Poverty and Electricity Scarcity of Lesser developed countries

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Issues

- Electricity Crisis In Developing World
- How and Why Central Grid Failed
- Distributed Renewables Vs Central Grid
- Case Study (JABA Village, India)

Global Electricity Crisis…

- No access – 1.7 billion
  - Rural Economies
    - South Asia 730 m
    - Africa 580 m
- Poor quality Access - >2 billion
  - Both Rural & Urban

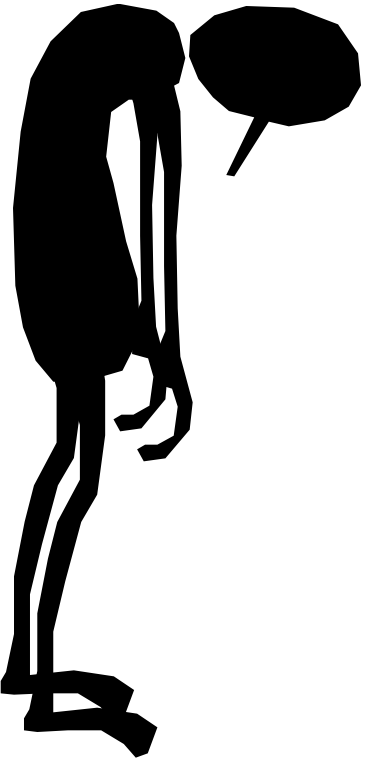
Rising Expectation

- High Cost for Low Income consumers
- 1/2 the world can no longer wait
- Electricity a law and order issue
- Recent government change in India

Electricity Crisis in India

- Access
  - Electricity - 55% (mostly poor quality)
  - Clean cooking fuel - 26%
- Financial Mess
  - Bankrupt Utilities 6 Bn US$ annual loss
  - Politicized and Unstable Grid Business
  - Repeated Failure of Reforms
    - 1992, 1995, 1998, 2002, 2004

History of Failures



Initial Public Sector
1947 - 1992

- Concessional global funding
- Maximum capacity 5000 mw/yr

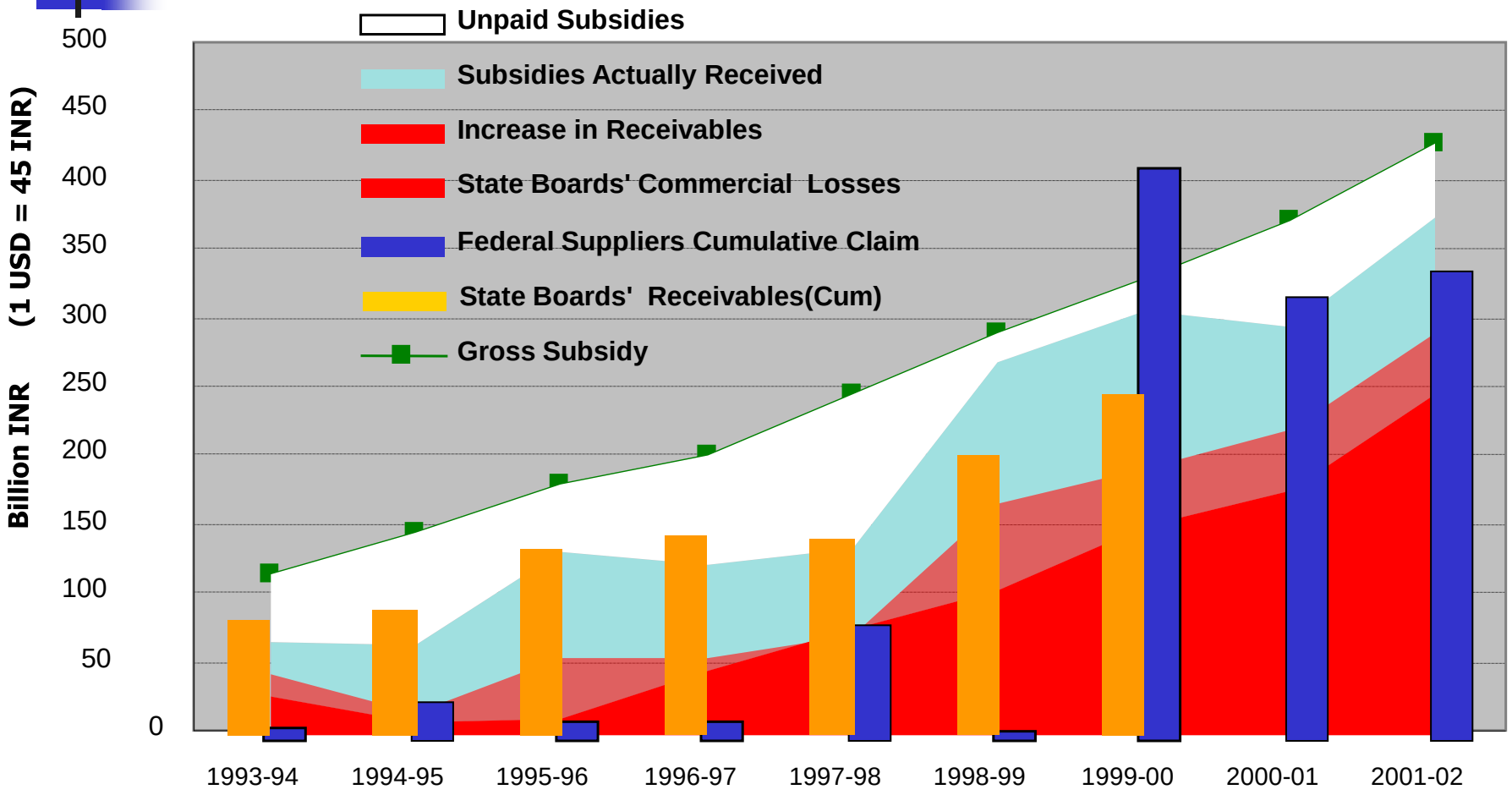
Private Sector Failures
1992 - 2002

- Global and domestic funding squeezed
- Maximum capacity added 2000 mw/yr
- ENRON (Dabhol)& AES (Orissa)fiasco

Back to Public Sector
2002

- Planned capacity 10,000 mw/yr!
- With 10b US$ gross subsidy in 2002!!

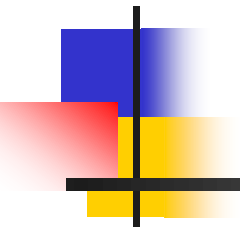
Bankrupt Utilities and Artificial Subsidy



Adopted from Planning Commission, India, 2003 SEB Report

Learning Path of Reforms

- Supply Side Myopia
  - Generation Privatization
    1992-1998
  - Distribution Reform
    1998-2004
- Demand Side Not Yet…
  - Consumer Income
  - Consumer Need



Analysis

Thinking Only Economics,

No Environment Please!

