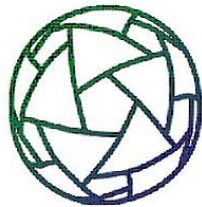


New Biomass Stoves and Carbon Credits

Dean Still

Executive Director, Aprovecho Research Center



Aprovecho Research Center
Advanced Studies in Appropriate Technology Laboratory

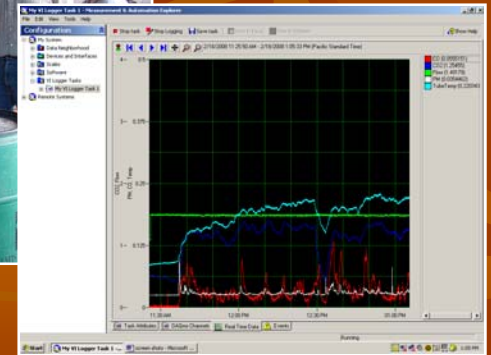
79093 Highway 99, PO Box 1175
Cottage Grove, Oregon 97424 USA

541-767-0287
www.aprovecho.org

Overview of today's talk

- Background history on stoves development
- Understanding modern stoves
- New market approaches :top down versus bottom up
- International standards
- Carbon credits

Aprovecho: Testing Stoves

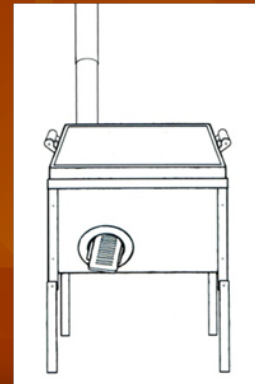
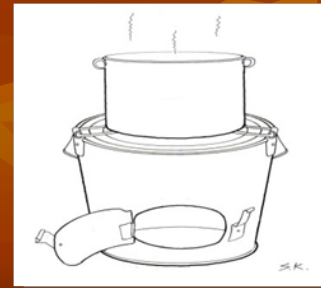
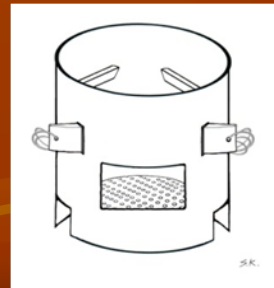
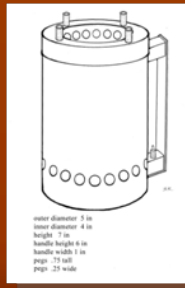
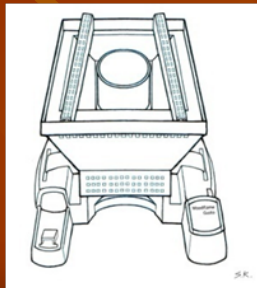
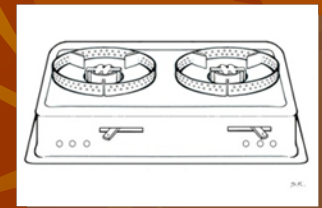
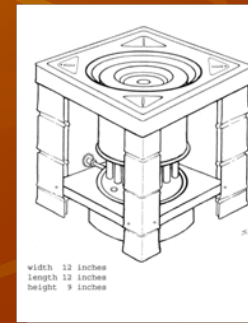
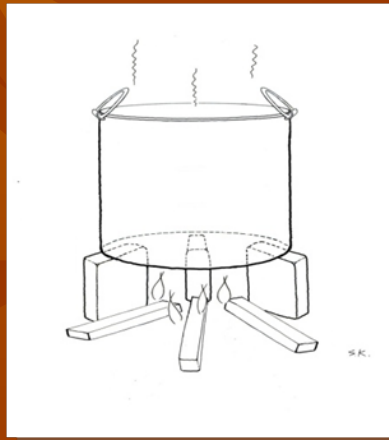
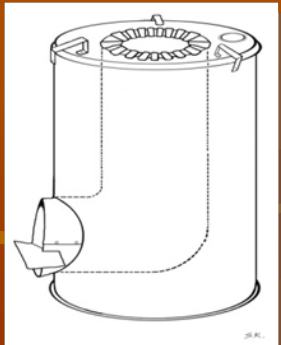
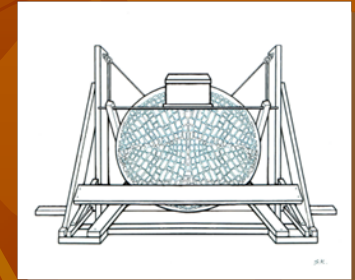
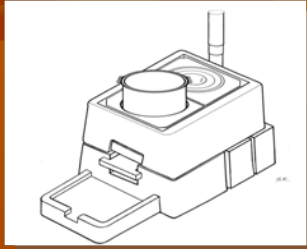
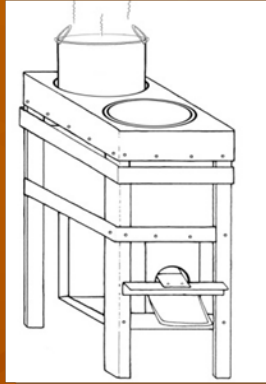
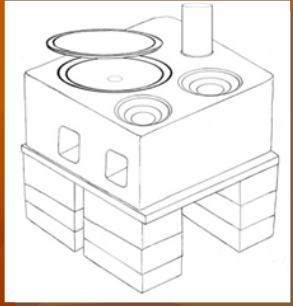


Laboratory Testing

In-Field Testing

Cooking Stoves

Aprovecho has a library of tests from over 50 stoves in use around the world.



