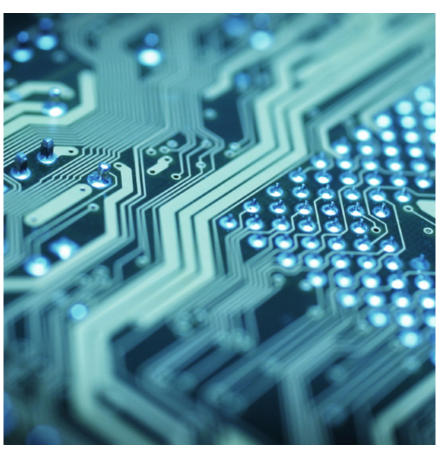
POWER FOR ALL



Utilities 2.0: Integrated Energy for Optimal Impact

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About this Paper

Utilities can be powerful partners in accelerating the end to energy poverty. However, traditional Utility 1.0 models—monopolistic, unidirectional, and siloed—that have informed power sector design in low energy access (LEA) countries, have rarely created profitable, sustainable energy companies in developing countries, nor have they ended energy poverty.

Low energy access countries can evolve 1.0 utility systems for an integrated future, using digitization, decentralization, and data to enable grid and non-grid energy to collaborate and maximize connections that improve quality of life. Utilities 2.0 identifies ways to leverage the comparative advantages of centralized and decentralized energy to create a robust, integrated system that enables a range of energy companies in the developing world to improve service delivery, stimulate demand, drive connections, and transform billions of lives.

Utilities 2.0 is a strategic initiative of Power for All and a coalition of partners to accelerate the end of energy poverty. Funded by The Rockefeller Foundation, Utilities 2.0 seeks to challenge conventional approaches to energy access and advance the role of "off-grid" decentralized renewable energy as a legitimate part of the global power supply. Learn more at powerforall.org.

I. Executive Summary

Utilities 2.0 is designed to combine centralized and decentralized technology into an integrated, intelligent, and interactive energy network that can deliver customer-centric, clean energy solutions to end energy poverty at the lowest cost, in the fastest time.

7 AFFORDABLE AND CLEAN ENERGY

With Sustainable Development Goal 7 (SDG 7), designed to ensure access to affordable, reliable, sustainable, and modern energy for all, the global community has prioritized bringing energy to 1 billion people trapped in energy poverty. As decades of experience trying to deliver universal access has shown, energy is not a one-size-fits-all proposition. Integrated energy—a concept omnipresent in developed markets but relatively new to access circles[1]—can design an optimal mix of energy technologies and service levels in a given area, solving for least-cost electrification in the fastest timeline possible. The promise of integrated energy lies in combining the advantages of traditional utilities (existing infrastructure, long-term low-cost financing, scale) with decentralized renewable energy, or DRE (lower costs, fast implementation, fewer regulations). With targeted interventions to drive demand, integrated energy can create a sustainable and profitable energy system that deepens and widens the social impacts of energy access, faster.

However, instead of finding ways to unite the electricity sector in achieving universal energy access, the global community has largely accepted disparate roles for centralized and decentralized electricity systems. Traditional grid infrastructure and decentralized energy in emerging markets rarely benefit from collaborative use of digital technologies and data tools that can enable coordination and, potentially, faster electrification. Even one of the most lauded integrated plans—Ethiopia's National Electrification Program 2.0 (NEP 2.0)—is not designed for long-term integration. Rather, NEP 2.0 is designed for parallel development, where the grid eventually replaces solar home systems (SHS) and mini-grids in rural areas. These limitations are symptomatic of a development approach that fails to leverage the comparative advantages of different energy systems to create a faster access timeline and a more reliable, affordable, safe, and resilient power supply.

Utilities 2.0 (U.2.0) presents an alternative framework to development-as-usual. Utilities 2.0 identifies ways to combine the forces of established utilities in energy-poor countries with decentralized, digitized, and data-driven technologies to accelerate universal electricity access.[2] Utilities 2.0,[3] conceptualized by leaders from both advanced and low access energy markets (Appendix A), is designed to combine centralized and decentralized technology (including solar home systems, mini-grids, grid, and smart grid systems) into an integrated, intelligent, and interactive energy network that can deliver customer-centric, clean energy solutions to end energy poverty at the lowest cost, in the fastest time. By leveraging trends in digitization, data, and decentralization with traditional power delivery, U.2.0 can accelerate access, stimulate demand, and deliver more reliable energy—leading to increased productivity and economic development.

Neither centralized nor decentralized energy is purpose-built to end energy poverty at scale, alone. However, together, innovative private companies and established utilities have the power to create a new frontier in the fight to end energy poverty. As utilities in emerging markets struggle to meet their provision of service obligations with traditional electrification approaches—struggling with unprofitable customer connections, over-electrification, peak demands, and capital constraints—there is a clear need for change. With a few key enablers in place, including mandates for integrated planning, regulations that support energy integration, and incentives for Tier 2 or higher connections, Utilities 2.0 stands to revolutionize the electricity industry, creating more connections, faster.

