Lighting Up Bihar

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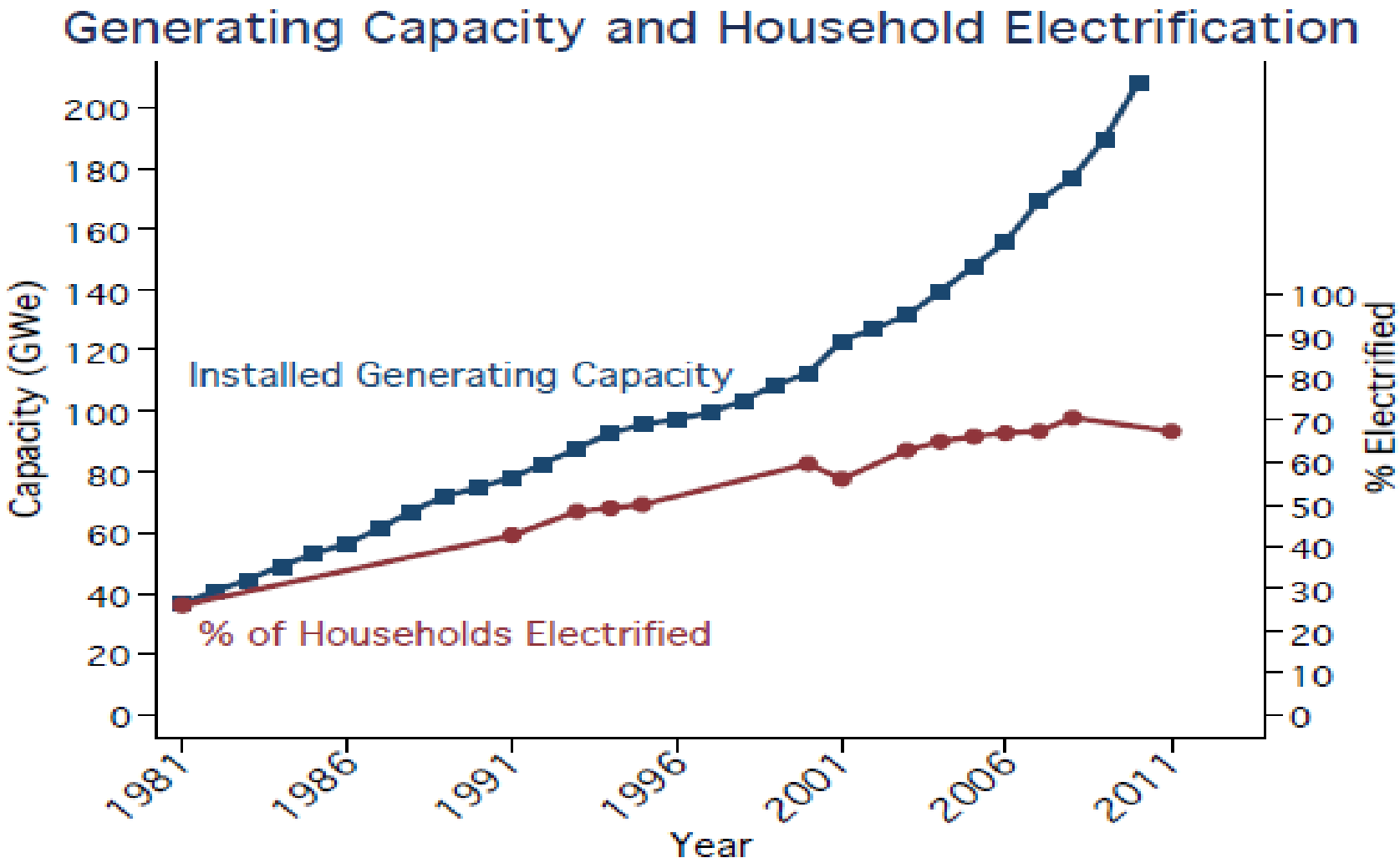
Part I

WHAT ARE WE TRYING TO DO? – THE BIG PICTURE

What Are We Trying to Do?

- Bihar is making strides on the generation side and in purchasing electricity from out of state
- But major problems on the distribution side remain – this is where we want to work with the Bihar Energy Department and in state distribution companies
- Commitment to electrification very strong in Bihar and extends from Chief Minister downwards
- Scope for jointly developing new models of electricity delivery that could be taken in other states in India facing similar problems

Household Electrification In India Has Not Kept Pace with Generating Capacity



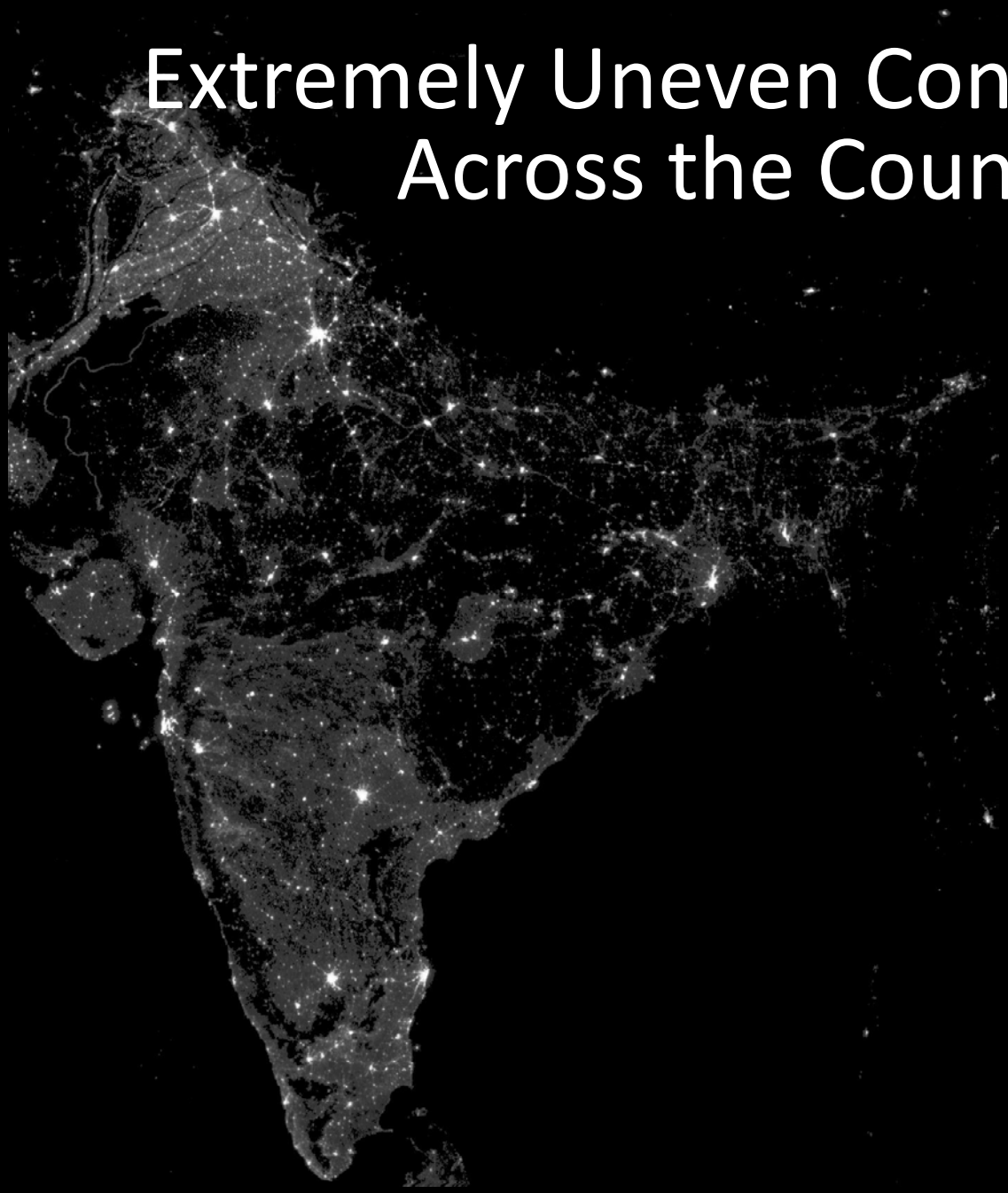
What Are We Trying to Do?

