The Household Energy Sector: A Place to Promote Health, Development, and Climate Protection

At the 0.03% level

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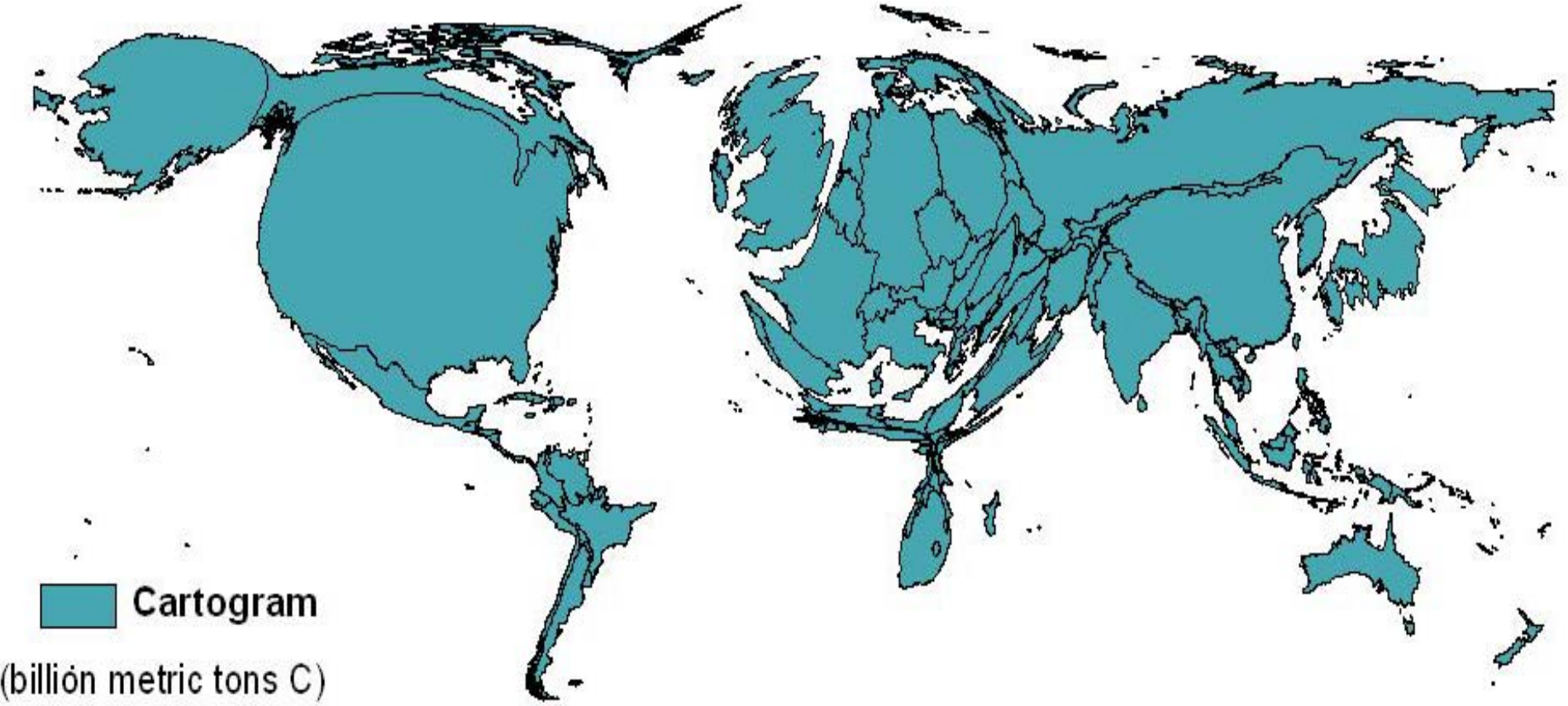
Climate Change and Health

- Climate change adds to the age-old challenges of public health due to
  - poverty
  - inequity
  - ignorance
  - complacency
  - counterproductive personal behavior
  - conflict
  - Infection, and
  - environmental stress
- It threatens to enhance existing risks at every level of development, from
  - heat stress in Barcelona to
  - malaria in Botswana.

CC and Health (cont.)

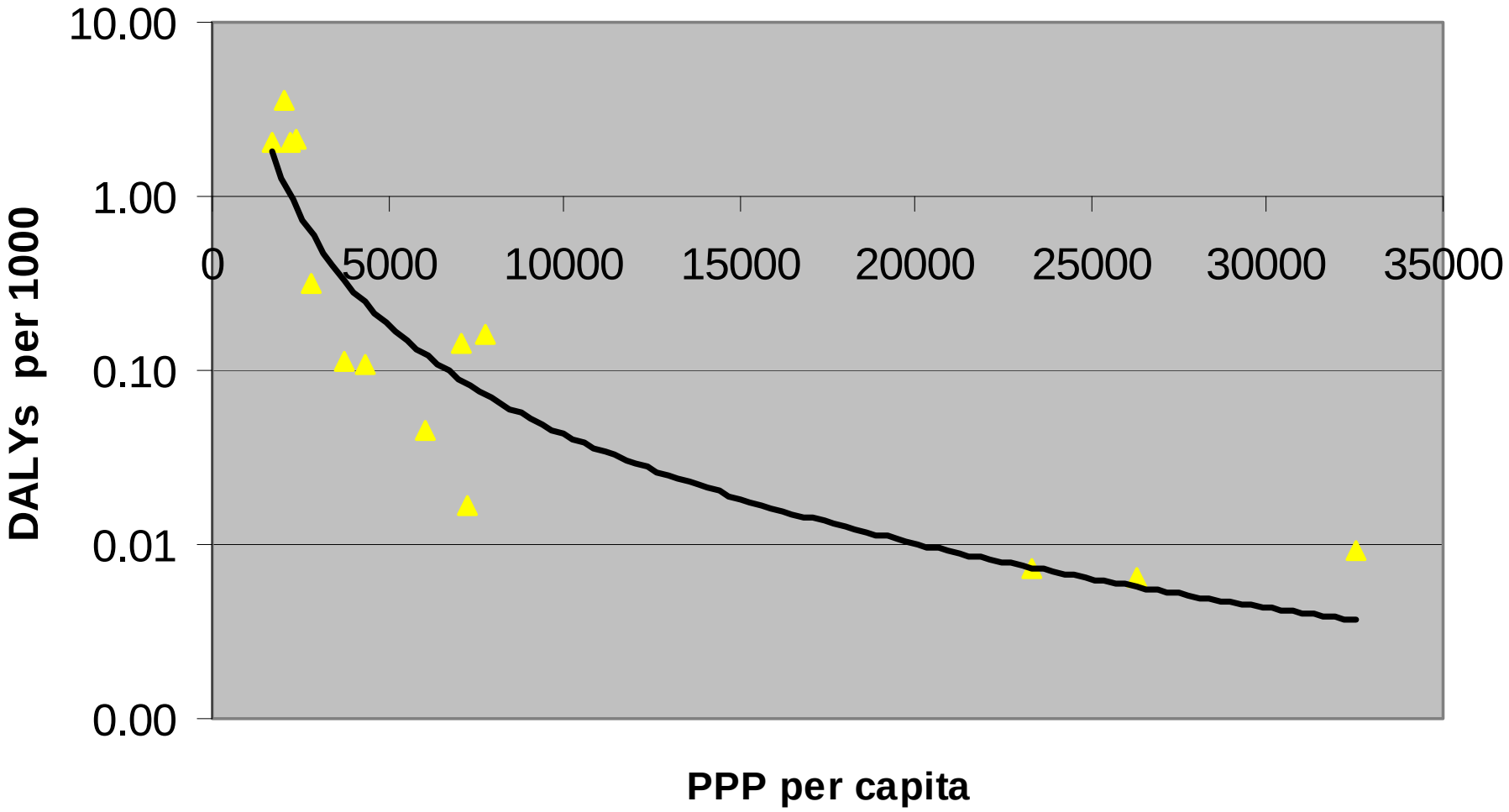
- In terms of absolute burden of disease, however, it most threatens the poorest and most vulnerable in all societies, closely in inverse proportion to income, wealth, and power.
- The rich will find their world to be more expensive, inconvenient, uncomfortable, disrupted, and colorless;
  - in general more unpleasant and unpredictable, perhaps greatly so.
- The poor will die.

