

# Health Impacts of Household Air Pollution in the PAHO Region

## What is to be done?

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# Problems due to household burning of solid fuels

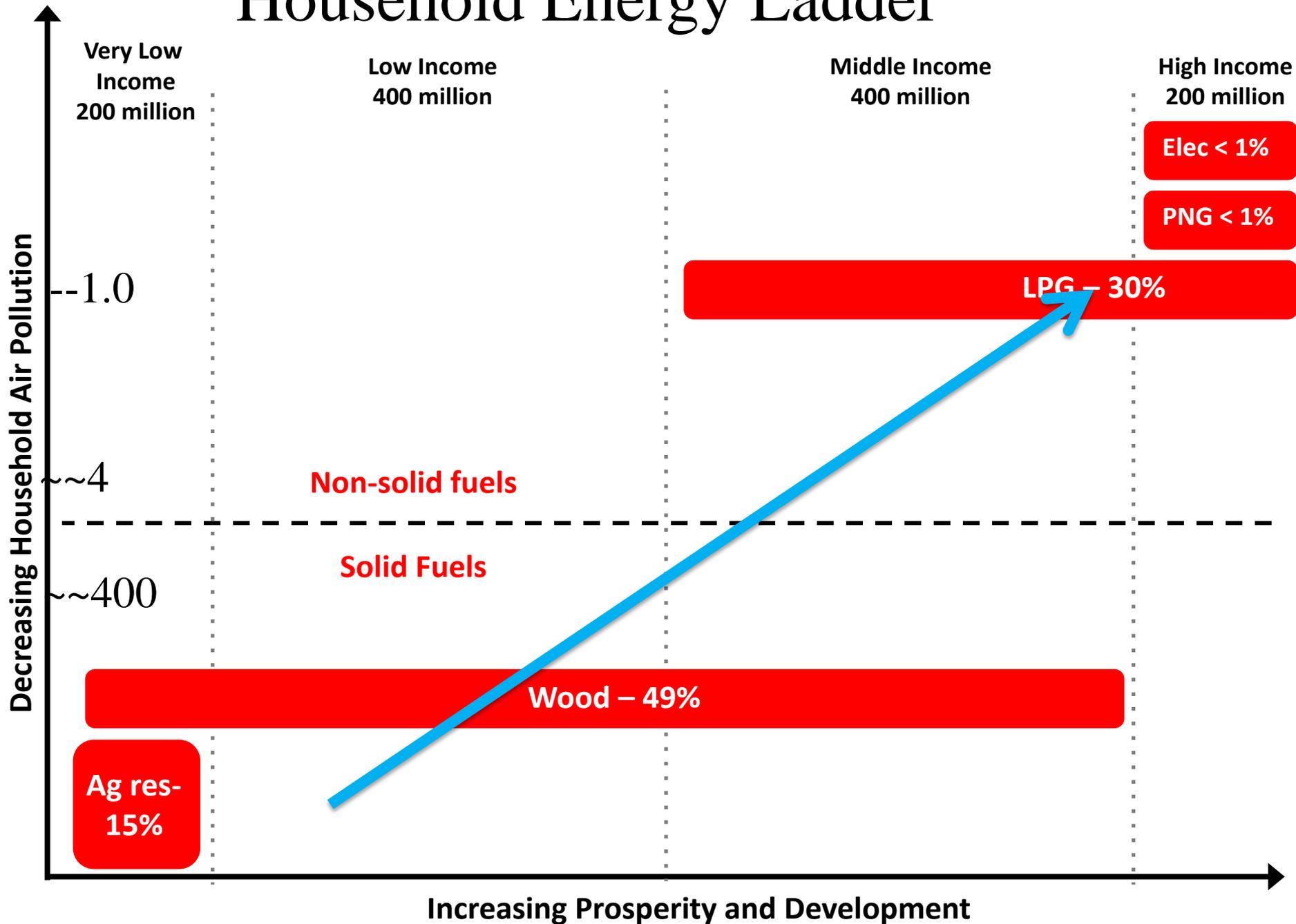
- Poor use of natural resources
- Threat to natural environment
- Inefficient use of women's time
- Climate impacts

But, here, I only focus on health

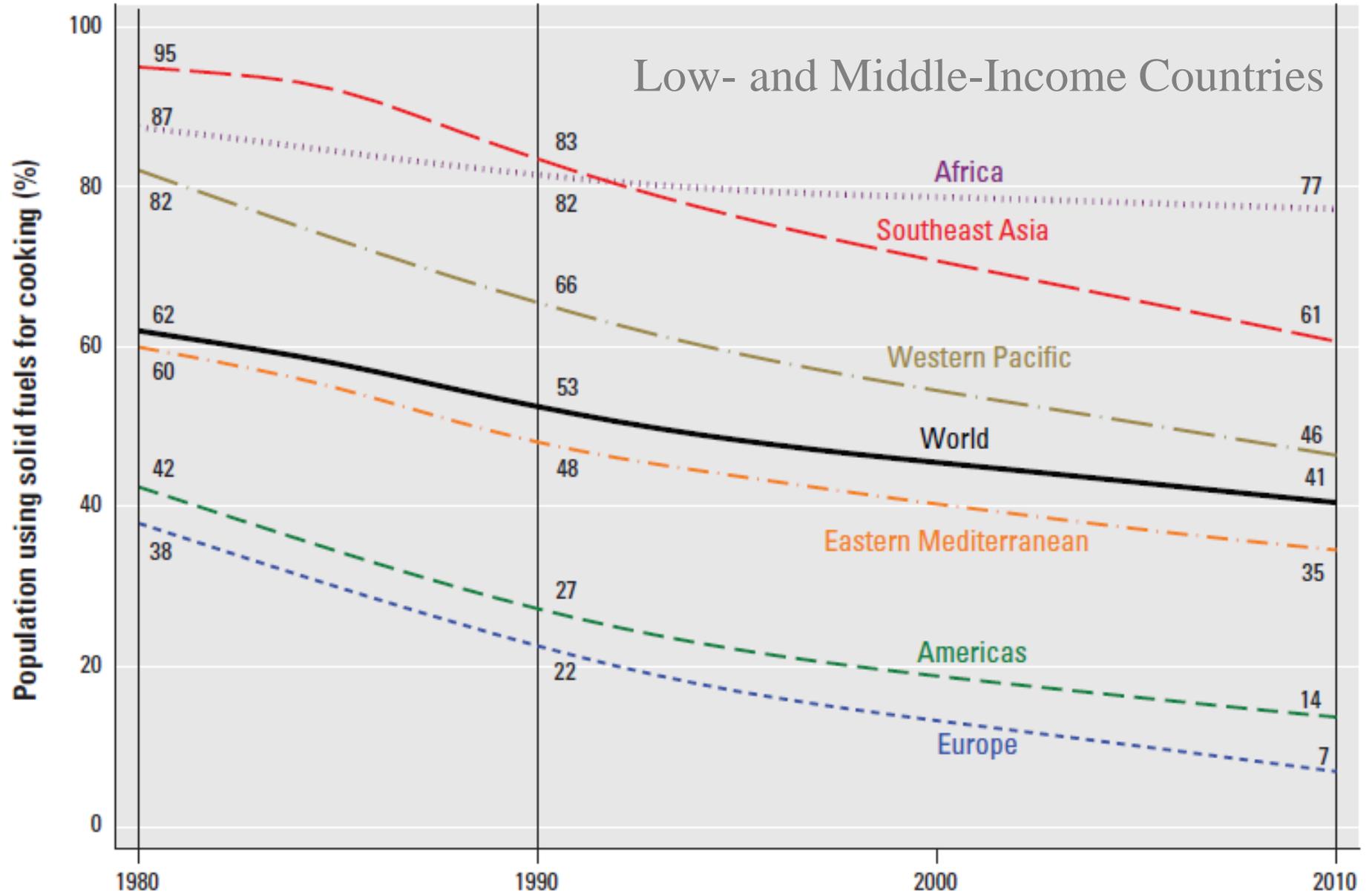
# What has been done-#1

- Wait for development to work.
- Bottom line
  - Percent using solid fuel slowly declines with development alone (no special policies)
  - But not always number of people exposed
  - But can decline much faster with targeted clean fuel policies

# Household Energy Ladder



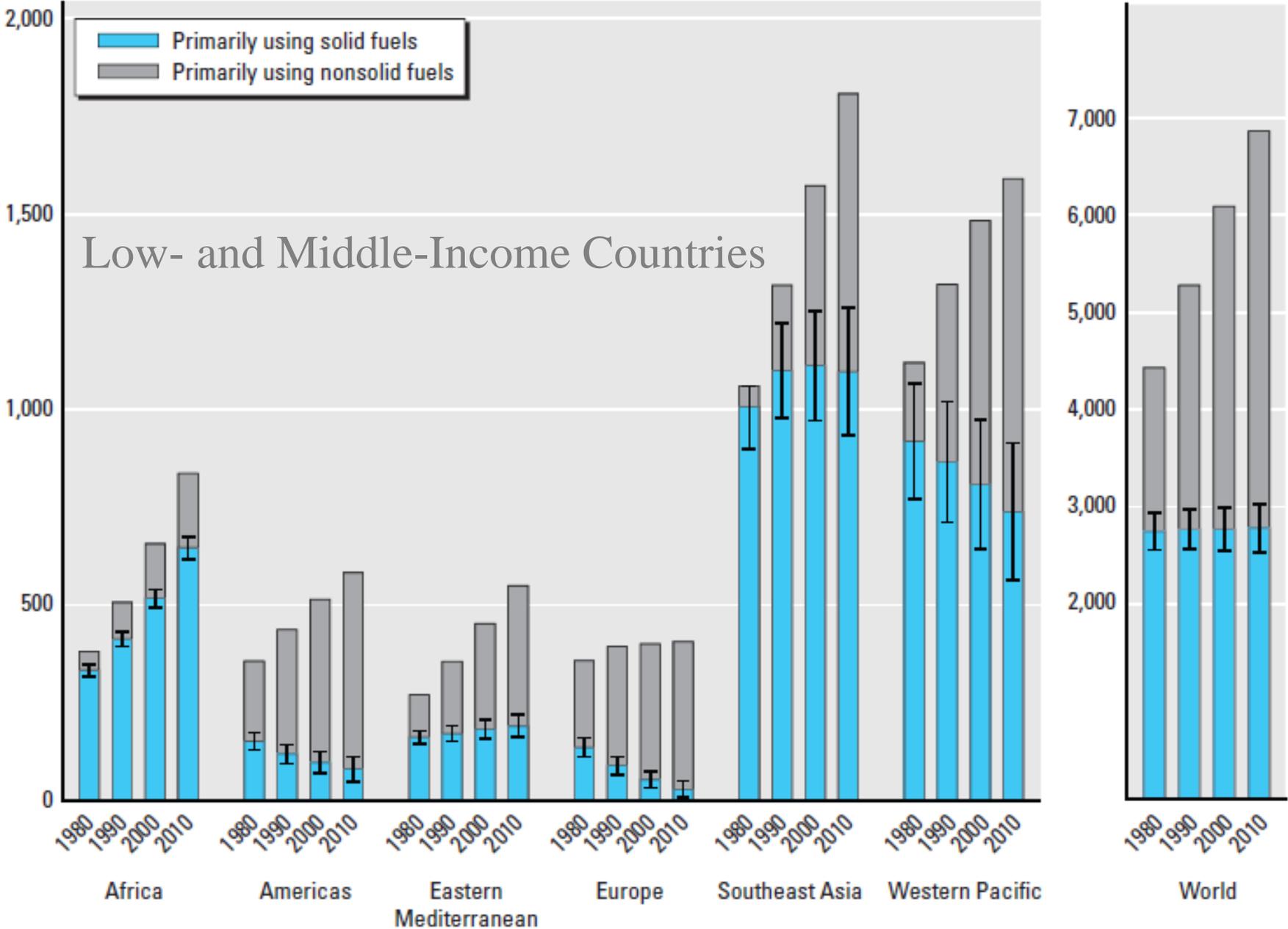
# Low- and Middle-Income Countries



■ Primarily using solid fuels  
■ Primarily using nonsolid fuels

## Low- and Middle-Income Countries

Population (millions)



# Cooking in PAHO LMICs 1990-2010

- Solid fuel users in region went from 120 million to 80 million (27% to 14% usage)
- Decline was due to Argentina, Ecuador, Uruguay, & Venezuela going to near zero usage from a total of nearly 20%
- And Belize, Brazil, Costa Rica, Chile, Guyana, & Jamaica cut usage by 3x
- Although Columbia, El Salvador, Mexico, & Peru only had slow declines in users

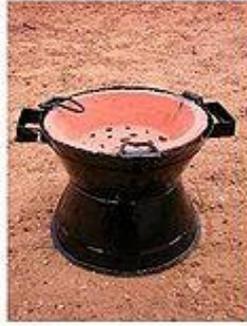
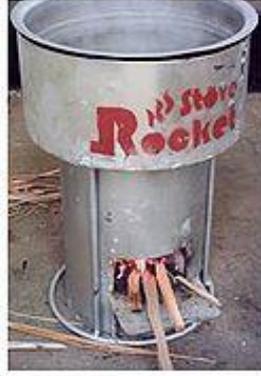
# History, cont.