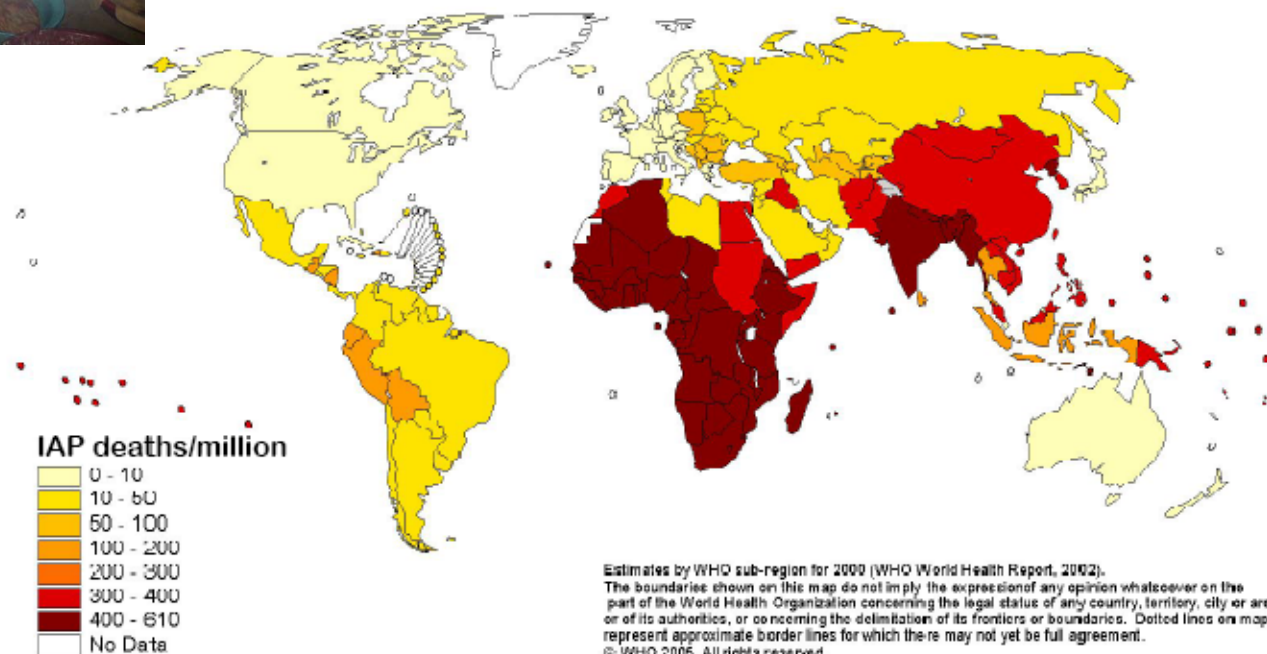
Health impact of solid fuels



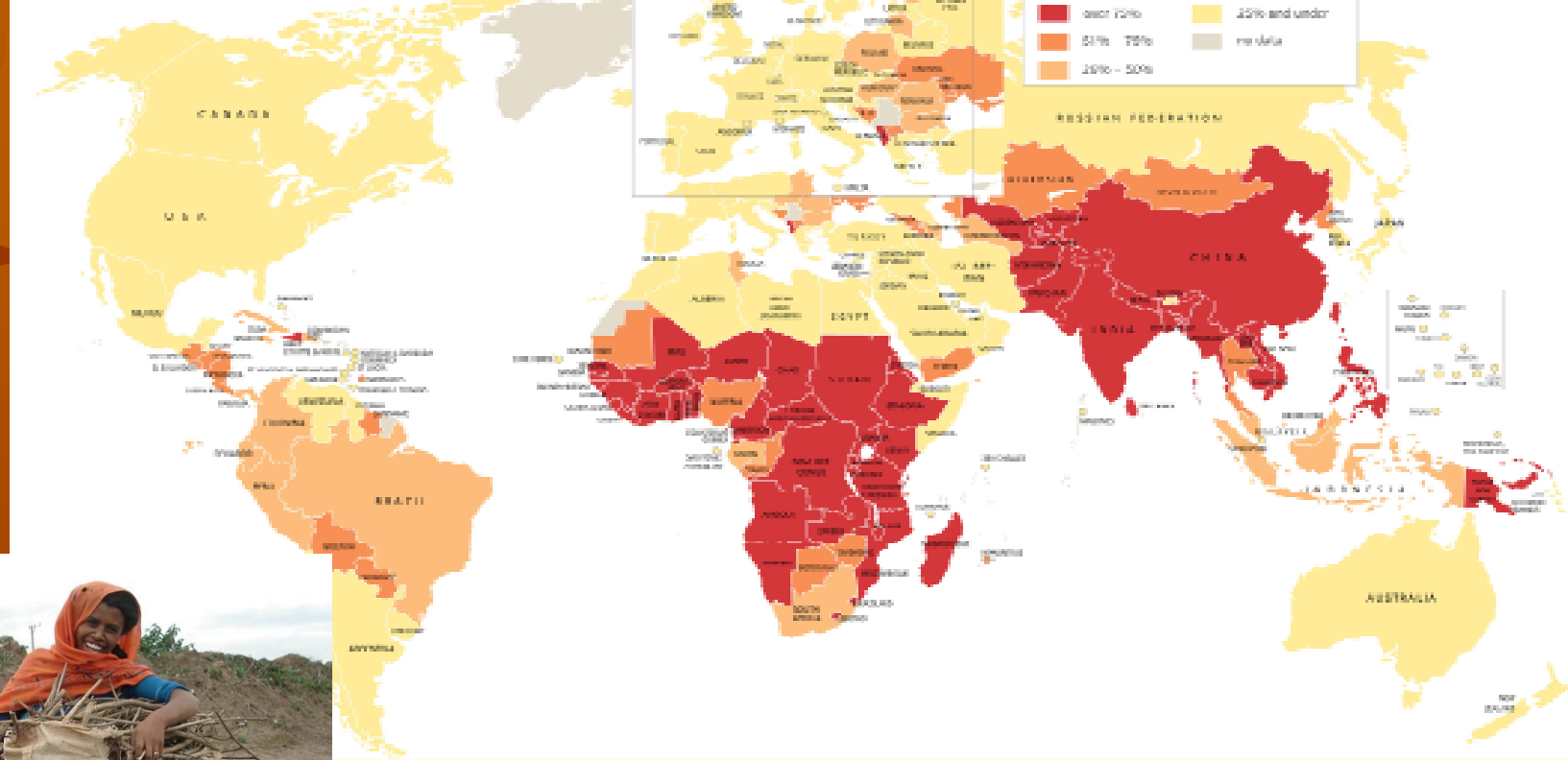
Indoor Air Pollution

1.6 million premature deaths per year according to WHO
Asthma, Colds, Eye Irritation, COPD, Pneumonia, ALPD, ...

