Alternatives to Fuel-Based Lighting in Rural China

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Team Introduction

- UC-Berkeley Graduate Students
  - 2 Materials Science & Engineering Ph.D. Candidates (novel material research)
  - 2 MBA Candidates (experienced in marketing research)
- Evan Mills, Staff Scientist, Lawrence Berkeley National Laboratory
- Project funded by UC-Berkeley and United Nations Industrial Development Organization "Bridging the Divide" Research Fellowship

Research Question

- Is a solar-powered LED lighting solution appropriate and competitive for addressing household lighting needs in rural China?
- Considerations:
  - Sociological needs
  - Alternative solutions
  - Market forces
  - Government role

Research Itinerary

- January-July 2004: Berkeley / Beijing
  - Make initial industry contacts
  - Develop research questions and methodology
- August 1-8: Beijing
  - Attend China-U.S. Renewable Energy Workshop (NREL Sponsored)
  - Meet with industry, NGO and government representatives
- August 9-21: Lhasa and Shannan Areas, Tibet
  - Meetings with NGO and industry reps; visit to Tibet Solar Research Center
  - Field research: visits and interviews at 6 villages
- August 22-25: Beijing
  - Seminar with experts in PV and LED industries
- September-December 2004: Berkeley
  - Compile Data
  - Draw Conclusions

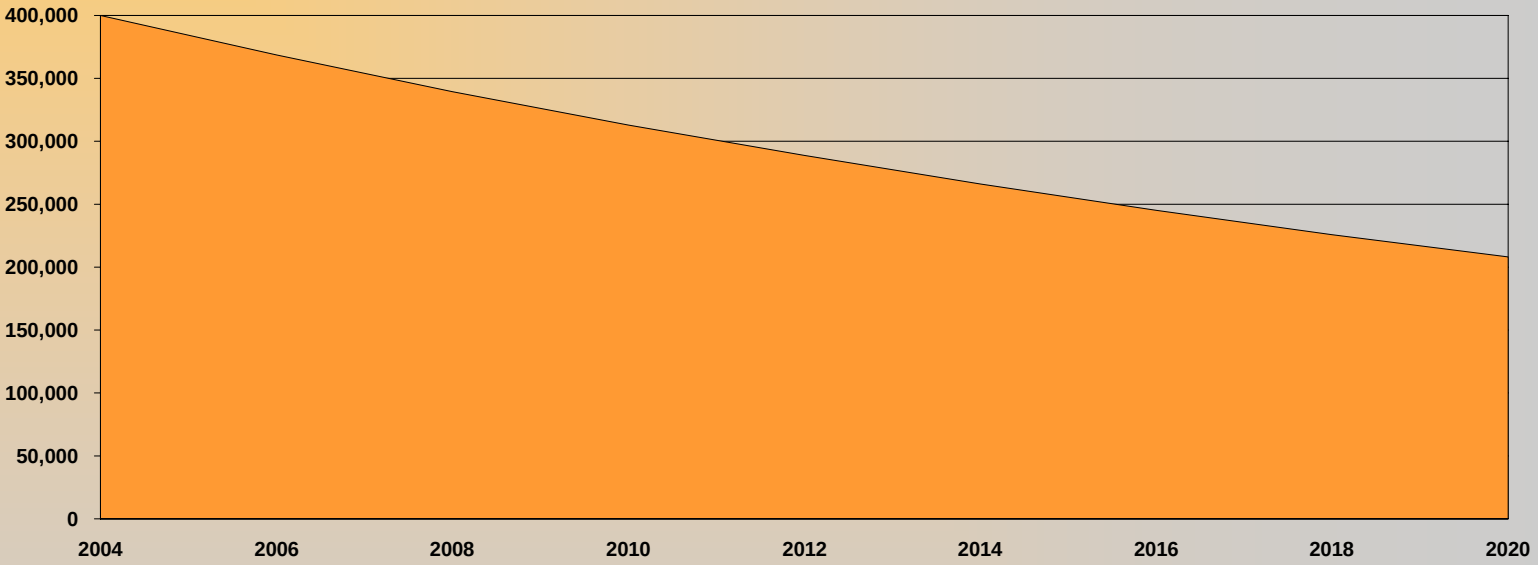
Field Research

- 6 villages, 3 counties in Tibet (near Lhasa)
  - focus groups (3)
  - household interviews (15)
- Families split between agricultural, nomadic or both

Toward Universal Electrification

- 30 million people not connected to electricity
- 100% electrification by 2020 according to Village Electrification Project, which begins in 2005
- Township Electrification Project completed
- Government statistics appear reliable

"Denomadification"



- Current Population 400,000
- 4% decrease / year *

* Xinhua News Agency, August 30, 2004

Lighting Needs

- 2.5-5.5 hours / day
- Used both pre-dawn and after-dark

Uses of Light

- Spinning
- Weaving
- Food preparation and cooking
- Cleaning
- Educational purposes
- Animal tending and transit with flashlights

Main Sources of Light

- Solar home systems with compact fluorescent lamps
- Diesel lamps
- Candles (infrequent)
- Flashlights (outside)

Diesel Lamps

- Cost of diesel 4-5 R.M.B. / liter
- 10-30 liters per year
- Most common in nomadic villages
- Used in conjunction with solar home systems
- Diesel comes from day trip to xiang
- Major complaint was smoke and spitting black in the morning
- Up to 5-6 hours / day