- Countries with about the same number using solid fuels after 30 years
  - Honduras
  - Nicaragua
  - Panama
- Countries with more users after 30 years
  - Cuba
  - Guatemala
  - Haiti
  - Paraguay

# What has been done-#2

- Many hundreds of “improved” biomass stove programs over ~40 years.
- Earliest in Guatemala – Lorena in 1970s
- Major national programs in China and India in the 1980s covering ~200 million households in all
- Peru, Mexico, Nepal and other countries today
- Hundreds of NGOs, big and small, promoting stoves around the world over the decades
- Hundreds of stove models

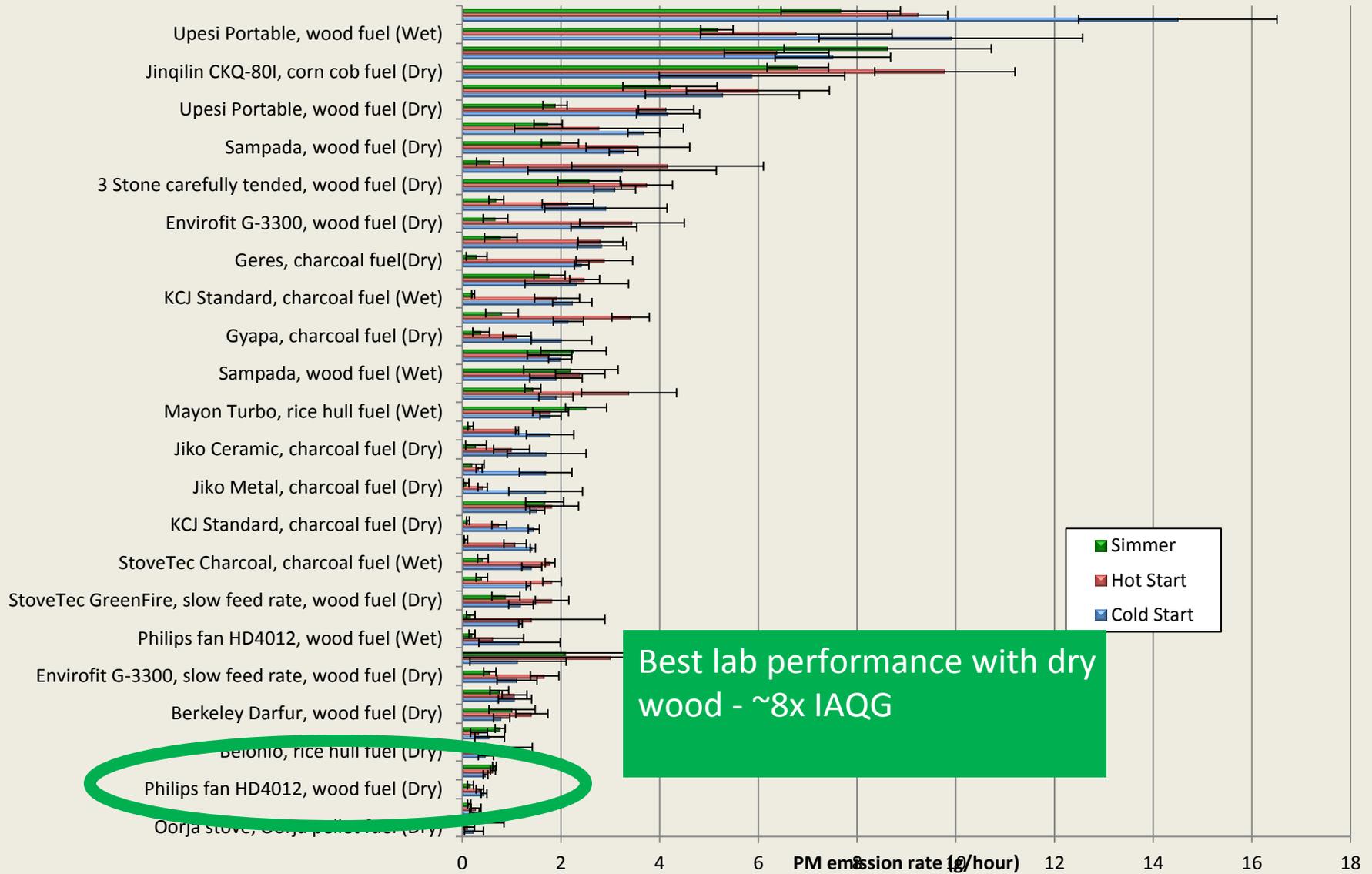
# Diversity of improved cook stoves



27.0



# Figure S29. PM<sub>2.5</sub> Emission Rate (per Time)



# RESPIRE

Impact on pneumonia up to 18 months of age



Traditional open 3-stone fire:  
kitchen 48-hour  $PM_{2.5}$  levels of  
600 - 1000  $\mu g/m^3$

WHO AQG = 10-35  $ug/m^3$



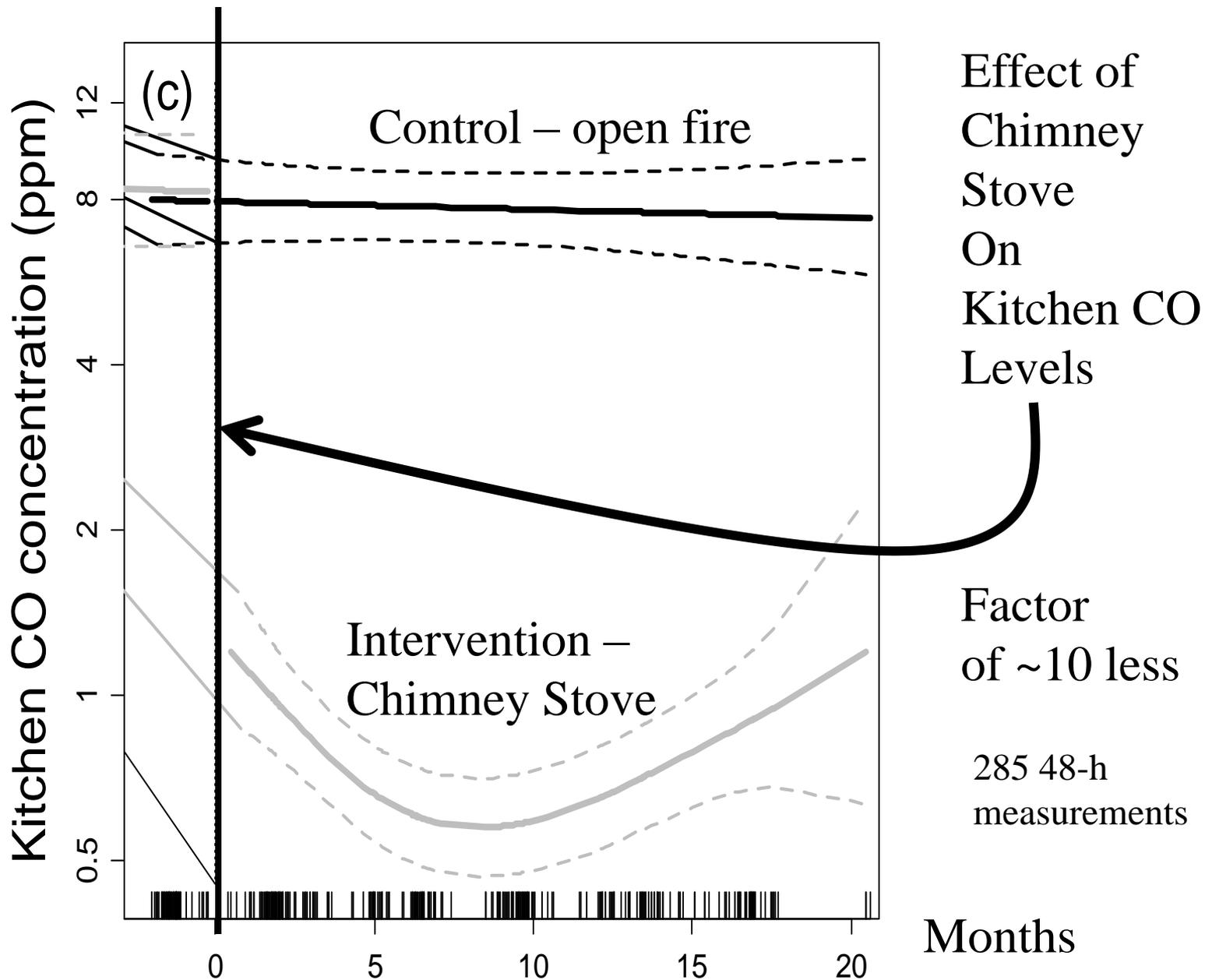
Chimney woodstove, locally made  
and popular with households



