Reducing the health burden from household air pollution (HAP)

Evidence and recommendations from the new WHO Air Quality Guidelines



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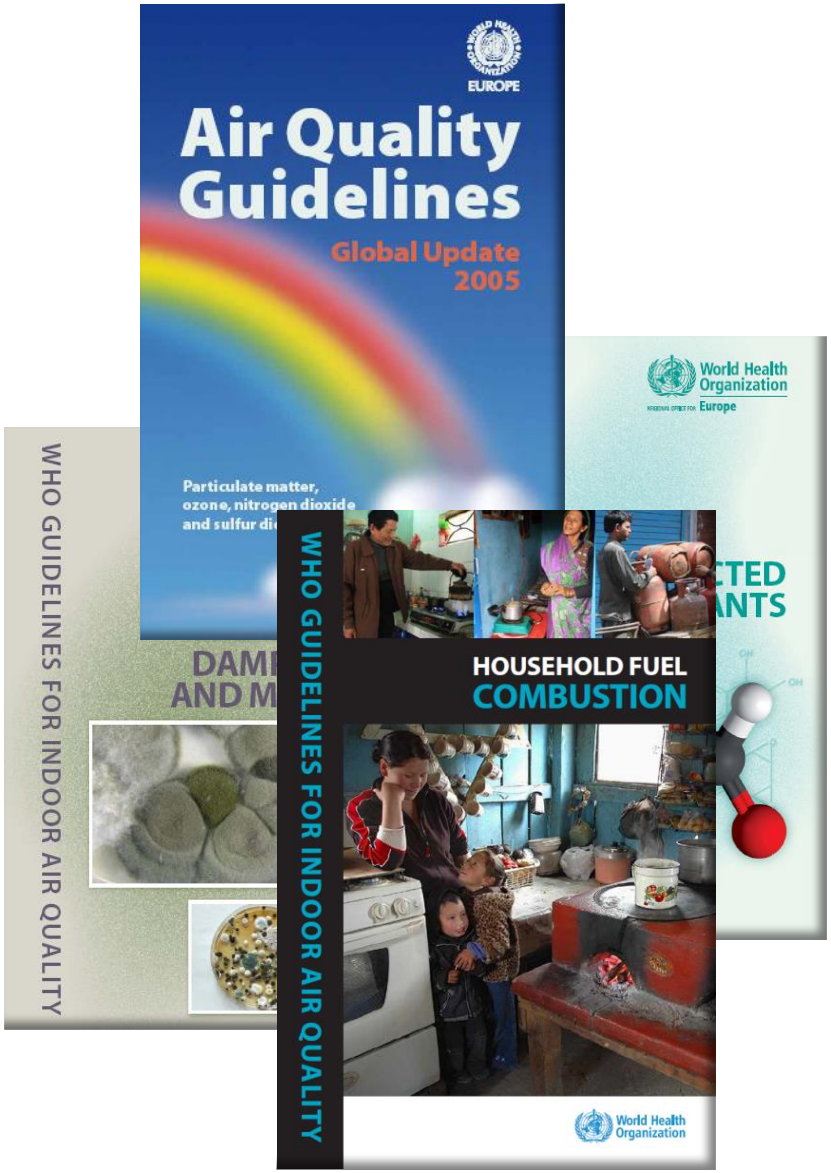
PAHO workshop - 16th June 2015

Overview of presentation

- Development of new guidelines – building on existing WHO Air Quality Guidelines
- Key questions for the new guidelines
- Evidence reviewed as basis for:
  - Recommendations
  - Implementation
- Recommendations
- Outline of implementation guidance

Development of new WHO Air Quality Guidelines

- 2005 Global update (ambient) - published 2006:
  - $PM_{2.5}$ and PM_{10}
  - Chapter on IAP
- Indoor AQG:
  - Dampness and Mould: 2009
  - Selected pollutants: 2010
  - Household fuel combustion: this project published Nov 2014



Existing WHO Air Quality Guidelines:
PM $_{2.5}$ and carbon monoxide (CO)

Pollutant	Guideline or target	Exposure period	Level (μg/m^3)
$PM_{2.5}$ (2006)	**Guideline**	**Annual average**	**10**
	IT-3		15
	IT-2		25
	IT-1		**35**
Pollutant	**Guideline or target**	**Exposure period**	**Level (mg/m^3)**
Carbon monoxide (2010)	Guideline	8-hour	10
	Guideline	**24-hour**	**7**

Key questions for guidelines

1. What emission rates* are required to meet WHO AQGs?
   - $PM_{2.5}$: annual average AQG (10 µg/m^3) and IT-1 (35 µg/m^3)
   - CO: 24-hr average (7 mg/m^3)
2. In light of the acknowledged challenges in securing rapid adoption and sustained use of very low emission household energy devices and fuels, particularly in low income settings, what approach should be taken during this transition? “How clean is clean enough?”
3. Should coal be used as a household fuel?
4. Should kerosene be used as a household fuel?

*The Guidelines Development Group determined that a focus on emission rates was key to effective policy

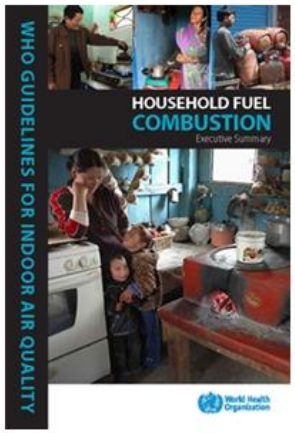
Evidence reviewed

1. Fuel use, emissions and pollution levels:
   - Global patterns of household fuel use
   - Emissions of health-damaging pollutants
   - **Model linking emission rates with air quality**
   - Population levels of household air pollution
2. Health impacts:
   - **Health risks from household air pollution – exposure risk functions**
   - Specific risks from household use of coal
   - Risks of burns, scalds and poisoning
3. Implementation - interventions and policy:
   - **Impacts of interventions in daily use on $PM_{2.5}$ and CO**
   - Factors enabling and limiting adoption
   - Interventions costs and financing options

Indoor air pollution

Indoor air pollution
Health impacts
Broader impacts
Interventions
Millennium Development Goals
Guidelines
Information resources

Indoor air quality guidelines: household fuel combustion



Almost 3 billion people, in low- and middle-income countries mostly, still rely on solid fuels (wood, animal dung, charcoal, crop wastes and coal) burned in inefficient and highly polluting stoves for cooking and heating. In 2012 alone, no fewer than 4.3 million children and adults died prematurely from illnesses caused by such household air pollution, according to estimates by the World Health Organization.

