Design for the other 90%

- 90% of today's designers work for the richest 10% of world's customers
- We need things like:
  - $2 eyeglasses
  - $3 drip irrigation systems
  - $5 household water filter
  - $10 solar lantern
  - $100 house with real market value

Design for other 90%

- Treadle pump example:
  - supply chain in Bangladesh
    - 75 private sector manufacturers
    - 3,000 village dealers
    - 3-4000 village technicians
  - impacts:
    - 2.1 million poor families in Asia and Africa
    - collective investment $50M
    - collective income increased by $210M/year forever!
    - cost to put same 1M acres under dam/canal irrigation: $2B+

Design for other 90%

- Hybrid Solar Food Dryer example:
  - conventional sun drying
    - inconsistent moisture level => low price
    - dependent on weather
    - limited capacity
    - lack of hygiene
  - solution:
    - hybrid solar/wood heat dryer
    - PV powered circuiation, moisture monitoring

Design for other 90%

- Hybrid Food Dryer cont.
  - 1000kg in, 250kg out
  - 10 year life
  - $62.50/day value
  - $12K cost => 192 day payback w/o credit, 288 days w/ credit, $150K lifetime value added
  - business plan includes local manufacturers, farmer coops, financing institution, entrepreneur, loan guarantor

Baylor University

- Converting Coconuts into Value-Added Products in Developing Countries
- "Coco-nuts" Team:
  - Graduate student - team leader
  - One each of sophomore, junior, senior engineering students
  - faculty sponsor

Baylor “Coco-nuts”

- Funding from:
  - NCIIA E-team grant
  - Kauffman Foundation
  - UN

Baylor “Coco-nuts”

- Customers:
  - Rural villages in developing countries
  - Abundance of coconuts, no electric grid
  - Customers need:
    - electricity
    - fuel for cooking
    - housing
    - income (jobs)

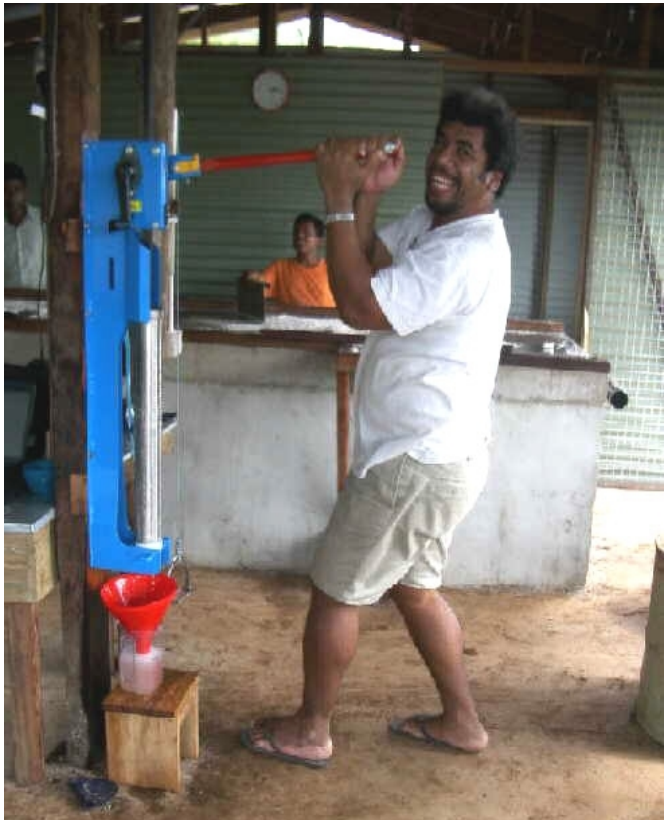
Baylor "Coco-nuts"

- Analyzed coconuts
  - young coconuts (9mo)
    - 65 calories
    - superior to Gatorade
  - mature coconuts (12mo)
    - husk - 35%
      - fiber, pith
    - shell - 12%
    - copra - 28%
      - oil - 9%
      - meal - 5%
      - water - 14%
    - milk - 5%

Fig. 1. Cross section of a coconut

Baylor “Coco-nuts”

- coconut milk
  - 5% of total mass
  - 127 calories
  - 12 g fat
- copra
  - 28% of total mass
  - 14% water, 9% oil, 5% meal
  - mechanical expeller for oil

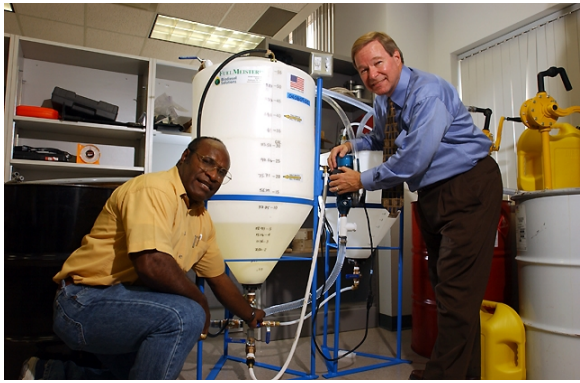


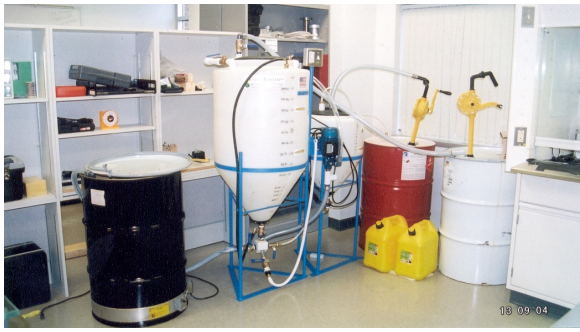
Baylor “Coco-nuts”