Deaths from indoor smoke from solid fuels



Indoor Smoke: Breaking Down Respiratory Defences

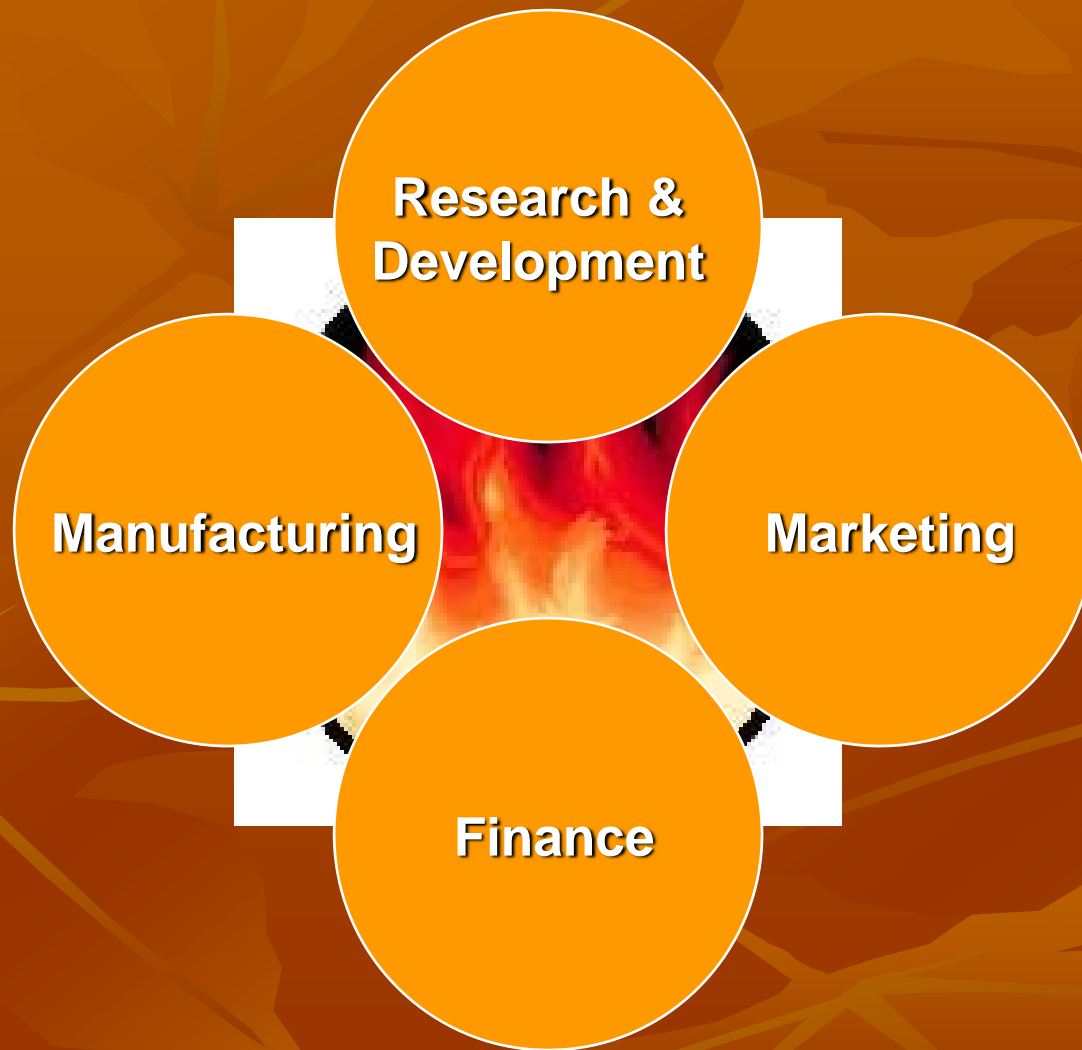


Global Warming :CO₂, CH₄, CO and black carbon emissions
from inefficient biomass stoves is accelerating warming
(Brown cloud over Asia)
Excessive Fuel Use: Deforestation,
Desertification and Drudgery/Danger

CookStoves: A Troubled History

- Bad “Improved” Stoves have been made
- A broad misunderstanding of traditional methods and cultures, as well as heat transfer and combustion, led to the faulty assumption that any stove is better than none
- Many designers still do not understand insulation vs. mass
- Manufacturing high-quality stoves in-country on a small scale has been a challenge
- Testing was not widely done to optimize and/or validate performance
- Stable financing was not generally available

Modern Stoves: A Four-Legged Approach



How close are we?

Defining 'Improved' CookStoves

- Good Stoves Can Turn Wood Into Clean Energy
- Stoves need to be as carefully designed as Toyotas.
- Moving forward:
 - Testing Needs to be standardized
 - In 2003, Shell Foundation/UCBerkeley/Aprovecho revised 3 test protocols to quantify and compare performance in lab, field, and homes.
 - Gold Standard has been developed for fuel savings/carbon credits.
 - R&D is required to quantify and improve combustion and heat transfer efficiency
 - Aprovecho provided first extensive laboratory fuel use and emissions testing, many other large organizations have also begun testing
 - Emissions testing kits are now available from Aprovecho
 - Without comparisons we don't know what we are aiming to achieve
 - International Standards are needed to provide minimum requirements of stove performance.

Testing COOKSTOVES

Research &
Development

- Aprovecho has designed easy-to-use emissions equipment, available to help projects with stove testing:

