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Policy Research

Plug In, Power Up! Connecting to Grid Electricity in Africa

A Center for International Policy Research and Evaluation Webinar and Forum
Washington, DC

November 29, 2017

Anu Rangarajan • Candace Miller • Kathleen Auth
Duncan Chaplin • Jörg Peters • Shreena Patel

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CENTER FOR

INTERNATIONAL POLICY RESEARCH AND EVALUATION

Today's Speakers

Candace Miller, Mathematica (Moderator)

Kathleen Auth, Power Africa!

Duncan Chaplin, Mathematica

Jörg Peters, RWI

Shreena Patel, MCC

POWER AFRICA

A U.S. GOVERNMENT-LED PARTNERSHIP

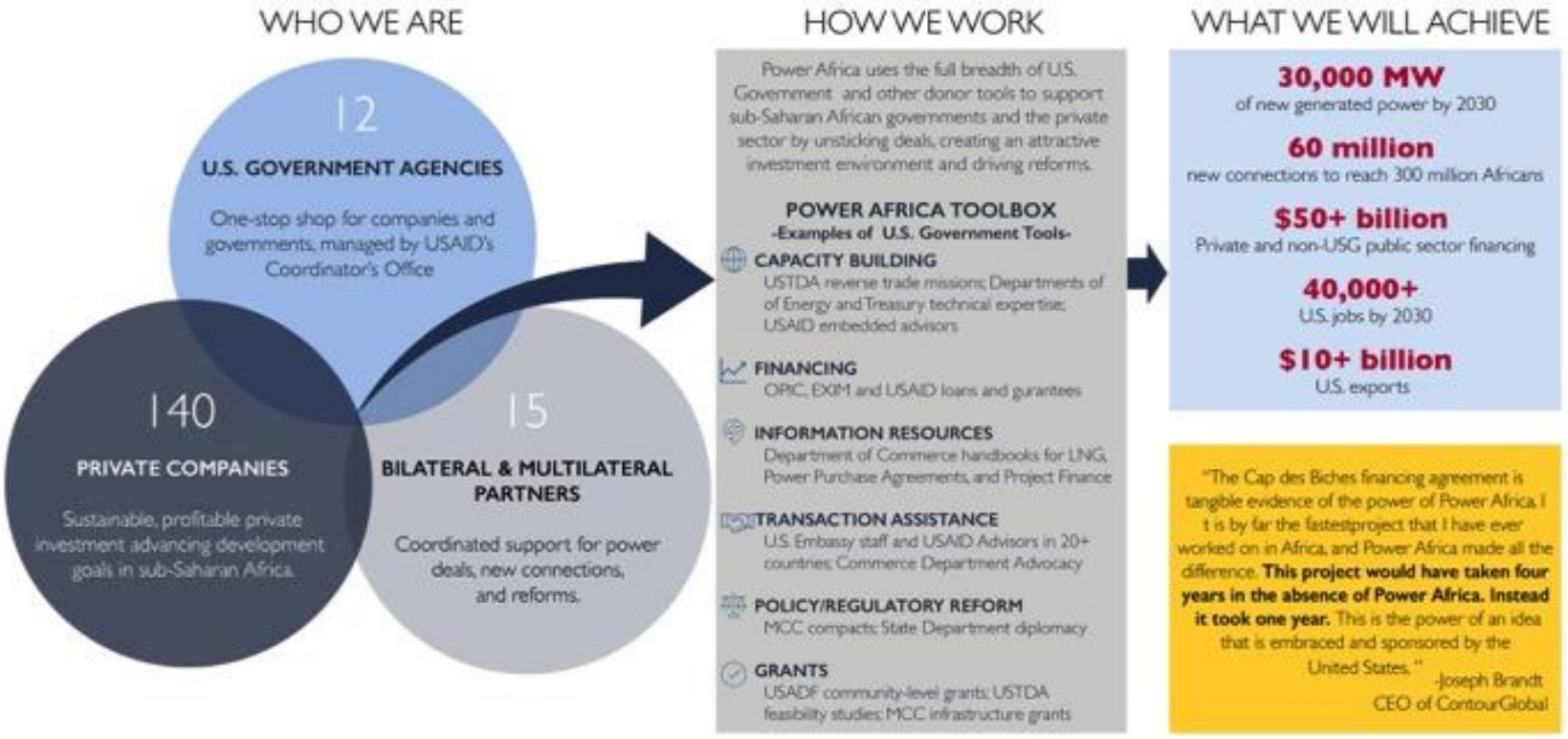
Plug in, Power up! Connecting to Grid Electricity in Africa

Kathleen Auth
Deputy Energy Office Director & Grid Roll-Out Team Lead

USAID
FROM THE AMERICAN PEOPLE

The Challenge

- Estimated **600+ million people** in sub-Saharan Africa without electricity
- For those with access, power is often **expensive and/or unreliable**
- Estimated **$835 billion investment needed** to achieve universal electricity access by 2030
- Electricity access is critical for economic growth, health, education, and stability. It is a **development and security imperative**



RESULTS TO DATE

- 84 transactions **(7,351 MW)** to financial close
- Over **10 million new connections** (on-grid, off-grid, mini-grid)

An Integrated Approach to Access

Optimizing On- and Off-Grid Solutions

Beyond the Grid (BTG) Opportunities

- Price decreases
- Quality improvements
- Scalable products

Grid Roll Out Opportunities

- Under-grid populations
- Rapid urbanization
- Commercial and industrial users
- Improved technologies / lessons learned from the off-grid sector

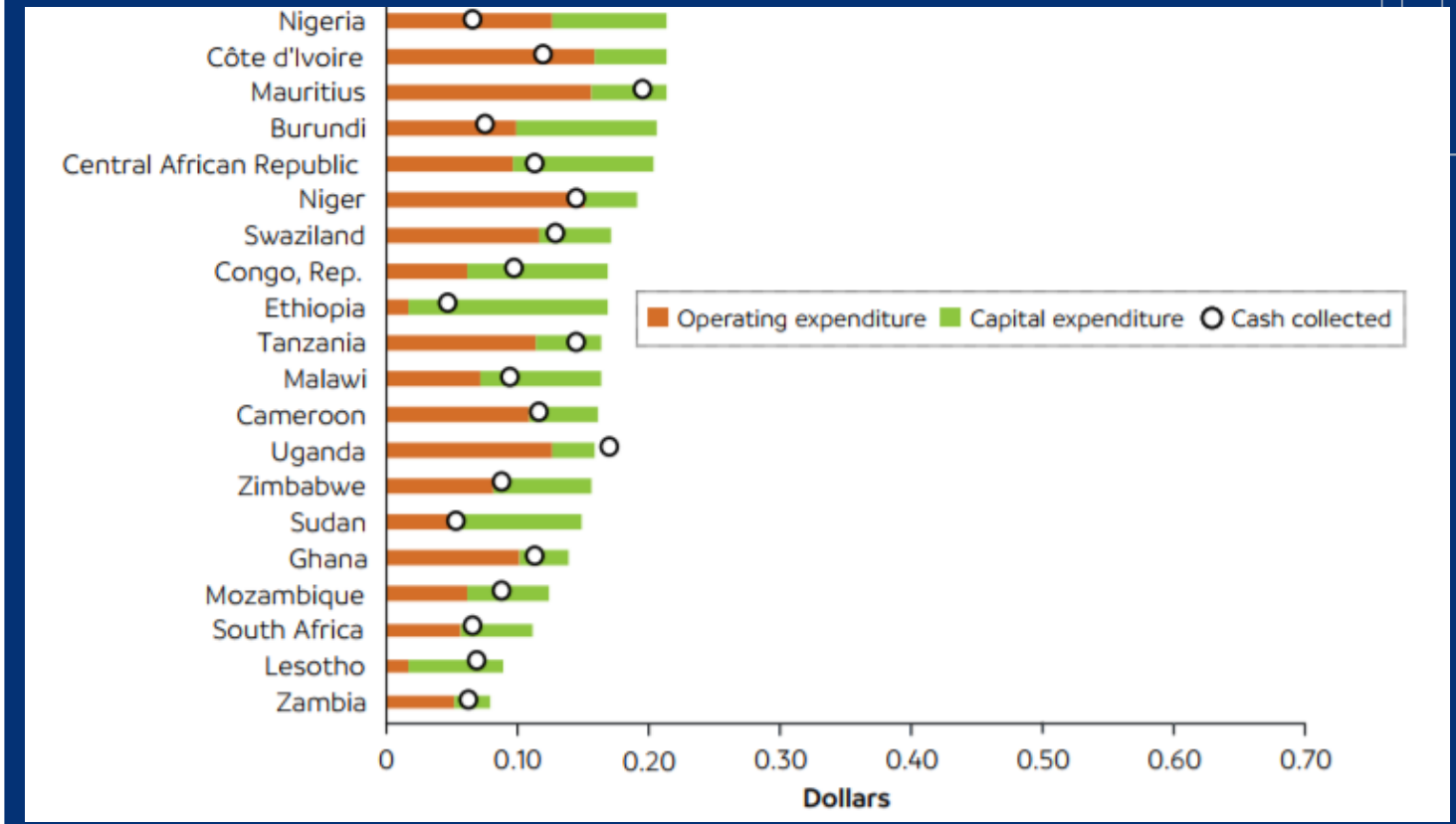
Our Goals:

