Alternatives to Fuel-based Lighting in Rural Areas of Developing Countries

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"We will make electricity so cheap that only the rich will burn candles"

- Thomas Edison

India

As of 2000: in the developing world, 14% of urban households and 49% of rural households had no electricity …

Photo: Evan Mills ©

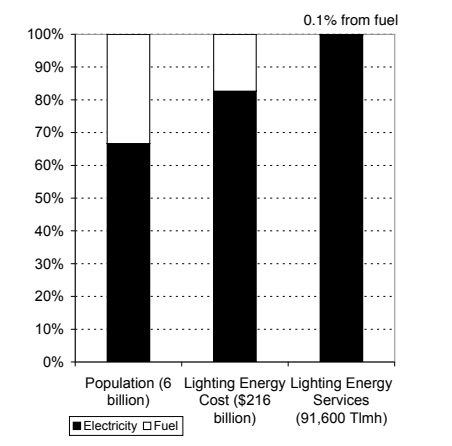
… In fact, there are more non-electrified households today than the <u>total</u> number in Edison's time.

Ghana

Photo: Rick Wilk

Lighting Inequities

Although one in three people obtain light with kerosene and other fuels - **<u>paying $40 billion/year</u>** - about 20% of global lighting costs, they receive only 0.1% of the resulting lighting energy services

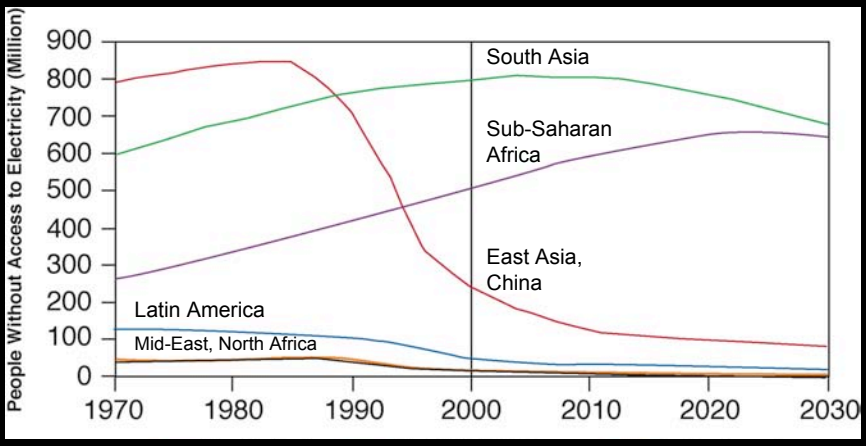


LBNL Analysis

Other issues: literacy, safety, women's work, indoor air quality, subsidy, scarcity, price volatility

Non-electrified Population is Falling Only 0.4%/year

- Excluding China, population is growing faster than electrification, e.g. 4-x faster in Sub-Saharan Africa



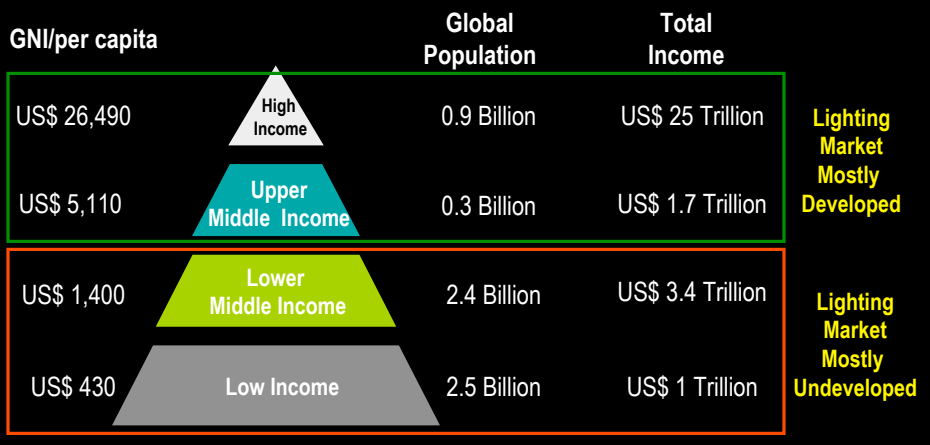
Source: International Energy Agency

Electrification: Not always effective

Yunnan China

Photos: Evan Mills ©

The $40B Lighting Market at the Bottom of the Pyramid



Note: Based on the "The Fortune at the Bottom of the Pyramid", C.K. Prahalad and World Bank Development Indicators, 2004

Greenhouse Gas Emissions

- Per Lantern: 100 kg CO_2/year
  - 40-times as much per unit of light as incandescent lamp; 180- times as much as compact fluorescent lamp
- Globally: 190 million tonnes CO_2/year
  - would be 8th most-emitting "country"

Small & Medium Enterprises (SMEs)

