Protecting Climate and Health in the Chinese Rural Energy Sector

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In collaboration with the
Center for Entrepreneurship in International Health and Development (CEIHD)

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MDG Carbon Facility

Is it possible to achieve both

- measurable and verifiable carbon credits?

 as well as

- measurable and verifiable progress toward China's Millennium Development Goals?

And,

- How does one handle trade-offs between the two, that is,
  - Make a decision to go with a project that achieves more progress toward MDGs, but costs more per ton of carbon?

Premises

- The energy sector is where carbon emissions and MDGs are most closely linked

- Rural energy is the energy sector where these links are strongest in China

MDG 4. Reduce child mortality.

- **Official Indicators**
  - 13. Under-five mortality rate
  - 14. Infant mortality rate
  - 15. Proportion of 1 year-old children immunized against measles
- **Rural Energy**
  - **Mortality/morbidity from pneumonia**
  - **Incidence of low birth weight**

MDG 5. Improve maternal health.

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- **Official Indicators**
  - 16. Maternal mortality ratio
  - 17. Proportion of births attended by skilled health personnel
- **Rural Energy**
  - Mortality/morbidity from chronic obstructive pulmonary disease (COPD)
  - Mortality/morbidity from lung cancer
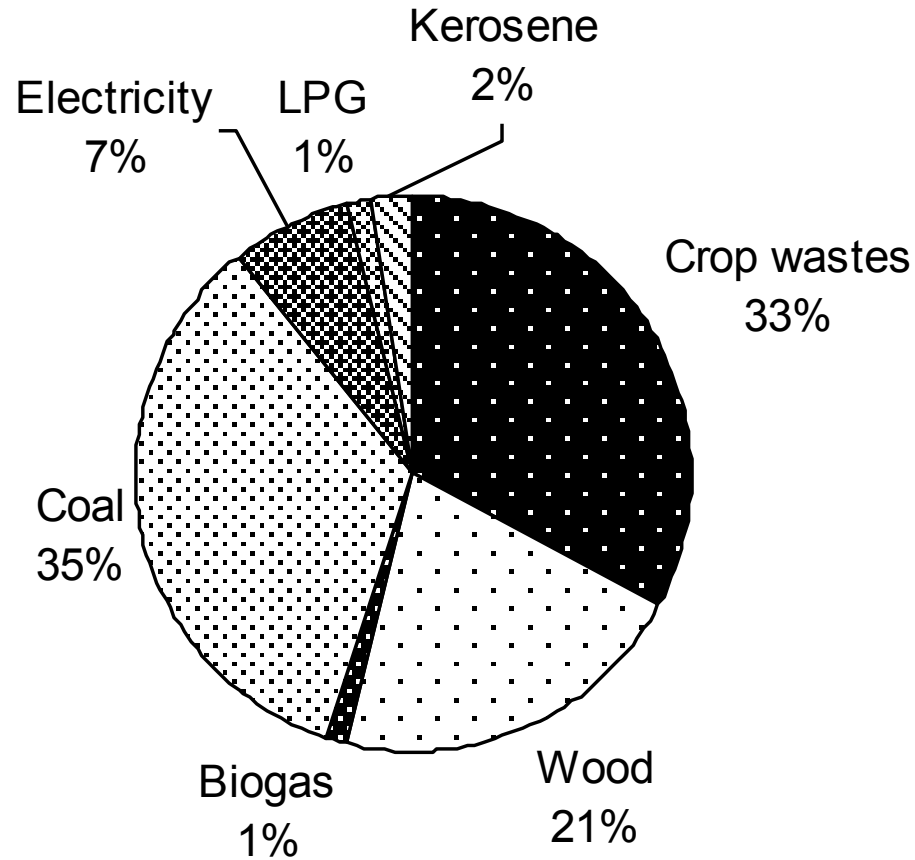
MDG 1. Eradicate extreme poverty and hunger.