Distribution of Natural Debt by Country: Carbon in Cumulative CO_2 emissions

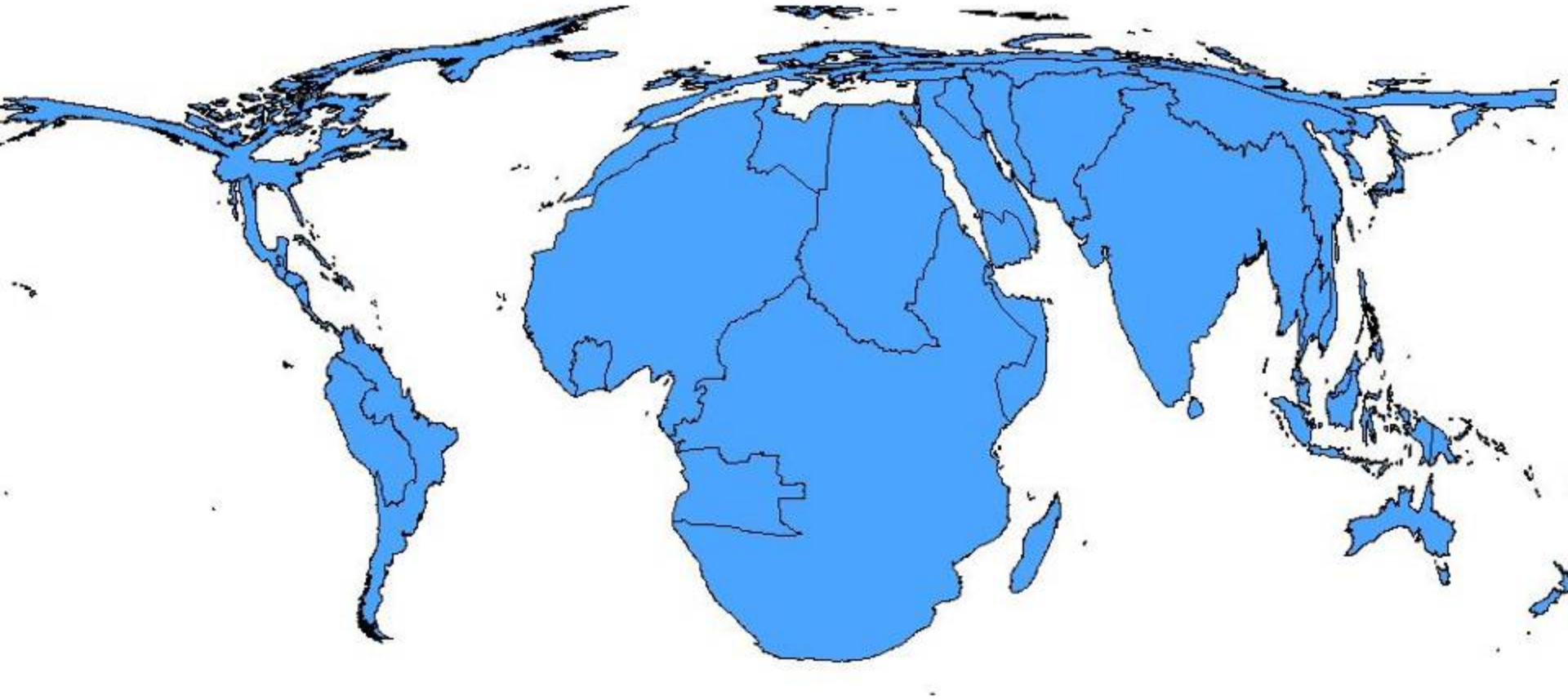


Patz et al.

Global Risk Transition
(Experiencing Risks)



