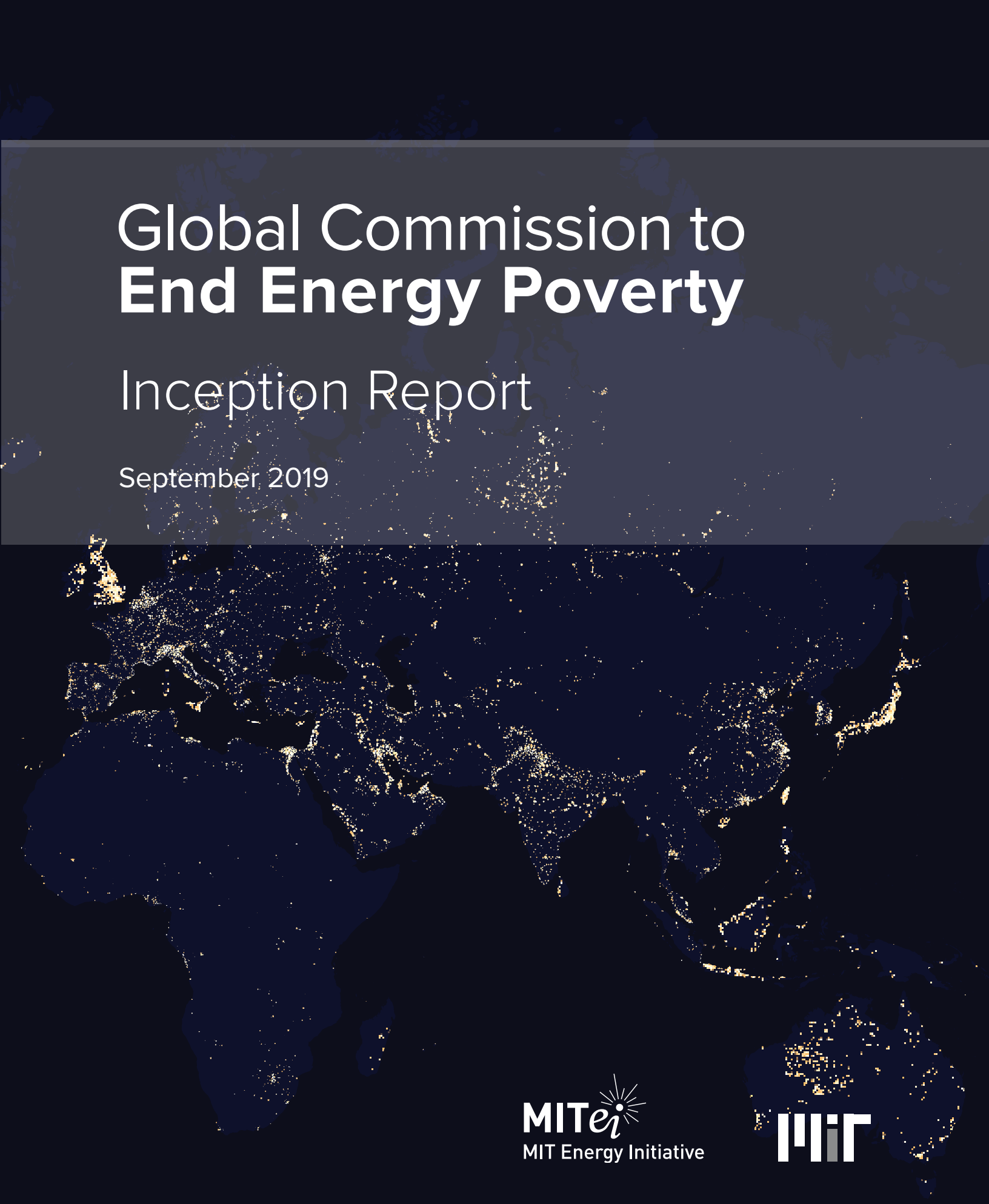
# Global Commission to **End Energy Poverty**

## Inception Report

September 2019



MITei
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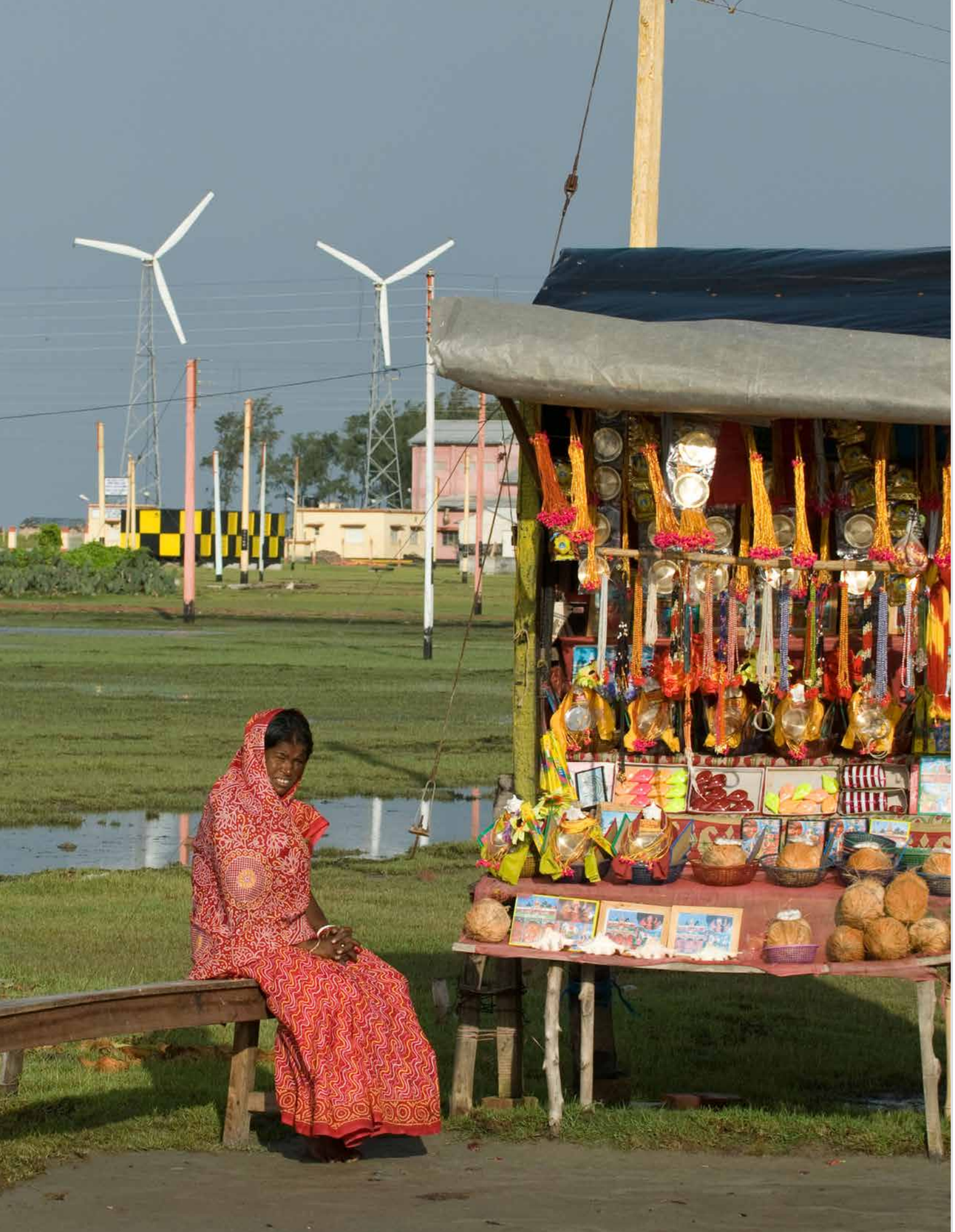
# Contents



# Foreword

This Inception Report marks the launch of the Global Commission to End Energy Poverty. It is the work of a research team we are proud to lead and be part of. We present it to the Commission as a framing of salient issues and ideas, and to serve as a starting point for discussion, debate, and much further work.

We are grateful to our team members Raquel de la Orden, Reja Amatya, Raanan Miller, and Shivangi Misra for contributing so much to this report. We also acknowledge and thank our colleagues at The Rockefeller Foundation, Suman Sureshbabu, Ashvin Dayal, Eric Gay, and Clare Boland, for their many contributions as well—indeed, for having conceived the idea of the Commission, and inspiring us to do this work. We look forward to working with them all in the coming year.

**Ignacio Perez-Arriaga, Robert Stoner, Divyam Nagpal, and Gregoire Jacquot**

Massachusetts Institute of Technology

# Executive Summary

The **Global Commission to End Energy Poverty (GCEEP)** was conceived to convene and help forge an actionable consensus among the many public and private actors who have a stake in bringing about universal access to modern energy services. Our ultimate objective as project developers, agency heads, regulators, leaders of development finance institutions, and private and public utilities is to present a compelling vision that can help attract investment into the energy sector of low-access countries and dramatically accelerate change.

Energy access is the 'golden thread' that weaves together economic growth, human development, and environmental sustainability.[1] Yet, the global community is still far from "ensuring access to affordable, reliable, sustainable and modern energy for all by 2030."[2] Moreover, the service quality and reliability available to many of those who nominally have access is so poor that it does little to improve daily life and has negligible economic impact. Despite recent progress, the world is not on-track to achieving the goal of universal energy access—sustainable development goal 7 (SDG 7) in the United Nations' 2030 Agenda for Sustainable Development—in electricity, with sub-Saharan Africa (SSA) at greatest risk of being left behind.[3]

The solutions to reach universal access must be commensurate with the magnitude of the challenge. In a few words: we must think big. Our mission is to achieve full electrification of entire provinces, countries, and even regions so that all citizens, public institutions, businesses, and industries have access to safe, secure, affordable, reliable, and adequate energy services.

In financial terms, this means a substantial augmentation of public and, in most cases, private investment, with a focus on specific segments of the electrical supply chain. At $30.2 billion per year, current annual total global investment in electricity access falls far short of the estimated $52 billion needed annually to meet our universal access goal. Private investment in electricity access has increased considerably over the past few years: in 2015–2016, private investors provided the bulk of funding in the sector—60% of total commitments—for the first time. Yet this investment has been disproportionally in generation projects in a small number of countries. Transmission and distribution received less than 20% of total investment in the sector; SSA, which includes 15 countries in a ranking of the top 20 countries with access deficits, received just 15% of total financial flows.

1 IEA. (2017). Energy Access Outlook 2017: From Poverty to Prosperity. OECD/IEA.
2 UN ESMAP Sustainable Development Goal 7 (SDG7) https://www.un.org/sustainabledevelopment/energy/
3 IEA, IRENA, UNSD, World Bank Group, & WHO. (2019 version). Tracking SDG7: The Energy Progress Report. https://www.irena.org/publications/2019/May/Tracking-SDG7-The-Energy-Progress-Report-2019

The GCEEP research team has examined key aspects of the electrification challenge: large generation, transmission, international power trading, the various levels of distribution, off-grid electricity supply, and the services that electricity can provide. Although we found serious shortcomings at every segment of the industry, we conclude that it is in distribution where the need for intervention is most acute. With a few exceptions, and for a variety of reasons, incumbent distribution companies (discos) in low-access developing countries are in dire financial straits. Because politically driven tariffs do not cover the cost of supply, which is frequently too high due to numerous inefficiencies, distribution companies—and often, in the end, national governments—are left to absorb the deficit.