Coconut oil converted to diesel fuel

- modify coconut oil to run in std engines
  - needs 16% methanol, small amt of lye
  - $0.69/gal + coconut oil
  - low emissions
  - first project in Papua New Guinea

- or modify engines to run on pure coconut oil
  - preheat coconut oil to >80C to lower viscosity
  - best properties of 50 vegetable oils for diesel fuel





Baylor “Coco-nuts”

- Husk
  - 35% of total mass
  - 11% fiber, 24% pith
  - heat and pressure cures pith into hard resin binder
  - make fiber reinforced panels directly by hot pressing husks

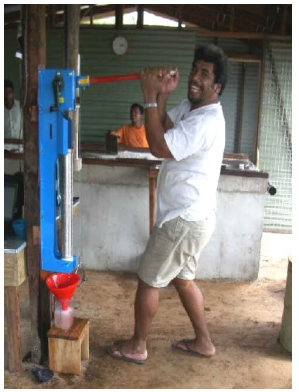
Baylor “Coco-nuts”

- shell
  - 12% of total mass
  - specific gravity of 1.2 (doesn’t float)
  - 2x hardness of furniture hardwood
  - strength similar to low strength aluminum
  - useable as fibers in engineering polymers
  - useable as cooking fuel or for charcoal

Baylor “Coco-nuts”

- White meal
  - 5% of total mass
  - 80g/coconut
  - 16% protein
  - good pig and chicken feed
  - sells for $0.25/kg

Baylor "Coco-nuts"