- Electricity provision in Bihar is low (i.e. it is a relatively dark state)

- Infrastructure and economic changes needed
  - Infrastructure investments well underway

- So by changing incentives for consumers to pay for electricity, for collectors (either state or private) to collect electricity charges there may be scope to “light up Bihar” relatively quickly

Extremely Uneven Consumption Across the Country



Average Per Capita Consumption:

Bihar – 122 kWh

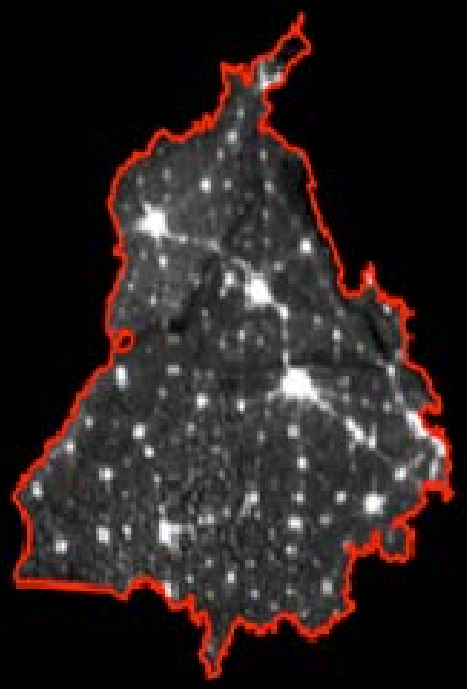
India – 626 kWh

USA – 13,325 kWh

Source: CIA World Factbook (2010); Govt. of Bihar

Bihar One of the Darkest States

Punjab



Bihar

Per Capita Power Consumption (2009-10) : Punjab (1527 kWh) Bihar (122.11kWh)

Source : http://www.eai.in/club/users/dheen/blogs/7285

Grid Electricity is Cheaper Than Decentralised Alternatives

- Cost of energy from grid electricity about one-third that from diesel generator or decentralised biomass/solar
- Scope to improve economic efficiency through electrification therefore enormous
- Consumers should be willing to pay for grid electricity, if it could be effectively delivered

What Are We Trying to Do?

- To make matters concrete, consider an electricity feeder servicing five villages, a small town or a section of a city

- In Bihar, little or no electricity may not be flowing to these consumers

- Why?

What Are We Trying to Do?

- (1) Lines/equipment connecting feeder station to households/businesses may have been stolen/vandalized/not properly maintained

- (2) Consumers not paying for electricity making it uneconomical to provide

What Are We Trying to Do?

- Repair to last mile delivery infrastructure is provided by electricity distribution companies (this is being done)

- So key elements (1) electricity and (2) and infrastructure to get it to consumers are falling into place

- The big challenge is to get people to pay for it (which in turn will generate investment to further expand provision)

Some Ideas

- Starting point would be to map all the distribution losses at feeder level (electricity in/revenue back) and to supplement this with customer billing information

- This provides Bihar Energy Department/Distribution companies with picture of where the greatest offenders are and where the greatest gains are possible

Some Ideas

- As electricity consumers may be colluding with collectors there is scope to reduce losses by changing collector incentives
- Performance pay
- Rewarding better performers with better posts
- Threat of loss of job for worse collectors

Some Ideas

- In more extreme version electricity bill collection would be sub-contracted to private sector

- These private utility companies are profit making will want to reduce theft and enhance collections

- Scope in Bihar to test across different franchising models using randomized design

Some Ideas

- Put perhaps the most powerful idea is to link the supply at the feeder or community level to hours of payment

- Core idea is to link power to payment

Some Ideas

- As payments flow in then electricity can flow out
- And revenue can be use to invest in expanding the grid further
- Together these two processes will be critical to “lighting up Bihar”
- This in turn will allow us to study whether/how the lives of citizens are affected by this rapid expansion in electrification

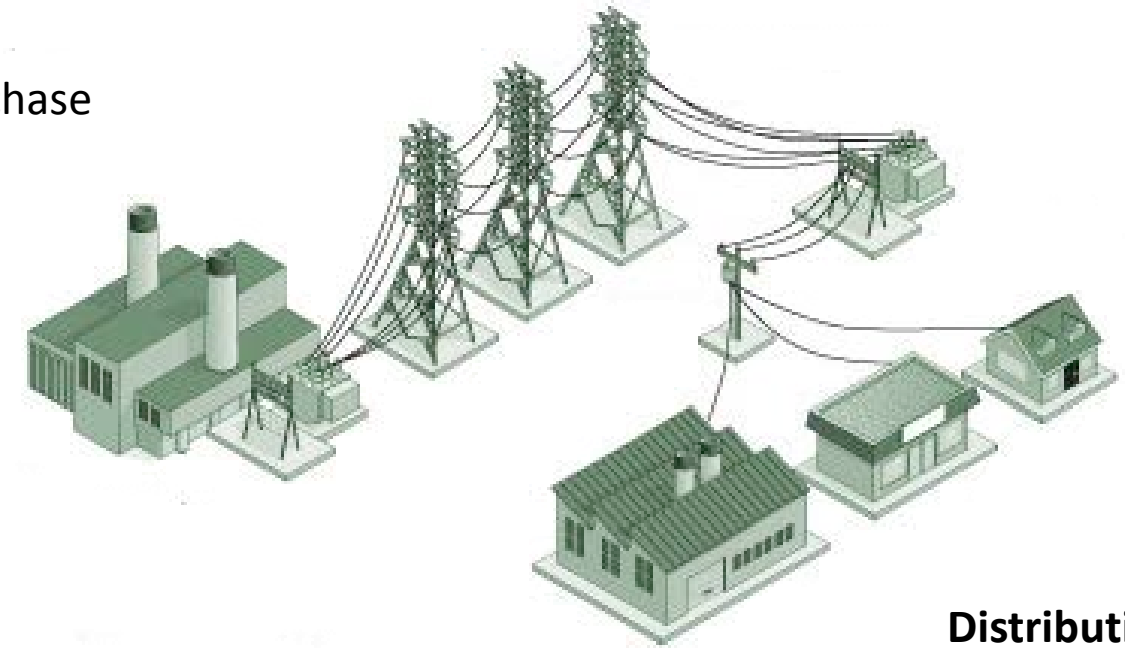
Part II

THE PLAN FOR ENERGY INDEPENDENCE IN BIHAR

Structure of the Electricity Sector

Generation
- Central allocation
- State generation
- Renewables
- Imports
- Short-term purchase

