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Local Governments for Sustainability
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CITIES & REGIONS ROADMAP
Supported by:
Federal Ministry for Economic Affairs and Climate Action
IKI INTERNATIONAL CLIMATE INITIATIVE
on the basis of a decision by the German Bundestag
CAPACITY BUILDING MODULE:
CLEAN COOKING


INTRODUCTION
WHAT IS CLEAN COOKING?

WHAT IS CLEAN COOKING?

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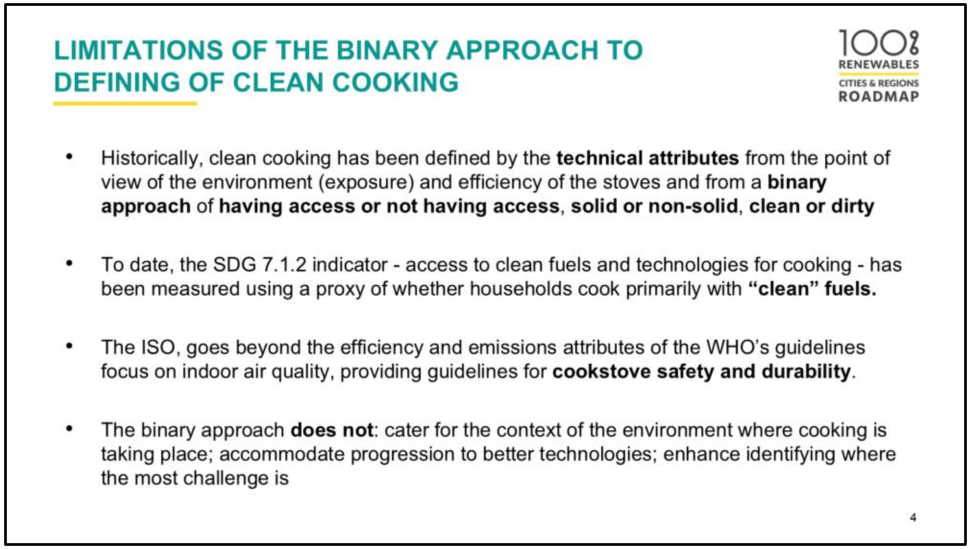
Photo credit: ENACT project

- *Tracking SDG 7: The Energy Progress Report* defines clean fuels and technologies as "**electricity, LPG, natural gas, biogas, solar, and alcohol fuels**" (IEA et al. 2020);
- … clean fuels can also be defined as **fuels that do not cause household air pollution (HAP) in homes** (CCA 2011);
- The Regulatory Indicators for Sustainable Energy (RISE) policy report - defines clean cooking solutions as **"the combination of stove technologies and fuels that have higher efficiency and/or produce lower particulate and carbon emissions levels than the current baseline in a given country**" (Foster et al. 2018);

- Over the past decade, much attention has focused on expanding access to "clean" cooking solutions, defined by the technical attributes of combustion and heat-transfer efficiency and emissions.
- Clearly, without a more complete understanding of the local context of cooking—including users' cooking experience, their physical
  cooking environment, and the markets and energy ecosystems in which they live—the uptake and sustained use of the stove technology-and-fuel solutions available today will remain limited.
- Processed biomass (e.g., wood pellets) has shown promise as a clean fuel when burned in a highly efficient stove, under correct user operation, and with a sufficiently low pellet moisture content (Champion and Grieshop 2019; Jagger et al. 2019).
- Unlike the definition in *Tracking SDG 7*, the RISE report definition also considers improvements in efficiency for cooking solutions that use solid fuels.



It presumes that all non-solid fuels are clean and efficient and that all solid fuels are harmful

It also overlooks aspects of context of the household

Cooking is not a binary activity, even at the household level. An important challenge in measuring access to cooking solutions is the phenomenon of "stacking"

Emphasis on binary definitions has sometimes **overlooked** effective and sustainable, **improved cooking solutions** that fit local contexts.

The approach of the International Organization for Standardization (ISO), for example, goes beyond the efficiency and emissions attributes of the World Health Organization's guidelines for indoor air quality, providing guidelines for cookstove safety and durability.

While an important step forward, the ISO approach is technocentric and does not integrate the cookstove user's experience. Yet, users' needs and preferences, along with their context while cooking, can have a large impact on cookstove uptake and should therefore be integrated into the design of cooking interventions.

BINARY FOCUS OF THE DEFINITION OF CLEAN COOKING

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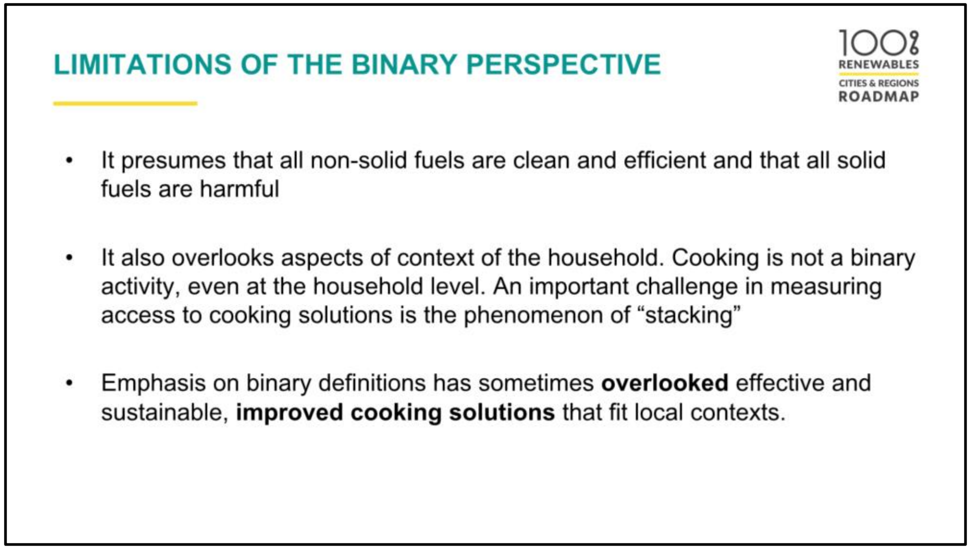
- To date, the SDG 7.1.2 indicator, access to clean fuels and technologies for cooking, has been measured using a proxy of whether households cook primarily with **"clean" fuels.**

- The approach of the ISO, goes beyond the efficiency and emissions attributes of the WHO's guidelines focus on indoor air quality, providing guidelines for **cookstove safety and durability**. While an important step forward, the ISO approach is **technocentric** and does not integrate the cookstove user's experience.

- The growing consensus is that measurement of access should reflect a **continuum of improvement that focuses not only on fuels, but also other attributes of the cooking system**

The approach of the International Organization for Standardization (ISO), for example, goes beyond the efficiency and emissions attributes of the World Health Organization's guidelines for indoor air quality, providing guidelines for cookstove safety and durability.

While an important step forward, the ISO approach is technocentric and does not integrate the cookstove user's experience. Yet, users' needs and preferences, along with their context while cooking, can have a large impact on cookstove uptake and should therefore be integrated into the design of cooking interventions.



Taking a binary approach has prevented actors from getting to the roots of the access challenge and also hindered the implementation of sustainable and local solutions

Instead of seeing cooking from a binary perspective as clean or polluting or solid and non-solid, a more holistic approach is needed

EXAMPLES OF CLEAN COOK STOVES

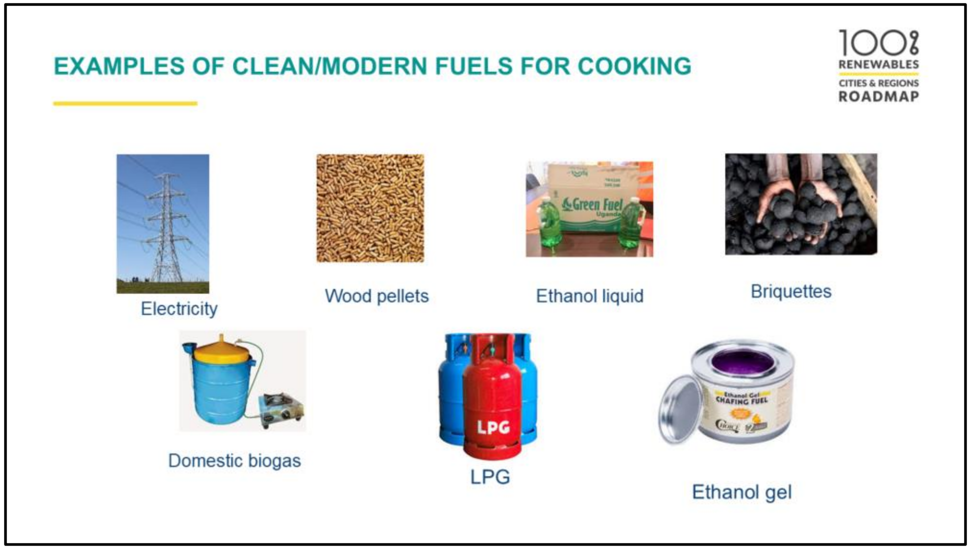
Electric:

Improved biomass:

Gas-based:

Ethanol-based:

