Standards for cookstove performance: guidance and resources

Standards are critical to ensure that cooking systems used in houses are safe, perform well and do not adversely impact health. When standards are applied correctly, governments and their agencies can set policies and foster product innovation to ensure that products that enter the market are safe and meet the needs and expectations of consumers.

Cooking is an area where there is an important role for standards. If a stove is too hot, the cook or children playing nearby could be burned. A stove with an unsteady base could topple to the floor, risking injuries or causing a fire. Standards can also help in addressing the risks from pollutants that are emitted while the stove is in use. By setting stove emissions standards, governments, program implementers, and consumers can make more educated decisions about stove purchases – and invest in technologies that ensure users are not harmed by dangerous levels of smoke. By specifying how efficient a stove must be, stove standards also help consumers save money and fuel. A stove is often one of the most-used products in a household, and standards focused on durability can confirm that it can withstand heavy use.

The World Health Organization (WHO) and other international organizations have developed resources and guidance that countries can use to set standards for cookstove performance to protect health. These resources are part of the WHO’s Clean Household Energy Solutions Toolkit (CHEST) Module 3: Guidance on standards and testing, and include:

- Indoor air quality guidelines: Household fuel combustion
- International Organization for Standardization (ISO) - Standards and voluntary performance targets (VPTs)
- WHO Setting national voluntary performance targets for cookstoves document
- WHO Performance Target (PT) Model

The WHO defines clean fuels and technologies as those that attain the fine particulate matter (PM$_{2.5}$) and carbon monoxide (CO) target and interim target levels recommended in the WHO global air quality guidelines (2021). Clean household fuels and technologies for health include solar, electric, biogas, natural gas, liquefied petroleum gas (LPG), and alcohol fuels, as well as biomass when burned in devices that meet the WHO guidelines.
Why should countries set national standards for stove performance?

National standards help determine which stoves are most likely to achieve health benefits based on their performance with standardized testing. Countries can use this classification to promote stoves with the highest performance possible, considering household needs, costs, supply issues and location. As conditions change, countries can promote increasingly cleaner technologies for health. Additionally, if stoves being sold on the market are tested and labeled with information on their tier classifications, consumers can make educated purchasing decisions. Labeling implemented in tandem with a communication strategy can help motivate consumers to purchase and use the best-performing stoves to achieve the greatest health benefits.

What international stove standards have been developed?

WHO produces global air quality guidelines (2021) that define levels of fine particulate matter (PM$_{2.5}$) and carbon monoxide (CO) that are safe for health, and are used to define clean fuels and technologies at the point of use. The International Organization for Standardization (ISO), in consultation with the WHO and other experts, developed a rating system for stoves based on their emissions of fine particulate matter and carbon monoxide, efficiency, safety, and durability. Based on the results of standardized laboratory tests, stoves are rated into tiers ranging from 0 (lowest performing) to 5 (highest performing), and can be classified as polluting, transitional, or clean for health at the point of use. Applying the WHO guidelines and ISO tiers of performance will enable the promotion of the best-performing technologies and help consumers make educated choices.

What tools are available to help set standards for stoves?

**The WHO indoor air quality guidelines: Household fuel combustion**

The WHO Guidelines for indoor air quality: Household fuel combustion specify emission rate targets for devices both with and without venting. These are recommended limits on the amount of fine particulate matter and carbon monoxide that household devices can emit in order for the majority of households to achieve the WHO global air quality guideline and interim target values. The guidelines also provide intermediate emission rate targets, which can be used by countries as preliminary benchmarks to achieve on the pathway toward reaching the final emission rate targets. WHO recommends that all countries strive for the lowest emission rates, as they lead to the most health protection.

