


D-Lab

Fall 2009

Development through
Dialogue, Design and Dissemination




D-Lab

Energy

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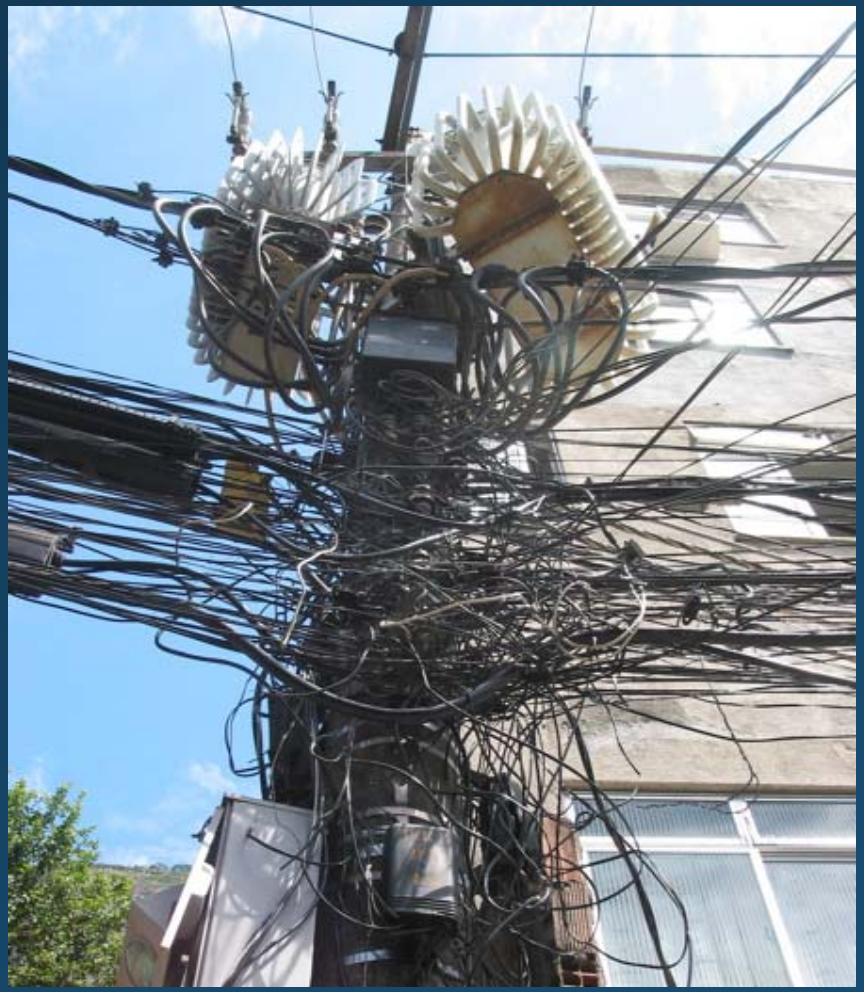
Energy

- Biomass, biogas and biodiesel
- Sun
- Human power
- Wind and water
- Rural energy delivery
- Modeling energy systems

Some Energy Facts

	Energy use/capita (kg oil equiv)	Electricity/capita (kWh)	Energy from biomass (%)	Electricity from fossil fuels (%)
Brazil	1,114	1,955	26.5	10.8
China	1,242	1,585	13.7	81.5
Ghana	386	247	69.1	12.6
India	531	457	37.5	83.9
Peru	479	794	17.7	27.1
Tanzania	498	54	91.6	4.9
USA	7,720	13,351	3	71.4
Zambia	605	693	79.5	0.6

Urban Electrification



Urban Electrification

Urban Access to Electricity

	Access to electricity
Kinshasa	66%
Rio de Janeiro	10%
Lagos	41%
Dhaka	90%
San Salvador	98%

Rural Electrification

- 800,000,000 have been connected to power grids in the last 2 decades
- 2,000,000,000 are still not connected
- Decentralization is the key
  - Solar
  - Micro-hydroelectric
  - Wind
  - Biogas

Rural Electrification

- Health clinics
- Schools
- Small industry and enterprise

Energy for Cooking

- 2,400,000,000 people use biomass (wood, charcoal, dung) for cooking
- Poor people can spend about 1/4 of their income on energy for cooking
- In some areas, women spend 4-6 hours a day, walking up to 10 km to gather firewood

Health Hazards

- Deforestation leads to decline in agricultural production which leads to malnutrition
- Deforestation causes erosion which leads to flooding and siltification of reefs and fisheries
- 1,800,000 people die each year of illness related to smoke from cooking fires (single largest cause of death in under-five-year-olds)

Possible Solutions

- Alternative fuels
- Efficient stoves
- Smoke hoods
- Solar cookers

Alternative Fuels

- Liquid Petroleum Gas (LPG)
- Kerosene
- Biodiesel
- Biogas
- Charcoal from agricultural waste products

Problems with Alternative Fuels

- Infrastructure and distribution systems
- Specialized equipment
- Cultural Acceptability