II. Why Utility 1.0 Will Leave 1 Billion Behind

It is difficult to find successful, profitable utilities in energy-poor countries that are meeting provision of service obligations. Capital-constrained, limited by human capacity, and plagued by losses, most countries have relied on the Utility 1.0 approach—a monopolistic, vertically integrated system of generation and distribution—for electrification. These challenges have limited the incorporation of new business models and technologies that can help accelerate access, stimulate demand, and improve reliability, as shown in Table 1. As grid infrastructure is expensive, with long payback periods, it is often difficult for utilities to consider incorporating new ways of delivering electricity. This path dependency threatens to both limit the long-term prospects and the sustainability of utilities, and handicap the world's ability to end energy poverty.

Utility 1.0 and Energy Inequality

In the early 1900s, small generation and distribution companies in the U.S. and Europe were grouped into electric utilities for economies of scale and regulation.[4] Targeting 100 percent access, governments funded massive rural electrification programs to connect populations that were uneconomical for central utilities.[5] As this Utility 1.0 framework was translated to developing countries, investment largely powered only industrial facilities or basic street lights in population centers.[6] In the middle of the 20th century, donor financing shifted toward larger electric infrastructure projects, and further deprioritized access to remote areas.[7] Most countries in Sub-Saharan Africa (SSA) became too indebted in the 1980s to attract private capital to expand their Utility 1.0 systems, contributing to substantial state ownership of electric assets and inefficiencies.[8,9]

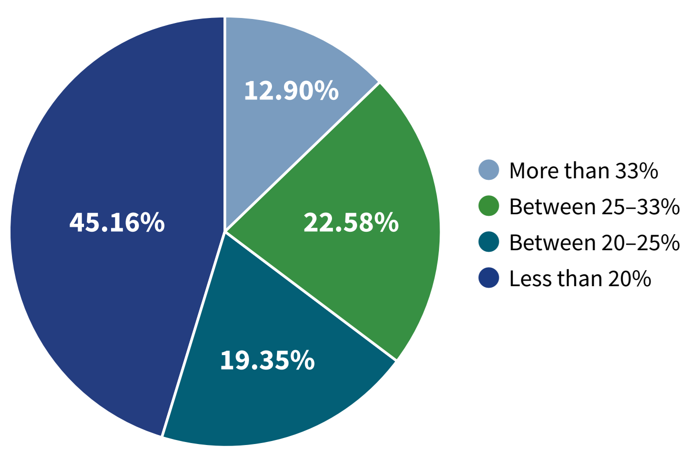
The Limitations of Utility 1.0 to End Energy Poverty

While Utility 1.0 has been largely successful in advanced energy markets like the U.S. and Europe, it has failed to fully translate to low energy access (LEA) countries like Uganda and Nigeria. Power utilities in emerging markets are capital constrained, have a low demand base (average annual per capita LEA country electricity consumption is roughly 400 kWh, compared to 8,000 kWh in OECD countries[10]), system inefficiencies, and large, underserved rural populations. Despite the mismatch of the 1.0 model for energy-poor countries, 70 percent of utilities in SSA still rely on vertically integrated utility structures with little competition, transparency, or monitoring.[11] The operational and commercial inefficiencies of these 1.0 models in SSA[12,13] are significant: Transmission and distribution losses in LEA countries are 5 to 10 times higher on average than those in the developed world (Figure 1), and almost all utilities in LEA countries operate under financial deficit.[14] Moreover, some grid connections can cost up to $2000—greater than the annual income of most of the currently unconnected population.[15] Even when connections are subsidized or free, millions of potential new customers do not consume energy, either due to lack of affordability or limited reliability.[16]

Evolving the Traditional Utility to Deliver Power for All

Healthy, thriving, and profitable utilities are critical to establishing and maintaining universal electrification. Despite the reach and scale of centralized utilities in the developing world, the Utility 1.0 approach is not ending energy poverty. While some countries have achieved significant electrification with grid-based approaches, problems such as system losses and non-vending customers stress

FIGURE 1: SSA T&D UTILITY LOSSES 2011–2015[17]



Of the 31 SSA countries that publicly reported annual transmission and distribution (T&D) losses between 2010 and 2015, more than half had losses greater than 20 percent of annual generation. Calculations by Power for All, based on the World Bank's technical dataset referenced in "Making Power Affordable in Africa and Viable for Its Utilities." Calculations based on data for 2015 or the latest available year.

a utility's ability to remain financially sustainable and maintain a high quality of service. By leveraging the integrative tools and technologies that enable the Utilities 2.0 electrification model, energy-poor countries have a broader range of available options for increasing access and improving reliability, instead of simply relying on raising energy tariffs to build out traditional infrastructure. Moreover, by approaching universal electrification as a powerful platform for public-private collaboration, utilities and their regulators can make more informed decisions about how to invest scarce public resources. This means better leveraging of private investments, and achieving maximum electricity connections with efficient use of capital in pursuit of energy access goals.

