Africa's Utilities of the Future

POWER FOR ALL

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Strathmore University
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Overview

- About our research
- Research Highlight: Utilities 2.0
- U2.0 Research Findings
- Research Highlight: #PoweringLobs
- Next Steps
- Q&A

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ABOUT

About: A Powerful Coalition of the Willing

NEED: High-quality evidence curation

Global Advocacy	Providing Thought Leadership through data-supported arguments and conceptualization that can shift institutional priorities	**Political Will**
Market Activation	Arming country-level private and public sector stakeholders with tools for market development	**Market Stimulation**
Behavior Change	Synthesizing knowledge and insight from data to create fact-based, compelling stories and messages	**Perception Change**

SOLUTION: Research + Communications

The Platform for Energy Access Knowledge is both a research engine and a joint initiative on science communication between Power for All and a growing network of academic institutions renowned for work on energy access including:

- The University of California, Berkeley's Renewable and Appropriate Energy Laboratory (RAEL), an energy analytics and research and international deployment laboratory.
- Duke University's Nicholas Institute Energy Access Area Program (EAP), drawing on legal and regulatory expertise of the Duke University
- The Strathmore Energy Research Center, Strathmore University, Kenya, an applied research facility and academic leader in East Africa

Link to Resources Page

CONTENT: Sharp + digestible + actionable

POWER FOR ALL RESEARCH SUMM

Under-the-grid populations represent major busir
mini-grid and cost-saving potential for DisCos

Research Summary

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In sub-Saharan Africa, a huge population li
within a national distribution company's (D
not properly served by the grid. A new repor
the opportunity for mini-grids to reach these
in Nigeria. We highlight their findings.

There are about as many under-grid customers as
representing USD billions of business opportunity.

- Globally, about 200 million people are sitting under the grid witho
access. In Nigeria, 90% of grid connections are considered unreliable, and outages are longer and more frequent in rural areas. (7)
- Government and development partners do not focus on under-grid customers because in theory, they already have at least nominal electricity access. (7)
- Under-grid communities, however, are good target customers because they tend to have greater electricity demand than their counterparts in off-grid communities due to their proximity to urban centers and higher share of commercial applications. (20)
- This could be an untapped opportunity to better serve under-grid communities through mini-grids utilizing existing distribution. (7) In Nigeria, 40 million rural residents are under-served, 35% of which RMI estimates could be served by 4,000 under-grid mini-grids, presenting a business opportunity of $1 billion per year. (17)

200 million
GLOBAL UNDER-GRID POPULATION

20%
POTENTIAL ELECTRICITY EXPENDITURE SAVINGS FOR UNDER-GRID MINI-GRID CUSTOMERS

$1 BN/year
UNDER-GRID MINI-GRID BUSINESS OPPORTUNITY

Under-grid mini-grids can be the most cost-effective way to capture the under-grid market, preventing as much as 50% of DisCo's financial losses.

- Nigerian DisCos are reportedly experiencing high financial losses due to non-cost-reflective tariffs and low collection rates. Revenue from electricity sales only recover 35% of costs. (11,13)
- A DisCo in Nigeria would need to raise its tariff 10 times, achieve a 100% collection rate and also provide 24-hour service, in order to break even in many communities.
- Collaborating with mini-grid could prevent up to 50% of financial loss for DisCo by transferring collection responsibility to mini-grid operators, and opening doors for additional revenue from sharing distribution infrastructure. (11,15)
- For example, transitioning 400 communities to under-grid mini-grids can save a Nigerian DisCo about $3 million a year. (17)
- Combining decentralized technologies and utility or grid resources can enhance the power sector's resilience and therefore, making power supply more stable and flexible against natural disaster or macroeconomic shocks. (8,10,19,21)

For under-grid customers, under-grid mini-grids bring more reliable, cleaner and more affordable alternatives to national grid.

- Under-grid customers often supplement grid services with expensive and polluting alternatives such as diesel generators that bite into their budget. Accounting for diesel generation and the use of kerosene, average community-wide electricity cost is around $0.58 per kWh for an under-grid consumer. (19)
- A typical residential consumer could save as much as $0.15 per kWh being served by under-grid mini-grid instead of paying for costly alternatives such as diesel generation, all while enjoying a more reliable service. (19)
- Reliable electricity service enables better productivity. Additional impacts such as job creation from vigorous economic activities can be captured by the community. (21)
- Tariffs for mini-grid companies are still higher than DisCos. Allowing customers to continue buying power at a subsidized tariff from current grid source can mitigate their concern for mini-grid's affordability. (21)