Transmission
- Natural monopoly



Distribution
- Natural monopoly, in each area

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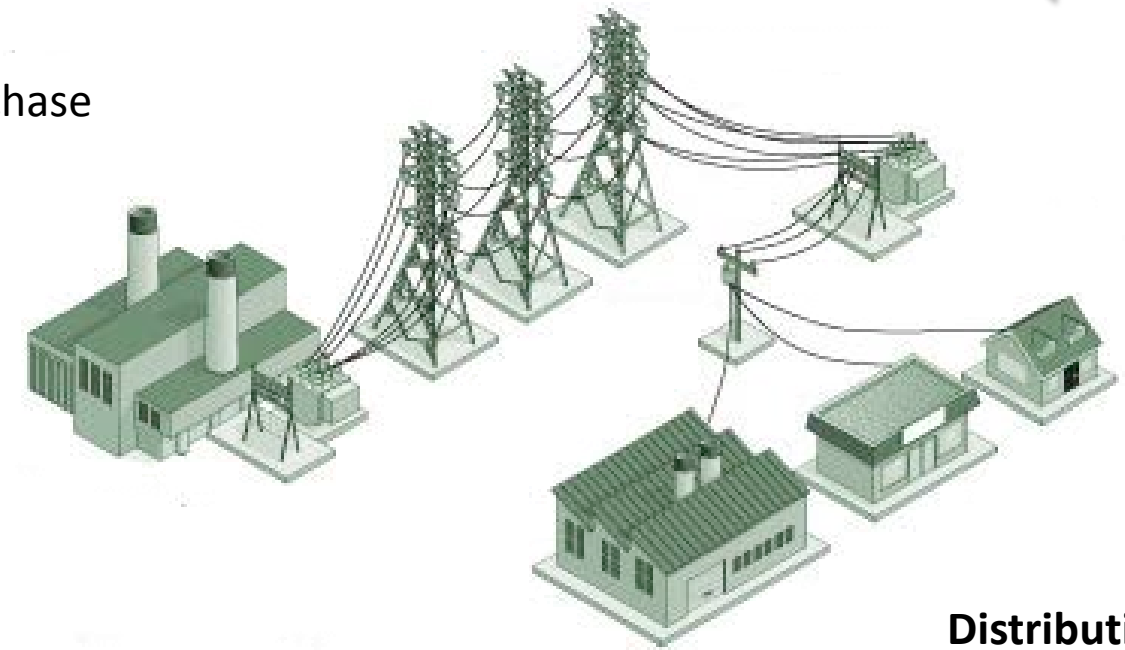
Revenue