TABLE 1: UTILITY 1.0 VS. UTILITIES 2.0 IN LOW ENERGY ACCESS COUNTRIES

	Dimension	Utility 1.0	Utilities 2.0
Technical	Resource location	Large-scale central generation units from load centers.	A mix of centralized and distributed generation; storage close to load centers.
	Network topology	Largely unidirectional, radial networks that provide a single electric path from a supply source for a given customer.	Bidirectional transmission and distribution networks with multiple electric paths from several supply sources to and between customers.
	Resource flexibility	Ramping up and down of large central generation, transmission links; some demand response.	Mainly automatized distributed demand response and storage, complemented with some central resource flexibility.
Institution	Ownership	Public or private under utility holding structure.	Multiple ownership models, public, private, partly owned by consumers, and other non-utility stakeholders.
	Regulatory approach	Cost-of-service regulation based on recovering revenue through volumetric rates; focus is on investing.	Performance-based regulation (PBR) based on dynamic pricing, revenue decoupling; focus is on end-use service provision.
	Business model	Recover allowed investments through electricity sales; incentive to increase sales, buildouts, and asset base; DRE is a threat to the business model.	Provide end-use, generation, and storage services to end users under a PBR framework; incentive to improve quality and reduce costs; DRE is an integral part of the business model.
	Accountability	Obscured by state or government ownership and size of the firm.	Enhanced by smaller operators and transparency through market mechanisms.
Social	Environment	High, due to fossil fuel generation, large scale generation siting impacts, and extended transmission lines.	Low, due to high reliance in renewable distributed resources and minimal transmission requirements.[18]
	Equity	Achieving universal access is slow, constrained by capital, insufficient supply options, and competing priorities.	Achieving universal access is accelerated, spurred by competitive customized solutions for energy access.
	Governance	Driven by policy makers and firm owners in regulated environments.	Driven by consumers through behavioral signals and consumption decisions in competitive environments.

III. Utilities 2.0: Collaboration for Universal Access

Altogether, by enabling decentralized electricity resources to help address the limitations of the traditional utility to deliver universal access, Utilities 2.0 is a framework to support grid and non-grid electricity in optimizing national energy systems and creating power for all.

The limitations of Utility 1.0 systems to deliver affordable, reliable energy access in an LEA country context demonstrate the need to redefine the traditional characterization of an electrical utility. To accelerate universal access, utilities must evolve from centralized monopolies to collaborative, adaptive energy networks with a variety of providers to deliver customized electricity that addresses unique customer segments. By working together to drive access, improve grid performance, and stimulate demand, Utilities 2.0 is designed to create better businesses and better serve more of the energy poor. As Utilities 2.0 requires a shift in the 1.0 mindset, collaboration is needed with market actors that excel at customer service (in the first mile or last mile), with freedom to choose which technologies best satisfy consumer demand. Altogether, by enabling decentralized electricity resources to help address the limitations of the traditional utility to deliver universal access—capital constraints, technical and non-technical losses—Utilities 2.0 is a framework to support grid and non-grid electricity in optimizing national energy systems and creating power for all (Table 2).

TABLE 2: COMPARATIVE STRENGTHS OF ENERGY SYSTEMS

Centralized	Decentralized
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, complementary products
“Deep bench” and experience	Innovation
Long-term design	Speed

The Promise of Integrated Energy

The decentralized, digitized, data-driven technologies embedded in Utilities 2.0 have much to offer centralized power providers, including a comprehensive access strategy for unelectrified rural populations.[19,20] Indeed, as data accumulates about the value of DRE technologies like mini-grids and solar home systems in accelerating connections,[21,22] more LEA countries are developing sector enablers like national DRE targets to speed connections in peri-urban and rural areas.[23] Utilities 2.0 builds on this momentum by illustrating how the comparative advantages of centralized and decentralized energy can create a robust, integrated energy system for grid and non-grid customers alike. By leveraging digitization and data analytics to integrate DRE technologies, utilities have new alternatives to grid extension, faulty transformers, and unprofitable connections. In collaboration with DRE companies, utilities can find more cost-effective ways to leverage smart meters, storage, and distributed generation to enable reliable, affordable universal energy access (Table 3).

III. Utilities 2.0: Collaboration for Universal Access

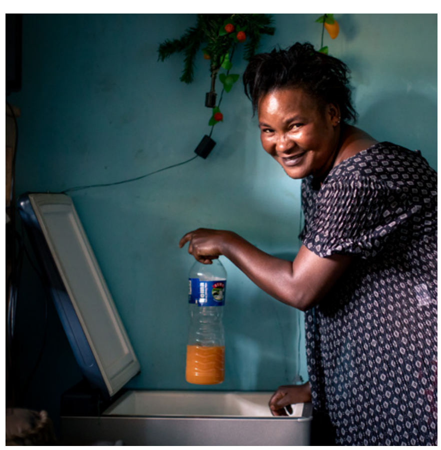
TABLE 3: HOW DRE TECHNOLOGIES ENABLE UTILITIES 2.0

Technology	Utility 1.0 Position	Utilities 2.0 Framework
Solar Home Systems	Very limited standalone service supply.	Part of a decentralized supply system to achieve universal access; backup against outages.
Mini-grids	Limited service supply to households; limited commercial applications.	Part of a decentralized supply; backup against outages; reliability via interconnection; higher service level (24x7 220v) vs. weak grids for hard-to-reach populations; productive use.
Advanced or Smart Meters	Billing; outage detection; limited customer usage information; expensive.	Metrics for results-based programs; outage detection; tailored offerings per use patterns, management, billing; prepayment; loss reduction; improved visibility and control.
Appliances	Consume electric energy to provide a single energy service (e.g. refrigeration).	Manage energy consumption; intelligence for system transactions (appliances, DRE generators); demand stimulation and response.
Distributed generation	Net-metering application when possible; backup against outages.	Integration for economies of scale; transactions with operators, aggregators, or other customers; backup against outages; ancillary services through smart inverters; achieve universal access.
Storage	Limited arbitrage and ancillary services supply at the utility scale.	Demand response, ancillary services, reliability enhancement at the distributed and utility scales; grid stabilization; transforms distributed energy into dispatchable resource; avoid CapEx for peak generation; universal access.