Cash-strapped discos are unable to invest in connecting new customers and refurbishing and maintaining their networks. In many cases discos stop purchasing bulk electricity at prices not covered by the tariffs, which leads to unreliable service and dissatisfied customers who refuse to pay their bills or even steal the power, thus further reducing revenues. This all-too-familiar vicious cycle typically lands discos in low-access countries in chronically perilous conditions. The publicly owned discos periodically require publicly financed bail-outs, while discos that have been privatized often find themselves focusing their resources on a small number of profitable customers and unable to raise capital for expansion.

A recent spurt in the adoption of off-grid electrification solutions—involving standalone systems and mini-grids combined with novel business and financing models and innovations in appliances—has, on the one hand, provided a renewed thrust for delivering access through a complementary route, while also adding to complexities at the distribution level. Electricity delivered by mini-grids can be less expensive than power supplied by the grid in rural areas with low-demand clusters of consumers who are far away from the existing network. Indeed mini-grids, or standalone systems (including mainly solar and hybrid solar-diesel home systems, solar kits, and solar lanterns), may be the only options available to rural households when an incumbent distributor fails to extend the grid.

Nevertheless, even in situations where they are the least expensive option, present day mini-grids are generally too expensive for poor rural households and cannot be viable without donor support, government subsidies—or the stable revenues available from large commercial, industrial or public off-takers willing to pay higher tariffs. The need for tailored financial support to bridge the viability gap becomes particularly key given the limited territorial area and consumer base of mini-grid operators compared to traditional utilities, whose larger customer base might offer opportunities for cross-subsidization. Standalone systems are becoming very popular, as they are affordable for better-off rural households; however, they do not provide a level of service consistent with grid access and are unable to serve productive loads of a magnitude that could power economic growth. In addition, in the absence of reliable service it has been the practice in many low-access countries, for commercial and industrial customers who require dependable power, to self-supply, typically with expensive diesel generation, and, more recently, with diesel-solar hybrid systems that may feed into the grid or a mini-grid when local demand is low. The challenge here is to make use of emerging technological opportunities and integrate disparate delivery modes and applications into a medium- and long-term vision of inclusive, efficient, and sustainable electrical supply for each of these countries.

## THE INTEGRATED DISTRIBUTION FRAMEWORK (IDF)

In preparing this report, the research team focused considerable attention on the concept of an integrated distribution framework (IDF), which offers a potentially promising solution to the distribution challenges currently facing many low-access countries. Of course, we recognize that other solutions or frameworks may emerge in the course of the Commission's deliberations that will warrant further investigation for the final GCEEP report. The IDF is a conceptual framework that addresses several requirements we consider indispensable for any universal electrification approach to succeed.

- **Inclusiveness.** Inclusive electrification within a designated region requires there to be an entity that assumes real—not just formal—responsibility for serving all consumers in the region, irrespective of their level of demand and under minimum quality conditions. In some low-access countries, establishing this actual commitment within a designated region may be accomplished in a single step, or it may be the end step in a multi-year evolutionary process.

- **Permanence.** Access to electricity must be assured indefinitely—that is, permanently over time. This requires an institution in charge with a long-term vision and commitment.

- **A mix of delivery modes.** The least-cost electrification plan to meet rural demand in a territory will involve a combination of on- and off-grid modes that distribution-responsible entities must deploy efficiently, balancing cost, reliability, and customer preferences, among other factors.

- **Harnessing external resources.** Without some external intervention it is difficult to imagine how most incumbent discos could substantially improve their present dire technical, managerial, and financial conditions. Many will have to partner with external entities able to access capital, advanced technologies, and management expertise, so that reliable service, loss reduction, and a new consumer engagement approach can be achieved.

The IDF is a conceptual framework encompassing these four requirements that helps us to identify viable approaches to universal electrification. It brings specificity to the usual requirements that any entity participating in the electricity sector must have a viable underlying business model, and be part of a long-term plan for system expansion and economic growth.

The IDF admits a range of business, regulatory and legal arrangements adapted to the specific characteristics of each country. At one extreme, the obligation to serve would remain with the incumbent disco—one or a few per country—which is compatible with the presence of mini-grid developers (meeting some standards of service quality and grid compatibility) and solar kit providers within the disco's territory. This disco should be subject to some reforms aimed at turning it into a viable business, as discussed below. In addition to extending the grid, the incumbent disco would have a default obligation to provide off-grid supply with some required minimum level of performance for those customers in off-grid designated areas that are not supplied by independent developers. The disco would also be the supplier of last resort in the case of default by an independent off-grid developer.

At the other extreme, in a situation where the incumbent disco has not made significant progress in electrifying its territory, mini-grid developers could occupy some geographical area and with time become *de facto* concessionaires, once they meet some minimum conditions. At that point, mini-grids would operate as normal utilities, subject to regulated cost-reflective revenue requirements, subsidies, and tariffs to end customers. These independent utilities would coexist with the incumbent disco, which in parallel should be subject to reforms to turn it into a viable business. Customary rules regarding exclusivity of supply within concession areas would apply, adapted to this particular situation. The options available to a mini-grid developer when "the grid arrives" should be clearly specified. All these utilities would compete to deliver services to still unelectrified customers under conditions established by the regulatory authorities.

Among the possibilities for external participation in the incumbent disco, partnering with the private sector is the most direct approach, with the possible (and desirable) involvement of capable local companies, mini-grid developers and vendors of standalone systems. The involvement of the private sector could take the form of a long-term concession, with responsibility for managing the company—including operations, planning, investment, metering, billing and revenue collection—under a previously agreed remuneration scheme, including performance incentives. Other approaches to regenerate incumbent discos will also be explored during the Commission's first year, and ideas are welcome in this regard.

The remuneration scheme for the incumbent disco, and for mini-grids, should recognize the different nature of "physical network assets and operation" (i.e., strict distribution network activity, or 'carriage') and "consumer interactions" (i.e., the retail activity, or 'content') components of the traditional distribution company. For purposes of this discussion, the IDF approach applies to both the incumbent disco and to mini-grids that also become concessionaires.

A subsidy for any disco that expands access is needed if governments and regulatory authorities are not willing to apply local tariffs that reflect the actual costs. Distribution of electricity in rural areas with disperse and low demand has never been economically viable in any developed or developing country without

subsidies—under diverse formats, ranging from tariff cross-subsidization to direct payments to the incumbent disco or territorial concessions under mutually agreed conditions. This applies both for on- and off-grid solutions. And this makes discos particularly dependent on legal security in their country.

There are multiple strategies for reducing the required volume of subsidies: optimal planning to find the least-cost mode of electrification; improving consumer satisfaction and deploying advanced metering to drastically reduce illegal connections and unpaid bills; cross-subsidizing tariffs for lower-income households through other loads that can absorb some price increases, such as high-consumption residential, commercial and industrial (C&I) customers; bringing back to the grid those C&I customers who defected because of poor reliability or excessive cross-subsidization; standardizing supply equipment and demand appliances with an emphasis on efficiency; creating activities around electricity access to stimulate additional residential demand, plus productive uses and community activities that need electricity; globally increasing useful demand and prosperity; and reducing per-unit supply cost.

Consumer engagement to change public perceptions and customer mindsets with respect to the electricity supplier is a critical component of the IDF. Initial investments will be necessary to achieve satisfactory reliability and quality of service, which are necessary conditions for any attempt to introduce cost-reflective tariffs and address unpaid bills and illegal connections.

The IDF goes beyond mere connection to stimulate local economic development by facilitating its customers' productive use of electricity, integrating the deployment of energy-efficient appliances with microfinance support and developing spin-offs, either with the concessionaire itself or through integrated partnership programs with external providers. In a virtuous cycle, additional energy-intensive uses of electricity will increase the capacity factor of newly connected demand, reducing per-unit energy costs. In this regard, expanded electric cooking—with its health, environmental and potential economic advantages—is an attractive policy proposition that deserves to be seriously examined.

The IDF will encourage the use of innovative technologies to efficiently provide high-quality electricity. For example, system design and pre-site preparation costs can be lowered substantially by the use of geospatial planning tools, while operation management costs can be reduced by using remote-controlled management systems, smart meters, and pay-as-you-go schemes.

### Adaptability of the IDF Concept

We believe that the IDF concept can be adapted to the diverse circumstances of low-access countries with their range of power sector structures and regulatory regimes, and we have noted that there are many paths to creating an effective concession. Although we are not aware of any situation to date in which all the defining features of the IDF have been successfully combined, each feature has been implemented successfully *somewhere*, providing a rich base of experience from which to draw lessons.

The IDF can be adapted to the power sector structure of each country. For example, in countries with vertically integrated utilities, distribution unbundling is not necessary to implement the IDF, since only a clear definition of the rights and obligations of the concession is needed, along with, notably, agreement about the method of remuneration.

Even in those countries where near full electrification has been achieved, but reliability and service quality are still poor, the IDF concept offers useful guidance. The partnership of the incumbent distributor with an external investor can provide the resources needed to improve local reliability and quality of service with strategically located local generation and storage, facilitate productive uses of electricity and appliance financing, and implement new approaches to customer engagement that are made possible by advanced technologies for metering, payment, and communication.

Electrification should be regarded as a dynamic process that depends on changing local conditions. In light of the speed with which they can be deployed, mini-grids and standalone systems are essential new weapons in our quest to end energy poverty quickly. They can also serve to unlock latent community demand for electricity, thereby justifying subsequent investments in larger systems and, ultimately, interconnection with the grid.



A key feature of the IDF concept is that the three available modes of electrification—grid extension, mini-grids and standalone systems—are deployed within a single planning regime and placed on a level playing field. With notable exceptions (e.g., the unfolding case of Rwanda), these three modes of electrification, where they appear, have been deployed in a largely uncoordinated manner and with the involvement of different entities, which has tended to lead to competition rather than complementarity. Ideally, a comprehensive integrated planning methodology based on GIS technologies would identify the least-cost mix of electricity delivery modes; an IDF-compatible entity would be motivated by financial self-interest to ensure that the plan is implemented effectively; and dedicated policies and regulations would be implemented to address any issues arising from the interaction between on- and off-grid solutions, as well as tariff-setting.

### Is the IDF financeable?

The IDF concept is sound from a regulatory and business-model standpoint. But the complexity created by the present, precarious condition of distribution companies in many low-access countries should not be underestimated. The ability to attract investment is the key challenge. Since rural electrification requires subsidies, the service provider runs the risk that the subsidy may be insufficient, or delayed—possibly indefinitely—with dire consequences. Some form of payment guarantee is needed from the national government in the first instance, underwritten by a willing financial institution. Experience so far has shown that such guarantees are not easily obtained in countries with dubious legal security, or with high sovereign debt—conditions that are common among low-access countries. Also, as indicated above, the situation is even more difficult for privatized distribution companies that may have high debt burdens and little access to additional capital.

These financial challenges can be overcome only with cooperation among internal and external stakeholders and a commitment to finding win-win outcomes. These stakeholders include:

- National governments, whose role in creating a stable and predictable investment environment with supportive policy and adherence to agreements with private investors cannot be overstated. Governments also play an indispensable role by implementing policies to accelerate and amplify the impact of energy system investments—for example, by funding and allocating subsidies among urban and rural consumers, productive and non-productive uses, and, in the case of the IDF, among on- and off-grid providers. In addition, governments must show leadership and political will in moving quickly to restore the financial viability of public and private distribution companies and by ending ineffective bailouts.
- Regulators, whose role in regulatory reform and enforcement will also be crucial, notably to establish cost-reflective tariffs and ensure that providers are appropriately incentivized to meet aggressive access, cost, efficiency, and reliability benchmarks, and to ensure that direct and indirect subsidies are deployed fairly and effectively. Specifically, with respect to implementing IDF-like concessions, regulators must also benchmark and enforce cost-efficient planning and institute backstopping mechanisms that ensure continuity of service should one or more parties to a concession fail to perform.
- Distribution companies, which must improve their operations and adhere to agreed financial and other performance metrics, and, in the case of the IDF, achieve access metrics that may call for the expanded use of off-grid technologies, either in their own businesses or by third parties operating within a shared concession.
- Off-grid firms, which have an unprecedented opportunity within the IDF to dramatically expand their businesses while also, through continuous innovation, playing an important role in accelerating rural access and creating value and opportunity for their customers in the long run.
- Development banks, which offer knowledge and expertise and are longstanding stewards of concessionary and significant commercial financing on behalf of the global community. Development banks already fulfill a wide range of roles and responsibilities, and have active operations in all the countries we hope to impact. They will be central to helping shape and adapt the IDF to the

differentiated needs and situations of individual countries. Indeed, it is hard to see how the aim of achieving universal access by 2030 can be achieved without the engagement and leadership of development banks.

