Health and Solid Fuel Use: Five New Paradigms

Kirk R. Smith, MPH, PhD
(Professor of Global Environmental Health
University of California, Berkeley)
Visiting Research Scholar
Indian Institute of Technology Delhi and
IIASA, Laxenburg Austria

Clean Cooking Conference, DFID/WHO/GACC
London, May 1, 2014
and
SE4All and UNIDO
Vienna, May 7, 2014
Declarations of Bias

• A focus on health, with other objectives secondary
• A focus on India, which does not represent all parts of the world
• Moment in time during ongoing shifts in thinking
Burden of disease attributable to 15 leading risk factors in 2010, expressed as a percentage of India DALYs

- Dietary risks
- Household air pollution
- Smoking
- High blood pressure
- Childhood underweight
- Occupational risks
- Ambient PM pollution
- High fasting plasma glucose
- Iron deficiency
- Alcohol use
- Physical inactivity
- Suboptimal breastfeeding
- High body-mass index
- High total cholesterol
- Sanitation

% DALYs attributable to risk factors

- War & disaster
- Intentional injuries
- Unintentional injuries
- Transport injuries
- Other non-communicable
- Musculoskeletal disorders
- Diabetes/urogen/blood/endo
- Mental & behavioral disorders
- Neurological disorders
- Digestive diseases
- Cirrhosis
- Chronic respiratory diseases
- Cardio & circulatory diseases
- Cancer
- Other communicable
- Nutritional deficiencies
- Neonatal disorders
- Maternal disorders
- NTD & malaria
- Diarrhea/LRI/other infectious
- HIV/AIDS & tuberculosis
Summary of Health Impacts

- One of the top risk factors in the world for ill-health.
- Biggest impact in adults – 3.4 million premature deaths (two-thirds the DALYs)
- Still important for children ~500,000 deaths (one-third the DALYs)
- About one million premature deaths in India
- Biggest single risk factor of any examined for Indian women and girls
- Important source of outdoor air pollution
- Impact going down slowly because background health conditions improving
1990:
85%: 700 million people using solid fuels

2010:
60%: 700 million people

~1980
700 million people in entire country

700 million people in the Chulha Trap

Fig. 1. Distribution by state of households using biomass or coal as their main cooking fuel in 2005. From [IIPS, 2007].

*Includes coal use:
J: 17%; WB: 13%;
C: 2%; O: 2%
What else has been done?

• Many hundreds of “improved” biomass stove programs over ~60 years
• Including major national programs in China and India in the 1980s covering ~200 million households in all
• And in Peru, Mexico, Nepal and other countries today
• Hundreds of NGOs, big and small, promoting stoves around the world over the decades
• Until recently, focused on fuel not health
• Hundreds of stove models
Diversity of improved cook stoves
• Link to climate co-benefits in carbon market
• Health effects research expanding greatly
• Global Alliance for Clean Cookstoves: 2010
• Standards being developed with ISO and WHO
• Often improvement in fuel use has occurred
• But, unfortunately,
• The cleanest models have been disseminated to only a few 100s of thousands of households
• 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
Household Energy Ladder in India

- **Very Low Income (200 million)**: Ag res 15%
- **Low Income (400 million)**: Solid Fuels
  - Wood 49%
  - Coal 1%
  - Kerosene 3%
  - Biogas 0.3%
  - LPG 30%
- **Middle Income (400 million)**
- **High Income (200 million)**: Non-solid fuels
  - Elec < 1%
  - PNG < 1%
Current Health Evidence

• Shows now that even major reductions (<90%) in emissions still lead to small health improvements
• Posing a very large technical challenge to solid fuels to reach 99% or greater reductions over open fires
• This is very difficult with any solid fuel
• But still worth pursuing
Integrated Exposure-response relationship

Risk

WHO air quality annual guideline: 10µg/m³
IT1 : 35 µg/m³

Leaves ~80% of burden untouched

Can we get here?

LPG 25
Fan 125
Rocket 200
‘Chimney 300 µg/m³
O/Fire

PM2.5 Exposure

Child pneumonia

Starting here

Going here
Five New Paradigms

Paradigm #1

Making the clean available
Public health and environment

14

International Conference on Occupational and Environmental Health

13-14 December 2013, New Delhi
Secretary Vivek Rae

- Doubled number of distributors for next year
  ~10 million new people
- Brought together heads of marketing for the 3 oil companies to hear the lecture
- By adjusting requirements for distributors and a massive push
- Ministry developing a plan to double LPG access in rural India by 2020
  ~250 million people!
LPG Expansion Requires

- Understanding and preparing upstream
  - Import arrangements, port facilities, etc
- Domestic infrastructure:
  - Rail, truck, cylinder manufacture, etc
- Downstream: relook at distribution
  - Size and location of distributors
  - Modes of distribution: e.g., household versus community
- Technology upgrades
  - Cylinders, stoves, lamps, etc.
Up to 25% more efficient
Indian Energy Ladder

- Very Low Income (200 million)
- Low Income (400 million)
- Middle Income (400 million)
- High Income (200 million)

Fuel Choices:
- Non-solid fuels: Kerosene, Coal, Liquefied Petroleum Gas
- Solid Fuels: Wood, Crop Waste Dung

- Electricity
- Natural Gas
Paradigm #2

Stepping out of the box
Story of Three States

Gujarat: 1981-2013

Kerala: 2005-2013

Odisha: 2012-2014
First person in human history to have her exposure measured doing the oldest task in human history

Kheda District, Gujarat, 1981
Gujarati Villages since 1981

- Reliable electricity and piped water
- Cell phones and satellite TV
- Pucca schools
- More pucca houses and roads
- In spite of 3-5 “improved” biomass stove programs since the 1970s – none now in existence
- Chulhas in every house
- But another transition taking off
What is an induction cookstove?

