Benefits of Electrification and the Role of Reliability: Evidence form India

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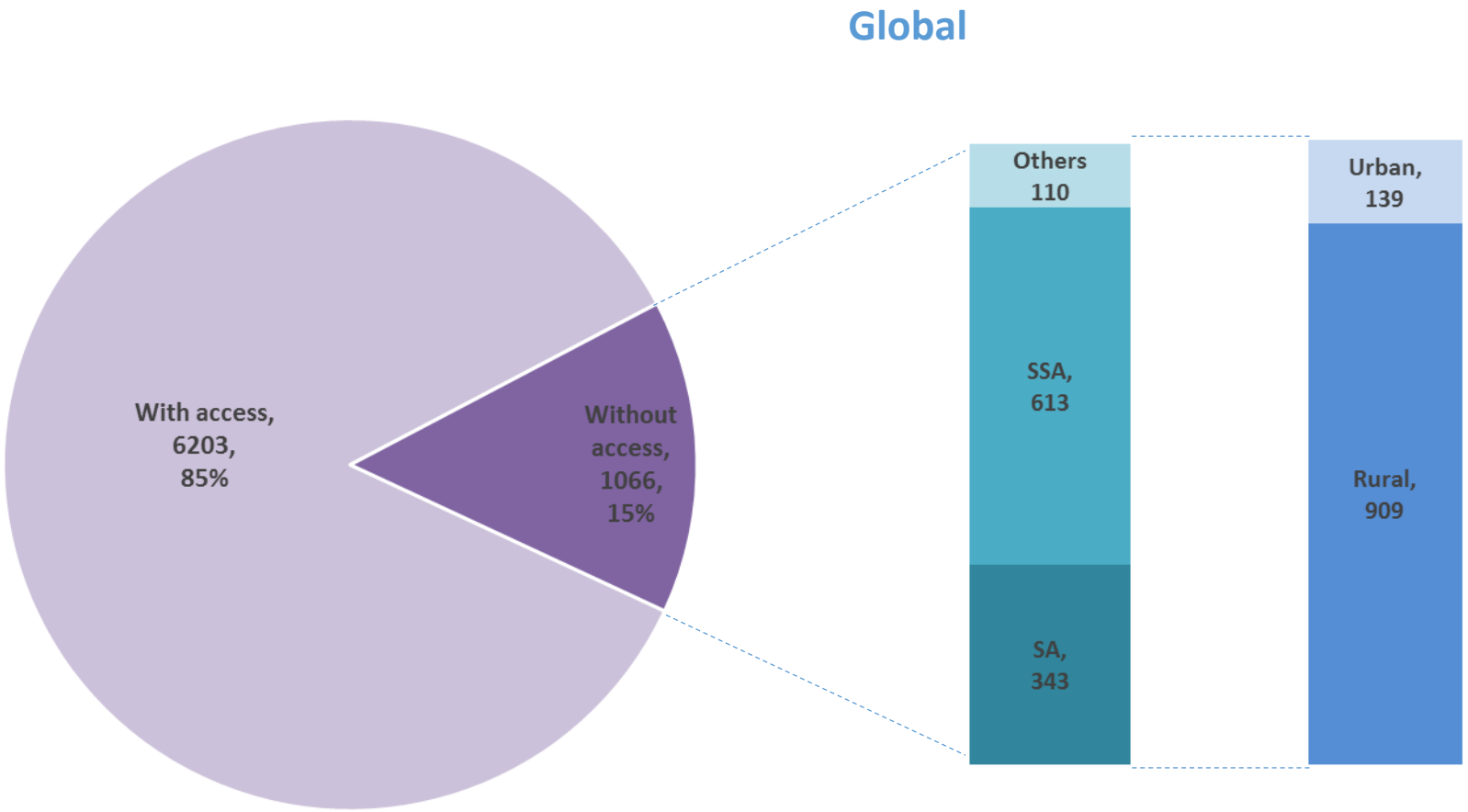
1.2 billion people have no access to electricity, most living in rural areas