Ethanol stove


EXAMPLES OF CLEAN/MODERN FUELS FOR COOKING
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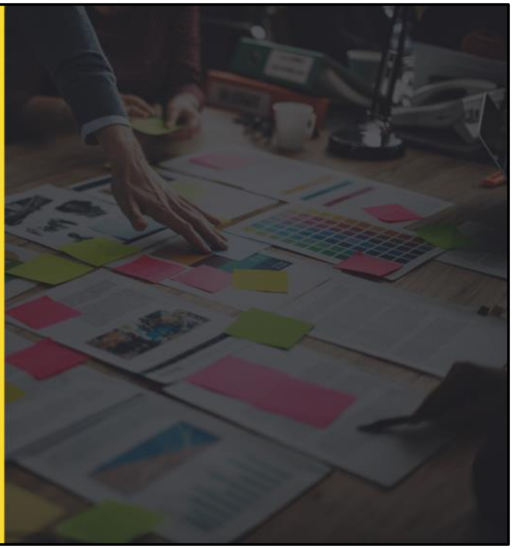
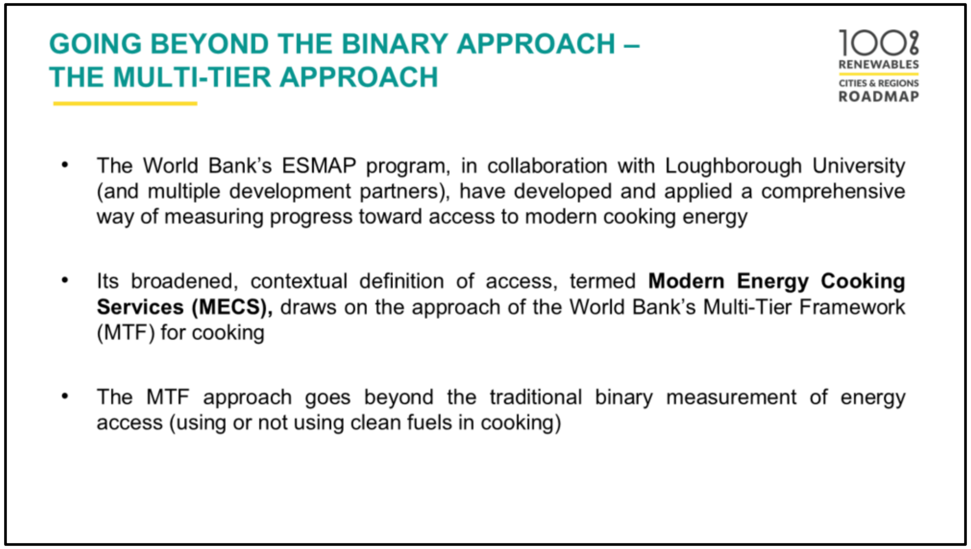
Electricity
Wood pellets
Ethanol liquid
Green Fuel
Briquettes
Domestic biogas
LPG
LPG
Ethanol gel
Ethanol Gel
CHAFING FUEL

By developing a thriving global market for clean and efficient cookstoves and fuels, we can transform the way the world cooks, saving lives, improving livelihoods, empowering women, and protecting the environment simultaneously. With a continued focus and targeted implementation efforts, clean cooking can directly deliver gains across 10 of the SDGs and contribute to an enabling environment for achieving the entire Agenda 2030, including:

MULTI-TIER APPROACH





Accelerating progress requires rethinking how households access modern cooking energy so that solutions are better aligned with users' priorities.

The MTF approach goes beyond the traditional binary measurement of energy access—(using or not using clean fuels in cooking)

Energy Sector Management Assistance Program (ESMAP)

The MTF captures detailed, indicator-level data for tracking stepwise progress across tiers of access.

This information encompasses various individual and multiple cooking solutions (i.e., "stacking"), user behavior, and cooking-environment conditions, as well as convenience and safety aspects.

Based on the MTF's multidimensionality, a household that meets the standards of Tier 4 or higher across all six measurement attributes can be considered to have gained access to MECS,

while one that scores at least Tier 2 but not Tier 4 or higher across all six attributes is considered in transition, with access to improved cooking services

WHAT IS THE MULTI-TIER FRAMEWORK FOR COOKING?

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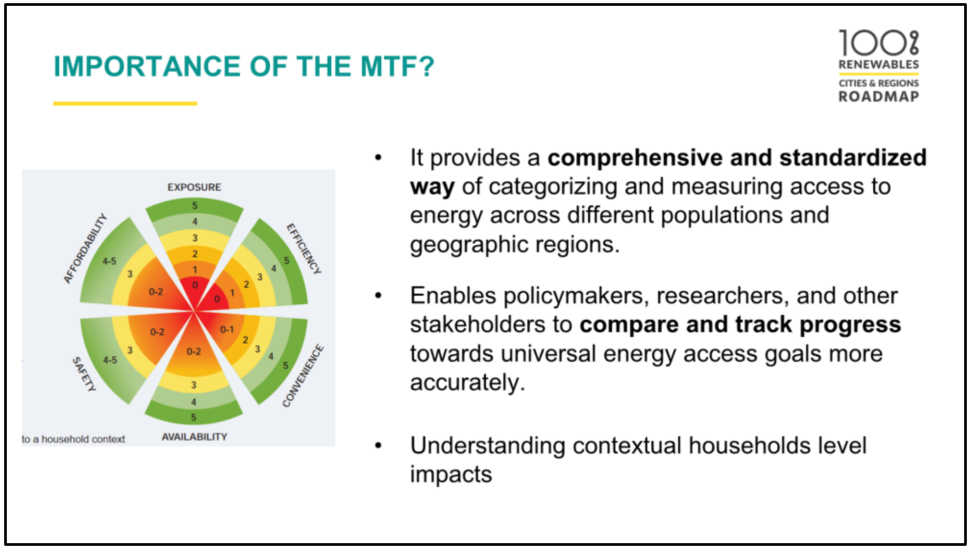
Source: World Bank.

- A multidimensional, tiered approach to measuring household access to cooking solutions across **six technical and contextual attributes** with detailed indicators, and **six thresholds of access**, ranging from Tier 0 (no access) to Tier 5 (full access).



Limitations of the MTF can be found here:
https://wbg.sabacloud.com/content/elearningngx/ykgL-lGJ4WsWHtOG1VX84A/1668885538/0088T3FadTBldnZXRDFqTC9YUDJ6WmFSTGQ3QTRsemtwQit5Q2hyb2FzdUhISDVXTEdYKzVTMEFaVXVxeUVacit4Vw==U2F0IE5vdiAxOSAwNjoxODo1OCBFU1QgMjAyMg==/eot/story_content/external_files/1.4%20Strengths%20and%20limitations%20section%20of%20MECS%20chapter%201.pdf

THE MULTI-TIER FRAMEWORK

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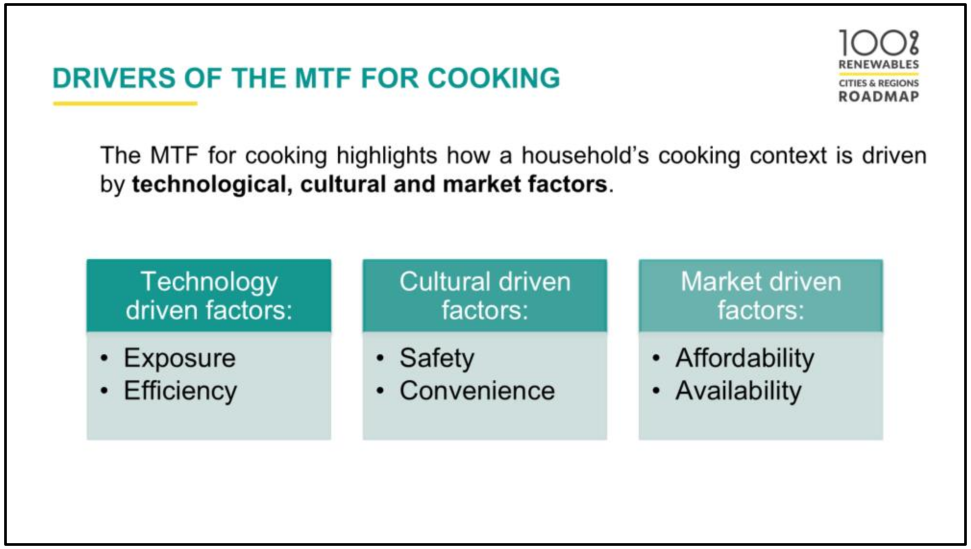
- The MTF attempts to capture the **multi-dimensional nature** of energy access and the vast range of technologies and sources that can provide energy access, while accounting for the wide differences in user experience.

- **The framework allows for disaggregate and aggregate analyses** that can yield detailed information about various parameters and indexes that facilitate comparison over time and across geographic areas.

- it enables tracking of progress toward access to MECS (to complement the current approach of tracking SDG 7.1.2.3), while also providing sufficient detail for understanding contextual household-level impact and setting sector-wide aspirations.



The role of context: negative externalities of non-clean cooking are exacerbated by their context, such as a total ban on biomass usage for cooking.

KEY ATTRIBUTES OF THE MTF FOR COOKING:

Photo credit: ENACT project

- Affordability
- Convenience
- Availability
- Accessibility
- Safety
- Exposure
- Efficiency

KEY ATTRIBUTES OF THE MTF FOR COOKING - DEFINITIONS:

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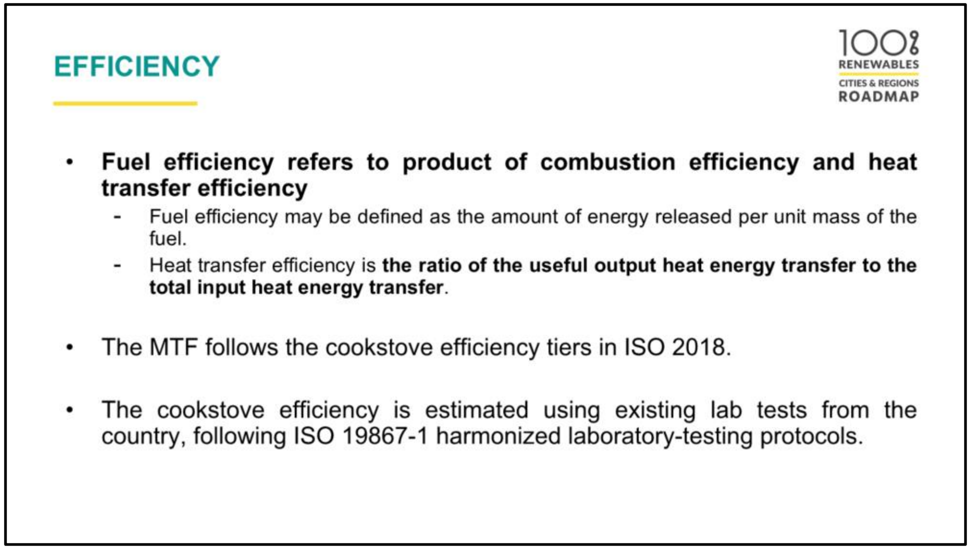
Exposure	Exposure refers to personal exposure to pollutants, which depends on stove emissions and ventilation
Fuel Efficiency	Fuel efficiency refers to product of combustion efficiency and heat transfer efficiency
Safety	Safety refers to severity of injuries caused by the fuel
Convenience	Convenience refers to time spent in collecting or purchasing fuel and preparing the stove
Affordability	Affordability refers to share of household budget spent on the fuel
Availability	Availability refers to readiness of the fuel when needed by the user

EXPOSURE

- Exposure refers to **personal exposure to pollutants, which depends on stove emissions and ventilation**
- The key parameters that determine the cooking-exposure tiers are: 1) **stove/fuel emission factor, 2) ventilation level, and 3) contact time**.
- The health impacts from household air pollution (HAP) linked to traditional cooking activities have been a key driver of promoting clean and efficient cooking. **PM2.5 and carbon monoxide (CO) emissions** are considered key marker pollutants for exposure to HAP
- According to WHO guidelines for indoor air quality, the average **annual $PM_{2.5}$** concentration should be **lower than 10 µg per m3**, and the **24-hour exposure to CO concentration** should be **less than 7 µg per m3** (WHO 2014).
- For ventilation level, following the approach used in ISO 2018, the MTF uses proxy questions to estimate three ventilation scenarios: (i) high, (ii) average/default, and (iii) low.