- Optimize the mix
- Accelerate universal access
- Ensure long-term viability

Challenges for Grid Connection

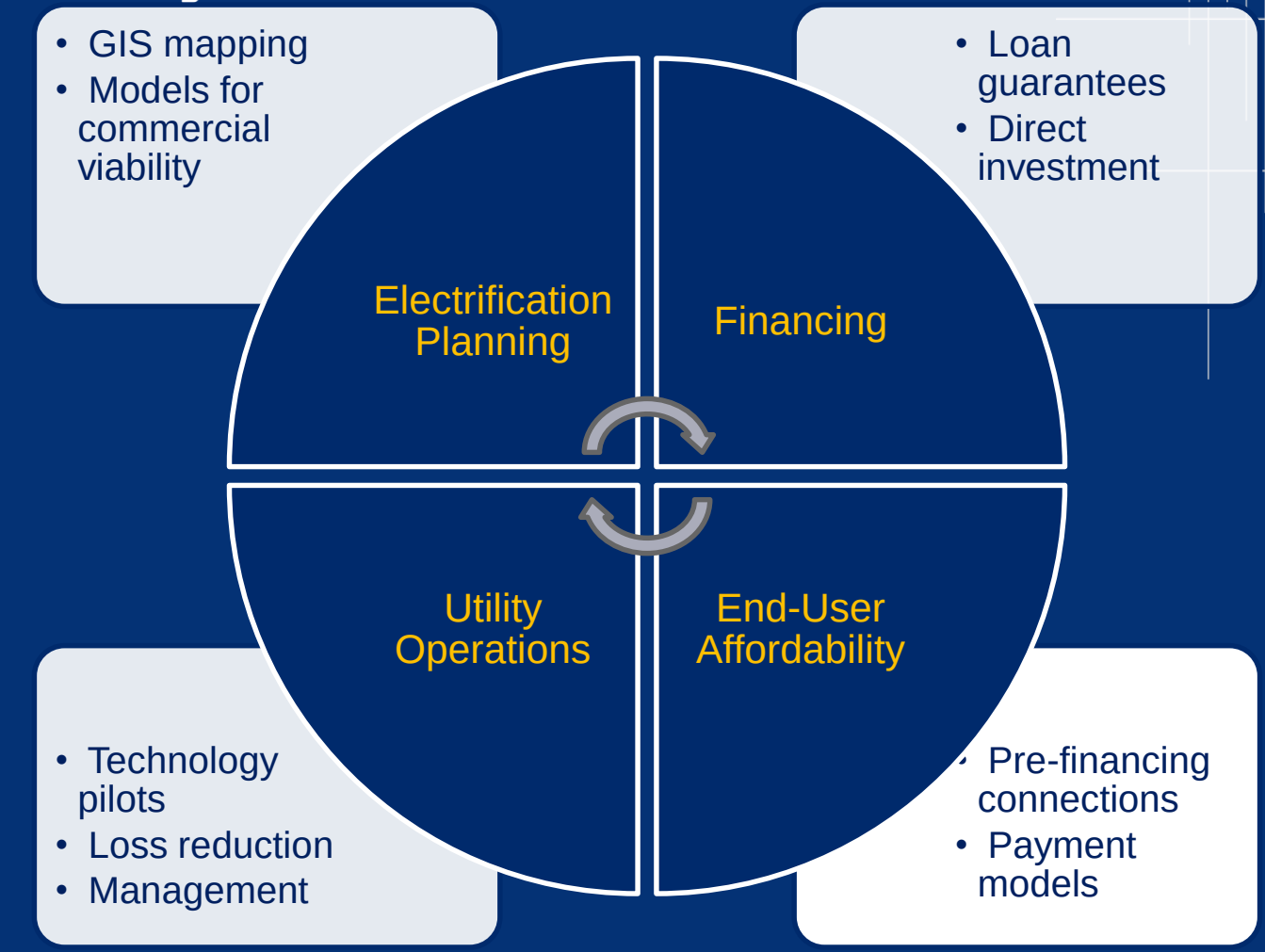
- Dispersed, low-income populations
- Politically driven electrification plans
- Dilapidated infrastructure → high technical losses
- Theft + billing/collection challenges → high commercial losses
- Non cost-reflective tariffs
- High upfront cost of connection

Only 2 utilities in sub-Saharan Africa actually cover their costs



Source: Kojima, Masami; Trimble, Chris. 2016. *Making Power Affordable for Africa and Viable for its Utilities. World Bank, Washington, DC.*

Strategic Pillars for Grid Roll Out



Key Questions We Consider

- Where, and in what sequence, **can we intervene** to have the greatest positive impact on a distribution system?
- Do **incentive structures** need to be changed? If so, how?
- What **political considerations** are in play?
- What **data** is available to inform electrification planning, and the optimization of on- and off-grid solutions? What data do we need?

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Impacts of MCC Electricity Line Extensions and Low-Cost Connection Offers in Tanzania

Presentation at Plug in, Power up! Connecting to Grid Electricity in Africa forum

Mathematica Policy Research, Washington, DC

November 29, 2017

Duncan Chaplin • Arif Mamun • Ali Protik • John Schurrer • Divya Vohra • Kristine Bos • Hannah Burak • Laura Meyer • Anca Dumitrescu • Christopher Ksoll • Thomas Cook