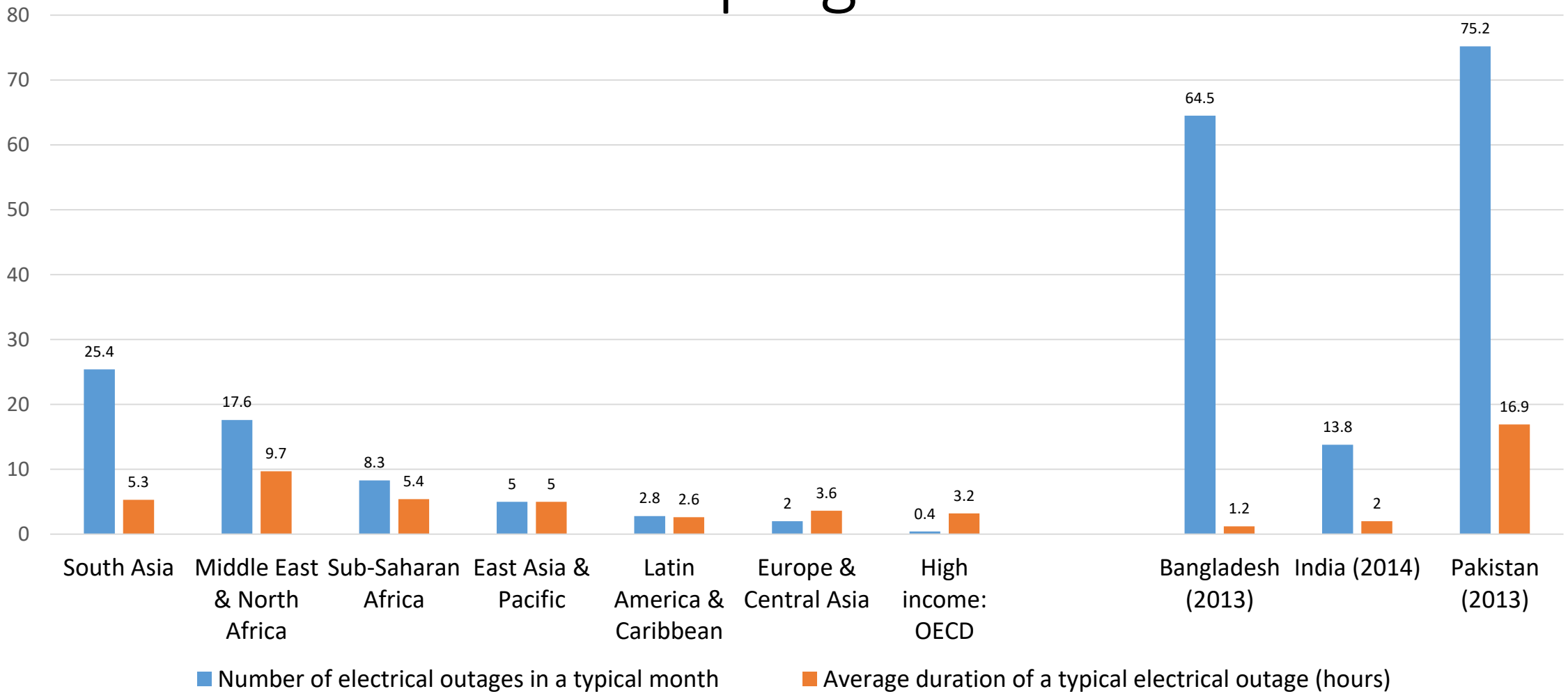


Source: World Development Indicators

A mixed picture about the economic viability of rural electrification

- Substantial benefits from rural electrification
  - Dinkleman (2011)
  - Khandker et al (2012)
  - Lipscomb et al. (2013)
  - Van de Walle (2015)
  - Chakravorty et al. (2016)
- Only modest impact
  - Lee, Miguel and Wolfram (2016)
  - Burlig and Preonas (2017)
  - Aklin et al. (2017)