- Private investors and developers, who we hope will remain engaged given the opportunities that will be created through cooperation across this wide range of stakeholders. Private investors and developers will also need to keep faith with those governments that sign on to a necessary program of reform and aggressive action.

## GCEEP AND WHOLESALE POWER SUPPLY

This report invites the Commission to focus primarily on electricity access problems at the distribution level. However, the rest of the power sector clearly cannot be neglected as ultimately the cost and reliability of the bulk energy supply will determine the reach and viability of grid power within the distribution segment. Reducing generation costs makes grid power affordable to more people, and reduces the need for subsidies. Additionally, high reliability is indispensable for engaging residential consumers and bringing back defected Commercial and Industrial (C&I) customers.

Moreover, we conclude that well-understood market mechanisms and cooperative arrangements exist throughout the world that could and should be emulated by the governments of many low-access countries—generally at little or no expense—with enormous potential implications for supply cost and reliability. The Commission is well positioned to play a convening and educating role aimed at making these opportunities more widely known, and at encouraging governments to act swiftly to pursue them.

A sustainable electricity supply at the wholesale level—where we mean sustainable in the broad sense of affordable, reliable, and environmentally acceptable—is critical for grid-connected consumers. In many low-access countries, low demand and inadequate physical interconnections between neighboring countries constrain the utilization of energy resources on a regional basis and limit the cost and efficiency benefits available from scale. Large centralized power plants, a transmission network infrastructure sized to meet national and cross-border needs, and effective collaboration between countries in planning and operation are all necessary ingredients for providing an adequate, reliable, and affordable wholesale supply of electricity.

### Centralized generation

Regions with large underserved populations have historically seen low levels of investment in generation. Total installed generating capacity in Africa (245 GW), for instance, is roughly on the order of that of Spain, which has 110 GW of capacity to serve a population of 45 million, versus Africa with a population of 1.2 billion. Furthermore, South Africa and North African countries account for nearly two-thirds (165 GW) of the regional capacity for all of Africa. Expanding generation capacity accounts for a majority of the estimated overall cost of achieving universal electricity access. Here, again, private-sector financing is crucial to bridge the existing investment gap. Often this requires structural reforms to provide an entry point for independent power producers (IPPs), backed by appropriate legislative and regulatory action.

Recent generation investments have been largely driven by long-term power purchasing agreements (PPAs) with IPPs, coexisting with the traditional integrated monopoly utility structure. Competitive bidding processes have increasingly been used to solicit private-sector participation, typically with build–own–operate or build–own–operate–transfer arrangements. Such processes have also been instrumental in the widespread deployment of utility-scale renewable energy projects in many developing countries.

A focus on planning, procurement, and contracting practices for new generation is needed to attract private-sector investment, along with simultaneous improvements in the performance of distribution utilities. Well-designed and robust PPAs are critical for establishing secure, long-term revenue streams for IPPs, thus reducing risks for private investors and facilitating access to financing under favorable conditions. Ideally, a ‘bankable’ PPA would provide for a long-term agreement with a creditworthy off-taker over a time horizon that allows debt servicing and provides risk-equivalent returns for investors. The integrity and transparency of the procurement process has to be protected, and contract structures have to clearly define the allocation of risks and rewards, as well as the rights and responsibilities of stakeholders. To create a robust framework for generation investments, efforts are underway to develop standardized templates for PPAs and other key contracts.

Despite encouraging trends in private participation in generation capacity expansion, much larger investments must be mobilized, and these investments must be spread more evenly, to address the needs of countries with the largest access deficits, especially in SSA. A number of country- and project-specific factors are known to influence IPP investments. At the country level, important factors include political and economic stability; a clear policy framework; transparent, consistent, and fair regulation; and coherent power-sector planning and competitive bidding practices. At the project level, they include favorable financing conditions, confidence in the creditworthiness of the off-taker, a secure and adequate revenue stream, and access to instruments for mitigating financial risks.

A critical factor that may impede the construction of large power plants (for example, to exploit existing hydro resources), or capacity additions of sufficient size to achieve optimal output efficiencies, is the lack of effective regional power-system integration and an adequate transmission network infrastructure to make it possible.

### Transmission

Transmission accounts for a relatively small portion of the overall power-sector value chain, but it is essential to connect low-cost, large-scale sources of electricity generation with important demand centers in cities and large industrial or commercial loads. These networks also reduce the operating and capacity reserves needed to ensure security of supply and support the integration of renewables into the power system. By enabling efficient dispatch at the national and regional levels, robust transmission networks facilitate the development of generation with large economies of scale in resource-rich areas to serve distant loads. In many countries with low internal demand, economies of scale can be reached only at a regional level. Upgrading and building new transmission infrastructure is an essential part of the overall expansion of the power sector.

Sub-Saharan Africa has a combined transmission network smaller than that of the country of Brazil. Nine SSA countries have no lines rated above 100 kilovolts (kV). On a per-capita basis, Africa has fewer kilometers of transmission lines than any other region of the world, despite having a much larger land mass and a more dispersed population. As with generation, substantial investments in transmission infrastructure will be needed to achieve full electrification, and to realize globally competitive electricity costs.

Nevertheless, transmission investment in many developing countries has lagged for a number of reasons: i) most developing countries finance transmission investments directly from utility revenues, government budgets, concessionary financing from development finance institutions (DFIs), or grants from donors, and do not have regulations that accept some form of private participation in transmission; ii) there are flaws or uncertainties in the regulation of transmission activity, which is very country-dependent; and iii) investors face country-dependent risks, similar to those previously described for generation investments.

Many countries have successfully introduced private-sector participation in the development, operation, and maintenance of transmission infrastructure. Private companies now finance a large share of transmission investment in many countries in North and South America and in Europe. Privately financed transmission has also been introduced in some low-access countries, particularly in South Asia and Latin America. The approach is similar to the concept of independent power producers in generation, which has already yielded good results in low-access countries.

The private sector could play a major role in scaling up transmission capacity in SSA and elsewhere. Again, the lack of investment in this segment of the power sector should not be attributed to any intrinsic difficulty with creating a viable transmission business model in developing and low-access countries, since a sound model can be defined in a standard way as an independent infrastructure project that is mostly financed by private capital. The difficulties reside in policies that do not permit the entry of private investors in transmission infrastructure, as well as in regulatory flaws, country-specific risks, and the failure to effectively implement a regional vision of the power sector.

### Power pools

Regional integration of power systems can be an effective way to create economies of scale for mobilizing private-sector investments, leverage synergies related to demand and supply, and advance economic integration. When properly designed and implemented, regional power pools can lower the cost of electricity supply and improve the quality of delivered electricity services, thereby driving socio-economic development. Power pools provide these benefits when they include regional-scale generation plants and adequate cross-border transmission infrastructure. These prerequisites can only be met under sound power pool rules and governance. Obviously, the cheapest and potentially fastest way to launch a virtuous circle of regional integration is by designing and implementing a well-functioning power pool, which is mainly a legal institution.

Bilateral trade agreements and regional power pools are commonplace across all regions that face electricity access challenges, from Southern, West, East, and Central Africa to developing Asia and Central America. Yet, in most cases their potential remains largely untapped. The main obstacles to achieving the known benefits of power pools are weak regional governance and flaws in the rules for regional trading and transmission cost allocation. Both factors discourage investments in transmission infrastructure and regional-scale generation plants, especially when combined with a lack of trust among states, a lack of willingness to liberalize markets, concerns over the preservation of national autonomy and sovereignty, as well as a preference for bilateral contracts over regional agreements. Effective interventions must focus on removing these obstacles, or at least mitigating their impact.

Proven regulatory solutions exist to address all these regulatory issues. Combining experience from the implementation of the EU Internal Electricity Market (IEM), Central America's MER, the Indian and Australian National Electricity Markets, and regional transmission organizations (RTOs) in the United States with necessary adaptations to reflect the conditions of power pools in emerging economies could have significant value.

Participating countries and external partners, including private entities and financing institutions that are willing to invest in regional infrastructure under the right conditions, need to have strongly aligned interests. National-level political commitments are needed to give executive responsibilities and adequate resources to regional institutions, identify barriers and vested interests that impede progress, and build the capacity to regulate and operate regional systems.

To be effective, any regional plan requires a clear economic justification and the buy-in of the political leadership. We hypothesize that progress can be made by taking advantage of political momentum and ongoing efforts to further regional integration to identify gaps and opportunities that can be addressed through expanded dialogue and analysis. We believe that the Commission can play a significant role—by shaping opinion and facilitating political action—in reinforcing regional institutions. The Commission can also, by promoting capacity building, help improve market rules following well-established international practices.

## A WINDOW OF OPPORTUNITY

To formulate actionable recommendations for accelerating electrification, new ways of thinking about the issues are needed. It will be important to account for the changing landscape of the power sector globally—and for emerging trends that favor decentralization, low-carbon resources, and smart infrastructure. At the same time, it will be critical to be aware of technological and other advances that offer truly transformative opportunities to do things differently. Several recent developments provide grounds for optimism that 'meaningful' energy access can be advanced in a timely manner, while also contributing to the achievement of multiple sustainable development goals.

Fundamental questions need to be raised and debated: What type of access should we aim for? With the advent of decentralized solutions and new power-sector players, how can utilities most effectively support the electrification agenda? What is the most effective role for the private sector? How can we ensure, through business-model design, policy, and regulation, that no one is left behind, and that the access and services that are created are *permanent*? Is the approach we adopt to electrification consistent with a sound long-term vision for the provision of electricity services?

Against the backdrop of these emerging questions, the goal of the **Global Commission to End Energy Poverty** is to describe a viable pathway for providing electricity services to hundreds of millions of underserved homes and businesses around the world—more quickly and more cost-effectively than can be expected by continuing along the current trajectory. The Commission convenes leaders from government, utilities, the private sector, DFIs, and intergovernmental organizations to advance the discourse on a new approach to electricity access—one that harnesses the potential of new technologies and opportunities, ensures inclusiveness, mobilizes large volumes of economically viable investment, and enables rapid progress toward the 2030 target of universal access.

GCEEP is a unique and wide-ranging community of stakeholders in electrification, representing international development banks, private investors, utility leaders, policy makers, philanthropists, project developers and entrepreneurs, and diplomats. We hope that our deliberations will lead to cooperative action, and that our final report will mark the beginning of a new phase in the global effort to end energy poverty.

