

# Traditional Biomass Use and Improved Cook Stoves



**WISER Workshop  
Afghan Clean Energy  
Access**

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**23 March 2010**

Image source: Saluki times

# What is traditional biomass use?

## Use of biomass fuel in basic cook stoves

- Crop residues
- Wood
- Dung

Health issues also of concern with household coal use

2.4 billion people rely on traditional biomass use for cooking and heating

>95% of Afghans rely on solid fuels



Sources: WRI, IEA

# Concerns with Traditional Biomass Use

Human health, Environmental Health, Gender Dimensions



Source: NASA



Source: Matthew Logelin

Source: Practical Action



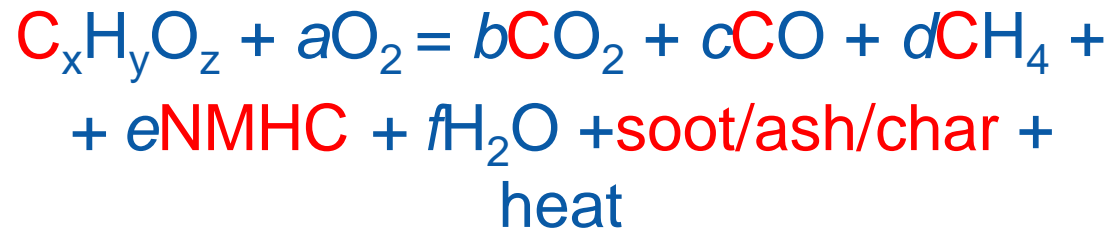
# Incomplete Combustion



## Complete Combustion



## Incomplete Combustion



# Products of Incomplete Combustion

## Carbon Monoxide (CO)

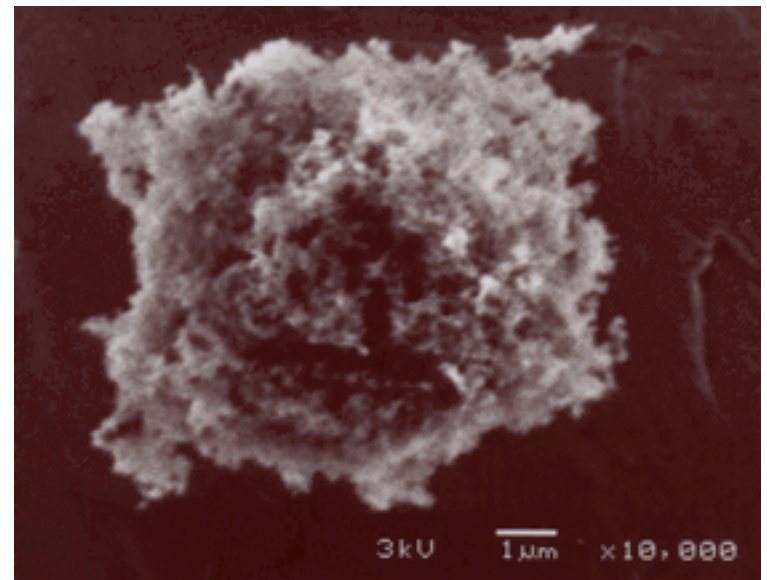
- colorless, odorless, **toxic** gas

## Hydrocarbons (HC)

- CH<sub>4</sub>, strong GWP
- Non-Methane HC

## Particulate Matter (PM)

- Irritant
- Carcinogenic



Credit: D.M. Smith, University of Denver

# WHO Guidelines for PM (24-hr avg)

	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )
Interim target-1	150	75
Interim target-2	100	50
Interim target-3	75	37.5
Air quality Guideline	50	25

## Typical indoor concentrations in biomass burning homes

- 24-hour average PM<sub>10</sub> 300-3,000 µg/m<sup>3</sup>
- Peak PM<sub>10</sub> concentrations up to 10,000 µg/m<sup>3</sup>

**Rule of 1000:** a pollutant released indoors is 1000x more likely to reach a person's lung than a pollutant released outdoors