Together with widespread use of kerosene stoves, heaters and lamps, these practices also result in many serious injuries and deaths from scalds, burns and poisoning.

These new indoor air quality guidelines for household fuel combustion aim to help public health policy-makers, as well as specialists working on energy, environmental and other issues understand best approaches to reducing household air pollution -- the greatest environmental health risk in the world today.

Recommendations, general to specific

The recommendations include general considerations for policy, a set of four specific recommendations, and a best-practice recommendation addressing linked health and climate impacts.

Among the general considerations, or overarching advice, is that policies should promote community-wide action, and that the safety of new fuels and technologies must be assessed rather than assumed.

Emission rate targets
Recommendation 1

Policy during transition to

Good practice: securing health and climate co-benefits
Recommendation 5

Guidelines

Read the report and executive summary in different languages

Frequently Asked Questions
pdf, 243kb

Press release

(Available in Ar, Ch, En, Fr, Ru, Sp)
12 November 2014 -- WHO recommendations, released today, highlight the dangers of burning fuels like unprocessed coal and kerosene in the home, and set targets for reducing emissions of health-damaging pollutants from domestic cookstoves, space heaters and fuel-based lamps.

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Indoor air pollution

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Indoor air quality guidelines: household fuel combustion

Share Print

Guidelines draw on diverse evidence

Nigel Bruce/WHO

Building on existing WHO guidelines for indoor air quality on selected pollutants, the new guidelines are informed by the best available evidence, including newly commissioned or published, systematic reviews.

The authors have also used strict criteria to assess the quality of available evidence and develop practical recommendations for public health policy-makers, as well as specialists working on energy, environmental and other issues.

Eleven distinct evidence reviews are available as listed below, along with a description of methods used to evaluate the strength of evidence and resulting recommendations.

Links to evidence reviews

Evidence review methods
pdf, 627kb

Emissions of Health-Damaging Pollutants from Household Stoves
pdf, 1.25Mb
Review 2

Model for linking household energy use with indoor air quality
pdf, 722kb
Review 3

Health effects of household air pollution (HAP) exposure
pdf, 2.36Mb
Review 4

Population levels of household air pollution and exposures
pdf, 2.10Mb
Review 5

Impacts of interventions on household air pollution concentrations and personal exposure
pdf, 1.62Mb
Review 6

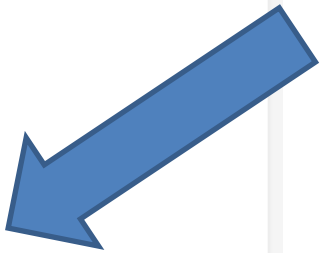
Factors influencing the adoption and sustained use of improved cookstoves and clean household energy
pdf, 2.22Mb
Review 7

Household Coal Combustion: Unique Features of Exposure to Intrinsic Toxicants and Health Effects
pdf, 1.00Mb
Review 8

Summary of systematic review of household kerosene use
pdf, 412kb
Review 9

Burns and Poisoning
pdf, 1.13Mb
Review 10

Costs and financing for adoption at scale
pdf, 1.32Mb
Review 11



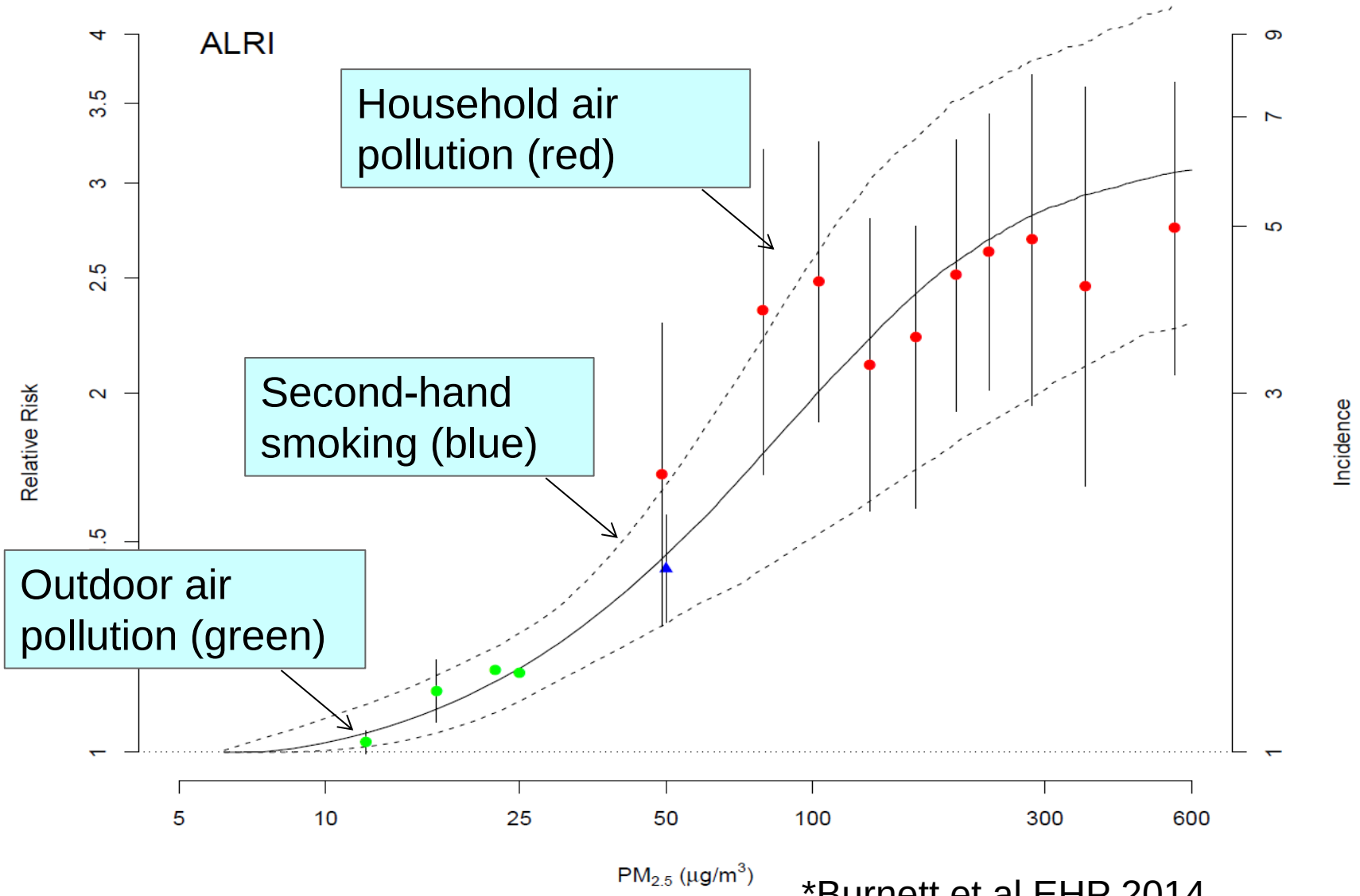
Evidence reviews (including methods)