# Chapter 1:
# The Electrification Challenge

## 1.1 THE URGENCY TO END ENERGY POVERTY

Although recognized as a key ingredient of growth and development, the achievement of universal energy access has seen slow progress. Even as the global population without access to electricity decreased from 1.2 billion in 2010 to about 840 million in 2017, sub-Saharan Africa has remained the region with the largest access deficit, with more than half of the population lacking access to electricity. By 2030, the target year for reaching universal access under Sustainable Development Goal 7 (SDG 7), a projected 650 million people will likely still remain without access to electricity. Nine out of ten of them will live in sub-Saharan Africa.[4]

The implications for economic development are alarming. Access to affordable, reliable, and sustainable energy is an imperative to catalyze economic growth and advance socio-economic development. It offers the opportunity to create prosperity and jobs at home and allows for education, reduced pollution, and improved human health and conservation of ecosystems, while contributing to climate change mitigation.

Technological innovation is also giving rise to a growing portfolio of electrification options, many incorporating low-cost off-grid solutions and efficient household and productive appliances. Inexpensive solar powered systems providing basic services such as lights and phone chargers, as well as more sophisticated solar home systems (SHS) are now widely available in many countries through innovative retailers who are using digital technology to rapidly achieve scale. Solar and solar-diesel hybrid mini-grids have taken hold more slowly despite their favorable economics for isolated communities and ability to power productive loads, but seem likely to become important for rural electrification as a complement to grid extension.[5]

4 IEA, IRENA, UNSD, World Bank and WHO (2019), *Tracking SDG 7: The Energy Progress Report*, Washington DC.
5 ESMAP (2019), *Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers*, Washington DC.

To achieve universal access by 2030 leveraging these and other emerging technologies, a rapid acceleration of progress in many countries will be needed. What is required is to think creatively and at scale about policies, regulation, delivery models, and financing solutions that can rapidly mobilize substantial amounts of public and private capital, build skilled labor capacity, and align government and industry incentives towards an efficient, integrated electrification approach.

Doing this will require cooperation and an extraordinary commitment on the part of a large number of stakeholders—from governments, to regulators, to private investors and developers, to monetary financial institutions (MFIs) and entrepreneurial off-grid firms. The role of the Commission is to convene these stakeholders and forge an efficient path forward, involving urgent commitments from all sides—with governments, regulators, and incumbent companies committing to a range of reforms and goals, and investors and financial institutions committing to deployment of capital and skills.

### Stepping up and focusing investment

Meeting the energy access challenge will require substantial investment across the power sector in on- and off-grid generation, transmission, and distribution, as well as in institutional capacity building. At $30 billion per year,[6] current total investment in electricity access lags significantly behind the estimated $52 billion required on average per year to achieve universal access by 2030.[7] Moreover, progress has been very uneven, creating pockets of low access among and also within countries—some of them with relatively high levels of overall electrification, as in Central America, as well as South and Southeast Asia.

At present, roughly 80% of total commitments are directed towards grid-connected generation projects, leaving a large investment gap in transmission and distribution as well as in off-grid solutions. Also, the 13 sub-Saharan Africa (SSA) countries among SEforALL's 20 High Impact Countries attracted less than 17% of total commitments in the sector, putting SSA countries at severe risk of missing the SDG 7 target.

The investment gap is too large to be filled with public financing and the limited concessional capital available from development finance institutions. Substantial private capital will therefore be required, but it will only materialize when the energy sectors of low-access countries become investable. To help achieve this, public financing must be deployed catalytically, addressing structural viability in each segment of the power sector: generation, transmission, and distribution.

## 1.2 FIXING DISTRIBUTION IS THE TOP PRIORITY

In many ways, the viability of the power sector and its ability to attract private investment hinges ultimately on the strength of the distribution sector. On one hand, generators and transmission operators rely on distribution companies, or discos, for reliable off-take and timely revenue collection and payment. On the other, the distribution sector is closest to consumers and thereby directly influences the quality of service delivered and the efficiency of retail processes (including billing). It is no coincidence that the distribution sectors in many low-access countries are in a state of disarray.

Many of these countries fall into a vicious cycle, often initiated by governments setting tariffs[8] below the cost of delivering power - which may itself be necessitated by the socio-economic status of populations, excessive generation costs, and high technical losses. The cycle is characterized by the resulting underinvestment in infrastructure and consumer retailing by the incumbent distribution company, leading to declining consumer satisfaction and willingness to pay, depressed revenues, and chronic indebtedness, which in turn drives further underinvestment. This inhibits the ability of distribution companies to act as reliable off-takers for generation and transmission, leading to higher wholesale costs; it also inhibits their ability to undertake capital-intensive efforts to expand infrastructure and electricity services to rural areas. Poor quality service encourages defection, which in turn further erodes revenues. In Nigeria, for instance, an estimated 86% of companies own or share diesel generators, which they use, on average, to meet nearly half their total electricity demand.[9] It is the robustness and ubiquity of this cycle that leads us and many others to argue that dysfunction in distribution lies at the heart of the energy access challenge.[10]

The distribution failure is most noticeable in the last mile, closest to the end customer. Traditionally, countries around the world have relied on cross-subsidies between urban and rural consumers—as well as between different consumer groups, or direct subsidies to the incumbent utilities—to keep rural electricity tariffs low while covering the full cost of electrical supply. Such approaches can be effective in providing last-mile electrification (which is markedly more difficult and costlier on a per-unit basis) in many parts of South and Central America, as well as Southeast Asia, with a high proportion of electrified customers. However, countries with large unconnected populations often cannot afford to do this, especially when these populations are dispersed in rural or isolated areas where electrification is expensive. As noted above, many countries attempt to make electricity affordable by setting artificially low tariffs, with predictably adverse consequences for grid reliability and for the financial health of their utilities, as well as chilling impacts on private investment.

The current financial condition of discos in many low-access countries has to be repaired, and this will require strong government action backed by regional and international development partners. A few discos have been privatized, but most remain publicly owned, and new financial arrangements will have to adapt to these initial conditions. Some countries, such as India, are attempting to address legacy challenges in the sector by under-writing the debt of publicly owned discos and linking future support with structural reforms, including tariff rationalization and improvements in operational parameters (e.g., distribution losses, billing). Increased private-sector involvement to improve operational efficiency and management, as well as to facilitate new investments in distribution, has also been pursued in some countries using approaches that have ranged from long-term concessions to straight privatization. Even where these approaches have partly succeeded, it still cannot be presumed that discos will have the resources and incentives to invest in rural electrification given the high cost of connecting and servicing rural customers with limited consumption.

### Off-grid energy solutions

Technological advances and innovative financing and delivery models are disrupting traditional electrification processes, offering new opportunities to accelerate progress toward universal access. Rapid cost reductions and improved reliability are allowing distributed renewable or hybrid energy technologies—both grid-connected and off-grid—to emerge as timely alternatives to centralized power infrastructure for end-users.[11] Worldwide, 47 million people are currently connected to 19,000 mini-grids, mostly hydro and diesel-powered. An estimated 7,500 mini-grids are planned, mostly in Africa, and mostly consisting of solar-diesel hybrid systems; these new systems are expected to connect more than 27 million people.[12] In Bangladesh, more than 18 million people, or 12% of the total population, have basic electricity access from solar home systems.[13] At least 154 million people were

6 Sustainable Energy for All (SEforALL) and Climate Policy Initiative (CPI) (2018), *Understanding the Landscape – Tracking Finance for Electricity and Clean Cooking Access in High-Impact Countries*. License: NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0).

7 This is an International Energy Agency (IEA) estimate for a particular set of assumptions concerning the level and geographical distribution of electrification: grid extension for all urban zones (500 kWh/yr consumption) and around 30% of rural areas (240 kWh/yr). The remaining rural areas would be connected either with mini-grids (65%) or solar home systems (35%).

8 We acknowledge our colloquial use of "tariff" in this situation. In fact, tariffs account for only a portion of the remuneration allocated to distribution, which may also include subsidies and other forms of compensation such as performance incentives.

9 GIZ (2015), *The Nigerian Energy Sector: An Overview with a Special Emphasis on Renewable Energy, Energy Efficiency and Rural Electrification*, Abuja, www.giz.de/en/downloads/giz2015-en-nigerian-energy-sector.pdf.

10 Kojima, Masami; Trimble, Chris. 2016. Making Power Affordable for Africa and Viable for Its Utilities. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/25091.

11 For example, in Kenya, Nigeria, and Ghana, on-site solar power can now be generated for $0.10 – 0.14 per kilowatt-hour (kWh), which is cheaper than the tariffs that apply to grid-connected C&I customers, although it resorts to the grid as backup. BNEF (2019), Solar for Businesses in Sub-Saharan Africa, https://data.bloomberglp.com/professional/sites/24/BNEF_responsAbility-report-Solar-for-Businesses-in-Sub-Saharan-Africa.pdf.

12 ESMAP (2019), *Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers*, Washington DC.

13 IDCOL (2019), IDCOL Solar Home System Program, http://idcol.org/home/solar.

estimated to have benefitted from electricity services from off-grid renewable energy technologies through 2017—a seven-fold increase over 2011—although only about 30 million people have a level of service that would be considered to constitute 'access.' [14,15] A recent ESMAP study of 53 operational mini-grids in Africa and Asia found that connection costs for mini-grids were highly competitive with grid connections, ranging from around $1,000 or less per household or business, to just over $2,100.[16]

Solar home systems and mini-grids are therefore becoming important within the distribution segment. Thus far, the development of off-grid electrification has largely taken place in a *laissez-faire* fashion, with the active involvement of the private sector and with limited coordination with incumbent distribution utilities. Ultimately, the absence of adequately harmonized planning policies is likely to result in inefficient and perhaps short-lived infrastructure investments, poor service standards, and sub-optimal resource utilization. While the flexibility and speed with which off-grid technologies can be deployed is important to meeting the needs of the underserved population in the near term, it will also be necessary to repair the structural, operational, and financial deficiencies of incumbent discos—with a view to achieving an efficient mix of delivery modes on the basis of cost and performance in the longer term.

### Searching for a sound approach

In summary, distribution in low-access countries faces two major challenges. First, the incumbent discos will need to undergo structural reforms and obtain external support to help address their financial and operational deficiencies while expanding within their service territories. Second, their role must be clearly articulated within an overall vision of the future power sector at the distribution level—one that retains the important characteristics of the traditional disco that give it permanence and predictability, but also encourages innovation and the adoption of new technologies, and makes room for cooperation and competition among several service providers within a common service region. To realize this vision, policy and regulatory action will be needed that assigns responsibility for universal access in the area of service, and guarantees permanence of service delivery.

We propose that the Commission should focus on the activity of distribution, and specifically on the 'last mile' of service delivery—that is, closest to the end consumer—while jointly addressing problems of reliability and quality of service, affordability, consumer engagement, and financial viability.

To the best of our knowledge, a satisfactory solution to the distribution segment's failure in low-access countries has not yet been articulated, or implemented. However, as discussed in Chapter Two, there are some successful experiences that strongly indicate promising directions for finding a comprehensive answer, with the ultimate goal of achieving a sustainable provision of reliable and affordable electricity services necessary for economic growth and human development.

### Electricity services

The meaning of 'access' varies greatly from context to context and is often defined by imprecise criteria such as a connection to the national grid (or to a mini-grid), or the existence of distribution infrastructure within a village. Designing a pathway to universal electricity access that yields substantial direct and indirect socio-economic dividends requires a more nuanced approach to defining access and setting targets.

Beyond counting connections, meaningful access should be measured across several attributes, including reliability, capacity, service hours, quality of supply, affordability, and safety.[17,18] Similarly, pathways to expanding access need to be sensitive not only to supply-side indicators, but also to end-user perspectives to account for future demand growth, accommodate current and anticipated energy needs (i.e., including productive end-uses), and address inclusivity concerns by ensuring that no one is left behind.