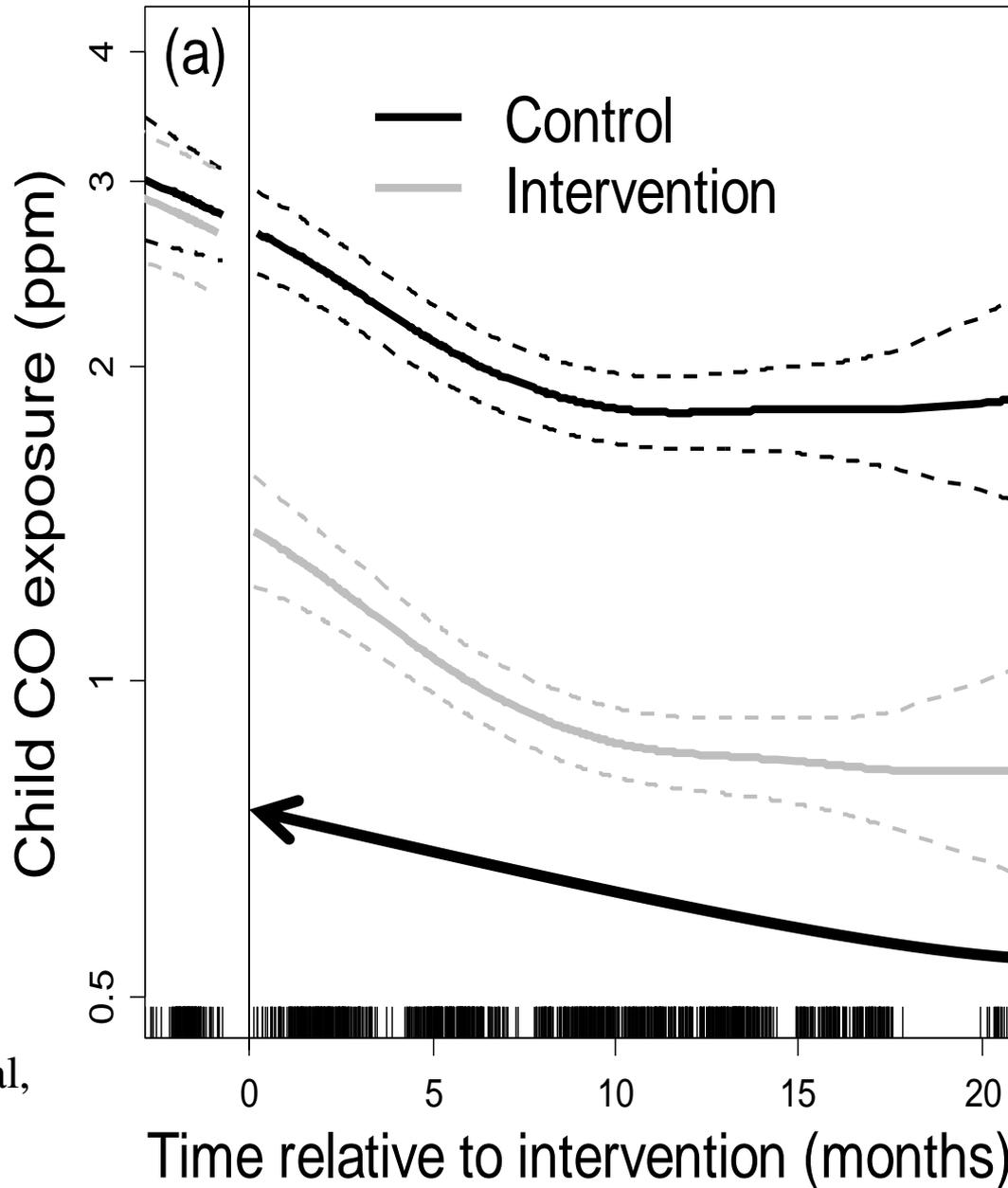
CO monitor

CO monitor

# Guatemala RCT: Kitchen Concentrations



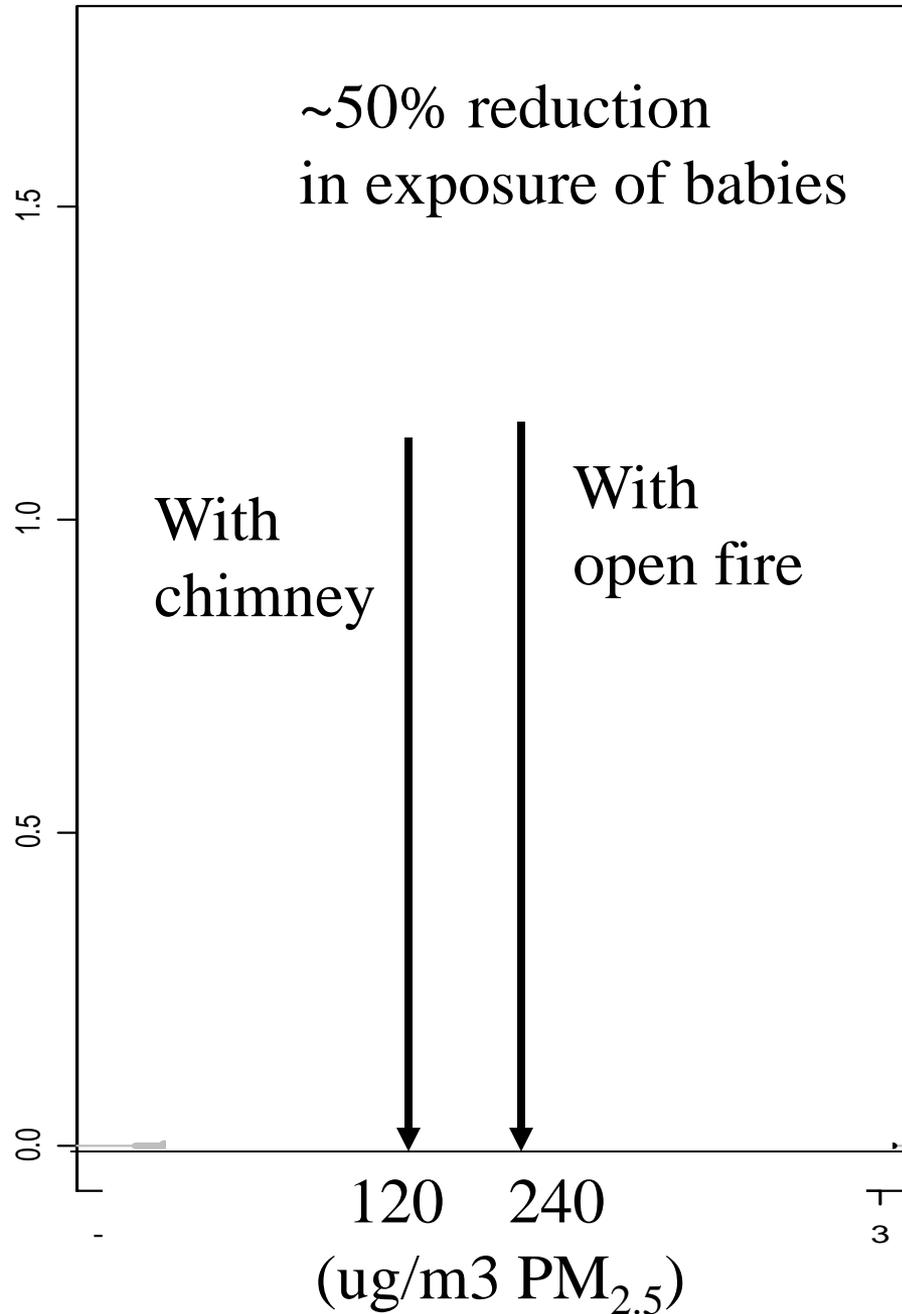
# Infant Exposures



1888 48-h  
measurements

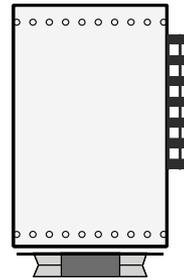
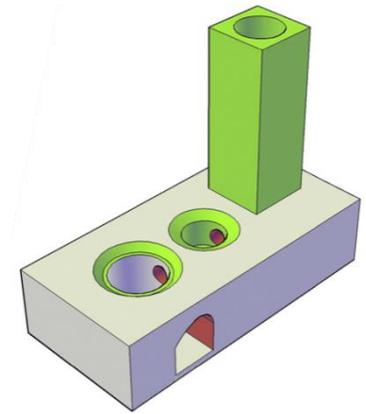
Effect of  
Chimney  
Stove  
On  
Infant  
Exposures  
- 2x less

(b)

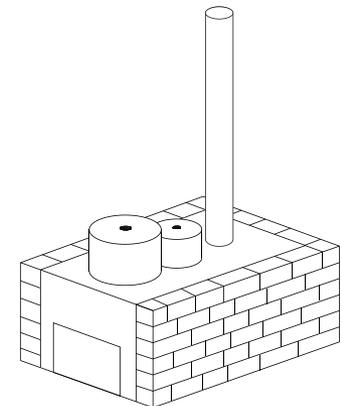


Chimney  
stove did  
not protect  
all  
babies

heart of  
the hearth



**LONG-LASTING  
LOW EMISSIONS  
COMBUSTION UNIT**





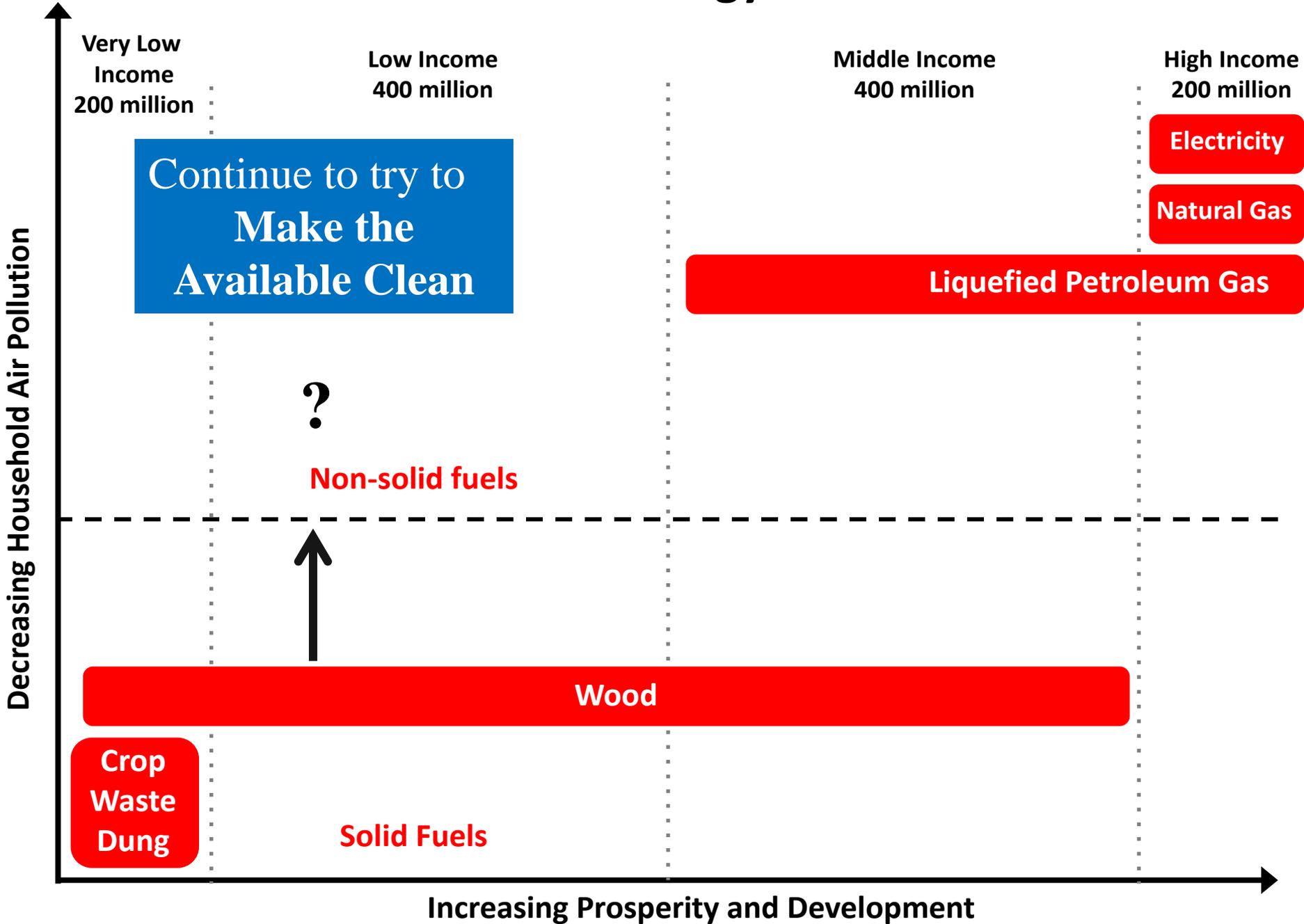
**Multi-million Dollar Global Innovation  
Prize for a Truly Clean  
Biomass Combustion “Engine”  
for Household Stoves**

Proposed by Ambuj Sagar and Kirk R. Smith, *Nature*, May 2013

## Bottom Line - #2

- The cleanest stove models have been disseminated to only a few thousand households in the region
- And, as yet, no biomass stove in the world comes close to the boundary – is clean enough to be truly health protective in household use
- Perhaps they can be clean enough, but much more work is needed

# Household Energy Ladder



Very Low  
Income  
200 million

Low Income  
400 million

Middle Income  
400 million

High Income  
200 million

Continue to try to  
Make the  
Available Clean

Electricity

Natural Gas

Liquefied Petroleum Gas

?