Fuel efficiency may be defined as the amount of energy released per unit mass of the fuel.

At its most basic, fuel efficiency is defined as **a measure of how much a car will convert energy in fuel into kinetic energy to travel**.

Heat transfer efficiency is **the ratio of the useful output heat energy transfer to the total input heat energy transfer**.

When energy is transferred between different forms, a proportion of the energy is usually lost to an unwanted form of energy during the conversion and is wasted in the surroundings. Due to the conservation of energy, the total energy output of the system includes both the useful energy output and the dissipated (lost) energy. The efficiency can be calculated as a percentage and cannot exceed 100% efficiency, as this would imply more energy came out of the transfer than went in! The formula used to calculate heat transfer efficiency is shown below, where either energy or power can be used.

SAFETY

- **Safety refers to severity of injuries caused by the fuel**
- The degree of safety risk can vary by type of cookstove and fuel used.
- Risks may include exposure to hot surfaces, fire, or potential for fuel splatter.
- In the MTF, reported incidences of past injury and/or fire are used to proxy safety

CONVENIENCE

- **Convenience refers to time spent in collecting or purchasing fuel, and preparing the stove**
- In the MTF, convenience is proxied by the amount of time necessary to collect the fuel and prepare the stove for cooking.
- It is a key consideration from the user's perspective and has high gender impacts.

AFFORDABILITY

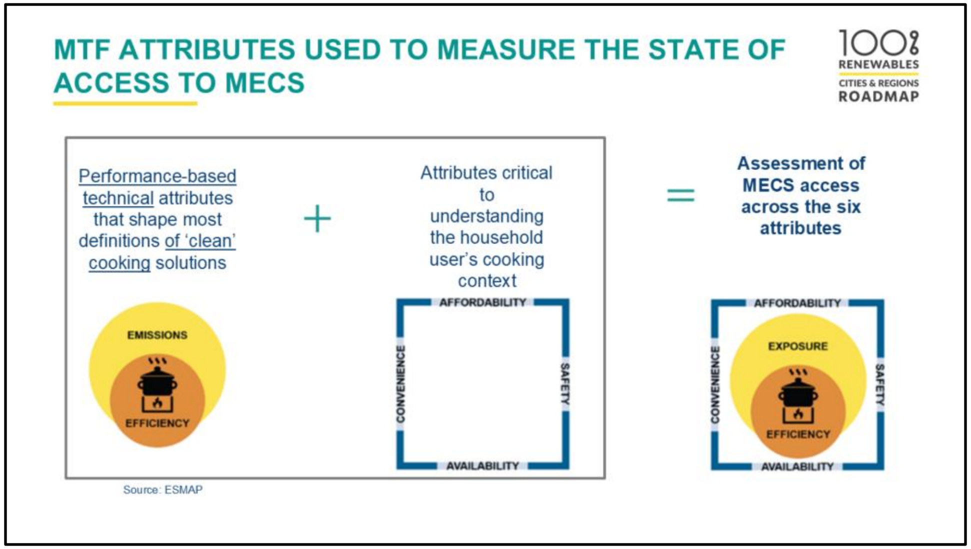
- **Affordability refers to share of household budget spent on the fuel**
- If a large share of household income (expenditure) is required for cooking fuel, then other elements of cooking solutions (e.g., safety, health, and convenience) may be constrained.
- To determine affordability, the MTF utilizes a levelized cost-of-cooking solution as a share of household expenditures.

AVAILABILITY

- **Availability refers to readiness of the fuel when needed by the user**

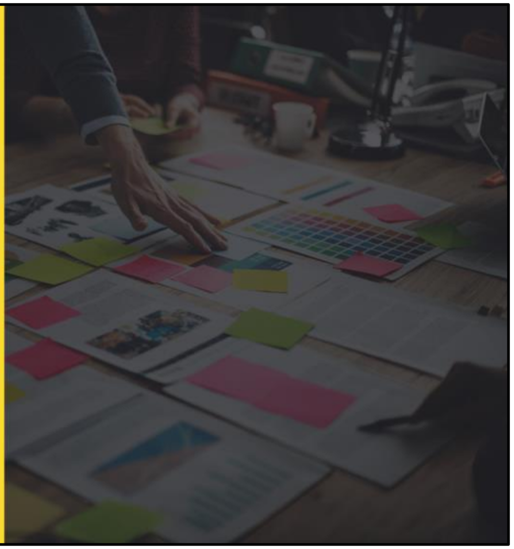
- A given fuel's availability can affect the regularity of its use. Constraints to availability can come in the form of seasonality, especially for types of fuel (e.g., wood); market supply shortages (e.g., LPG cylinders); or limited, grid-connected electricity supply (e.g., manifested in blackouts).

- Shortages in fuel availability can cause households to resort to using inferior, secondary fuel types. The MTF uses the household's reporting on primary fuel availability for the previous 12 months.



MECS in defining the cooking landscapes uses attributes of:
This includes the physical structures where people live and cook and the
It still includes the technical components of exposure and efficiency
The inclusion of additional criteria reflects the consideration for the physical environment and the social context where people live

USING THE MULTI-TIER FRAMEWORK (MTF)



MULTI-TIER FRAMEWORK FOR COOKING

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- Each of these attributes are scored across 6 tiers (0 to 5).
- A score of zero is low performance and score of 5 indicate high performance
- **Meeting tier 4 across all dimensions is required to refer to a household cooking solution as modern and clean**

TIER STRUCTURE OF THE MTF FOR COOKING:

SYMBOL	WORDS	EXAMPLE
>	greater than	10 > 3
<	less than	2 < 6

Attribute	*Measurement indicators*	Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Exposure	ISO's voluntary performance targets on emissions-default ventilation						
	$PM_{2.5}$ (mg/MJd)	> 1030	≤ 1030	≤ 481	≤ 218	≤ 62	≤ 5
	CO (g/MJd)	> 18.3	≤ 18.3	≤ 11.5	≤ 7.2	≤ 4.4	≤ 3.0
	High ventilation						
	$PM_{2.5}$ (mg/MJd)	> 1489	≤ 1489	≤ 733	≤ 321	≤ 92	≤ 7
	CO (g/MJd)	> 26.9	≤ 26.9	≤ 16.0	≤ 10.3	≤ 6.2	≤ 4.4
	Low ventilation						
	$PM_{2.5}$ (mg/MJd)	> 550	≤ 550	≤ 252	≤ 115	≤32	≤ 2
	CO (g/MJd)	> 9.9	≤ 9.9	≤ 5.5	≤ 3.7	≤ 2.2	≤ 1.4
Efficiency	Stove efficiency, using ISO's voluntary performance targets (%)	<10	≥ 10	≥ 20	≥ 30	≥ 40	≥ 50
Convenience	Fuel acquisition and preparation time (hours/week)	≥ 7		< 7	< 3	< 1.5	< 0.5
	Stove preparation time (minutes/meal)	≥ 10			<10	< 5	< 2
Safety	Severity of accidents caused by the stove over the past year	Serious			Minor	None	
Affordability	Fuel cost as a share of household expenditure (%)	≥ 10			< 10	< 5	
Availability	Ready availability of primary fuel when needed (% of the year)	≤ 80			> 80	> 90	100

Source: The World Bank

KEY DEFINITIONS RELATED TO THE MTF FOR COOKING

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Source: World Bank.