Creating effective linkages with productive end-uses and with public services (e.g., schools, health clinics, community centers) is crucial. In the health sector, for instance, off-grid technologies, often solar-based, are delivering reliable, affordable, and sustainable energy to power medical devices and support the provision of basic amenities (e.g., light, communications, water). In the Indian state of Chhattisgarh, solar electrification of more than 900 health centers and district hospitals has been linked to several health-related benefits: a 50% increase in patient admissions, a doubling of successful childbirths per month, and improved day-to-day care.[19]

In the agriculture sector, access to modern energy solutions can substantially improve agricultural productivity and yields.[20] Across the agri-food value chain—from primary production to processing, storage, and consumption—different energy needs exist. Increasing the energy intensity of the agriculture sector in emerging economies, and doing so through a greater share of renewables, offers the opportunity to improve climate resilience (especially for smallholder farmers), productivity, and incomes through value addition, while also reducing drudgery.[21]

In an effort to improve the quality and reliability of electricity services, discos will need to harness new digital, telecommunications, and automation technologies, including remote monitoring equipment with the distribution infrastructure (e.g., at the transformer level), smart metering, and data analytics for predictive maintenance. In Zambia, for instance, ZESCO developed Africa's first digital sub-station to address issues related to the high cost of maintenance and repair, poor hardware (cross-regional) interoperability, limited availability of information (e.g., voltage, currents, active/reactive power, frequency) and low grid visibility.[22] As discos look to focus on the quality of electricity services, they will need to invest in the grids of the future.

## 1.3 A COMPREHENSIVE VIEW OF THE ELECTRIFICATION PROCESS

The next challenge is creating a low-cost and reliable supply of electricity to feed the grid. While the Commission will focus on last mile distribution, the bulk power system cannot be ignored. Least-cost, adequate generation and efficient transmission infrastructure are both critical to a well-functioning distribution system. The reliability and quality of distribution, which may over time come to include embedded mini-grids and embedded generation, depend in turn on the presence of an efficiently operated and adequately supplied bulk power system, comprising centralized generation and transmission infrastructure. The wholesale price of electricity is key to the affordability of electricity supply for grid consumers, and in this sense controls the relative affordability of grid versus off-grid service. This is important because high wholesale costs fundamentally undermine the viability of the grid, with potentially negative consequences for industry and economic development.

This section summarizes key challenges in centralized generation, transmission and power pools. Chapter three presents actionable recommendations that the Commission could consider, in addition to solutions to the electricity distribution problem, supporting other parts of the electrification process, such as promoting the integration of African national power systems into regional entities, or power pools.

### Centralized generation

Countries with large underserved populations have historically seen low levels of investment in generation. Throughout the 1990s, new capacity additions in SSA

14 IEA, IRENA, UNSD, World Bank and WHO (2019), *Tracking SDG 7: The Energy Progress Report*, Washington DC.
15 IRENA (2018), *Off-grid Renewable Energy Solutions: Global and regional status and trends*, IRENA, Abu Dhabi.
16 ESMAP (2019), *Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers*, Washington DC.
17 Jain *et. al.*, (2018), *Access to Clean Cooking Energy and Electricity: Survey of States 2018*, Council for Energy, Environment and Water, New Delhi.
18 The Multi-Tier Framework (MTF), developed by ESMAP (2015), is a survey-based approach to measuring electrification across seven attributes - capacity, service hours, reliability or service interruptions, quality or voltage fluctuations, affordability, legality, and safety. On the basis of these attributes, the MTF assigns any given household to one of five tiers, ranging from Tier 0 (no meaningful access) to ultimately Tier 5 (unrestricted continuous service).
19 Severi, L. (2018), "In conversation with: Chhattisgarh State Renewable Energy Development Agency (CREDA)", http://poweringhc.org/in-conversationwith-chhattisgarh-state-renewable-energydevelopment-agency-creda/.
20 FAO (2012), *Energy-Smart Food at FAO: An Overview*, Food and Agriculture Organisation, Rome.
21 IRENA (2016), *Renewable Energy Benefits: Decentralised solutions in the agri-food chain*, International Renewable Energy Agency, Abu Dhabi.
22 Frost and Sullivan (2018), Digitization of Energy Transmission & Distribution in Africa, https://www.gegridsolutions.com/press/gepress/2018/WP-Digitization.pdf.

(excluding South Africa) remained negligible due to persistent financing challenges.[23] Even today, the total installed generating capacity in SSA is comparable to that of Spain, which has 110 gigawatts (GW) of capacity to serve a population of 45 million. South Africa alone accounts for nearly half of the regional capacity for all of SSA.

Historically, public utilities have been the main sources of investment in new generation capacity. A number of countries have initiated structural power-sector reforms,[24,25] and independent power producers (IPPs) are now the fastest-growing investment vehicle for generation capacity in more than 30 countries in Africa, with 270 existing projects. Together these projects total more than 27 GW of new capacity and represent about $52 billion of investment.[26]

Despite these encouraging trends, much larger investments must be made, notably in countries with the largest access deficits, especially in SSA. Many of the barriers to private sector investment in the generation segment are well understood. The extent of the barriers varies from country to country, but generally includes poor power sector governance (e.g., transparency in regulatory processes, project timelines, rule of law, sanctity of contracts), lack of a regulatory framework (e.g., tariff-setting processes, settlement of accounts or costs associated with third-party wheeling), limited regional integration and economies of scale, financial risks (e.g., creditworthiness of off-takers, structure of long term contracts), and macroeconomic conditions (e.g., sovereign credit rating, arbitration). [27]

### Transmission network[28]

Transmission accounts for a relatively small portion of the overall power-sector value chain, but it is essential to connect low-cost, large-scale sources of electricity generation with important load-bearing distribution centers. By enabling efficient dispatch at the national and regional levels, transmission networks facilitate the development of generation with large economies of scale in resource-rich areas. These networks also reduce the operating and capacity reserves needed to ensure security of supply and support the integration of renewables into the power system. Upgrading and building new transmission infrastructure is an essential part of the overall expansion of the power sector.

Many countries in Latin America and Asia have successfully introduced private-sector participation in transmission financing. The approach is similar to the concept of independent power producers in generation. Transmission has not yet benefited from the same influx of private investment as generation in SSA countries. Only a handful of governments have introduced regulations that accept some form of private participation. Most countries finance transmission investments directly from utility revenues or from the government budget, which significantly constrains network expansion. Others rely on concessionary financing from DFIs, and, in some cases, grants from donor countries.

The deficiency of private investment in transmission should not be attributed to any intrinsic difficulty with creating a viable business model, since one can be defined in a standard way as an independent infrastructure project that is mostly financed by private capital. The difficulties reside in policies that do not permit the entry of private investors in transmission infrastructure, as well as in regulatory flaws and country-specific risks, such as risks related to reaching agreements for construction, obtaining permits for necessary rights-of-way, enforcing rules for cost-sharing among different agents (particularly important for cross-border transmission). and providing payment guarantees.

23 Eberhard, A. (2018), *Independent Power Projects in Sub-Saharan Africa: 20 years of investment trends and lessons*, Presentation made at the African Energy Forum 2018, www.africa-energy-forum.com/sites/default/files/clarion_africa_energy_forum/pdfs/day_1_-_reflections_on_the_last_20_years_-_prof_anton_eberhard_ipp_investment_trends_and_lesson_in_ssa.pdf.

24 Eberhard et. al., (2017), Independent power projects in Sub-Saharan Africa: investment trends and policy lessons. Energy Policy 108:390–424.

25 AfDB and APUA (2019), *Revisiting Reforms in the Power Sector in Africa*, https://www.gsb.uct.ac.za/files/Final_Report_Revisiting_Power_Reforms.pdf.

26 *Ibid.* Over 42% of new capacity additions through IPPs during the last decade has been for solar PV, and over 37% for other renewables including wind, hydro, biomass, and geothermal generation. Auctions (international competitive bidding programs) are now a well-established trend for guaranteeing lowest prices for new renewable energy projects.

27 Eberhard et. al., (2017), *Independent power projects in Sub-Saharan Africa: investment trends and policy lessons*. Energy Policy 108:390–424.

28 World Bank (2017), *Linking Up- Public-Private Partnerships in Power Transmission in Africa*, Washington DC.



### Power pools

Regional power pools[29] and cross-border electricity trading are beneficial for low-access countries for several reasons. They allow investors to reach larger and more diverse markets, while also realizing economies of scale that can help access low-cost power. Regional power pools are particularly relevant in the specific context of sub-Saharan Africa, both because the size of the national power system in at least 20 countries in this region is below the efficient level of output for a single power plant[30] and because some countries have sufficient renewable resources (e.g., hydro, geothermal) to not only meet domestic demand but to also export excess power.

Many emerging economies have well-established bilateral power trading arrangements and may also be members of regional power pools. Four power pools have been established in SSA—with the most advanced, the Southern Africa Power Pool, launched in 1995. Concrete steps are being taken in other regions to transition from bilateral trade agreements to market-based trading platforms for electricity. Examples include the ASEAN Power Grid in Southeast Asia[31] and crossborder trade in South Asia between Bangladesh, Bhutan, India, Myanmar, and Nepal.[32]

Despite potential benefits, regional integration is frequently hampered by the absence of strong regional institutions and enabling regulations. Existing power pools generally lack executive powers and capacity in two key regional institutions: the system operator and the regulator. This undermines regional transmission planning and operation and results in poor regulatory harmonization.

On the regulatory side, some common weaknesses include: (1) the lack of sound rules that strike a balance between pooling generation resources, coordinating network expansion, and preserving national sovereignty; (2) asymmetric allocation of benefits among exporting and importing countries; (3) absence of regulatory mechanisms to mitigate risks in long-term contracts (e.g., hedging price differences); and (4) poorly designed transmission charges and a lack of commonly agreed cost allocation rules that inhibit investments in cross-border transmission infrastructure.[33]

Proven solutions to address these regulatory and governance issues exist based on the experiences of other power pools and regional markets. The Central America Electricity Market (MER) is an example of a more mature system for facilitating regional electricity trade among developing countries.[34] In this case, legal, institutional, and technical mechanisms were established to facilitate coordinated planning and operation and to promote private sector investment in the region's electricity system.[35] MER countries also created domestic regulatory bodies and strong regional

29 We resist using the term "regional market" and we typically opt for "power pools" or an equivalent proxy, when the basic conditions for a wholesale market are not met.

30 Program for Infrastructure Development in Africa (2012), *Interconnecting, integrating and transforming a continent*, www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/PIDA%20note%20English%20for%20web%200208.pdf.

31 IRENA (2018), *Renewable Energy Market Analysis: Southeast Asia*. IRENA. Abu Dhabi.

32 CERC (2019), *Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019*, www.cercind.gov.in/2019/regulation/CBTE-Regulations2019.pdf.

33 An AfDB-funded study performed by Multiconsult and published in June 2018, "Roadmap to the New Deal on Energy for Africa: An analysis of optimal expansion and investment requirements," estimates a total investment need of $8.9 billion in regional interconnectors from 2018 to 2030 to support a least-cost power investment and expansion plan across the African continent.

34 MER currently supplies around 4.5% of regional energy demand, with Guatemala as the main exporter (67% of total sales) and El Salvador as the lead importer (88% of total purchases). Energy exchanges totaled 2,656 GWh in 2018, compared to 700 GWh in 2013, when MER began operations. Data from IDB (2019), *The IDB Group in the Central American Isthmus and the Dominican Republic: Activities Report 2018,* Washington DC.