**International Organization for Standardization (ISO) - Standards and voluntary performance targets**

The ISO has developed standards for testing stoves in both laboratory and field settings. The ISO standard laboratory protocols include detailed procedures for using water boiling tests to assess stove efficiency and emissions, and for conducting safety and durability evaluations. Stove performance may differ when used in homes because usage conditions vary more than in controlled laboratory settings. Thus, ISO field testing protocols are also available for testing the usability, fuel consumption, energy consumption, power, safety, and durability of stoves in homes under typical usage conditions. Guidance is also provided for measuring ambient concentrations and personal exposure to PM$_{2.5}$ and CO.
The ISO voluntary performance targets are a tiered system for rating stoves based on their ability to achieve air quality and health targets, linked to the results of laboratory testing. Each tier is associated with a target level of kitchen concentrations of PM$_{2.5}$ and CO that would result from using the device. Levels of PM$_{2.5}$ are in turn associated with a certain relative risk for acute lower respiratory infections (ALRI).

Stoves are classified into tiers ranked from 0 (lowest performing) to 5 (highest performing) based on five characteristics:

**Thermal efficiency:** The percent of heat from fuel that is converted into cooking energy

**CO emissions:** The amount of CO released per megajoule of energy delivered to a pot

**PM$_{2.5}$ emissions:** The amount of PM$_{2.5}$ released per megajoule of energy delivered to a pot

**Safety:** The degree to which the stove design reduces the risk of injury

**Durability:** The degree to which the stove will continue to function over time

The ISO targets use global data on kitchen characteristics and cooking behaviors to estimate stove emission rates required to achieve the PM$_{2.5}$ and CO levels associated with each tier. If the default values for kitchen volume, cooking time, and kitchen ventilation rates are appropriate for the local context, countries can adopt the ISO voluntary performance targets, choosing between standard, high, or low ventilation scenarios.

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### WHO setting national voluntary performance targets for cookstoves document

This document is intended to assist policy-makers and technical staff in ministries responsible for developing standards and policies on clean household energy. Key information in the guide includes:

- Description of the ISO voluntary performance targets (VPTs) and tiers of performance
- Explanation of how the tier values for emissions, efficiency, safety, and durability were determined, including the relationship of the air pollutant emissions to health risk
- Explanation of different VPTs for high and low ventilation scenarios
- Methods for using the WHO Performance Target (PT) Model to set locally-specific tier values based on unique characteristics of the location
- Strategies for integrating the ISO standards and VPTs into a policy promoting the transition to cleaner, safer household energy

### WHO Performance Target (PT) Model

If locally-specific data is available on average kitchen size, time spent cooking per day, and air circulation in kitchens and these values are significantly different from the global values used for the ISO tiers of performance, the WHO Performance Target (PT) Model can be used to develop country-specific tier ratings for PM$_{2.5}$ and CO emissions. The PT Model can be used to determine the PM$_{2.5}$ and CO emission rates that stoves, heaters, or lights must meet to achieve certain levels of air quality and health outcomes associated with the 6 tiers of the ISO framework, considering local conditions. Locally-specific data may be obtained either through previously published literature, from the WHO household air pollution model input data database or through primary data collection.
What is a “clean” technology?

Fuel and technology combinations are classified as clean for health at the point of use if they achieve:

• The annual average air quality guideline level (AQG, 5 µg/m³) or the Interim Target-1 level (IT1, 35 µg/m³) for PM$_{2.5}$; and
• The 24-hour average air quality guideline level (AQG, 4 mg/m³) or the Interim Target-1 level (IT1, 7 mg/m³) for CO.

Transitional technologies are those that provide some health benefit, but do not enable achievement of the air quality guideline or target levels. Transitional devices should only be used when clean technologies are inaccessible, and should be prioritized over more polluting stoves.

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<thead>
<tr>
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<td>Electric</td>
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<td>Biomass stoves classified as tier 4 or 5 for PM$_{2.5}$ emissions and tier 5 for CO emissions</td>
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Who should use the tools for setting standards?

All of the tools for setting standards can be used by groups responsible for developing and implementing policies on clean household energy, including:

• Policy and technical staff in ministries, departments and agencies who contribute to multi-sectoral clean household energy strategies
• Laboratory staff who test stoves and fuels and report results
• Personnel in national standards bodies who develop national standards for household energy devices

Resources and contact information:


Questions?

Contact householdenergy@who.int

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