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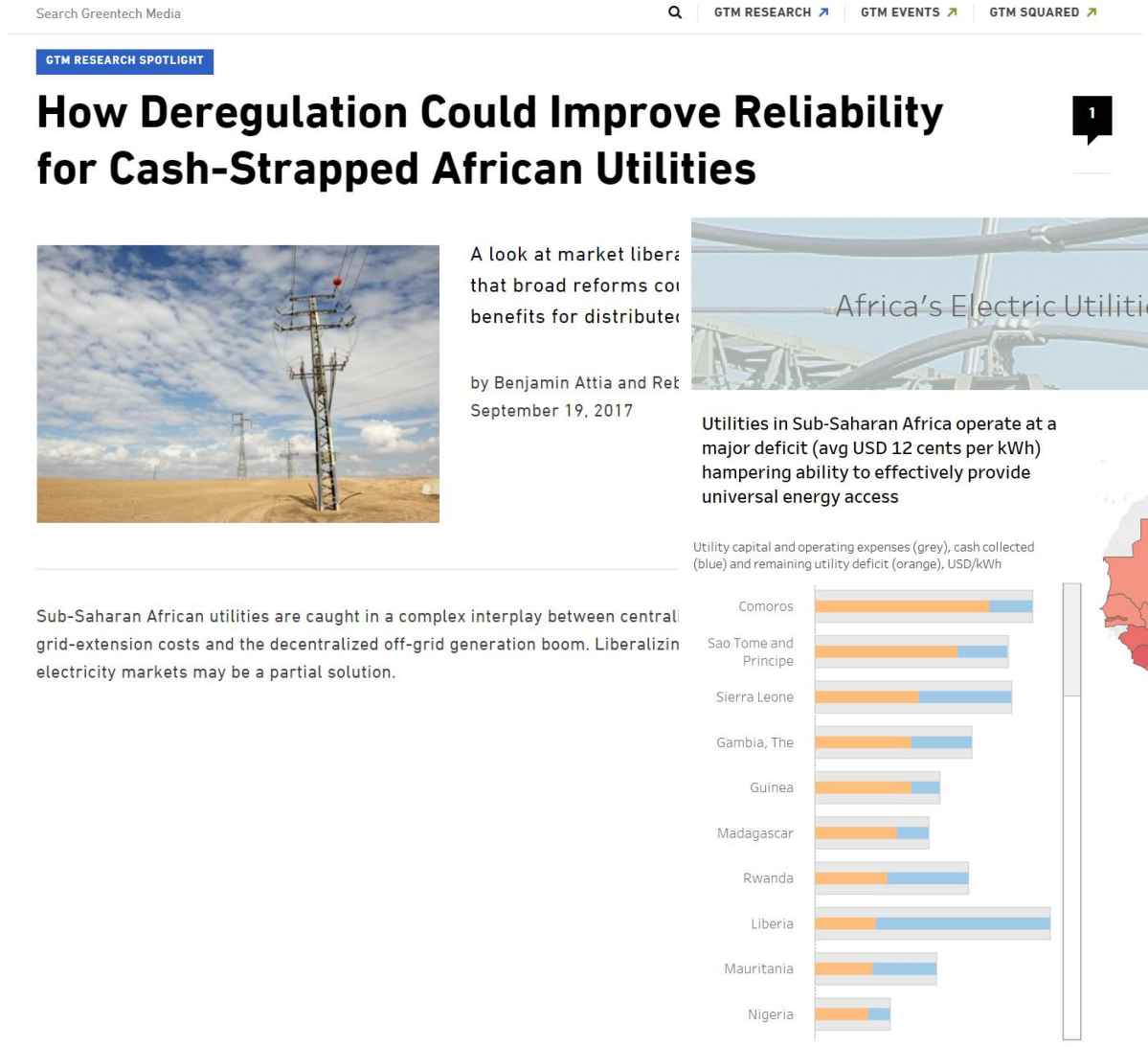

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GTM RESEARCH SPOTLIGHT

How Deregulation Could Improve Reliability for Cash-Strapped African Utilities

1

A look at market libera
that broad reforms cou
benefits for distributec

by Benjamin Attia and Reb
September 19, 2017

Africa's Electric Utilities in Deficit Crisis

Utilities in Sub-Saharan Africa operate at a major deficit (avg USD 12 cents per kWh) hampering ability to effectively provide universal energy access

Utility capital and operating expenses (grey), cash collected (blue) and remaining utility deficit (orange), USD/kWh