Distribution
- Natural monopoly, in each area

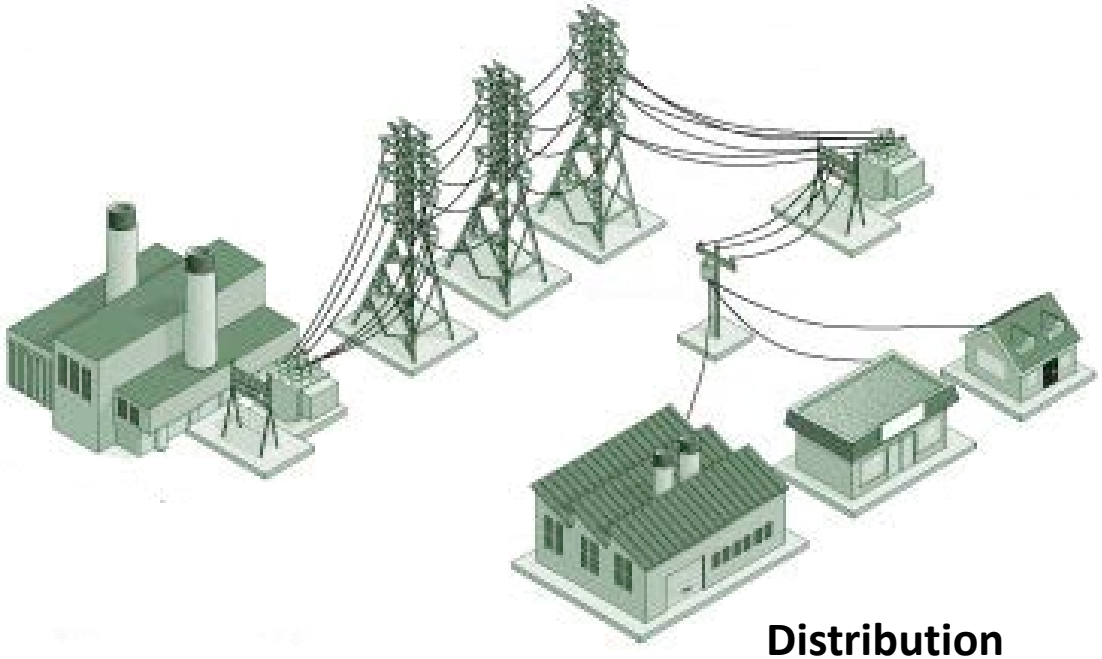
Revenue

Structure of the Electricity Sector: Unbundling From November, 2012

Bihar State Power Holding Company Limited

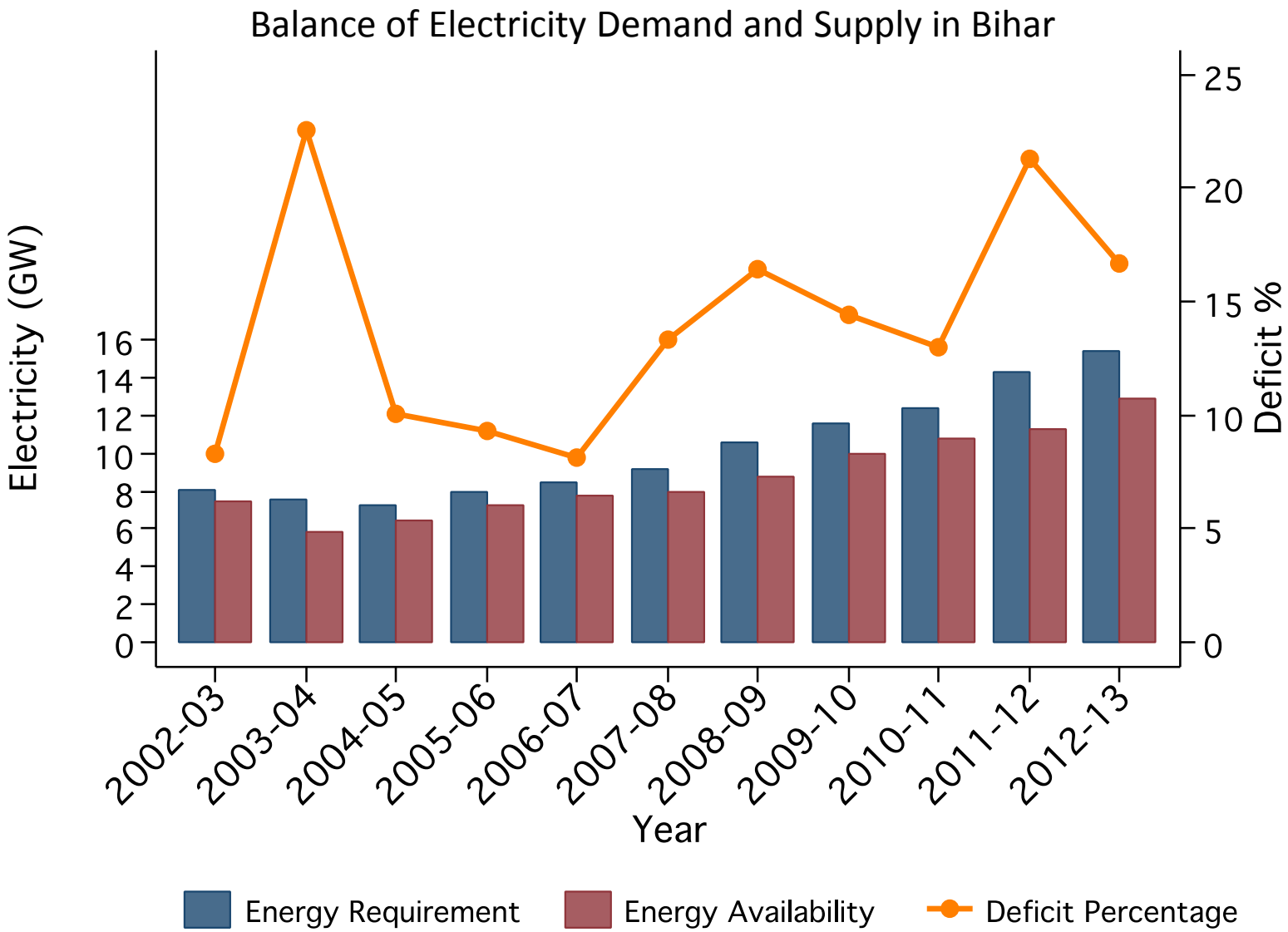
Generation
Bihar State Power
Generation Company

Transmission
Bihar State Power
Transmission Company



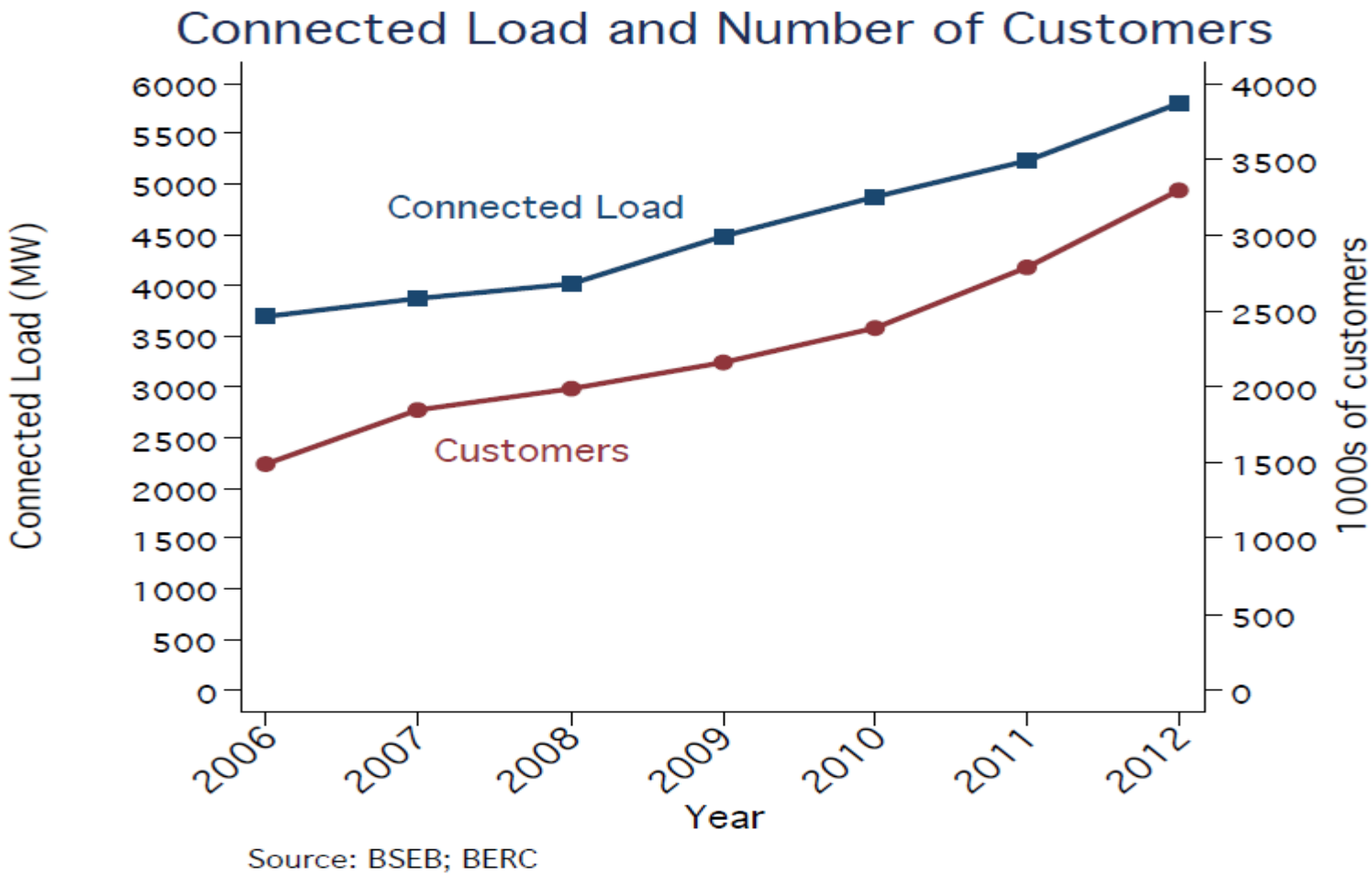
Distribution
North and South Bihar Power
Distribution Companies

Bihar Has a Substantial Energy Deficit



Source: CEA; Planning Commission

And Demand is Growing Quickly



Government of Bihar Planning on All Fronts to Close this Gap

Generation

- Planned three-fold rise in supply in three years
- Every possible source: Own state generation, renewables, purchases and central allocation