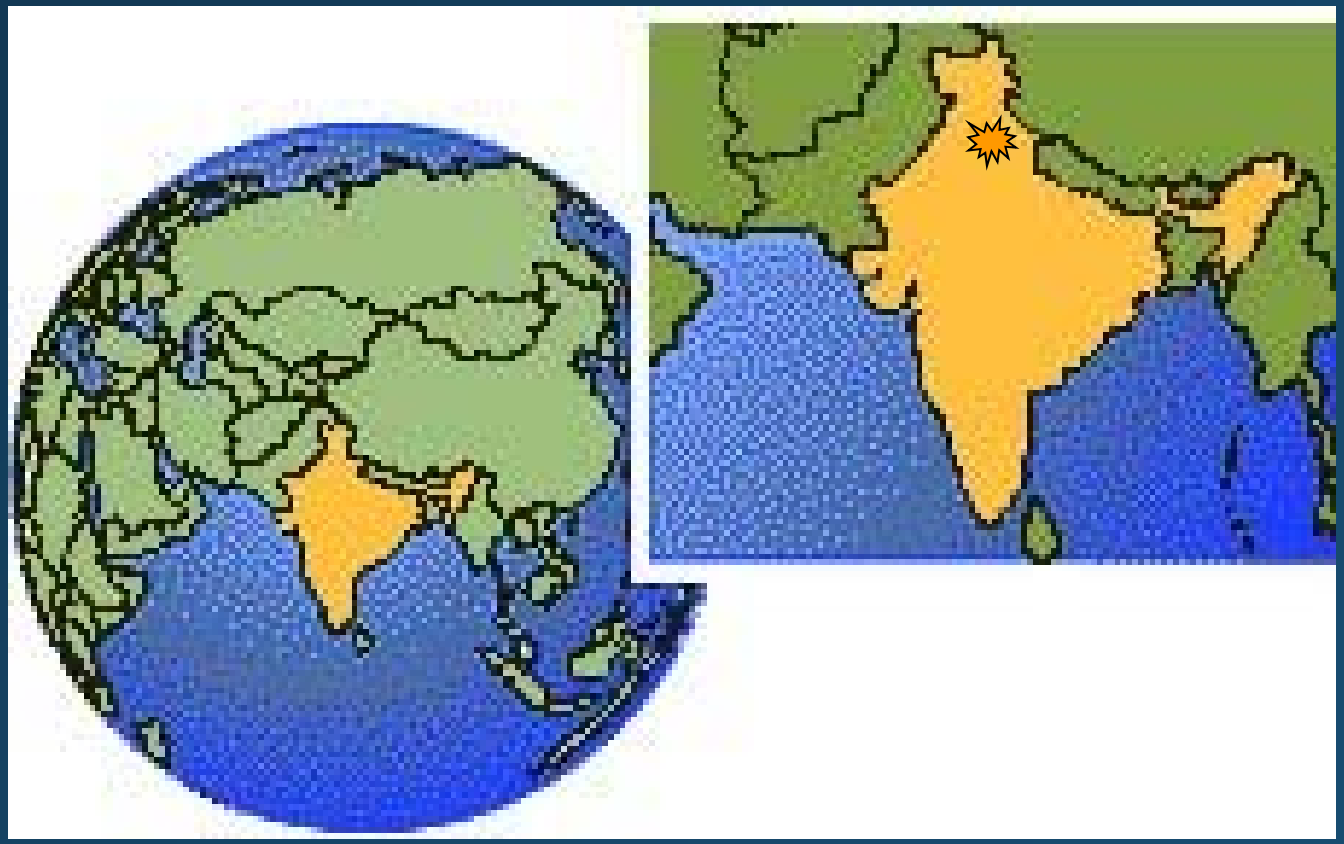
Biogas

- Methane gas produced from human and/or animal waste
- Chemical process is most efficient between 30°C and 40°C
- Provides fuel for cooking and lighting

Biogas

- 1 m^3 of biogas
  - Lights a 60 W bulb for 6 hours
  - Runs a 1 HP motor for 2 hours
  - Cooks 3 meals for a family of 5 or 6