Review #4: Health risks from exposure to Household Air Pollution (HAP) from solid fuels

Strong evidence	Tentative evidence
• Child pneumonia • Low birth weight • Chronic obstructive pulmonary disease (COPD) • Lung cancer (coal) • Lung cancer (biomass) • Cataract • [Cardiovascular disease]	• Stillbirth • Pre-term birth • Stunting • Cognitive development • Asthma • Other cancers (naso-pharynx, uterine cervix) • Tuberculosis

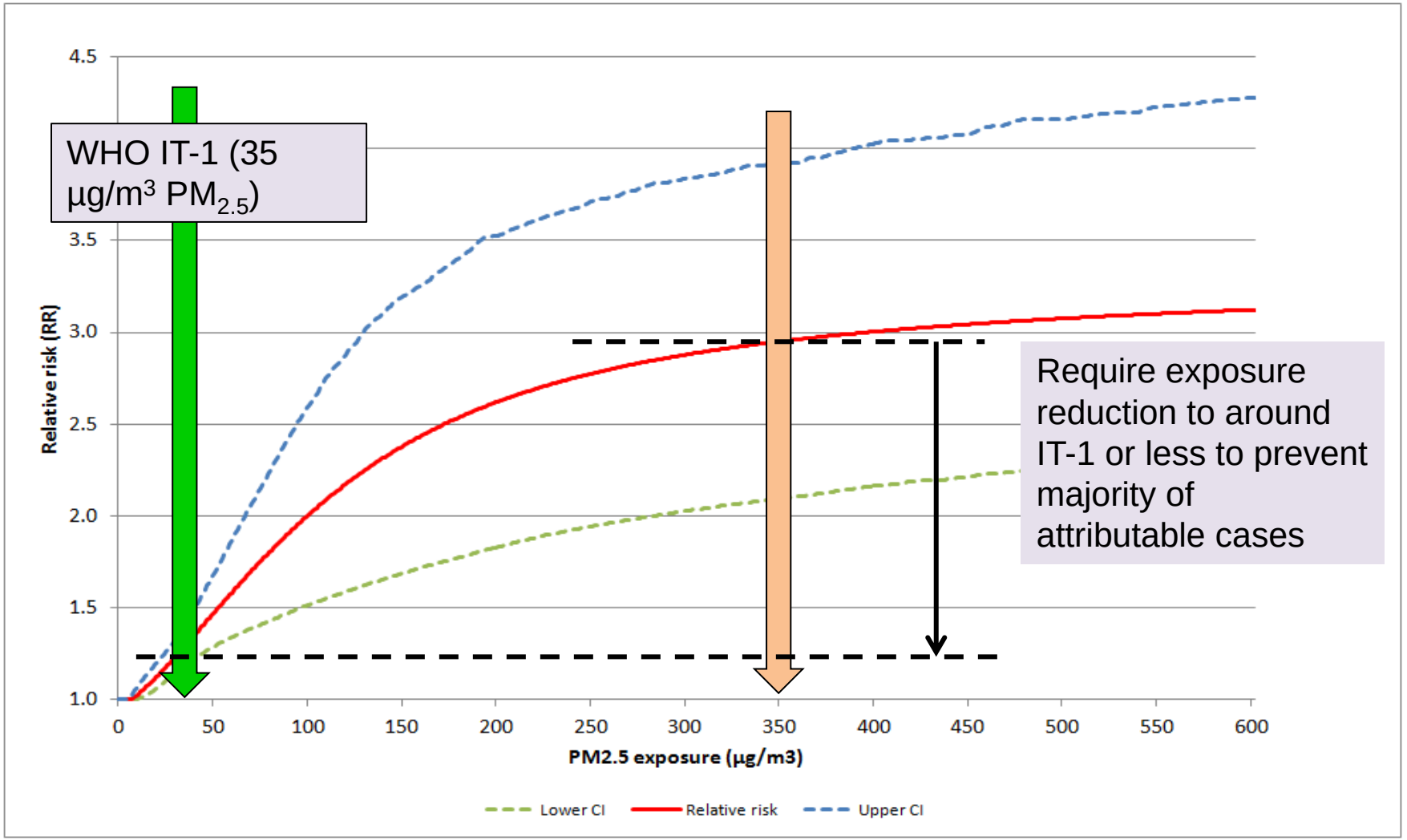
Also reviewed: health risks from kerosene and gas