Millennium Challenge Corporation's Energy Sector Project in Tanzania

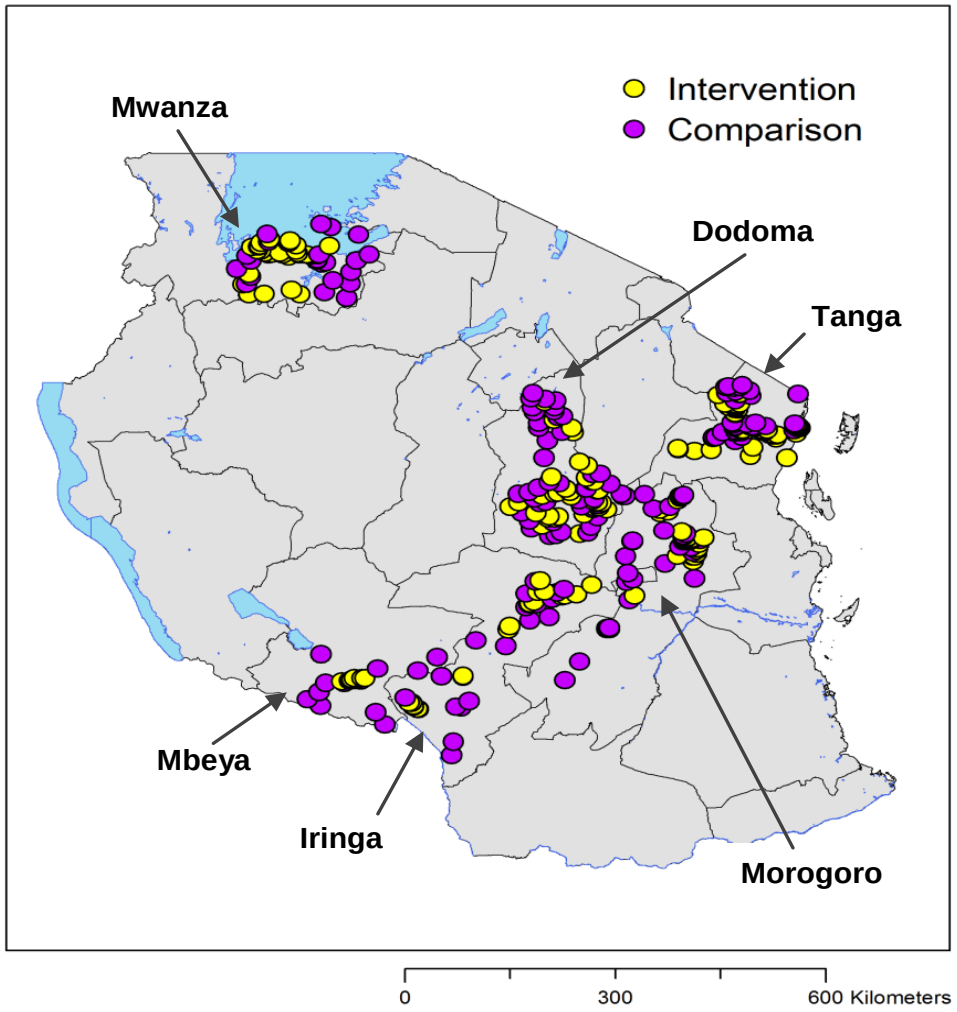
- **Compact ($700 million)**
  - Roads
  - Water
  - Energy ($200 million)
- **Today's presentation focuses on two components of the energy project**
  - Line extensions ($126.2 million)
  - Low-cost connection offers ($2 million)

Evaluation Questions

- What impacts do line extensions have on connection rates?
- What impacts do low-cost connection offers have on connection rates?
- What impacts does actually connecting have on household outcomes related to energy use, education, health, and economic well-being?
  - Provides suggestive estimates of potential impacts of line extensions and/or low-cost connection offers if connection rates were high

Line Extensions ($126 million)

- **Rationale:** 4% of rural Tanzanians have electricity
- **The Initiative:** Communities targeted for line extensions based on estimated costs and benefits
- **The Evaluation**
  - 178 treatment communities
  - 182 matched comparison communities
  - 2,595 km of lines

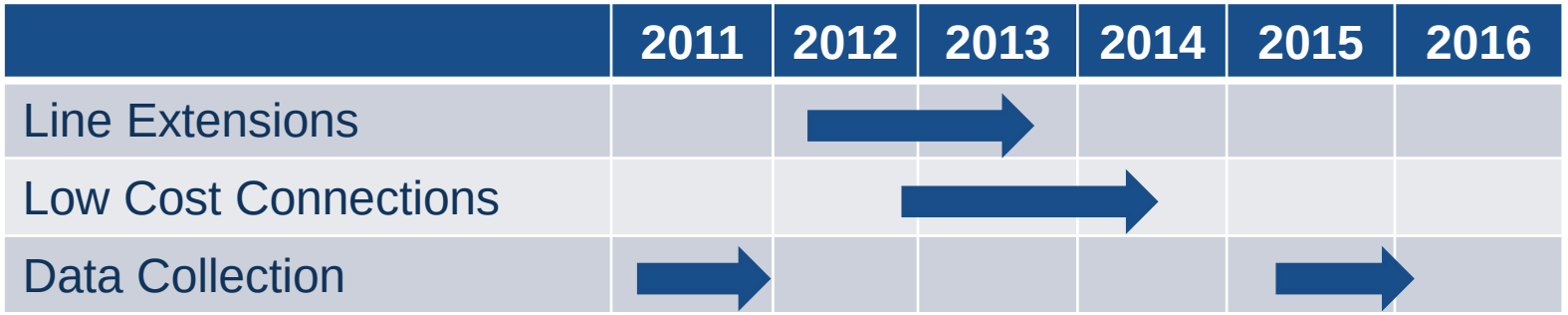


Low-Cost Connection Offers ($2 million)

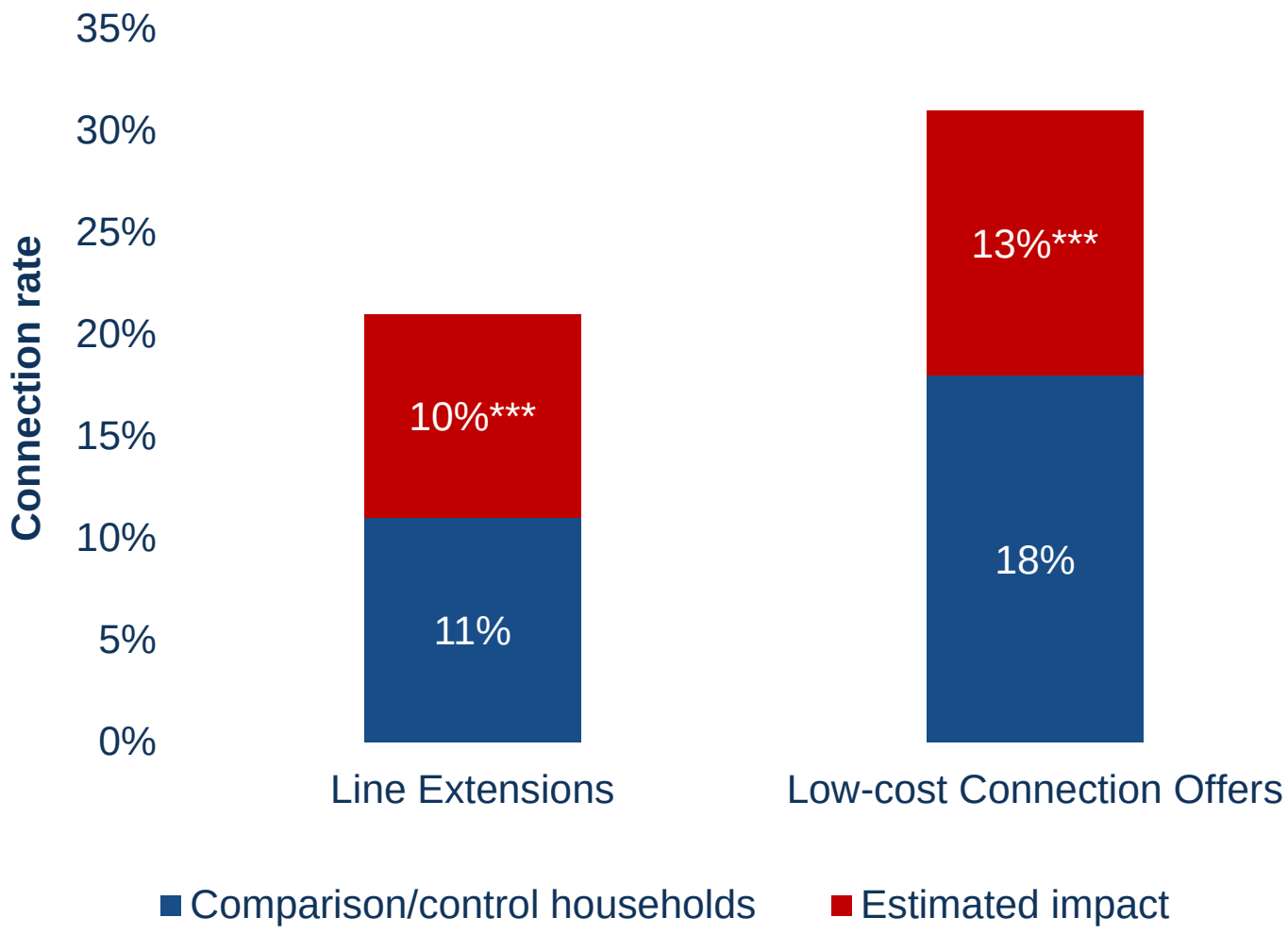
- **Rationale**
  - Connection fee high: $110 (rural) to $200 (urban)
- **The initiative**
  - Fee lowered by at least 80%
  - Communication campaign
- **The evaluation**
  - 178 line extension communities
  - Randomly chose 27 for treatment
  - All households in treatment communities given low-cost offers