Ranikhet, India



The Fixed Dome Digester

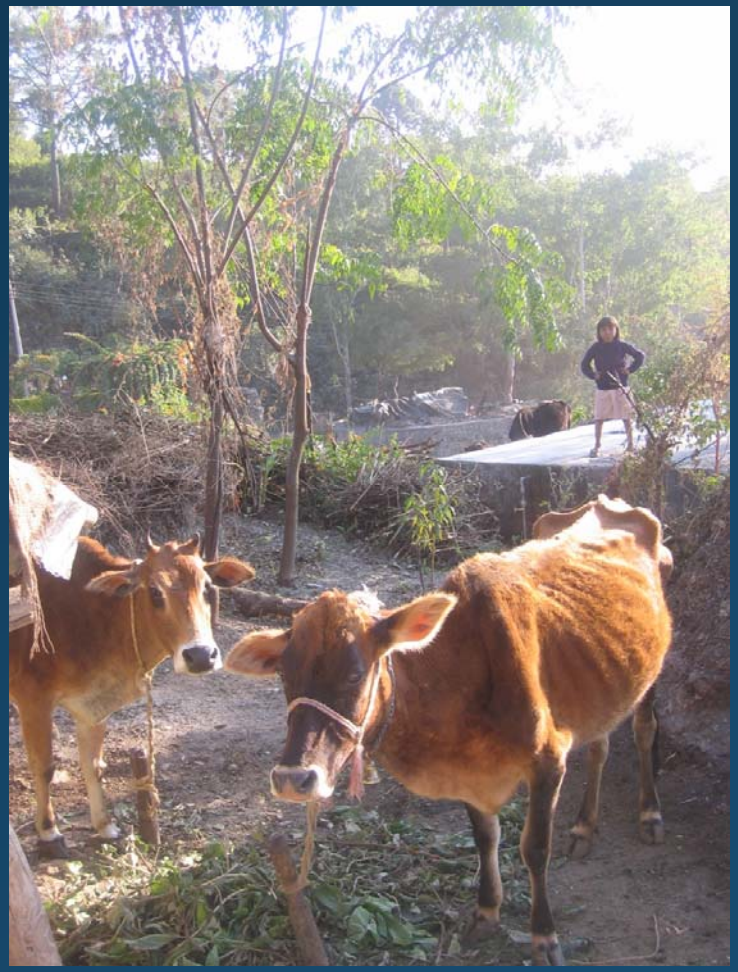
The Fuel

The Stove

Guadalupe Carney, Honduras

The Digester

The Fuel



Bokor National Park, Cambodia

Floating Drum Digester

The Stove

Nyali, Kenya

Low-Cost Floating Drum

The Philippines

The Digester

The Cooker

Liaoning, China

The 4-in-1 Digester

The 4-in-1 Digester

The 4-in-1 Digester

Cultural Challenges

- Cultural taboos about working with manure
- Religious taboos against working with human waste
- Other uses of feedstock
  - building material
  - fuel
- Changes in cooking behavior
- Changes is the social hierarchy

Construction Challenges

- Cost reduction
- Maintenance
- Supply chain
- Transportation and storage of gas
- Drying and packaging of effluent
- Other opportunities for income generation

Biodiesel

- Has the highest BTU content of any alternative fuel, comparable to diesel
- Comes from vegetable oils that have been transesterified to reduce their viscosity
- Can be used in diesel engines without modifying them

Efficient Stoves

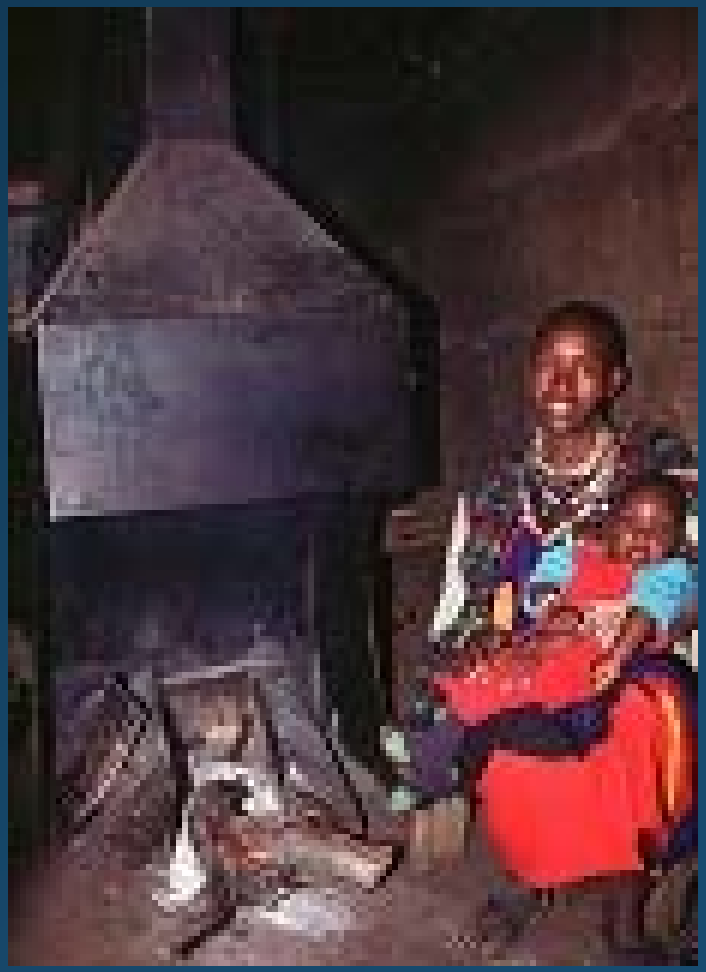
- Most traditional cooking stoves are about 10% efficient
- Improved stoves have increased efficiency of 20-25%

The Kenyan Jiko

Problems with Efficient Stoves

- Specialized equipment
- User behavior can influence efficiency
- Cultural acceptability

Smoke Hoods



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