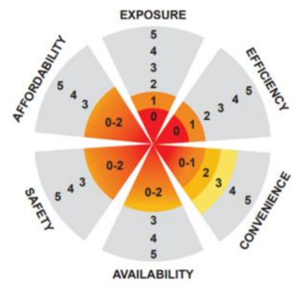
- **Clean cooking solutions:** Fuel-stove combinations that achieve emissions performance measurements (Exposure and efficiency) of Tier 4 and above
- **Modern Energy Cooking Services** (MECS): A household context that has met at least the standards of Tier 4 or higher across all six measurement attributes of the MTF
- **Improved Cooking Services:** A household context that has met at least the Tier 2 standards of the MTF across all six measurement attributes of the MTF, but not all for Tier 4 or higher
- Household in **transition:** A household context with a status of MTF Tier 2 or Tier 3 (lower than tier 4)

https://cleancooking.org/wp-content/uploads/2021/07/598-1.pdf

ILLUSTRATIVE EXAMPLES OF USING THE MTF

Because this household scores Tiers 0–3 across the six attributes of the MTF, it cannot be considered to have gained access to MECS.

a. Household using mainly readily-available, purchased biomass with a traditional stove

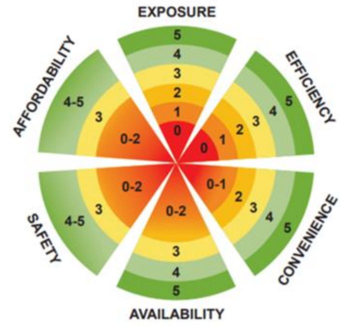


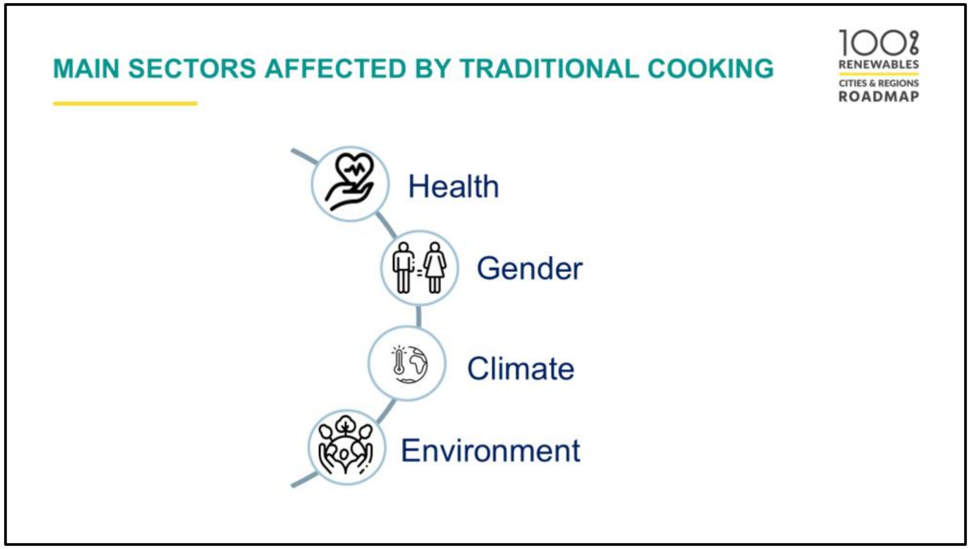
Source: World Bank.

ILLUSTRATIVE EXAMPLES OF USING THE MTF

This highly efficient electric cookstove used by this household, with relatively reliable electricity and affordable tariffs crosses at least the Tier 4 threshold across all six attributes and thus meets the MECS criteria.

b. Household using cheap, relatively-reliable grid power, with a high-performing electric cookstove




MAIN SECTORS AFFECTED BY TRADITIONAL COOKING
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Health
Gender
Climate
Environment


PART 1
HEALTH IMPACTS

COOKING IN URBAN SETTINGS

HOUSEHOLD AIR POLLUTION (HAP)

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- Smoke from biomass fuels (wood, charcoal, dung, crop residues) burned in open fires or unclean cook stoves
- Smoke from kerosene lamps
- Tobacco smoke
- Substances produced include Carbon Monoxide (CO), Particulate Matter (PM), Nitrogen dioxide (NO_2)

(Wood combustion contributes to both indoor and outdoor air pollution. Known as $PM_{2.5}$, fine particulate matter is smaller than 2.5 micrometers (µm) in size. Its small size allows the pollutants to penetrate into the deep lungs.)

In urban settings, smoke from cooking activities in homes, streets, corridors, etc.., goes into the atmosphere, thus affecting the occupants

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OUTDOOR AND INDOOR EXPOSURE, CONCENTRATION SOURCES

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We spend 80-90% time indoors, especially;

- Newborn
- Elderly
- Disabled
- Sick people
- Pregnant and breast feeding mothers.

INDOOR AIR QUALITY DEPENDS ON:

- Interaction between building and its outside environment.
- The way the building is used.
- Behavior of its occupants.
- Air conditioning system.

HAP AND HUMAN HEALTH

- Inhalation of smoke from the unclean stoves and fuels →into the lungs → the blood vessels to the rest of the body.

- Effects: Immediate and long term damage – usually invisible until late stages

EFFECTS ACROSS THE LIFE COURSE

Pregnancy/unborn baby: compromises placental blood flow; direct effect on the baby	• Bleeding (antepartum hemorrhage) • Pre-eclampsia (high blood pressure) • Low birth weight • Premature births • Poor lung function at birth
Lungs	• Increased risk of lung diseases- pneumonia, asthma, chronic pulmonary obstructive disease (COPD), lung cancer, mucosal reactions, chronic bronchitis, upper airways inflammatory disease.
Heart	• Cardiovascular disease-myocardial infarction/heart attacks
Brain	• Poor neurocognitive functioning • Stroke
Eyes	• Cataracts, ocular reactions

UNDER-RECOGNIZED EFFECTS OF HAP

HAP is associated with **higher risk** of:

- Burns especially in children
- Poisoning and girls suffer most affected
- Disability
- Discomfort.
- Odour perception
- Sensorial irritation
- Annoyance.
- Sick building syndrome
- Intoxication
- Lost opportunities (money and time costs)
- Mortality.

AIR POLLUTION IS A SILENT KILLER

About 2.4 billion people worldwide (1/3 of the global population) cook using open fires or inefficient stoves

In 2020, HAP was responsible for

- estimated 3.2 million deaths
- more than 237 000 of the deaths of children under the age of 5.

Women and children are disproportionately affected because they are typically responsible for household chores such as cooking and collecting firewood.

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ACUTE RESPIRATORY INFECTIONS (ARI) IN CHILDREN

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- Shortness of breath was significantly associated with cooking fuel type
  - increased risk associated with wood fuel compared to charcoal cooking.
- In urban areas, shortness of breath was reported among 18.9% of children in wood fuel households compared to 1.09% in charcoal fuel households
  - wood fuel increased the risk of shortness of breath

International Journal of *Environmental Research and Public Health*

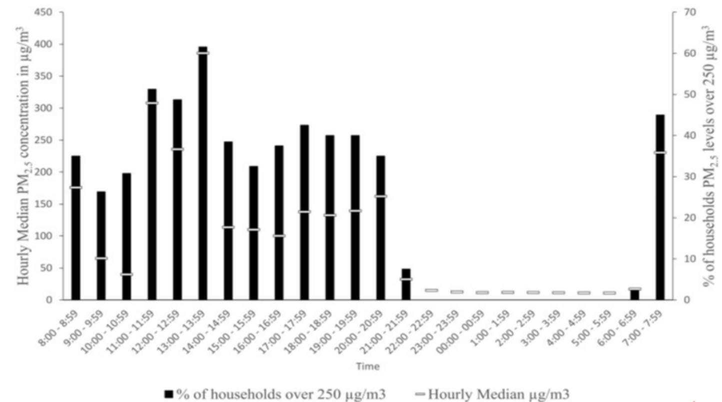
MDPI

Article

Investigating the Association between Wood and Charcoal Domestic Cooking, Respiratory Symptoms and Acute Respiratory Infections among Children Aged Under 5 Years in Uganda: A Cross-Sectional Analysis of the 2016 Demographic and Health Survey

Katherine E. Woolley [1,†], Tusubira Bagambe [1,†], Ajit Singh [2], William R. Avis [3], Telesphore Kabera [4], Abel Weldetinsae [5], Shelton T. Mariga [6], Bruce Kirenga [6], Francis D. Pope [2], G. Neil Thomas [1] and Suzanne E. Bartington [1,*]

HOUSEHOLD AIR POLLUTION PATTERNS

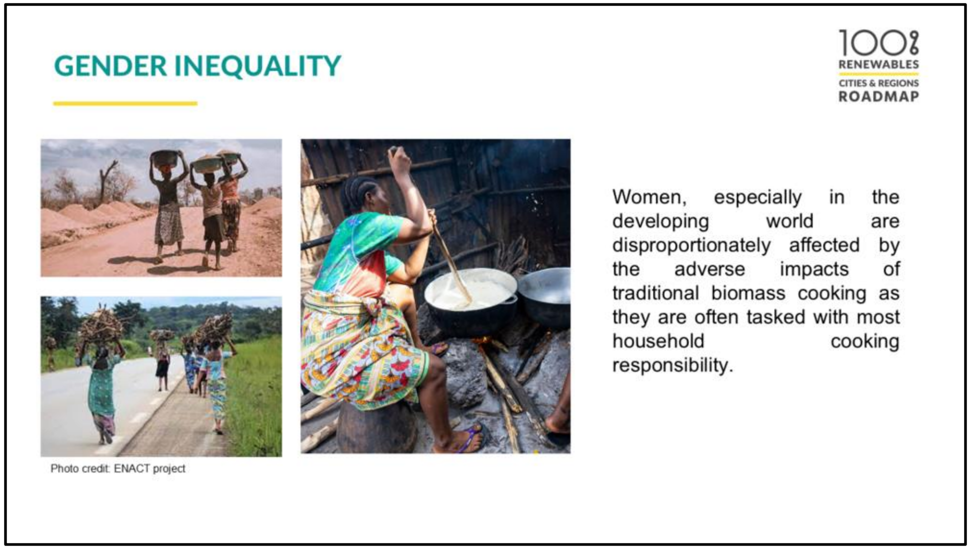


Source: Okello G, et.al 2019

CONCLUSION

- HAP is a major problem especially in LMICs (Low or middle income countries).
- It is a development issues, linked to poverty, health and gender
- Progress towards reduction of the health impact of HAP has been made but it is very slow
- Efforts to increase access to clean and sustainable energy especially among the poor and vulnerable populations need to be urgently accelerated.
- Raising public awareness and providing information to the public about the sources nature and level of risks of traditional cooking methods and its disadvantage in comparison with the use of renewable energy sources will be of great benefit to their health.