Source: WHO

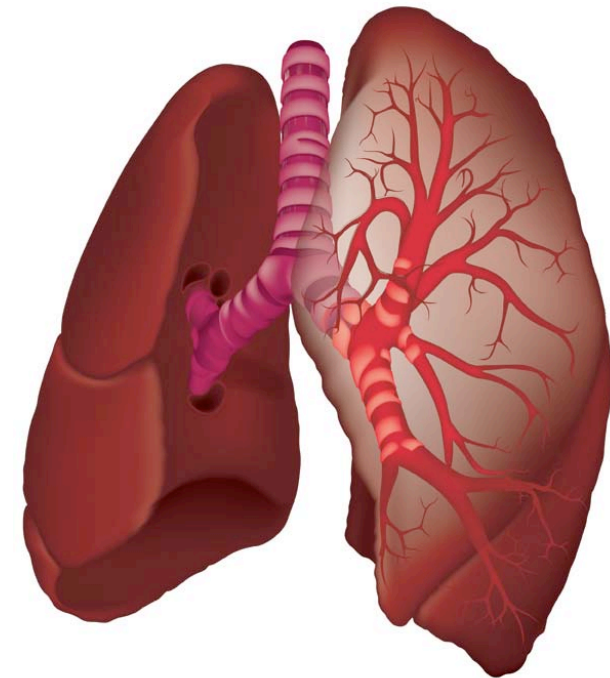
# Health impacts of Indoor Air Pollution

## Strongest Evidence

- Acute Lower Respiratory Infections (ALRI) in *children*
- Chronic Obstructive Pulmonary Disease (COPD) in *women*
- Lung Cancer (coal) in *women*

## Moderate Evidence

- COPD in men
- Lung cancer (coal) in men
- Lung cancer (biomass) in women
- Asthma in women and children
- Cataracts
- Tuberculosis



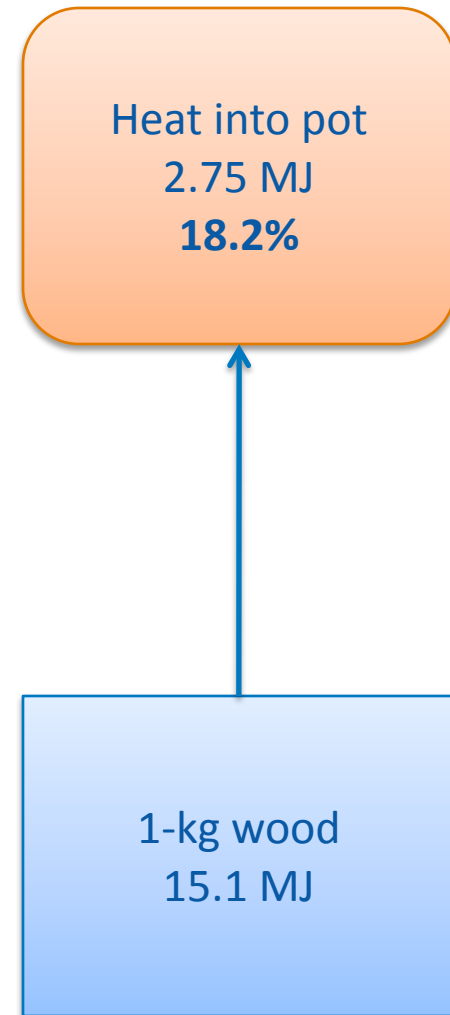
Source: WHO

Image source:  
[www.rmhealthcarealliance.com](http://www.rmhealthcarealliance.com)