IER function*: $PM_{2.5}$ and child ALRI risk



*Burnett et al EHP 2014

IER function for $PM_{2.5}$ and child ALRI risk (linear scale)

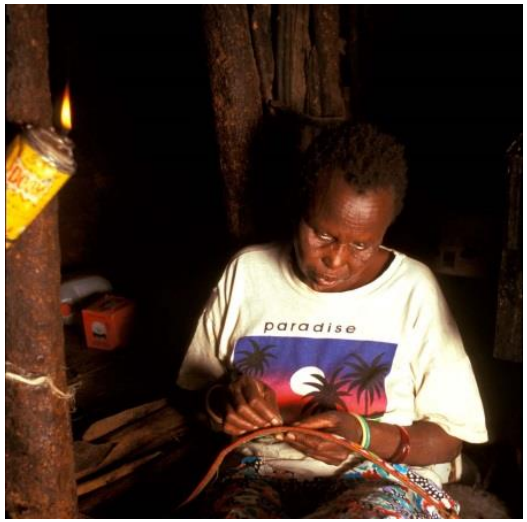


IER functions available to date

- Child ALRI
- Ischaemic heart disease
- Stroke
- Chronic obstructive pulmonary disease
- Lung cancer

Burnett R et al, Env. Health Perspect. 2014

Kerosene health risks (Review #9)



- Emissions and exposure*:
  - PM, CO, PAH, CH_2O, SO_2, NOx
  - Area levels (PM, CO, SO_2) shown to exceed AQGs
  - Wick devices: $PM_{2.5}$ of 20 to >1000 µg/m^3
  - Fuel quality and contaminants also important
- Epidemiological studies*:
  - SR (25 studies): risk of cancer; respiratory symptoms; impaired lung function; asthma; ALRI, TB, cataract.
  - Concern about inconsistency and risk of bias (no M/A).
  - CO toxicity
- 4 recent studies (post SR): increased risk of still birth, low birth weight, neonatal deaths, ALRI and cataract (significant)
- Safety: fires, burns and poisoning [Review #10]

*Systematic review: Lam et al 2012

Review #6: Impacts of interventions - daily use ($PM_{2.5}$)

Device and fuel type	Number of studies (estimates)	Kitchen $PM_{2.5}$ ($\mu g/m^3$)		
		Pre-intervention mean	Post-intervention mean	Summary % reduction (95% CI) in mean
Solid fuel unvented	4 (7)	780	410	-48% (-34, -54)
Solid fuel vented	18 (23)	1030	370	-63% (+14, -89)
Advanced solid	1 (3)	650	380	-41% (-29, -50)
Ethanol	4 (4)	720	120	-83% (-63, -94)
Gas	1 (2)	890	280	-64% (-48, -80)
Electricity	1 (1)	160	80	-50% (N/A)

WHO annual AQG = 10 $\mu g/m^3$

2: Impacts of interventions - daily use ($PM_{2.5}$)

Device and fuel type	Number of studies (estimates)	Kitchen $PM_{2.5}$ (µg/m^3)		
		Pre-intervention mean	**Post-intervention mean**	Summary % reduction (95% CI) in mean
Solid fuel unvented	4 (7)	780	**410**	-48% (-34, -54)
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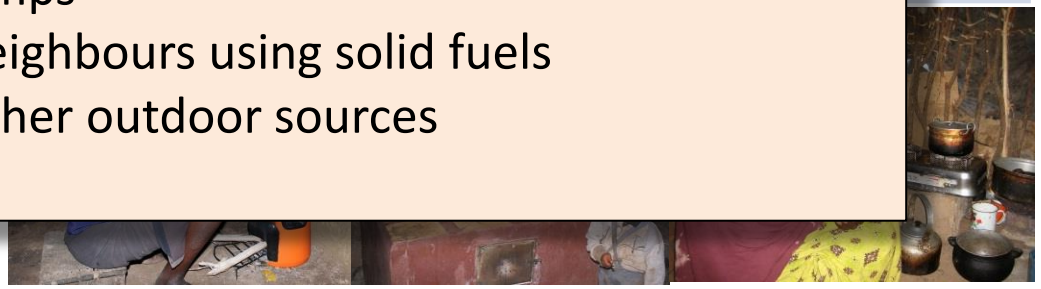
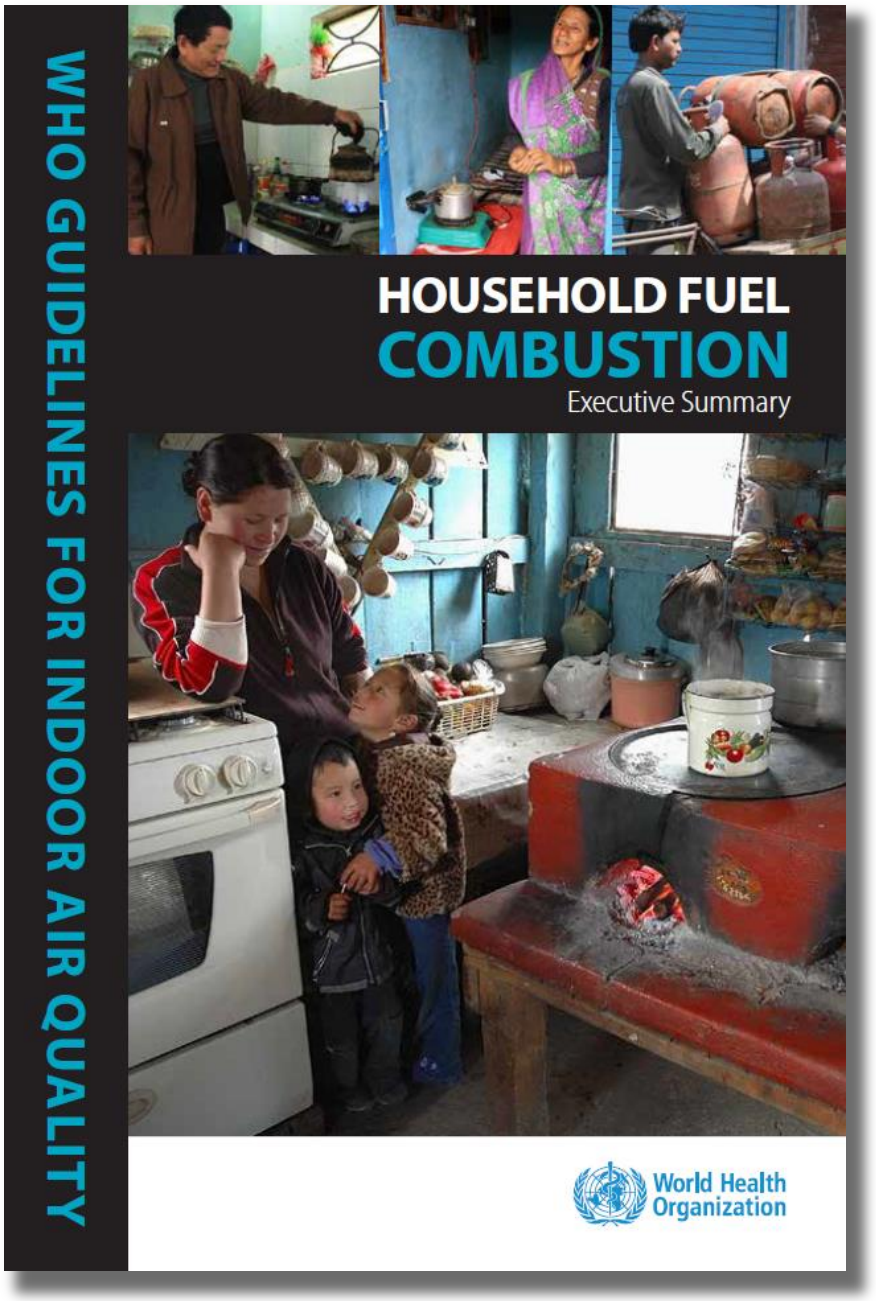
Solid fuel vented	18 (23)			39)
Advanced solid	1 (3)			0)
Ethanol	4 (4)			4)
Gas	1 (2)			0)
Electricity	1 (1)			