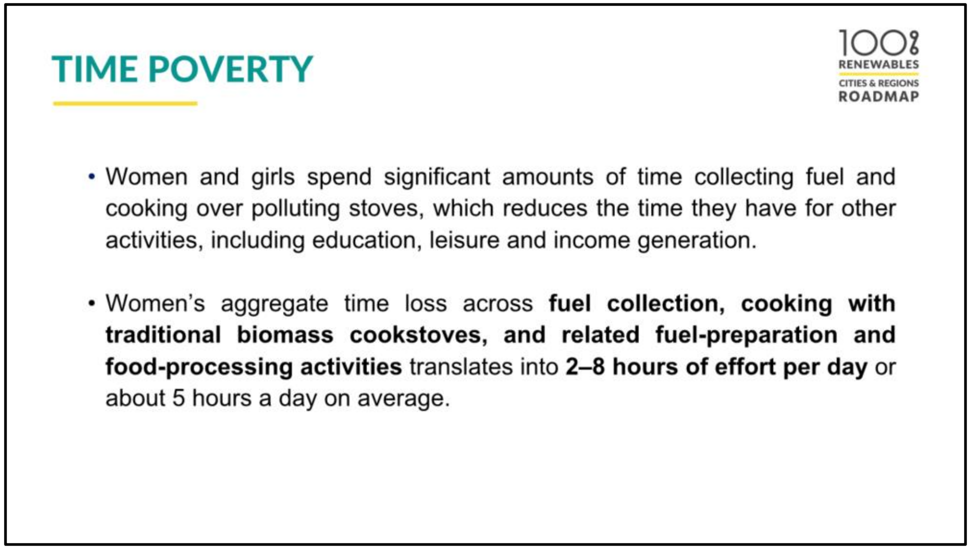

PART 2
GENDER INEQUALITY



A Day in the Life: Understanding the Realities of Lacking Access o Clean Cooking (Video)

- More than ½ of the world still cooking with traditional methods, and most of this responsibility is mostly on women and girls, and perpetuates women and girls
- Story of Chiwa (Lilongwe).
- Chiwa is a mother of 4
- Each day, she leaves her home to fetch wood
- She travels further and further each day due to growing scarcity
- She spends about 3 hours a day on this
- She has waste and back pains due to heavy carrying
- She is exposed to the risk of carrying the wood and walking long distances
- She uses a three stone fire to cook
- Starting the fire is often a challenge
- She enhails smoke while cooking
- Her children are near the fire while she is cooking as she takes care of them
- She spends about 1 hour cooking a meal
- Then has to wash the plates after cooking

- She has started cooking unceasingly due to exposure to smoke
- Her girls will soon start fetching the wood as they grow older

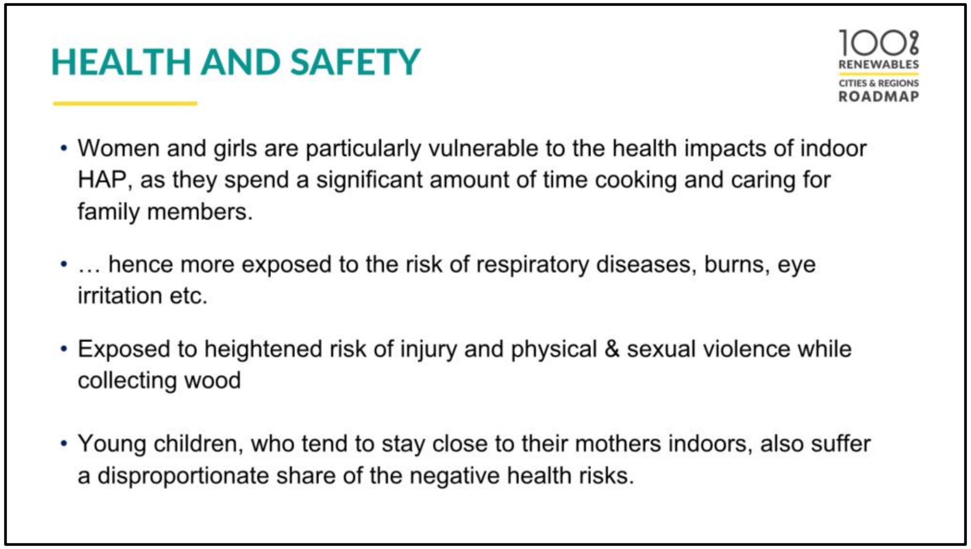


- This means that women in such countries bear a disproportionate share of the negative health risks from HAP, as well as the time poverty associated with traditional household cooking, leading to opportunity costs (i.e., less time for education, rest and leisure, and income-generating activities).
- Young children, who tend to stay close to their mothers indoors, also suffer a disproportionate share of the negative health risks. And children born to such mothers may suffer from low birth weight and stunting.
- In addition, many children, particularly girls, may not attend school in order to help their mothers with fuelwood collection and food preparation.

Time spent on fuelwood collection can contribute significantly to women's time poverty; but the gender differential varies across countries and regions.

Household time-use surveys show that women spend significantly more time on fuelwood collection than do men. However, the gender differential varies by cultural norms (e.g., with respect to hard physical labor and the acceptability of women's work outside the home).

Across most of Sub-Saharan Africa and in parts of China, women are the primary fuelwood collectors.



- Owing to gender and sociocultural norms, women in many developing countries have primary responsibility for household cooking (including food preparation and postmeal cleanup), relying on polluting stoves and fuels, as well as fuelwood collection and fuel processing (e.g., drying and cutting).

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Across most of Sub-Saharan Africa and in parts of China, women are the primary fuelwood collectors.

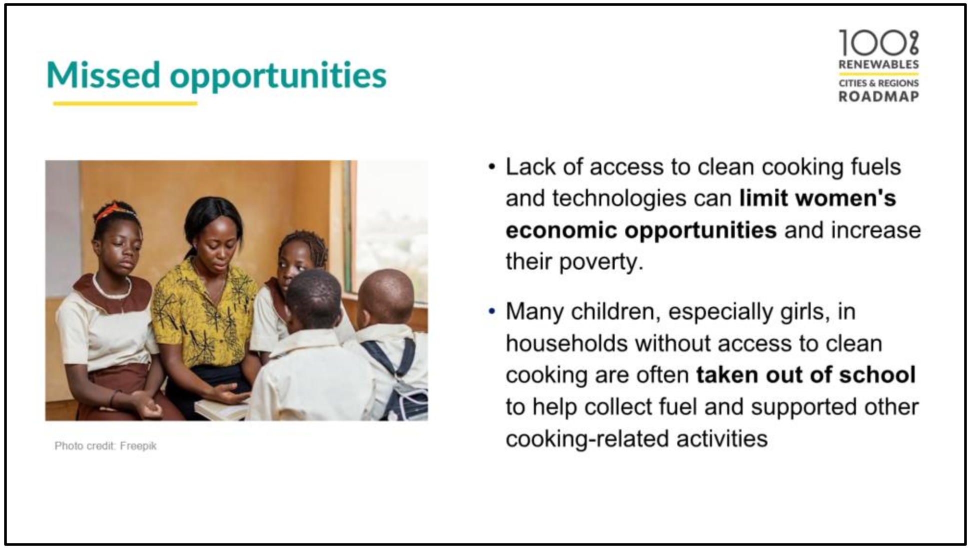
Beyond women's disproportionate health burden, evidence shows that risks of physical injury and violence associated with women's involvement in fuel collection are endemic.

Women and girls must often walk long distances to obtain cooking fuel, and, as a result, face increased risk of physical and sexual violence.

According to the United Nations High Commissioner for Refugees (UNHCR), 42 percent of households in Chad reported incidents of gender-based violence (GBV) during firewood collection over a six month period in

2014.

Such risks are particularly high for refugee women and female children, who are more vulnerable to sexual violence because of their low status in host communities and the resulting daily need to leave their camps



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PART 3
CLIMATE IMPACTS

GHG EMISSIONS

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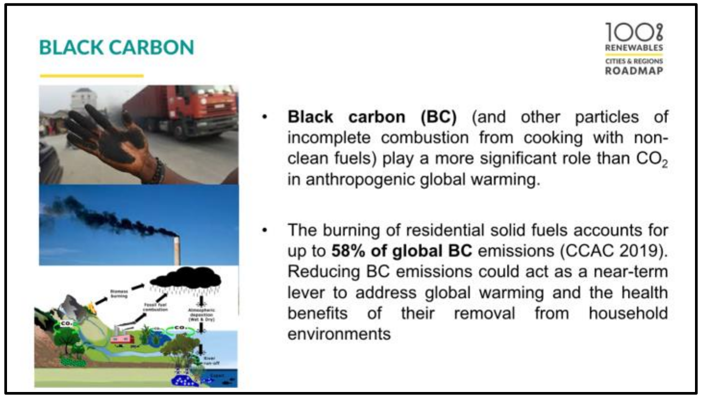
Photo credit: ENACT project

- Traditional cooking methods are often **inefficient and waste energy**, leading to higher levels of emissions and decreased energy security for communities.
- Large scale consumption of wood & charcoal **produces GHG emissions [**incl. carbon dioxide (CO_2) and methane (CH_4)], contributing to global warming and climate change.
- Globally, emissions from non-renewable wood fuel consumption amount to **1.9 to 2.3% of global CO_2 emissions**

- Methane and carbon dioxide are produced during traditional charcoal production.
- Alternatively, sustainable charcoal production done via improved kilns and stoves is useful from the aspect of reducing the environmental pollution



Black carbon is the sooty black material emitted from gas and diesel engines, coal-fired power plants, and other sources that burn fossil fuel. It comprises a significant portion of particulate matter or PM, which is an air pollutant

While CO2 remains in the atmosphere for decades, BC particles have an atmospheric lifetime of only 8–10 days, thus, reducing BC emissions theoretically leads to relatively rapid, global cooling

- Made up of pure carbon, black carbon is a major component of fine particulate matter (PM2.5) and soot. It is often created from the incomplete combustion of fossil fuels or biological material, such as from forest fires. In Antarctica, black carbon is usually emitted from sources like ships, aircraft or power generators.
- The pollutant was long infamous for its role in urban air pollution since the Industrial Era. But it was first discovered to have global atmospheric importance during the 1950s when it was found within Arctic Haze aerosols – the reddish-brown haze seen over the Arctic caused by air pollution – and on the snow, thus contributing to the Arctic warming faster than any other region on the planet.