Backdrop: USA vs. India Supply

USA	India
Electrification Started pre-1900	
75 m Urban Rich Using Commercial energy New York, Chicago, Other metros	250 m Rural poor Using biomass/Castor oil Bombay, Calcutta, Other Cities
After 100 Years post-2000	
All 300 m people 3500 BU	500 m people 400 BU 500 m people 0 BU
Why is it so success in the USA?	But not in India!! 50% in dark
	>70% Rural and/or Poor

USA vs. Indian Rural Demand

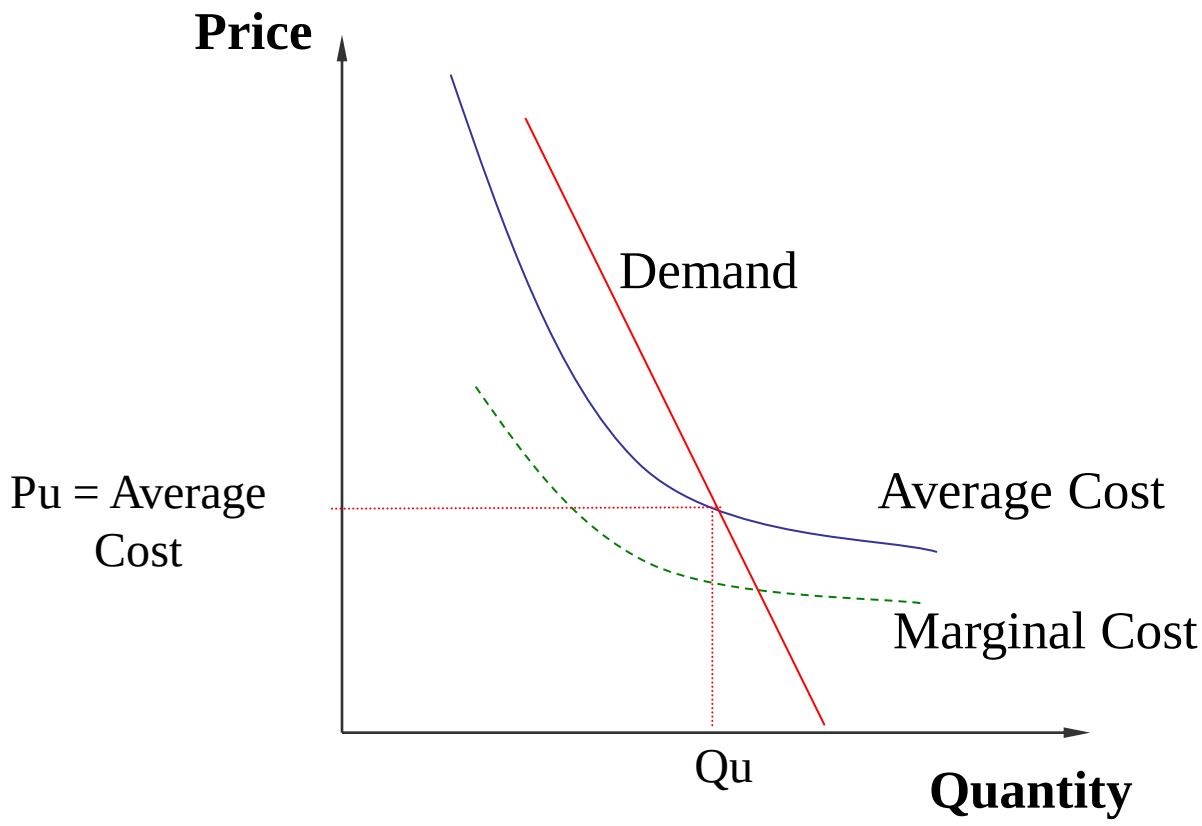
	USA	India
Rural population	<25% (61m)	>70% (700m)
HH Income in US$	>30,000	<1000
Electricity spending %	<0.5	>5
Electricity Cost in C/kWh	10-25	>15
Start of Rural Electrification	1936	1960

India vs. USA Grid Demand

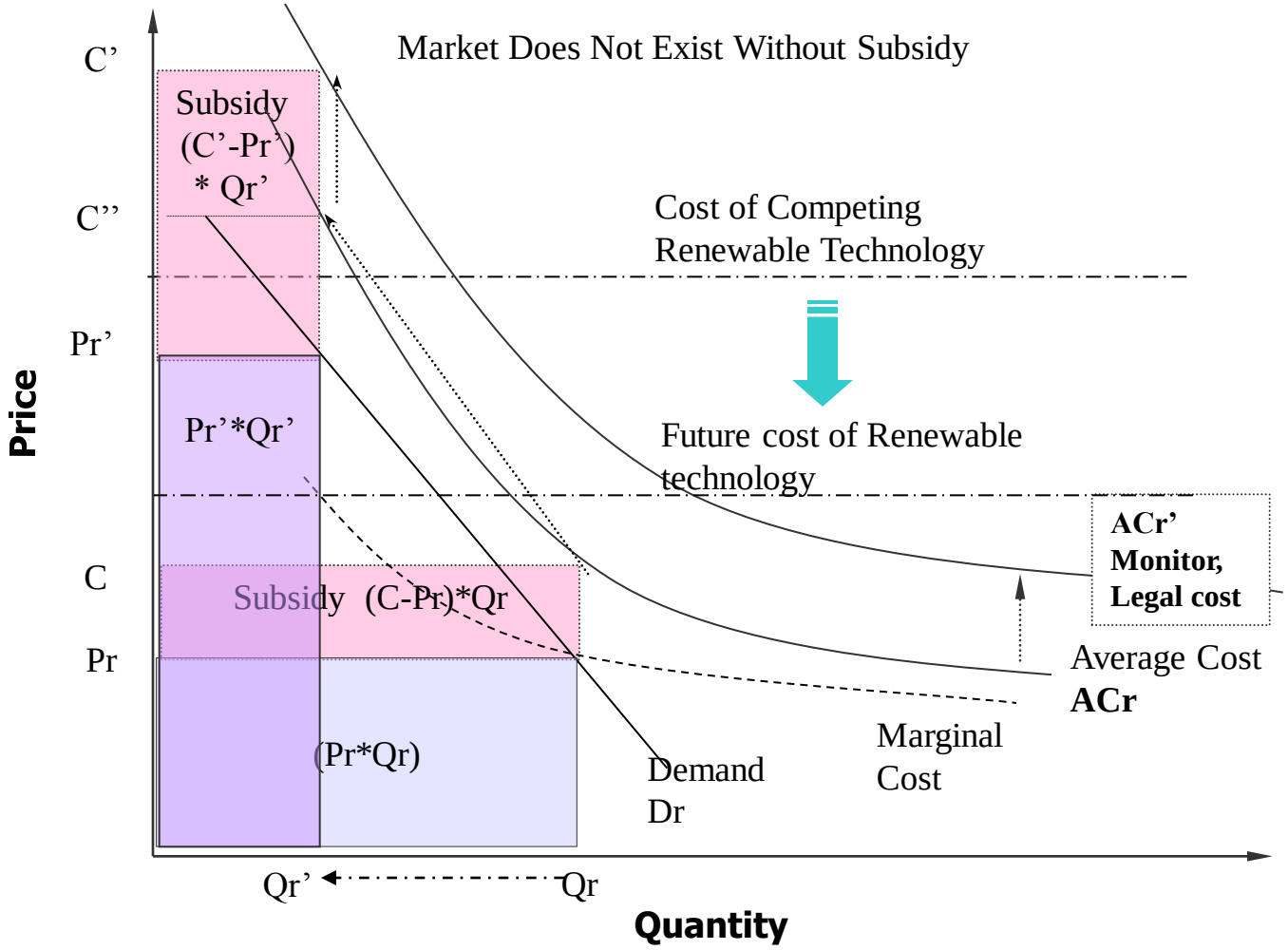
	USA Rural	USA Urban	India Rural	India Urban
Customers/mile	5.8	35	20 (5 can actually pay)	200
Annual Revenue / mile	7000$	59,000$	1500$	15,000$
Annual Income / household	60,000$	70,000$	1200$	2400$
Annual Revenue / customer	1200$	1700$	36$	75$