WHO annual AQG = 10 µg/m³

Why are post-intervention levels so high – including for clean fuels?

- Some continued use of solid fuels ('stacking')
- Other sources in home, e.g. kerosene lamps
- Neighbours using solid fuels
- Other outdoor sources





WHO Guideline recommendations

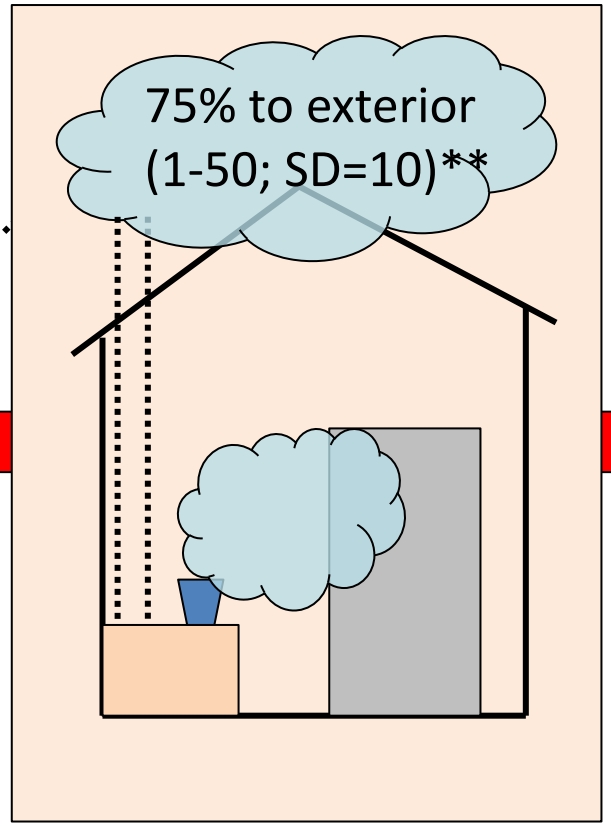
Focus on emissions reductions – why?

1. Indoor → outdoor → indoor
2. Evidence base stronger than for other approaches (e.g. ↑ ventilation, cook outdoors, protect children)
3. Implementation practicality – via design, production, standards, etc.
4. Some options (clean fuels), are relatively independent of user behaviour.

Review #3: Model linking emissions to AQ

Inputs:

- Emission rates:
  - $PM_{2.5}$
  - CO
- Kitchen volume:
  - $30m^3$ (5-100; SD=15)*
- Air exchange rate:
  - 15/hr (5-45; SD=7.5)*
- Duration of use:
  - 4 hours/day (45 mins-8 hours; SD=2)*



Outputs:

Predicted average concentrations of:

- $PM_{2.5}$
- CO

What emission rate is needed, given these assumptions?

Aim to meet AQG of 10 µg/m^3

* Based on studies carried out in India

** Based on studies from multiple countries

Source: Johnson M et al (Review 3)

Recommendation 1(a): Emission rate targets ($PM_{2.5}$)

Recommendation
For 90% of homes to meet the WHO AQGs for $PM_{2.5,}$ emission rates should not exceed the emission rate targets (ERTs) set out below.

Emissions rate targets (ERT)	Emission rate (mg/min)	Percentage of kitchens meeting AQG (10 µg/m³)	Percentage of kitchens meeting AQG IT-1 (35 µg/m³)
Unvented			
Intermediate	1.75	9%	60%
Final	**0.23**	**90%**	**100%**
Vented			
Intermediate	7.15	4%	60%
Final	**0.80**	**90%**	**100%**

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Recommendation 1(b): Emission rate targets (CO)

Recommendation
For 90% of homes to meet the WHO AQG for CO, emission rates should not exceed the emission rate targets (ERTs) set out below.