- **Official Indicators**
  - 1. Proportion of population below $1 (PPP) per day
  - 2. Poverty gap ratio [incidence x depth of poverty]
  - 3. Share of poorest quintile in national consumption
  - 4. Prevalence of underweight children under-five years of age
  - 5. Proportion of population below minimum level of dietary energy consumption
- **Rural Energy**
  - Fuel costs per person-meal.
  - Time spent cooking.
  - Time spent obtaining and preparing fuel
  - Economic modeling of the effects of expanding rural energy activities
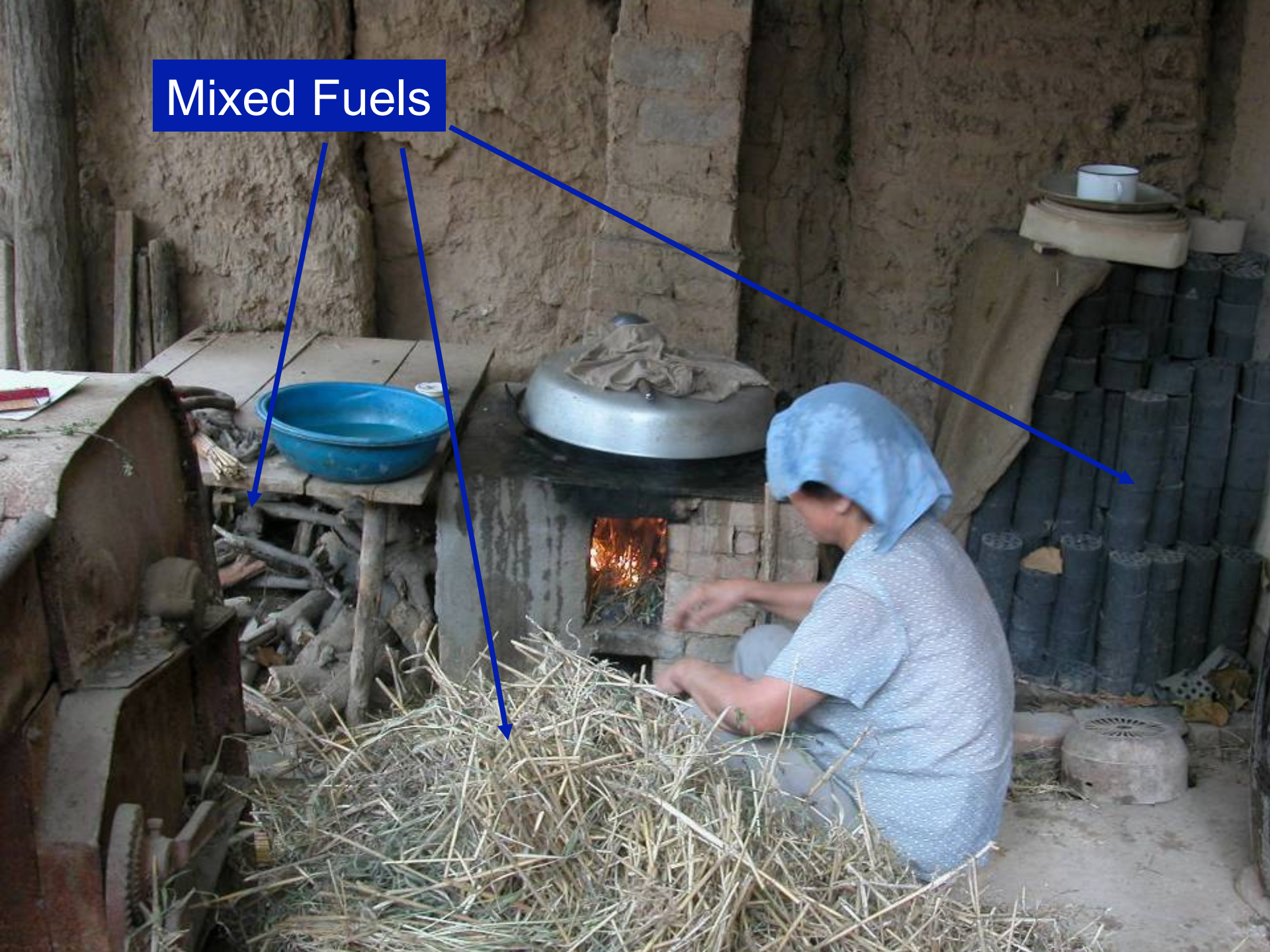
Total Rural Energy in China: 2005

Kerosene 2%

Electricity 7%

LPG 1%

Crop wastes 33%

Coal 35%

Biogas 1%

Wood 21%

Ministry of Agriculture

Village Biomass Storage

Mixed Fuels

Portable coal briquette stove, Shaanxi

Coal heating and cooking stove with chimney installed for winter, Shaanxi

Cooking and heating stove without chimney, Shaanxi

Also used for *kang* (heated platform bed)

Improved Biomass Stoves in China
More than 180 million introduced since 1983

Health Impact in China

- Indoor air pollution from household solid fuel use – 2002 (WHO)
  - Children: 21,000 premature deaths from pneumonia
  - Women: 342,000 from COPD

    18,000 from lung cancer
  - Burden = 3.2 million DALYs
    - Disability-adjusted life years lost – standard international metric for combining mortality and morbidity
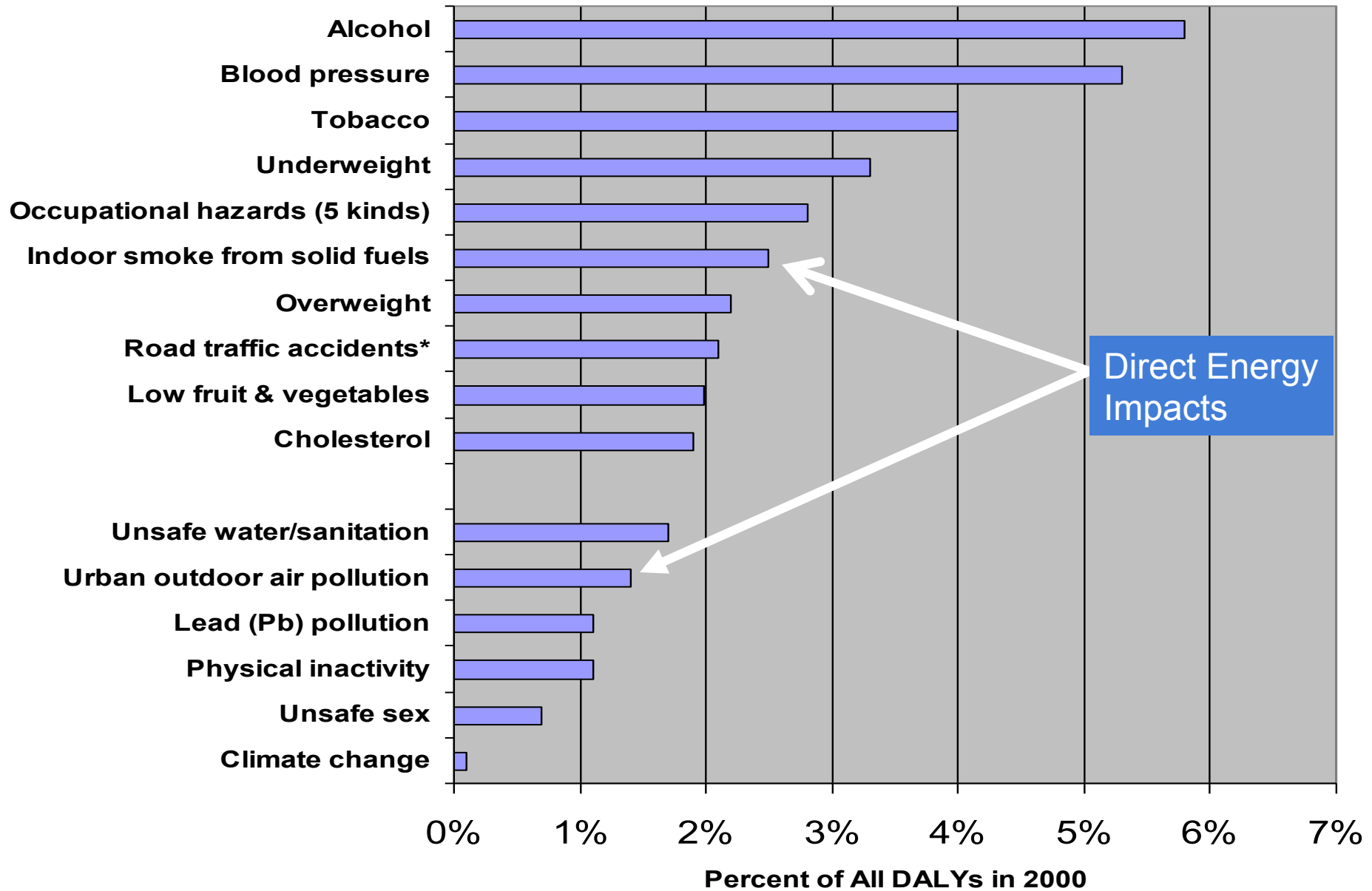 - 1.6% of national burden of disease in China