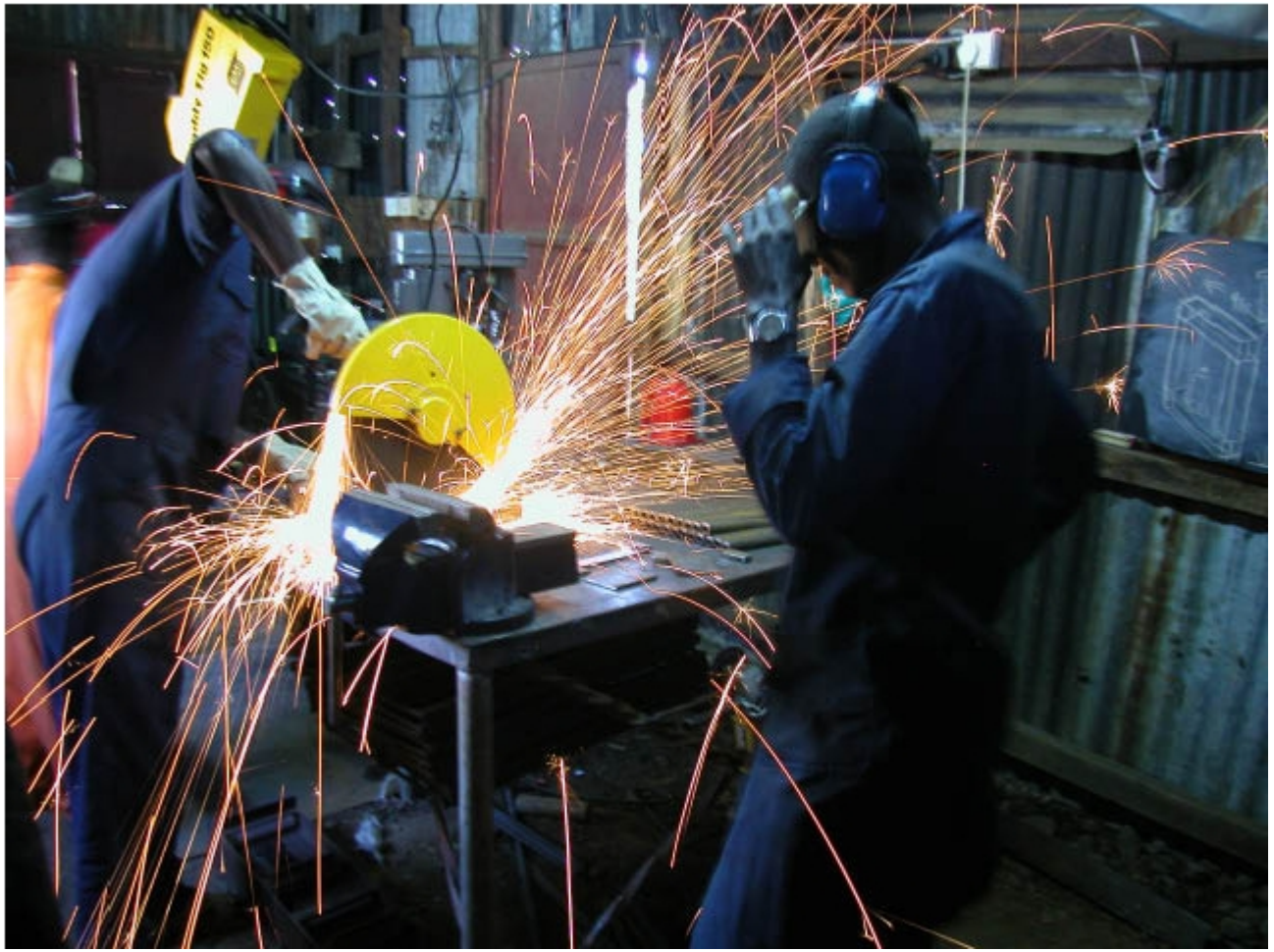


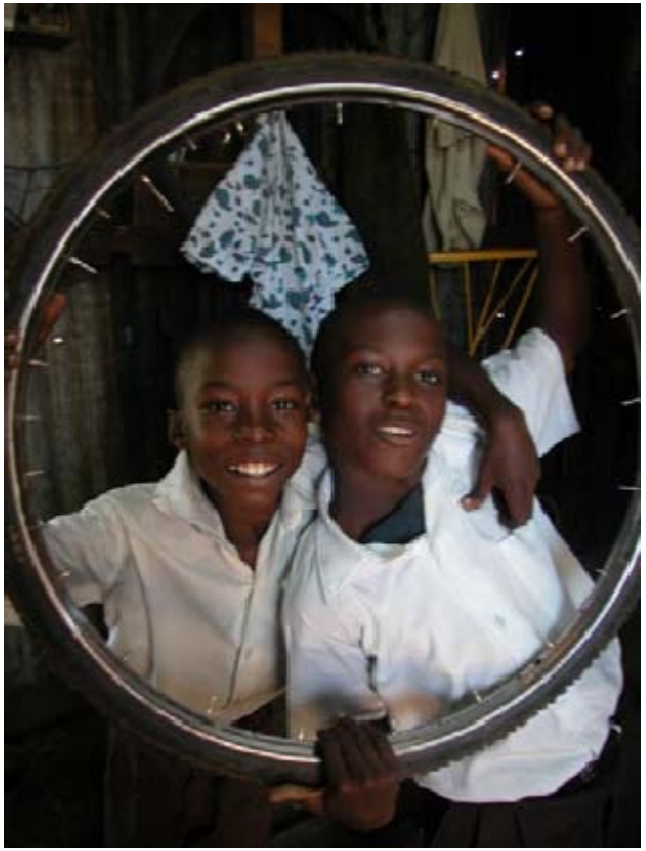
- Coconut economics summary:
  - 100 coconuts wholesale prices
    - 3 gal of diesel fuel $ 9
    - 2 sheets of particle board $20
    - 19kg of coconut shell $20
    - 8kg of meal for animal feed $ 2
    - cost of production -$6
    - cost of processing -$8
  - profit is $0.37/coconut