Lacks Scale: Inappropriate Technology for Rural or Poor

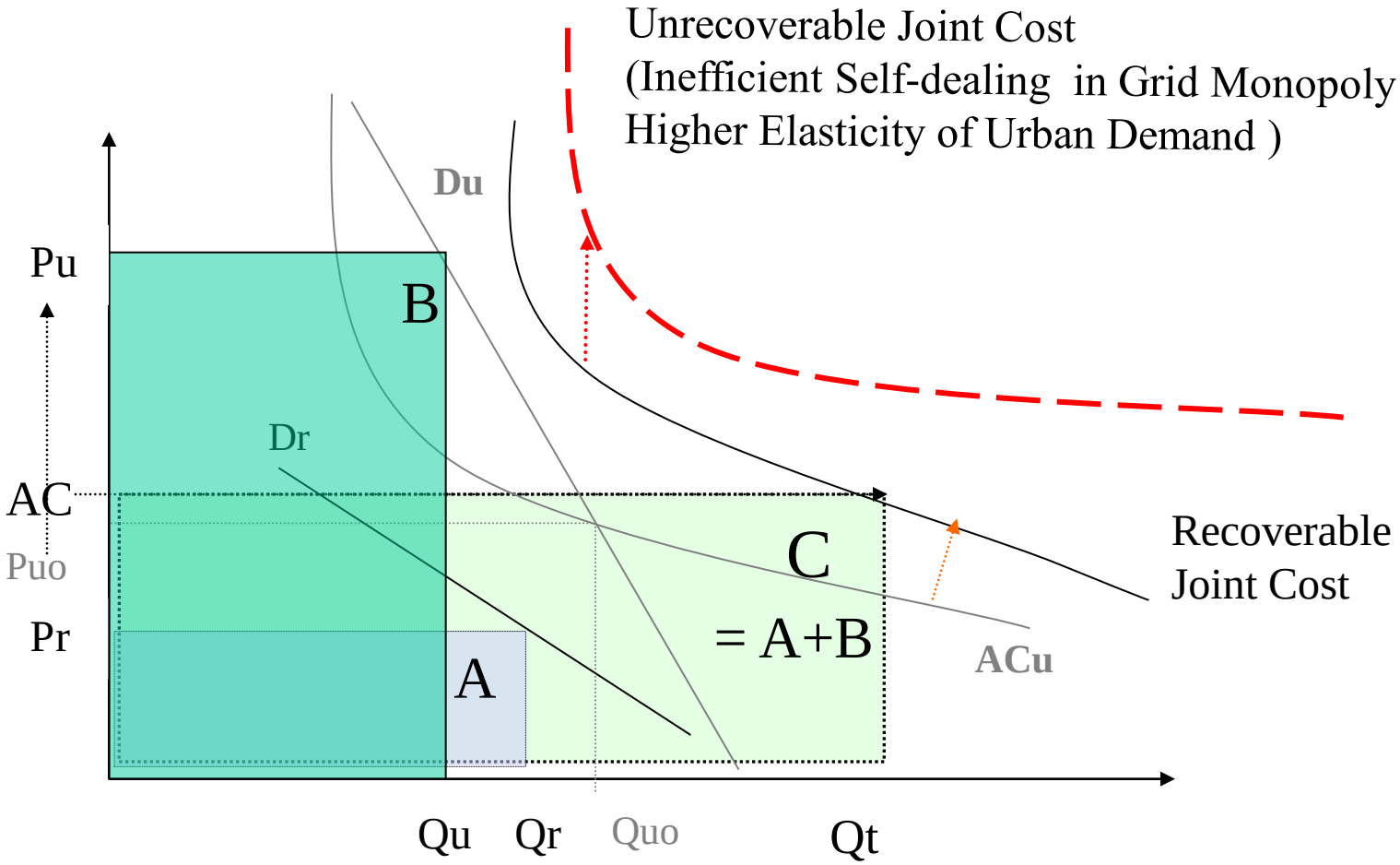
Urban Grid Market



Rural Grid (Non)Market



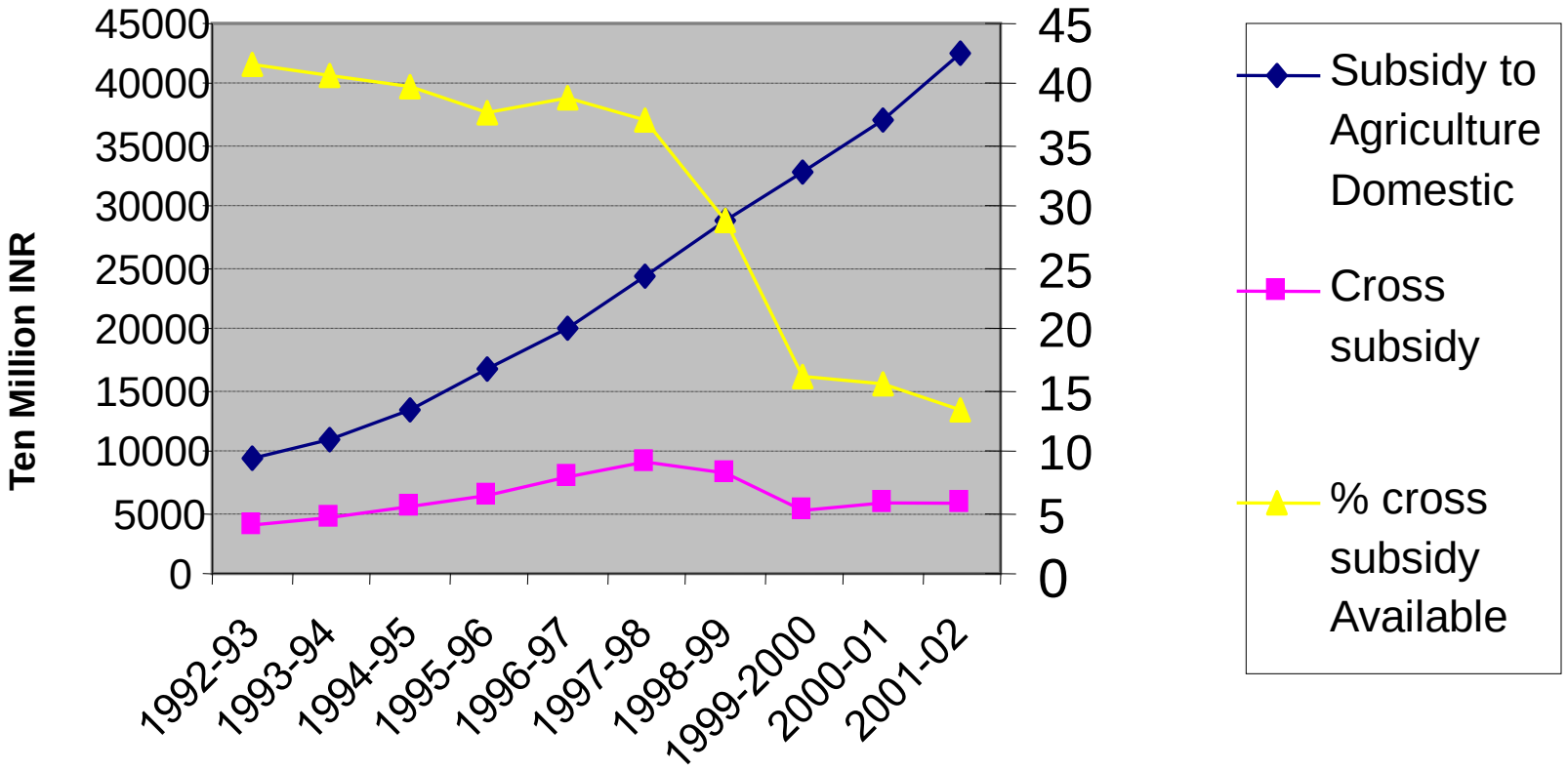
Joint Unstable Market



Grid Subsidy

- Govt. Direct Subsidy
  - Low tax revenue
  - Inefficient Administration
- Industry Cross Subsidy
  - Low consumer surplus
  - Three vicious circles

Cross subsidy has its limit



Planning Commission India 2003 SEB Report

Three Vicious Cycles

1. High cost → exit of valued customers → high cost

2. Revenue shortfall → poor quality → low willingness & ability to pay→ more shortfalls

3. Investment shortfall → public finance→ rent seekers: monopolist & customers → all problems

Result: High cost, artificial subsidy, rampant corruption, losses, low investment, and no development.