Cumulative distribution of PM10 estimates in cites
Selected World Regions
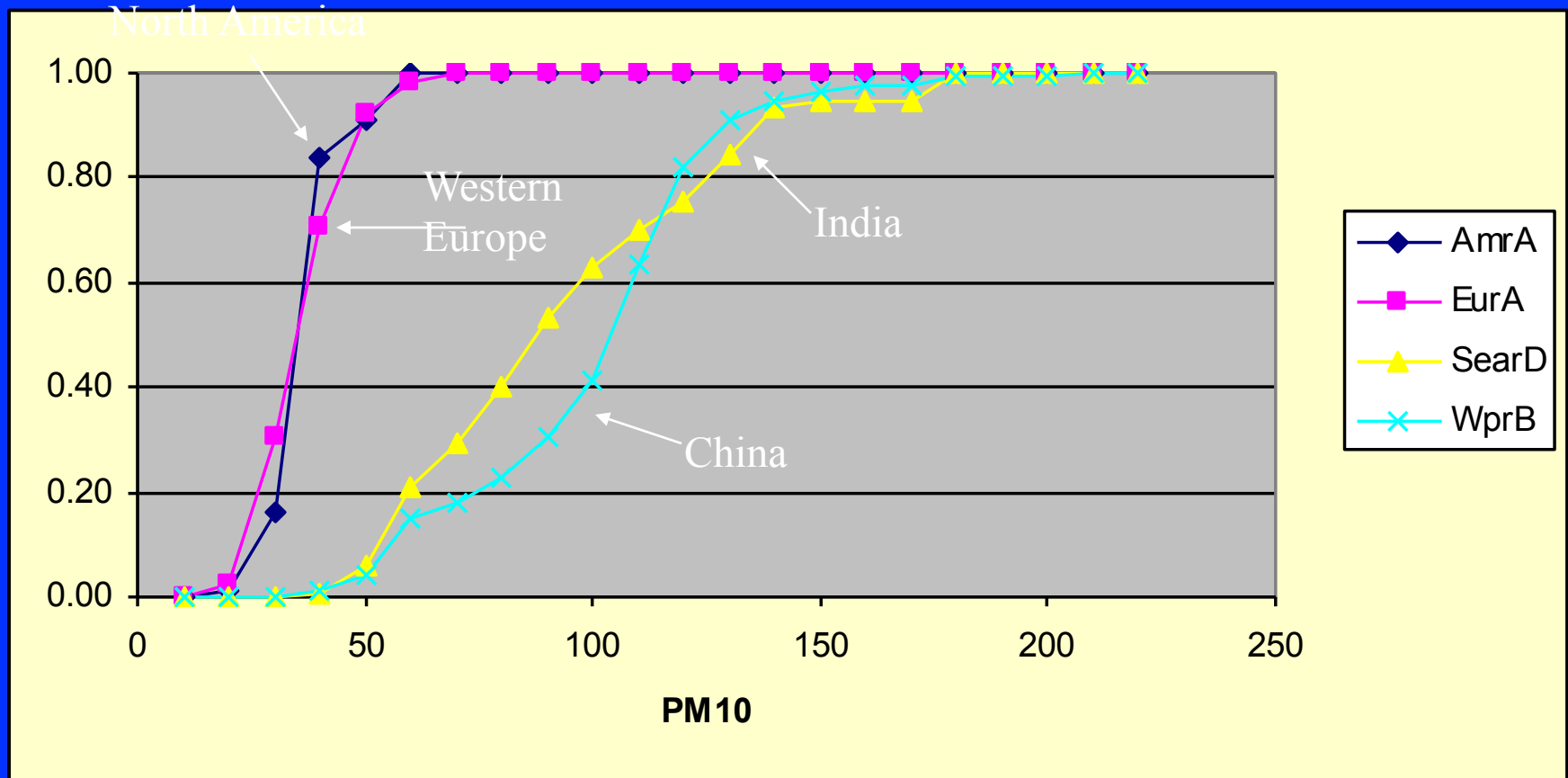
From the Outdoor Air CRA: WHR-2002