Non-solid fuels

Wood

Crop  
Waste  
Dung

Solid Fuels

Decreasing Household Air Pollution

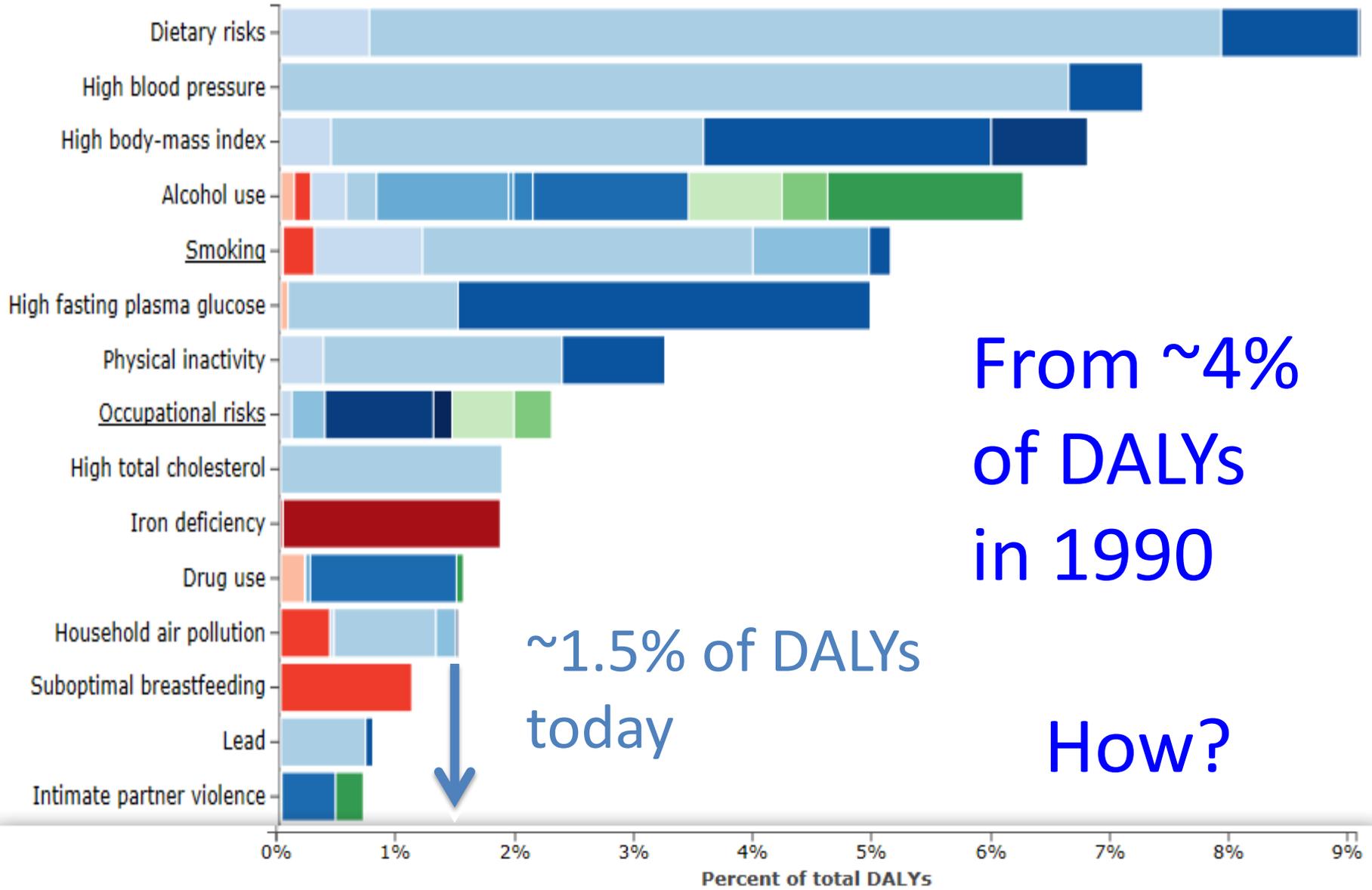
Increasing Prosperity and Development

# New Paradigms

## Paradigm #1

Making the clean  
available

Latin America and Caribbean (World Bank), DALYs  
Both sexes, All ages, 2010

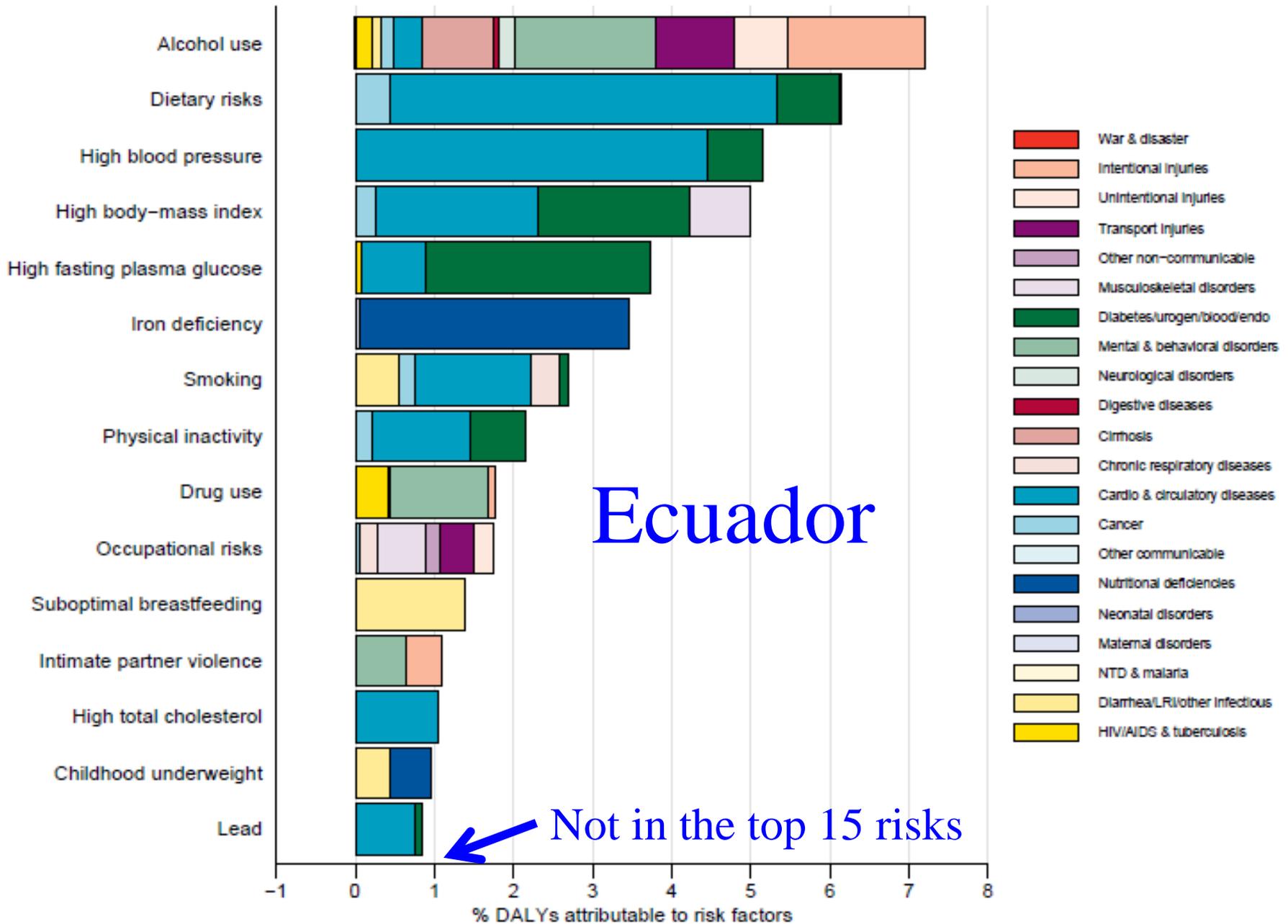


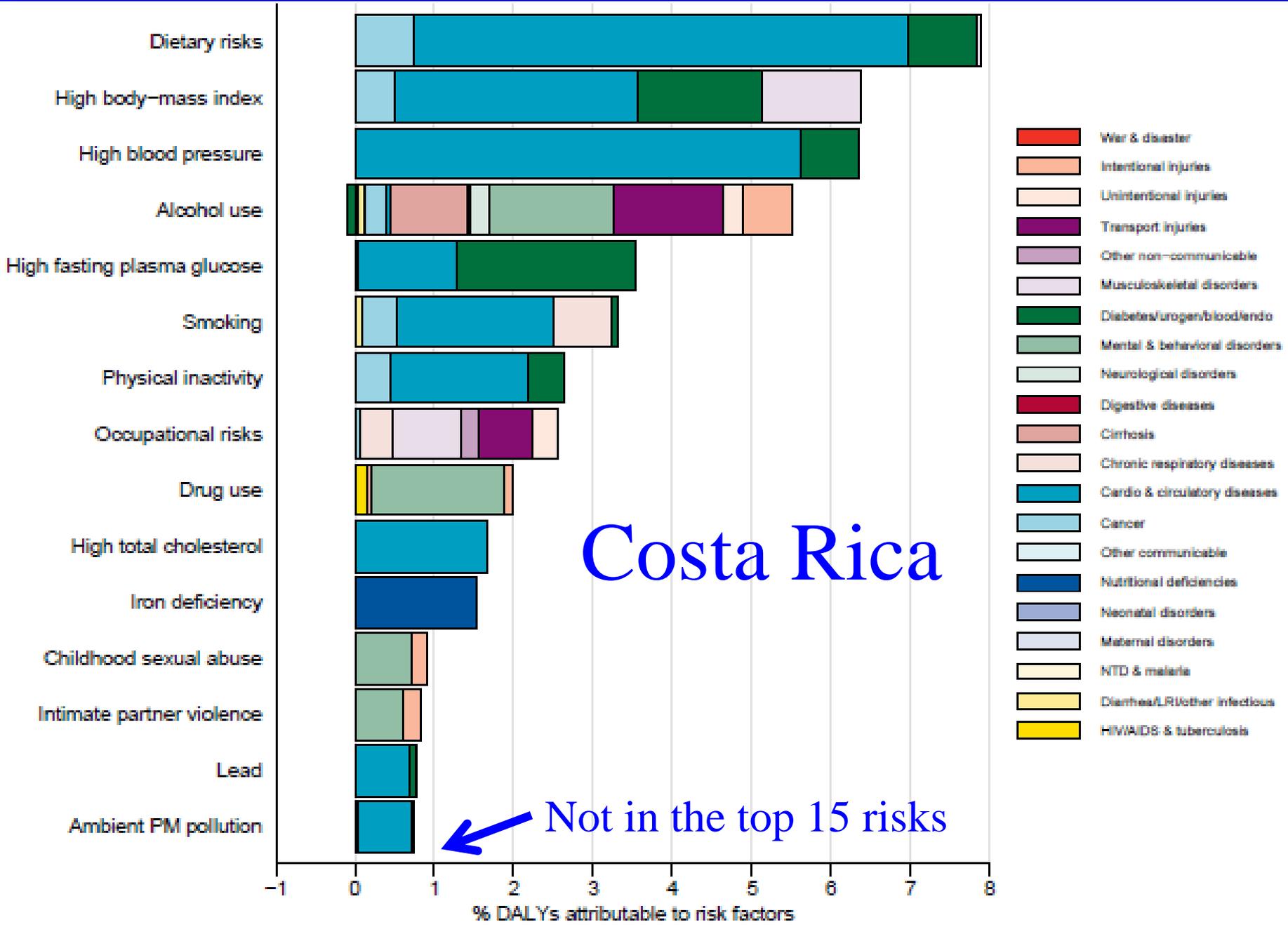
From ~4%  
of DALYs  
in 1990

~1.5% of DALYs  
today

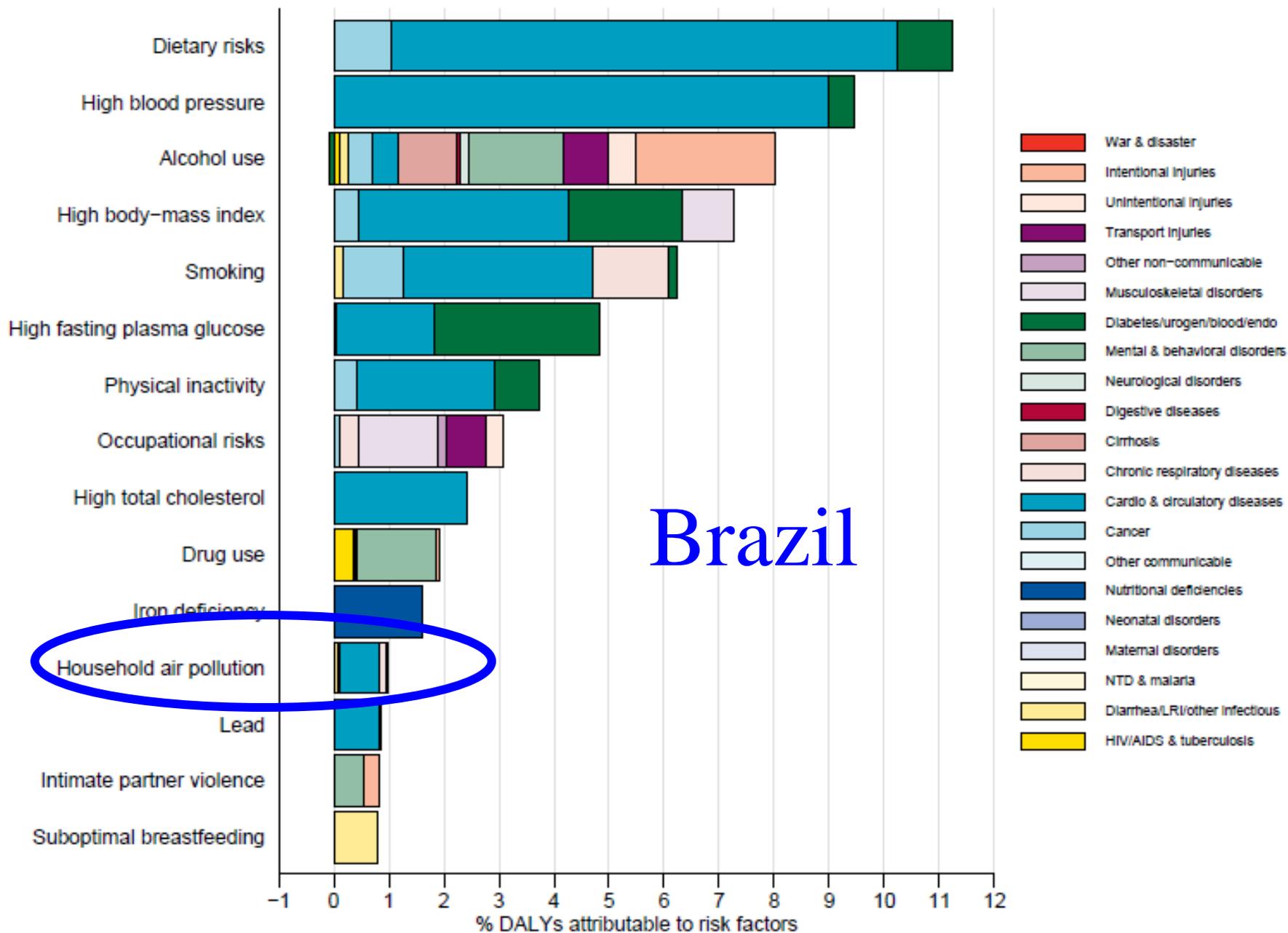
How?

