., health assessments, air pollution measurements, surveys, stove use monitoring, administrative or programme records).
  - Consider interviewing implementing agencies about their approaches to and capacity for policy or programme implementation.
  - Decide whether data will be collected digitally, on paper or with monitoring equipment (e.g., air pollution monitors, health equipment, stove use monitors).
  - Determine which agency will be responsible for collecting which data.
  - Determine the frequency of data collection (e.g., monthly, twice a year, annually).
  - Set a timeline with benchmarks for data collection.

- Identify or develop survey questions to track the chosen indicators.
  - Plan to either update or refine existing surveys or write new survey questions.
  - Depending on that decision, design surveys and/or integrate key questions (e.g., those from the WHO and World Bank core questions on household energy use; see Box 13) into existing national household surveys.
  - Ensure that survey data processing and other record-keeping systems are designed to enable tracking of the identified outcomes.

- *Develop an analysis plan*.
  - Identify a comparison group for each indicator, if possible. Results could be compared with: 1) the baseline data collected in the HEART assessment in step 1; 2) a control group with similar characteristics as the programme beneficiaries but which does not participate in the programme; or 3) the programme goal or targets.
  - Develop a plan for calculating each indicator.
  - Prepare tables for compiling results after data collection and analysis.

Annex F. Budget template for completion of policy guide steps

	Units/Level of Effort	Cost per unit	Total
Step 1: HEART assessment (6 months)			
Local consultant to complete assessment	*100%*		
International consultant (for oversight)	*25%*		
Inception workshop to plan for HEART assessment			
Venue			
Participant travel			
Food/refreshments			
IT			
Printing/supplies			
HEART Report review workshop			
Venue			
Participant travel			
Food/refreshments			
IT			
Printing/supplies			
Formatting, layout, printing, and distribution of HEART report			
Step 2: Formation of steering committee (3 months)			
Local consultant to organize, spearhead process	*100%*		
International consultant to advise and lead training	*50%*		
Steering committee initiation workshop and training on CHEST tools			
Venue			
Participant travel			
Food/refreshments			
IT			
Printing/supplies			
Bi-weekly steering committee meetings			
Step 3: Identification of intervention options (3 months)			
Local consultant to lead identification of options	*100%*		
International consultant to advise	*25%*		
Bi-weekly steering committee meetings			

Step 4: Analysis of intervention options (6 months)			
Local consultant to conduct BAR-HAP analyses and apply decision guide	*100%*		
International consultant to advise	*25%*		
Bi-weekly steering committee meetings			
Workshop to discuss and finalize intervention selection			
Venue			
Participant travel			
Food/refreshments			
IT			
Printing/supplies			

Step 5: Action plan development (6 months)			
Local consultant to lead the process	*100%*		
International consultant to advise	*25%*		
Steering committee workshop to develop action plan (1 week)			
Venue			
Participant travel			
Food/refreshments			
IT			
Printing/supplies			
Workshop/meeting with broader stakeholders to finalize and gain support for action plan implementation			
Venue			
Participant travel			
Food/refreshments			
IT			
Printing/supplies			
Media outreach (to publicize/disseminate Action Plan)			

Overarching costs			
Office supplies and communications			
Office space			
Travel-related costs for Steering Committee participants			

Annex G. Additional Resources

Regulatory indicators for sustainable energy (RISE). RISE is a set of indicators developed by the World Bank's Energy Sector Management Assistance Program to assess policy and regulatory support for four "pillars" of sustainable energy: energy access, renewable energy, clean cooking and energy efficiency. RISE can be used by policy-makers to compare their country's policy and regulatory frameworks with regional and global ones in order to determine whether their policy actions meet targets in the four pillars. (https://rise.esmap.orgap.org).