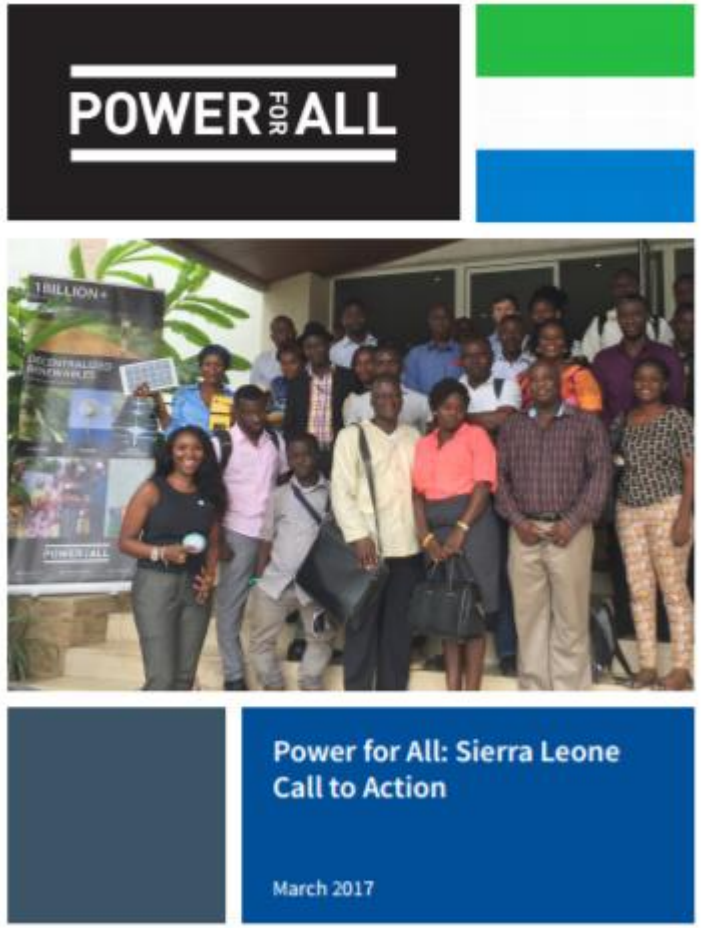
Comoros
Sao Tome and Principe
Sierra Leone
Gambia, The
Guinea
Madagascar
Rwanda
Liberia
Mauritania
Nigeria

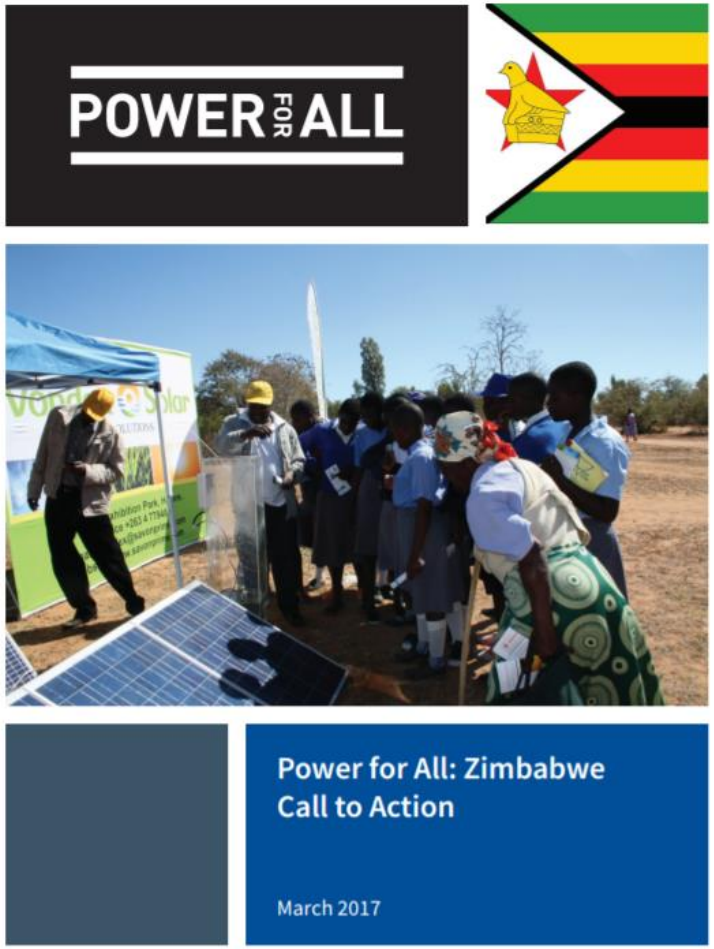
Avg Subsidy, USD/kWh
($0.05) $0.49

Sub-Saharan African utilities are caught in a complex interplay between central
grid-extension costs and the decentralized off-grid generation boom. Liberalizin
electricity markets may be a partial solution.