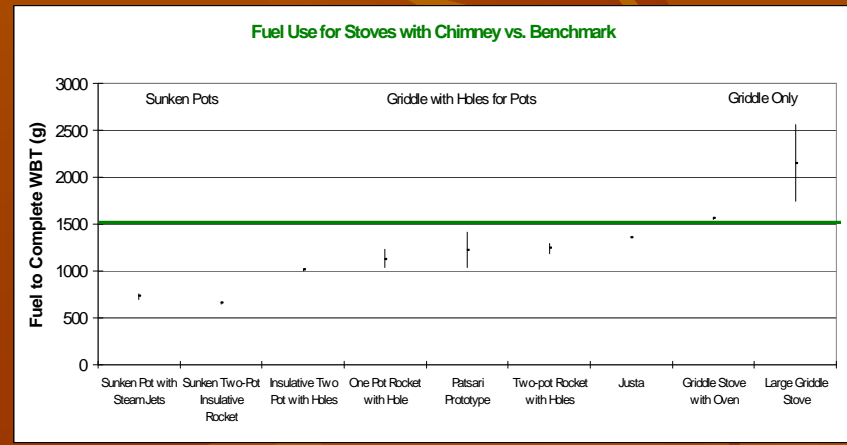
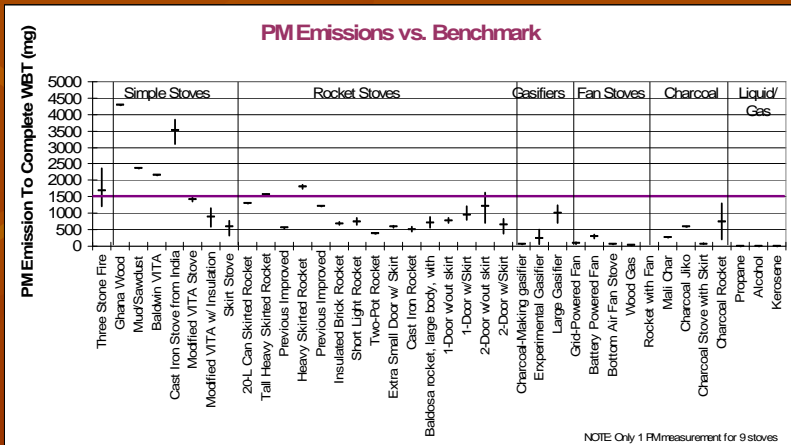
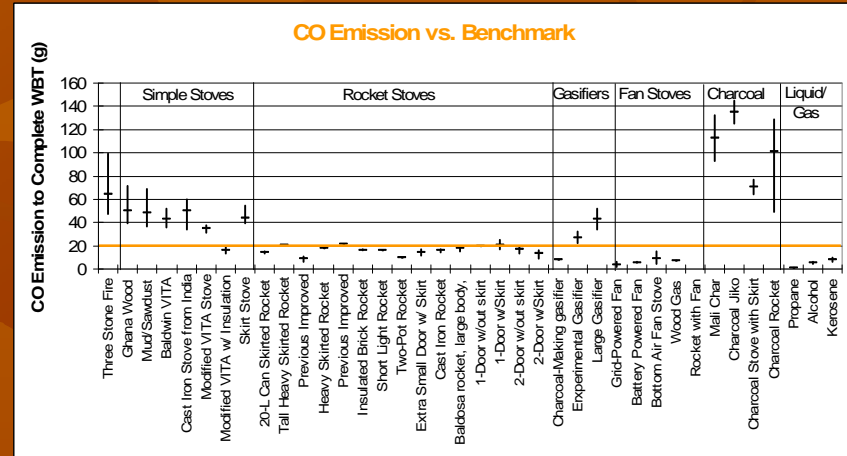
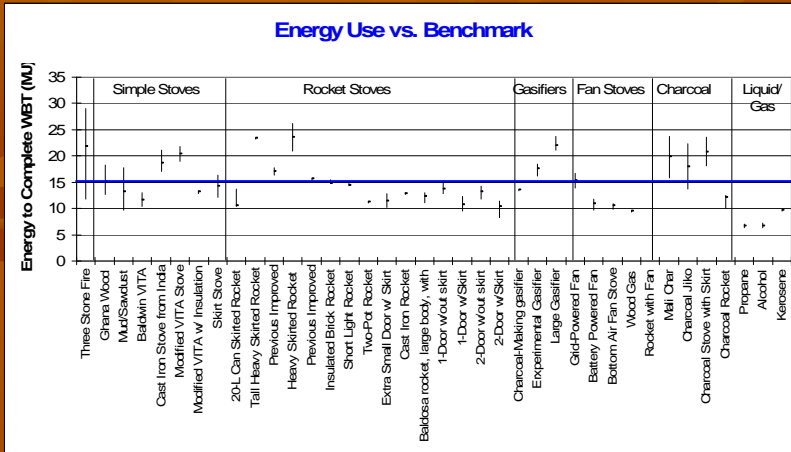


Portable
Emissions
Measurement
System
(PEMS)



Indoor Air Pollution/Exposure Meter

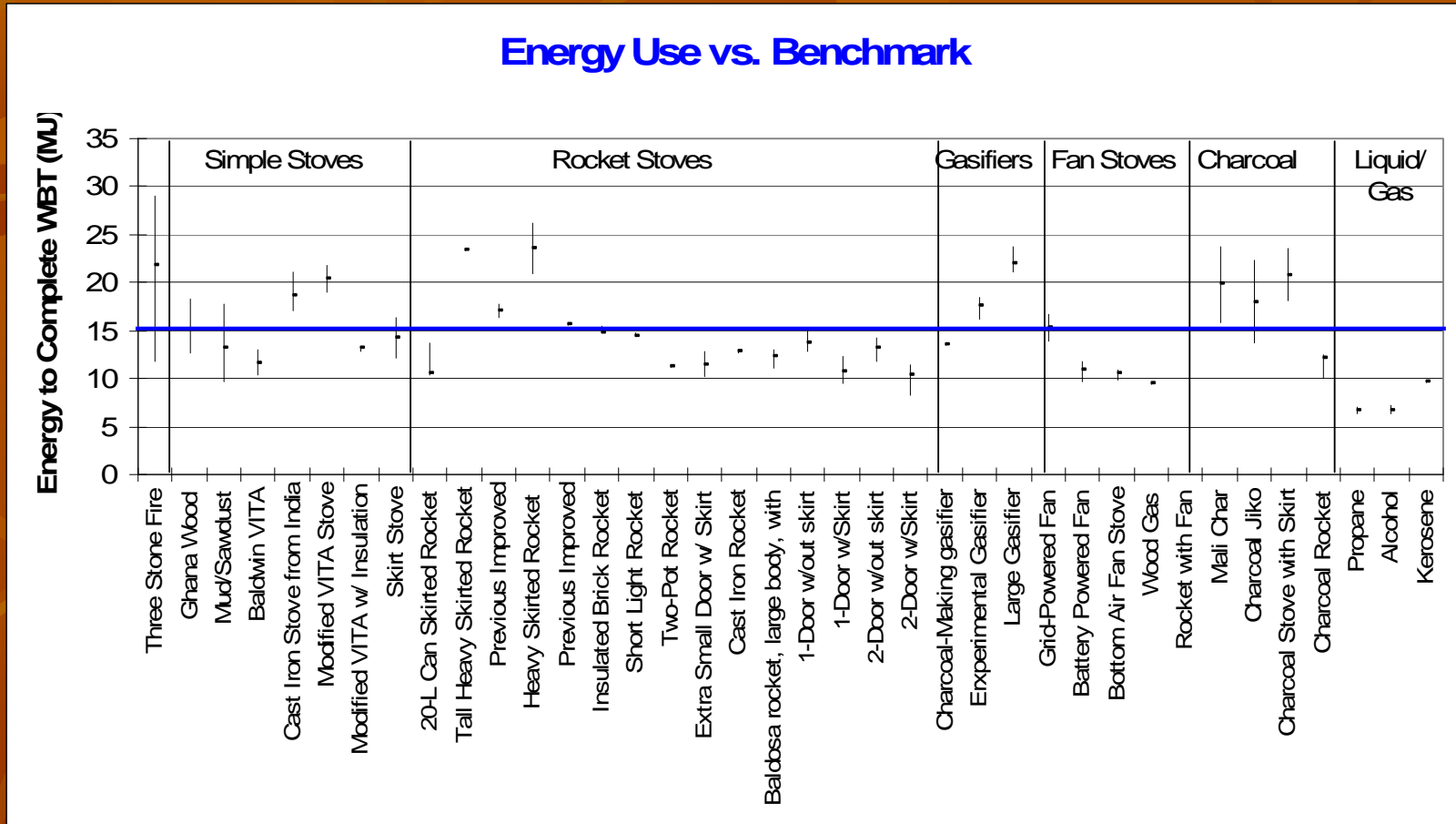
Benchmarks for Stove Performance



The Aprovecho Library of performance of over 50 stoves was used to create benchmarks for Shell Foundation, Philips, and others.