- the ability of a surface to deflect solar radiation, a characteristic called ‘albedo,’ is important for reducing heat on the planet. Snow, ice and clouds are surfaces with a high albedo – in other words, they reflect a lot of the sunlight that hits the Earth back into space. Sea ice in polar regions such as the Antarctic and Arctic are crucial for reflecting sunlight and keeping the planet cool.
- But black carbon, which can absorb a high amount of solar radiation, reduces albedo.
- When black carbon particulates are emitted, travel through the air and become deposited in the Arctic, the surface of the snow darkens and then reflects less radiation. Even a little darkening can spur further drops in albedo, as the snow’s darkened surface absorbs more of the sun’s heat and melts. Water has a lower albedo than snow, so more heat is absorbed from sunlight, leading to even more melting.

- But even more than snow-based black carbon, airborne black carbon particles have an even greater role in heating the planet as they directly absorb sunlight and keep it in the air. It is even thought that these can influence cloud formation patterns, which might then affect precipitation and climate change.

CLIMATE CHANGE

The pollutants and emissions from use of traditional wood and charcoal for cooking contributes to global warming, and hence climate change,

… which then causes water and heat stress, drought, flooding, un-predictable rain-fall patterns, reduced agricultural production etc.


PART 4
ENVIRONMENTAL IMPACTS

ENVIRONMENT

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- Effects on the environment come in mainly two forms:
  - **deforestation and forest degradation**
  - **air pollution:** the incomplete combustion of fuelwood which **pollutes the air** and contributes to global warming
- Others:
  - Biodiversity loss
  - Climate change
  - Landslides and flooding

- Deforestation is when humans remove or thin forests for lumber or to use the land where the trees stood for crops, grazing, extraction (mining, oil, or gas), or development as the population increases and people migrate
- Deforestation is the permanent removal of trees to make room for something besides forest. This can included clearing the forest for construction, road networks, new settlements etc.
- **Forest degradation** occurs when forest ecosystems lose their capacity to provide important goods and services to people and nature. Over half of the tropical forests worldwide have been destroyed since the 1960s, and every second, more than one hectare of tropical forests is destroyed or drastically degraded
- **Forest degradation** is where the ecological quality or health of the forest is lost due various to human actions
- Forest degradation occurs when forest ecosystems lose their capacity to provide important goods and service to people and nature.
- Impacts of deforestation:
  - **Trees purify air, filters water and prevent erosion and act as a buffer against CC. They offer a home to plant and animal species while also providing natural resources such as food, medicine, timber, fuel**
  - Consequences of deforestation:
    - Increase in temperature and global warming, increase in pollution, temperature, global warming, soil erosion, loss of habitat of wild animals, shortage of food produced, natural disaster like floods and

droughts.

DEFORESTATION AND FOREST DEGRADATION

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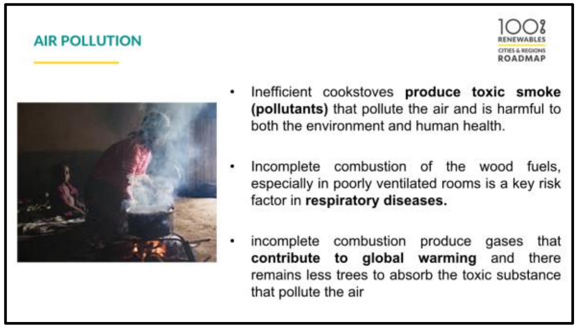
- Increased demand for firewood for cooking contributes to deforestation, which not only **exacerbates climate change** but also affects the livelihoods of local communities and the ecosystems they depend on.
- Continued extraction of wood from the forest leaves once closed forest systems turned into shrub lands.
- In Africa, wood collection and the charcoal supply chain are the principal drivers of regional forest degradation, jointly accounting for **48%** (Hosonuma et al. 2012)



- Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere. Household combustion devices, motor vehicles, industrial facilities and forest fires are common sources of air pollution.
- Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires. The solid and liquid particles suspended in our air are called aerosols.

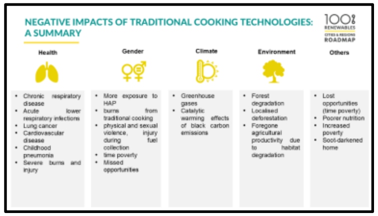
Effects of Air Pollution

- Harming Human Health. ... Harming Animals and Plants. ... Causing Acid Rain. ... Reducing Sunlight. ... Making a Hole in the Ozone Layer. ... Adding Too Much Nitrogen to the Land. ... Effects of Greenhouse Gas Pollution.

- It increases the risk of respiratory infections, heart disease and lung cancer. Both short and long term exposure to air pollutants have been associated with health impacts. More severe impacts affect people who are already ill. Children, the elderly and poor people are more susceptible.
- The WHO Air quality guidelines are a set of evidence-based recommendations of limit values for specific air pollutants developed to help countries achieve air quality that protects public health.
- There are 4 basic components of air quality standards:
  1. The indicator: this defines what is measured and how it is measured. the pollutant like CO, O3, N2O, NO2, SO2, PM. This could also be primary pollutant or secondary
  2. Averaging time: this is the exposure time and the intensity. the duration is defined as 8hrs, 4 hrs etc.
  3. Threshold level: eg 9ppm for 8hrs for CO, 1 hr for 35 ppm for CO. For larger duration, small conc. Dose means conc X the duration. The does should not be at a level that can affect health nefagtively. These limits are informed by scienctific research
  4. Form: this refers to the frequency (eg 1 time a year, etc.)

BIODIVERSITY LOSS

- Biodiversity loss is an attendant result of removal of wood species for use as fuel.
- There is a **reduction in the variety of wood species** composition in the forest cover.
- The habitat of fauna (animals) is eventually disturbed and leads to **loss or extinction of particular animals**
- Biodiversity loss further **denudes the land cover** through exposure to the wind, sun and fire and **affects agriculture**



Health

• Broad range of health conditions associated with household air pollution (HAP), including chronic respiratory disease, acute lower respiratory infections (ALRI), lung cancer, stroke, and cardiovascular disease

• Burns suffered by household members cooking with traditional fuels and appliances

• Chronic and acute physical ailments that can occur during fuel collection

Gender

• Disproportionate effects on women and young girls: o Health conditions associated with HAP o Burns from cooking with traditional fuels and appliances o Physical ailments, injury, and gender-based violence (GBV) associated with fuelwood collection o Time poverty (from cooking, fuel collection, and drudgery), resulting in less time for lei- sure and opportunities for market employment, with potential risk of lowered household status

Other social effects

• Avoidable spending on fuel due to reliance on inefficient fuel-stove combinations • Lost opportunities for income generation due to time spent cooking • Reduced access to education due to impaired child health and time spent on fuel collection • Poorer nutrition due to partly prepared food or reduced food budgets • Increased poverty due to diversion of scarce resources to pay for fuel • Negative aesthetic effects (e.g., poor lighting and soot-darkened home environment)

Climate

• Greenhouse gas (GHG) emissions due to the use of inefficient fuel production and consumption • Catalytic warming effects of black carbon (BC) emissions

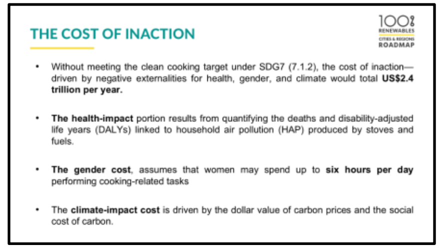
Environment

Forest degradation and deforestation due to fuel collection and production • Foregone agricultural productivity due to habitat degradation and combustion of dung as fuel

Employment

• Risk of displacement of existing economic activities for poor rural and urban households in the woodfuel value chaina

EMPLOYMENT The economic impact of biomass fuel use is not unequivocally negative because the woodfuel value chain employs millions of poor rural and urban households. While highly negative from the standpoint of energy poverty, dependence on fuels like biomass has positive impacts in terms of rural livelihoods and urban employment for tens of millions of small-scale wood collectors, charcoal producers, transporters, and last- mile retailers around the globe. The World Bank estimates that the Sub-Saharan Africa charcoal sector alone employs 7 million people, with aggregate employment expected to reach 12 million people by 2030 (World Bank 2011). Clean cooking solutions carry both risks and rewards in terms of broader macroeconomic potential, particularly in terms of local job creation. While introducing alternatives to the traditional use of biomass runs the risk of substantial disruption up front—creating winners and losers, particularly when displacing long-established charcoal value chains—the employment impacts of modern fuels (e.g., LPG, electricity, and clean-combustion biofuels) can be positive once transition costs are absorbed. For electricity and LPG, capital infrastructure projects—notably focused on grid or pipeline extension or fuel-storage facilities—create job surges during construction periods and improve local economic environments. Specifically, rural-electrification initiatives have been shown to augment female labor supply, driven by such factors as increased home- business activities (Dinkleman 2011; Peters and Sievert 2015). Among alternative biofuels, ethanol exhibits high employment potential, given that value chains depend on feedstock cultivation, a labor-intensive sector that, if scaled, could potentially employ millions of small landholders (Kappen et al. 2017; Thurlow 2010). Moreover, Task Team interviews show that decentralized ethanol production via micro-distilleries can help establish vibrant local economies. In addition, pellet and briquette value chains depend on collected biomass or waste feedstock, a byproduct of existing agriculture value chains or waste collection. *For full list of references, please see Chapter 2 of The State of Access to Modern Energy Cooking Services.