Burden of disease attributable to 15 leading risk factors in 2010, expressed as a percentage of Ecuador DALYs





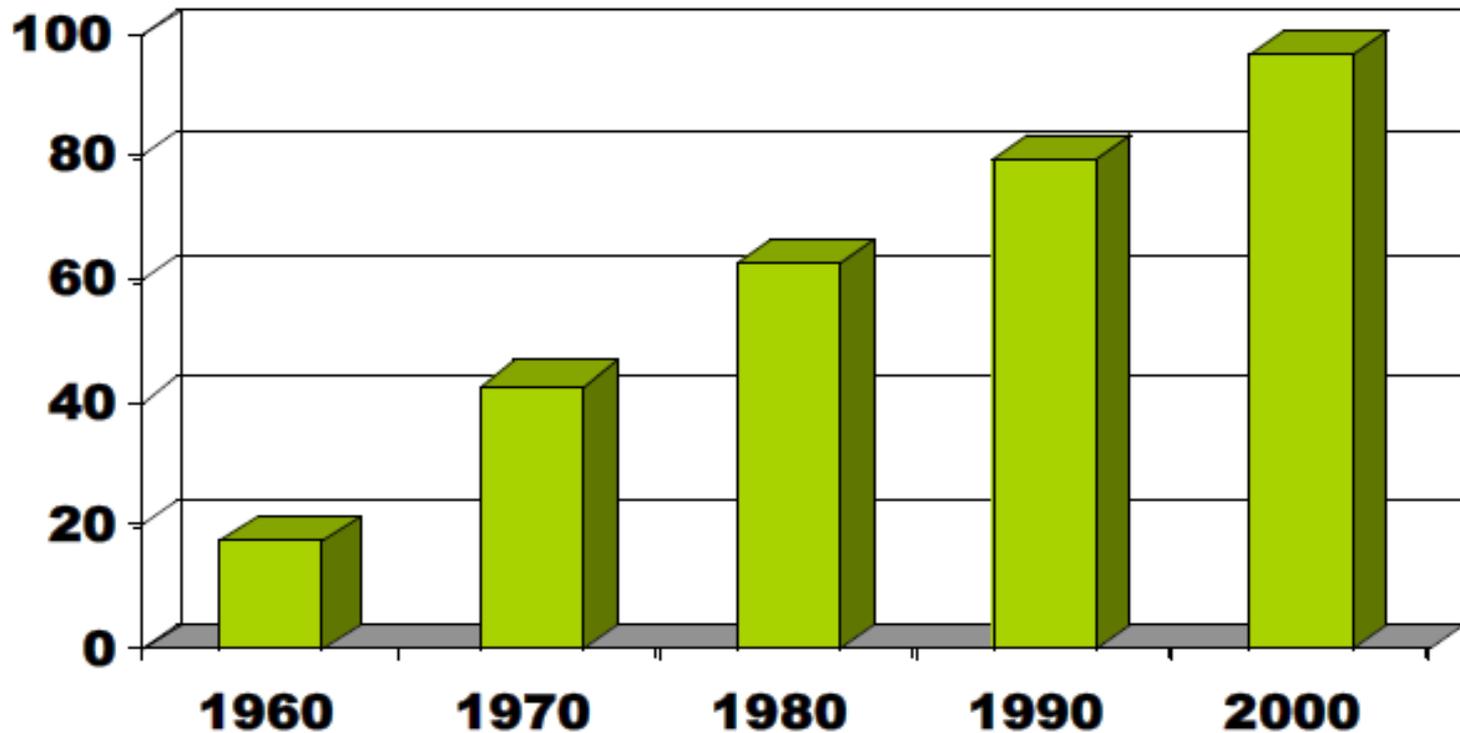
Burden of disease attributable to 15 leading risk factors in 2010, expressed as a percentage of Brazil DALYs



# The Brazil Story

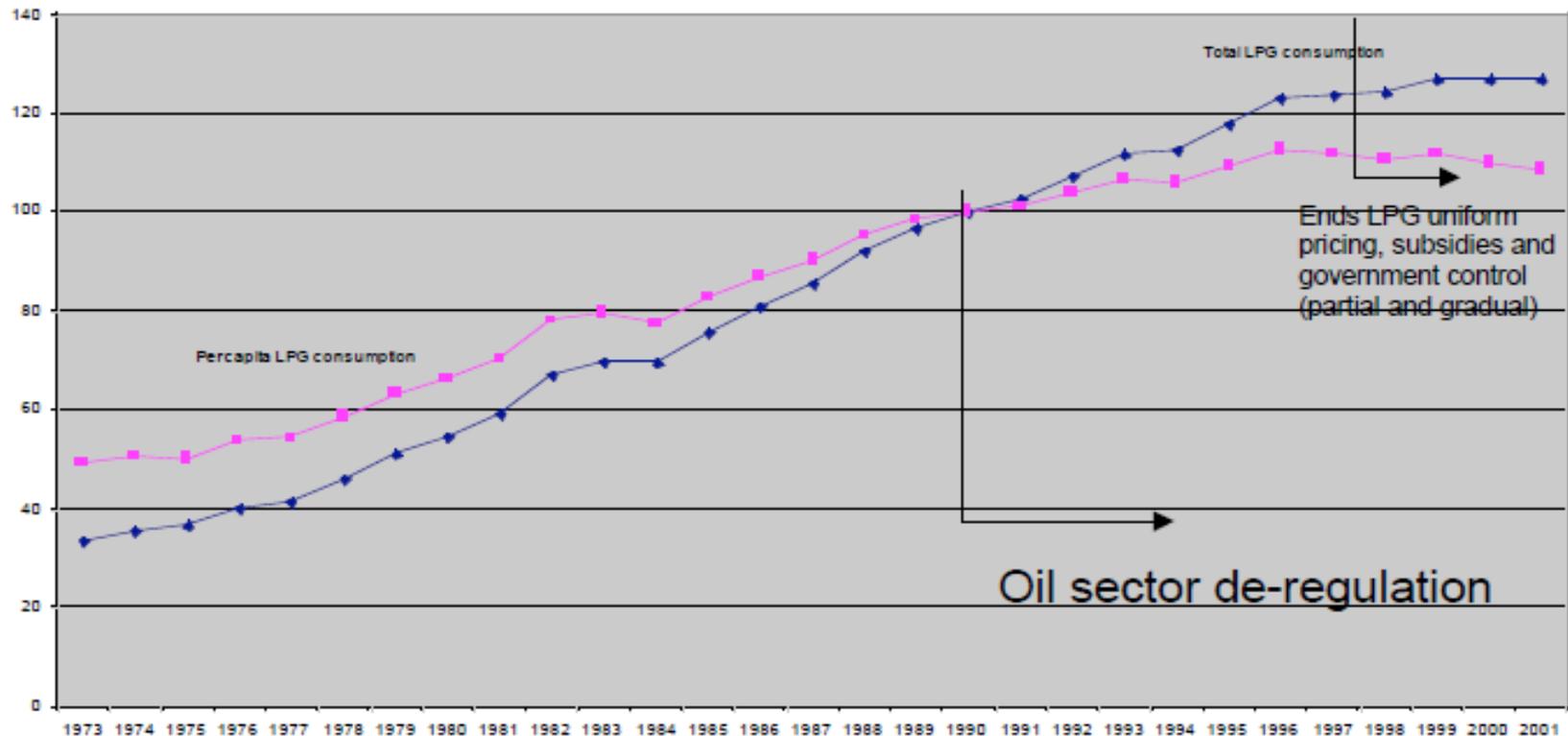
## The saturation levels of LPG (% total HH)

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# The Brazil Story

## Evolution of LPG demand: total and average percapita consumption (1990=100)



# Porous radiant burners → Porous medium combustion

## Advantages

- ✓ Flameless combustion
- ✓ Based on recirculation

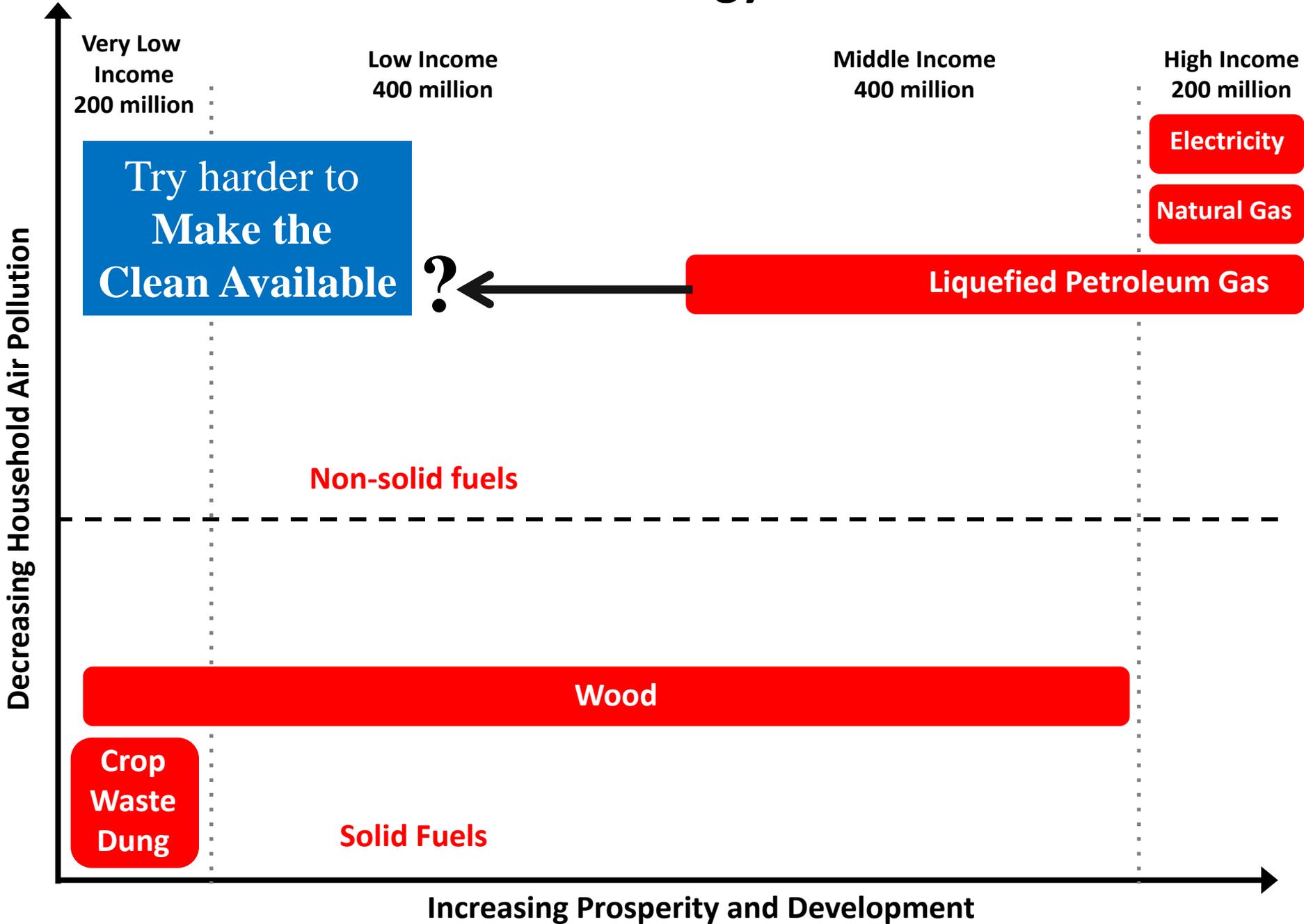
Up to 25% more efficient

high thermal flux  
for high value fuels

## Conventional L



# Household Energy Ladder



## Paradigm #2

Stepping out of the box

If you don't need your father's land  
line for a phone,  
why your mother's stove?