Dilemma

- Electrification needs investment, but, who will invest without return?

- Rich countries need subsidies for rural grid market, can poor countries avoid it?
- Subsidies on Kerosene? Grid? Or, Renewables?

Grid Vs. Renewables

Central Grid

- Strong Economy of Scale
  - Increasing cost
- Good for Urban Rich
  - Poor can not support it
- Monopolistic still not a friend of Conservation

Large Plant - Low per unit cost
Wasteful Use - High total cost

Distributed Renewables

- Strong Learning Curve
  - Reducing cost
- Good for Rural Poor
  - Rich also prefer it
- Competitive still a true friend of Conservation

Conservation by design

Automatic Demand Control

Myths of Central Grid

- Grid electricity most flexible?
  - Not dispatchable in mid-night: high supplemental fuel cost:run with a loss.
  - Dangerous and intrusive in its entire value chain
- Grid electricity cost low? (averages!!)
  - Only for bulk consumers
  - Total cost may be higher for a rural household
    - Price per kWh not Total outlay
  - Marginal investment cost and fuel risks
  - long-term reliability and litigation risks (40 b dollar US)
  - Safety and security risks (No pollution, global warming)

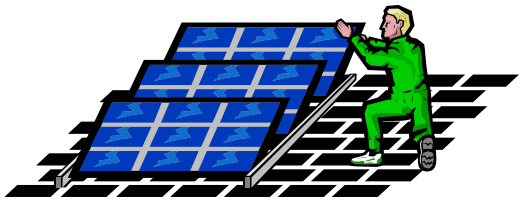
True Average Cost of Electricity??

	USA		India	
Parameter of Cost	**Grid**	**Renewables**	**Grid**	**Renewables**
Whole sale bulk	3 – 10 cents	3 – 20 cents	3 – 12 cents	3 – 30 cents
Average Distribution	8	20 - 50	10	20 - 30
Distribution Urban	5 – 15	20 - 50	5 - 15	20 - 30
Distribution Rural	15 - 25	7 – 50	15 - 30	7 – 30
Marginal fuel+capital costs	+20 %	7 – 50	+20 %	7 - 30
Distribution with Conservation	20 – 50	7 - 50	20-80	7 - 30
End-user effective price Reliability/risk	+10%?	7 - 50	+30%?	7 - 30
End-user's social cost	??	<7 - 50	??	<7 - 30
End-user's environmental cost	? ?	??	??	??

End of Grid Age ? Rural India earlier: Urban USA later

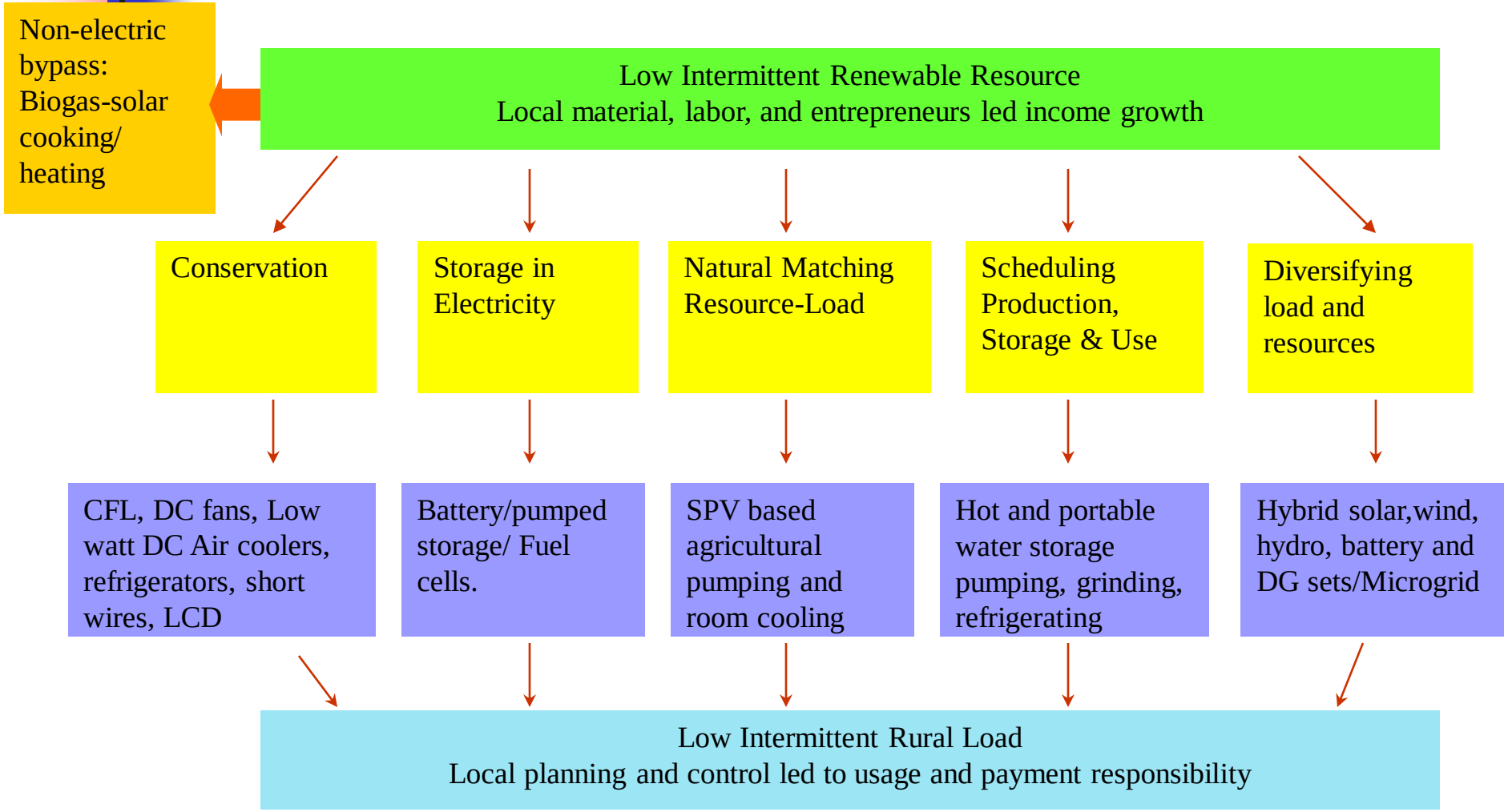
Needs Analysis: Facts of Renewable Electricity

- Too little
  - Poor can only afford a little (Kerosene Vs. Solar Lamp)
- Too Intermittent and unreliable
  - Grid Unavailable or Unreliable too
  - Cooling/heating/irrigation do not need continuous supply
  - Can use hybrid models



- Cannot be stored
  - Willing to schedule and conserve to minimize storage
  - Easy to store at sub-kWh level
  - First Conserve, Then, Design and Use (Combo Solar Lamp, TV, Laptop and Radio)