Clean Cooking Alliance's country-specific market assessments. These assessments provide snapshots of the cooking sectors in various countries. They include information on the supply of and demand for fuels and devices, trends in fuel usage, consumer preferences and an overview of the industry and the overall policy environment of cookstoves. The assessments can indicate the feasibility of building on existing supply chains, manufacturing capacity and consumer perceptions of different clean fuel options in a country. If no market assessment has been performed for the country, those for other countries in the same region may be consulted. (https://www.cleancookingalliance.org/sector-resources/reports-tools/index.html)

Global LEAP Awards Buyer's Guide. Published by the Collaborative Labelling and Appliance Standards Program, an international non-profit organization, in partnership with the Modern Energy Cooking Services programme, this catalogue lists the "best-in-class appliances for off- and weak-grid environments", determined in an annual international competition. The 2020 buyers' guide lists the best electric pressure cookers. (https://www.clasp.ngo/programs/brands/global-leap-awards/ and https://www.clasp.ngo/research/all/2020-buyers-guide-for-electric-pressure-cookers/).

Energy Sector Management Assistance Program's State of access to modern energy cooking services: This report addresses the contextual factors of cooking, including users' cooking experience, their physical cooking environment and the markets and energy ecosystems in which they live, to better measure access to clean cooking and to increase the uptake and sustained use of stove technology and fuel solutions. The report presents evidence that can contribute to better-informed decision-making and the design and delivery of more effective solutions to accelerate progress towards meeting the aspirations of the SDG 7.1 target. (https://www.esmap.org/the-state-of-access-to-modern-energy-cooking-services).

Energy Sector Management Assistance Program's Cooking with electricity: A cost perspective. This report presents five case studies for comparing current and projected costs to consumers of various electric cooking solutions on the basis of the current costs of cooking fuels in various settings. The findings show that electric cooking can be cost–effective in both off-grid and grid-connected settings and is likely to become increasingly viable in the near future. It adds to evidence that cooking with electricity could make a significant contribution to achievement of SDG 7. (https://www.esmap.org/cooking_with_electricity_a_cost_perspective).

Annex H. Table Templates

The following templates can be completed while working through the practical steps in this guide.

Template A. Sample list of steering committee members and their roles

Name	Affiliation	Job title	Sector	Role on committee	Area of expertise	Contact information

Note: See Table 2 in Task 2.2 for details.

Template B. Summary of the technology and fuel combinations under consideration

	TECHNOLOGY/ FUEL COMBINATIONS	COST	WHO CLASSIFICATION FOR PM & CO (CLEAN, TRANSITIONAL, POLLUTING)	EFFICIENCY TIER	$PM_{2.5}$ TIER	CO TIER	SAFETY TIER	DURABILITY TIER
Cooking				N/A				
				N/A				
Heating				N/A				
				N/A				
Lighting				N/A				
				N/A				
				N/A				

Note: There are no transitional lighting options; all fuels and technologies under consideration for lighting should be clean. See Table 4 in Task 3.1 for details.

Template C. Summary of cooking, heating and lighting policies under consideration

Policy	Policy type	Related fuel and technology	Scale, scope	Clean or transitional	Notes

Note: See Table 5 in Task 3.2 for details.

Template D. Short list of interventions for consideration

Fuel type/ or technology targeted	Policy or programme	Cooking, heating or lighting	Scale or scope	Already widely used in country or new?

Note: See Table 6 in Task 3.3 for details.

Template E. Comparison of results from analyses using Benefits of Action to Reduce Household Air Pollution (BAR-HAP) tool

Technology or policy*				
Total benefits per year (private and social)				
Health benefits: Disease reduction, mortality (YLL/Year)				
Health benefits: Disease reduction, morbidity (YLD/year)				
Total time saved (HR/Year)				
Climate benefits (full; tonnes of climate-forcing pollutants reduced/year)				
Environmental savings (kg unsustainable wood harvest avoided/year)				
Total costs per year (government and private)				
Total cost to government (US$/year)				
Total private cost (US$/year)				
Net social benefits (net present value)				

***This column should be filled in with the technology and/or policy options compiled in task 3.3 and listed in Table 6 (Template D).**
YLL, years of life lost; YLD, years lived with disability.

See the table in Case Study 3: Hypothetical Example of Steps 3 and 4 for an example.

Template F. Three policy and/or technological interventions to be proposed

Intervention	Category	Implementing agency	Benefits	Risks	Reasons for selection

Note: See Table 7 in Task 4.3 for details.

Air Quality and Health Unit
World Health Organization
20 Avenue Appia
1211 Geneva 27 Switzerland

https://www.who.int/teams/environment-climate-change-and-health/air-quality-and-health

9789240070202