Chinese Burden of Disease from Top 10 Risk Factors
Plus Selected Other Risk Factors

Risk Factor	Percent of All DALYs in 2000
Alcohol	5.8%
Blood pressure	5.3%
Tobacco	4.0%
Underweight	3.3%
Occupational hazards (5 kinds)	2.8%
Indoor smoke from solid fuels	2.5%
Overweight	2.2%
Road traffic accidents*	2.1%
Low fruit & vegetables	2.0%
Cholesterol	1.9%
Unsafe water/sanitation	1.7%
Urban outdoor air pollution	1.4%
Lead (Pb) pollution	1.1%
Physical inactivity	1.1%
Unsafe sex	0.7%
Climate change	0.1%

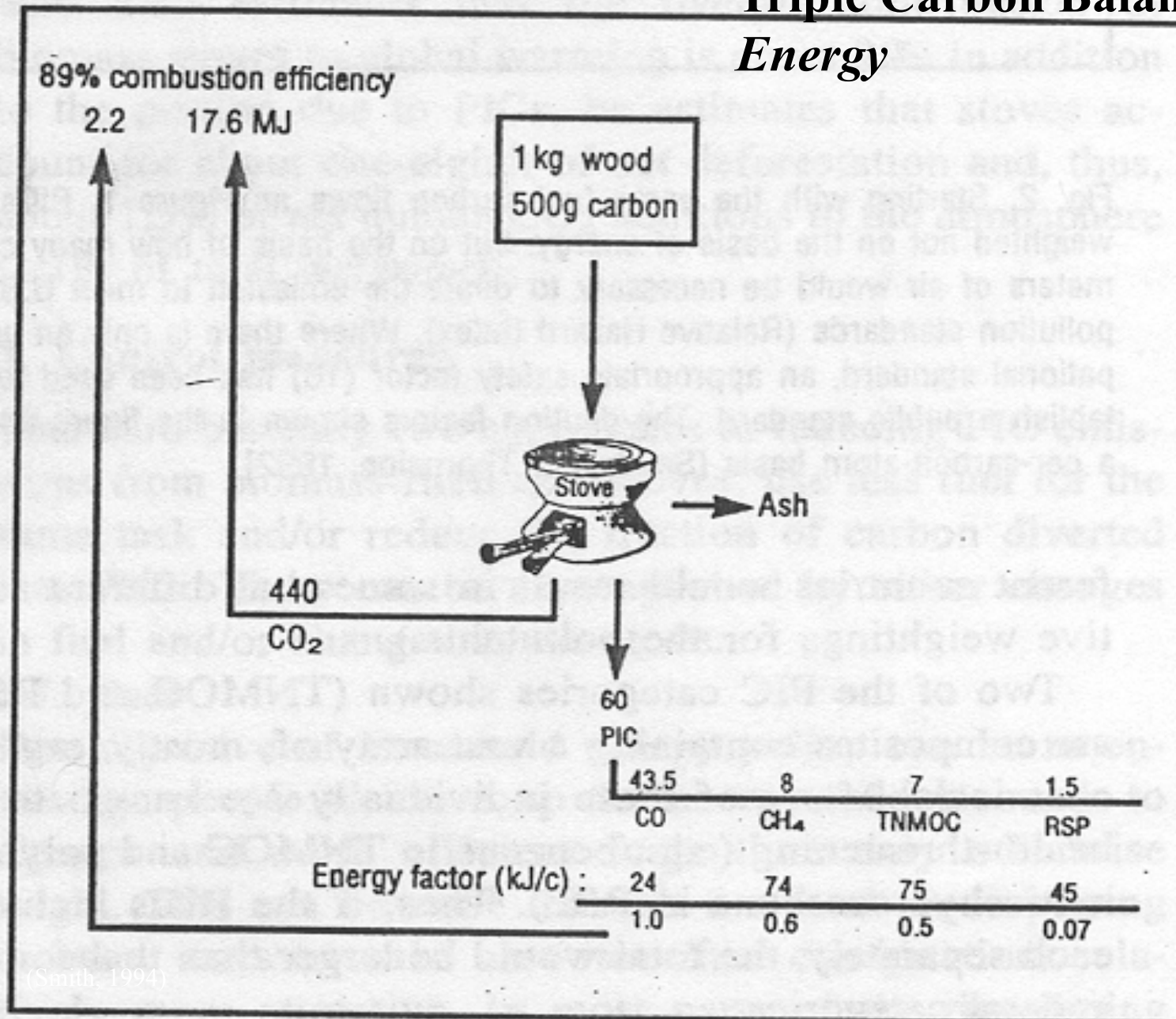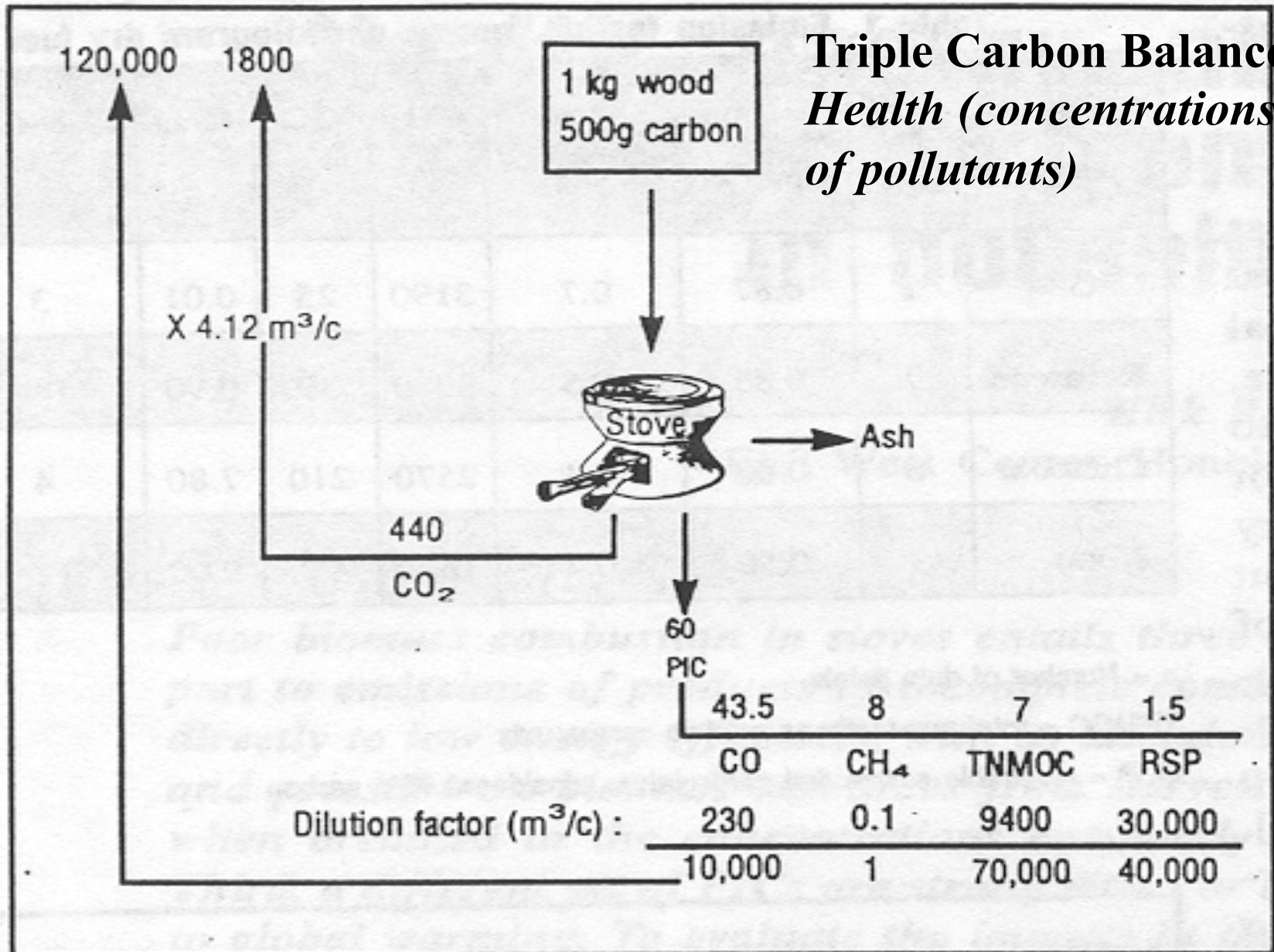Direct Energy Impacts