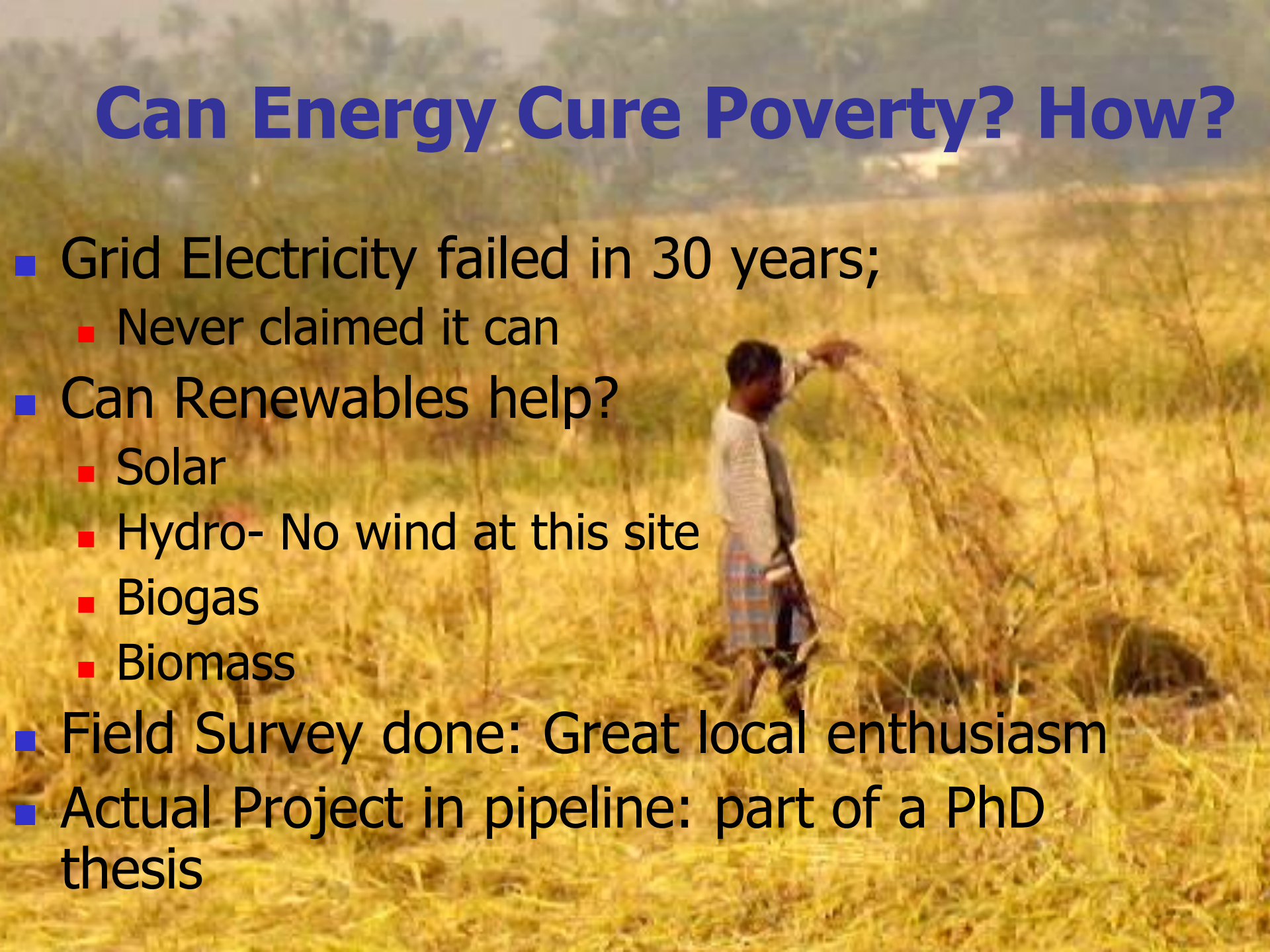
Sustainable & Competitive Solutions (Multiple Markets - Multiple Technologies)



Case Study – JABA village, India

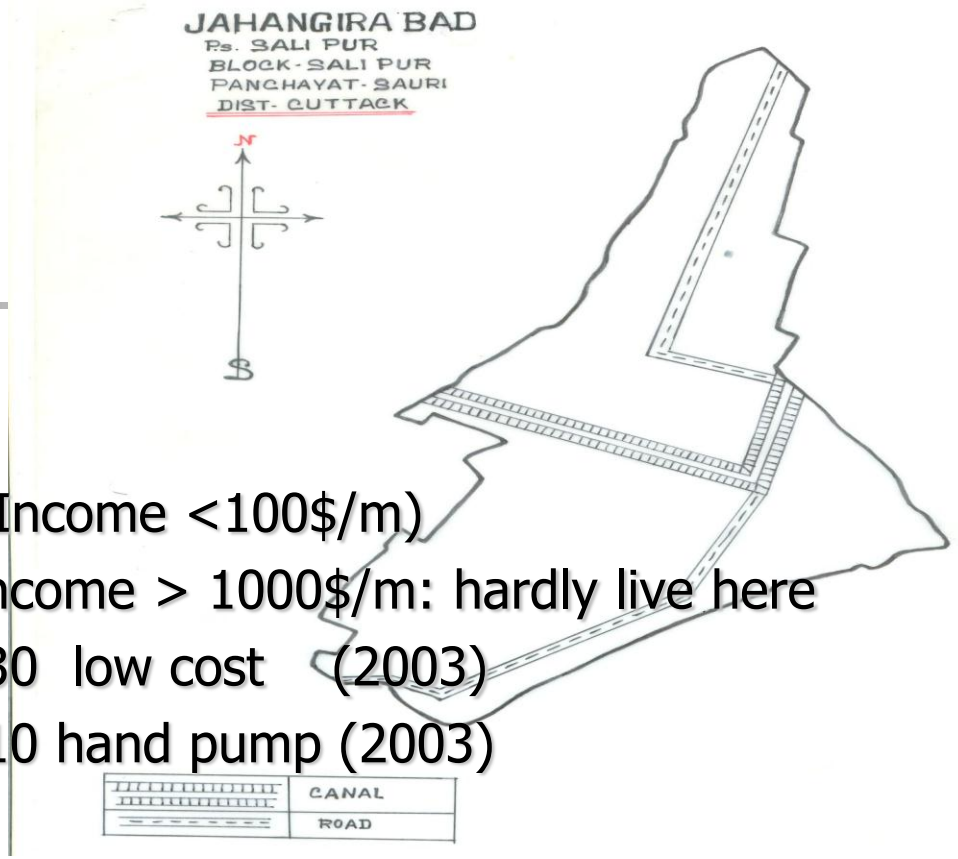
- Study objective
- Demography & Data collection
- Proposed Solution
- Implementation Plan

Can Energy Cure Poverty? How?



- Grid Electricity failed in 30 years;
  - Never claimed it can
- Can Renewables help?
  - Solar
  - Hydro- No wind at this site
  - Biogas
  - Biomass
- Field Survey done: Great local enthusiasm
- Actual Project in pipeline: part of a PhD thesis

Demography



- Population 417
- Households 100 (Income <100$/m)
  4 (Income > 1000$/m: hardly live here
- Toilets 30+ 30 low cost (2003)
- Water Pump 10+ 10 hand pump (2003)

- Energy in households

Fuel Wood	All (90 kg/ house hold)	Polluting
Kerosene	All !(3 ltr./ house hold))	Inferior fuel
LPG	4 from 1995	High Cost
Electricity	40 from 1970	Unreliable Subsidized
Solar Lantern	12 from 2003	New Technology

Energy Use

	Quantity per person	Price in US cents per unit	Total spending In USD	% Income spent
Electricity	100 kWh	6	6	6%
Bio mass	80 kg	1	0.8	o.8%
Cattle dung	10 kg	0	0	0
Kerosene	3 ltrs	22	0.6	0.6%

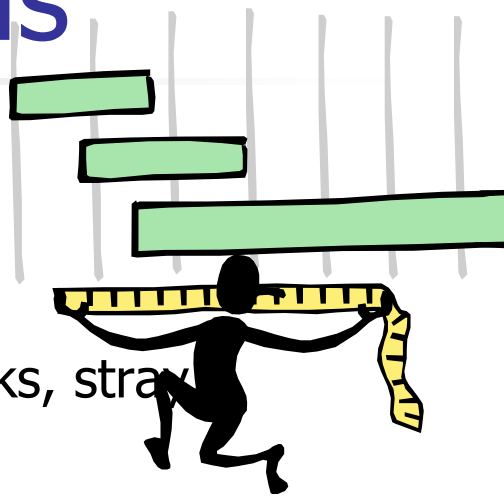
Electricity Appliances (Non)Use

	Heating/ Washing	Water heater	Refrigerator	Water Pump	Tube-light	Fan	TV	Elect Bulb
Total numbers	1	2	4	8	17	78	32	184
HHs those have	1	2	4	8	14	32	32	40
% Of deprived household	99%	98%	96%	92%	87%	69%	69%	62%

Who gets Fuel Subsidies?