# Efficiency: Mud stove burning wood



Source: WHO

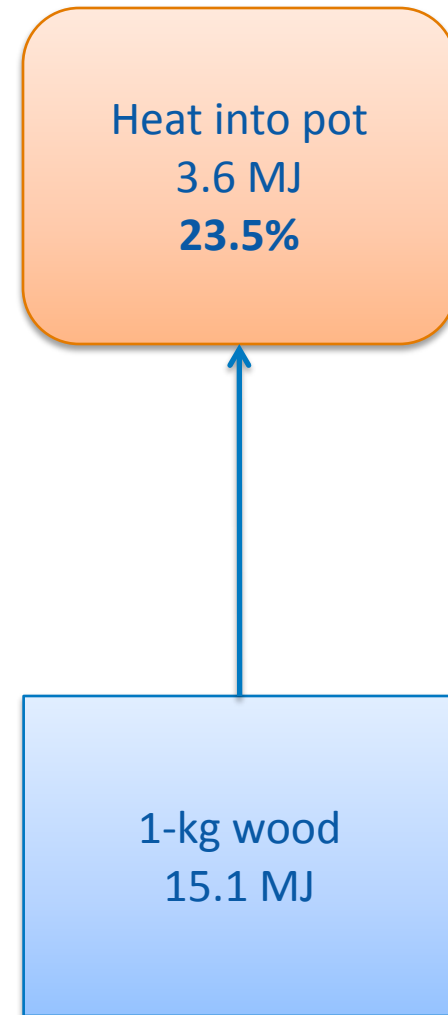


Adapted from Smith et al. 2000

# Efficiency: Improved mud stove with chimney burning wood



Source: Hedon

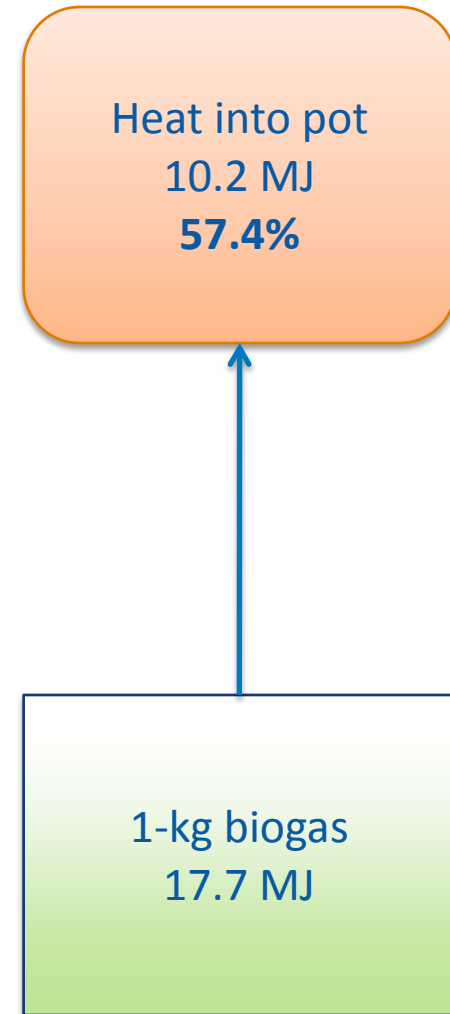


Adapted from Smith et al. 2000

# Efficiency: Biogas Stove

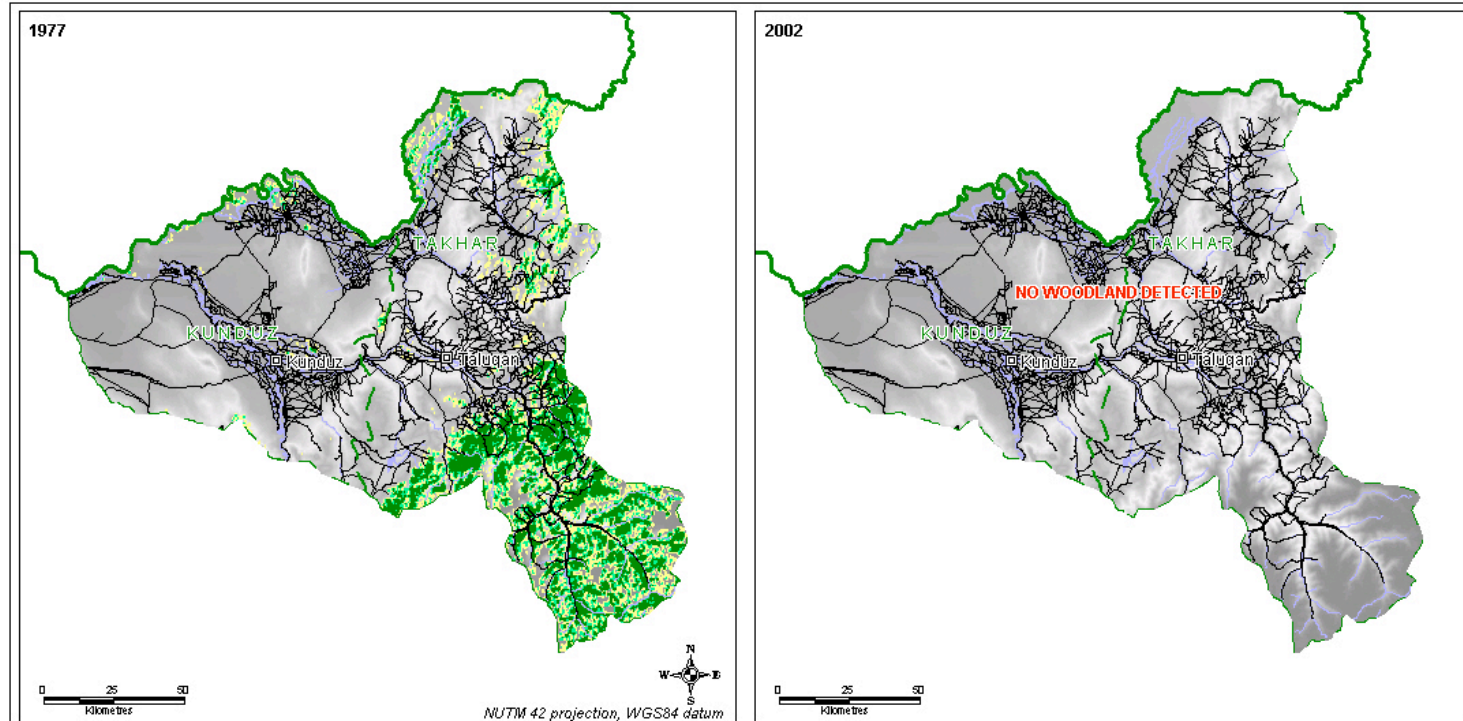


Source: WWF

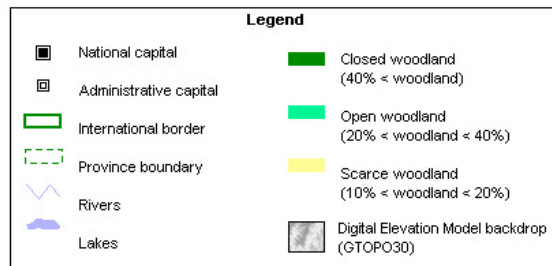
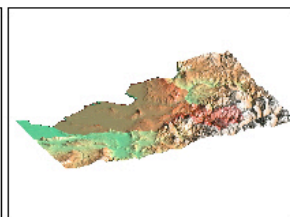
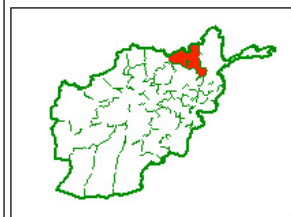