Carbon from Rural Coal

- Ministry of Agriculture: 167 million tons coal used in 2005
- About 450 million tons CO2
- About 10% of Chinese emissions

89% combustion efficiency

2.2   17.6 MJ

1 kg wood
500g carbon

Stove → Ash

440
CO_2

60
PIC

43.5	8	7	1.5
CO	CH_4	TNMOC	RSP

Energy factor (kJ/c) :	24	74	75	45
	1.0	0.6	0.5	0.07

(Smith, 1994)

Triple Carbon Balance: *Health (concentrations of pollutants)*

120,000   1800

1 kg wood
500g carbon

X 4.12 m³/c

Stove → Ash

440

CO_2

60
PIC

	CO	CH₄	TNMOC	RSP
	43.5	8	7	1.5
Dilution factor (m³/c) :	230	0.1	9400	30,000
	10,000	1	70,000	40,000

Triple Carbon Balance: *Global Warming Potential*

CO_2 equivalent
470   440

1 kg wood
500g carbon

Stove

Ash

440
CO_2

60
PIC

20 years	43.5	· 8	7	1.5
	CO	CH_4	NMHC	RSP
GWP (CO_2 equivalent/c) :	4.5	22	12	1
	196	184	84	1.5

100 years

170

GWP (CO_2 equivalent/c) :	1.9	7.5	4.1	1
	83	61	29	1.5

How to quantify, verify, and value? Carbon Savings

- Fuel savings (CO_2) plus improvements of combustion efficiency (CH_4)
- Probabilistically weighted sample surveys with a subset of measurements: techniques originally developed in China and now being field tested in Mexico
- Can measure methane and other GHGs as well
- Use global carbon market prices

University of California (Berkeley and Irvine)

- Has developed standard methods for evaluating fuel use, indoor air pollution, and GHG emissions from household combustion devices

- Work started in India and China in early 1990s

- Now being used worldwide for fuel use and air pollution

- First field tests of GHG methods ongoing in Mexico and Uganda.