Emissions rate targets (ERT)	Emission rate (mg/min)	Percentage of kitchens meeting AQG (7 mg/m^3)
Unvented		
Intermediate	0.35	60%
Final	**0.16**	**90%**
Vented		
Intermediate	1.45	60%
Final	**0.59**	**90%**

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Recommendation 1(b): Emission rate targets (CO)

Recommendation
For 90% of homes to meet the WHO AQG for CO, emission rates should not exceed the emission rate targets (ERTs) set out below.

Research recommendations:

1. Build regional database of model input data.
2. Define standardized protocols for measurement.
3. Develop user-friendly interface for model.

Emissions rate targets (ERT)	**Emission ra (mg/min)**	
Unvented		
Intermediate	0.35	
Final	**0.16**	
Vented		
Intermediate	1.45	
Final	0.59	90%

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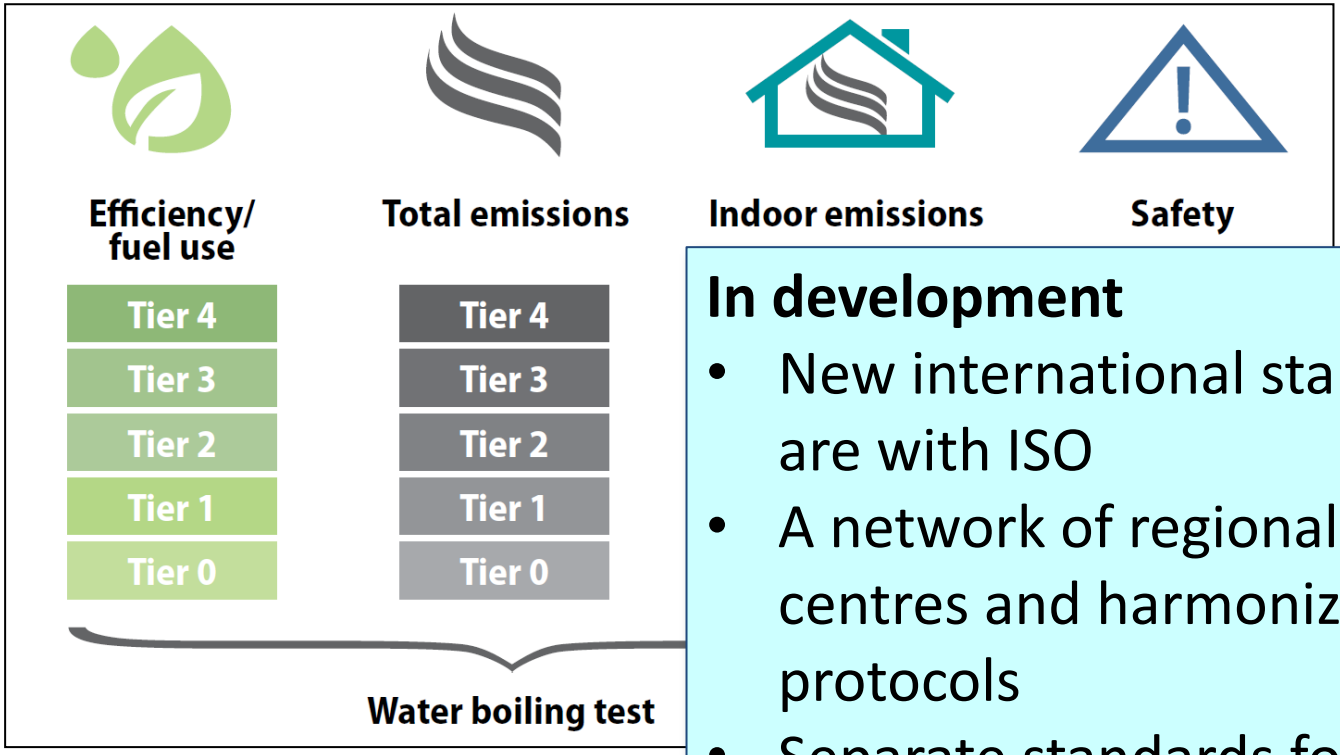
Standards, testing and certification

Annex 9 of Guidelines



In development

- New international standards are with ISO
- A network of regional testing centres and harmonized protocols
- Separate standards for laboratory and field testing

Recommendation 2: Policy during transition

Recommendation:

- Accelerate efforts to meet these emission rate targets (ERTs).
- In practice – evidence indicates this requires clean fuels.
- Where intermediate steps are required, prioritise those which offer substantial health benefits.

Research recommendations:

1. Carry out field evaluation of intervention options.
2. Develop and evaluate policy for rapid and sustained transition.