Adapted from Smith et al. 2000

# Unsustainable biomass harvesting



**Afghanistan provinces woodland:  
Takhar and Kunduz, 1977 and 2002**

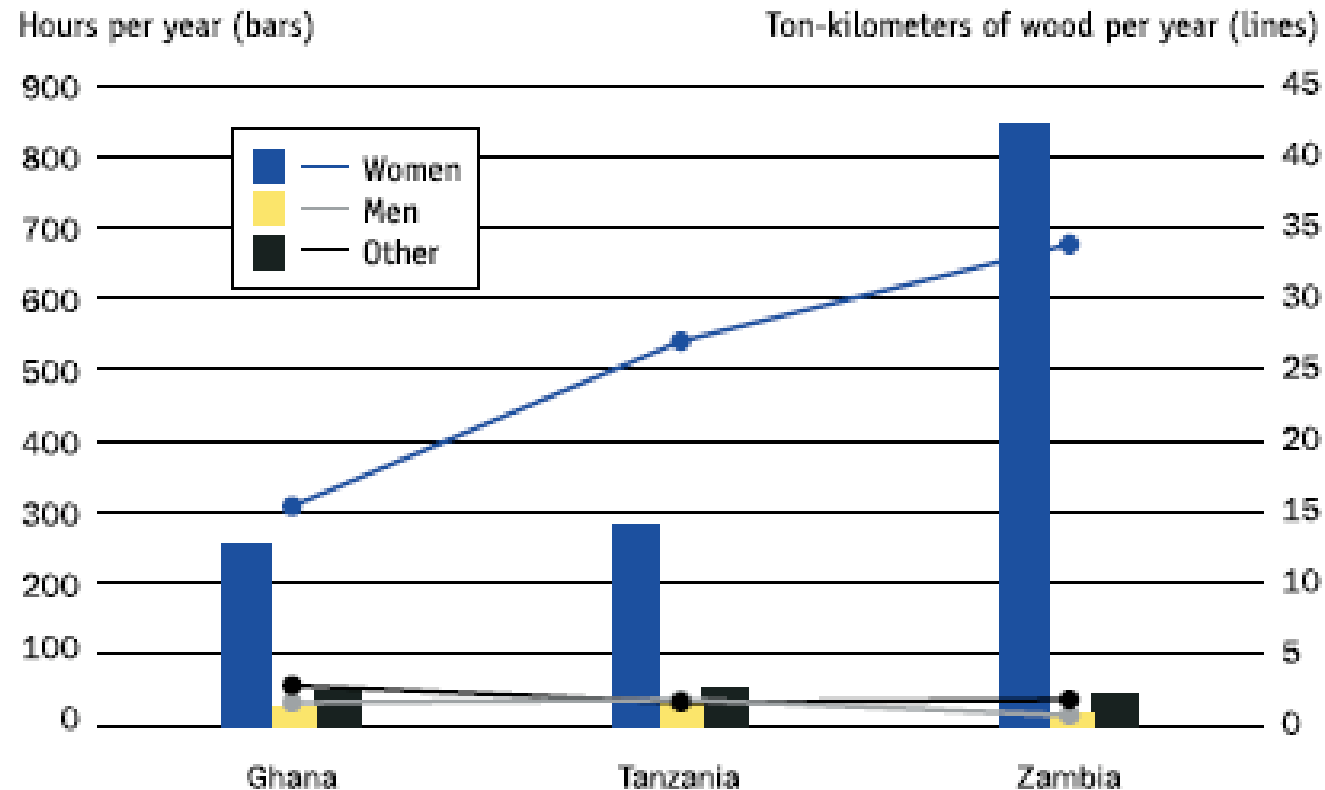


About the map  
Changes in forest cover and density derived from Landsat MSS and ETM+ satellite imagery.  
Date of image acquisitions:  
11 September 1977 and  
12 September 1977 (MSS)  
18 August 2002 and  
22 September 2002 (ETM+)  
Image processing: DIGITECH Int'l