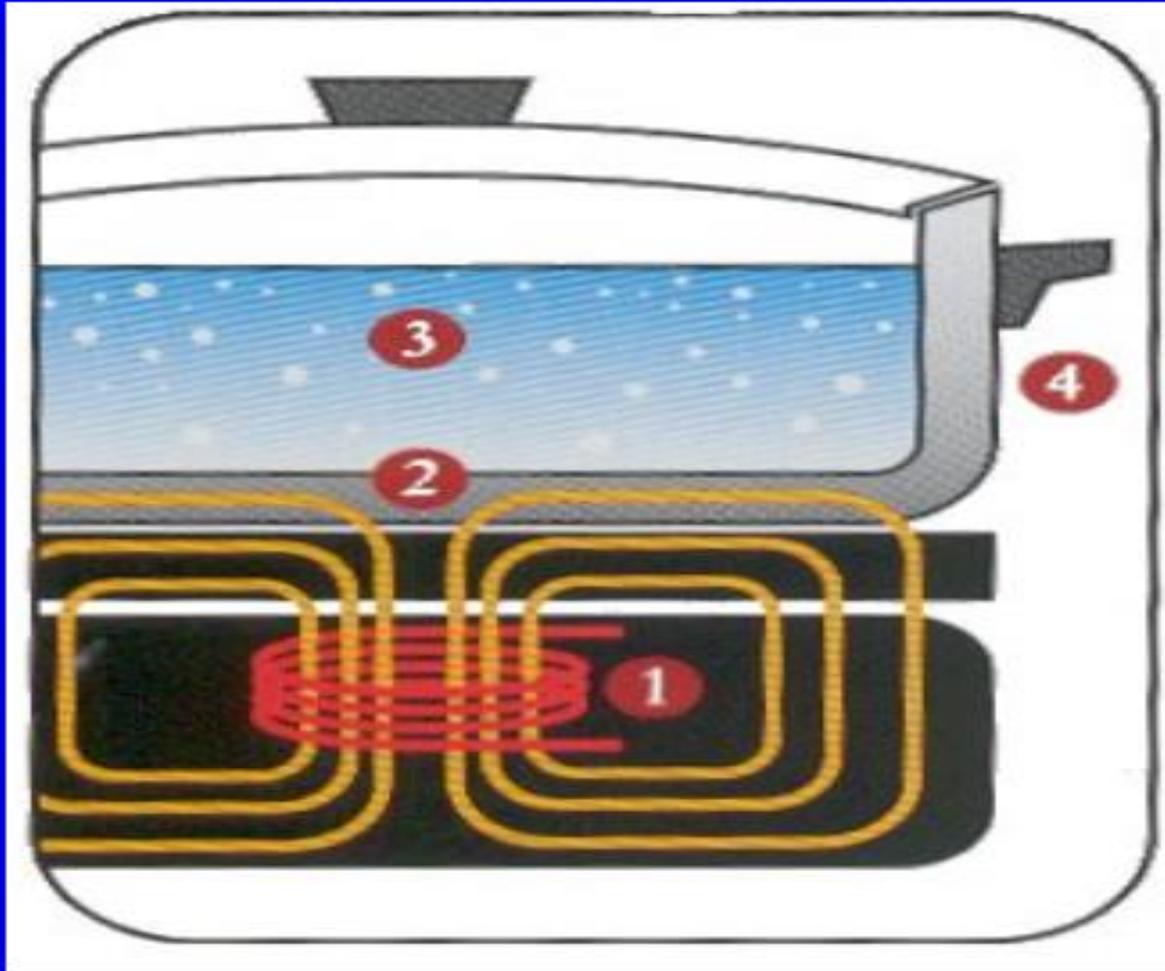
- Electrification is an essential human need – brings many social and economic benefits
- Electrification also allows a wide range of highly efficient cooking devices
- Every time a switch is flicked, instead of a match, it is good for health



# What is an induction cookstove?

- Electric, yes, but entirely different technology from traditional electric stoves
- High frequency magnetic field induces heat in pot alone
- More efficient ~90% instead of ~60%
- Faster cooking ~1.5x
- Safer and cooler— surface is warm but does not burn or cause fires
- Long-lived, easy to clean
- Large economies of scale in manufacture like other electrical devices

# Cooking with Induction







Safer – the stove does not get hot

# Induction Cooktop Market in India 2012-2016

Published: March 2013  
Infiniti Research Limited

35.4% per year growth  
predicted: 2012-2016

Factor of nearly  
five increase!

- Bajaj Electrical Ltd.
- Compton Greaves Ltd.
- Eurolux
- Glen Appliances Pvt. Ltd.
- Inalsa
- Jaipan Industries Ltd.
- Kenwood Ltd.
- Khaitan Electrical Ltd
- Morphy Richards
- Panasonic Corp.
- Phillips
- Preethi Kitchen Appliances, Ltd.
- Sunflame
- TTK Prestige Ltd.**
- Usha International Ltd.
- Westinghouse

# Flying off the shelves in China



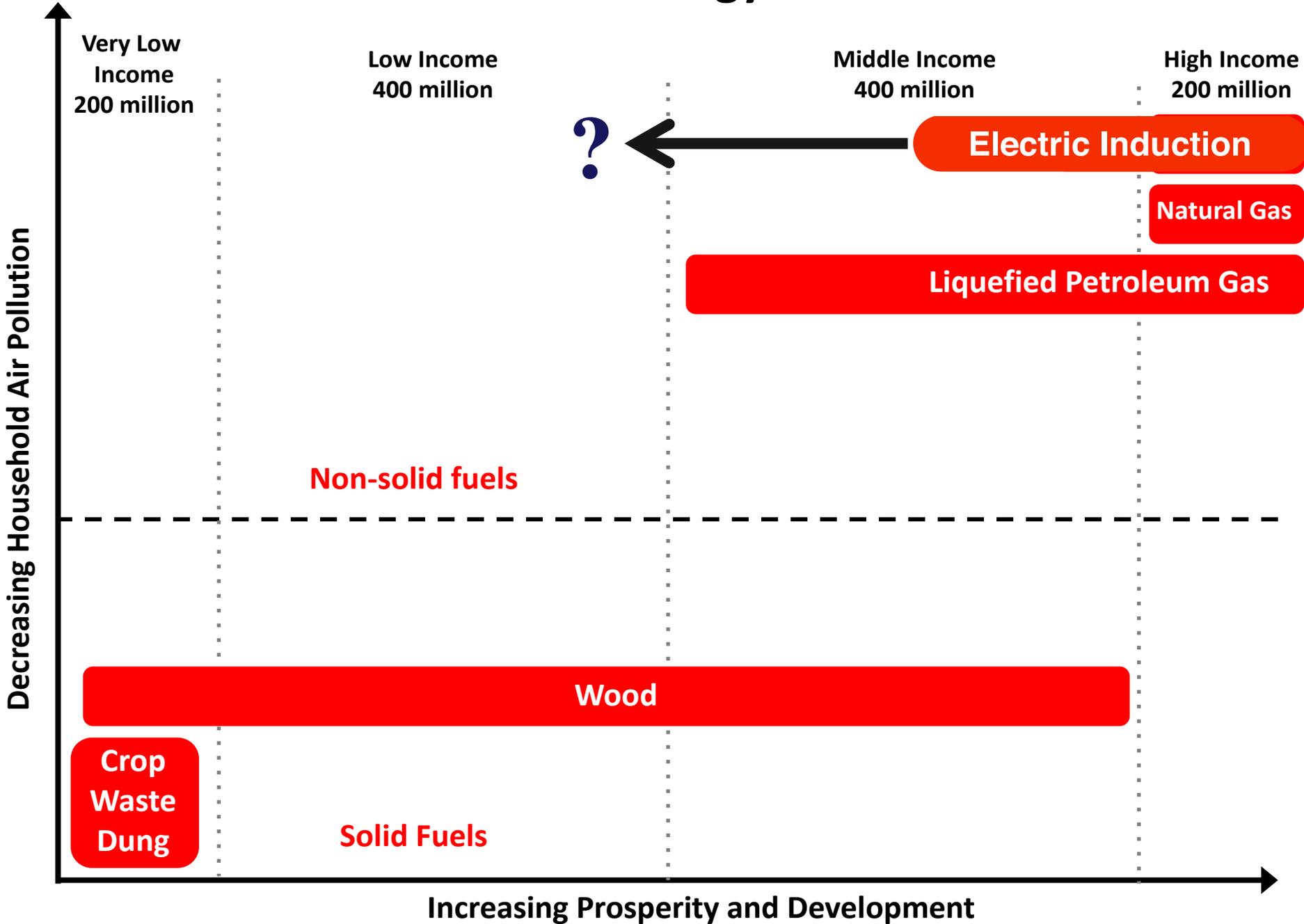
# Costs coming down dramatically

US \$7.80 each (with warranty):

The cost of two coffee lattes

Ecuador has \$250 million loan from  
Chinese Export Bank to begin to  
change out every stove  
in the country to induction

# Household Energy Ladder



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High Income  
200 million



**Electric Induction**

**Natural Gas**

**Liquefied Petroleum Gas**

**Non-solid fuels**

**Wood**

**Crop  
Waste  
Dung**

**Solid Fuels**

Decreasing Household Air Pollution

Increasing Prosperity and Development

# Paradigm #3: It takes a village



Gujarat, Feb Evening

# Changing out one hearth at a time is not as effective as changing out whole villages

- Learned in sanitation programs years ago:
- Benefits:
  - Herd effect: both household and community benefits to clean fuels/stoves and latrines.
  - With community interventions, a new set of incentives and social pressures are possible.
  - More efficient provision of service

# Smokeless Villages?

- Government of India has been promoting sanitation coverage to ensure better health and quality of life for people in rural India.
- In 2005, it launched an award-based Incentive Scheme for open-defecation-free villages,
- Same kind of “herd” effect operates for dirty combustion – need to not have offending material in places where people live

# Paradigm #4: It is a health issue

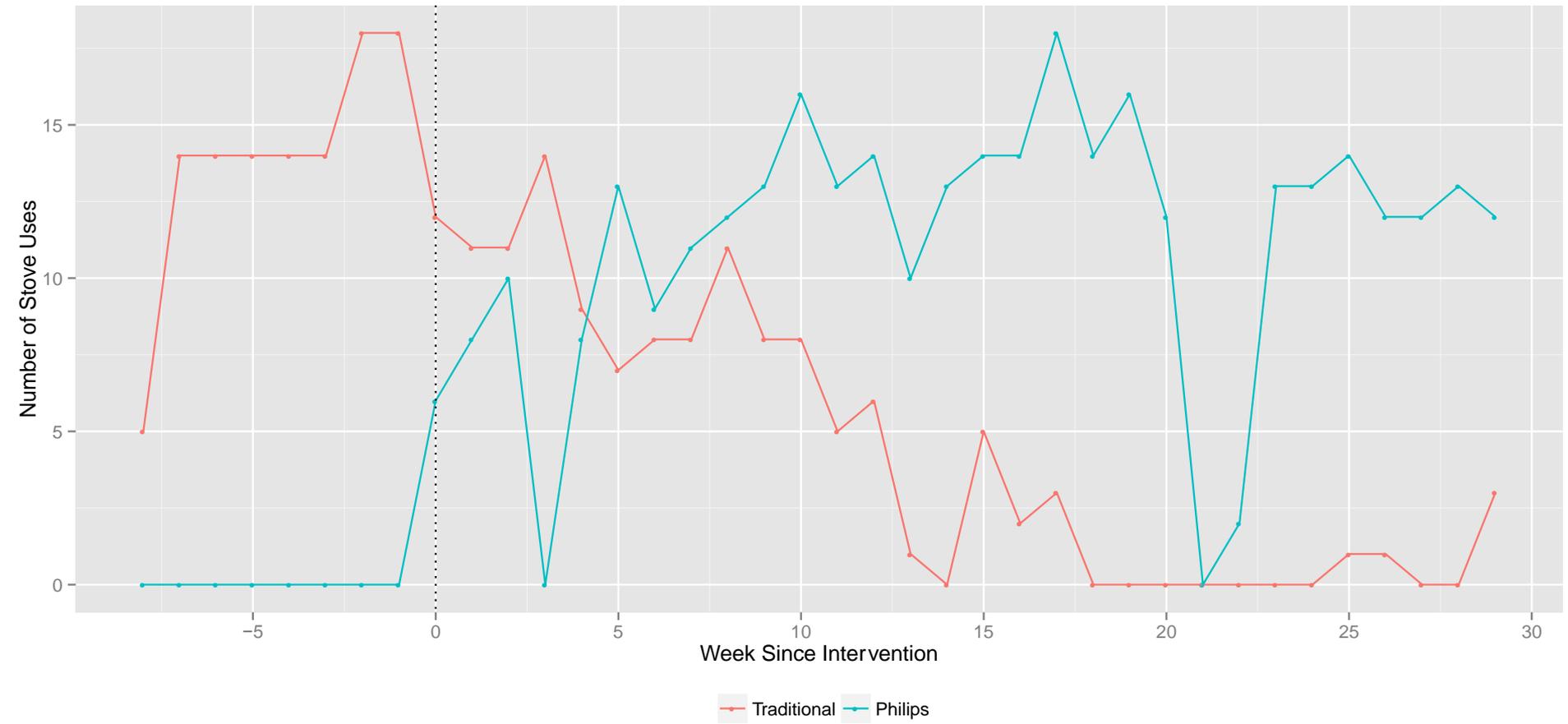
- Not primarily an energy, climate, or employment issue
- Health sector finds the most effective solutions possible and makes them available
- Treats all the same: we do not have rural vaccines and urban vaccines
- Not stopped by taste, custom, poverty, special interests, or political correctness
- Not afraid of advanced tech that works

# The health community expects proposed health Interventions

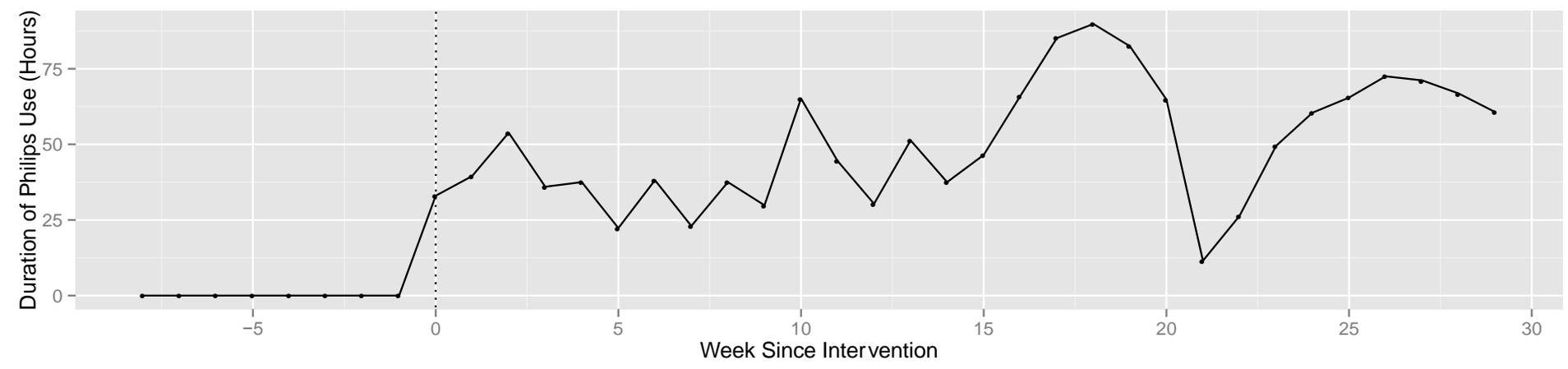
- To have systematic and phased evaluations of their laboratory and field efficacy and effectiveness – as with vaccines, drugs, , bednets, latrines, etc.
- This must include rigorous monitoring: “You don’t get what you expect, but what you inspect” (No lograrás lo que esperás, sino lo que inspeccionás)
- With cookstove/fuels, the best analogy is not a vaccine, but DOTS: directly observed therapy