[Link to Resources Page]

OUTCOME: Conversation + Local Action





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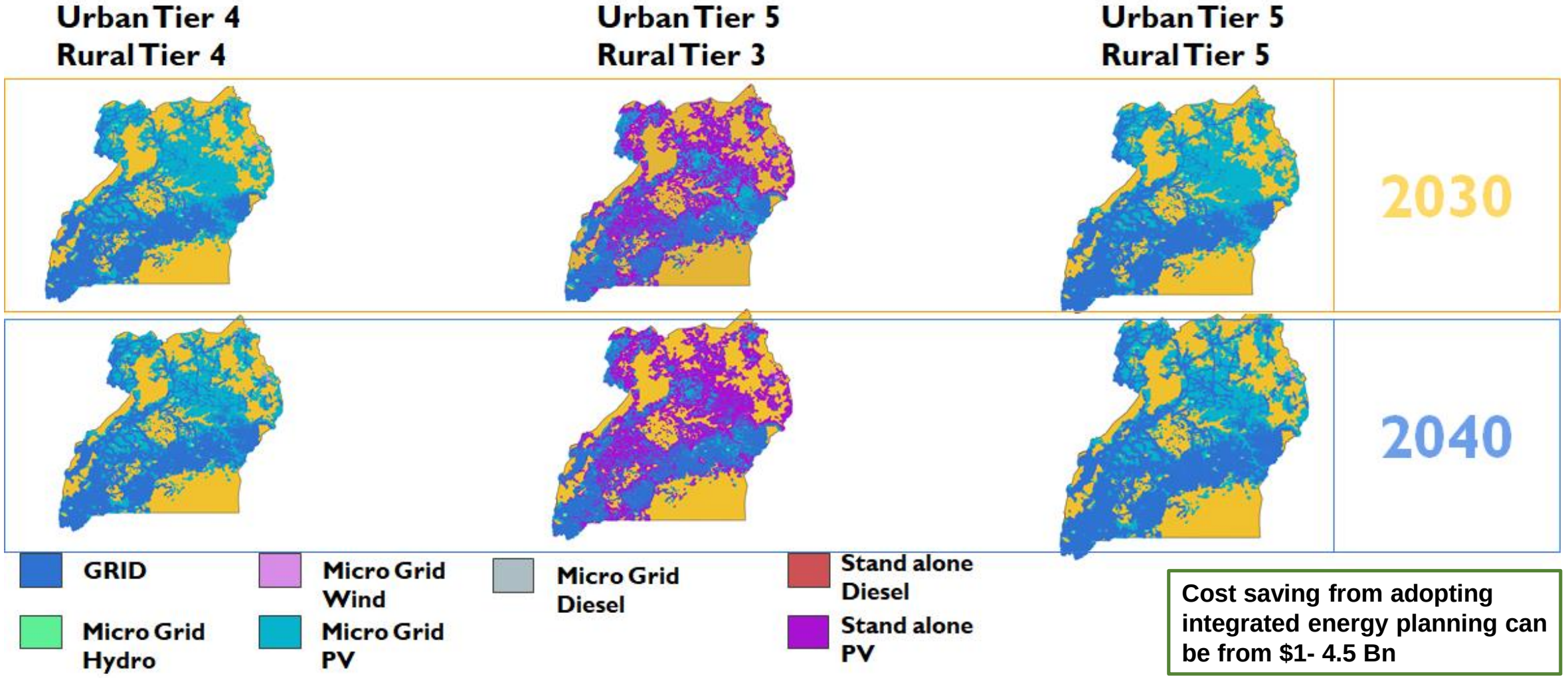
UTILITIES 2.0

Grid + Micro-grids can achieve T5 UEA by 2040



Cost saving from adopting integrated energy planning can be from $1- 4.5 Bn

Problem Statement: Optimized electrification

- African utilities mandated to deliver electricity access rarely include distributed, digitized energy technologies as part of the access model

- Current planning strategies and analytical tools treat the decision of distributed vs centralized energy access as mutually exclusive paths; assume grid has perfect reliability; neglect T&D losses and associated costs; do not value tiers of access other than grid connection

- **U20 Overarching question**: What are the fastest, most cost-effective utility models for providing reliable, universal energy access in low energy access countries?

Solution: Complementary electrification paths

“Centralized” Strengths	“Decentralized” Strengths
Infrastructure	Modularity
Incumbency	Competition
Scale	Agility
Low-cost, long-term debt	Range of investors, options
Significant customer base	Customer-centric brands
Billing and collection	Ancillary services + products
Capacity + “deep bench”	Innovation

Thesis: By leveraging the strengths of both centralized and decentralized systems and advances in digitization, profitable, affordable and accelerated universal electricity access is possible for sub Saharan Africa.