# Women's Time

Hours spent and volume collected by sex in Ghana (1989), Tanzania (1989) and Zambia (1991)



Note: "Other" hours and "Other" volume include children's collection of fuelwood and various combinations of men's, women's and children's collection efforts.

Source: Maimberg Calvo 1994

# Biomass use and Afghanistan Millennium Development Goals

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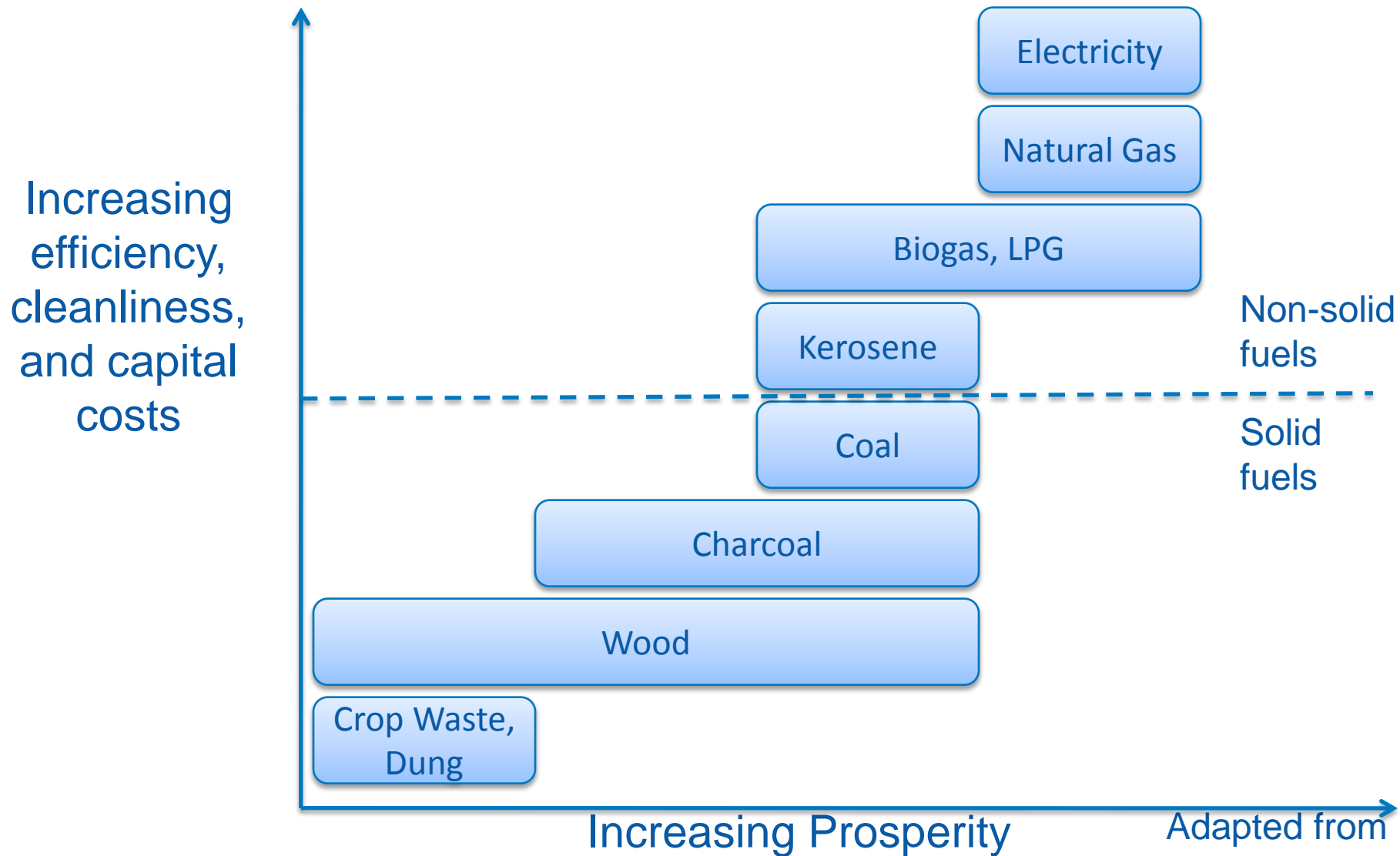
## Reduce Child Mortality

- “Most deaths among children under five years of age in Afghanistan result from vaccine preventable diseases, diarrhoea, and acute respiratory infections which together account for nearly 60% of deaths.”