Baseline and Follow-up Data

- **Baseline surveys: 2011**
  - 10,210 households in 360 communities
  - Excluded those connected or within 30 meters of grid at baseline
- **Follow-up surveys: 2015**
  - 8,899 households in 360 communities
  - 20-34 months after new lines,
  - 14-24 months after low-cost connection offers



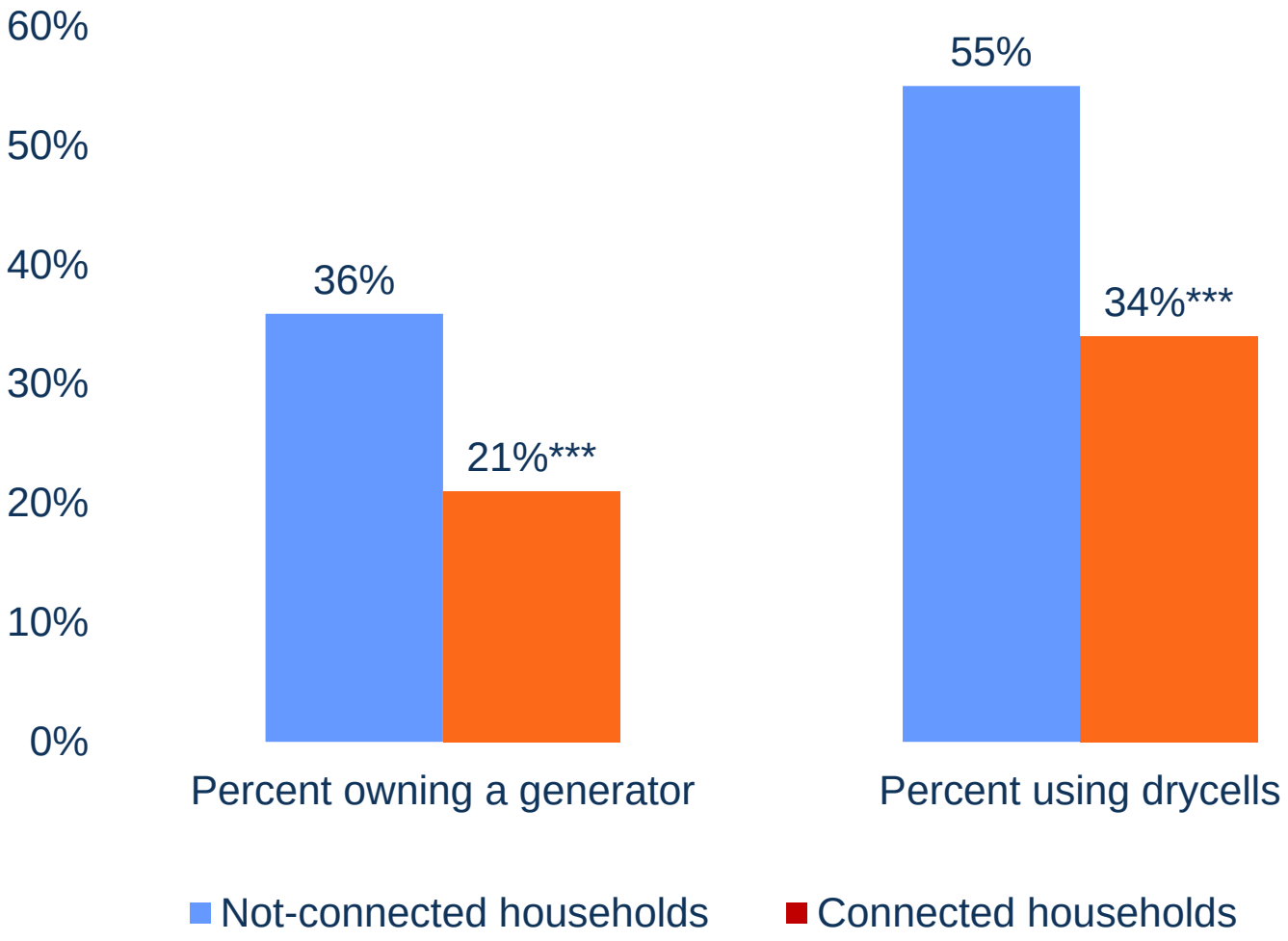
Line Extensions and Low-Cost Connection Offers Increased Connection Rates



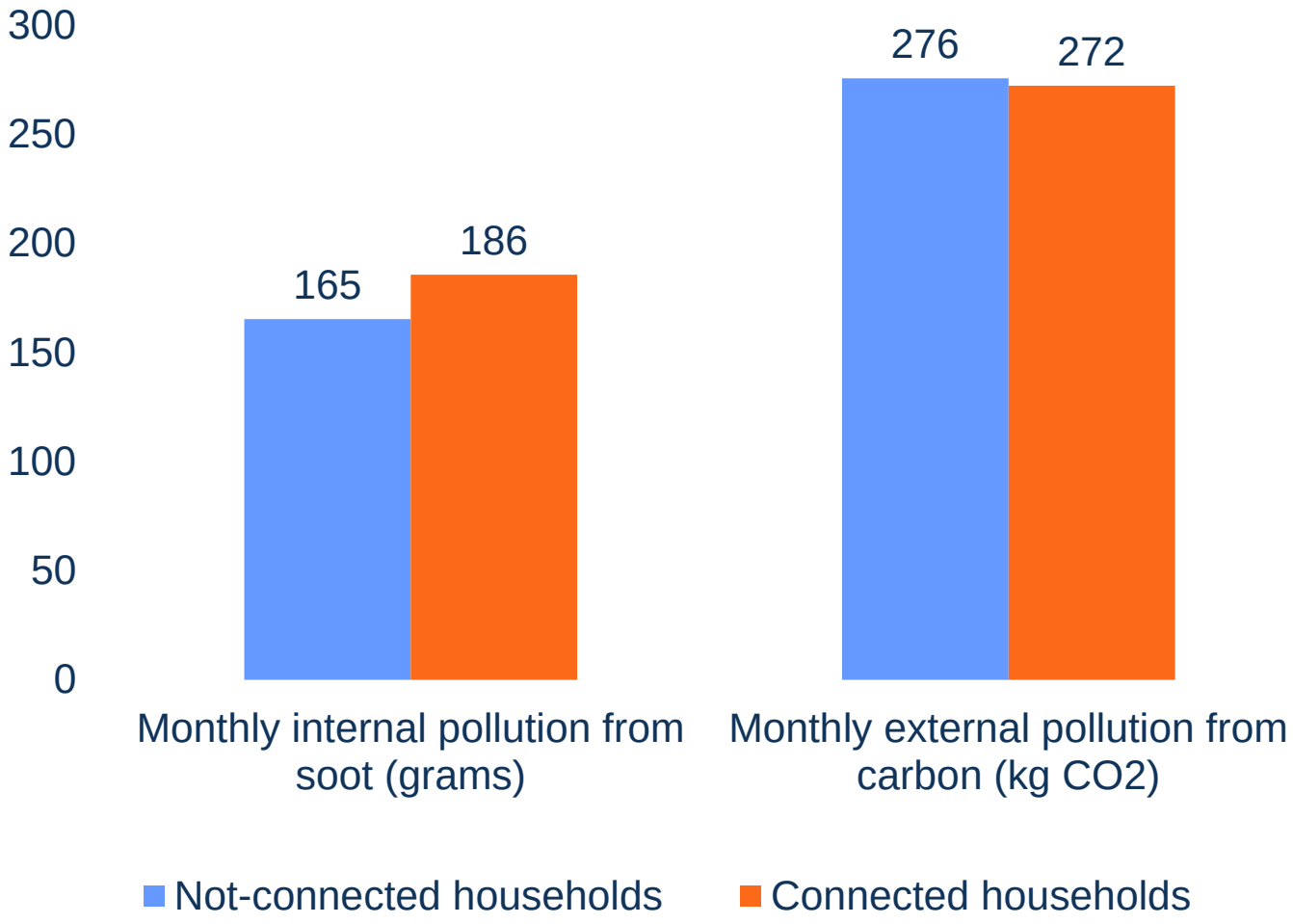
Methods: Estimated Impacts of Actually Connecting