Planning: Integrated Energy for Least-Cost, Fastest-Path Access

Based on policy targets and regulations, traditional energy planning often relies on expensive consulting firms to conduct baseline studies of energy use, load forecasting, and generation requirements for future use. This Utility 1.0 style of energy planning for 10-to-20 year timelines forecasts future demand, as well as how demand will be met by central grids for the *already* connected. More, this consultant-based approach is often led by technical institutions and consultancies using a variety of software tools and proprietary data sets—tools and data that the governments who commission the work may not have either the ownership of or capacity to use.

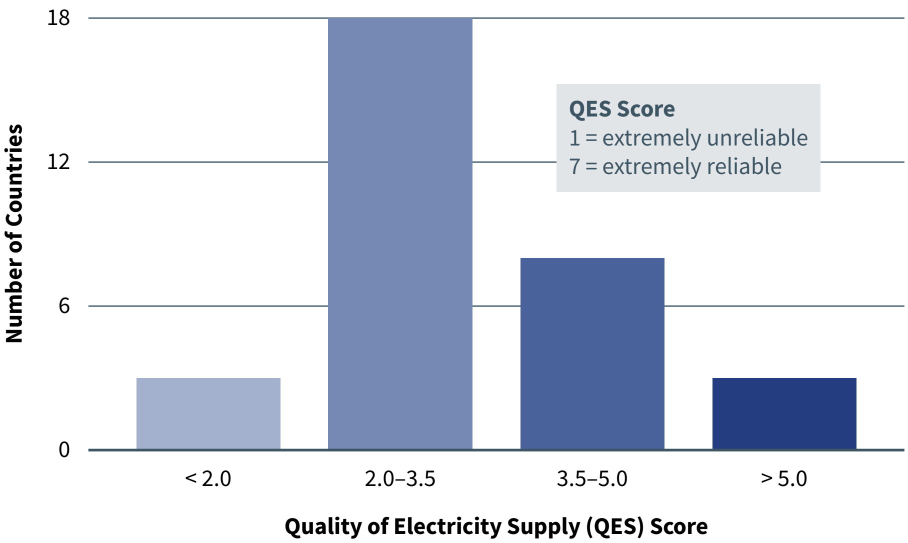
In the Utilities 2.0 framework, integrated planning is dynamic, open, data-driven, and optimized to deliver least-cost, fastest-path universal energy access. Affordable low- or no-cost modern tools—such as The World Bank's Electrification Pathways,[24] University of California at Berkeley's Grid Access Planning (GAP) model, or the Massachusetts Institute of Technology's (MIT) Reference Electrification Model[25] (REM)—use publicly available data to evaluate the least-cost way for a regional or national power system to meet demand by concurrently modeling generation, transmission, distribution, DRE investments, and operational costs. Not only are these approaches faster and more cost effective to execute, GAP analysis suggests electrification strategies that fully integrate DRE create 15 percent to 20 percent savings, compared to traditional grid extension models that supply the same number of customers.[26]



Performance: Integrated Technologies for a Smarter Grid

Just as traditional planning tools must be adapted to meet the needs of low energy access countries, Utility 1.0 electrical grids and business models must evolve to deliver sustainable, universal and affordable energy to all. Currently, the majority of SSA countries suffer grid inefficiencies that affect billions of people every day, including transmission and distribution losses as high as 50 percent and service interruptions over 500 hours per year.[27] Altogether,

FIGURE 2: QUALITY OF ELECTRICITY SUPPLY (QES) IN SSA COUNTRIES[41]



The QES score is a weighted average of responses to the question, "In your country, how reliable is the electricity supply?," from the 2017–2018 World Economic Forum's Executive Opinion Survey. Business executives from 21 out of the 32 SSA countries responding scored their nations significantly lower (average 2.5) than the global median score (3.43).

hundreds of millions of customers who are currently connected to power grids fail to have reliable energy access[28] (Figure 2).