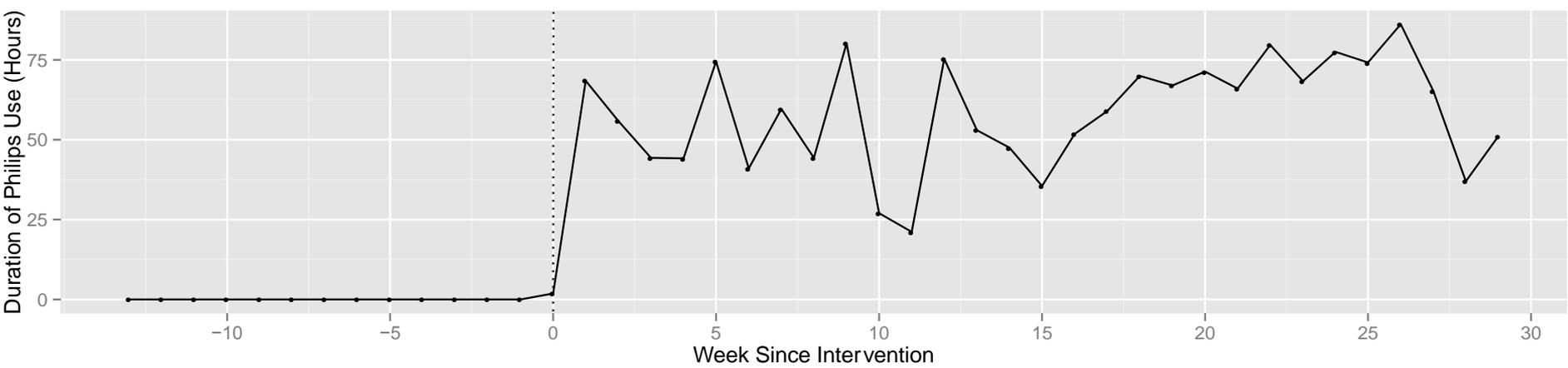
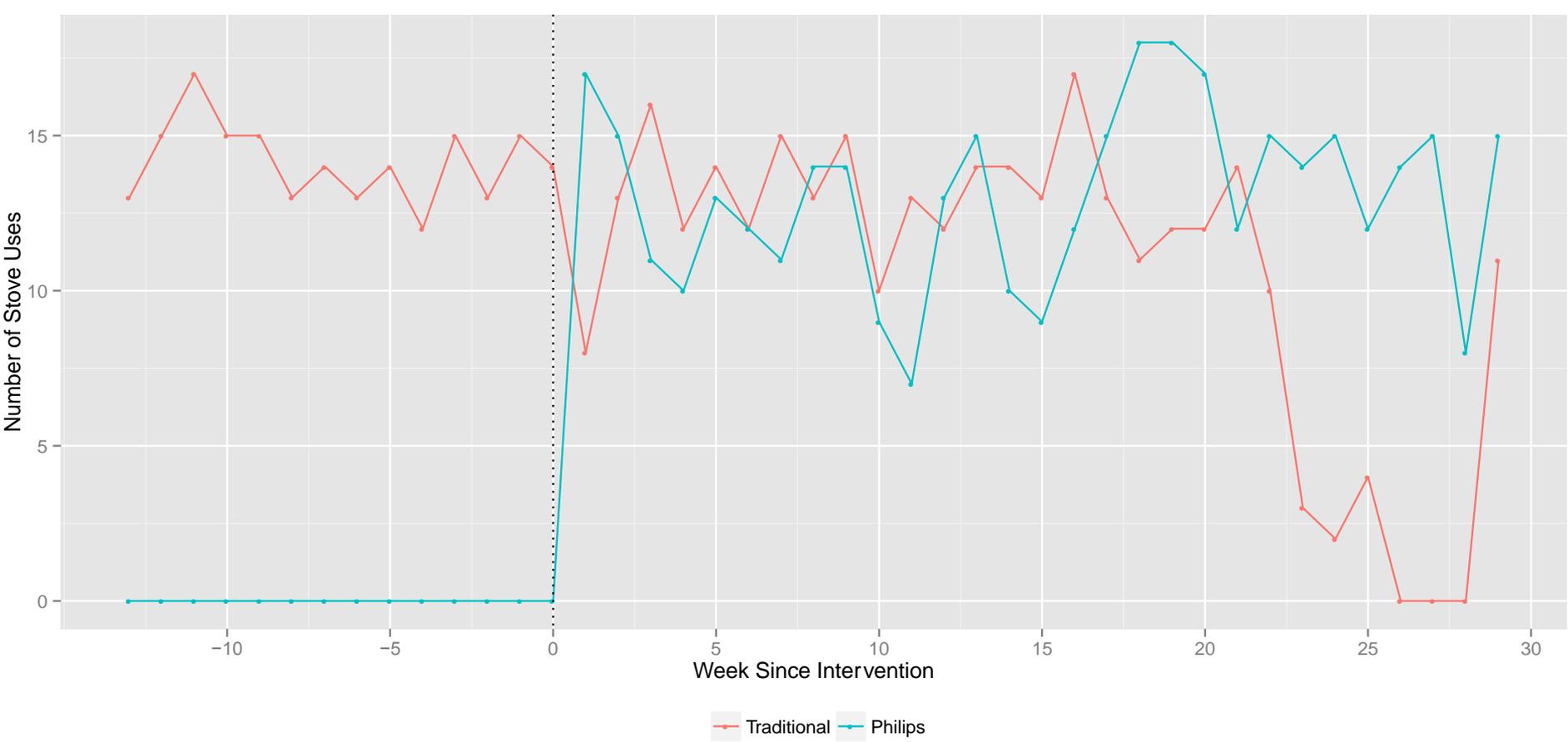


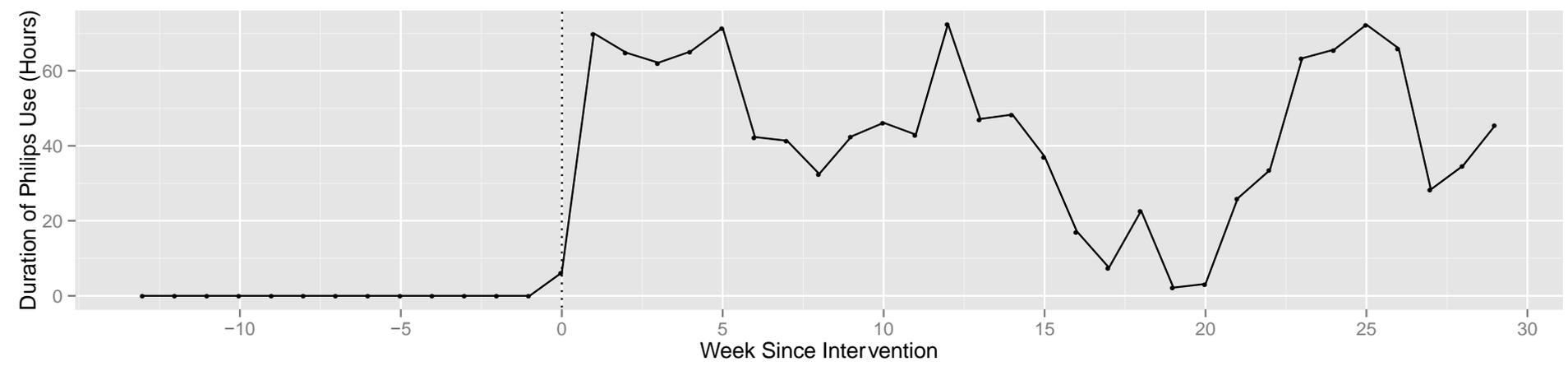
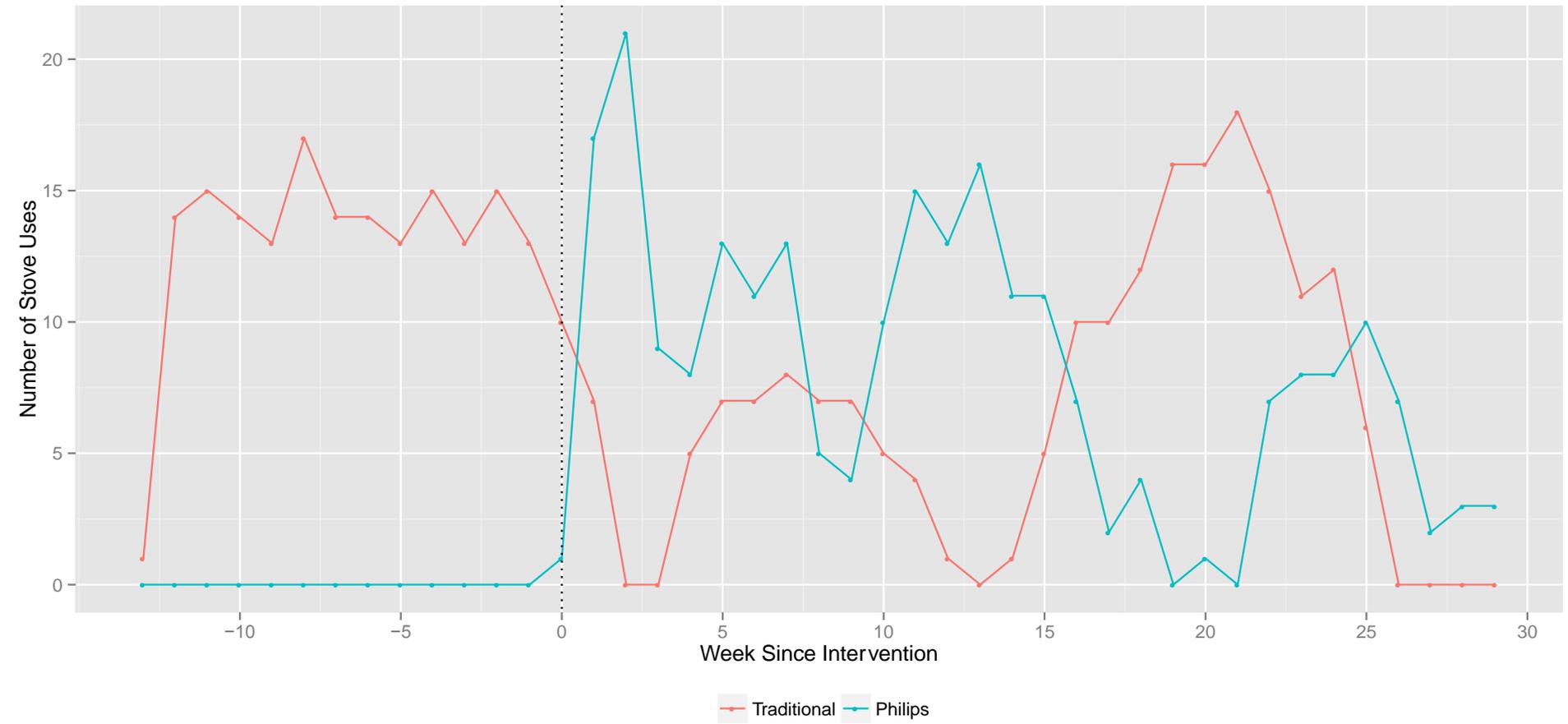