35 OECD (2017), *Energy Integration: The Central American experience in designing and implementing the Regional Electricity Market*, www.oecd.org/aidfortrade/casestories/casestories-2017/CS-139-SIECA-Integraci%C3%B3n-Energ%C3%A9tica-La-experiencia-de-Centroam%C3%A9rica-en-el-dise%C3%B1o-e-implementaci%C3%B3n-del-Mercado-El%C3%A9ctrico-Regional-English-Translation.pdf.

institutions such as a regional system operator and a regional regulatory agency.[36,37]

## 1.4 INFORMING A NEW APPROACH TO ACCESS: THE GLOBAL COMMISSION TO END ENERGY POVERTY

To formulate actionable recommendations for accelerating electrification, new ways of thinking about the issues are needed. It will be important to account for the changing landscape of the power sector globally—and for emerging trends that favor decentralization, low-carbon resources and smart infrastructures. At the same time, it will be critical to be aware of technological and other advances that offer truly transformative opportunities to do things differently. Several recent developments provide grounds for optimism that 'meaningful' energy access can be advanced in a timely manner, while also contributing to the achievement of multiple sustainable development goals:

1. **Political commitment** to the issue of energy access is stronger than ever before. Since 2010, 45 countries have achieved universal electrification. Progress has been especially noteworthy in South Asia (led by India and Bangladesh), where access to electricity increased from 75% of the population in 2010 to 91% in 2017,[38] and in the sub-Saharan countries of Kenya and Ethiopia, which tripled and doubled access between 2012 and 2016,[39] respectively.

2. **Steep cost reductions** and the improved reliability of off-grid renewable energy technologies and energy efficient appliances have led to a sharp increase in adoption.

3. **Innovations in delivery and financing models** for off-grid energy solutions are unlocking new markets that had been considered unviable by traditional utilities. Recognizing the value of off-grid solutions for unlocking demand and enabling last-mile electrification, countries are increasingly formulating integrated plans to implement these solutions.[40]

4. **Large energy companies and infrastructure investors** are seeking opportunities to expand into promising new markets. IPPs are rapidly spreading across Africa and are now present in more than 30 countries (for a total of more than 270 projects representing about $52 billion in total investment and 27 GW of capacity[41]).

Harnessing these opportunities will require new ways of thinking about access in terms of technological solutions, planning, policy and regulatory design, financing infrastructure, and traditional institutional roles and responsibilities.

Fundamental questions need to be raised and debated by governments and stakeholders, such as: What type of access should we aim for? With the advent of decentralized solutions and new power-sector players, how can distribution companies most effectively support the electrification agenda? What is the most effective role for the private sector? What type of financing instruments are needed in on- and off-grid generation, transmission, and distribution to bridge the remaining, substantial investment gap? How can we ensure that no one is left behind, and that the access and services that are created are *permanent*? Is the approach we adopt to electrification consistent with a sound long-term vision for the provision of electricity services?

Against this backdrop, the Global **Commission to End Energy Poverty** convenes at an opportune moment. New technology solutions, revived government and international policy and financial support, along with a vibrant private sector can all be embraced to drive substantially scaled-up investments in energy access. The Commission provides a crucial platform for leaders from government, regulatory agencies, financing institutions, the private sector, and non-governmental organizations to explore ways of harnessing the opportunity at hand to tackle the energy access challenge with urgency. The Commission's final report should eventually offer a consensus view of key stakeholders concerning what needs to be done, and by whom, to ensure that reliable, affordable, adequate, and environmentally sustainable energy is available to everyone as soon as possible.

The two critical areas we have identified and will develop further in the next chapters—distribution and bulk supply—have in common the need for cooperation and coordinated action. This follows from the interconnected nature of the electricity sector and its many interdependencies. No single entity has the capacity to do it alone. We have convened the necessary and appropriately broad range of stakeholders with specialized knowledge and broad experience in a new forum for a specific purpose—to come to a common understanding of the interconnected challenges we are confronting, and to develop an actionable agenda for addressing them.

36 Ramesh Ananda Vaidya, Niru Yadav, Nirjan Rai, Saumitra Neupane & Aditi Mukherji (2019), *Electricity trade and cooperation in the BBIN region: lessons from global experience*, International Journal of Water Resources Development, DOI: 10.1080/07900627.2019.1566056.
37 IDB (2019), *The IDB Group in the Central American Isthmus and the Dominican Republic: Activities Report 2018*, Washington DC.
38 IEA, IRENA, UNSD, World Bank and WHO (2019), *Tracking SDG 7: The Energy Progress Report*, Washington DC.
39 Bilotta, N and Colantoni, L. (2018), *Financing Energy Access in Sub-Saharan Africa,* Istituto Affari Internazionali, ISSN 2610-9603 | ISBN 978-88-9368-089-9.
40 Some latest examples being Kenya's National Electrification Strategy, which was launched in December 2018, and Ethiopia's National Electrification Program 2.0 (2019).
41 AfDB and APUA (2019), *Revisiting Reforms in the Power Sector in Africa*.

# Chapter 2:
# **Distribution**

## 2.1 THE MAIN CHALLENGES

In Chapter One, we observed that a viable distribution sector is necessary to ensure the reliable supply of electricity to end-customers. We then outlined a vision for a reimagined distribution sector that combines grid and off-grid aspects in low-access countries.

Grid connectivity plays a major role in any power system, and has proven over many years to be adaptable to new technologies and societal needs. As contemporary power systems continue to evolve, today more than ever, in the presence of numerous energy resources, "grids are not the nefarious vestigial remnants of the old system, rather they are a critical aggregation tool which will enable our transition to a distributed, renewable energy economy."[42] The long-term vision for the distribution networks of Benin, Mozambique, or Myanmar should probably not differ much from today's distribution networks in Denmark, Morocco, or Chile.

We believe there are two major challenges to overcome: making distribution companies financially viable in the near term, and articulating a clear vision about the future structure and functioning of the power sector at the distribution level. What is the best path to viable and inclusive distribution in the presence of new technologies and business models that compete with the role of the traditional distributor? What is needed to make the money-losing distribution activity in low-access countries viable?

### Financial viability

Several factors converge to render the distribution companies (discos) in low-access countries financially unviable. Prominent among them is the existence of regulated tariffs that are insufficient to cover the actual costs of supplying electricity. Raising tariffs is a politically sensitive issue, particularly when the reliability and quality of the service are poor due to lack of maintenance and chronic under-investment. Supply costs are high since the discos are inefficiently managed and the price of wholesale electricity is also frequently high—because of lack of scale in generation plants, low capacity utilization, and inefficient operation. A large fraction of the energy that is produced is wasted via technical network losses, and in many of these countries a substantial fraction is stolen through illegal connections or may be unbilled, or—if billed—then not paid for. The combination of these factors results in collected revenues well below incurred costs. In at least 25 countries in sub-Saharan Africa (SSA), these revenues do not even pay the operation costs.[43] Depending on the power-sector structure in each country, a deficit accrues to the vertically integrated

42 PowerGen, the largest private mini-grid developer, envisions a future power sector that is mostly interconnected, although perhaps with a different structure of ownership and operation than the one that predominates in most industrialized countries. See "The global future of power." http://www.powergen-renewable-energy.com/pg-publications/.

43 Kojima, Masami; Trimble, Chris. 2016. Making Power Affordable for Africa and Viable for Its Utilities. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/25091.

utilities or to the unbundled distribution companies, which are subject to regulation that requires them to collect the revenues and pay the wholesale electricity costs. In some extreme cases, privately owned discos have illegally withheld some of these payments.

In most low-access countries, the distribution segment—whether integrated in the vertically integrated utility or unbundled—is publicly owned, and the government is obliged to bail out the disco whenever its financial situation becomes untenable, or to subsidize unpaid generators. This is, for instance, the case of South Africa (Eskom) and Tanzania (TANESCO). In a few other countries, such as Nigeria, distribution has been unbundled and privatized; this is a more complex situation, as nobody is coming to the rescue and the discos are just incurring losses and defaulting on their regulated obligations. A third case is that of a publicly owned utility that has awarded a long-term concession to one or more private firms to manage distribution on its behalf, as is the case in Cote d'Ivoire and Uganda. Depending on the specific conditions of the concession and how efficiently it is managed, the business model for the concessionaire can be financially viable, even if the incumbent publicly owned utility may not fully recover its historical investment costs. More about this third model will be discussed below.

Whether public or privately owned, under the conditions of insolvency we have described, a utility will be ill-equipped to raise capital and forced to defer maintenance and delay network expansion investments. Its priority must be to cover essential costs, meet regulated obligations, and provide at least a minimum reasonable quality of service. Likewise, unless mandated to expand its network as part of its agreement with the utility, and remunerated accordingly, a distribution concessionaire will seek only to meet its established minimum performance requirements while reducing costs and avoiding further investment—including in expanded access.

An additional difficulty in financing rural access is its high cost. Supplying geographically dispersed low-level rural loads is much more expensive per connection and per kWh than electrification in urban areas. These per-unit costs increase as electrification goes deeper into more isolated areas, far from the existing grid. If the regulated revenue requirement for the discos were cost-reflective, the corresponding tariffs for all end customers would have to increase whenever new rural customers become connected, since charging a cost-reflective local tariff in rural areas is politically fraught and unaffordable for impoverished customers. In reality, in the vast majority of low-access countries, tariffs are set well below costs and are equalized for each category of customers, regardless of their geographic location, or whether they are rural or urban. Thus, extending access automatically results in a deficit in the remuneration of discos. Under existing conditions rural electrification is a "low hanging loss."

We conclude that a subsidy is needed for any disco that expands access if governments and regulatory authorities are not willing to raise local tariffs that reflect actual costs. Distribution of electricity in rural areas with dispersed and low demand has never been economically viable in any developed or developing country, without subsidies—under diverse formats, ranging from tariff cross-subsidization to direct payments to the incumbent disco or territorial concessions under mutually agreed conditions. This applies both for on- and off-grid solutions. And this makes discos particularly dependent on legal security in their country.

Investability requires legal security, in the sense of a stable and predictable regulatory environment. Legal security is a country-specific characteristic and affects all types of investment, but rural electrification adds a notch of difficulty since it needs to be subsidized, which is not the case with other segments of the electricity supply chain. And subsidies—although they should be based on objective criteria—strongly depend on regulatory and policy decisions. The disco runs the risk that the subsidy may be insufficient or delayed—possibly indefinitely—with dire consequences. Guarantees that subsidies will be paid must therefore be provided by national governments and underwritten by deep-pocketed financial institutions.

Experience so far has shown that such guarantees are not easily obtained in countries with dubious legal security or with high sovereign debt—conditions common among low-access countries. The situation is even more difficult for privatized distribution companies, which are exposed to the same regulatory and legal risks as public firms, but have less access to government bailout funds—and face additional pressure from anxious, highly leveraged shareholders.



### A vision for the distribution of the future

Besides making the distribution segment financially viable, the second major challenge for low-access countries is to define a clear vision for the future structure and functioning of the power sector at the distribution level. Regulators, policymakers, and the discos themselves have to decide how the traditional distribution business model can cope with the presence of off-grid electricity suppliers, and with the need to partner with some external entity, to find a way out of the unviable situation in which they are presently trapped.

Off-grid electrification solutions—involving exciting technologies, such as mini-grids and solar home systems, embedded in novel business models—have recently erupted onto the scene. Electricity delivered by mini-grids can be less expensive than power supplied by the grid in rural areas for low-demand clusters of consumers far from the existing network. Indeed mini-grids, or standalone solar systems (including solar home kits, or lanterns) may be the only options available to unconnected rural households when the incumbent disco fails to extend the grid. Besides, in the absence of reliable service, it has been the practice in many low-access countries for commercial and industrial customers who require dependable power to self-supply, typically with expensive diesel generation and, more recently, with diesel–solar hybrid systems that may feed into the grid, or into a mini-grid, when local demand is low. Where might this situation lead? Without a plan, the last mile of the electricity supply chain might become balkanized, marked by multiple owners, tariffs, reliability criteria, incompatible technologies, and stranded consumers whom nobody is interested in serving. The challenge here is to integrate disparate delivery modes and applications into a medium- and long-term vision of inclusive, efficient, and sustainable electricity supply for each country.