Diesel Lamps

Diesel Lamps

Diesel Lamps

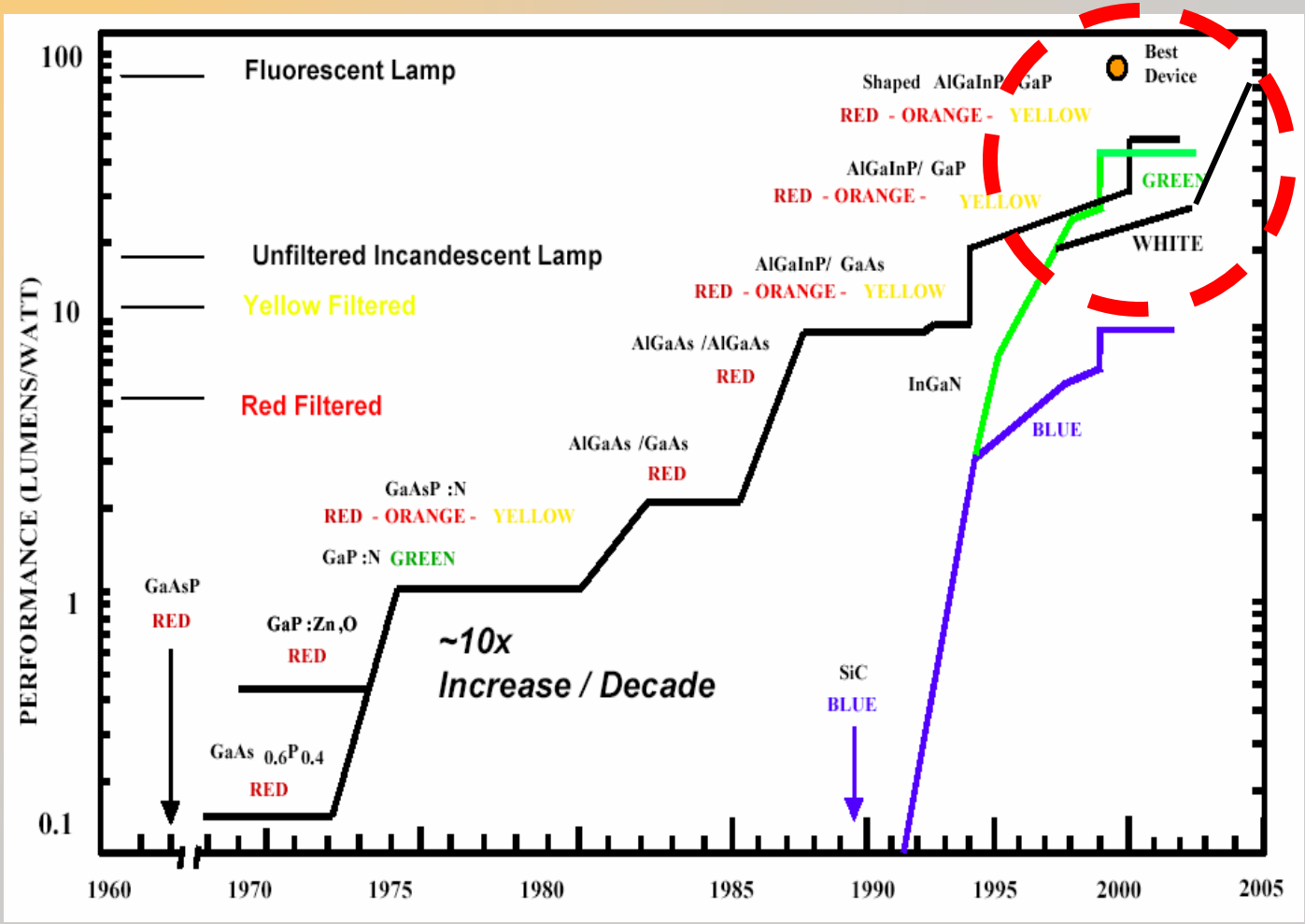
Solar Home Systems

- Systems subject to breakdowns from cracked solar panels and discharged batteries
- 10 to 20 watts with 1-2 compact fluorescents
- Home systems were both purchased and donated
- Villager contribution to solar system: 0 – 1,200 R.M.B.
- CFL bulbs replaced 2 months to 2 years
- 2,000 R.M.B. Increase in annual income with solar lighting

Solar Home Systems

Solar Home Systems

Why Light Emitting Diodes?



Reduced Solar Need

Alternative	Useful Illumination	Light Output	Photovoltaic Needed
6 watt Compact Fluorescent (CFL)	18 lux	131 lumens	10 watts (5 x 2 cell panel)
1 watt LED	160 lux	60 lumens	1 watt cell

- LED represents a 10X savings on solar panel and battery costs
- Facilitates portability
- Facilitates other end uses for solar including
  - Radio
  - DC television

Field Research

- Market tested two bulb types
  - 1 watt high color quality white Luxeon bulb
  - 0.3 watt low color quality LED composite bulb

Field Discoveries

- Preference for higher light output over light quality
- Strong preference for diffuse over directional lighting
- Tendency to value directionality of light for outdoor use
- Villagers did not seem to place high value on claims of longer life for LEDs

Conclusions

- LEDs should achieve significantly higher market penetration as flashlight
- Focus for this market should be on optics that provide diffuse light rather than light quality
- As LED prices decline, their frequency in rural homes with solar should increase

Questions