Cartogram of Climate-related Mortality (per million pop) yr. 2000

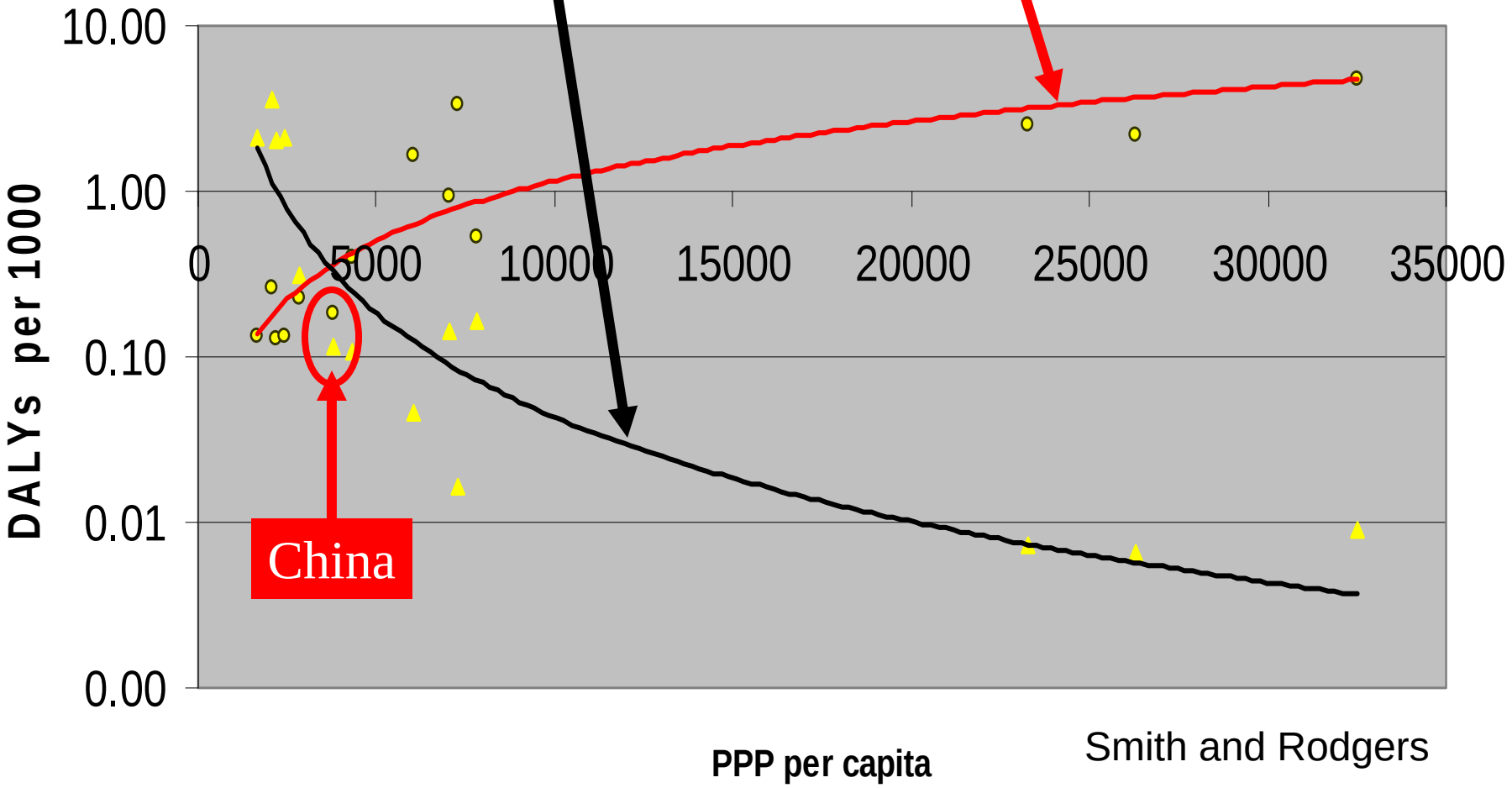


Patz et al.

This map shows estimated mortality (per million people) attributable to climate change by the year 2000. Map is a density-equalizing cartogram in which the sizes of the 14 WHO regions are proportional to the increased mortaility.

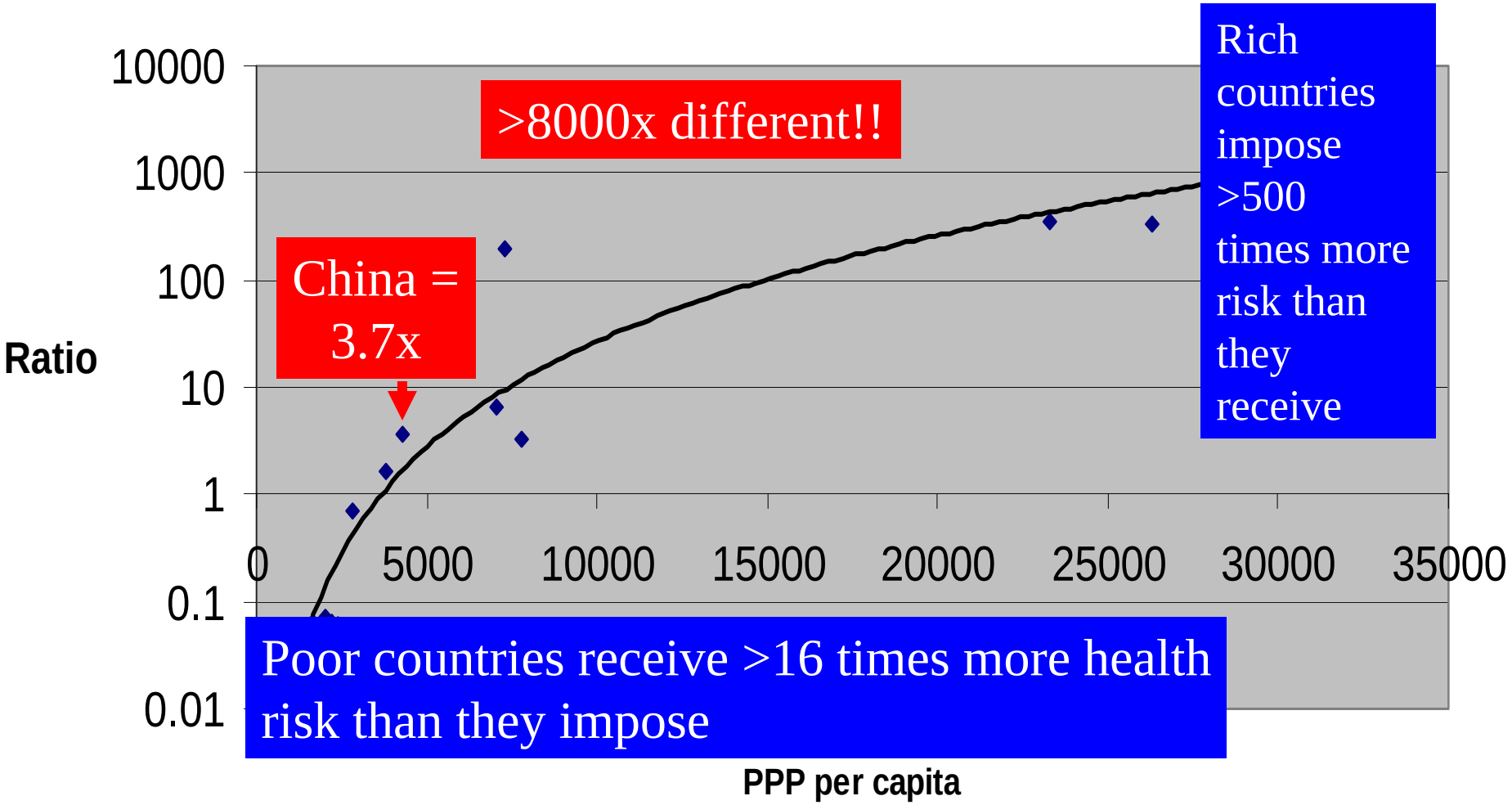
Distribution of Health Impacts from Climate Change

(Experiencing versus Imposing)