CAPITAL

UTILITIES

NGOs/CSOs

ELECTRICITY ACCESS ECOSYSTEM

COMPANIES

MEDIA

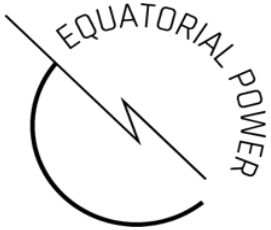
POLICY

CONSUMERS

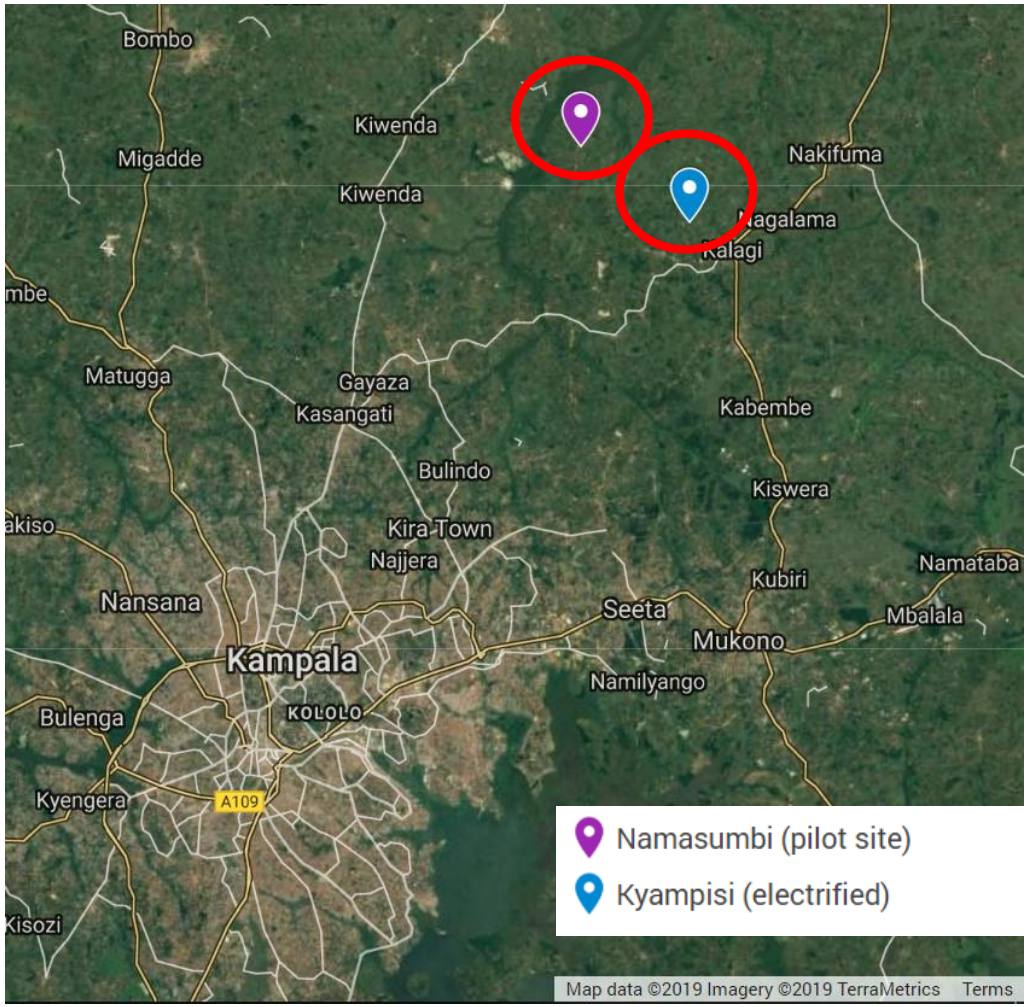
ACTIVATION: Testing Utilities 2.0 in Uganda

- In 2018 Power for All along with a consortium of partners launched the U2.0 campaign, and conceived an experimental exercise in integrated electricity delivery.
- The consortium included 30 leaders in centralized and decentralized energy and global companies working in 10+ energy poor countries
- Across stakeholder groups there is shared beliefs that energy is a basic human right, access should be accelerated, and that utilities have a universal electricity service obligation which lacks an ecosystem of support.

ECOSYSTEM APPROACH: Partners Creating U2.0



Demo Site: Namasumbi Village, Mukono District



Demonstration Village and Control Site

- Close/neighboring to grid-connected communities but completely off-grid
- Mix of households and small scale commercial enterprise (approx. 400 households and businesses)
- Multiple schools and health centers
- Subsistence and commercial agriculture; active economy
- Kyampisi and Nyenge: close-by previously electrified villages


UMEME
Powering Uganda
At your service 24/7

1000+ Consumer Exploration Research Exercise

- Education levels are higher in electrified village
- Number of persons that own a smart phone in electrified village is higher
- The number of persons that pay for charging is less in the electrified village
- 40% of HH and 50% of business in unelectrified village want to consume at least 2.5 kWh per day (avg 6kWh)
- Desired HH assets: TV, radio, iron, fridge, fan
- Desired Business assets: fridge, computer, cash register or point of sale device

Central commercial area in Namasumbi

Next Steps: Partners proving ideas together

GOAL: The goal of the U2.0 campaign is to fill critical gaps in our understanding of how to achieve this integrated future through existence proof/demonstration exercises to test viable business models.