- Treatment group = households connecting to MCC and non-MCC lines
- Comparison group = matched non-connected households in study communities
- We addressed potential limitations of a quasi-experimental design

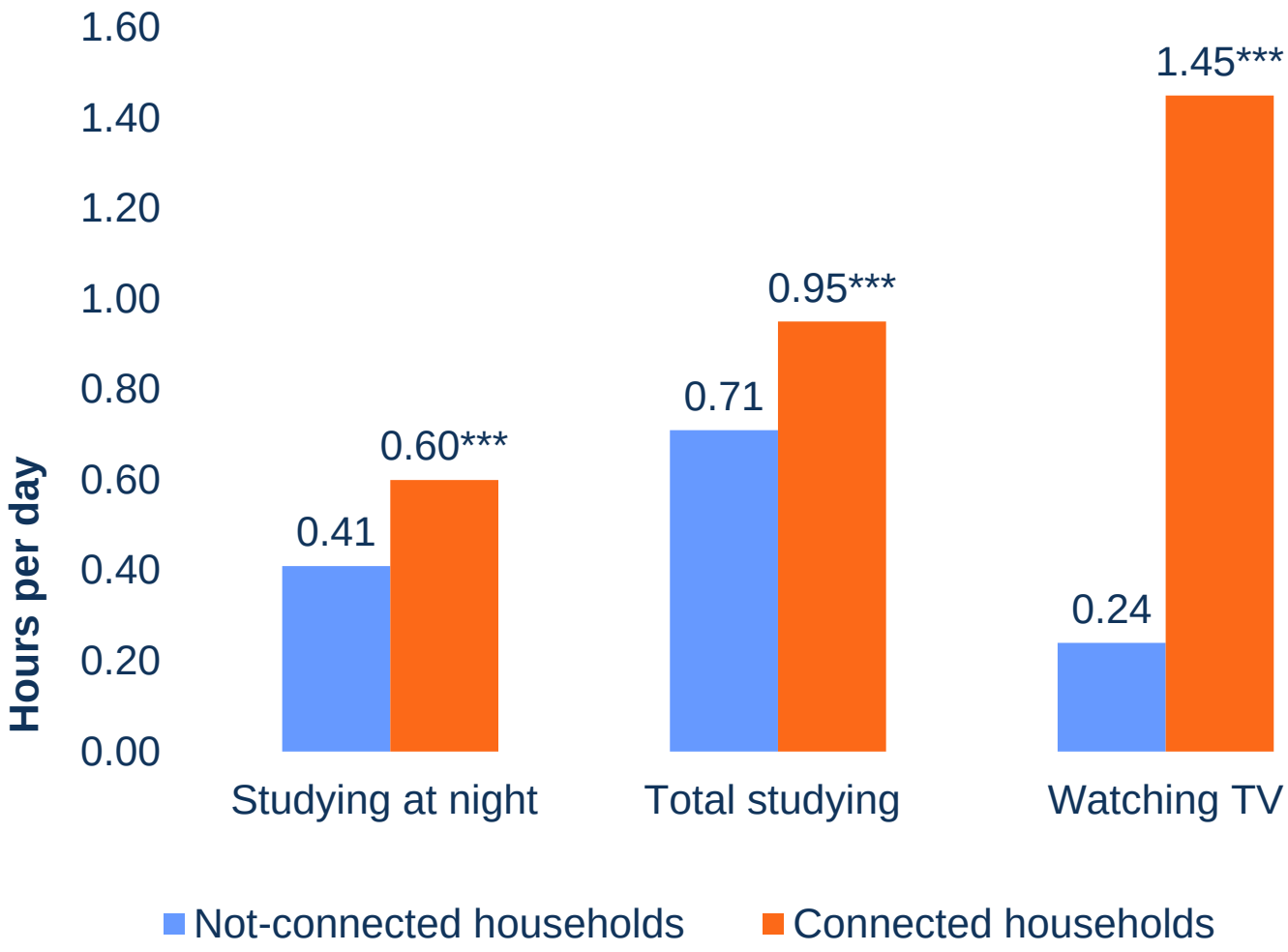
Actually Connecting Reduced Generator and Battery Use



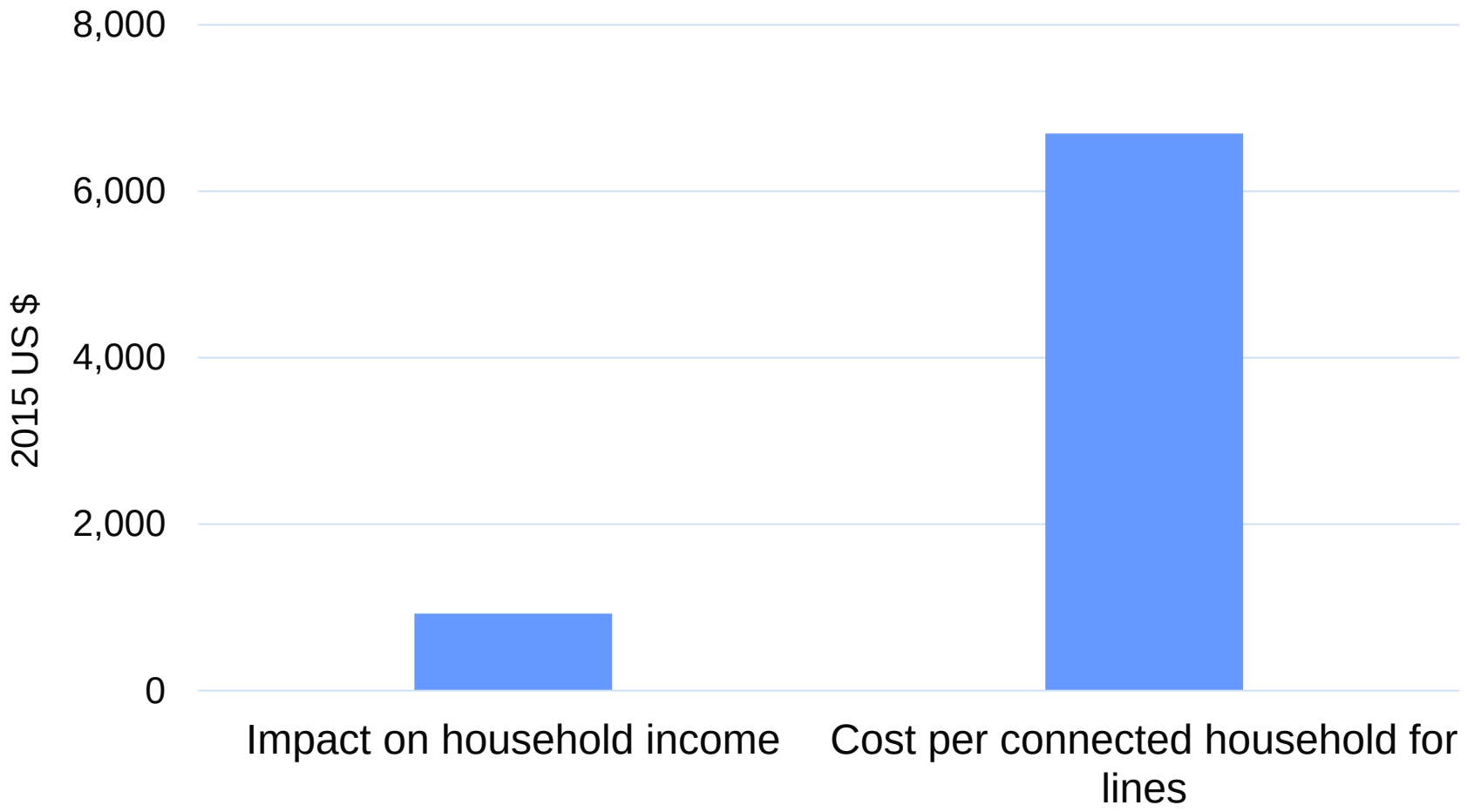
Actually Connecting Had No Clear Impact on Internal or External Air Pollution