Smith and Rodgers

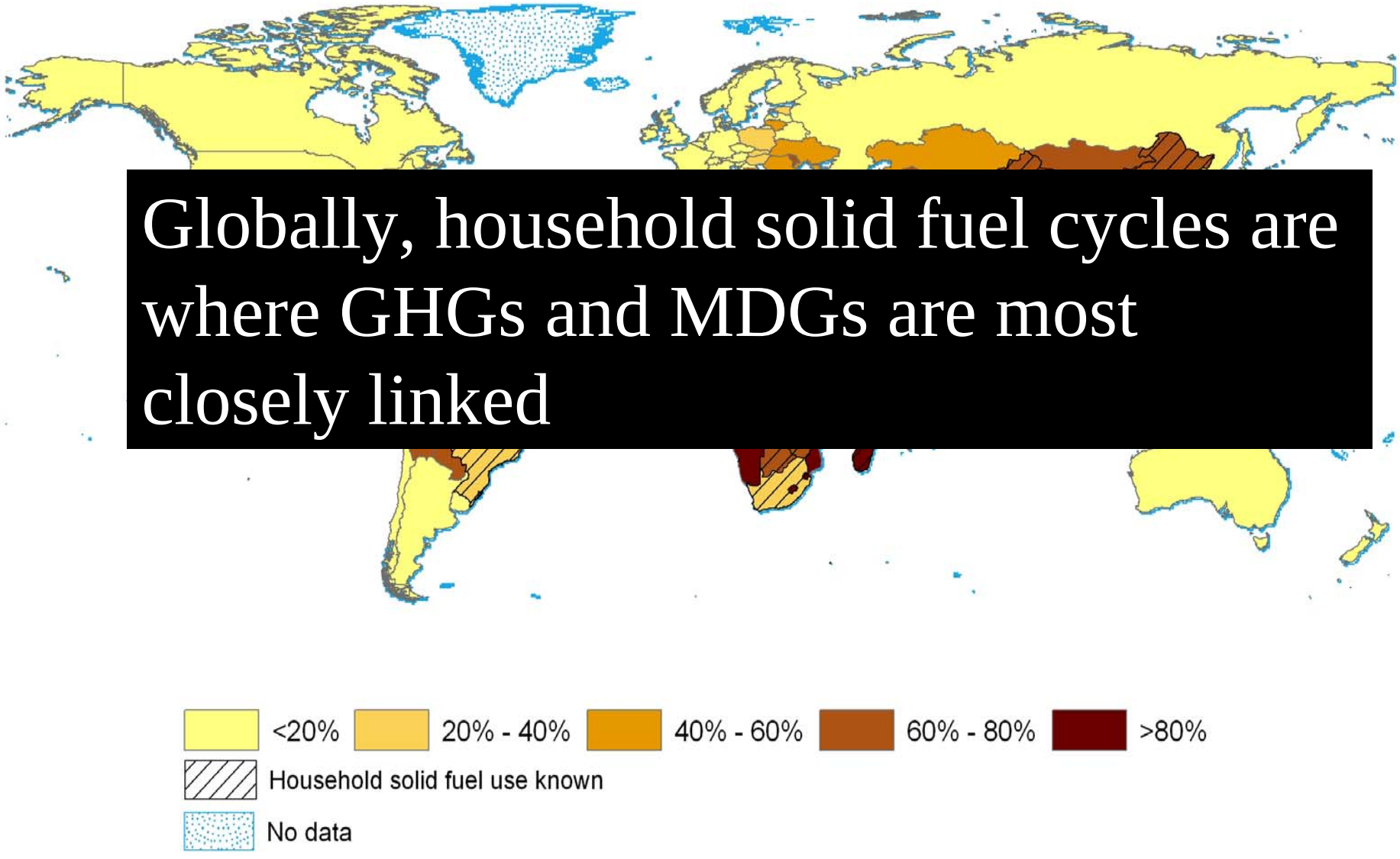
Distribution of Health Impacts from Climate Change (Ratio: Imposing/Experiencing)



The challenge and opportunity

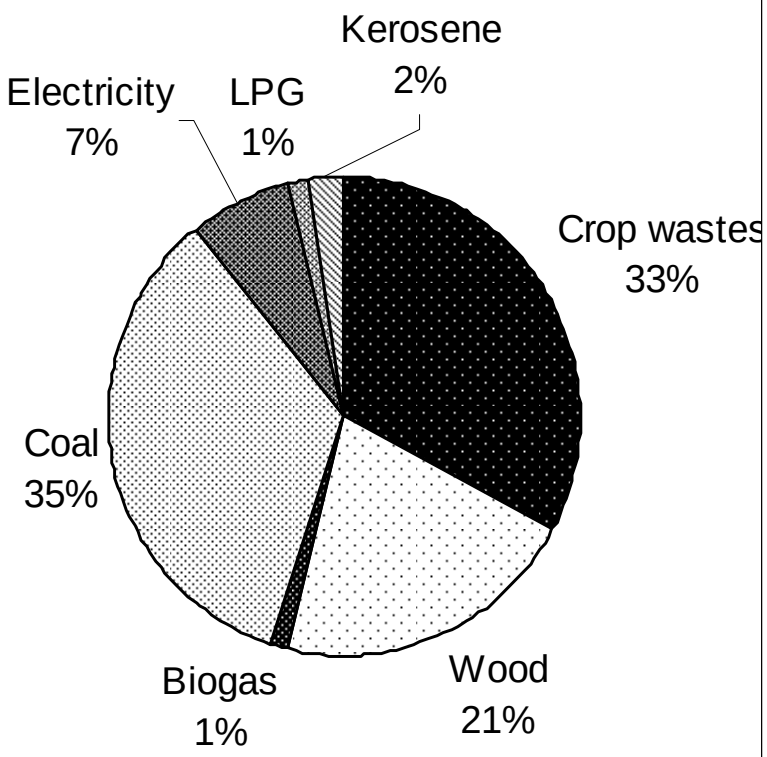
- The burden of global climate change will fall most heavily on the poor in developing countries
- This exacerbates the difficulties in achieving the Millennium Development Goals (MDGs) and other targets for development
- Global society is gearing up to devote major resources to combat climate change through GHG mitigation and other measures
- Directing a portion of these resources to projects with significant co-benefits can cost-effectively achieve both mitigation and progress toward MDGs

National Household Solid Fuel Use, 2000



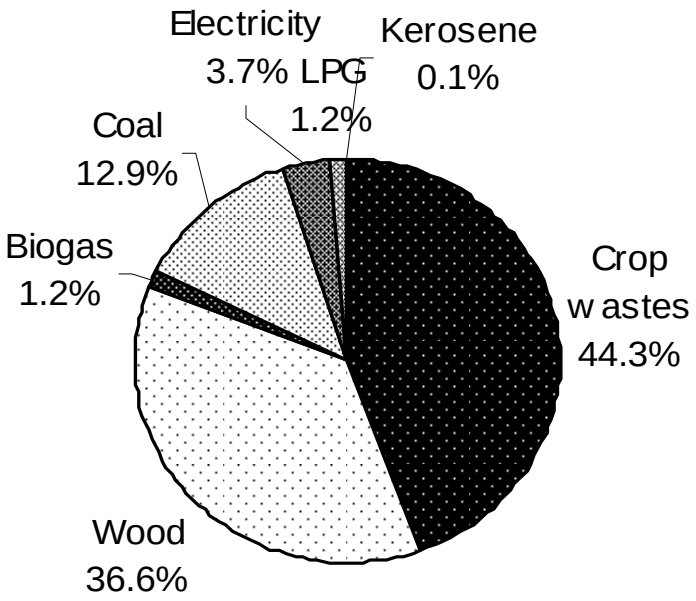
Rural Energy in China: 2004

Total



Ministry of Agriculture

Households



70% of total

National Bureau of Statistics

China rural energy situation complex:

Woodsmoke is natural – how can it hurt you?