Electricity supply is unreliable in the developing world

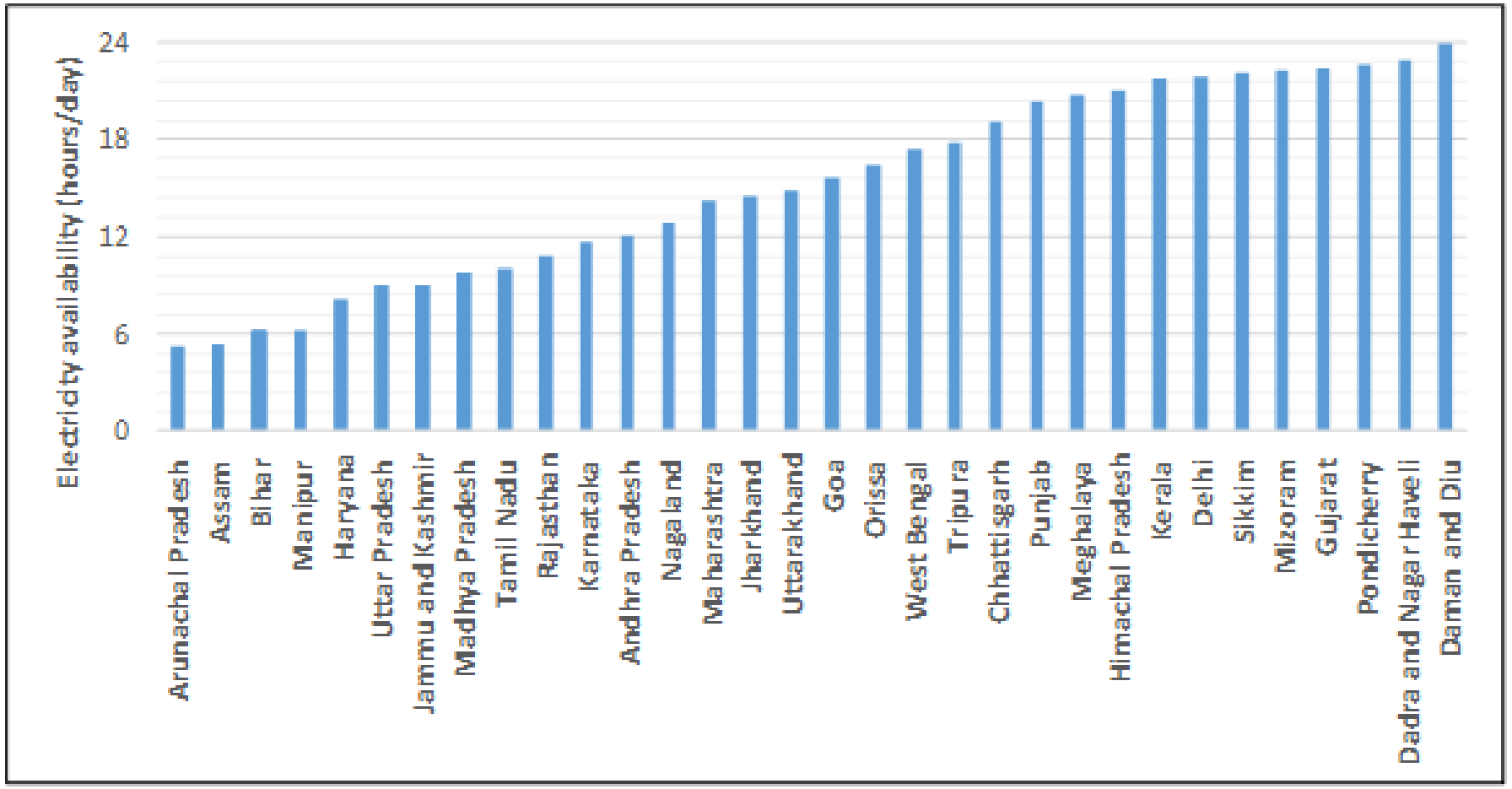


Source: World Bank Enterprise Survey

Taking advantage of new panel survey data

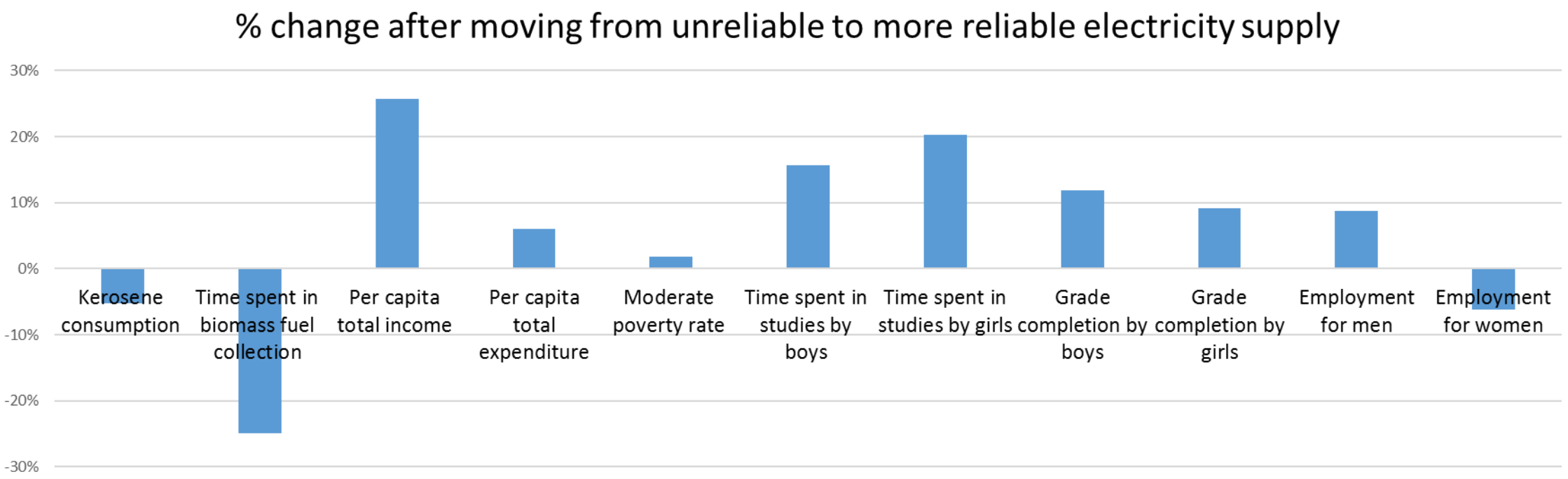
- Indian Human Development Survey
  - Two rounds of nationally representative survey for 2005 and 2012
  - A panel dataset of more than 24,000 households from rural India
  - Households report daily average duration of outages
  - Large variation in both access and quality
    - National electrification program launched in 2005
    - Access rate increased from 62% in 2005 to 77% in 2012

A dozen states experienced outages lasting more than 12 hours a day in 2012



Source: Indian Human Development Survey (2012)

Observational Evidence



Source: Samad and Zhang (2016)

Empirical Model

- The model
  - Consider the effects of both access to and quality of grid electricity

$$Y_{it} = \beta X_{it} + \gamma E_{it} + \delta(E_{it} * D_{it}) + T_t + u_i + \eta_{it} + \varepsilon_{it}$$

where Y_{it} denotes the outcome variables, such as kerosene consumption, income and expenditure, etc. X_{it} is a vector of household- and community-level characteristics. E_{it} measures electricity connection status, D_{it} measures daily average hours of power outages

- In practice
  - There maybe nonrandom grid expansion at the village level and nonrandom adoption of electricity at the household level.