Actually Connecting Increased Studying and TV

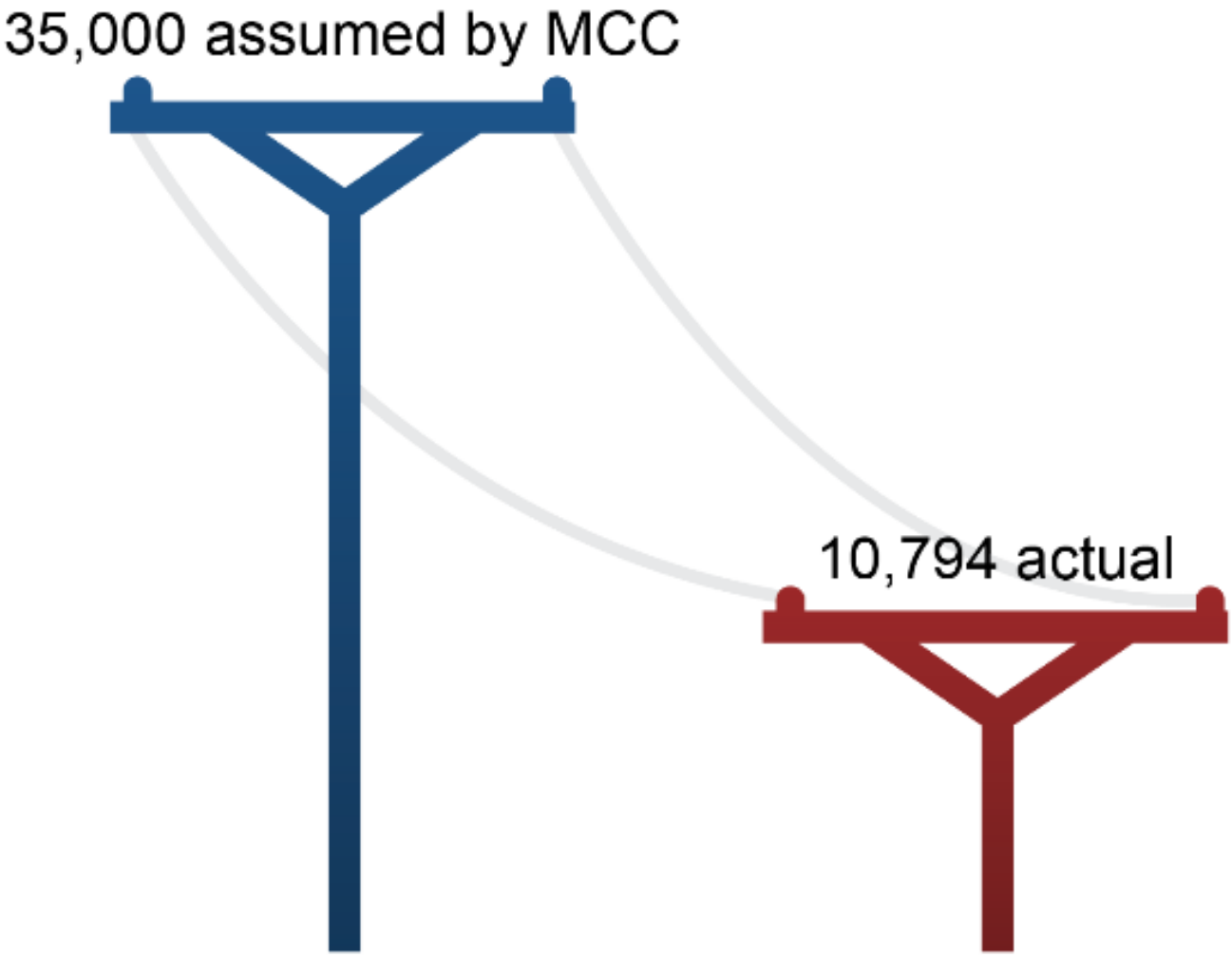


Impacts of Actually Connecting on Income much Lower than Costs of Lines



1 USD = 2,126 TZS

Actual Number of Connections to the Grid were Much Lower than Assumed



Challenges to Increasing Connection Rates

- Line placement
- Utility capacity
- Customer costs
- Customer awareness

Housing that poses challenges to electrification

Lines follow the road, but the population lives away from the road

Summary

- **Impacts of new lines on connection rates modest**
- **Cost of lines $6,694 per connected household**
- **Impacts on household income $500-$900**
- **Other benefits found on education and safety**
- **Expanding access cost-effectively challenging**
- **Future research could target**
  - Longer-term impacts on connection rates
  - Reduced wiring costs
  - Better information
  - Improving incentives for utilities