Subsidized fuel	Not Used by Poor a lot	Used by Rich a lot	No. of days income required for first cost
Electricity	Can not afford	Lighting, entertainment, cooking, cooling	50-100$ 1 month for connection alone (wires, protection, running expense)
Biogas	Can not afford	Cooking	80 – 100 $ 1 month/yr Raw material (labor, pump, water,)
Kerosene	Using for light	Cooking	1 day/m for Poor's running expenses
SPV/ Solar Lantern	May afford With credit	As emergency light / Camping/ portable torch	1 day/m for poor: running mortgage cost

Unmeasured cost of Grid for poor households



- High direct costs for a low consumption
  - Initial deposit and side payment
  - Costly metering/protection; still unsafe (shock, sparks, stray voltage, and damage)
  - Connected but not reliable; Back up fuel lamp/ battery
  - High cost wiring still not mobile; extra wire for outdoor work or battery torch
- Lost labor time
  - procure, maintain, store and operate multiple inferior technologies

Economic Costs for Lighting

Technology Rs/month	Grid	Kerosene	Solar
Capital	25	0	50
Energy	45	105	0
Back-up	75	0	35
Labor	90	180	20
Total	235(5$)	285(6$)	105 (2.2$)

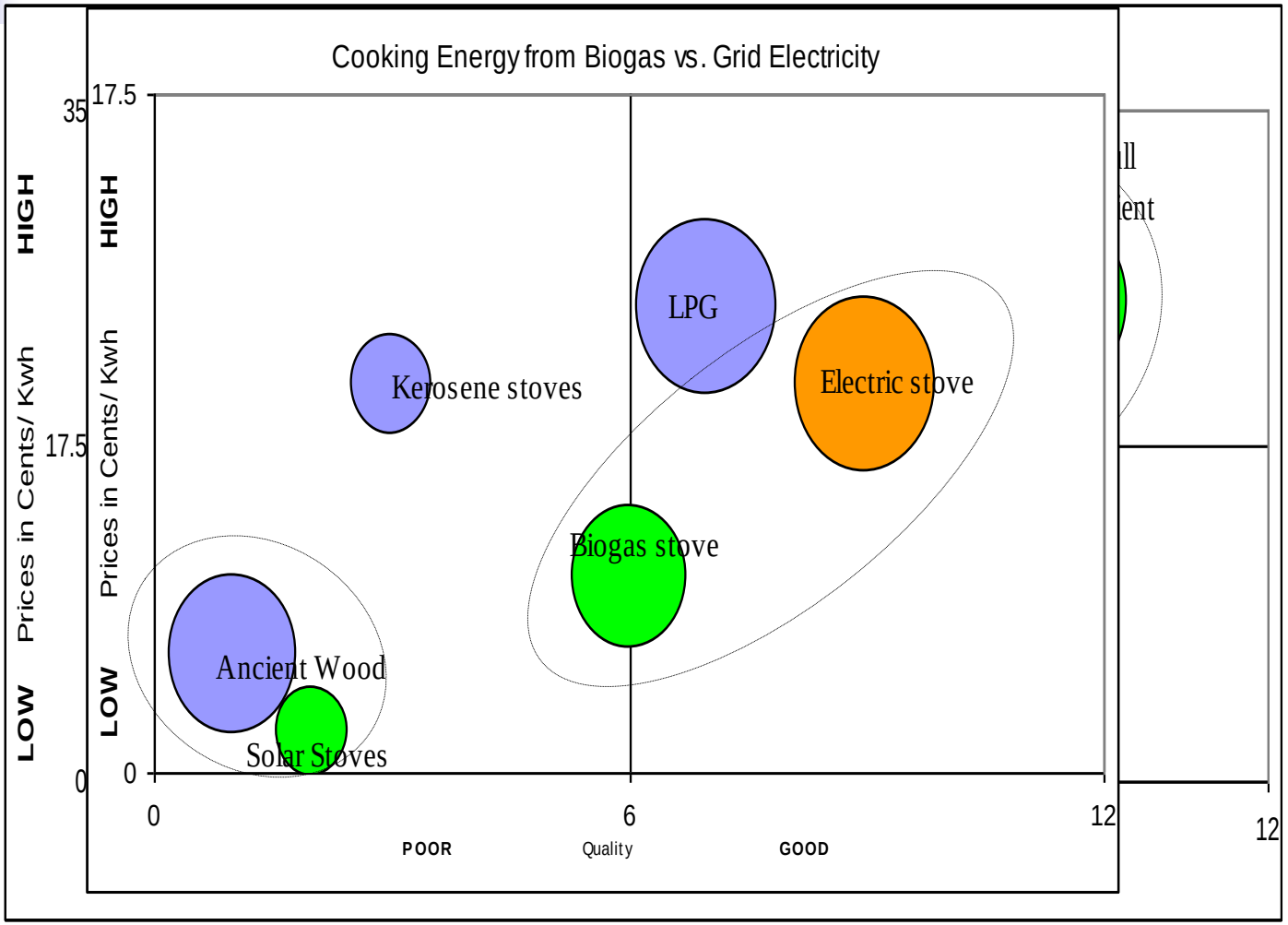
Economy Saves 2.8-3.8$/month/house = say 3.3$x12

(138 m*40$/Yr=5.5 billion $/y) Government Savings on Subsidy=.8+2=2.8 billion $/y