Transmission

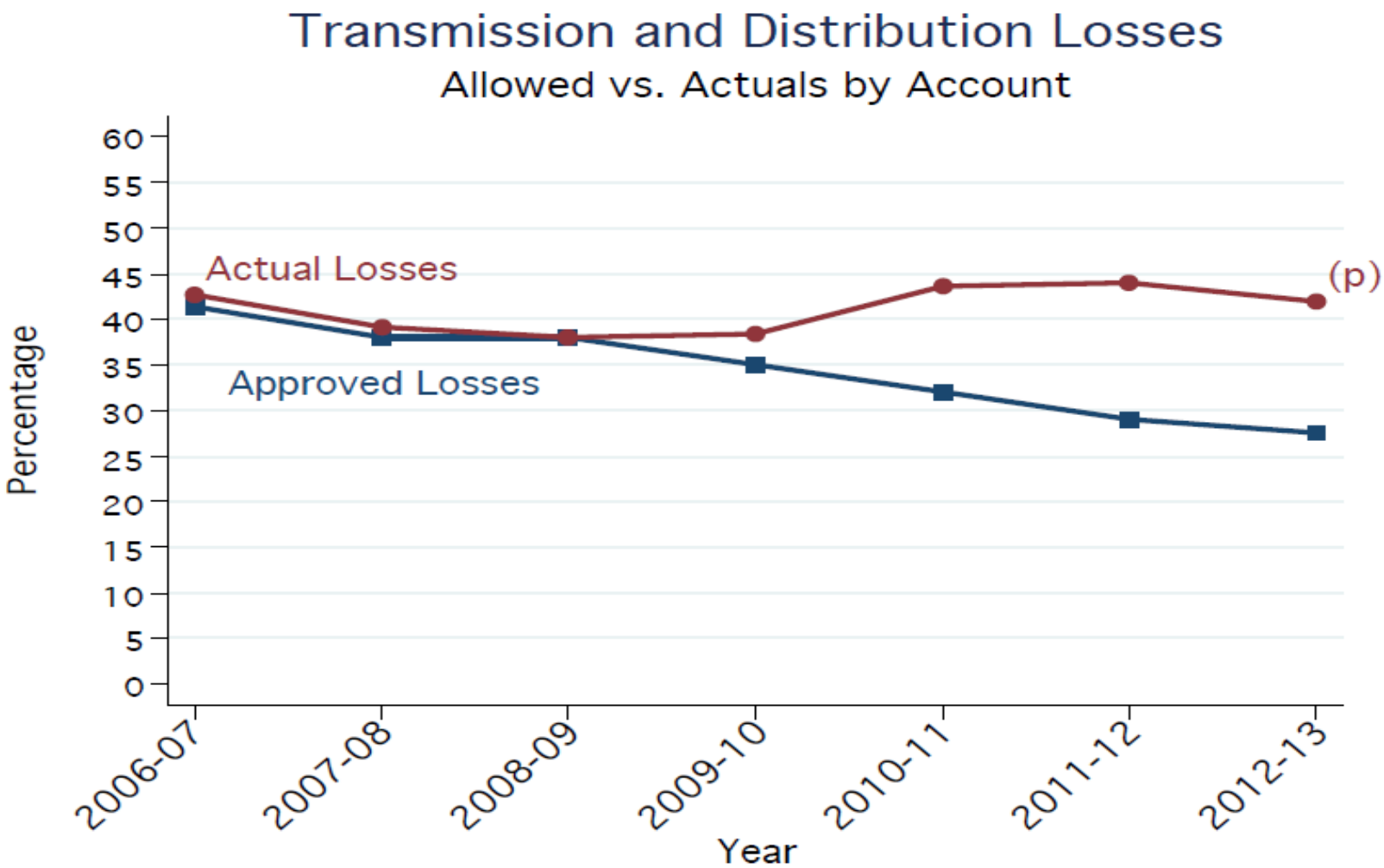
- Investment in grid to convey power from new sources

Distribution

- Service quality and technical upgrades
- Universal customer metering plan nearly complete
- Franchising of urban circles and rural feeders

Source: Business Plans of Bihar State Power Companies

Distribution Losses are The Most Important Target for Sustainability



Source: BSEB; BERC

Distribution Is the Key to a Sustainable Electricity Sector

- Shorter Time Horizon
  - Distribution reform can see results faster
- Distribution a *Source* of Revenue
  - Revenue → investment in power supply
- Gains Proportional to Power Demand
  - Growth not sustainable without loss reduction

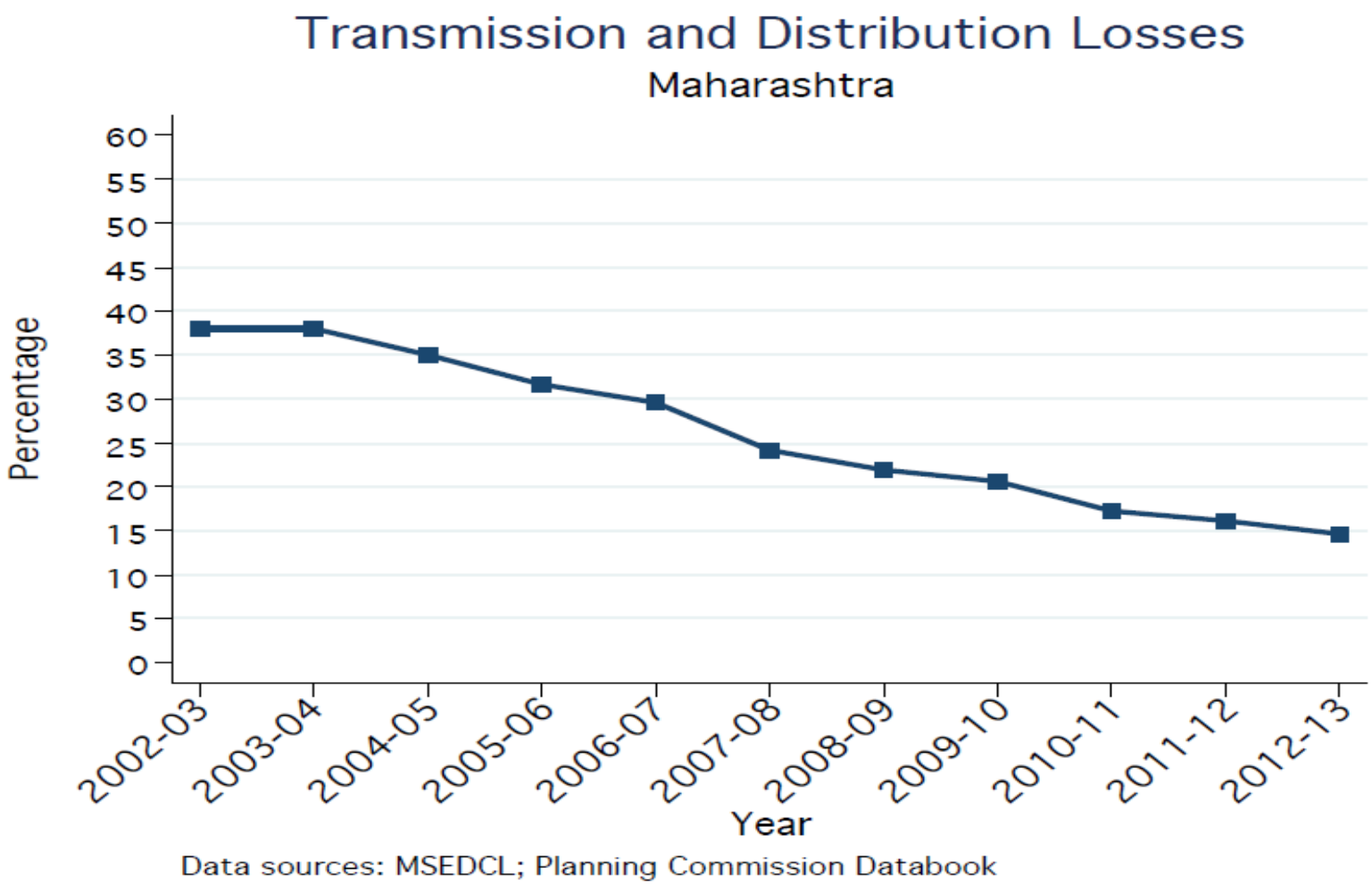
Part III

PILOTING STRATEGIES TO BRING LOSSES DOWN

What Does “Loss” Mean?