In the Utilities 2.0 framework, traditional utilities do not need to solve these problems alone. Today, comparatively cost effective Utilities 2.0-related digitized technologies—like integrated smart meters, predictive tools like Gridwatch (which uses cell phone charging outages to predict transmission failure), and remote monitoring systems standard in many DRE products—can help create an intelligent network that taps mini-grids or networked rooftop systems in case of distribution issues, transmission outages, and demand response.[29] Switch, sectionalizer, and recloser[30] automatization in medium voltage networks can drastically reduce the duration and extension of outages by isolating the fault and restoring the system.[31] Integrated DRE technologies can increase reliability of connections, reduce losses, and improve power quality and utility performance, while creating sustainable businesses on both sides of the wires.[32]

Power Products: Integrated Appliances and Services to Stimulate Demand

Energy is not a one-size-fits-all proposition. As mentioned, LEA countries often have low demand, which makes investment and cost recovery difficult for utilities. New customers who may never have used electricity before—the main focus of most energy access programs—can end up being losing propositions for utilities. Already, almost all utilities in energy-poor countries operate under financial deficit—the average utility deficit is US$ 0.10 per kWh and can range up to 2 percent of a country's entire GDP.[33] Even if grid extension costs are heavily subsidized, the evidence shows that many of these new customers cannot afford to consume energy, or they cannot acquire appliances to derive energy services from their electrical connection.[34,35] Profitable customers are critical to the success of universal access; the newly connected must be able to afford (through subsidy, financing, or other schemes) to use electricity, or the benefits of electrification will go unrealized. While affordability itself is highly personal and market-dependent, the right combination of financing and awareness can stimulate demand, and raise perceived or real affordability for the energy poor.

Just as integration of energy systems can create mutual benefit for decentralized and centralized companies, the same is true of collaboration to drive consumer use.[36,37] Customer-centric products and services designed for low-voltage or weak grid environments—financed by the utility, DRE companies, or a third-party—can drive consumption and create profitable customers. In 2016, an end-user stimulation pilot program in the Mwanza region of Tanzania, which focused on appliance financing through loans, resulted in increased demand, consumption, and profitability.[38] After the JUMEME Rural Power Supply Ltd. (JUMEME) developed a solar-powered mini-grid, customers could not afford to purchase appliances.[39] However, with productivity that resulted from appliance financing, targeted businesses were able to pay off appliance loans.[40] This is just one example of how collaboration between utilities, the DRE sector, and productive use appliance manufacturers can enable alternative revenue streams (e.g., appliance financing, cross-selling customers) and drive energy use, as well as the human development index (HDI) benefits associated with energy access.

IV. A Call to Action: Utilities 2.0

As energy is not a one-size-fits-all approach, energy planning of the future must enable adaptive, scalable solutions that meet the needs and support the aspirations of the (currently) energy impoverished.

To realize the untapped potential of unifying centralized and decentralized energy to end energy poverty, Utilities 2.0 will require significant changes in electrification planning, finance, regulations, data use, and private sector engagement. While these changes won't happen overnight, there are three specific courses of action that the energy sector, national governments, and international donors can undertake now to create an "on-ramp" for Utilities 2.0: (1) mandate integrated planning; (2) establish regulations that support energy integration; and, (3) provide equitable incentives programs for new, affordable connections for a broad range of energy providers, including DRE companies.

1. Optimize Energy: Mandate Integrated Energy Planning

While traditional planning employs load forecasting to determine future gaps in energy supply, this process assumes predictable and stable demand. Yet low energy access countries are rife with demand uncertainty, which is often best addressed through modular, flexible decentralized energy. For example, a standard grid connection in theory provides power 24 hours a day, but new low income consumers often use power for a fraction of available uptime. Not only is 1.0 planning at odds with the dynamic needs of developing markets, but it is difficult to predict demand of new consumers that are either inexperienced with, or entirely new to, energy access. As energy is not a one-size-fits-all approach, energy planning of the future must enable adaptive, scalable solutions that meet the needs of and support the aspirations of the (currently) energy impoverished.

For this reason, utilities, regulators, and ministries (energy and finance) must embrace a range of services through comprehensive electrification planning, and enable the optimal mix of service levels to unelectrified areas by mandating integrated planning. Integrated planning tools that incorporate GIS-based modeling, population density, proximity to power infrastructure, and energy resource availability can help ensure the optimal technology mix to deliver least-cost, fastest-path energy access. Still, regulators will rightly want to validate service provision to all connected customers, regardless of technology. For this, a process that guarantees system-level coordination between energy sources—such as a distributed system operator or DSO—can orchestrate the interaction between the physical grid, the distributed resources, customers, third-party providers, and the transactions between them.[42,43] While supervisory control and data acquisition (SCADA) systems exist, technology platforms can be developed to best enable harmonization and sharing of data relevant to a DSO, including directional megawatt-hour or kilowatt-hour exported or imported, communication system failures, general reliability, and uptime proof.[44] The management of this amount and type of information will require high privacy and security standards, and most likely include the anonymizing and sharing of data between SHS, mini-grid, and grid systems (while maintaining alignment with General Data Protection Regulations).

2. Create Certainty: Establish Utilities 2.0-Ready Policies and Regulations

Standards and regulations that enable a pluralistic, Utilities 2.0 approach can provide the regulatory certainty necessary to encourage private investment that will help achieve universal energy access. In the ideal application of the Utilities 2.0 framework, collaboration encourages sustainable energy along with sustainable business. For example, DRE technologies can improve grid reliability acting as

IV. A Call to Action: Utilities 2.0

Utilities 2.0 will require a level field that provides equitable incentives to grid, mini-grid, and household-level solutions alike to reward faster connections and the dividends associated with access to modern energy services.

backup power for unreliable grids,[45] while also creating flexible distributed networks that can ensure safe, affordable, and dependable power. With regards to reliability, metering, data networks, and sensing, the data and digitization that underlie Utilities 2.0 can improve capacity to predict and respond to outages, as well as technical and non-technical losses.