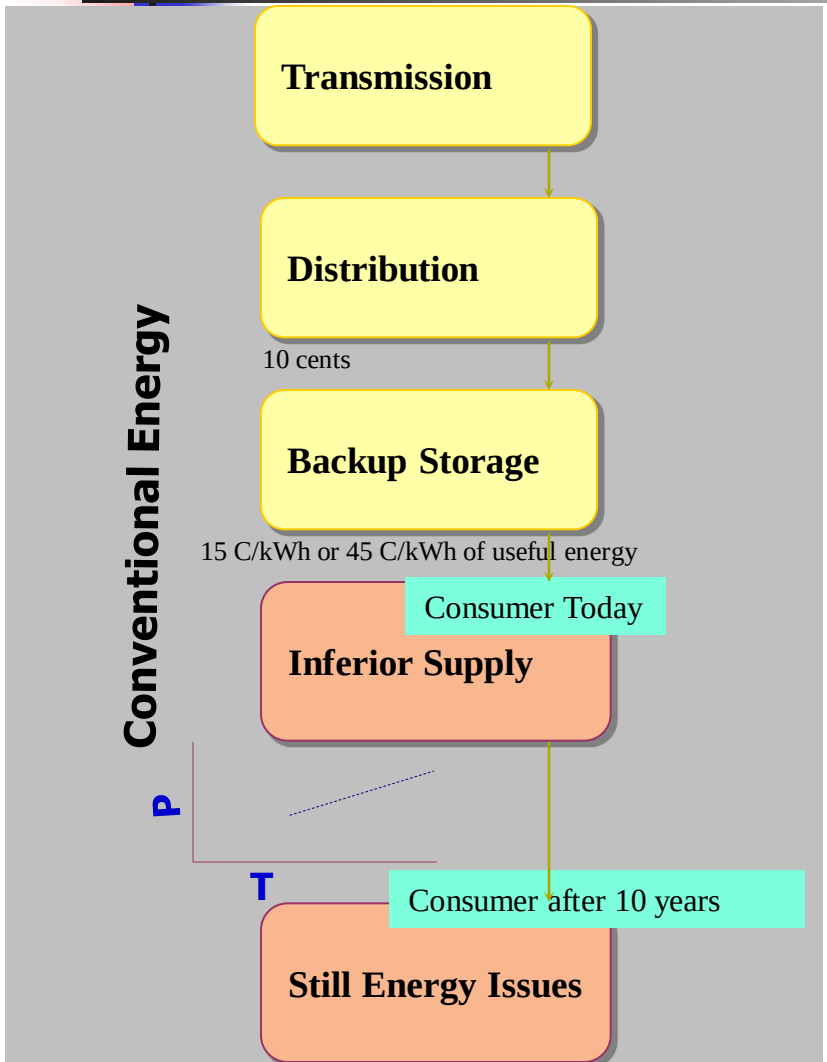
Proposed Solution

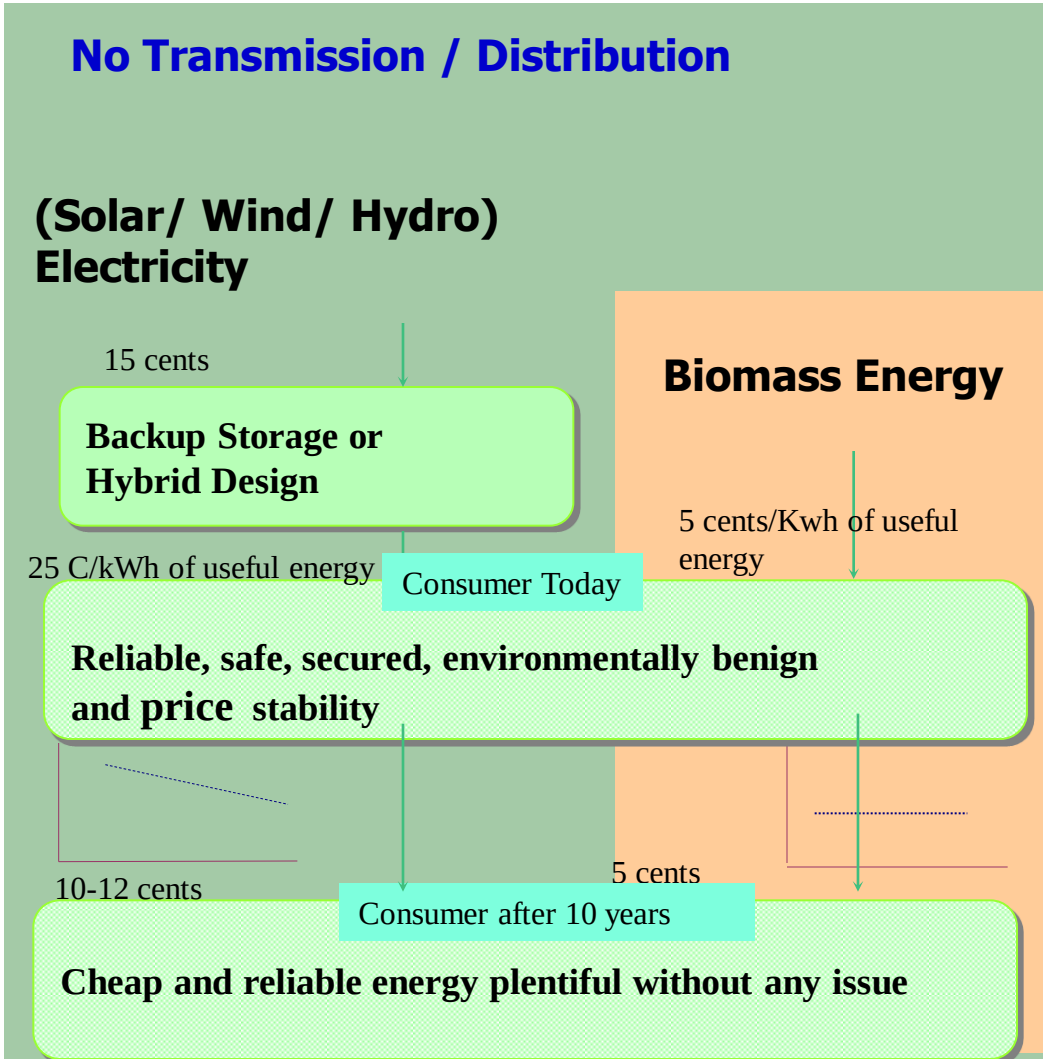
- Rural renewables to drive Supply and Demand
  - SPV based Light and Entertainment
    - Portable, Clean, Reliable & Cheap Radio Lantern
    - Efficient TV, Fans, Air coolers, Refrigerators
  - Biogas and/or Solar Cooking/Heating
  - Biomass based Rural Industry
    - Cold storage, grinding, carpentry, water pumping, fuel and food processing
- Replace Kerosene and Grid Subsidies
- Increase Investment and Education

Market Segmentation



Renewables after 10 Years





Enabling Environment

- Technology Commercial but Needs
  - Rural Marketing to Build Awareness
  - Micro Financing To Spread Fixed Cost
  - After Sales Service to Sustain Sales
- Need for subsidies?

Micro Financing

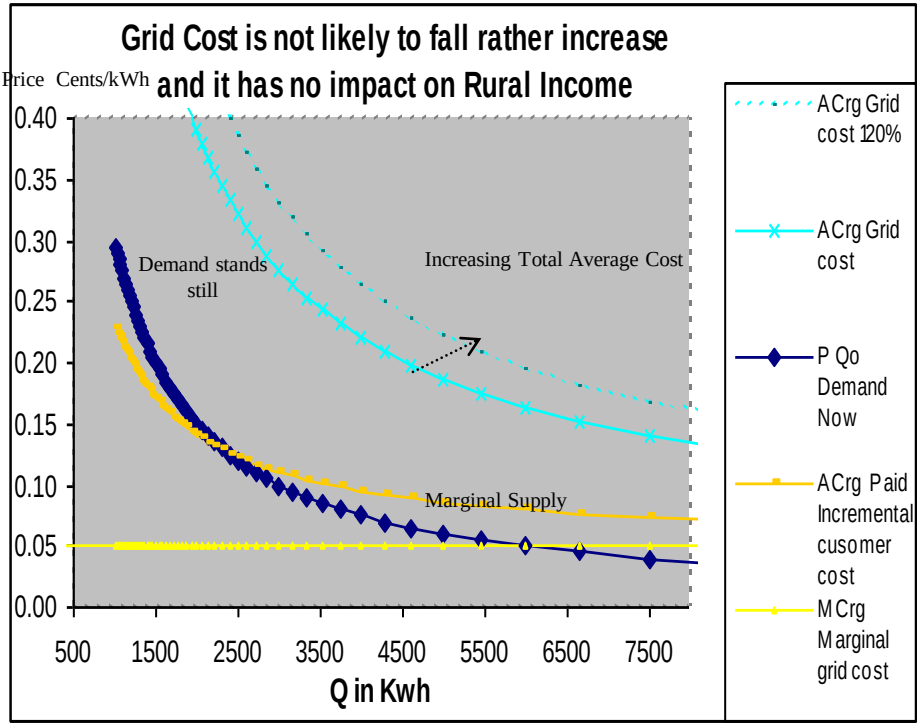
- Willing to pay higher interest rate
  - Gramin Bank Bangladesh and India
  - No powerful political support, also care for social stigma
  - Lest have to revert back to costly alternative: grid and kerosene
- Poor never default for a livelihood financing
- Increased income and reduced consumer risk accelerates repayment