## Ensure Environmental Stability

- “Forest cover appears to have been cut in half since 1978 as a result of lack of energy alternatives to firewood”

# Energy Ladder for Cooking



# Improved Cook Stoves: Why and How

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## Objectives

Maximize Efficiency

Minimize Impacts on:

Health

Time

Environment

## Approach

Improve Combustion Efficiency

Improve Heat Transfer

Vent Pollutants From Human Environment

*Caution: Enclosed stoves are not always better than 3-stone fire*

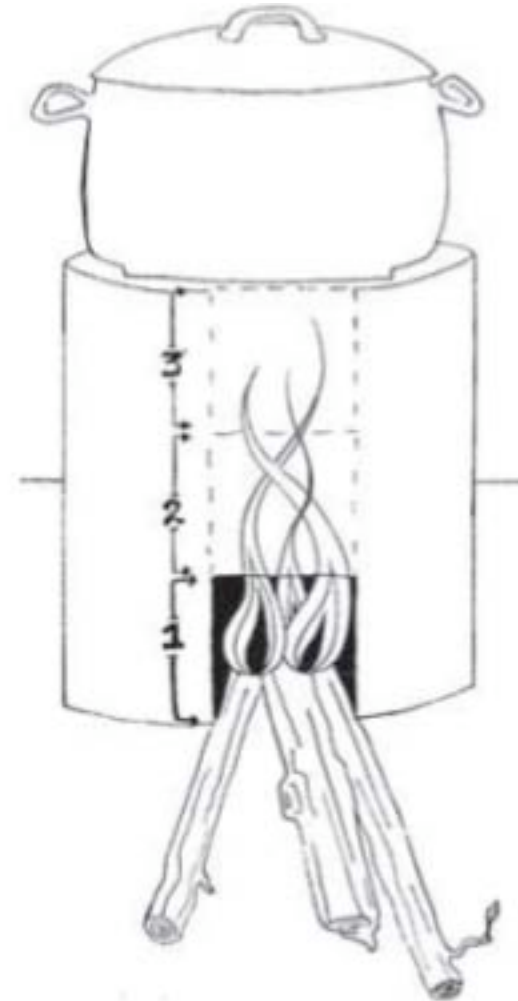
# Design: Insulated Short Chimney

## Insulate Around Fire

- Lightweight materials
- Keeps fire hot
- Reduces emissions

## Short Chimney Over Flame

- Height = 3 x Diameter
- Flames reach smoke
- Pots placed above chimney

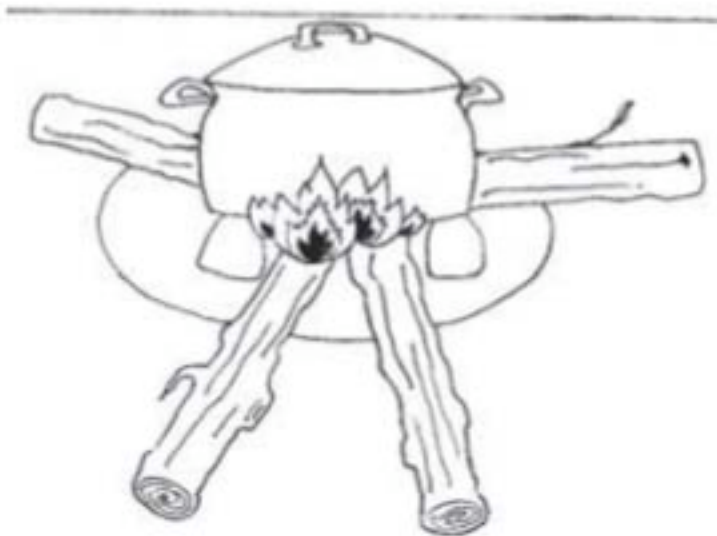


Source: Aprovecho