However, distributed energy resources, such as battery storage, have matured faster than the rates, regulations, and utility business models needed to create a reliable, affordable future grid. Examples of these "missing link" regulations range from interoperability standards (technical specifications as well as safety) to rules or regulations about grid arrival to non-grid areas powered with decentralized energy.[46] The cost of continuing regulatory and policy uncertainty will be the loss of private investments that could otherwise lead to a significant scale-up of grid-quality electricity in rural communities. Alternatively, clear, consistently applied regulations can send a clear market signal to new developers and sources of capital.[47] For example, the Nigerian Electricity Regulatory Commission (NERC) created one of the most private-sector friendly regulations for mini-grids, including a standardized tariff calculation methodology and clear compensations for interconnection.[48] As a result of the Nigerian policy and licensing frameworks, there has been a dramatic acceleration in mini-grid investment and activity.[49]

3. Incentivize Access: Create a Level Field for Productive Connections

The integrated energy at the center of Utilities 2.0 will require a level field that provides equitable incentives to grid, mini-grid, and household-level solutions alike to reward faster connections and the dividends[50] associated with access to modern energy services. Policies that support affordable, reliable Tier 2[51] and above connections can employ a set of enablers, ranging from a clear definition of "connections," to cost-reflective tariffs or subsidization parity. In addition, it will be important to build a knowledge pipeline and cross-learning to ready Utility 1.0 institutions for the transition, including building an understanding of technologies, process, and human capacity needed to achieve the goals of Utilities 2.0. This U.2.0-related information should include incentives for all energy technologies—including results-based financing to performance-based regulations—that tie accelerating connections for the energy-poor to payments and rewards.

Pay-on-performance schemes like results-based financing (RBF) show promise to accelerate connections for a range of DRE solutions including solar home systems and mini-grids. With RBF, payment (usually funded by donors) is made upon verification that results have actually been delivered.[52] Well-designed, results-based finance that is rapidly deployed can create the confidence and trust in commercial investors to support substantial DRE financing and deployment.[53] Results-based financing enhances transparency, accountability, and governance across the value chain. Similarly, for centralized utilities, performance-based regulations (PBR)—a set of regulatory tools including benchmarking and performance incentives that reward the utility for achieving targets—can drive access as well as translate to lower cost for customers and more efficient operations. While RBF and PBR programs are not yet widely used in developing countries, RBF and PBRs together could create a powerful incentive structure to build electricity access metrics into business models.

V. Answering The Call: Enabling Utilities 2.0

Together, centralized and decentralized energy can help identify critical path technology, process, and regulatory interventions needed to transform their national energy systems into robust networks that deliver reliable, affordable, universal access for all.

Applying the Utility 1.0 model to LEA countries has had limited success in creating sustainable utilities, let alone universal energy access. An integrated energy future embedded in Utilities 2.0 holds untapped potential to drive universal electrification. Utilities, regulators, policymakers, and donors all have critical roles to play in creating an integrated, intelligent electricity network that can deliver energy solutions to accelerate universal access.

Centralized and Decentralized Energy: Collaborate to Integrate

The future envisioned by Utilities 2.0—where armies of energy providers join together to win the war on energy poverty in grid and non-grid environments—is rooted in cross-sector collaboration. To have any chance of achieving SDG 7, it is critical that centralized utilities—private and public alike—and the decentralized sector determine how to best integrate DRE storage, smart devices, and other technologies to improve overall energy system performance and achieve universal electrification. As evidenced by recent investments by large, multinational energy firms like EDF and ENGIE investing in Fenix International, Simpa Networks, and ZOLA Electric, traditional energy companies see the business opportunity underlying SDG 7. A small but growing number of energy entities, such as the Energy Company of the Future (ECOF) in Kano, and Umeme in Uganda, are testing ways to partner with DRE companies. These partnerships include achieving access targets, as well as driving improvements in SAIDI (hours of outages per customer per year) and SAIFI (number of outages per customer per year).

National grids are not going out of business any time soon. As such, the DRE sector should proactively engage LEA utilities to identify new business opportunities for centralized and decentralized energy to work together to end energy poverty. Examples of integrative business models include use fees for sub-concessions, shared incentives for new connections, and reducing capital expenditures by relying on DRE technologies for network support. In U.2.0, national grids in LEA countries can act as “base stations” for a network of networks that can interconnect many points of generation, storage, and consumption needed to provide universal energy access. This Utilities 2.0 emphasis on bidirectional energy exchange must be supported by bidirectional knowledge exchange. To be sure, traditional utilities have a great deal to offer decentralized companies. Ranging from deep experience to the challenges of scaling-up electricity infrastructure, the DRE community can leverage valuable insights from utility partnership. Accustomed to working with donors on large-scale, big-budget projects, traditional utilities can help the DRE sector mature and prepare to scale in order to achieve universal access. Together, centralized and decentralized energy can help identify critical path technology, process, and regulatory interventions needed to transform their national energy systems into robust networks that deliver reliable, affordable, universal access for all.