Income increases affordability

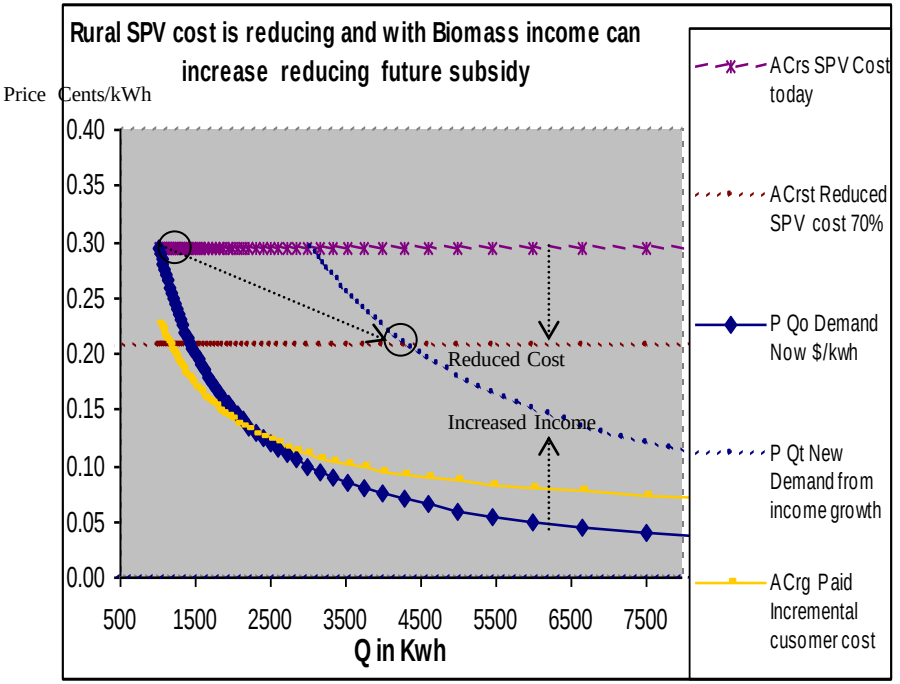
- Increased/Flexible Work Hours
- Enhanced Income Opportunities
  - Jobs in Renewables Value Chain
  - Rural Enterprise: cell phone/laptop based
  - Rural Agriculture: farm/dairy/flowers/herbs
- Improved Health/Sanitation
- Heightened Productivity

Diverging Grid: Converging Renewables

Monopoly Grid Increases Rural Supply Gap

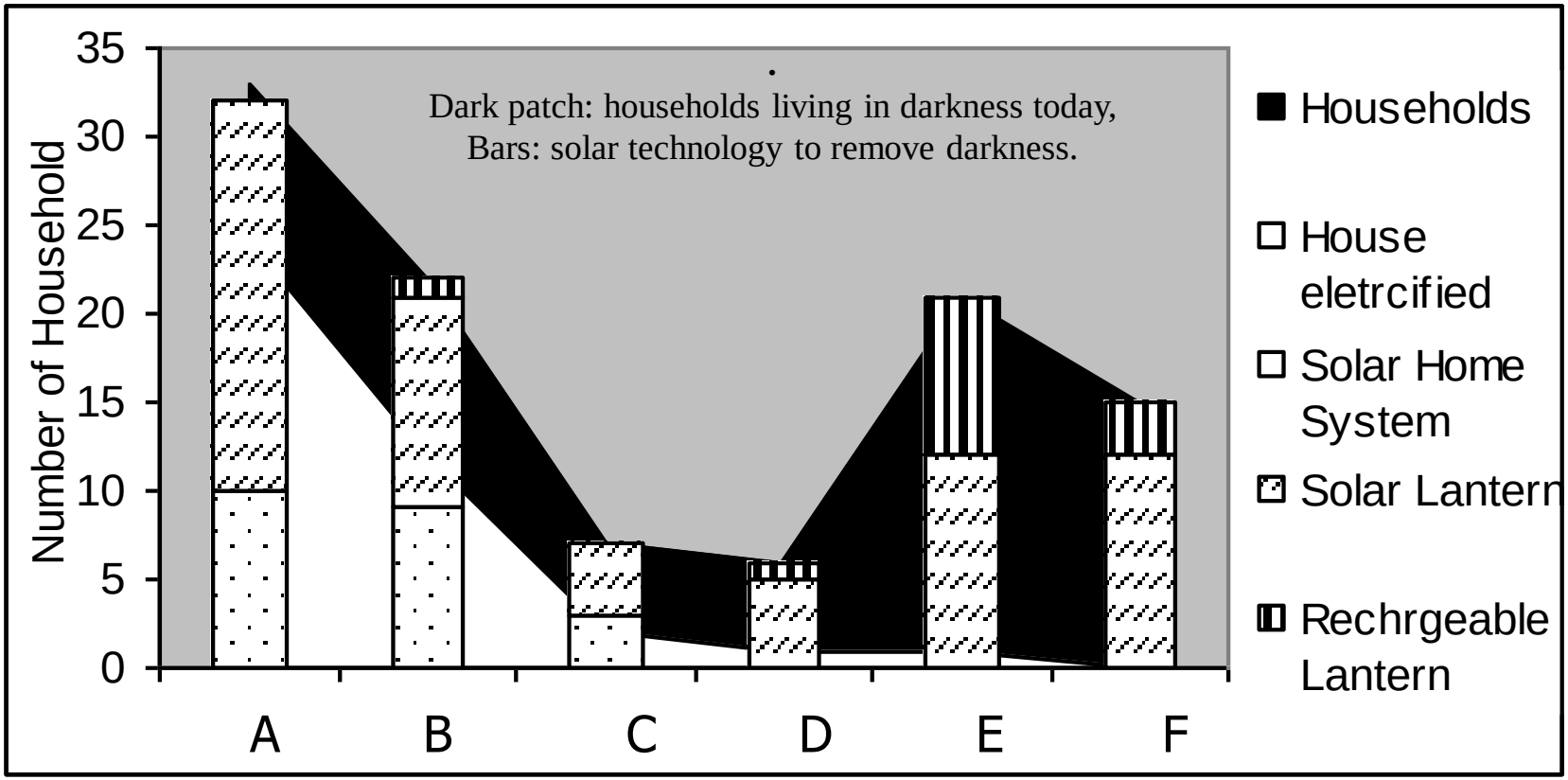


Modular SPV Closes The Gap



Implementation Plan

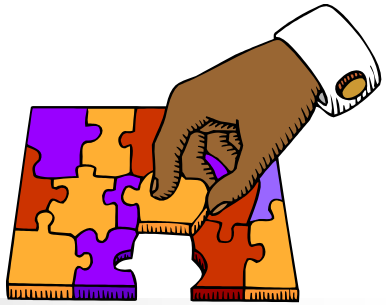
Present and Possible Lighting in JABA by Caste Groups



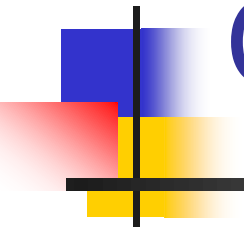
Renewable closing the gap

- Cost & Price
- Demand & Supply
- Expectation & Fulfillment
- Lifestyle & Sustainability

Conclusion



- Regulating electric industry
  - neither necessary nor sufficient
  - increases phantom subsidies
- Subsidy to inferior technologies retarding newer technologies
- Renewables bringing competition faster and wider



Questions

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