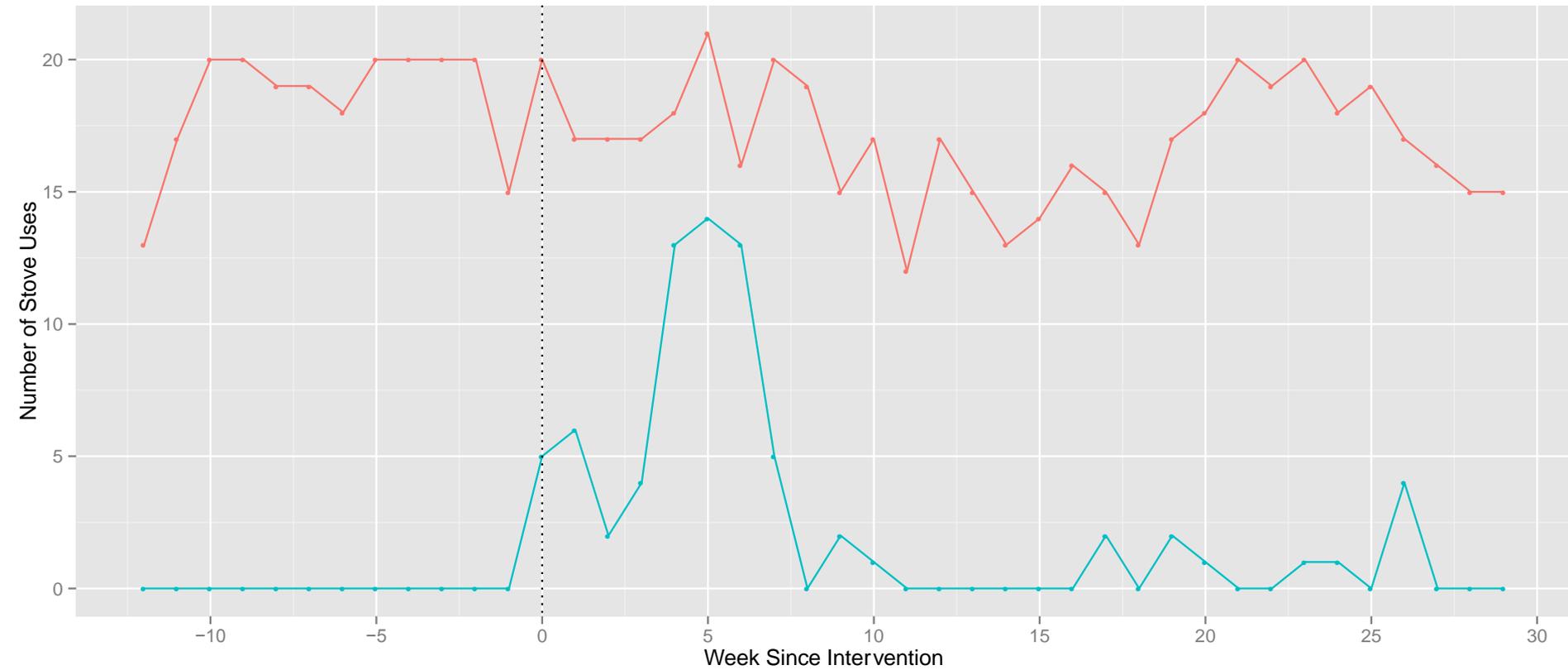


Traditional Philips

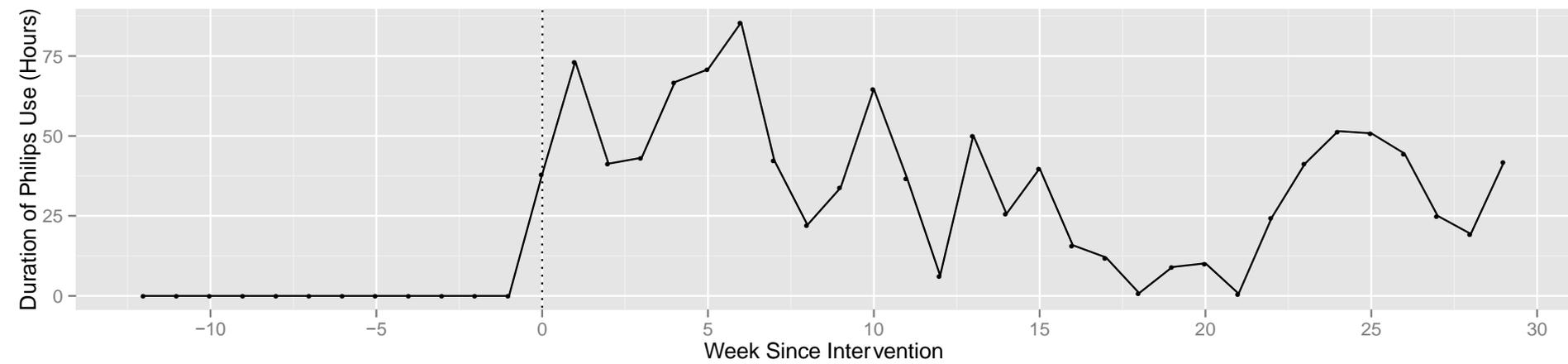








Traditional Philips



# Indian Ministry of Health Air Pollution Task Force

- First Ministry of Health in world to treat AP as one of its major priorities and consider along with other risk factors in its mission
- First government agency in the world not to address AP by location, but by total exposure – a true health focus
- Thus, not indoor/household, not outdoor, but by what will give the most health benefit

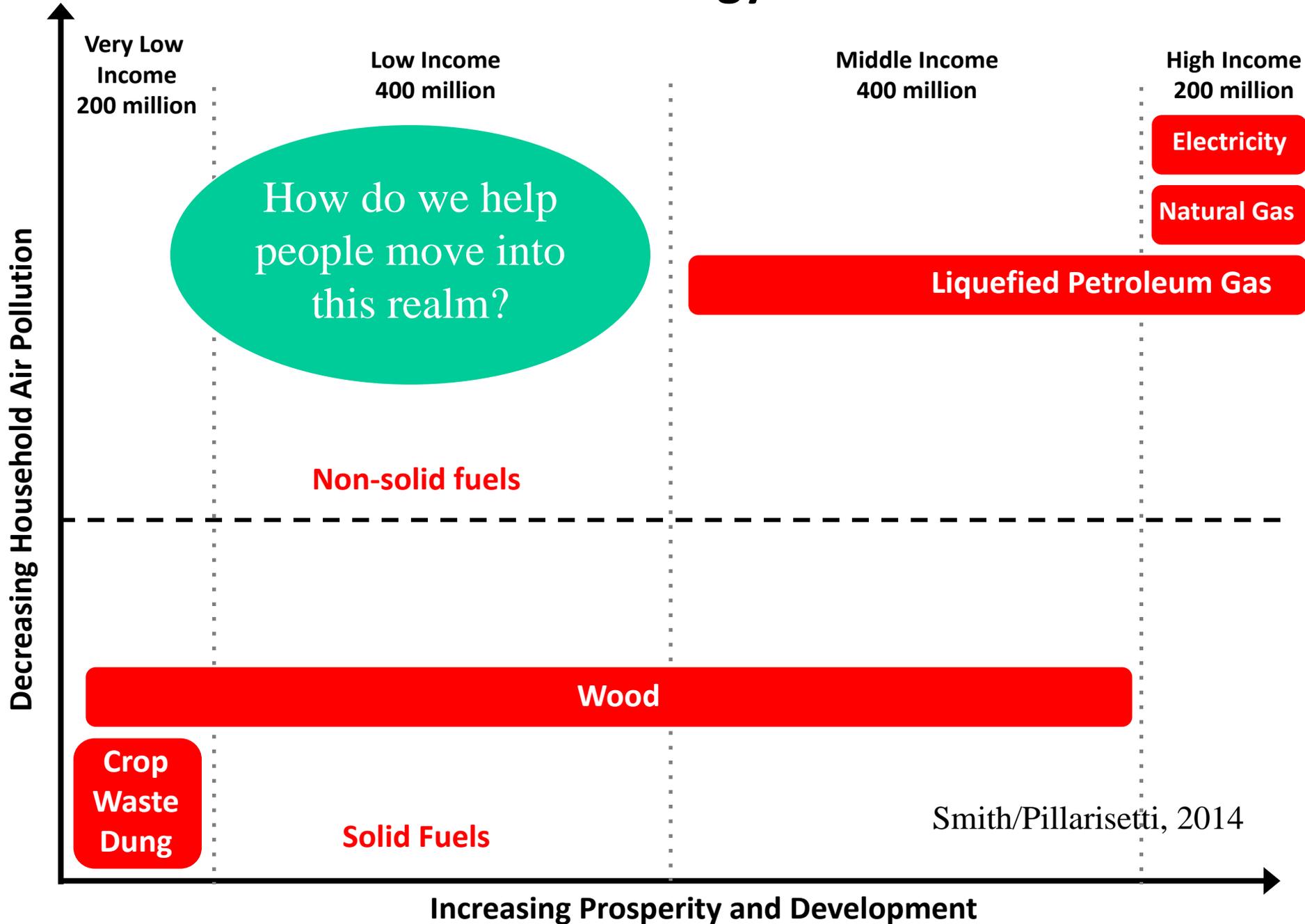
# Proposal for PAHO Region

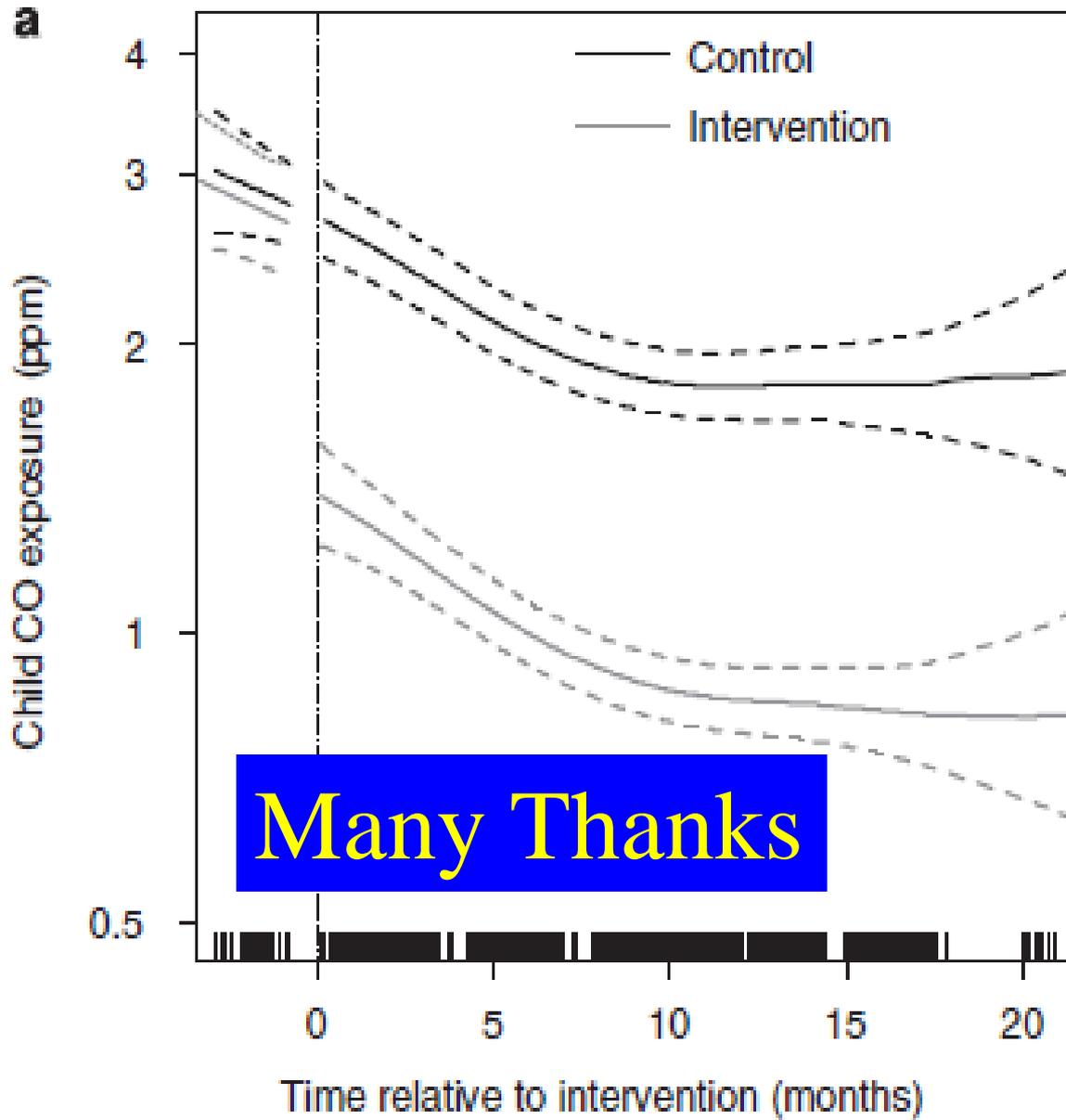
- Workshop followed by publication
- Household Fuel Transitions for Health in Latin America
- Share histories, lessons learned, etc from nations have made transition
  - Brazil, Ecuador, Costa Rica, etc.
- And those wishing to do so

# Paradigm Shifts

- **Make the clean available, as well as make the available clean**
- Embrace/enhance transformational leap-frog technologies
- Look for community solutions
- Enhance displacement of clean fuels from richer to poorer households
- Act recognizing that it is primarily a health issue and thus optimize on exposure reduction not renewability, local content, or climate

# Household Energy Ladder





Many Thanks