Regulators and Policymakers: Plan for Utilities 2.0

As guardians of the public trust, regulators and policymakers in energy-poor countries must be actively engaged in creating the environment for an integrated energy system that improves grid performance, stimulates consumption, and drives energy access. Developing the knowledge base and the internal capacity to make best use of U.2.0 technologies can be daunting. A first step can be with signing on to the strategic energy planning principles established by DFID’s Energy and Economic Growth (EEG) Applied Research Programme (Appendix C).

V. Answering The Call: Enabling Utilities 2.0

Soon to be released, these global themes have been created to present a roadmap for emerging markets to embrace integrated energy planning, including an emphasis on national-owned energy plans, data accessibility, and transparency.[54]

To encourage a level playing field, policies must be consistently applied across a range of electricity providers. By establishing clear, accessible, and understandable policy around exclusivity of operations, cost-reflective pricing, and grid integration, national governments create a powerful market signal. In some cases, policy changes may also be required to empower national energy planning authorities to procure information needed for effective planning. As noted in the EEG principles, it is essential that planners ensure transparency regarding the quality of data and assumptions that they use, so stakeholders feel confident in planning decisions. This same effort is critical to set the stage for an empowered and effective centralized electrification directorate and a DSO.

Development Partners: Reward Connections and Collaboration

Donors have a unique role to play as the most critical source of financing for energy-based development programs. Development funding and planning dictate whether progress happens in collaboration or in silos. Aid agencies and development banks alike can incentivize energy systems to work together and achieve more together. At the global level, development partners can urge reassessment of projects and encourage the prioritization of Utilities 2.0-ready infrastructure. Utilities 2.0 is more than just a change in infrastructure, it's a change in mindset. Utility 1.0 entities will need a host of resources to

help with the education, capacity-building, and change management needed to transition to a 2.0-style energy company. Donors must help aggregate experiments and results into accessible, easy-to-use research that helps create sustainable and compelling business propositions for the collaboration envisioned in Utilities 2.0. Creating a community of practice that facilitates the testing, development, and scale of a comprehensive, systemic approach to accelerate the access pipeline is required to move beyond point-specific, isolated solutions.

Ensuring alignment across the multibillion dollars of donor-funded development programs is critical to accelerating access, as is releasing committed funds. A small group of donors, including the U.K.'s Department For International Development (DFID) and the Swedish International Development Cooperation Agency (SIDA), see the value of innovative programs like RBF to reward connections, but several others have adopted a mixed position on subsidy for decentralized solutions. Even among supporters for this kind of disruptive "connections finance," there is little coordination. This lack of consistency wastes developers' precious time filling out new paperwork that could have been spent on building new connections. In just one example of how these forces converge and actually slow progress toward universal access, according to the African Mini-Grid Developers Association (AMDA), donors and concessional lenders globally have committed to deploy $1 billion to help the mini-grid sector move from early stage to market scale—yet less than 10 percent of that capital has reached developers.[55]

Power for All: Universal Access Requires Us All

Neither centralized nor decentralized energy is purpose-built to end energy poverty at scale, alone. Creating a new energy system based on the optimal mix of service levels and technologies for a given area is a global imperative. Utilities 2.0 provides a starting point for this reimagining of the electricity sector for emerging markets. With enablers such as mandates for integrated planning, regulations that support energy integration, and incentives for connections, the U.2.0 framework can help revolutionize the electricity industry. By enabling smarter grids, productive use, and faster connections, the Utilities 2.0 energy system of the future can do more than end energy poverty—it can build the foundation for energy prosperity.

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ZOLA Electric (cover, center left; p. 10), and CLASP/Storyby.Design/Timothy Mwaura (p. 7).

Appendix A: Utility 2.0 Bellagio Participants

Power for All convened 30 leaders in both centralized and DRE to create a framework for electrification success at the Utilities 2.0 summit in July 2018. Together, these leaders from the Global North and Global South developed a vision to bring grid, mini-grids, and solar rooftop systems together to create sustainable energy businesses and accelerate access. Ranging from Italy's ENEL to Ethiopia's EEU and India's Tata Power, Bellagio participants defined Utilities 2.0 as an integrated, intelligent, and interactive energy network of public and private actors, that delivers customer-centric clean energy solutions to end energy poverty. This same group of leaders have committed to advance the Utilities 2.0 vision and prove that centralized and decentralized energy technologies have important roles to play in achieving universal energy access, and that these role are bolstered by working together. The Utilities 2.0 collaborative is actively seeking progressive utilities in emerging markets to plan, design, and implement integrated energy pilots.