# Burn Tips and Adjust Heat with Number of Sticks

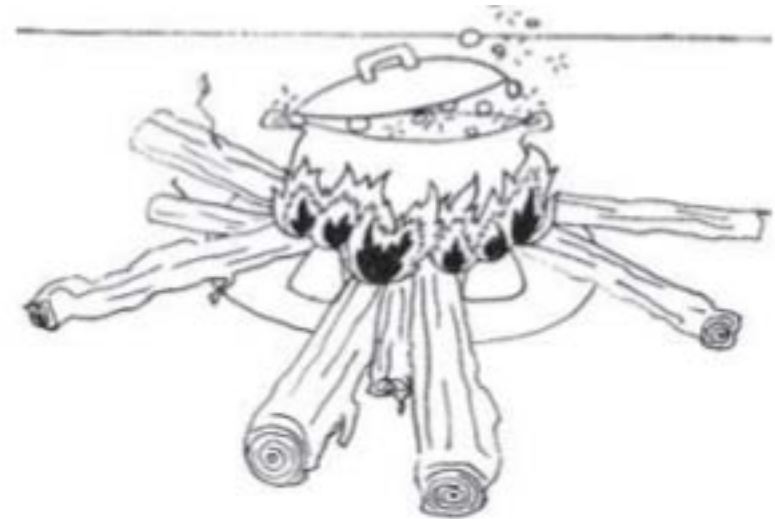
## Burn Only Tips

- Move wood tips into the fire as it burns
- Keep the rest of the wood cold



## Adjust Heat With Number of Sticks

- Add more sticks for higher heat



Source: Aprovecho

# Chimney Stoves and Smoke Hoods



Chimney stoves must be precisely designed and cleaned regularly.



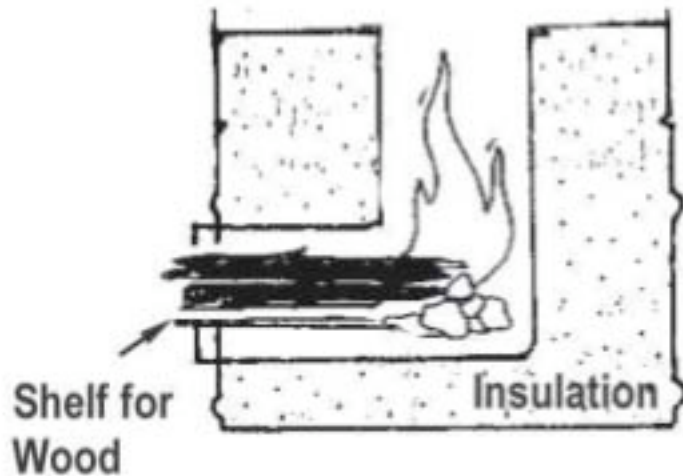
Smoke hoods are less sensitive to design but do not reduce fuel usage.

Source: Practical Action

# Create a Draft

Strong draft keeps fire hot and reduces emissions

Too little draft increases smoke



**Help maintain draft by**

Create a grate for wood and fire

Create a constant area cross-sectional area for air flow

- Opening for wood
- Spaces within stove
- Exhaust chimney

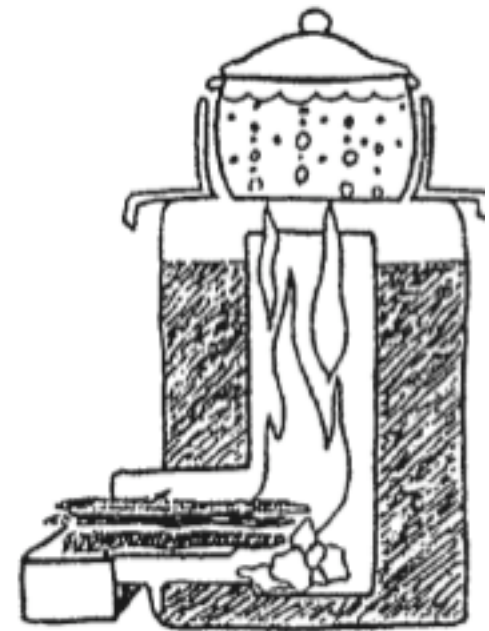
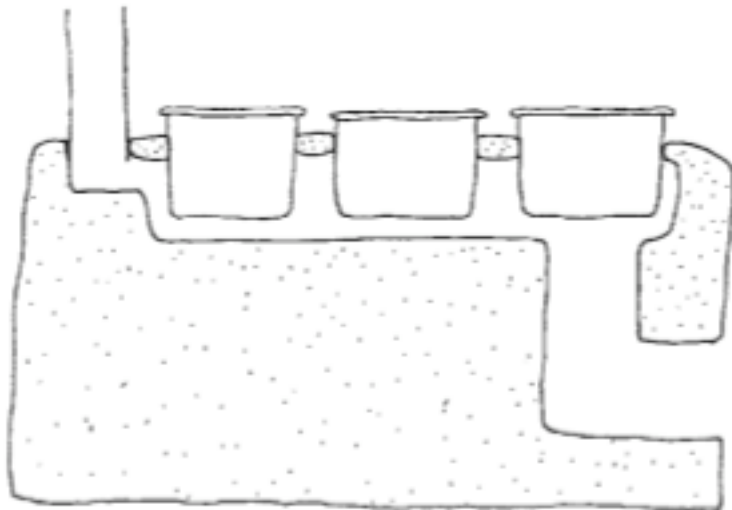
Source: Aprovecho