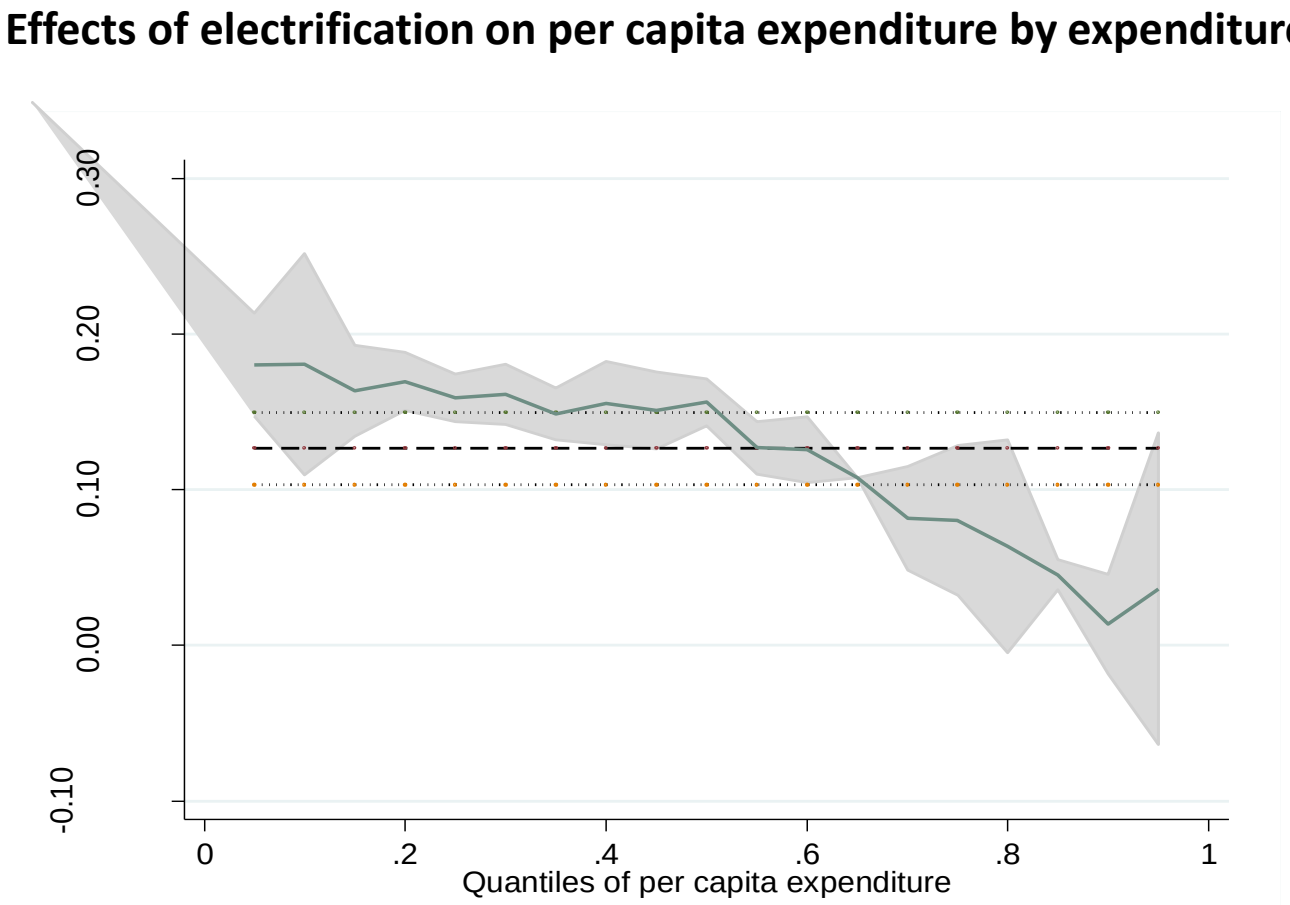
Addressing selection bias

- Two-stage propensity-score-weighted fixed-effects model to control for time-invariant and time-varying unobserved factors
  - First stage: estimating conditional probability of connecting to the grid
  - Second stage: reweight observations based on estimated propensity score