International Standards are in the works...

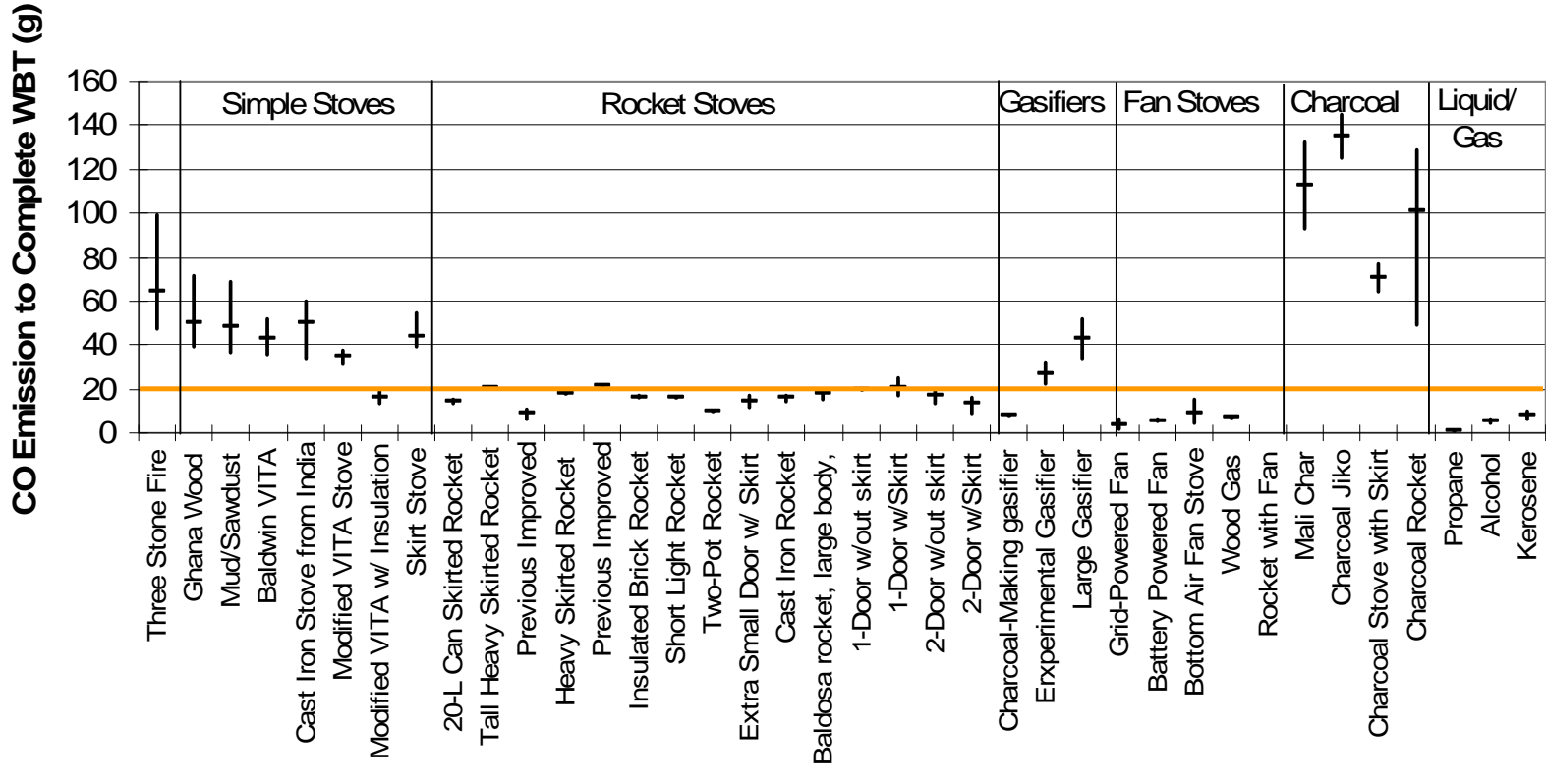
Benchmarks for Stove Performance



Fuel Use Benchmark: The wood-burning stove without chimney should use less than 850 g of wood (15 MJ of energy) to complete the WBT.