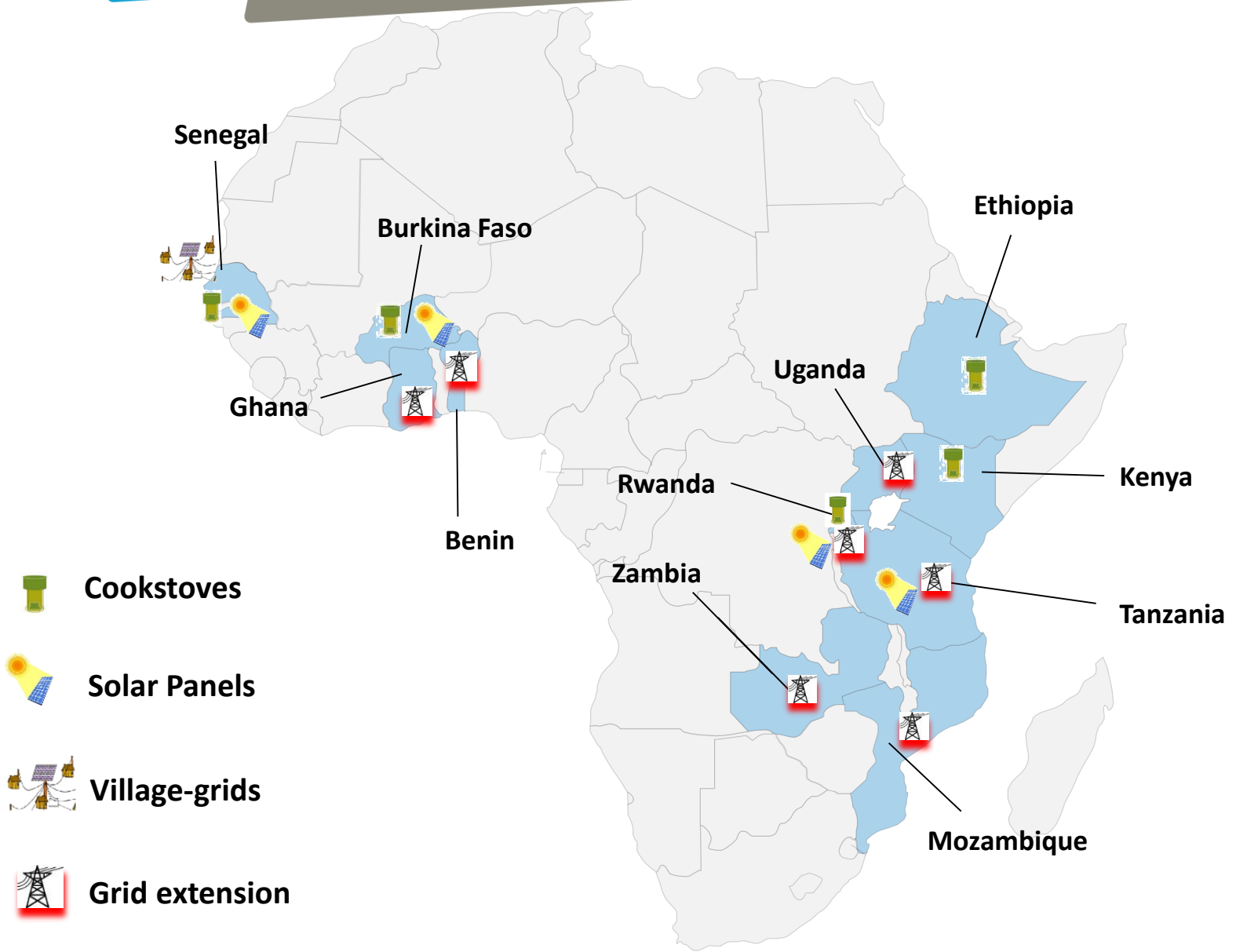
Why we need an Electrification Masterplan for Africa

Jörg Peters

RWI

Passau University

Our Work on Energy Access: Impacts and Adoption



Out of Africa:
Indonesia, Nepal

Four Key Messages

1. Electricity has a high priority for the rural poor

2. Electricity consumption in connected areas is very low

3. Impacts on economic development are modest

4. On-grid electrification is rarely cost-effective

Electricity has a high Priority for the rural Poor

Süddeutsche Zeitun

NEUESTE NACHRICHTEN AUS POLITIK, KULTUR, WIRTSCHAFT UND SPORT

SCHE.DE HF2 MÜNCHEN, FREITAG, 3. NOVEMBER 2017 73. JAHRGANG / 44. WOC

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Das Wichtigste

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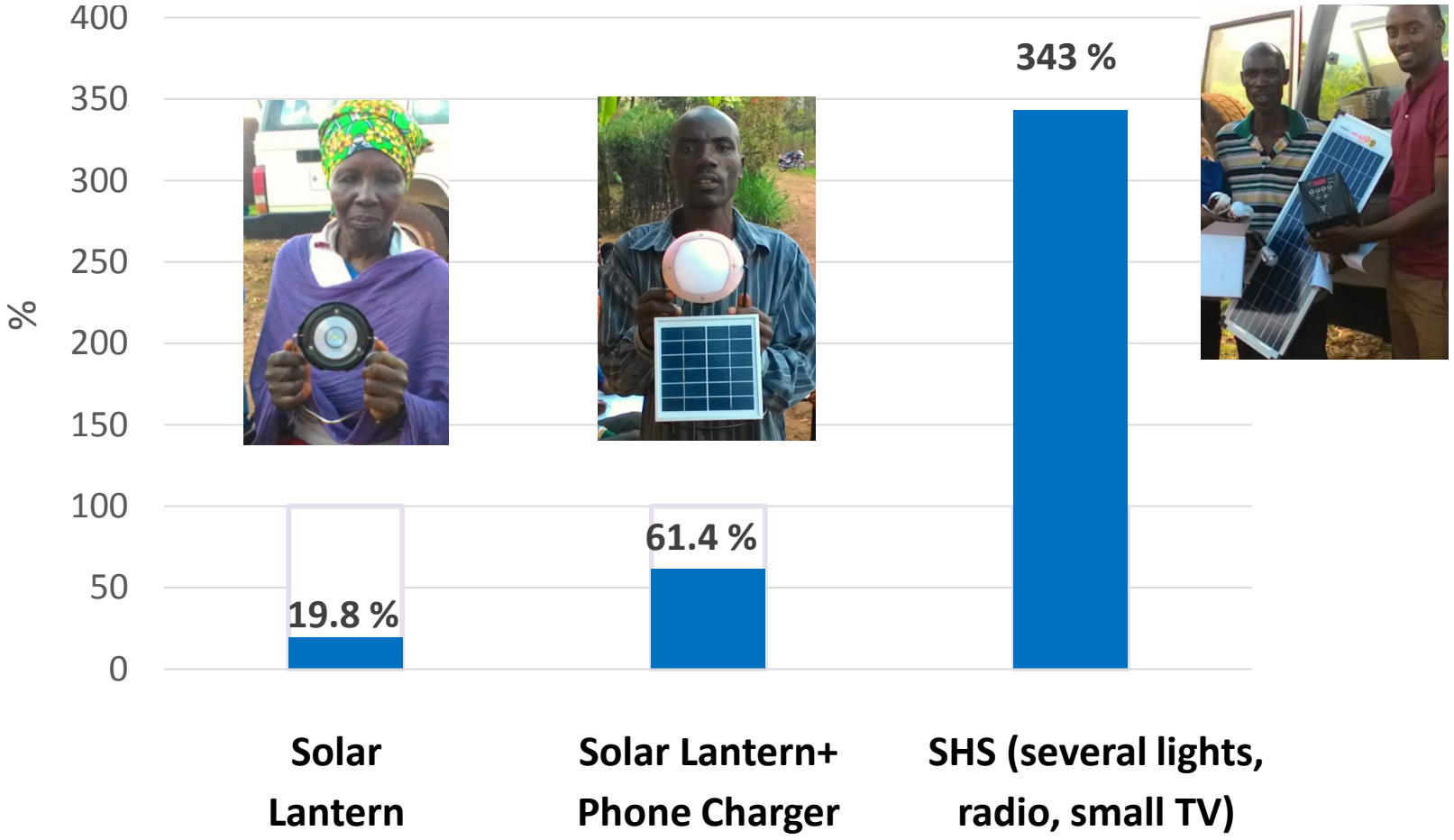
Electricity has a high Priority for the rural Poor