- Aggregate technical & commercial loss
  - Power bought for which revenue not collected
- Technical
  - Unavoidable but need not be large
- Commercial
  - Outright theft
  - Unmetered power (agricultural pumps)
  - Unbilled power
  - Billed but not collected

Maharashtra Has Made Great Progress



Pilot Strategies to Bring Down Distribution Losses

1. Where does power go? : Energy accounting

2. How to bill for that power? : Collector Incentives

1. Who should bill for that power? : Franchising

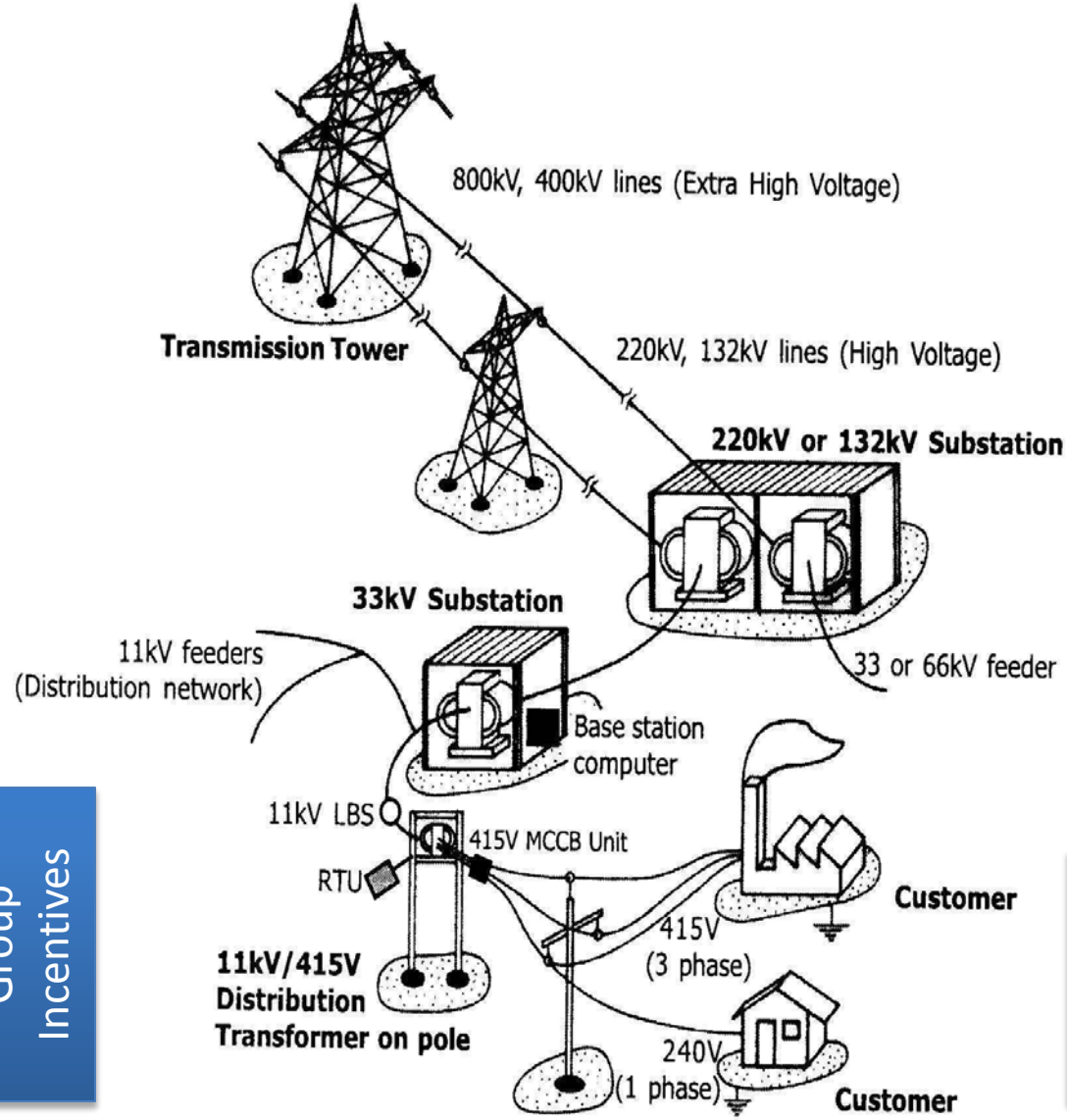
2. Where should the power go? : Group Incentives

Strategies Give Incentives at Different Levels of Grid

Energy Accounting

Franchising

Group Incentives



Collector Incentives

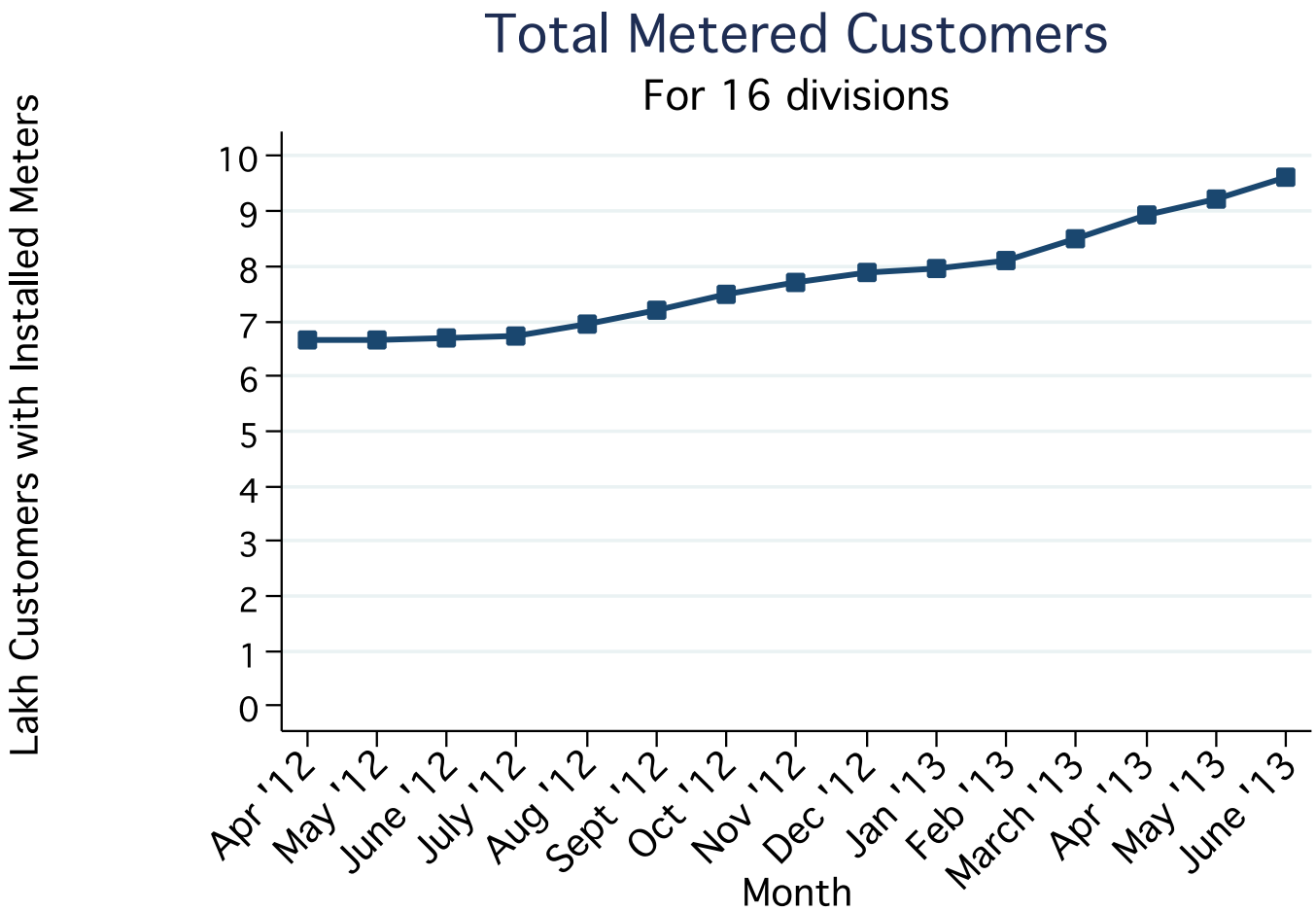
Strategies to Reduce Losses: 1. Energy Accounting