A long history of failures in providing universal electricity access strongly indicates that the incumbent discos in low-access countries are unable, on their own, to fix their current technical, managerial, and financial problems. Remedying this situation, and bringing to incumbent discos the resources they require—in capital, advanced technologies, management expertise, and political influence—so that the regulatory and legal environment is one in which they can operate as viable businesses, is at the heart of this inquiry. The need for some external help seems unavoidable. How this external support is provided, and which entities are involved, could substantially modify the structure of the power sector, at least at the distribution level. Thus, interactions with off-grid business models will have to be carefully analyzed in developing actionable recommendations.

## 2.2 IN SEARCH OF A SOLUTION: THE REQUIREMENTS FOR SUCCESS

The challenges we have identified in the distribution segment—financial unviability and the need for a medium- and long-term vision for the distribution business model—demand a rigorous answer. This section describes four requirements that we consider indispensable to the success of any strategy for achieving universal electrification. Both the general approach we propose, and the implementation of that approach in any specific country, will need to satisfy these requirements and address the major challenges we have identified.

**Inclusiveness.** This first requirement is meant to guarantee universal access—it means that nobody can be left behind in the electrification process. A direct corollary is that inclusive electrification within a designated region requires there to be a responsible distribution entity that assumes real—not just formal—responsibility for serving *all* customers, irrespective of their level of demand under minimum quality conditions. Power sector regulations in most countries require the incumbent distribution utilities to provide universal service but, given existing difficulties, this legal requirement is not enforced. The Commission means to make this requirement the centerpiece of our approach. For instance, inclusiveness can be inserted as a hard condition in contracts for territorial concessions. In some low-access countries, establishing this actual commitment for a given region may be accomplished in a single step, or it may represent the end stage of a multi-year evolutionary process.

**Permanence.** Electrical supply must be assured indefinitely—that is, *permanently* in time. This indispensable component of sustainability requires an institution in charge, with a long-term vision and commitment. The most immediate response to this

requirement is some entity that we could characterize as “utility-like”, meaning that the entity operates with a similar level of service commitment as a traditional utility even if it adopts a different business format. Other approaches might be possible, such as appointing a government agency whose mission is to guarantee the permanence of service by ensuring there is always a supplier of last resort, but we doubt it. Utilities of all sizes and with different forms of ownership, ranging from utilities that supply entire countries to cooperatives that service a single town, have met this requirement in most countries for more than a century.

**A mix of delivery modes.** The third requirement follows from an examination of the ample experience with planning for electrification in multiple countries by different knowledgeable institutions, as well as actual, observable situations. The least-cost plan for meeting rural demand in a territory generally consists of a combination of on- and off-grid delivery modes—grid extension, mini-grids and standalone systems—that responsible distribution entities must deploy efficiently and rapidly, while balancing cost, reliability, and customer preferences, among other factors.

**Harnessing external resources.** Without a jump-start it is difficult to imagine how most incumbent discos could rise above their present dire technical, managerial, and financial condition. Therefore, it seems necessary for most discos to partner with some external entity that can provide capital, advanced technologies, and management expertise so that reliable service, loss reduction, and new approaches to consumer engagement can be achieved. Several possibilities exist, but partnering with private-sector entities appears to be the most direct approach. This is consistent with recent global estimates in electricity infrastructure investment needs, which point to the need for massive amounts of both public and (mostly) private capital. There are several attractive private and public-private partnership (PPP) schemes that may be adapted for this purpose, and the flexibility of the concession model makes it suitable for a diversity of specific country conditions.[44]

## 2.3 THE INTEGRATED DISTRIBUTION FRAMEWORK (IDF)

This section defines a conceptual framework that can help us identify electrification approaches that share some specific features, meet the requirements discussed earlier (i.e., inclusivity, permanence, mix of delivery modes, and effective partnership with an external entity), and have the potential to accelerate electrification. Different aspects of this framework can be adapted to the specific characteristics of one or several countries. The electrification approaches we identify must be able to address the two major challenges of the distribution segment: they must provide a viable business model and be consistent with a reasonable vision of the future power sector.

We call this conceptual framework the Integrated Distribution Framework (IDF). The IDF has been presented in various forums and discussed with experts. A pilot implementation is currently being designed for deployment in a small territory of Nigeria. It is also possible to learn from a few IDF-related international experiences. The IDF has several key features:

### Allocation of effective responsibility for inclusive and sustainable supply

The IDF requires that for any geographical area there must be an entity with the explicit, comprehensive obligation to provide universal access to electricity supply, by any electrification mode, and with the commitment and capability to ensure permanence. This requirement is closely related to a vision for the future structure of the power sector, since the entity with these responsibilities must play a fundamental role in shaping and achieving that vision.

44 Grégoire Jacquot (2019). *Assessing the potential of electrification concessions for universal energy access: towards integrated distribution frameworks*. MIT Energy Initiative Working Paper. These partnerships could be with other (semi-)public utilities (c.f. the support provided by CIE to Ghana’s national utility), bilateral (technical) agencies (c.f. USAID and GIZ in Nigeria), multilateral development agencies (c.f. IADB in the design and implementation of Central America’s electricity market), privately-owned multinational energy companies (c.f. role of EDF in Senegal, Engie in Tanzania and Zambia, Shell in Nigeria, EDF in South Africa), or private equity funds (c.f. Actis/ENEO in Cameroon, Eranove/CIE in Cote d’Ivoire). As a matter of fact, partnering with external structures to improve operations is far from being the norm in SSA (and to a lesser extent in other developing economies).



One may think that these responsibilities should normally fall on the incumbent distribution company; however, we have seen that in low-access countries most discos have neither the incentives nor the resources to do the job; moreover, in some countries, areas without electricity access do not have an assigned incumbent disco.[45] Some governments may decide to transfer these responsibilities to private concessionaires, which will manage the government’s publicly owned discos, for some specified period of time, under exclusivity conditions in a designated territory. In other cases, given the incapacity of the incumbent disco (if there is one) and the time and effort that would be required to fix the disco, governments might decide to leave the provision of electricity to willing clusters of customers open to private initiative (as occurred, for example, with small-scale mini-grid development in Tanzania). In time, the areas where these clusters are located could perhaps become local concessions; in these cases, a ministry, regulator, or rural electrification agency must be charged with developing complementary activities to make sure that no potential customers are left behind. All of this is possible, and it is happening—the question is which of these options, or other options that could be proposed, really meet the requirements of inclusiveness and permanence, and lead to a future power-sector structure that is also acceptable. The IDF may include diverse possibilities that meet these requirements. Here we examine two major options: one that is more centralized and based on the incumbent disco, and a second option that relies on a more decentralized approach.

**The centralized option:** A territorial concession, with default obligation of supply using any mode of electrification, has already been tested and implemented in the power sector, although not exactly under the low-access and rural-demand conditions of interest here. The use of a concession is an interesting option for incumbent discos in difficult situations in most low-access countries. If the renewal of an existing concession is already pending, adopting the proposed IDF approach can make the renewal more attractive for customers and the government. Whether exclusivity should be added to the concession or not may depend on the specific case, since developers of off-grid solutions—mini-grids and standalone systems—might already exist within the concession territory. In the event that non-exclusivity is adopted, the concession will allow the presence of mini-grid developers (provided they meet some standards of service quality and grid compatibility supervised by the concessionaire) and standalone/solar kit providers within its territory. Clearly defined rules must exist for the situation where the main grid “arrives” to the site where a mini-grid already exists, so that the risk for all parties is minimized and proper interconnection or compensation—if applicable—can take place. The single concessionaire would also be the supplier of last resort in case an independent mini-grid developer defaults, and the default supplier for solar kits in those areas where neither grid extension nor mini-grids are economically advisable. Under this approach, the long-term vision for the structure of distribution will be centered around the disco, perhaps with some developers operating mini-grids, either grid-connected or not, under the disco’s supervision and in partnership with the disco. The need for related regulation with respect to tariffs and subsidies will be discussed later.

Designing and creating a partnership between the incumbent disco and a private-sector entity to implement a concession for distributing electricity in some given territory will require the agreement of civil society, the government, regulatory authorities, and the disco itself, plus the support of one or more development financial institutions (DFIs). Gaining this support is a complex process that will take time. The urgency of accelerating the electrification process, frequently driven by the government’s need to show progress and the demands of the communities that still lack access, provides motivation for pursuing more decentralized approaches that can be implemented quickly.

**The decentralized option:** In a situation where the incumbent disco does not make significant progress in electrifying its territory, or if some unelectrified territory has not been assigned to any particular incumbent disco, mini-grid developers could *de facto* occupy some geographical area and could, with time, become

45 In Colombia, close to half a million unelectrified households are located in “non-connected zones” that cover 51% of the national territory and do not belong to the concession areas of any of the incumbent distribution companies.

informal or formal concessionaires. This would mean eventually meeting some minimum conditions: they would operate as normal utilities, subject to a regulated cost-reflective revenue requirement, subsidies, and tariffs for end customers; and exclusivity of supply would apply within these local concession areas. These independent utilities would coexist with the incumbent disco, which in parallel should be subject to some reforms aimed at turning it into a viable business, as indicated below. Still unelectrified areas would be open to the initiative of the incumbent disco or independent entrepreneurs who could offer services through very localized bottom-up approaches (see, for example, Mali and Senegal for experience in this regard). Some governmental agency, ministry, or regulatory authority would be responsible for creating the conditions needed to attract agents who could complete the electrification process, if necessary, and also to make sure that a last-resort provider will be found in case of default by some independent developer.

This second, more decentralized option can certainly be faster in providing access to rural communities, and it can also be more attractive to independent developers since it allows them more autonomy from the incumbent disco. In some cases, a decentralized approach may make better use of the potential for self-organization within local communities, eventually leading to well-run cooperative solutions. However, the decentralized option poses several challenges compared to the centralized one: (1) It does not offer a clear solution to the inclusiveness problem; (2) a guarantee of permanence from independent developers is weaker than a guarantee from the incumbent utility; (3) a decentralized approach, if it leads to a balkanized long-term power-sector structure, may result in inefficiencies because of a lack of scale and because it requires a more complex process of supervision and regulation. The two options (centralized and decentralized) are not incompatible, and some middle ground can be found, when adapting the IDF approach to the specific conditions of a given country.

In what follows, our main line of thought, and the one to be developed in more detail in this document, involves a single concession that is awarded by the incumbent disco—thereby allowing non-exclusivity for off-grid solutions under the supervision of the concessionaire—in a large territory of the size of a district, a province, a state, or a country. The concession would respect the existing allocation to the incumbent disco(s). Other options are possible under the IDF umbrella, and most of the discussion that follows may apply, in a broad sense, to all of them. In the end, each country will need a tailored design.

### Effective deployment of an efficient mix of delivery modes

Some comprehensive, geospatially-based method of electrification planning must be employed to determine the least-cost allocation of electricity delivery modes in each zone of the considered region. The planner can consider other factors, beyond the mere techno-economic ones, in making this decision, including already existing solutions and practices. This information can be useful in different ways. It can be the basis of an objective method for the regulator to establish electrification targets for the concessionaire in some territory, as well as corresponding revenue requirements for the ensemble of delivery modes to be deployed. The same applies to individual mini-grids installed and operated by independent developers. Incentive performance mechanisms to attain targets for electrification level, reliability, or losses can be designed based on the information obtained from electrification planning studies. Well-founded tariffs and subsidies can be derived from these results. Governments, regulatory authorities, or rural electrification agencies may launch partial electrification programs based on the outcome of the electrification planning process, or they could condition eligibility for subsidies on compliance with the plan (e.g. only mini-grids sited in areas designated for that purpose can receive subsidies).