# Maximize Heat Transfer to Pot

Choose pots with large diameter to place over fire

Use a pot skirt

Submerge pot



# Locally Manufactured vs. Commercial

## Local Manufacture

- Enterprise opportunity for local artisans
- Maintenance likely if local repairs are possible
- Often less expensive

## Commercial Models

- May perform more consistently if machine manufactured
- Often more expensive
- Repairs may be difficult without local service contractors

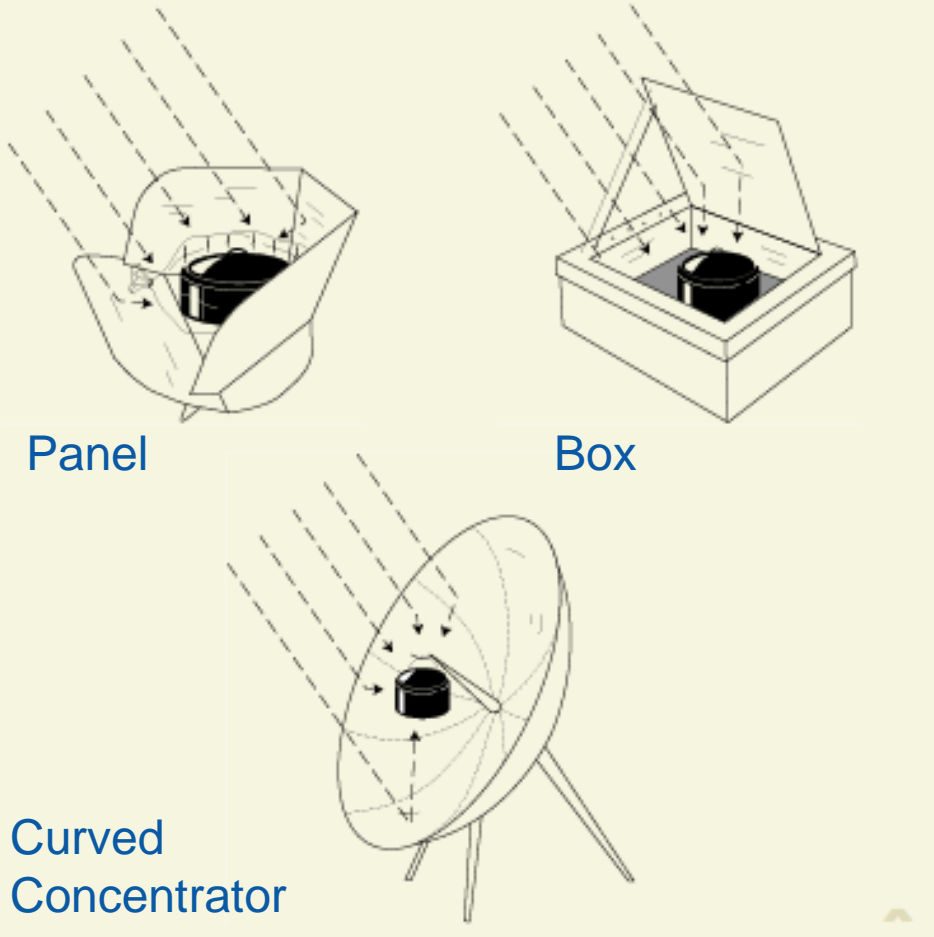
# Fuel Switching: Gas Fuels

## LPG & Biogas

- Cleaner burning
- Extra costs
  - Equipment
  - Fuel
- Unable to cook some traditional foods



# Fuel Switching: Solar Cookers



## Requirements

- Dark pot to absorb energy
- Heat trap (glass or plastic)
- Reflective surfaces to direct extra sun energy to pot

## Challenges

- Time requirements
- Cooking traditional meals

Source: Solar Cooking International

# Summary: Biomass Use & Improved Cook Stoves



Moving away from traditional biomass use benefits:

- Health
- Resources
- Women and children

Advanced technologies help but face challenges with:

- Costs
- Maintenance
- Changing traditions



**For more information visit**  
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**[www.aprovecho.net](http://www.aprovecho.net)**  
**[www.who.int/indoorair/en/](http://www.who.int/indoorair/en/)**