- Energy accounting
  - Measurement and analysis of where energy flows
  - Balancing against billing and collections

- Discoms making investments in measurement
  - 100% metering of customers near completion in North and South Bihar
  - Metering of grid elements close behind

- Basic Research: Analyse where power is lost, and where the benefits of expansion are the greatest.

Over 300,000 Meters Added in Only 16 Divisions of North Bihar



Data sources: NBPDCL
Divisions: Barauni, Begusarai, Chapra E/W, Dalsinghsarai, Darbhanga U/R, Gopalganj, JhanJarpur, Khagaria, Madhepura, Rosera, Saharsa, Samastipur, Siwan, Supaul

Strategies to Reduce Losses: 2. Collector Incentives

- Ground-level commercial losses through:
  - Theft
  - Lack of billing
  - Lack of collections on bills

- Discoms to require customer verification / signature on every bill

- Incentivize / monitor performance of ground-level staff
  - Incentive pay based on bills issued and collections per customer, accounting for customer mix and energy use
  - Recent experience with govt. incentives positive

Strategies to Reduce Losses: 3. Franchising

- Why does government have to collect every bill?
  - Private companies may give stronger incentives

- Franchising program underway in Bihar
  - Input-based franchise pays increasing rate based on share of energy paid for.
  - Urban model for circle / towns, rural model for feeder

- Clear area for evaluation
  - Scheme just beginning but with large potential
  - See if/how private companies are able to increase collections. What is the best contract?
  - Previous experience in odd cases (e.g. Delhi discoms)

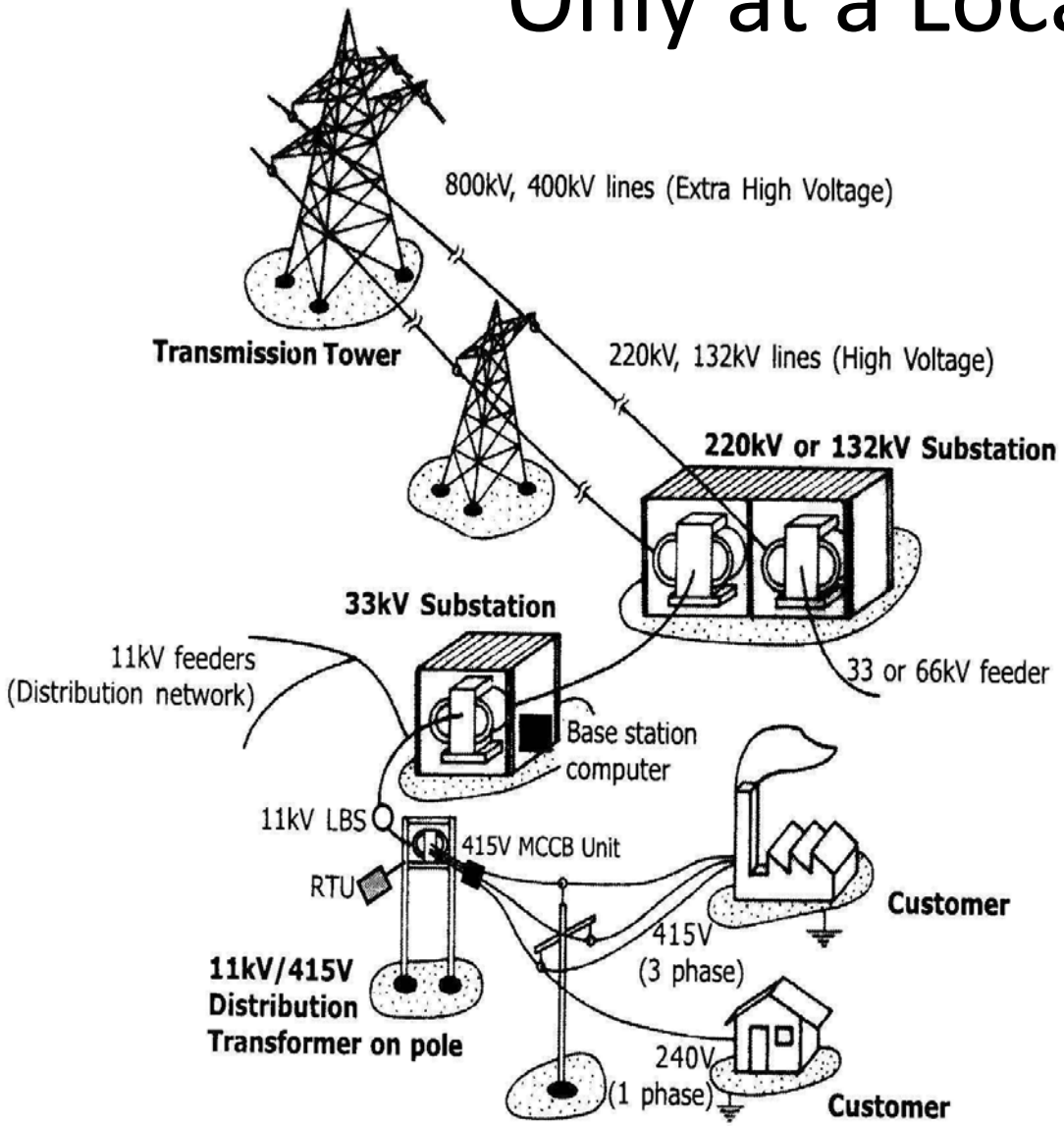
Strategies to Reduce Losses: 4. Group Incentives