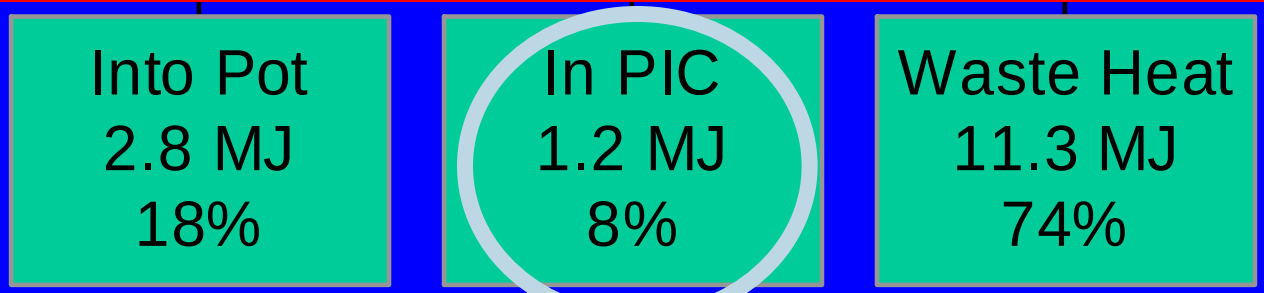
Or, since wood is mainly just carbon, hydrogen, and oxygen, doesn't it just change to CO_2 and H_2O when it is combined with oxygen (burned)?

Reason: the combustion efficiency is far less than 100%

Energy flows in a well-operating traditional wood-fired Chinese cooking stove

A Toxic Waste Factory!!

Typical biomass cookstoves convert 6-30% of the
fuel carbon to toxic substances + methane



PIC = products of incomplete combustion = CO, HC, C, etc.

Source: Zhang, et al., 2000

Toxic Pollutants in Biomass Fuel Smoke from Simple (poor) Combustion

Plus methane, a powerful GHG

- Small particles, CO, NO_2
- Hydrocarbons
  - 25+ saturated hydrocarbons such as *n-hexane*
  - 40+ unsaturated hydrocarbons such as *1,3 butadiene*
  - 28+ mono-aromatics such as *benzene & styrene*
  - 20+ polycyclic aromatics such as *benzo(α)pyrene*
- Oxygenated organics
  - 20+ aldehydes including *formaldehyde* & *acrolein*
  - 25+ alcohols and acids such as *methanol*
  - 33+ phenols such as *catechol* & *cresol*
  - Many quinones such as *hydroquinone*
  - Semi-quinone-type and other radicals
- Chlorinated organics such as *methylene chloride* and *dioxin*

Source: Naeher et al, *J Inhal Tox*, 2007

Diseases for which we have epidemiological studies

ALRI/ Pneumonia (meningitis)

Asthma

Low birth weight & stillbirth

Early infant death

Cognitive Effects?

Chronic obstructive lung disease

Interstitial LD

Cancer (lung, NP, cervical, aero-digestive)

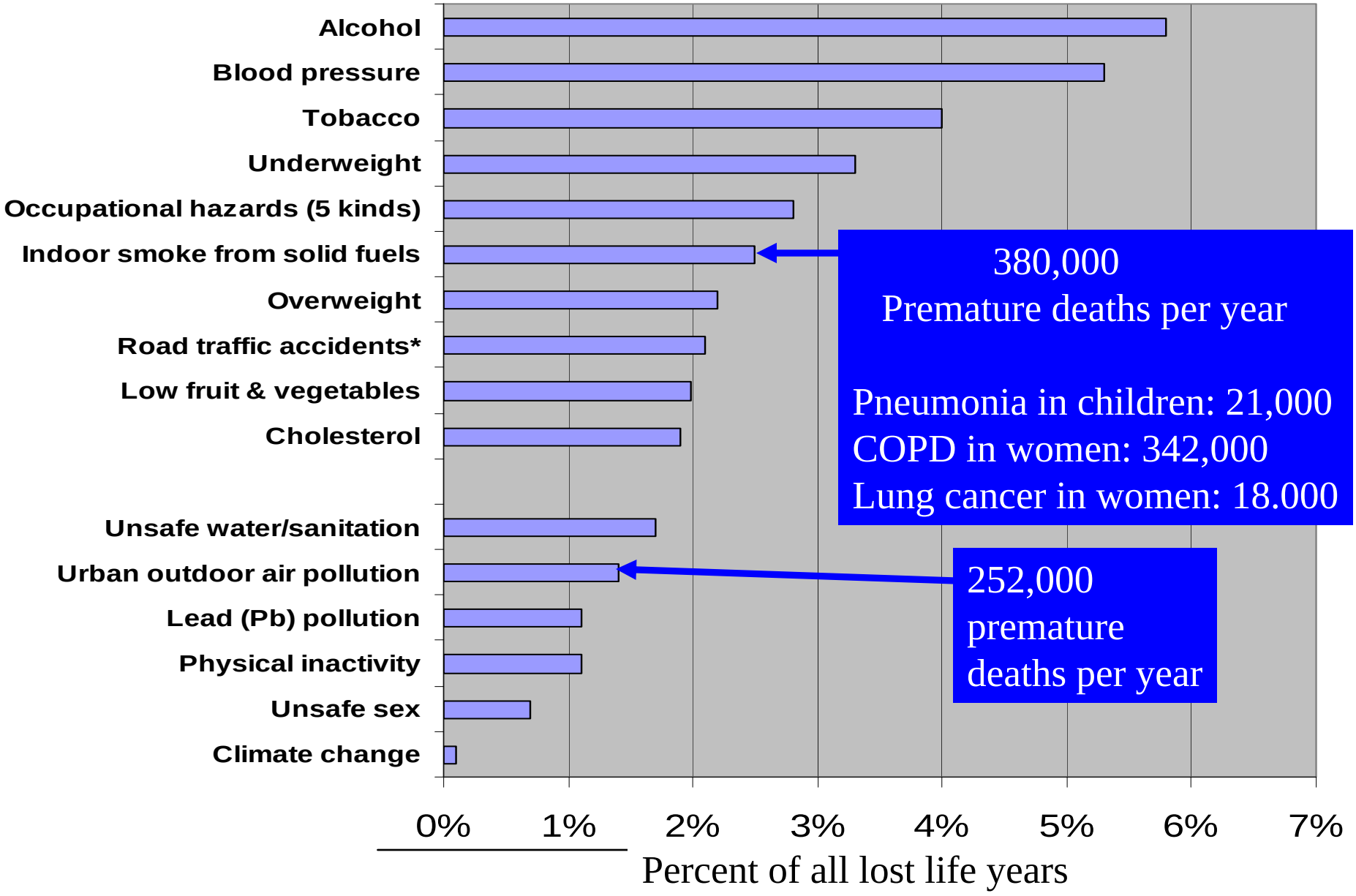
Blindness (cataracts, trachoma)