Main results: larger gains with reliable power

Welfare Outcomes	Gaining access to reliable electricity	Gaining access alone
Kerosene consumption reduction	-14.1%**	-12.6%**
Per capita income increase	16.7%**	9.6%*
Per capital expenditure increase	12.0%**	10.5%**
Moderate poverty rate reduction	-9.5%**	-6.8%**
Increase in time spent on studies by boys (hours/week)	1**	0.27**
increase in time spent on studies by girls (hours/week)	0.64**	0.30**
Increase in women's employment hours (hours/month)	31.2%**	11.7%*

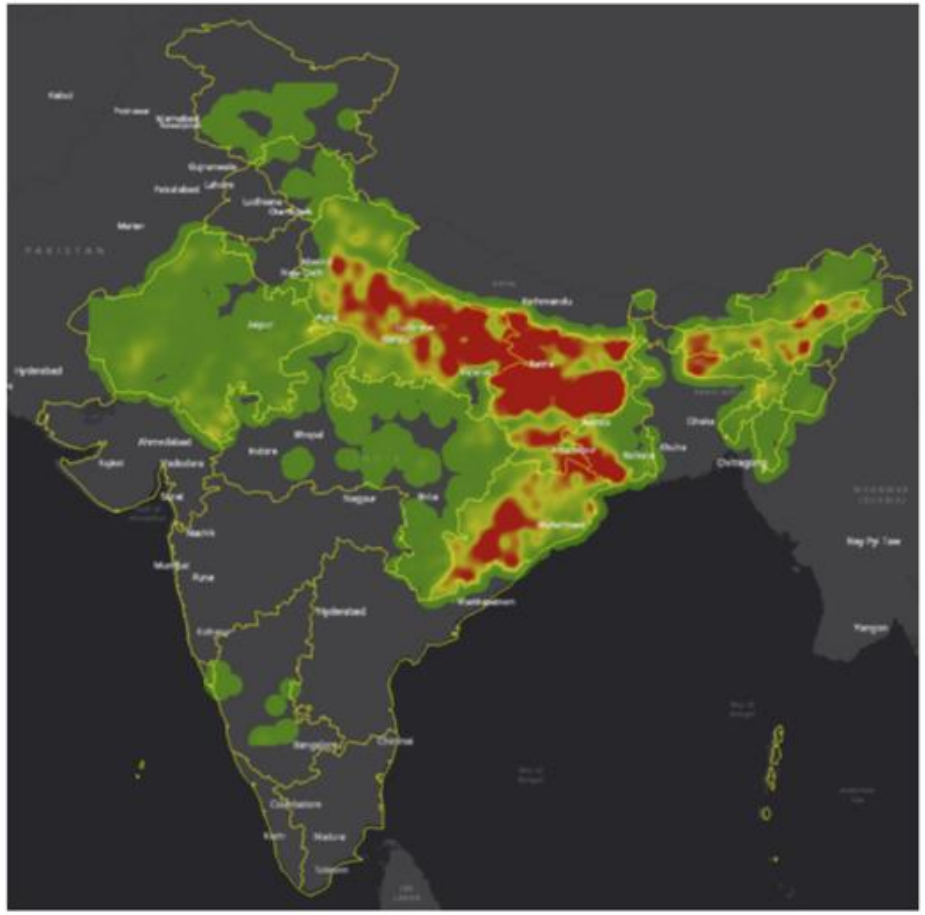
Larger opportunity cost for poor people



Shaded area represents 95% confidence intervals

Outages are correlated with increased new village electrification

RGGVY New Village Electrification, 2005–12



A New Measure of Power Outage Intensity