Summary of Slides Removed (unpublished data)

- Laboratory results do not match field results: Need to measure in real use in real households

- A few relatively simple measurements do well in predicting total GHG emissions

- Portable instruments do almost as well as lab instruments in monitoring emissions

- Probe does almost as well as the more difficult-to-employ hood in determining emissions

How to quantify, verify, and value? Mothers' and Children's Health

- Apply peer-reviewed results of meta-analyses of health benefits from household energy improvements using standard epidemiologic risk techniques to estimate DALYs for each population group

- Probabilistically weighted sample surveys and subset of pollution measurements: techniques developed in China and now applied many places

- How to determine economic value? WHO/IBRD has developed methods and recommendations

Commission on Macro-economics and Health, 2001

- Recommended methods and criteria for setting priorities among health interventions based on
  - DALYs: saved healthy life years
  - Cost: in terms of local income levels

- Adopted by World Health Organization and World Bank
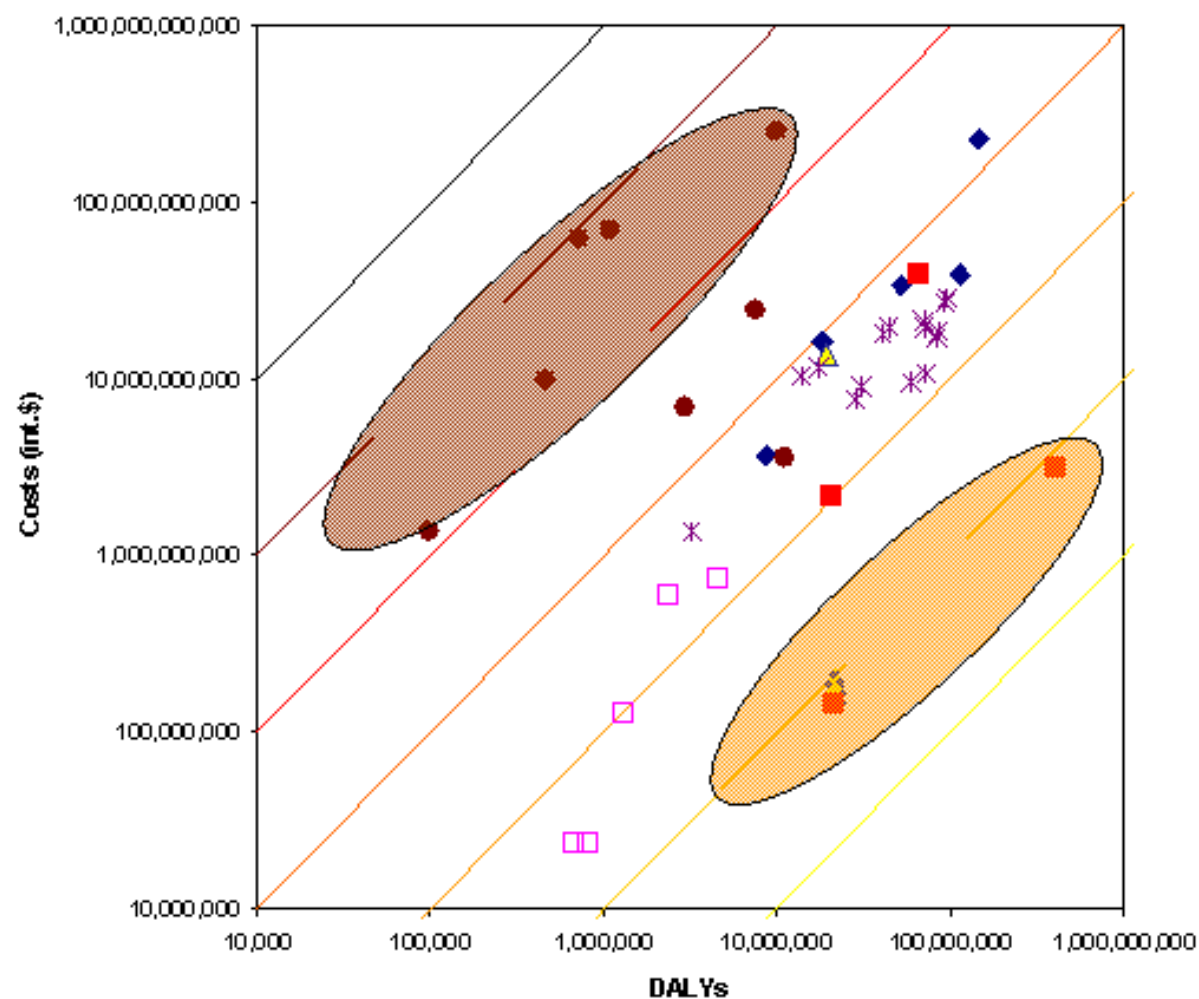
Recommendations

- **"Very Cost-Effective":** Less than the local $GDP/capita per DALY should be considered part of primary health promotion and be undertaken as quickly and widely as possible.

- **"Cost-Effective"** : Between one and three times the local $GDP/capita-DALY, interventions should be seriously considered and with appropriate attention to the needs of special populations, regions, etc; the cheaper ones should generally be undertaken first.

- **"Not Cost-Effective"** : More than three times the local $GDP/capita-DALY, interventions should be left to private markets and not be part of government or donor activities.

Cost-Effectiveness Analyses

- Need to apply consistent criteria
- Need to stick to UNFCCC rules for CDM
- No need to depart from recommendations by WHO/IBRD for health analyses
- Need to reflect standard financial analysis methods
- Is need to adjust discount rates and other protocols to bring the three types of analysis together
    - DALYs - health
    - Global Warming Commitments – climate change – including use of GWPs for combining GHGs
    - Costs – financial analysis

Summary metrics for use in co-benefits scoping.