Tuberculosis

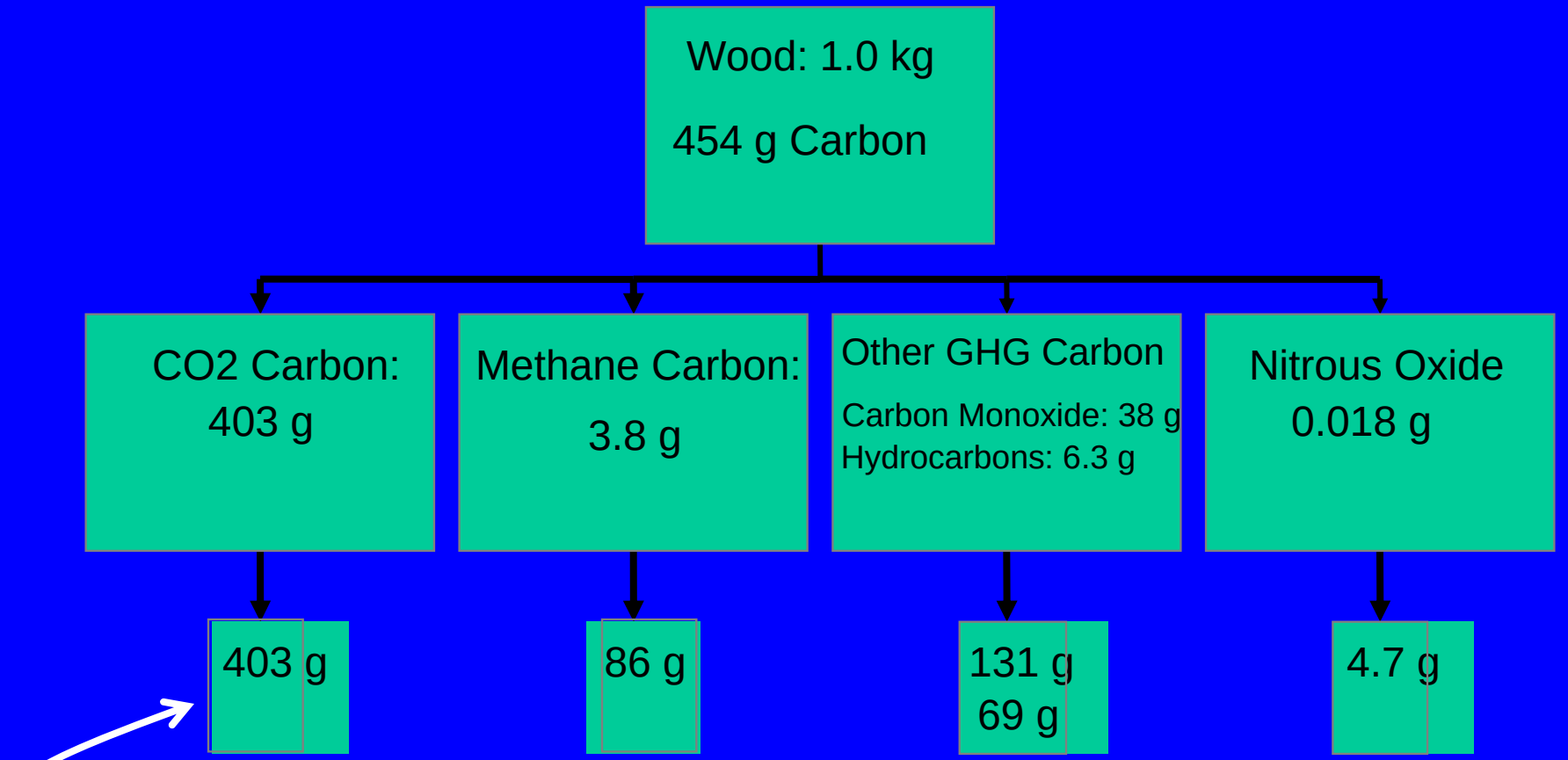
Heart disease

Chinese Burden of Disease from Top 10 Risk Factors

Plus Selected Other Risk Factors



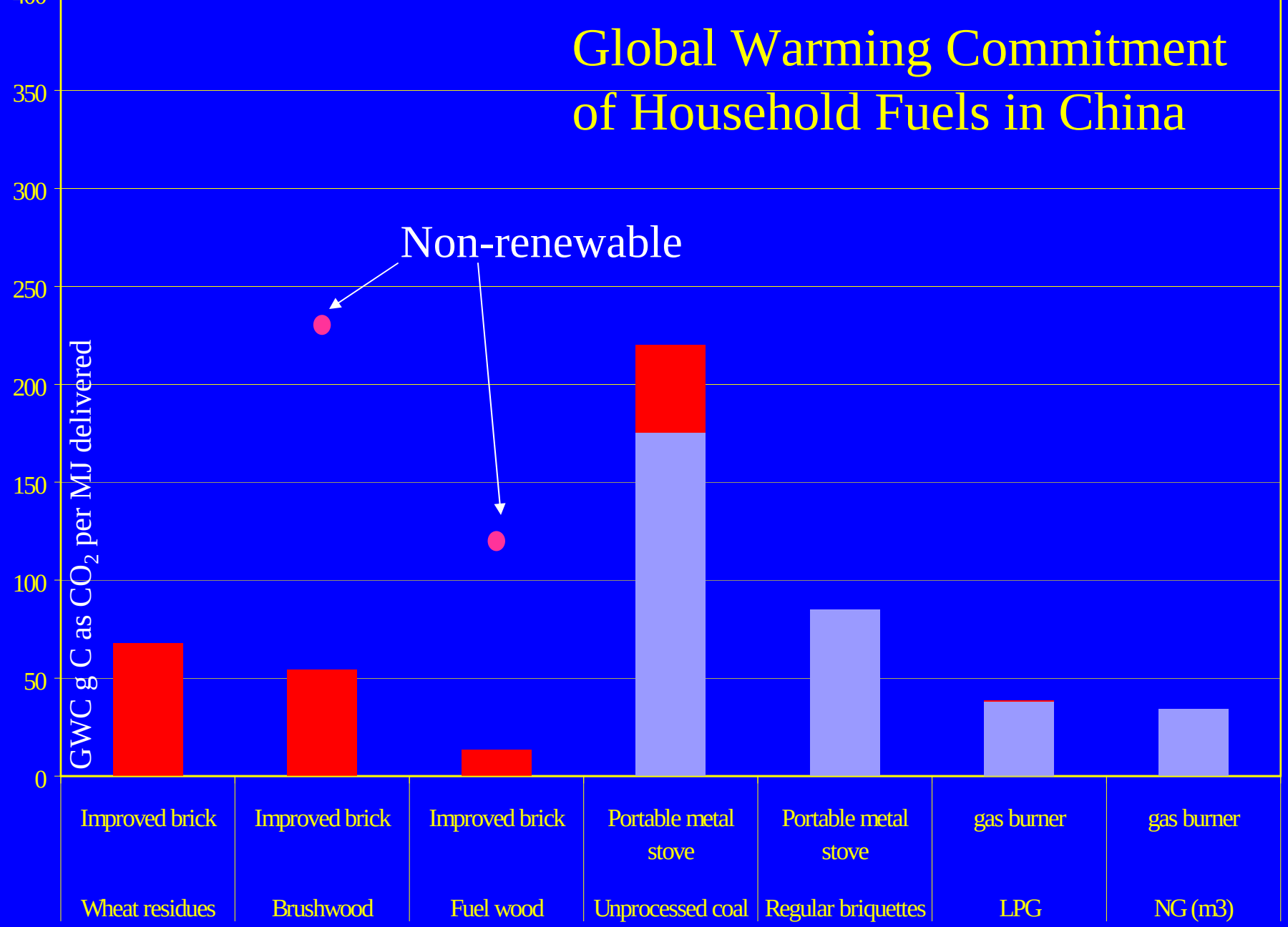
Greenhouse warming commitment per meal for typical wood-fired cookstove in China