Mini-grids: Are grid-integrated mini-grids operating in utility sub-concessions able to reduce the costs of new customer connection while providing higher service reliability and better customer service at a faster rate of deployment? Is “customer development” valued by utility?

Distributed storage: Does the combination of solar and storage improve reliability of connections at lower system cos? What are the challenges with smart and interconnected storage systems?

Appliance finance: Does the financing of appliances and associated interventions (eg. financial literacy training) increase adoption and user consumption to the level where the utility’s cost of servicing customers is met? What financing scheme works best for customer segments?

Mobile technology: Is it possible to create a smart grid without smart meters through mobile technology, thereby improving shared data availability and saving on AMI deployment costs?

#PoweringJobs: Creating the U2.0 Workforce

- #PoweringJobs launched in 2018
- Partnered with local research inst's
- Design & conduct first comprehensive, annual job census, including baseline for sector, job creation potential.
- Identify skills needed to power SDG7 and other SDGs with DRE (globally and select countries).
- Identify reforms needed in skills/training in low access countries and ministries/agencies needed to create transformation (global and national).
- Develop and mobilize thought leadership platform and campaign plan to pursue reforms.
- Started in Kenya, Nigeria, and India, with survey of ~150 companies.
- Expand to more countries in 2020

Q&A

Thank you! For more info:
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CAMPAIGN GOALS: Utilities of the Future

Vision:
Utilities of the future are an integrated, intelligent, interactive, data-driven and collaborative network of public and private actors that delivers customer-centric energy and other products and services to households and businesses as quickly as possible, providing clean, affordable, reliable, equitable electricity access to everyone.

Objective:
The goal of the U2.0 campaign is to fill critical gaps in our understanding of how to achieve this integrated future through existence proof/demonstration exercises that answer key outstanding questions.

Questions:
- Can we distill the key levers, business models, incentives and process structure that successfully incentivize cooperation between public and private sector stakeholders in sharing data and jointly providing electricity access?
- Can we design a successful framework which employs existing planning tools for identifying communities and customers that would be optimally served through integrated approaches?
- Does the integrated approach fit with current regulatory structures and if not, can we identify the key regulatory interventions required for success and scale?

Pilot Structure: Focus Area Working Groups

Focus Area	Topics	Phase 1 (Demonstration)	Phase 2 (Replicability)	Phase 3 (Scale)
Products	Technology integration	Impacts of tech mix, configurations	Grid connection, data exchange	Customized sites, expansion
Profits	Business models	Identify, assess 5-6 models	Refine; Seek regulatory ok	Contracts and agreements
Policy	Regulations, access strategy	Inventory, assess U.2.0 policy needs	Test and iterate framework	"U.2.0 Ready" policy suite
Planning	Operations, stakeholders	High-touch consumer explor.	Test predictive methods	Apply predictive methods at scale
People + Process	Social impacts, utility process	Human-centric design, teams	Diffuse learnings internal,	Develop champions

Current focus

Phase 1 (2019): Research Agenda

Research Objective:
To test the benefits of integrating centralized and decentralized energy and demonstrate integrated public-private energy planning, business models and implementation in practice.

Governing Research Question:
Given the process and partners engaged in this demonstration, what business model innovations, product and service offering interventions, enabling policies and frameworks for engagement improve the process of integrated planning and indicate replicable best-practice?

Working Hypotheses:

- The use of integrated planning, coordinated energy markets, and innovative finance can reduce connection cost, accelerate connection pace, and improve affordability for end-users.
- The use of smart, integrated technologies can improve reliability of connections and reduce grid losses for the utility thereby deferring infrastructure investment and improving service.
- The use of data and finance innovations can drive demand stimulation for all energy companies' bottom lines and customer benefit.