Benchmarks for Stove Performance

CO Emission vs. Benchmark

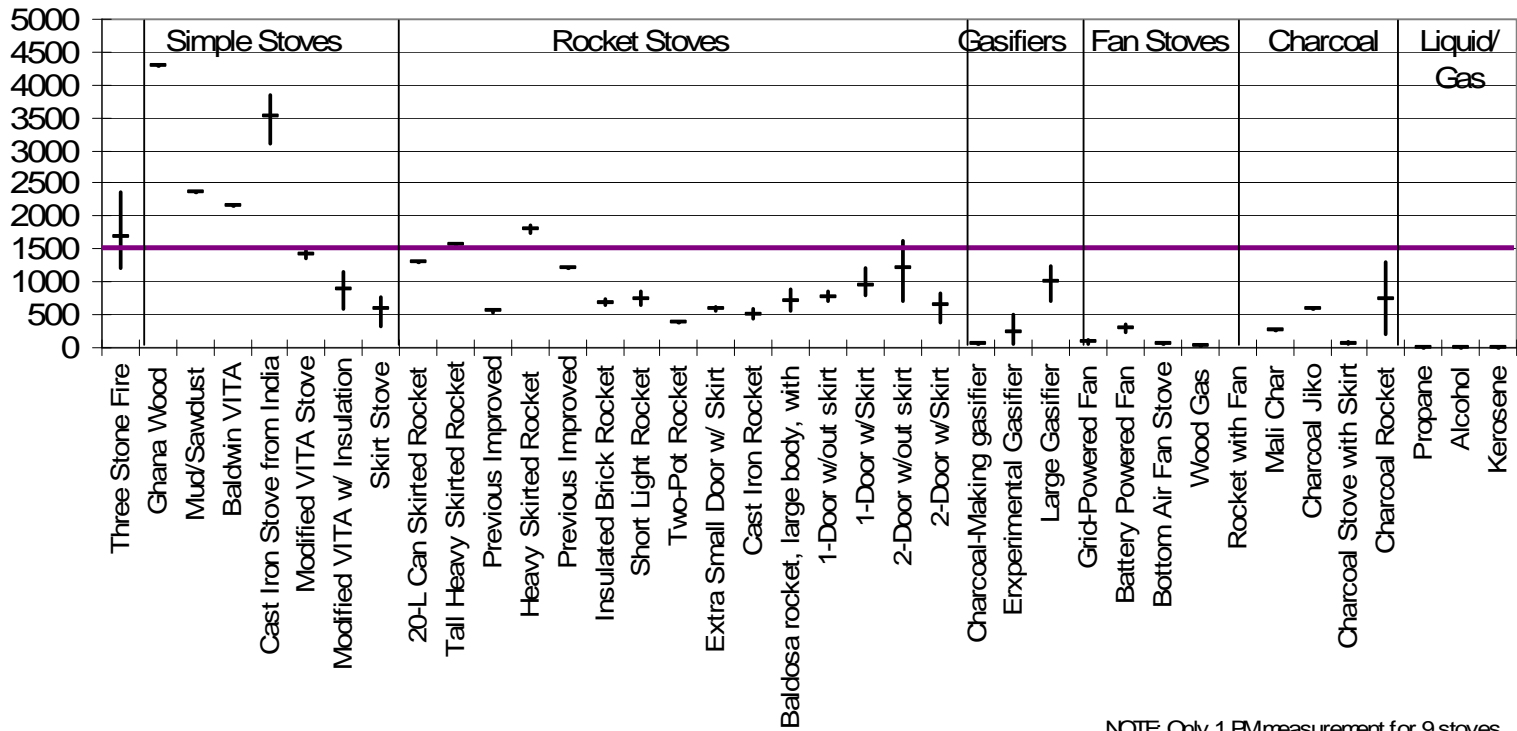


CO Benchmark: The wood-burning stove without chimney should emit less than 20 g of carbon monoxide to complete the WBT.

Benchmarks for Stove Performance

PM Emission To Complete WBT (mg)

PM Emissions vs. Benchmark



NOTE Only 1 PM measurement for 9 stoves

PM Benchmark: The wood-burning stove without chimney should emit less than 1500 mg of PM to complete the WBT.

Performance Standards

Research &
Development

- Ideally, standards will:
 - Encourage development locally to compete with companies selling stoves globally
 - Improve all stoves by keeping big and small stove makers on the same page
 - Help to promote user safety considerations in stove designs
 - Increase stove durability and longer performance
 - At the end, ensure stove projects are worth pursuing

Improvements in Design

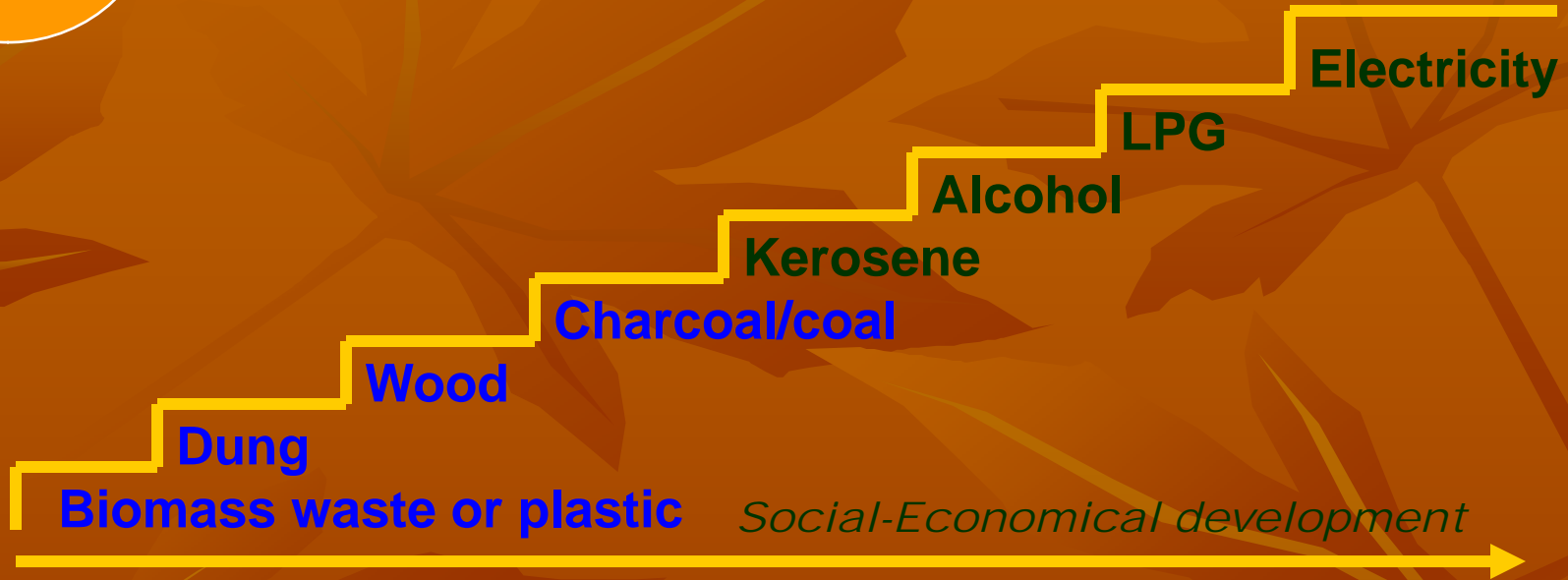
Research &
Development

- Heat Transfer can be improved
 - Containing the fire and forcing heat against the pot can save 30-50% of fuel compared to Open Fire
- Combustion Efficiency can be improved
 - Several methods of combustion can save 50-90% of emissions compared to Open Fire
 - Rocket Combustion Chamber from China (\$2 = 1/2 emissions)
 - Gasification (\$5 = 1/2 emissions)
 - Fan Stove (\$20 = 1/8 emissions)

Moving Biomass a Step Up the “Energy Ladder”

- Stoves with small (1 Watt) electric fan can burn wood as cleanly as kerosene
 - 40% Of Biomass Users Have Electricity in Their Homes
- Chimneys: The solution to Indoor Air Pollution?
 - Chimneys remove smoke in the US, Europe: Why not everywhere?