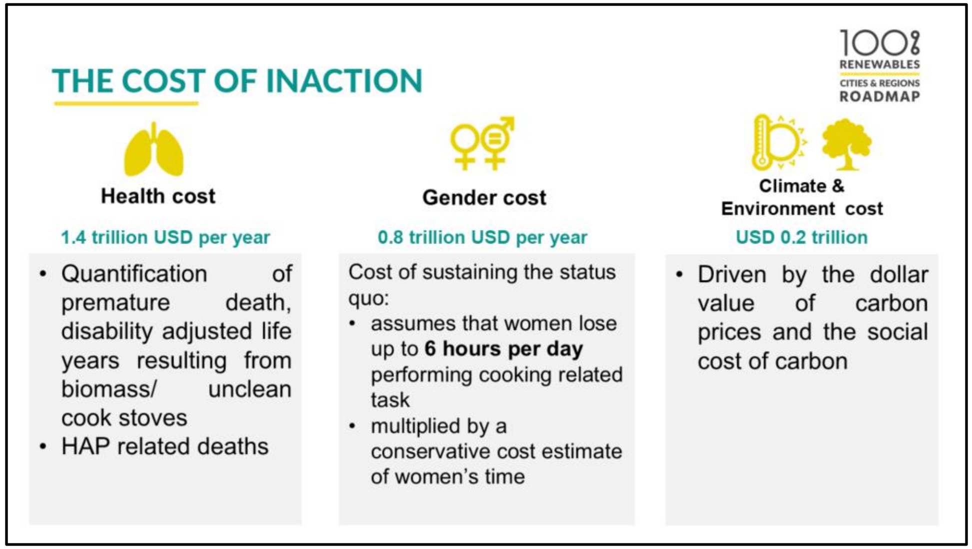
- **The cost of inaction varies widely across regions:**
  - **East Asia** has the highest overall cost while
  - **Latin America** and **the Caribbean's** has the lowest

  - The highest cost of inaction for both gender climate/environment are reported in **South Asia**
  - …followed by **SSA**, mainly because population and GDP per capital are incorporated into the estimation methodology

- Women and children account for most of the estimated 4 million premature deaths that occur each year from household air pollution (HAP) linked to cooking with traditional stoves and fuels.1 The health-impact portion alone is estimated at US$1.4 trillion
  per year.
- Women bear a disproportionate share of the cost of inaction in the form **of poor health and safety, as well as lost productivity,** which is estimated at US$0.8 trillion annually.
- In addition, cooking with high-emissions stove technologies with fuels sourced from non-renewable biomass contributes to environmental degradation and adverse climate impacts, estimated at US$0.2 trillion per year.

- **These alarmingly high figures are conservative estimates,** suggesting the adverse development impacts resulting from households' ongoing use of polluting stove technologies and cooking fuels (table 2.2). The DALYs included in the health-impact calculation account for **morbidity, but do not assume productivity losses due to ill health, which would likely raise the final value**. In the gender calculation, **the cost of women's time is set relatively low, at US$0.54 per hour.** Even so, the value of women's time spent on cooking-related tasks and drudgery skyrockets. The dollar value of the climate impact is driven, in part, by carbon prices and estimates of the social cost of carbon, which many in academic and policy communities perceive as being set too low (Annex 2). These and other negative impacts underscore the urgent need to move households without Modern

Energy Cooking Services (MECS) up the tiers of access.

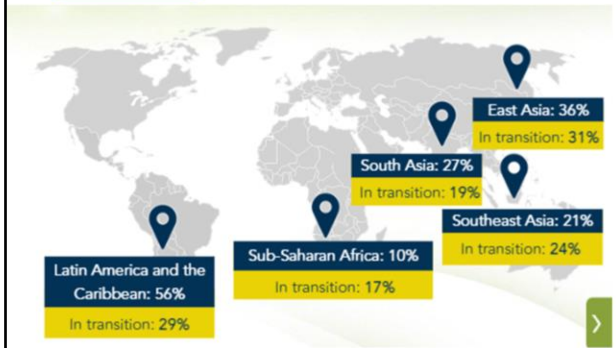


One DALY represents the loss of the equivalent of one year of full health.

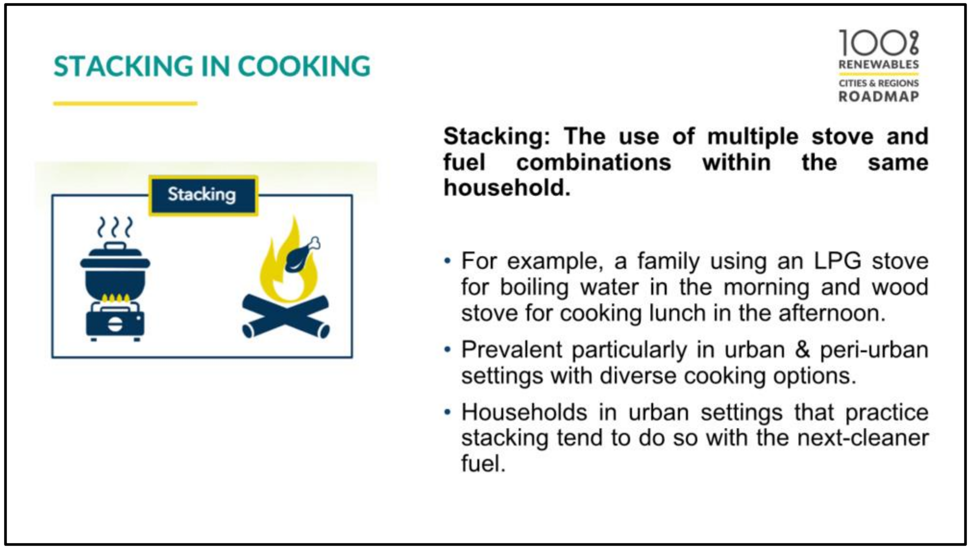
These alarmingly high figures are conservative estimates, suggesting the adverse development impacts resulting from households' ongoing use of polluting stove technologies and cooking fuels (table 2.2). The DALYs included in the health-impact calculation account for morbidity, but do not assume productivity losses due to ill health, which would likely raise the final value. In the gender calculation, the cost of women's time is set relatively low, at US$0.54 per hour. Even so, the value of women's time spent on cooking-related tasks and drudgery skyrockets. The dollar value of the climate impact is driven, in part, by carbon prices and estimates of the social cost of carbon, which many in academic and policy communities perceive as being set too low (Annex 2). These and other negative impacts underscore the urgent need to move households without Modern Energy Cooking Services (MECS) up the tiers of


PART 5
FACTORS AFFECTING THE UPTAKE OF CLEAN COOKING

UPTAKE OF MODERN ENERGY COOKING



- Significant regional differences in uptake, with SSA having the lowest adoption rates.
- Those in transition meet Tier 2 of the MTF, and require more support to move up the clean cooking ladder.
- Transitions are often governed by stacking.



Clean stacking has a potential for positive short and long-term impacts and behaviours and trends may change positively.

The biggest challenge today is overcoming the trend of dirty stacking as traditional stoves are still being used as back-up solutions

This points to the fundamental importance of behaviour change and contextual factors that sit outside the binary consideration of clean fuel vs non clean fuel access

Questions: given the health benefits, why are HHs with access to cleaner technologies still using more rudimentary and polluting solutions?

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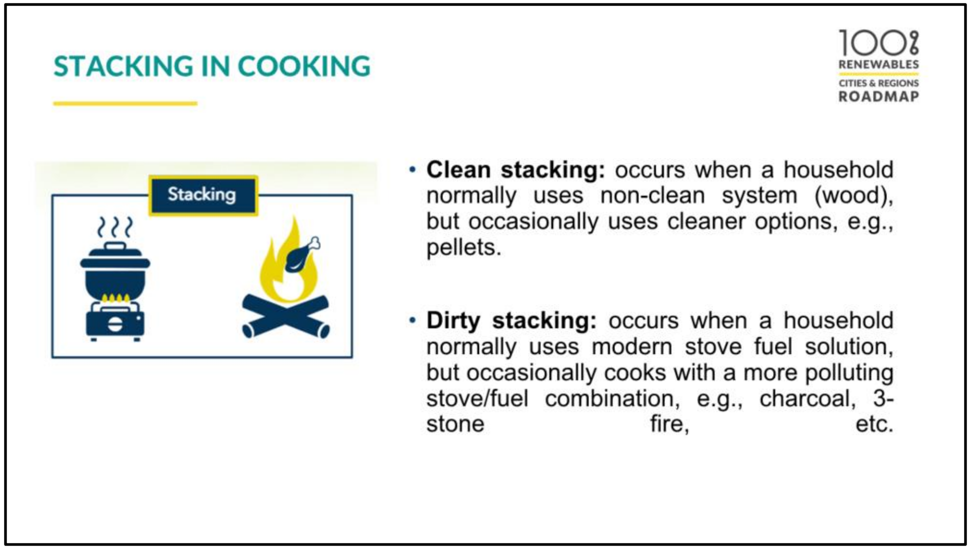

Many primary users of clean stoves and fuels persist in high-frequency, secondary use of traditional fuels (e.g., wood and charcoal) and stoves (e.g., three-stone fires, fireside cookers and wood ovens, charcoal stoves, and charcoal barrels). A recent study in Kenya, for example, reveals that households that are primary LPG users consume 42 percent as much charcoal as households that are primary charcoal users (Republic of Kenya, Ministry of Energy 2019).

STACKING IN COOKING

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- In general, using multiple cooking solutions in parallel often reduces the health benefits of a clean primary cooking solution…

  …but the effect depends on the type of stacking.

- With **dirty stacking**, households that have met the threshold for primary clean-fuel access continue to face substantial exposure to household air pollution (HAP) linked to their secondary use of traditional stoves and fuels.

- **Clean stacking** represents less use of a non-clean cooking solution, which could potentially facilitate greater adoption of clean fuels over time, leading to gradually less exposure of the household to HAP.

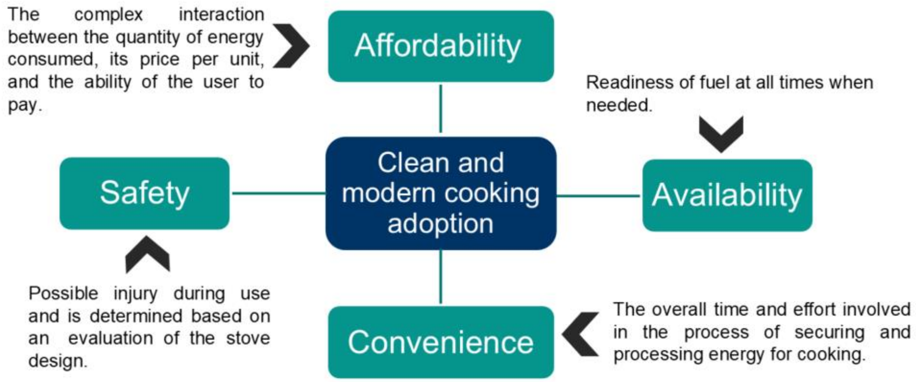
Questions: given the health benefits, why are HHs with access to cleaner technologies still using more rudimentary and polluting solutions?