Pilot: Methods

Planned Pilot Research Method:

- Determine business model structure(s) and then based on consumer data, ID potential customers, deploy mini-grids or grid to larger public loads (e.g. higher tier health centers)
- In the selected site(s), **size and deploy mini-grid(s)** to service main commercial areas (e.g. main road, market areas, schools) to leverage density.
- **Deploy infinity grid (PV and storage)** in the moderate density areas and SHS in least dense areas.
- **Provide finance options** for commercial agricultural appliances and equipment to identified customers.
- Deploy sensors to **observe and measure service performance** (outages, power quality) where sensors/smart meters not already deployed.
- **Collect data** throughout on costs and duration of service phases as well as consumption, customer needs and satisfaction etc (digitally and also using follow-up customer surveys).
- **Compare to current and historical** Umeme process and data on cost, duration and population coverage for the neighboring grid-connected community (or compare to area where Umeme recently completed or is completing a grid extension for same community type).
- **Compare to historical data of decentralized technology companies** operating

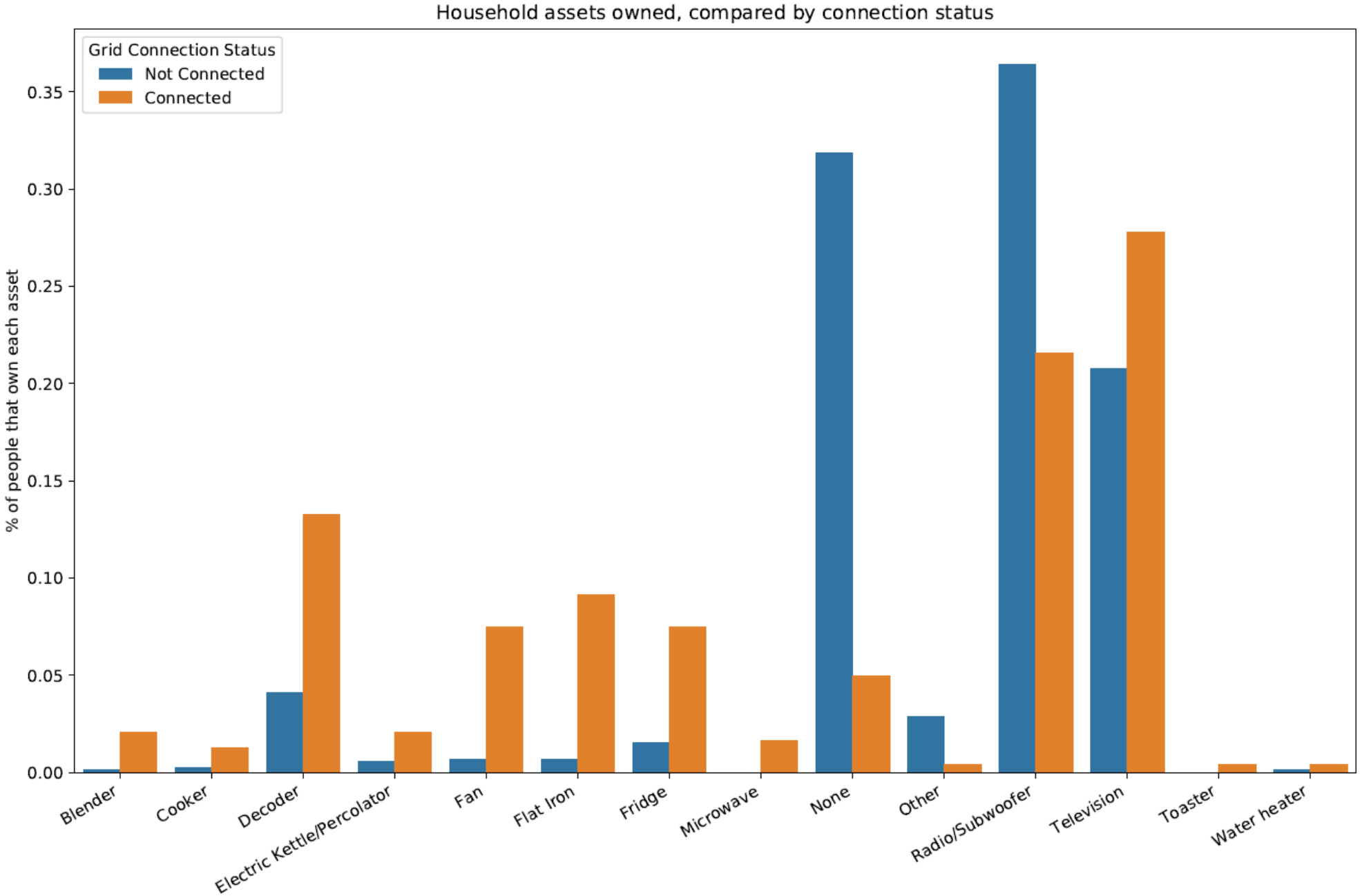
NEXT STEPS: Outcomes and Deliverables

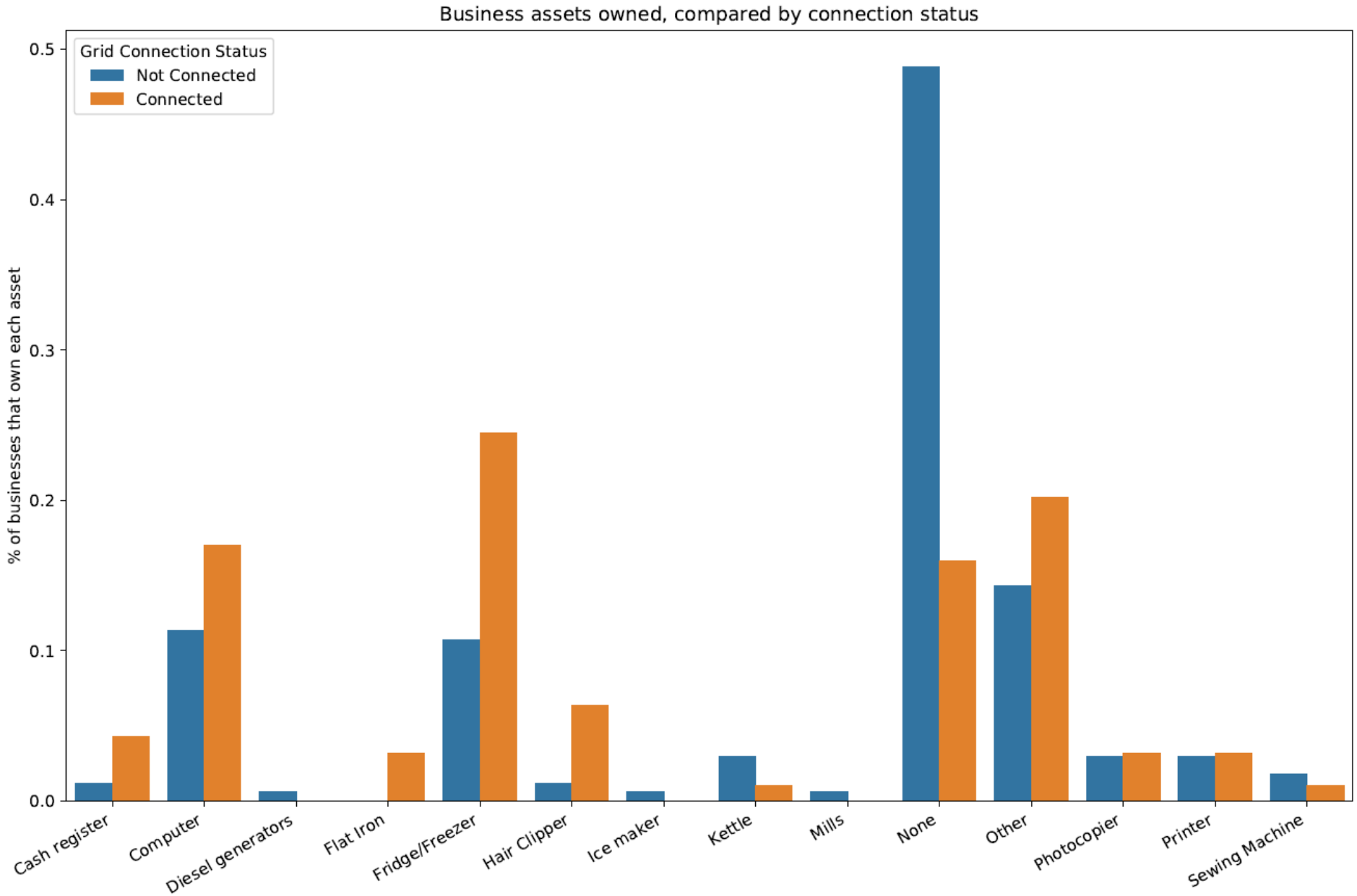
Outcomes:

1. A strong understand of structures and incentives that work to pull companies and utilities toward integrated approaches to electrification.

2. Data and evidence of the impacts of the U20 approach on pace of connections, cost and reliability. Evidence on key interventions to drive demand stimulation.

3. A successful, replicable process for U20 development, including core technologies, such as mini-grids, so that the U20 concept can be taken to scale.


Household assets owned, compared by connection status
Grid Connection Status
Not Connected
Connected
% of people that own each asset
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
Blender
Cooker
Decoder
Electric Kettle/Percolator
Fan
Flat Iron
Fridge
Microwave
None
Other
Radio/Subwoofer
Television
Toaster
Water heater


Business assets owned, compared by connection status
Grid Connection Status
Not Connected
Connected
% of businesses that own each asset
0.0
0.1
0.2
0.3
0.4
0.5
Cash register
Computer
Diesel generators
Flat Iron
Fridge/Freezer
Hair Clipper
Ice maker
Kettle
Mills
None
Other
Photocopier
Printer
Sewing Machine