  - village could produce 500 coconuts/day (1250 trees) for $55K / year profit
  - capital costs of $90K

Baylor “Coco-nuts”

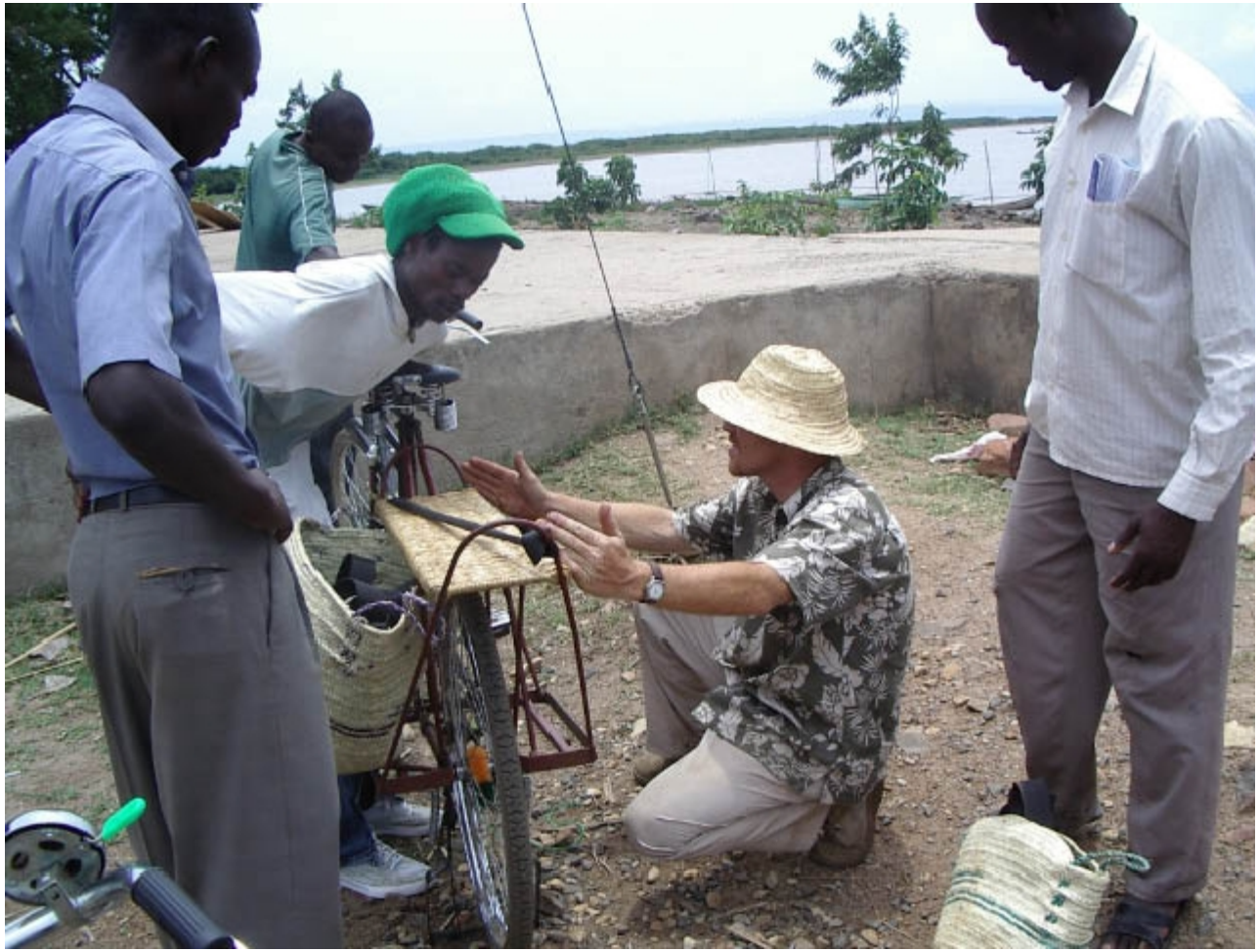
- Rural electrification
  - $11K would buy 30kW generator run on biodiesel
  - 500 homes would get evening lighting
  - $0.45/kwh (cheaper than kerosene or propane)
- Deployment Projects under way
  - PNG
  - Hyderabad, India
  - Acapulco
  - Kenya