- providing a fallback stove when the primary one cannot meet key functionalities or when fuel is unavailable.
- time savings from being able to prepare multiple meals simultaneously.
- preference for preparing some meals on particular cookstoves (cooking, reheating, boiling, food drying).
- fuel availability and affordability.
- *Available infrastructure (e.g., gas line, electricity).*

BARRIERS TO CLEAN COOKING

- Low awareness regarding clean cooking technologies
- High upfront costs of clean cooking technologies;
- Lack of access to finance
- Lack of standards/ low adoption of standards for clean cooking technologies;
- High cost of alternatives to charcoal/ firewood
- Limited number of technicians to repair clean cooking technologies.

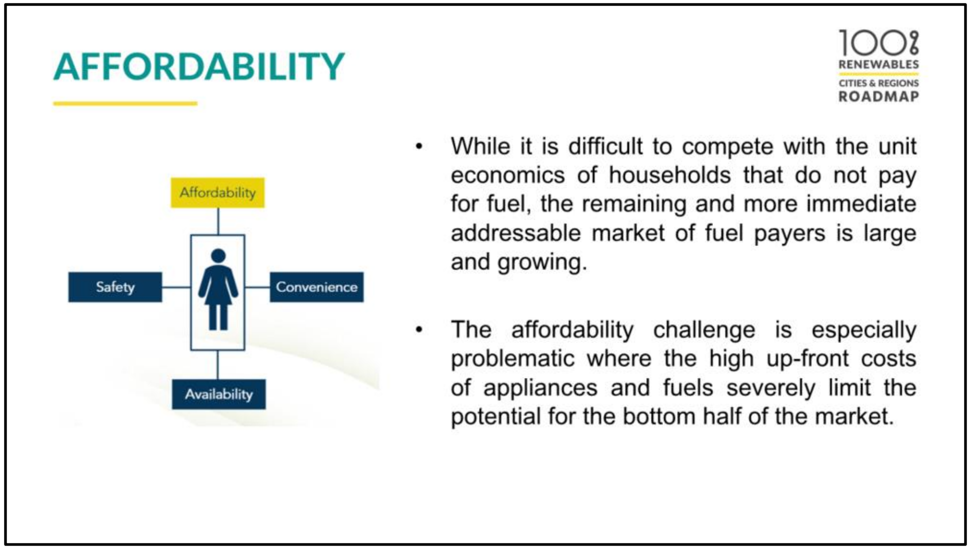
KEY ACCESS & USABILITY FACTORS



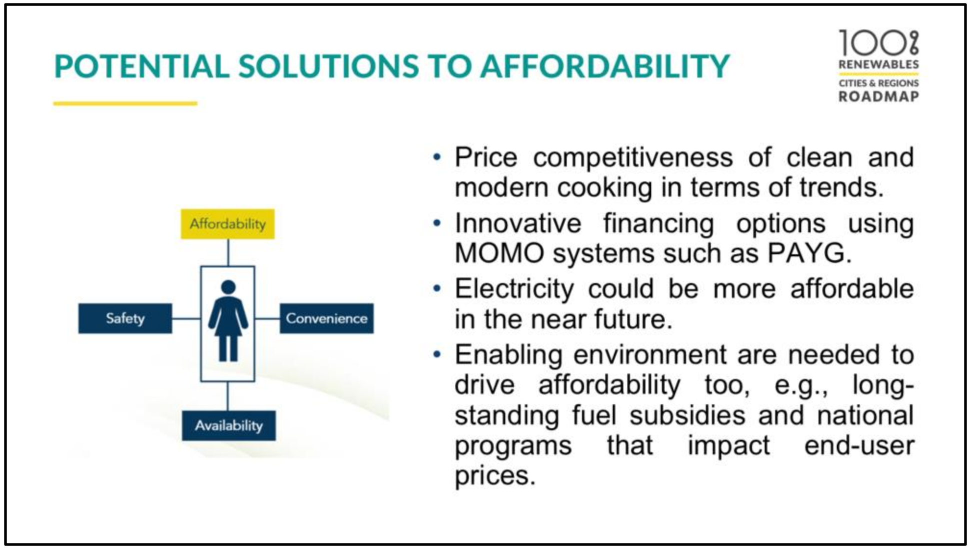
AFFORDABILITY

Higher-income quintiles are more likely to afford access to clean and modern cooking solutions.

- Compared to urban users, rural users tend to spend less on fuel, mainly due to the prevalence of wood that can be freely collected.
- In urban settings, where households are less likely to have access to readily available, free fuel sources, a larger proportion of their income must be allocated to cooking energy



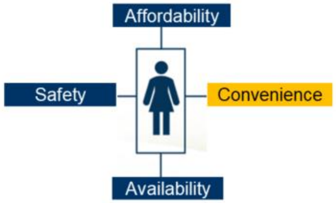
- Assuming that HHs need to spend the equivalence of up to two months worth of HH energy-related monthly expenses to buy cleaner cookstoves, just 34% of the global population will be able to afford a clean cooking stove
- In addition to this, post purchasing they stove, the HH also needs to regularly buy the required cleaner fuel, which also comes at an additional expenditure.



Income remains a fundamental driver of fuel and stove demand, with the lowest quintiles most dependent on the historically most affordable fuels—primarily wood and charcoal.

However, markets that feature substantial, long-standing fuel subsidies and national programs that impact end-user prices allow for more widespread adoption of primary clean fuels

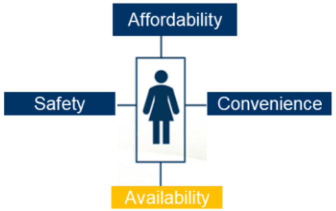
CONVENIENCE



Stove preparation time is a principal reason for adoption of clean and modern cooking.

- Average stove preparation time for users of electricity, LPG, and biogas fuels is generally lower than that of charcoal or wood users, especially in urban settings.
- Cooking time also plays a crucial part in adoption of clean cooking solutions electricity and LPG for primary use.
- Less cooking time, in some cases, may equate to less energy consumed, which, in turn, may equate to lower average expenditure and higher affordability.

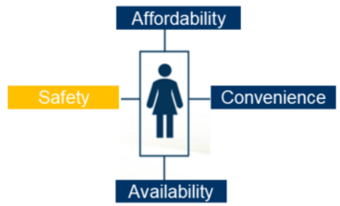
AVAILABILITY



Availability factors can be key drivers of fuel-stacking, particularly when accounting for seasonality and supply-chain volatility.

- For example, a localized study in Mexico finds that, in some contexts, stove stacking using fuelwood is driven by seasonal LPG shortages (Ruiz-Mercado and Masera 2015).
- Results of this study reinforce the importance of accounting for availability factors in understanding a household's energy use, even if a household's primary fuel source is a clean cooking solution.

SAFETY



- While fuels like LPG have often faced uptake challenges due to perceptions of safety risks, selected country data indicate that the use of LPG, electricity and other clean fuels, has generally resulted in a lower incidence of serious impacts (e.g., physical injury, illness, or death), as well as less-serious ones (e.g., fires without injury, itchy/watery eyes, or light coughing).
- MTF household data analysis from Cambodia and Nigeria highlight that approximately 2 to 4% of primary LPG-using households, on average, report either serious or minor injuries, compared to an average of 7to 14% of households using mainly charcoal or wood.

And, of course, underpinning all these factors, is the level of awareness among end-users about affordable, convenient, available, and safe alternatives. Information needs to reach the right people through the most effective means.

This may require significant investment in sensitisation and awareness raising activities, as well as longitudinal studies on the effect of awareness raising in facilitating uptake and behavioural change.

CREATING AN ENABLING ENVIRONMENT

POLICY

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Photo credit: ENACT project

- **Low policy prioritization to improve and expand clean cooking, despite the high social and economic opportunity costs of inaction:** To date, policies, cross-sectoral plans, and public investments have struggled to catalyze large amounts of private financing due to unclear national-scale clean cooking policies, strategies, and targets.
- **Limited intergovernmental co-ordination:** To foster truly holistic solutions requiring participation across multiple sectors, ranging from energy, health, climate, industry, and finance to rural and urban development, gender, and social protection, among others
- **Underdeveloped infrastructure:** Limited access to clean fuel sources and the absence of supply chain infrastructure make it difficult to distribute clean cooking solutions to underserved areas.
- **High taxes and misaligned tariff codes**, particularly in market stages, hinder industry growth, e.g., making it especially difficult to import fuel-production equipment, quality stoves and components, and clean fuels.

Taxes

In many contexts, LPG is stored as a liquid, but taxed as a gas, which limits the opportunity for more efficient global value chains and impedes players from adequately storing and reliably supplying fuel.

In addition, clean biofuels like ethanol and formally distributed pellets and briquettes nearly always face sales taxes (i.e., value-added tax) and, in many cases, high levels of import duty.

A follow-on Electricity Access Scale-up Project, co-financed by CCF (a total amount of $20 million: $10 million IDA, $10 million CCF), will benefit 1.66 million people and 600 public institutions with clean cooking access.

ECONOMIC

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Photo credit: ENACT project

- **Manufacturing and distribution challenges:** It is difficult to find businesses that have reached volumes that enable economies of scale. In Sub-Saharan Africa, for example, only 15 alternative biofuel businesses (e.g., ethanol and pellets)—less than 18% of the estimated active number at 2018—consistently supply more than 5,000 households with cooking fuel.
- **Inadequate financial capital to fully commit to scaled clean cooking promotion:** SEforALL estimates that funding commitments for high-impact countries for residential clean cooking have decreased, falling from nearly US$120 million to US$32 million in, as of 2019.
- **End-user affordability:** The upfront costs of technologies, and the ongoing costs of fuel sources can be expensive to end-users, making it difficult for low-income households to adopt.

A follow-on Electricity Access Scale-up Project, co-financed by CCF (a total amount of $20 million: $10 million IDA, $10 million CCF), will benefit 1.66 million people and 600 public institutions with clean cooking access.

END OF MODULE

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