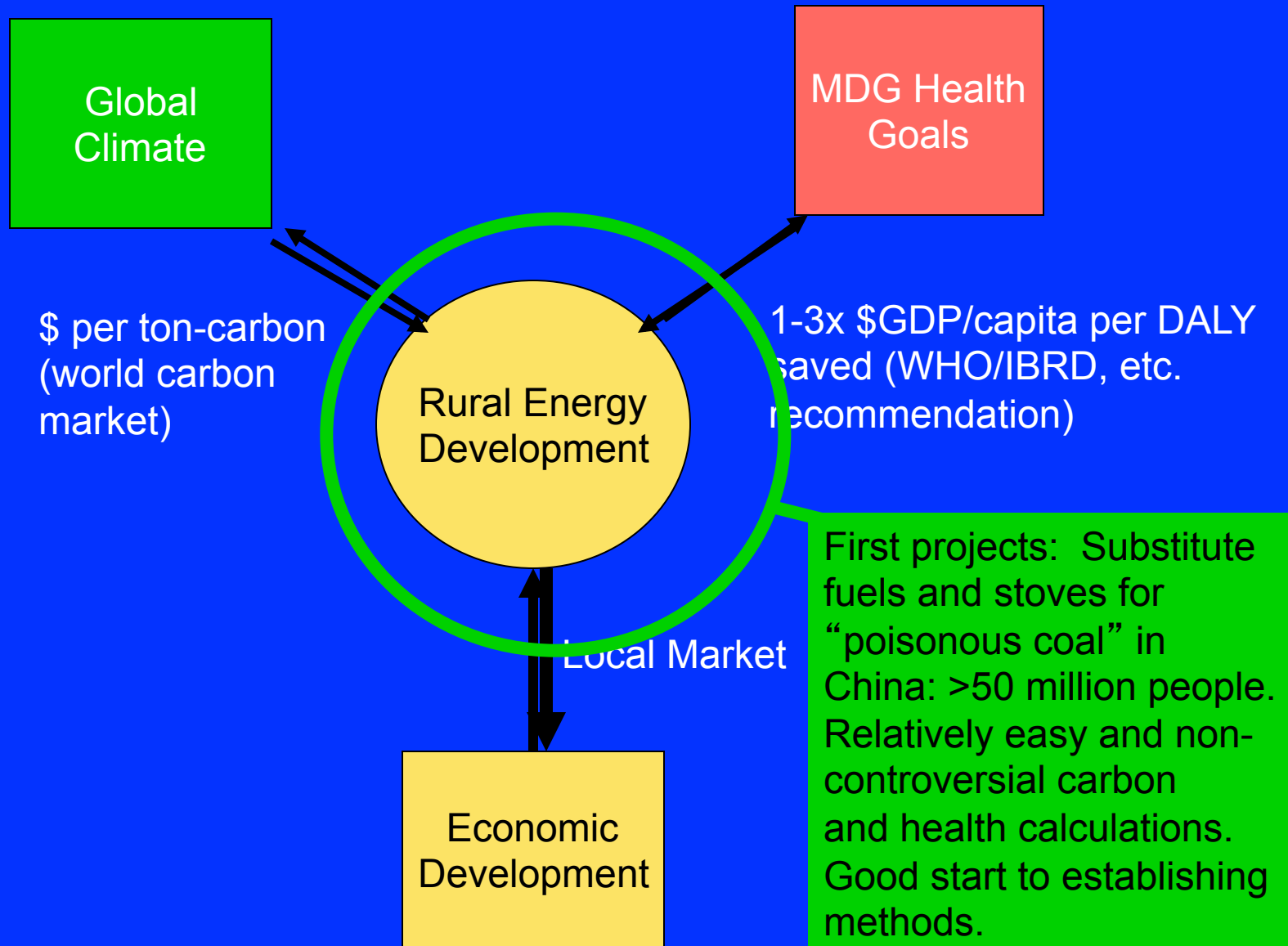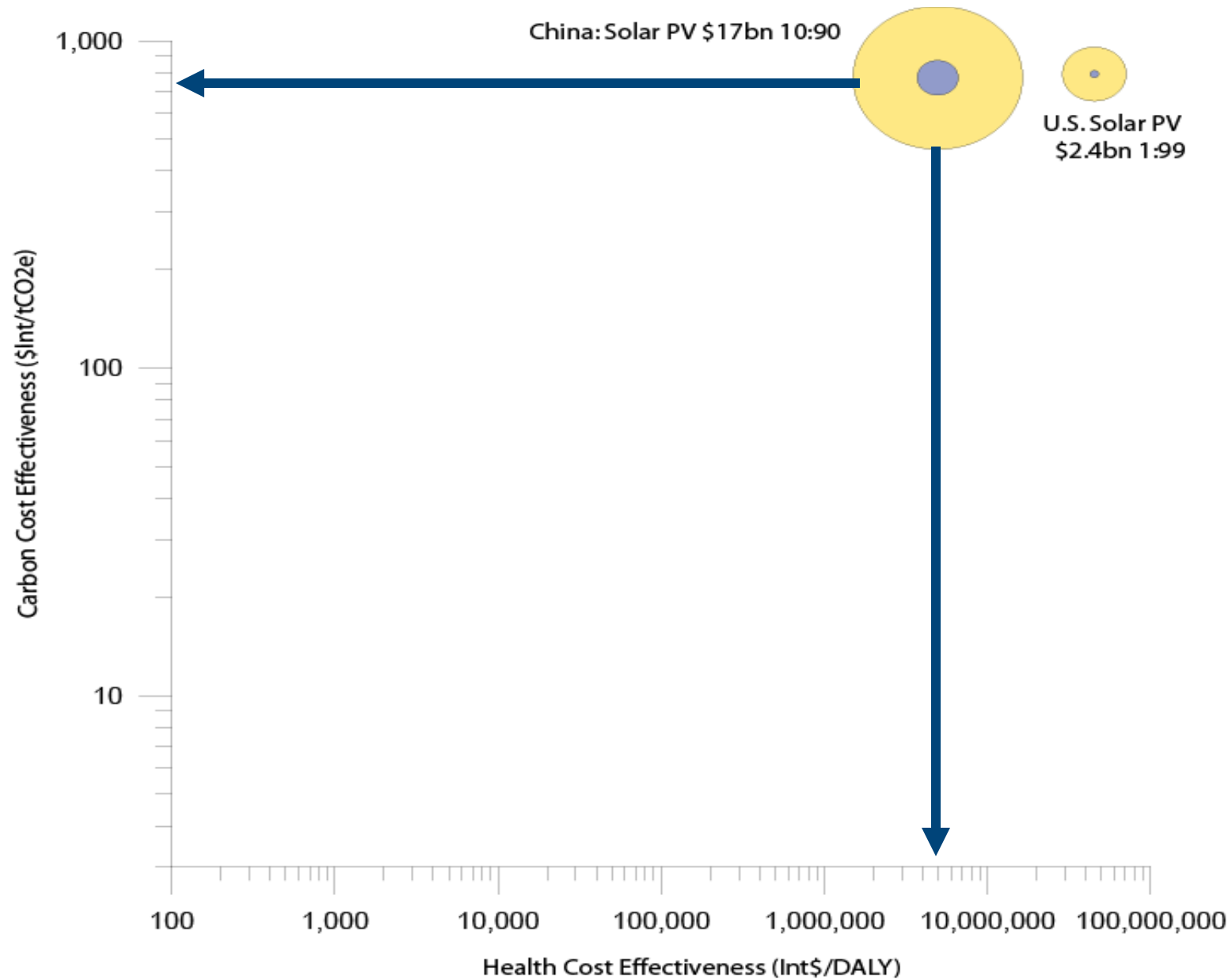|	Health	Climate Change	Money
Metric	DALYs (Disability-Adjusted Life Years)	GWC (Global Warming Commitment)	International Dollars
Unit	Years	Tons CO_2 equivalent	US Dollars
Formulation	Years lost from premature death plus weighted years lost to disability	Tons CO_2 plus tons other GHGs multiplied by their global warming potentials (GWPs)	Local currency adjusted by its capability to buy standard market basket of purchases
Discount Rates			
Kyoto Case	1%	100-year ~ 0.7%	3%
Base Case	3%	20-year ~ 4.3%	3%
Financial Case	3%	20-year ~ 4.3%	6%