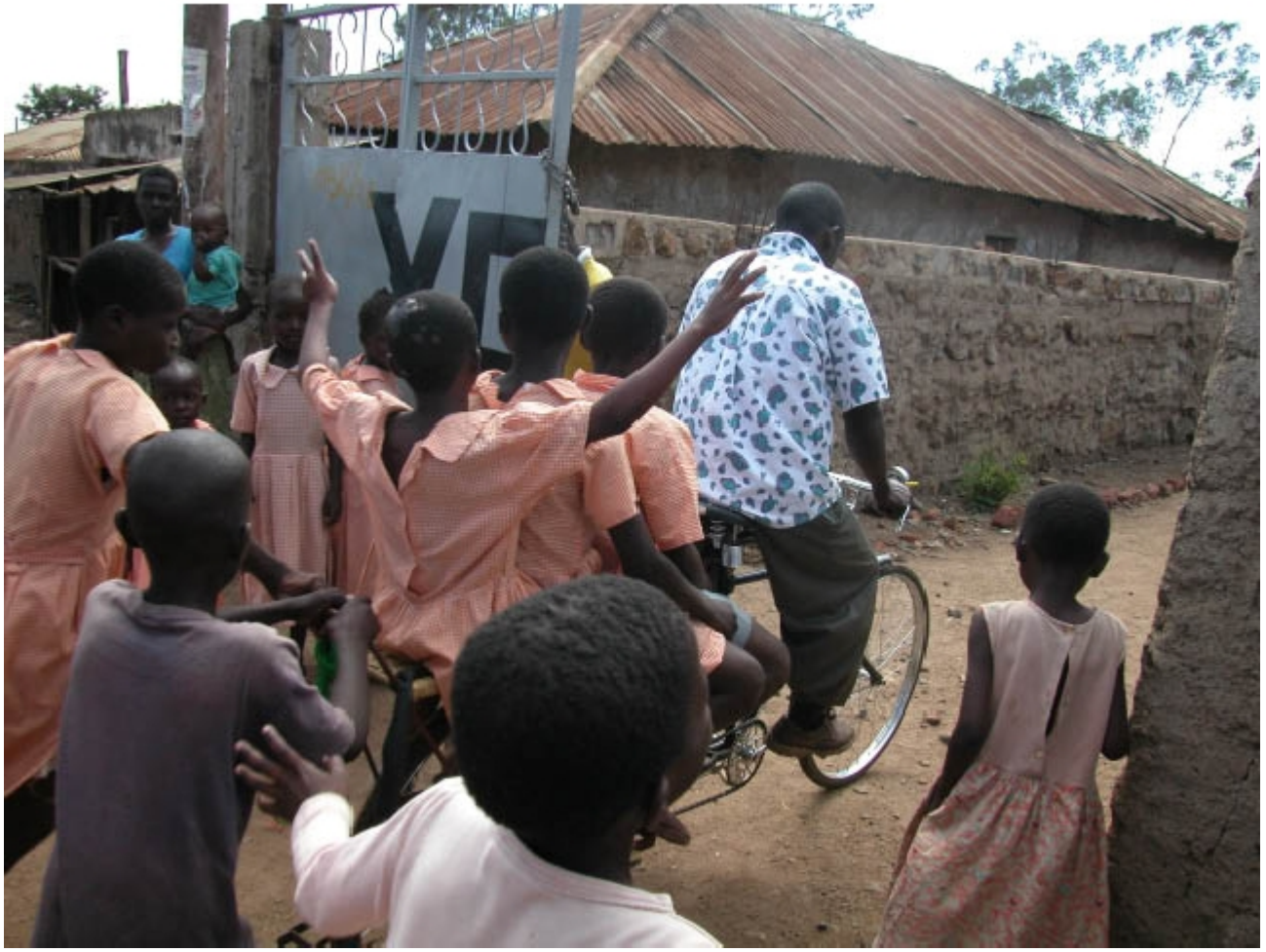
Manufacturing for the other 90%

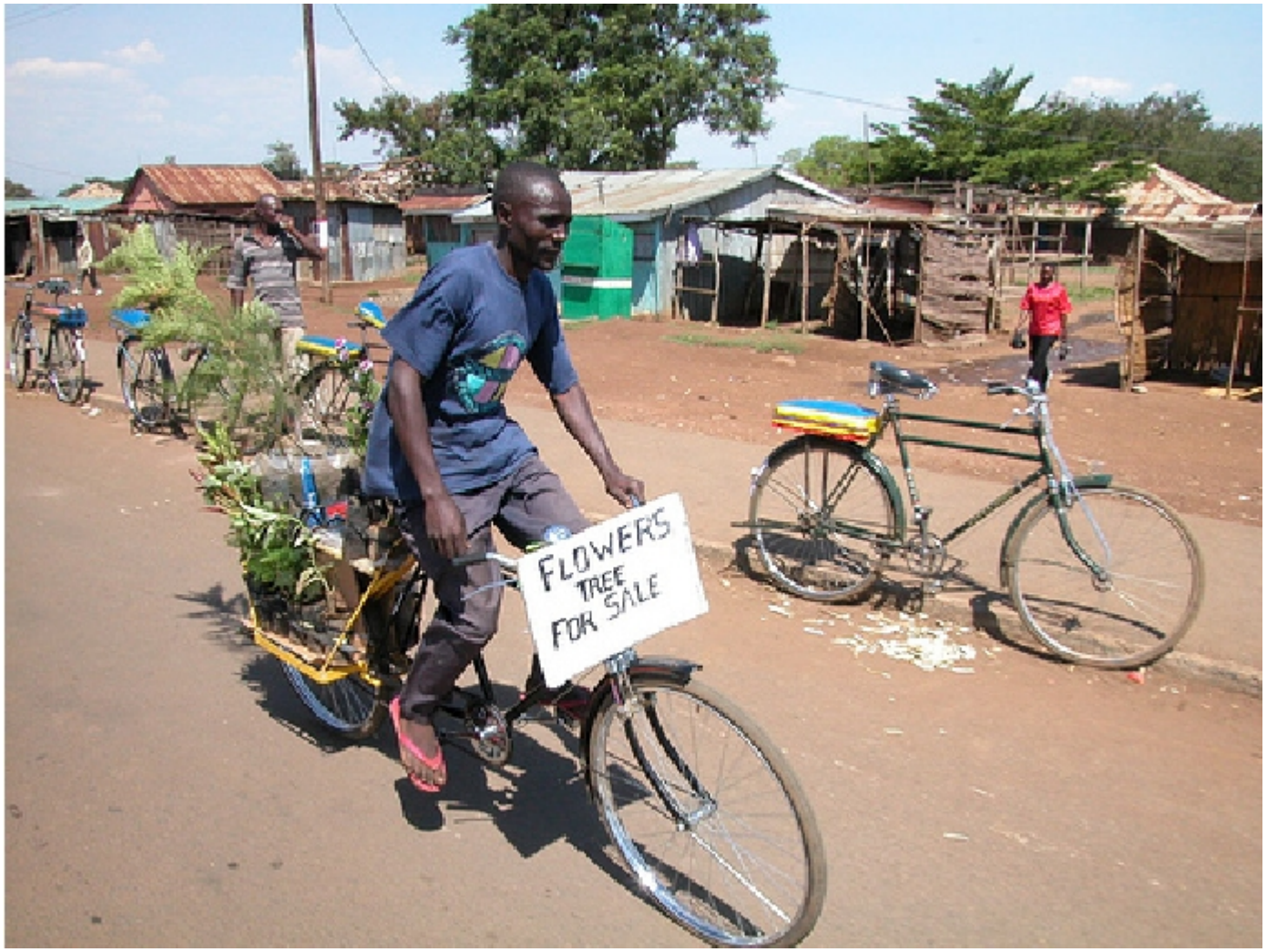


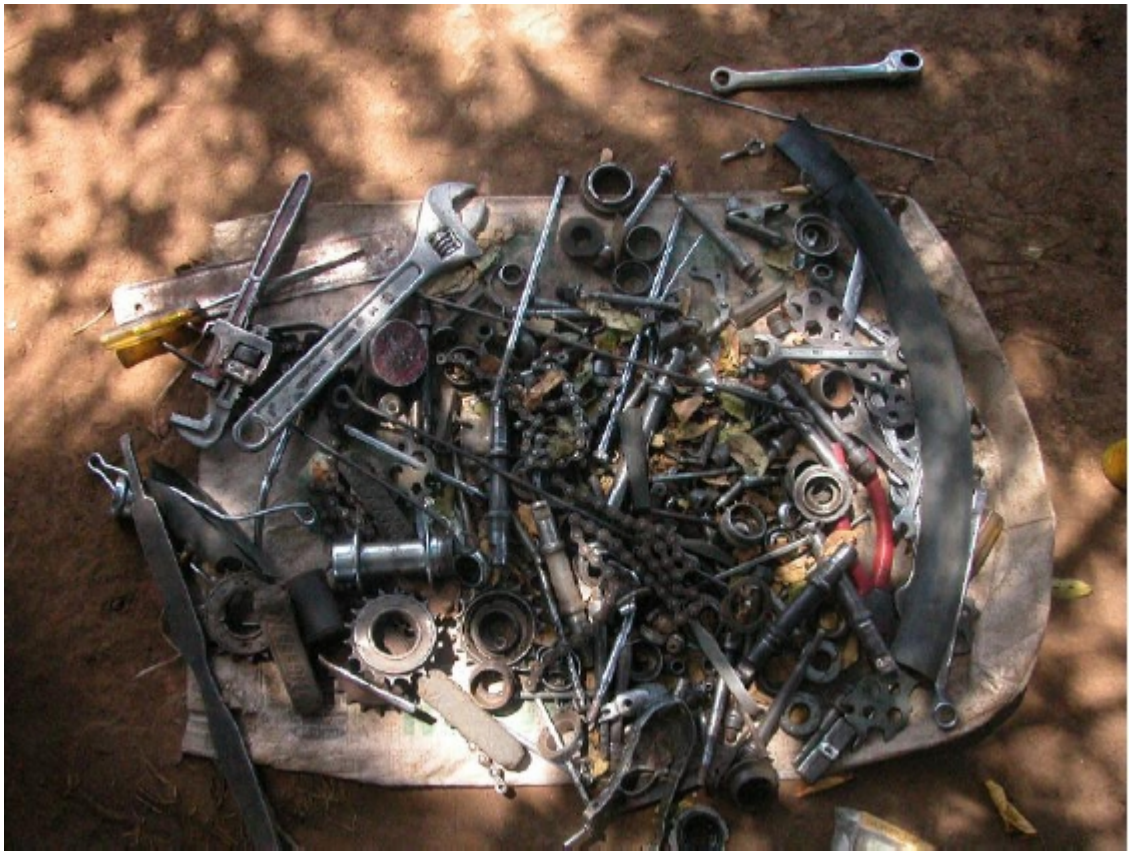


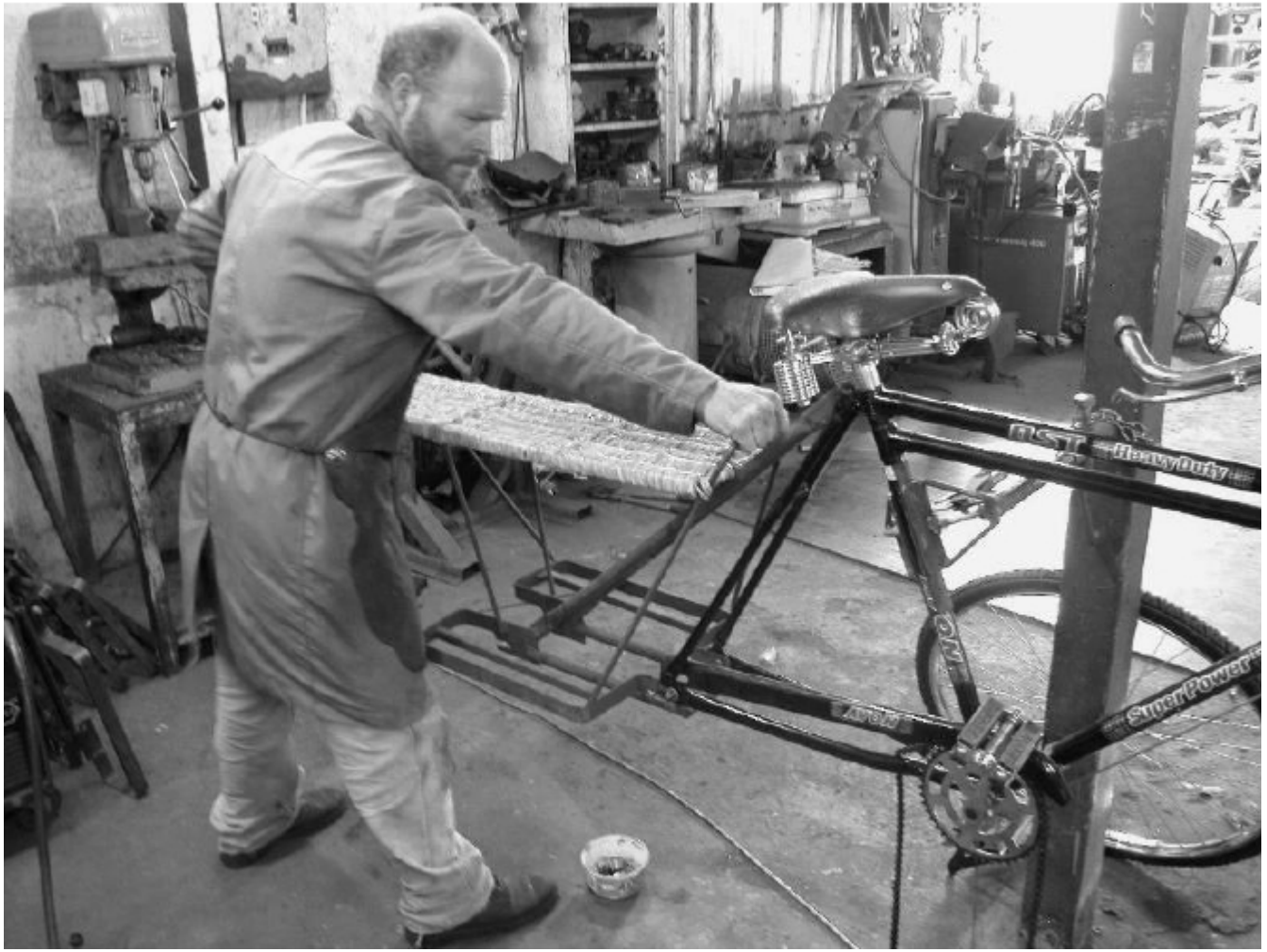
Worldbike.org





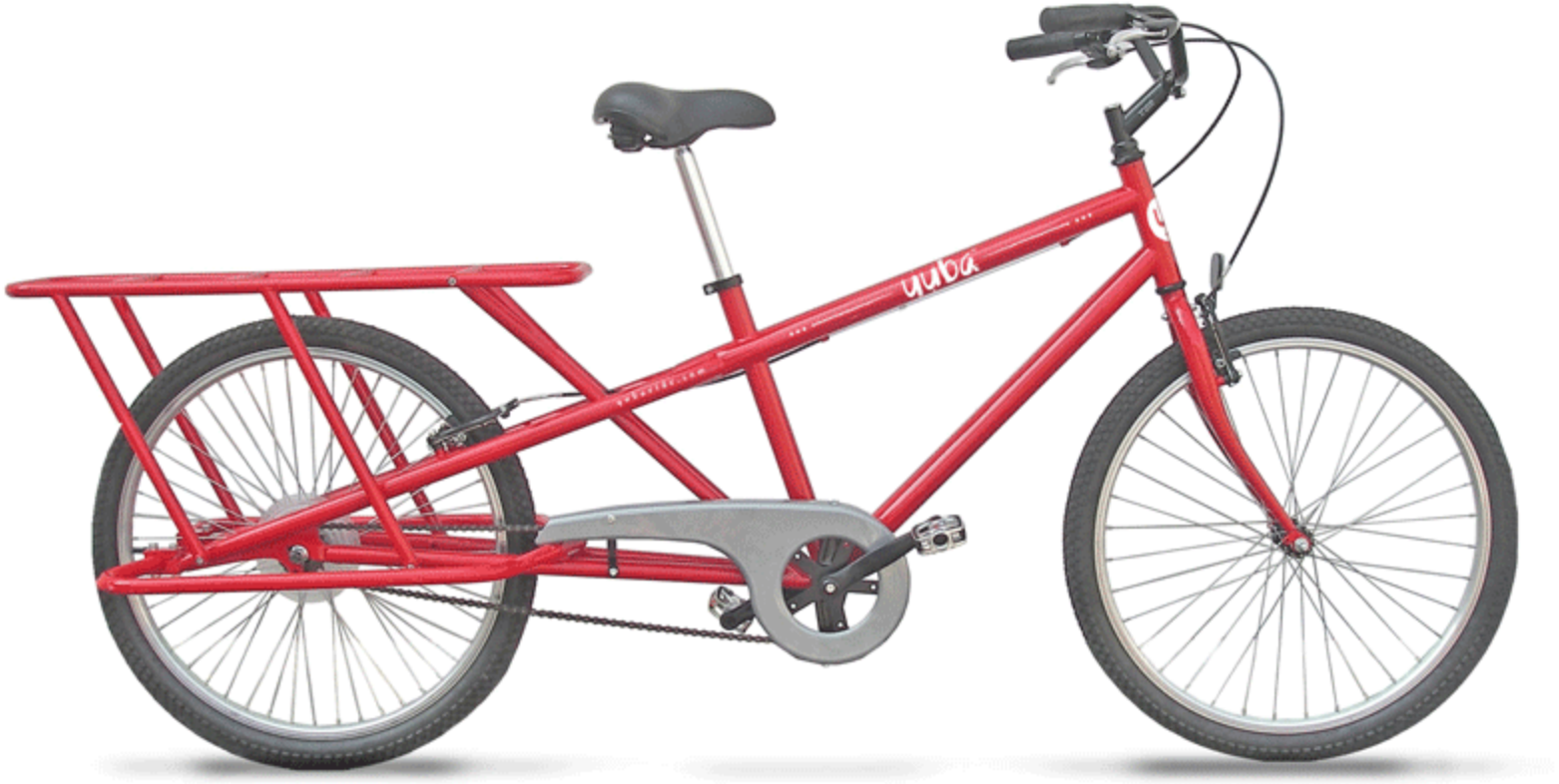

FLOWERS
TREE
FOR SALE