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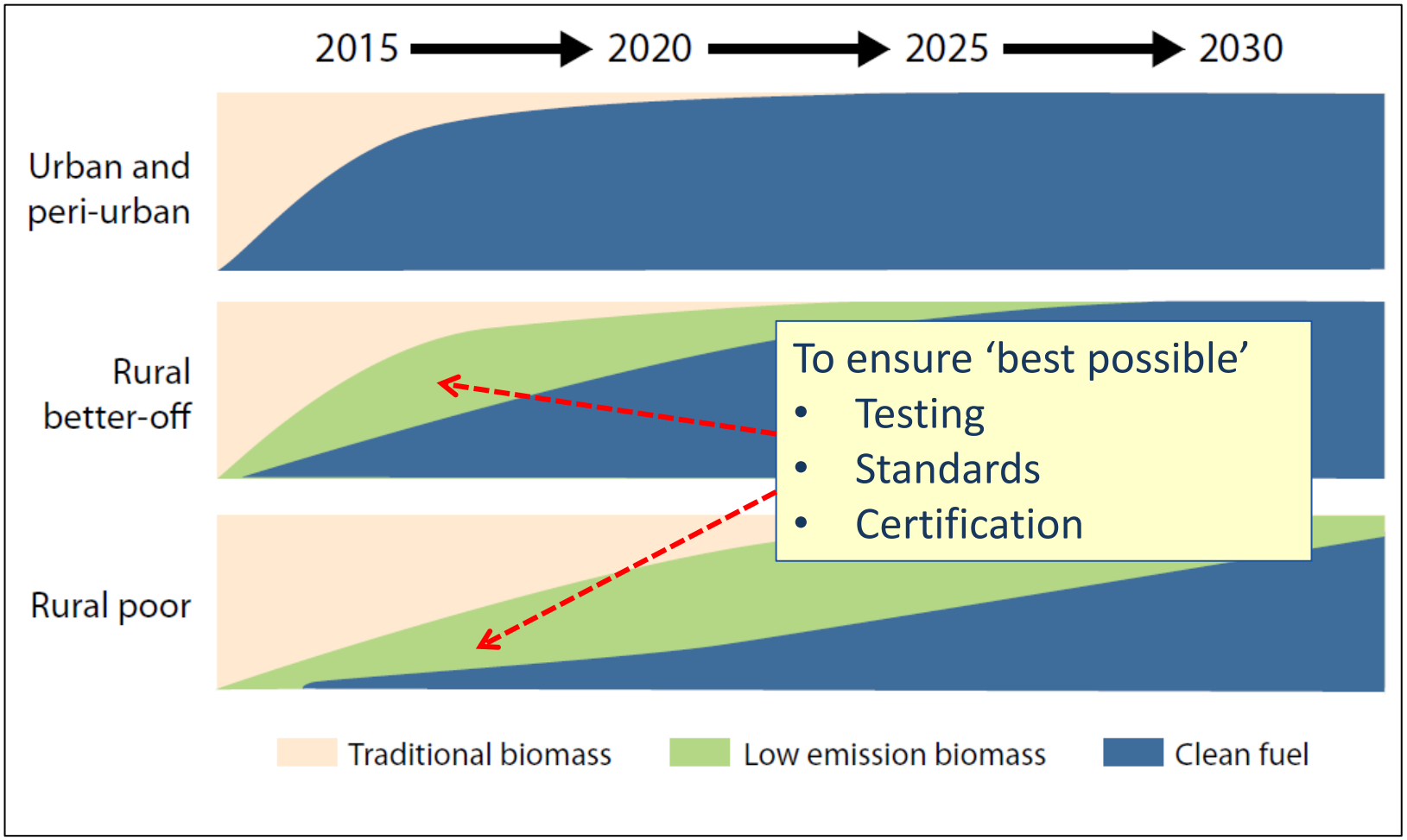
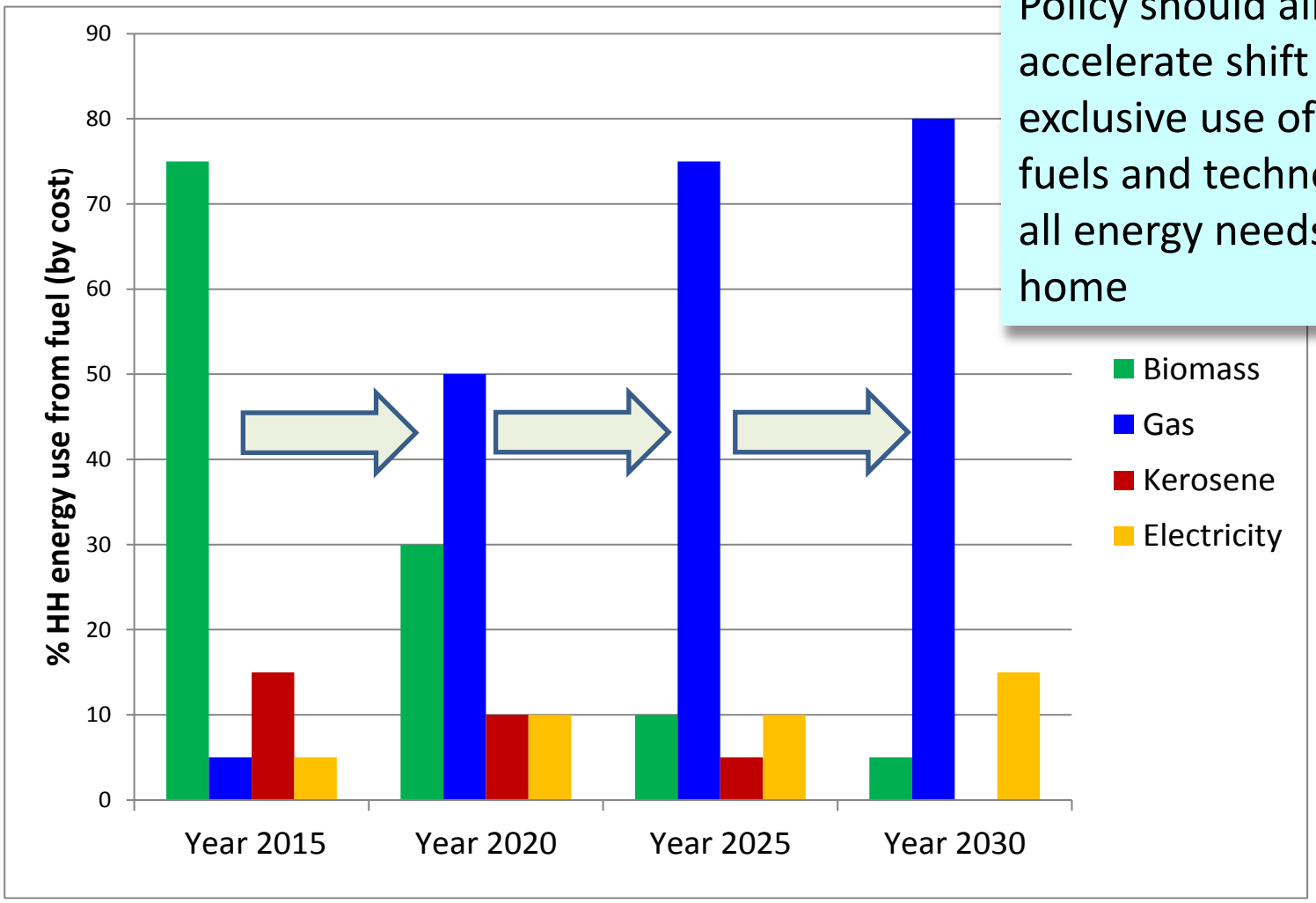
For solid fuel users, expect varying rates of adoption of clean fuels across society ...



