



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

Treadle Pump

- supply chain in Bangladesh
 - 84 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+





Liter of Light

- families in shanty towns can't afford electricity, live in the dark.
- Liter of Light project trains entrepreneurs to install bottle lights filled with water and bleach
- 28,000 homes in Manila now lighted





Hybrid Solar Food Dryer

- conventional sun drying

- inconsistent moisture level => low price
- dependent on weather
- limited capacity
- lack of hygiene

- solution:

- hybrid solar/wood heat dryer
- PV powered circulation, moisture monitoring



Hybrid Solar Food Dryer

- 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”

- 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%

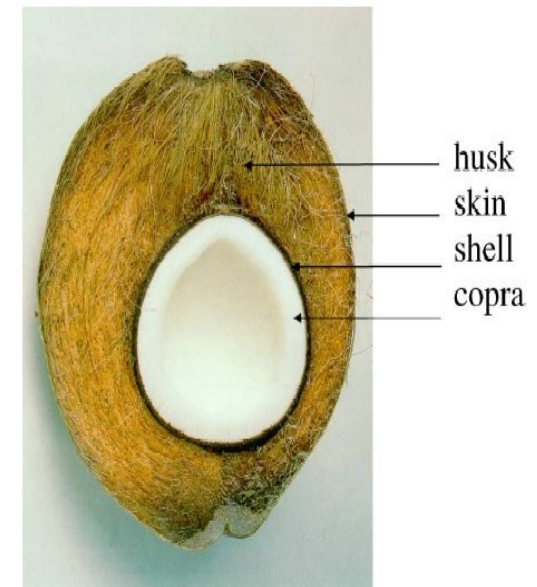


Fig. 1. Cross section of a coconut.

Baylor “Coco-nuts”

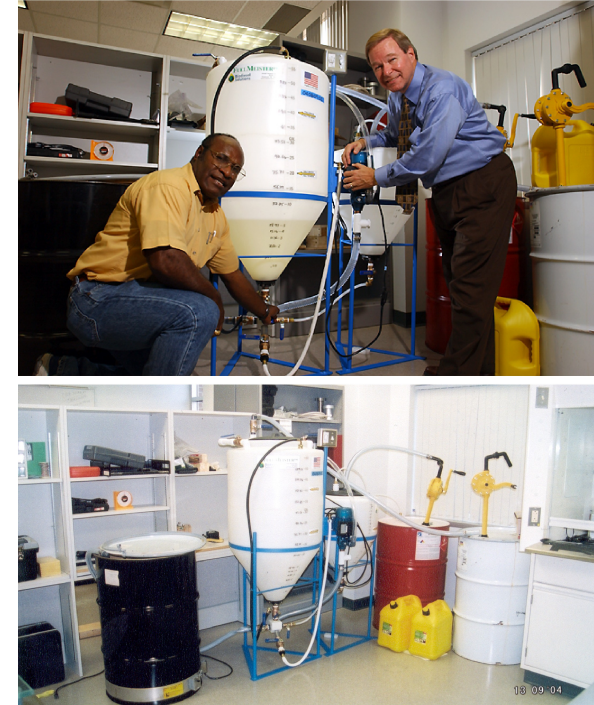
- coconut milk
 - 5% of total mass
 - 127 calories
 - 12 g fat
- copra
 - 28% of total mass
 - 14% water, 9% oil, 5% meal
 - mechanical expeller for oil



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 $>80^{\circ}\text{C}$ 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”

- 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

The PlayPump



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