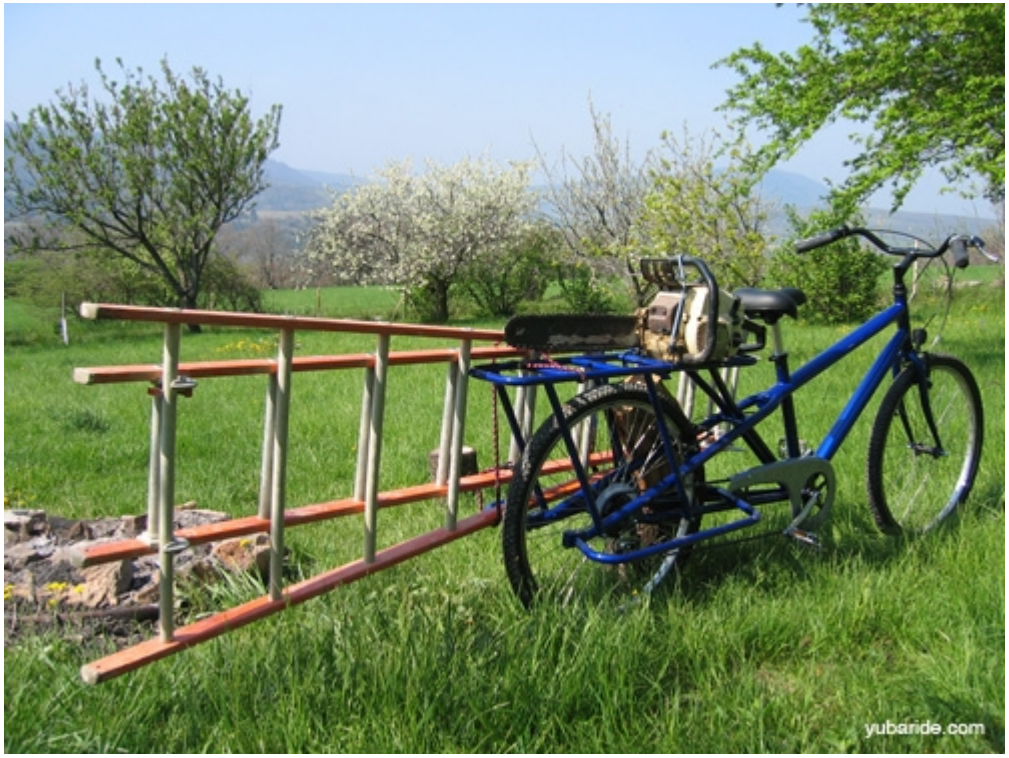



MSP
Heavy Duty
SuperPower

Worldbike.org

Yuba Utility Bicycle



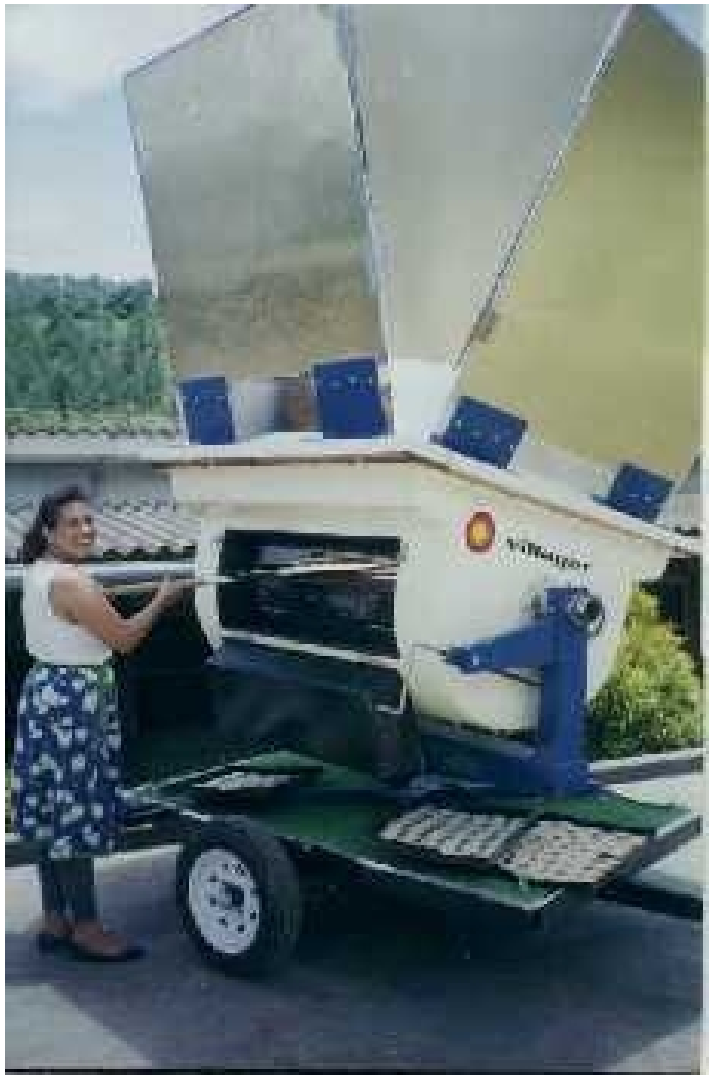

yubaride.com

The PlayPump

http://www.youtube.com/watch?v=qjgcHOWcWGE

Villager Sun Oven

- http://www.sunoven.com/assembly.asp



So how to bridge the divide?

- Manufacturing is the basis of most economic activity
- Economic activity is essential to all 100% of the world's population – spread it out!
- An exponentially increasing world population needs exponentially increasing productivity
- Automation is the only way to achieve the efficiencies needed to provide energy, food, goods, and services for the world population
- Use people when appropriate and robots when appropriate
- Watch for unintended consequencies
  - displaced local farmers or workers
  - environmental degradation
  - resource depletion
  - defacto subsidies for uneconomical processes