Global warming commitments of each of the gases as CO_2 equivalents

Source: Smith, et al., 2000

Global Warming Commitment of Household Fuels in China



A Chinese Biomass Gasifier Stove

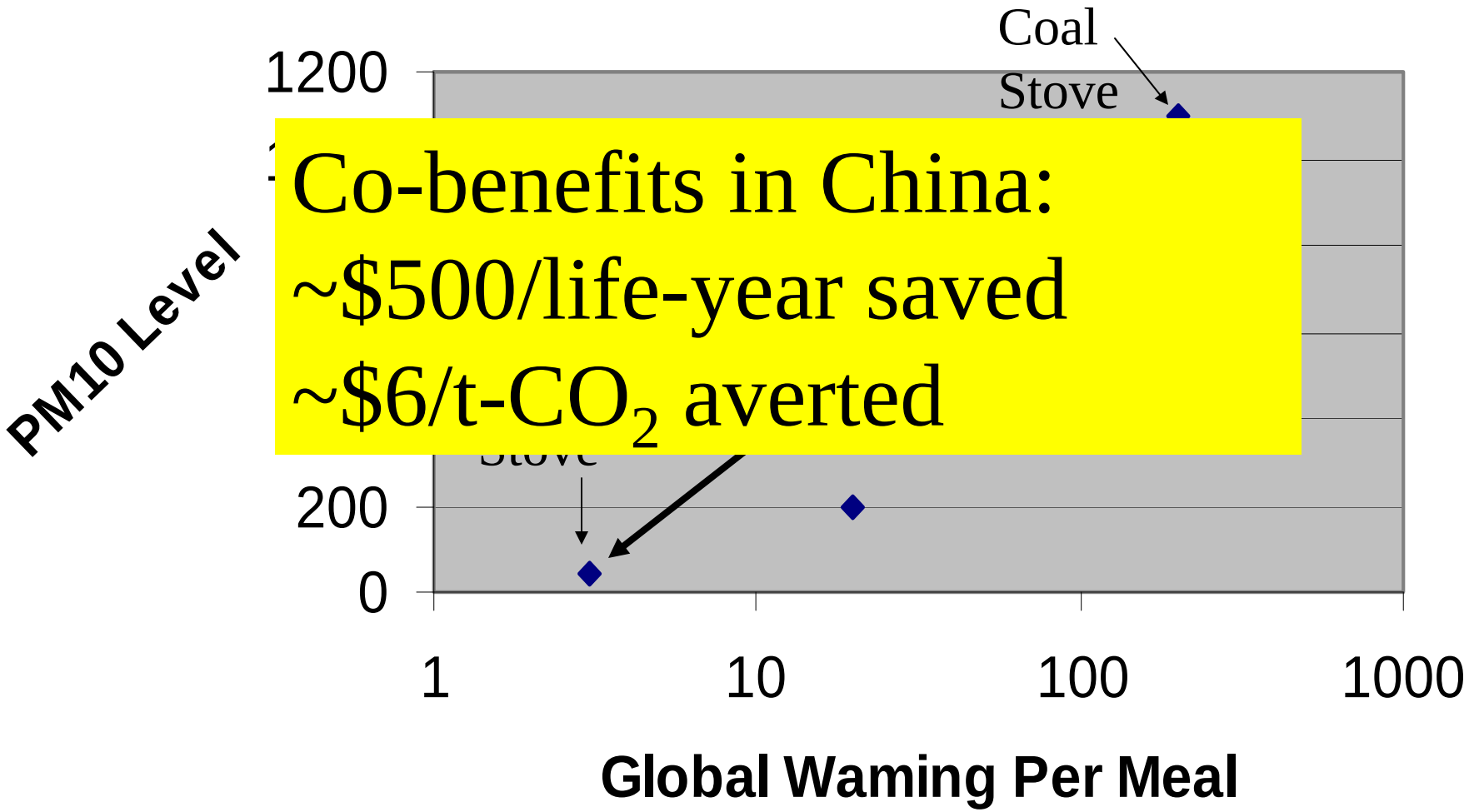
Tests show PIC emissions nearly at LPG levels.

Winner of Chinese national contest announced March 2007 for best stove meeting emissions and reliability criteria:
cost 300Y

Consider the substitution of coal stoves in rural China with advanced biomass gasifier stoves, now commercially available in several provinces

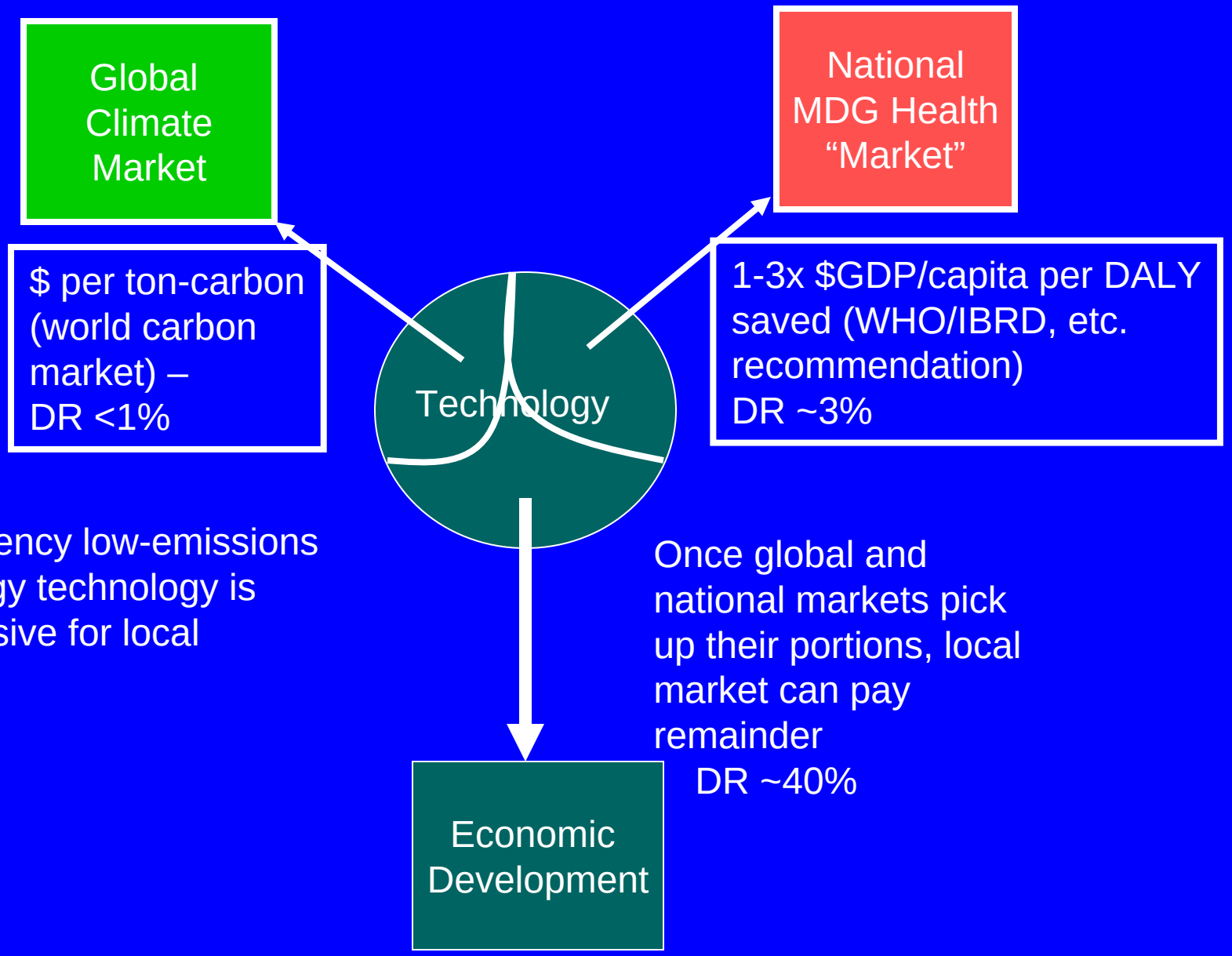
- 300Y retail cost/stove + 50% program cost
- 50% of performance in lab
- Typical household fuel use
- Kyoto greenhouse gases only, including methane
- Financial calculations as in CDM requirements
- Health calculations based on Chinese data using WHO methods