- 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
Kerala story

• Like most of India, Kerala has had an electric peak in early evenings
• Starting after mid last decade, however, Kerala started experiencing a fast-growing morning peak as well
• Reason: massive sales of induction cookstoves (ICs) were shifting demand
• Experience is that once a woman is used to an IC, she does not want to go back.
10,000 induction cookstoves to NALCO employees

National Aluminium Company Ltd. (NALCO) is considered to be a
Roti being made on an induction stove

SDA Market
New Delhi

April 2014
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
Considerations

• Power now only reliable in major cities and 2-3 full states, but on the march nationally.
• Cooking would add serious additional demand, but at great benefit, and not large compared to need in general
• To whatever degree ICs substitute for biomass or even LPG, the calculus for electrification benefits changes dramatically
Considerations, cont.

- PV microgrids are proliferating in India to supply villages with power
  - Technically doable to provide sufficient power for induction cooking, but economics uncertain
- Pushback because of
  - Cost
  - Utilization of primary fuel
  - Displacement of pollution to power plant
  - CO2 from the coal
- Good counter-arguments available for all
Increasing Prosperity and Development

Decreasing Household Air Pollution

Very Low Income 200 million

Low Income 400 million

Middle Income 400 million

High Income 200 million

Crop Waste Dung

Solid Fuels

Wood

Non-solid fuels

Biogas

Liquefied Petroleum Gas

Natural Gas

Electric Induction

Conceptual Indian Energy Ladder
Paradigm #3: It takes a village

Village pollution in Gujarat
Changing out one chulha at a time is not as effective as changing out whole villages

- Learned in sanitation programs years ago
- There are both household and community benefits to clean fuels/stoves and latrines.
- And with community interventions, a new set of incentives and social pressures become possible.
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, blocks, etc called “Nirmal Gram Puraskar”

Perhaps we need a parallel or even joint “Smokeless Village Scheme”? 
Paradigm #4: All Indians cook in the same kitchen!
How is that?

• All breathe the pollution coming from everyone else’s kitchen
• Health impacts directly affect all – families, migration, worker productivity, etc.
• Clean fuel availability for cooking linked nationally
%PM$_{2.5}$ from “Residential” Emissions: NASA


Chafe, 2010
Increasing Prosperity and Development

Decreasing Household Air Pollution

- Very Low Income: 200 million
- Low Income: 400 million
- Middle Income: 400 million
- High Income: 200 million

India’s Kitchen - 2012

- 169 million households
- 92 million households

Solid Fuels: Wood - 49%
- Coal - 1%
- Kerosene - 3%
- Biogas - 0.3%
- LPG - 30%
- Electric - 1%
- PNG - 1%

Non-solid fuels: Ag res - 15%
- India’s Kitchen - 2012
- 169 million households
- 92 million households
Energy Scenarios Website Launched
By Planning Commission (March 2014)

http://www.indiaenergy.gov.in/
---piped natural gas (PNG) - is slowly replacing liquefied petroleum gas (LPG) …

---- there are 28 areas - whose size can vary from a single city to a whole district - where the network of pipes is already in place.

They are also being built in 49 more areas.

By 2015, it is expected that 201 geographical areas will be supplied with PNG.
Increasing Prosperity and Development

Decreasing Household Air Pollution

Very Low Income 200 million

Low Income 400 million

Middle Income 400 million

High Income 200 million

244 million households --2.6x increase in 15 years

81 million households >50% reduction in 15 years

Non-solid fuels

Solid Fuels

Wood --20%

Ag – res - 5%

Biogas – 2%

LPG

Natural Gas

Electricity

Elec – 15%

PNG – 17%

India’s Kitchen - 2027
Paradigm #5: 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
Indian Energy Ladder

Very Low Income: 200 million
Low Income: 400 million
Middle Income: 400 million
High Income: 200 million

How do we help people move into this realm?

Solid Fuels
- Crop Waste
- Dung

Non-solid fuels
- Kerosene
- Coal
- Liquefied Petroleum Gas
- Biogas
- Natural Gas
- Electricity

Smith/Pillarisetti, 2014
India: What If?

Millions

A Chulha Trap or a Clean Fuel Gap?

9% instead of 5.5%/yr for 20 years
Five Paradigm Shifts

• Make the clean available, as well as make the available clean
• Embrace/enhance transformational leapfrog technologies
• Look for community solutions
• Enhance displacement of clean fuels from richer to poorer households
• Act recognizing that it is primarily a health issue
Many thanks

Publications and presentations on website – easiest to just “google” Kirk R. Smith