Ademola (Demmy) Adesina CEO, Rensource
Azeb Asnake CEO, Ethiopian Electric Power
Colonel Kadathur Bhaskar (Vijay) Managing Director, Mlinda Sustainable Environment Private Limited
Clare Boland Ross Senior Associate Director and Initiative Strategy Lead, Power Initiative, The Rockefeller Foundation
William Brent Executive, Power for All
Mithun Chakraborty Deputy General Manager, Tata Power Delhi Distribution Limited
Sanusi Garba Deputy Director Chair, Nigeria Electricity Regulatory Commission
Giulia Genuardi Head of Sustainability Planning and Performance Management, ENEL
Xavier Helgesen Co-founder, ZOLA Electric
Dan Klinck CEO, East Africa Power
Aaron Leopold CEO, Africa Mini-grid Developers Association (AMDA)
Valérie Levkov Senior VP Africa and Middle East, EDF
Ify Malo Campaign Director, Nigeria, Power for All
Emily McAteer CEO, Odyssey Energy Solutions
Caroline McGregor Lead Specialist for Energy Access and Gender, Sustainable Energy for All (SEforALL)
Adefris Asfaw Merid Senior Technical Advisor to CEO, Ethiopian Electrification Directorate
Damilola Ogunbiyi Managing Director, Rural Electrification Agency, Nigeria
Pradeep Pursnani Deputy Director, Shell Foundation
Riccardo Ridolfi Founder and CEO, Equatorial Power
Chiara Odetta Rogate Energy Specialist, World Bank
Joshua Romisher CFO, Fenix International
Jim Rogers Former Chair and CEO, Duke Energy
Dana Rysankova Global Lead on Energy Access, World Bank
Candace Neufeld Saffery CEO, Telefonica's Alpha Energy
Mesfin Dabi Seboka Senior Energy Analyst, Ethiopia Electrification Directorate
Rebekah Shirley Chief Research Officer, Power for All
Kristina Skierka CEO, Power for All
Sam Slaughter CEO, PowerGen
Rob Stoner Deputy Director for Science and Technology, MIT
Suman Sureshbabu Associate Director, The Rockefeller Foundation
Jay Taneja Assistant Professor, Electrical and Computer Engineering, University of Massachusetts
Raphael Tilot Chief of Customer Solutions, ENGIE Africa

Appendix B: Advanced vs. Low Access Markets

TABLE 4: CHARACTERIZATION OF ADVANCED ENERGY MARKETS V. LOW ENERGY ACCESS MARKETS		
Country classification	**AEM (Advanced Energy Markets)**	**LEA (Low Energy Access)**
Definition	Countries where at least 98% population has access to affordable and reliable electricity.	Countries where less than 50% of the rural population has access to electricity.
Access to electricity	>98% households	<50% households
Reliability	High; ~2 hrs outage/yr.	Low; ~500 hrs outage/yr.
Competition	High; in generation and transmission; some retail competition.	Low in all segments, single vertically integrated supplier is the typical mode.
Household use	High; average 7995 kWh/capita/year.	Low; average 390 kWh/capita/year.
Household spending	Low, average 4 cents/kWh.	High; average 10 cents/kWh.
Private sector involvement	High; private sector owns and operates most infrastructure.	Low; state-owned enterprises are the most common mode.
Accountability and transparency	High; independent regulators and system operators; active consumer advocacy.	Low; operation and regulation by state; limited consumer advocacy, stakeholder engagement.

Appendix C: EEG Strategic Planning Principles

IMPACTS

Impact: More effective allocation of resources for energy access in developing countries

Impact: Improved coherence of strategic energy systems planning by increasing the effective use of evidence and analysis by decision-makers in developing countries

	1	2	3	4
OUTCOMES	**Outcome 1** **Harmonized engagement:** Improved knowledge-sharing and coordination among development partners and practitioners on energy systems modeling and planning	**Outcome 2** **Capacity building through co-creation:** Improved strategic energy planning and modeling capacity of key national institutions (both technical and political)	**Outcome 3** **Data, models, and standards:** Improved quality of the evidence behind strategic energy modeling and planning	**Outcome 4** **Community platforms:** Improved awareness of—and access to—decision-support tools and data by all different users
OUTPUTS	**Output 1** Applied common principles for engagement in energy system modeling and planning	**Output 2** Sustained support for capacity building in energy systems modeling and planning	**Output 3** Improved data, models, and standards	**Output 4** Online platform(s) hosting/linking to open-source data, tools, and knowledge
ACTIVITIES	Define and adopt common principles	Access capacity needs in political and technical users	Develop discussion papers for roundtable events	Identify existing platforms to be involved/enhanced
	Apply principles (e.g., within terms of reference)	Identify and fund existing capacity building initiatives that involve co-creation process	Develop technical papers on energy modeling and planning topics	Identify and develop key platform's features
	Regular roundtable events and engagement with in-country planners	Foster support for national and regional centers of excellence	Work with tool developers to support interoperability	Communication activities about the platform(s)

PROBLEM/CONTEXT: INTEGRATED ENERGY SYSTEMS PLANNING AND MODELING

Incoherent energy planning manifested by:

- Fragmented donor support, often externally driven
- Lack of accessible, transparent, and standardized resources
- Local capacity is not sustained and institutionalized
- Current platforms have gaps and are difficult to navigate
- Lack of integrated energy planning (overemphasis on supply)

Leads to:

- Difficulties of current models to address new energy transition shift
- Lack of buy-in to evidence-based planning by local stakeholders, leaders, and policymakers

Resulting in:

- Inefficient allocation of energy resources for energy access

Notes

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