- Billing and metering address some sources of loss
  - Outright theft, unbilled power, meter circumvention may remain stubborn problems
- Group incentive pioneered in Maharashtra
  - Link power supply to payment / collections
  - Similar to govt. implementation of input-based franchise
- Research to adapt and pilot in Bihar
  - Use Maharashtra experience and Bihar energy accounting / customer mix to design
  - Pilot in high-loss areas to encourage improvement

MSEDCL Distribution and Collection Losses (DCL) Scheme: You Get What You Pay For

Group	Non-Agricultural Area		Agricultural Area	
	Definition	Power Supply	Definition	Power Supply
A	0 – 18%	20:45	0 – 21%	13:00
B	18 – 26%	20:00	21 – 29%	12:30
C	26 – 34%	19:15	29 – 37%	12:00
D	34 – 42%	18:30	37 – 45%	11:30
E	42 – 50%	17:45	45 – 53%	11:00
F	50 – 55%	17:00	53 – 58%	11:00
G1	55 – 60%	16:15	58 – 63%	10:30
G2	60 – 65%	15:30	63 – 68%	10:00
G3	> 65%	14:45	> 68%	10:00

Group Incentive Can Work Only at a Local Level



Voltage	No of Sub Stations/feeder	Number of Customers / Node
220 kV (PSS)	9	444,000
132 kV (PSS)	76	52,000
11 kV Feeder	1721	2,300

Piloting Loss Reduction in Bihar

Phase	Activity	Key Outcome
I. Diagnosis (2 months)	Use Energy Audit and Collections to Identify High-loss, High-return Classes	Categorisation of Losses and Projection of Revenue
II. Planning (2 months)	Draw up Schedule of Load Shedding in Line with Loss	Approval of Schedule
III. Piloting (8 months)	Roll-out for High-loss Classes and Areas	Phased implementation to evaluate scheme effects in high-loss urban areas
IV. Scaling	Bihar-wide implementation	Collections of NBPDCL / SBPDCL, power availability

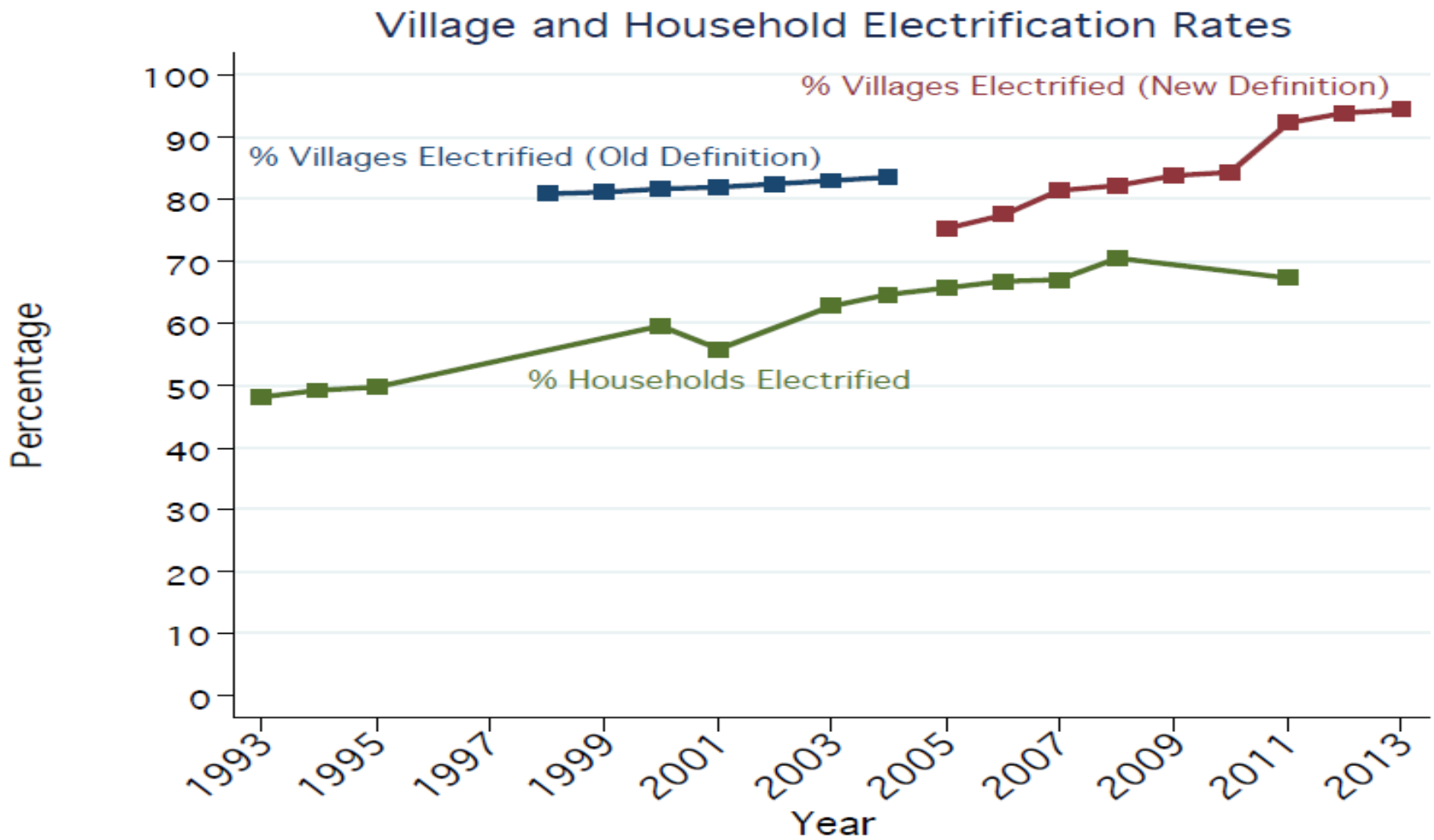
Research Design: Feeder-level Randomized-controlled Trial

Activity	Group	
Feeder Categorisation	High-loss (e.g. >50%) Feeders in Urban / Town Areas with 100% feeder metering	
Pilot	Treatment: Adopt incentive schedule, post notices in neighborhood and in power bills	Control: Status quo schedule of power supply
Measurement	Monthly feeder-level losses, collections, and power supply	

Prerequisites for Success

- Technical side
  - Fine-grained metering
  - Operational control over power supply and strict monitoring
- Economic side
  - Simple, transparent schedule
  - Promotion: every bill, pole with notices of group

Conclusion: Sustainable Electrification Requires Financial Sustainability



Source: CEA; Census of India; NSS

Conclusion: Sustainable Electrification Requires Financial Sustainability

- Era of wishful thinking in electrification failed
  - Lines laid, no power flowed
  - Total losses of distribution companies 1-1.5% of Indian GDP, crippling any electrification efforts

- Reducing losses therefore precondition of sustainable expansion

- Bihar is well-placed to expand its electricity sector
  - Necessary technical conditions being rolled out
  - Revenue growth will enable simultaneous and meaningful electrification in rural areas