The energy ladder

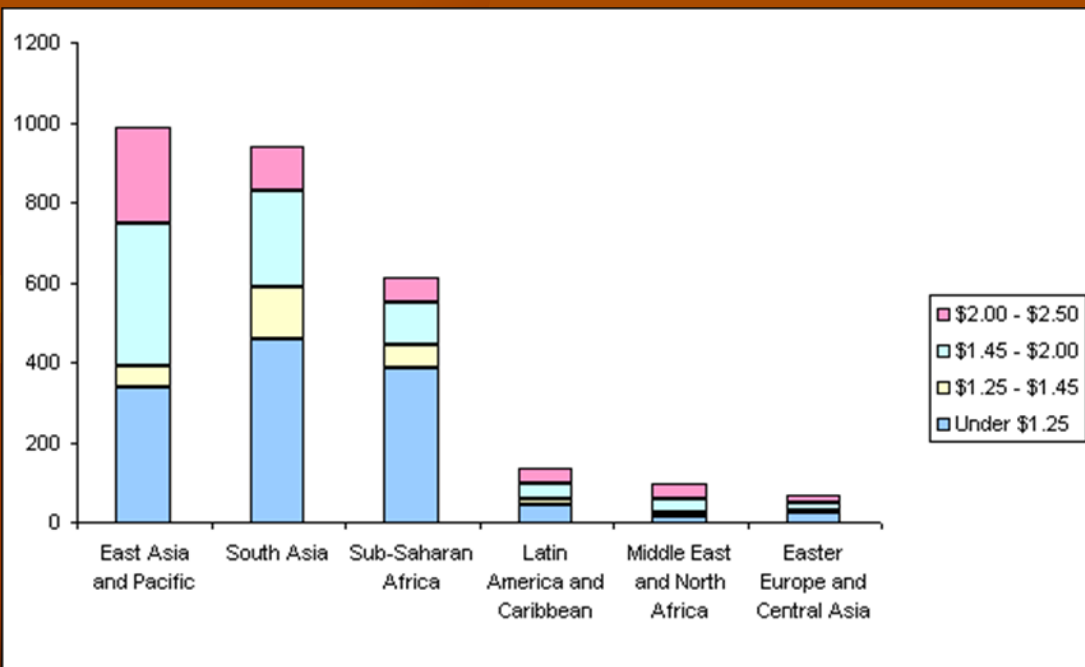
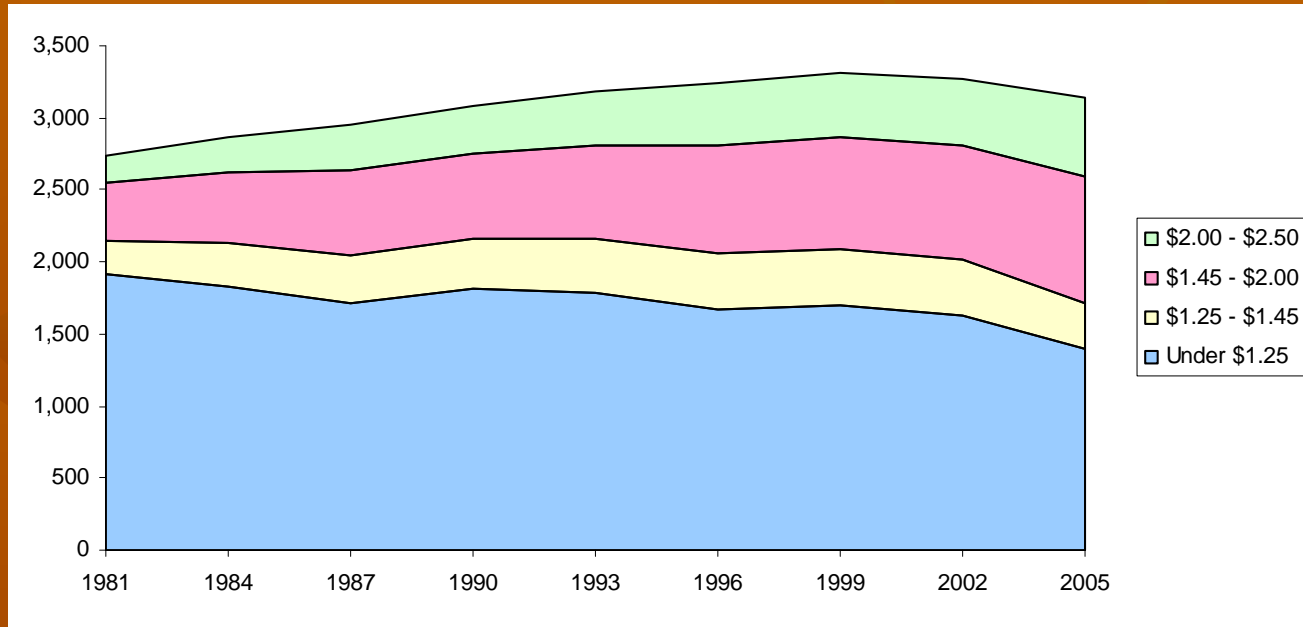


Three groups of people using traditional solid fuels:

- **The poorest of the poor** (< US\$ 1.25/day)
(will not move up the energy ladder, need subsidy?)
- **The poor** (US\$ 1.25-3/day)
(long term transition) *Immediate commercial market
- **The low middle class** (> US\$ 3/day)
(Likely in transition ?)

Marketing

Poverty lines
(millions of people)
by mean per capita
consumption (US\$
per day)



Regional breakdown of the
2005 poverty lines (millions)

Source: Chen and Ravallion (2008)

Complimentary Approaches

Manufacturing



There is room for everyone.

Manufacturing

Manufactured Stoves for Sale Today



StoveTec



Philips



Envirofit –
Shell



British Petroleum



Ecostoves



StoveTec:
powered by
“rocket stove”,
made in China
for the global
market.
Optional fan
wood and
charcoal
burning stove.



Envirofit-Shell:
powered by rocket
stove, sold in India (&
Brazil and Eastern
Africa).



S-2100

Ecostove:
powered by
rocket stove,
made and sold in
Latin America
by SMEs (Brazil,
Honduras,
Nicaragua and
Bolivia). One
model for many
markets.



**Philips: made and
sold in India.
Thermoelectric
powered fan.**



British Petroleum
(BP): fan stove,
made and sold in
India. Pellet fueled.



Biofuels stoves

Dometic: ethanol stove
for Africa and Brazil.