Also, transition of household energy mix over time



Policy should aim to accelerate shift to more exclusive use of cleanest fuels and technologies for all energy needs in the home

Recommendation 3: Household use of coal

Recommendation:

Unprocessed* coal should not be used as a household fuel.

Rationale:

- Carcinogenic (IARC)
- Toxic contaminants

*Unprocessed coal is forms of this fuel which have not been treated by chemical, thermal or physical means to reduce contaminants.

Research recommendation:

1. Evaluation of policies and interventions to support transition to cleaner alternatives.
2. Emissions and health risks from ‘smokeless’ and ‘clean’ coals; impacts of bans on household coal use.

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Recommendation 4: Use of kerosene

Recommendation*:

Household combustion of kerosene is discouraged while further research into its health impacts is conducted.

*Conditional on account of uncertain epidemiological evidence

Research recommendation:

1. Health risks from devices used in LMICs for cooking, heating and lighting.
2. Health risks from more advanced kerosene heaters.

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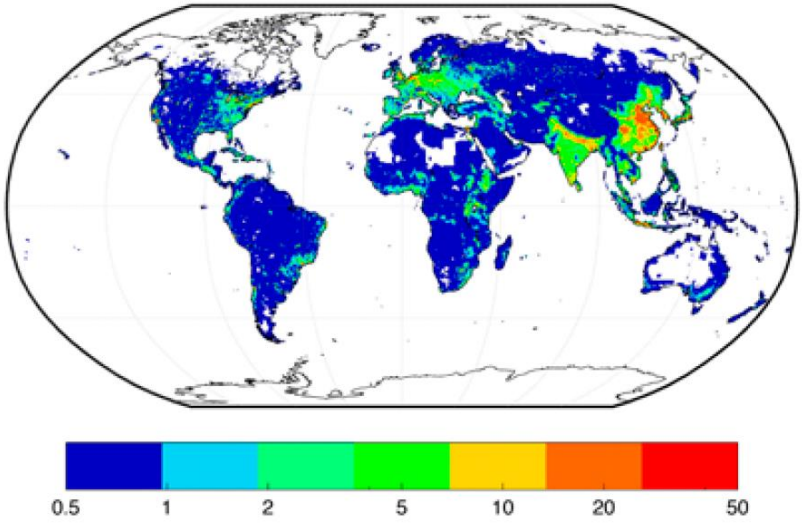
General considerations

- HH emissions → ambient air, re-enters homes and lower IAQ: hence, total emissions should be minimised.
- Local ambient air quality (from homes and other sources) affects indoor air quality: this must be considered in order to achieve clean indoor air.
- Homes have multiple energy needs (cooking, heating, lighting, etc.) so use and emissions from all sources should be considered.
- HH energy use carries risks of burns and poisoning. Safety of interventions should not be assumed: approaches to minimize exposure to emissions should be taken in a way that incorporates safety concerns.

Good practice recommendation: Securing health & climate co-benefits

Recommendation:

Considering the opportunities for synergies between climate policies and health, including financing, governments and agencies who develop & implement policy on climate change mitigation should consider action on household energy and carry out relevant assessments to maximize health and climate gains.



Research recommendation:

Evaluate impacts of policies on health and climate

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Implementation support

5. Implementation of the guidelines

5.1 Introduction

Although the scope of these guidelines is global, the main focus ha
health impacts from household fuel combustion in LMICs where
by far the greatest. Consequently, the primary concern of WHO
technical support for implementation of the guidelines lies with L
nizing that higher income countries identifying health risks (mair
heating fuels) will have mechanisms and resources to address thes
WHO acknowledges that – particularly for lower income and/or m
ulations – implementing these recommendations will require coor
from ministries, other national stakeholders (NGOs, public and pr
and often input from international development and finance organiz
will work with countries to support this process through its regiona
offices, and is preparing web-based guidance and tools that build or
reviews used to inform these guidelines.

In addition to the above general support, WHO will work clos
of the countries most affected by this issue to learn from initial sta
mentation, and use this experience to revise the guidance and t
updates, Section 6.2).

An overview of the main areas in which WHO will provide tech
for implementation is provided below. Further details are available a
who.int/indoorair/guidelines/hhfc.

5.2 Approach to implementation: collaboration a role of the health sector

The multiple issues involved in achieving equitable and lasting adopt
and safer household energy demand inputs from a range of agencie
mechanism for policy coordination at government level is therefore
step. In most countries, mechanisms for cross-sectoral collaboratio
a range of policy areas involving ministries and other stakeholders are likely to be
in place, and these can be built upon as needed.

To date, many ministries of health have not engaged fully with this prob-
lem, in part because it is considered the responsibility of other sectors including
energy, environment and finance. However, in many cases cooking and heating
technologies that improve energy efficiency to levels needed to reduce deforest-
ation and deliver fuel and time savings for households, do not yield air quality

Section 5:

1. Collaboration and role of health sector
2. Needs assessment
3. Intervention options and strategies
4. Policy for effective and sustained adoption
5. Standards/testing; regulation
6. Monitoring and evaluation
7. Research needs

Thank you!