India: street vendor

Tanzania: night market

Photos: Evan Mills ©

Wick Lanterns

Photos: Evan Mills ©

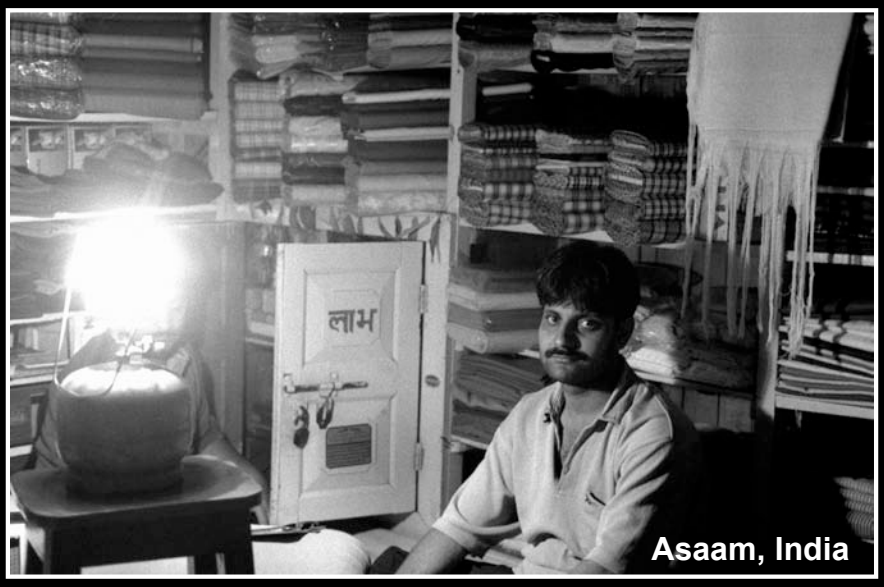
Merchant (Candle)

Photo: Evan Mills ©

Market (Candles)

Photo: Evan Mills ©

Textile Seller (Propane Mantle Lamp)



Asaam, India

Photo: Evan Mills ©

Yak Butter

Nepal

Yunnan, China

Photos: Evan Mills ©

Whale and Seal Oil

Photo: Evan Mills ©

Fuel Wood is Widely Used for Lighting

The Burden of Fuel-based Light

Huangshan, China

India: propane lamp

Photos: Evan Mills ©

Kitchen: 2% Recommended Level

Photo: Evan Mills ©

Refugee Camps

Photo: Salgado

- Classroom light levels as low as 2% of western standards

Kenya (Kibera Slum)

- Teachers grading homework with light levels 1% of western standards

Tanzania (Periurban Area)

Photos: Evan Mills ©

“Electrification” (Yunnan, China)

Photos: Evan Mills ©

Traditional Solar-Fluorescent Systems Have only 0.2% Market Penetration

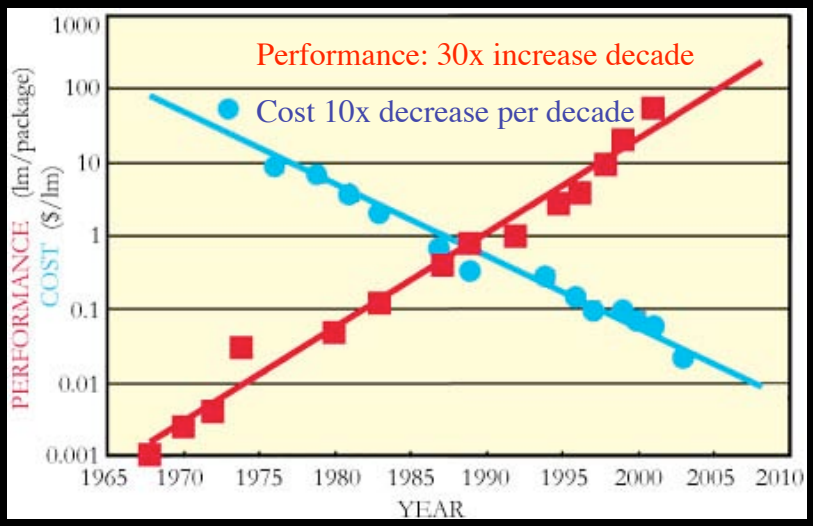
(and less at the bottom of the pyramid)

Photo: Evan Mills ©

White Light-emitting Diodes ("LEDs")

- Efficient
- Long life
- Low voltage
- Directional
- Portable
- Rugged

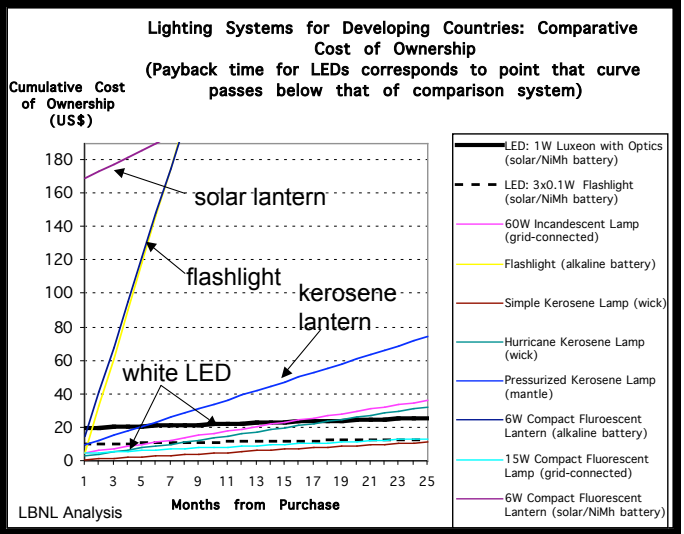
White LEDs: Rising Light Output; Falling Cost



Source: Lumileds

Total Cost of Ownership: LED Payback is 1 month to 2 years

- **10-100x a hurricane lantern's light output**
- **Cost of saved oil: $15/bbl**



Stanford + IDEO + LBNL (and others from Silicon Valley)

"The 93,000,000 mile extension cord"
Form
&
Function
million points of light
BETTERENERGYSYSTEMS Ltd
SOLIO
plug into the sun

Productive Uses
Tanzania: shoe seller - flame [left]; 1-watt white LED [right]
Photos: Evan Mills ©

“I can see the money!”

Kenya: vegetable stand in Kibera slum

Photo: Evan Mills ©

Proposed GROCC Demonstration

- *Interactive* design - end users as co-developers
- Insight into lighting structure and behavior
- Understanding productive uses
- Synergisms with the mobile phone market & a diversity of SMEs
- Innovative distribution & assembly strategies

More Information

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