Bosch-Siemens: plant oil
stove for Asia market

Manufacturing of Improved Cook Stoves: Adding Opportunity

Manufacturing

■ Local Production

+ PROS: Better knowledge of market, Lower transportation costs,

Capacity building

- CONS: Unimproved design, Lower quality materials, Lower Quality

Control and consistency, Home-made appearance, May not meet Benchmarks

■ Centralized Production

+ PROS: Improved design, Higher quality materials, Higher quality

control, Meets Benchmarks, Modern factory-made appearance

- CONS: Generic stove may not be a great fit, Higher transportation

costs, Adds distribution jobs but not manufacturing

Financing Stove Programs

- Foundations
- Government
- Aid Agencies
- Microfinance
- Carbon Markets – The new opportunity

The Newest Source of Funding: Carbon Credits

Financing

FORTUNE MAGAZINE Sustainability by Marc Gunther

Column

Email | Print | Type Size

Cooking up carbon credits

By distributing energy-efficient stoves in Africa, JPMorgan Chase aims to reduce greenhouse gases - and increase profits.

By Marc Gunther, senior writer

AUGUST 12, 2008: 8:25 AM EDT

JPMorgan isn't alone. All the big global investment banks - including Barclay's (BCS), Citigroup (C), Fortune 500), Goldman Sachs (GS, Fortune 500), and Merrill Lynch (MER, Fortune 500) - are hurrying into carbon finance. Point Carbon, a consulting firm, says the global carbon markets generated \$59 billion in revenues in the first half of 2008 - almost as much as the markets did in all of 2007.

"If you can distribute 10 million stoves, you are talking about a substantial tonnage of carbon," says Odin Knudsen, who oversees JPMorgan's carbon finance business. Do the math - you could be looking at a business with modest costs and between \$200 million and \$450 million a year in revenues.

If projects like the Uganda cook stoves are approved under the Kyoto protocol, which governs the regulated carbon markets, the business will become even more lucrative. Credits on the European Union's regulated market are currently trading for more than \$32 a ton. ■



COURTESY: BUE O'CONNOR

Carbon Emissions

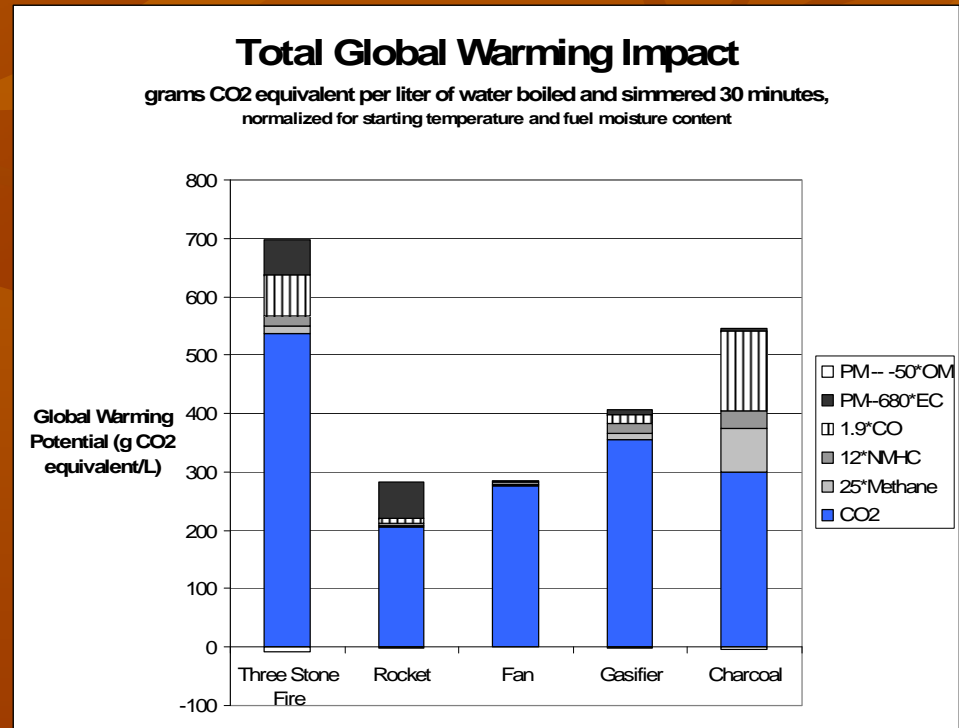
Financing

Emission	Global Warming Potential (GWP) – 100 year time-frame --	Potential Reduction from Three-Stone Fire Methods
<i>Primary Kyoto Basket</i>		
Carbon Dioxide CO ₂	1	~ 30-50%
Methane CH ₄	25 <small>IPCC 2007</small>	~ 75%
Nitrous Oxide N ₂ O	298 <small>IPCC 2007</small>	N/A
<i>Secondary Kyoto Basket</i>		
Carbon Monoxide CO	1.9 <small>IPCC 2007</small>	~ 75%
<i>Others Not Yet Counted</i>		
Unburned Hydrocarbons NMHC	12 <small>Smith, 2002</small>	~ 75%
Black Carbon EC	680 <small>Bond, 2005</small>	0-90%

Carbon and Cookstoves

Financing

- Household stoves can save about 1-3 tons of CO₂ per year based on fuel reductions alone
- Cleaner-burning stoves get extra credit as well
- ~\$30 per Ton CO₂_{eq.} per year currently – projected to increase after U.S. elections
- Credit can cover costs of both the Stove and the Distribution?



Improved Rocket, Fan and Gasifier Stoves can provide substantial carbon savings.

Source: MacCarty et al., A Laboratory Comparison of the Global Warming Impact of Five Major Types of Biomass Cooking Stoves, *Energy for Sustainable Development*, June 2008.

Gold Standard Certification

- Based on verified kitchen survey proving savings
- Statistically Significant Results (~100 Houses)
- Fuel use measured, Emissions predicted
- Also considers stove lifetime

Many Marketing Chains...

- Retail
- Relief
- Microfinance
- Social entrepreneurship
- NGOs
- National Distribution Chains
- Local Markets
- Governments

Many Networking Opportunities...

The 4th Biennial Partnership for Clean Indoor Air Forum

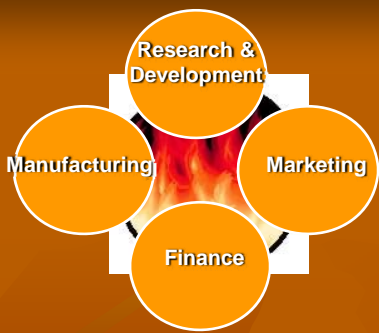


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Biomass Stoves Today



- ✓ R& D
- ✓ Manufacturing
- ✓ Finance
- ✓ Marketing (BC)
- ✓ Availability