Health Impact in China

- Indoor air pollution from household solid fuel use – 2002 (WHO)
  - Children: 21,000 deaths from pneumonia
  - Women: 342,000 from COPD
              18,000 from lung cancer
  - Burden = 3.2 million DALYs
- If half reduced, at $4500/DALY (3x GDP/cap) = $7.2 billion/yr
- Without credit for poisonous coal

Carbon from Rural Coal

- Ministry of Agriculture: 167 million tons coal used in 2005

- If half could be saved: 260 million tCO2 at $15 = $3.9 billion/yr

- If combustion efficiency could be increased so that the methane emissions are reduced from the remainder, depending on GWP, perhaps an additional $2 billion/yr could be had

What makes sense to do first?

Global Climate

MDG Health Goals

Rural Energy Development

$ per ton-carbon (world carbon market)

1-3x $GDP/capita per DALY saved (WHO/IBRD, etc. recommendation)

Local Market

Economic Development

First projects: Substitute fuels and stoves for "poisonous coal" in China: >50 million people. Relatively easy and non-controversial carbon and health calculations. Good start to establishing methods.

Source: Smith & Haigler, in prep

Initial Pilot Project

- A near-term pilot project can be designed immediately to demonstrate the feasibility of combining MDG indicators and carbon finance.

- As an example, indoor air pollution monitoring and fuel savings data can be collected as MDG indicators in a program to generate carbon credits from the replacement of inefficient household coal stoves with high-efficiency gasifier stoves that use processed crop residues as fuel.

- Such a model project would provide relatively quick proof of method.

MDG Carbon Toolkit

- Develop an MDG Carbon Toolkit that can be used by rural energy project developers for a wide range of project activities.
- To create this handbook, invite a select group of experts to prepare and present analyses on modeling benefits of investments in rural household energy, including experts from UC Berkeley as well as academics in Norway, the Netherlands, and several Chinese universities.
- This conference will assist provincial officials and others to think about how to score poverty alleviation along with carbon credits, health improvements, and other indicators of progress on MDGs.
- Economic modeling tools will be included

Provincial-level pilot

- Pilot and validate the MDG Carbon Toolkit in a province, likely the same location where the conference was held. This might further involve the organization of an institution to oversee the implementation of projects with funds from the carbon offset facility.

What we are already doing

- CAREI: Promoting renewable and efficient energy in rural areas of China
- UC Researchers
  - Pioneered methodologies for measuring GHG emissions and indoor air pollution, many initiated in China
  - Conducting health effects studies of household fuel interventions
  - Conducting method development for co-benefits calculations
  - Modeling economic benefits in developing countries
- CEIHD: Disseminating tools for M&E, e.g. protocol for fuel use assessment
- Venture Strategies: Acting as project developer for improved stove project in Uganda. Writing PDD and developing M&E for carbon offset funding

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Thank you