Health and Greenhouse Gas Benefits of Biomass Stove Options



Co-benefits in China:
~$500/life-year saved
~$6/t-$CO_2$ averted

Paying for Rural Energy Development



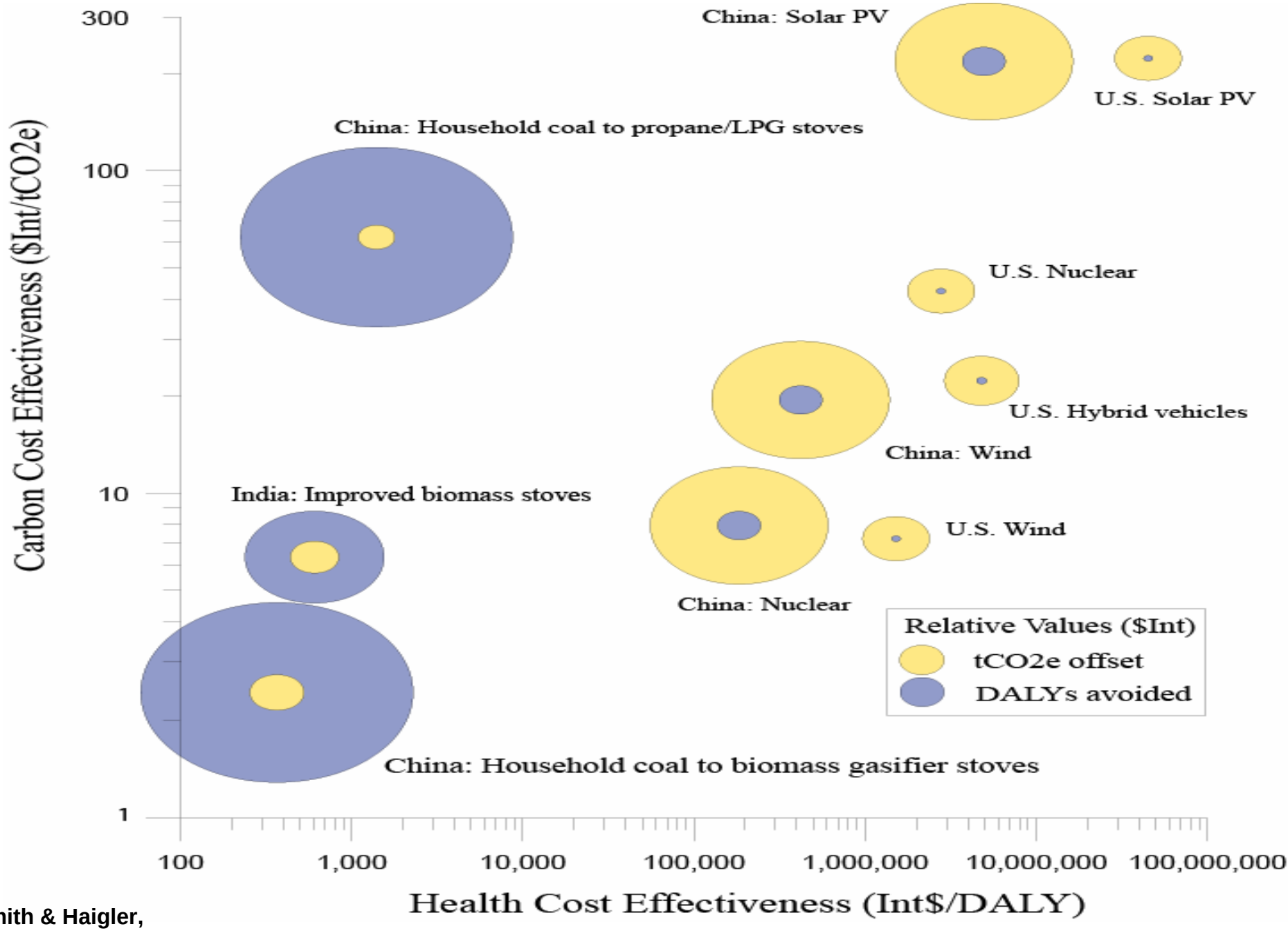
High-efficiency low-emissions rural energy technology is too expensive for local markets

Once global and national markets pick up their portions, local market can pay remainder
DR ~40%

Conclusion #1

- In terms of energy delivered, the most
  - most wasteful,
  - most unhealthy, and
  - most GHG intensive

  fuel cycle in the world is the one directly affecting the largest number of people: solid household fuels in developing countries
- Or, put another way, it is the system in which MDGs and GHGs are most closely linked
- Improvements thus offer the opportunity to both maintain progress toward MDGs and contribute to GHG mitigation in highly cost-effective ways



Smith & Haigler, in press

Conclusions #2

- The first scoping of co-benefits should use the methods and metrics established by the international collaborative assessments (IPCC, UNFCCC, WHO CRA, MDGs, DCPs, Commission on Macro-Economics and Health, etc.)
  - they represent a consensus of world expert opinion on how best to navigate through the complexity of such analyses
  - This would represent in all analyses, the **Base Case**
- Elaboration can be made in additional analyses (cases) based on particular needs or local conditions
  - Departures from Base Case to be clearly stated
  - Restricted, however, to peer-reviewed methods in published literature

Need, however

- To slightly adjust the methods proposed by the different groups to be consistent with one another, e.g.
  - Discount rates
  - Valuation techniques
  - Time periods
- Must be verifiable at reasonable cost
  - “You don’t get what you expect, you get what you inspect”

Lancet Series on Energy and Health published Sept 13, 2007 (370: 5-83)

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This review is partly based on the articles:

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Symposium on Climate Change and Health, KR Smith, ed.
Annual Review of Public Health, 29 (in press, 2008).
Smith KR and Haigler E

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Environmental Health Perspectives 115 (6): 848-855, 2007
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Atmospheric Environment, 34(26): 4537-4549, 2000
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All at: http://ehs.sph.berkeley.edu/krsmith/