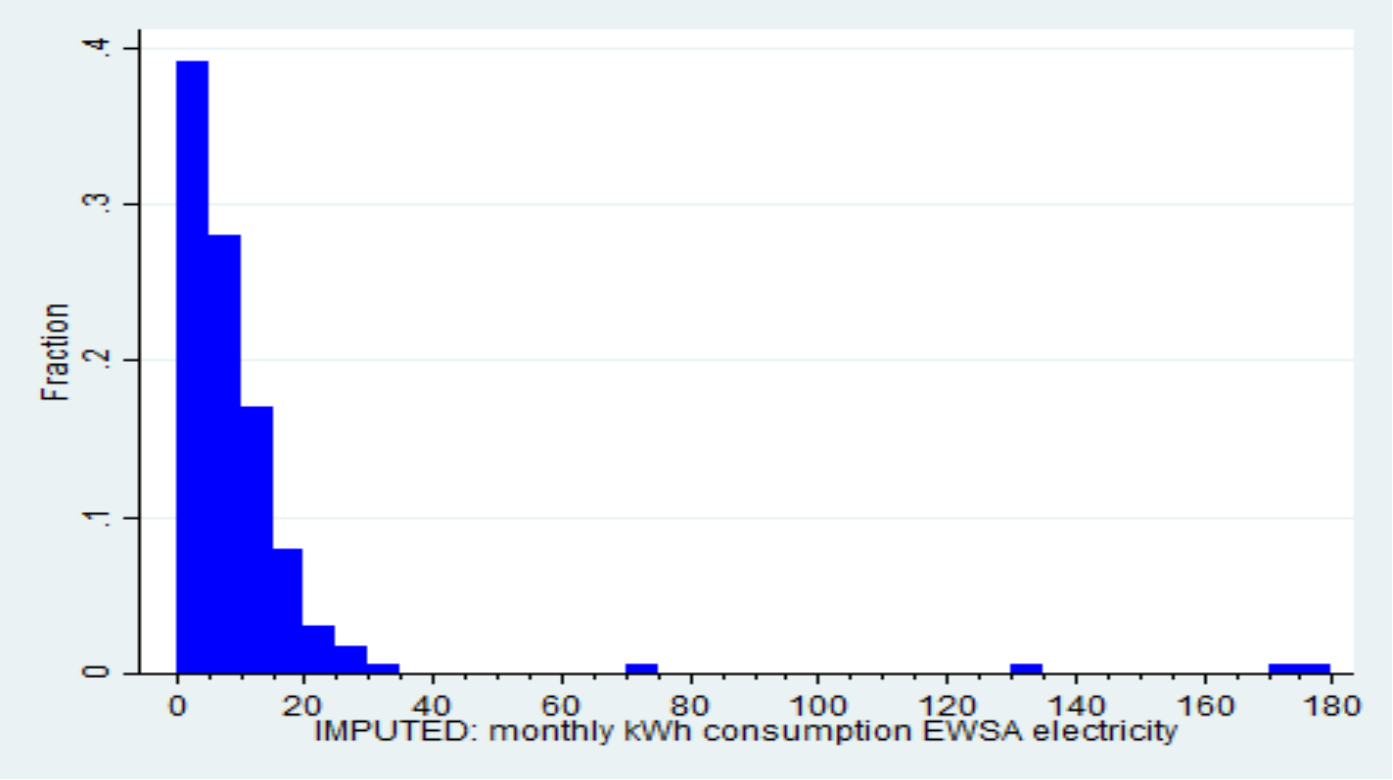
Willingness to pay for off-grid solar as a share of monthly expenditures



Source: Grimm et al. 2017

Low Consumption in Connected Areas

Monthly electricity consumption in Rwanda (in kWh)



- Rural households use lighting, radio and sometimes TV sets
- Electricity is (virtually) never used for cooking and refrigeration

Modest Impacts on Economic Development

- Impacts on home business activities, firm creation and expansion are very modest
- Electricity is not the main bottleneck
- Access to supra-regional markets is extremely limited
- If business potentials exist they are already exploited using generators
- No electric pumps for irrigation

On-grid Electrification is hardly cost-effective

15 USD

Solar Lantern

35 USD

Solar Lantern+ Phone Charger

200 USD

SHS (several lights, radio, small TV)

>1,500 USD

Grid Connection

Towards an Electrification Masterplan

- Whatever the true costs and benefits of rural electrification are…
- …connecting every single African village to the grid is not reasonable
- Given the SE4All-goal and the limitations of public budgets we have to develop an

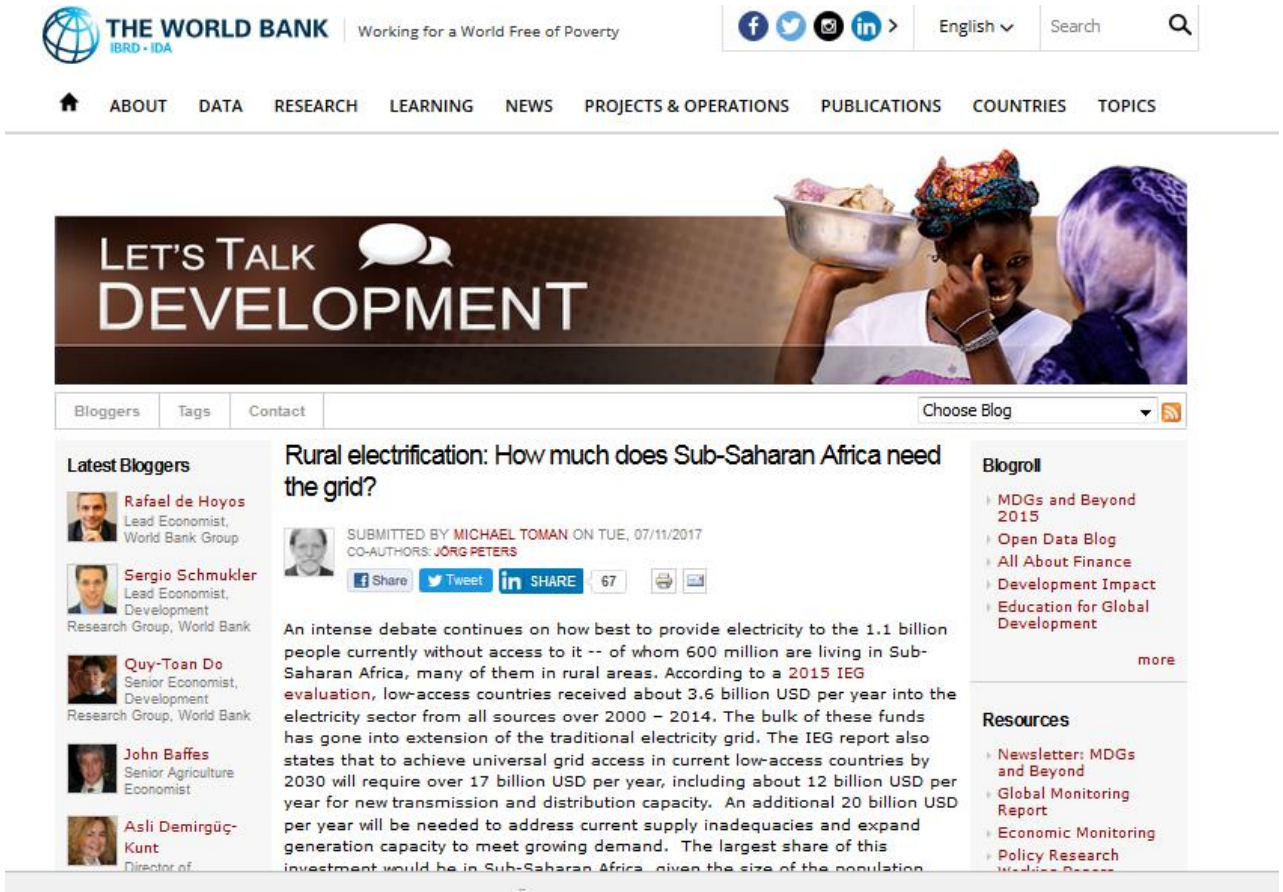
Electrification Masterplan

….that is pro-poor and more cost-effective

- Grid extension should focus on selected thriving regions and rural industrial zones
- Off-grid solar should be promoted (subsidized?) to reach the vast majority of the rural poor

thank you!

Some further reading: [Mike Toman & myself on Let's Talk Development]



Discussant Remarks

Shreena Patel, MCC

MILLENNIUM CHALLENGE CORPORATION
UNITED STATES OF AMERICA

Question & Answer Session

Candace Miller, Mathematica (Moderator)

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For More Information

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