### Effective partnership with an external entity

The managerial, financial, and operational changes that most incumbent discos need will require some form of partnership with an external entity. We believe that in most cases the most adequate form of partnership is a concession with a private-sector entity, with some guarantee of financial support from a DFI, and an explicit commitment by government and regulatory authorities to create the appropriate legal and regulatory conditions. In principle, the involvement of capable local companies with experience in customer engagement or enumeration and delivery of energy services, together with the involvement of mini-grid developers and vendors of standalone systems, is possible and desirable. Other options might be possible under the IDF, and ideas are welcome in this regard, but this is the chief option we will pursue in this report.

The concession may take many different forms; there is ample experience in this respect.[46] Here we mean a long-term concession, where the concessionaire has responsibility for managing the company—operation, planning, investment, metering, billing, revenue collection—and operates under a previously agreed remuneration scheme, including performance incentives. A concession agreement of this nature typically includes many clauses regarding, for instance, performance-based incentives, utilization of existing assets, and termination conditions, among others. Different possibilities and characteristics of concessions are discussed in more detail in an annex to this chapter, which can be found at the end of this inception report.

### The regulatory regime

The viability of an IDF-based approach to electrification critically depends on regulation. Distribution via grid extension is a regulated activity everywhere, and regulation must also apply when supplying off-grid electricity with mini-grids—for multiple reasons: on top of safety and compliance with technical compatibility standards, there are issues of exclusivity in the concession areas, as discussed earlier, as well as issues with respect to the consistency of tariffs and subsidies, and with respect to clarifying options when the grid eventually arrives at mini-grid sites. The most important regulatory issues for a disco concern the remuneration regime and legal security, as both are critical to its financial viability.

Sound regulations must use objective and transparent—i.e., known to the public—methods to determine the revenue requirement for the distribution company. The *revenue requirement* must recover efficiently incurred costs that are needed to supply electricity. For grid extension, these costs comprise the purchase of wholesale electricity, plus the costs of investing in and operating the distribution business over its lifetime (i.e., indefinitely), plus the retail costs of interacting with customers. For electricity supplied with mini-grids, the wholesale purchase cost of energy is replaced by the cost of energy generation and storage. Each physical distribution component must be assigned an economic lifetime (e.g., five years for batteries, forty years for poles and overhead wires, etc.) so that the corresponding annuity can be determined. As indicated previously, geospatially-based electrification planning tools can help determine the overall cost-reflective revenue requirement, which obviously must include an attractive rate of return on the invested capital. The same approach applies to grid extension and mini-grids. Alternative methods for mini-grid remuneration have been proposed, which depend on ex-post "remuneration per connection"—an example is the Smart Results-Based Financing method proposed by the Africa Mini-Grid Developers Association.[47] The cost of purchase—for solar kits—and the installation and operation costs of larger standalone systems are also part of the overall cost of electrification, although the regulatory treatment of these costs will, in general, be different.

The remuneration scheme of the incumbent disco, as well as that of the mini-grid(s), should recognize the different nature of "physical network assets and operation" (i.e., strict distribution network activity or "carriage") and "consumer interaction" (i.e., the retail activity or "content") components of the traditional distribution company. The former must be largely based on the "efficient cost-of-service" approach, while the second should be centered on performance incentives related to customer satisfaction and non-technical losses. This applies to all modes of electrification.

Note that the revenue requirement that the concessionaire receives must consist of the regulated subsidized tariff paid by customers, plus an explicit subsidy determined by the regulator and paid by the government. The subsidy is computed to "top up" the revenues from the tariffs to reach the regulated revenue requirement. Special transitory arrangements will be

46 Grégoire Jacquot (2019). *Assessing the potential of electrification concessions for universal energy access: towards integrated distribution frameworks*. MIT Energy Initiative Working Paper.

47 Africa Mini-grid Developers Association (2018), SMART RBF Policy Recommendation. http://africamda.org/wp-content/uploads/2018/10/WHITE-PAPER-SMART-RBF-Policy-Recommendation.pdf.

needed to account for the initial situation of illegal connections, non-billed customers, and non-paid bills.

The same principle must apply to off-grid supply with mini-grids. For those areas where electrification planning has established that the best supply option is a mini-grid, the corresponding subsidy must also cover the difference between the chargeable tariff—which could be the same one applied to grid-connected customers—and the total cost of supply. This is not an initial subsidy to cover the initial cost of investment, but rather a permanent annual subsidy, which may have to be revised as tariffs gradually get closer to being cost-reflective.

Legal security is critical because rural electrification requires subsidies, which are subject to the discretion of governments and regulators in each country. Subsidies are needed to complement the typically insufficient revenues derived from tariffs[48] to complete the revenue requirement for the distribution company. Intervention by DFIs in this business arrangement will be of help, both to nudge country authorities to honor their commitments and to provide guarantees in case they do not. It is important to notice that the contractual conditions of a concession agreement will typically embed any subsidies to the concessionaire within the agreed terms of the contract—which is more legally binding than a regulatory disposition—thereby significantly reducing the discretion of governments and regulators.

### Customer engagement

Customer engagement is a critical component of the IDF, which brings a change of public perception and customer mindset concerning the electricity supplier. Initial investments will be necessary to achieve satisfactory reliability and quality of service, which are necessary conditions for any attempt to introduce cost-reflective tariffs and address unpaid bills and illegal connections.

### Focus on electricity services

The IDF goes beyond mere connection to stimulate the local economic development of its customers by facilitating the productive use of electricity and integrating the supply of energy-efficient appliances and microfinance support, by producing spin-offs of the concessionaire itself, or by forming integrated partnerships with external providers. In a virtuous cycle, additional energy-intensive uses of electricity will increase the capacity factor of newly connected demand, reducing per-unit energy costs. In this regard, expanded use of electricity for cooking—with its health, environmental, and potential economic advantages—is an attractive policy proposition that deserves to be seriously examined.

### Use of advanced technologies

The IDF will resort to transformative technologies to efficiently provide high-quality electricity service: the costs of the electrification plan and pre-site preparation can be lowered substantially by the use of geospatial planning tools, and operation and management costs can be reduced by using remote-controlled management systems, smart meters, and pay-as-you-go schemes.

## 2.4 CROSS-CUTTING ISSUES

### Financing the IDF

Private investment in electricity access has increased considerably over the past few years, yet it remains largely limited to grid-connected generation projects in a small group of countries. The investment gap in distribution, especially in sub-Saharan Africa, is significant and it directly affects the ability of distribution companies to deliver quality electricity services and expand infrastructure access to unconnected areas.

There is consensus that bridging the investment gap in distribution, and in the power sector more broadly, will require the mobilization of significant amounts of private capital. Public financing for electricity access, whether through national accounts or DFIs, will need to be scaled up further, but limits on public resources mean that public funding has to be delivered through instruments that also leverage and mobilize substantial private capital. Stakeholders, including governments and DFIs, are increasingly steering policy and investment decisions in this direction, but the effectiveness of such efforts will depend greatly on the financial viability of the distribution segment.

For reasons discussed in depth earlier, the traditional distribution sector in many low-access countries faces substantial challenges in attracting private investment to extend electricity access. The IDF approach proposed in this report offers the opportunity to rapidly accelerate the expansion of electricity access using all available modes, while also addressing the viability concerns with respect to distribution that affect the entirety of the power sector. The question is: Is the IDF financeable? And if so, what steps are needed and by whom to direct financing for advancing the IDF?

The road to viability for distribution companies and to universal electrification will vary from country to country and is likely to involve different models for partnering with the private sector. As an example, public-private distribution partnerships have been tested in a number of countries, including Cameroon (ENEO), Côte-d'Ivoire (CIE), Gabon (SEEG), and Uganda (Umeme) in sub-Saharan Africa and several franchises have been tested in largely urban areas in India. In other countries, the co-existence of distribution companies and off-grid private-sector entities in a designated territory may emerge as the most effective pathway to electrification.

Each approach will require a tailored portfolio of financing solutions that range from direct subsidies to address the viability gap for rural distribution[49] to blended finance that allows different types of capital (i.e., commercial, concessional, grants) to help bring private investors, including institutional investors, into the distribution sector. Depending on the appropriate mix of electrification modes, the target groups for financing will also vary, covering distribution companies and PPPs, mini-grid and standalone projects and enterprises, as well as end-users with requirements for financing systems, productive appliances, or connection fees.

The IDF offers a holistic, integrated approach to tackling the issue of electricity access and financial viability in the distribution sector. It therefore requires a multi-faceted financing solution that can be developed through effective cooperation among different stakeholders with a commitment to finding win-win outcomes. These stakeholders include:

- National governments, whose role in creating a stable and predictable investment environment with supportive policy and adherence to agreements with private investors cannot be overstated. Governments also play an indispensable role by implementing policies to accelerate and amplify the impact of energy system investments—for example, by funding and allocating subsidies among urban and rural consumers, productive and non-productive uses, and, in the case of the IDF, among on- and off-grid providers. In addition, governments must show leadership and political will in moving quickly to restore the financial viability of public and private distribution companies, and by ending ineffective bailouts.
- Regulators, whose role in regulatory reform and enforcement will also be crucial, notably to establish cost-reflective tariffs and ensure that providers are appropriately incentivized to meet aggressive access, cost, efficiency, and reliability benchmarks, and to ensure that direct and indirect subsidies are deployed fairly and effectively. Specifically, with respect to implementing IDF-like concessions, regulators must also benchmark and enforce cost-efficient planning, and institute backstopping mechanisms that ensure continuity of service should one or more parties to a concession fail to perform.
- Distribution companies, which must improve their operations and adhere to agreed financial and other performance metrics, and, in the case of the IDF, achieve access metrics that may call for the expanded use of off-grid technologies, either in their own businesses or by third parties operating within a shared concession.

48 Kojima, Masami; Trimble, Chris. 2016. Making Power Affordable for Africa and Viable for Its Utilities. World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/25091.

49 Distribution in the rural areas of developing countries needs subsidies to be economically viable. There are, however, multiple strategies for reducing the required volume of subsidies: least-cost electrification planning; improvements in consumer satisfaction and advanced metering that can lead to drastic reductions of illegal connections and unpaid bills; cross-subsidization of the tariffs for lower-income households; extending the grid to those C&I customers that make use of captive generation because of poor grid reliability or excessive cross-subsidization; standardization in supply equipment and efficient appliances; demand creation; and reductions in per-unit supply cost.

- Off-grid firms, which have an unprecedented opportunity within the IDF to dramatically expand their businesses while also, through continuous innovation, playing an important role in accelerating rural access and creating value and opportunity for their customers in the long run.

- Development banks, which offer unrivalled stores of knowledge and expertise and which are longstanding stewards of concessionary and significant commercial financing on behalf of the global community. Development banks already fulfill a wide range of roles and responsibilities and have active operations in all the countries we hope to impact. They will be central to helping shape and adapt the IDF to the differentiated needs and situations of individual countries. Indeed, it is hard to see how the aim of achieving universal access by 2030 can be achieved without the engagement and leadership of development banks.

- Private investors and developers, who we hope will remain engaged given the opportunities that will be created through cooperation across this wide range of stakeholders. Private investors and developers will also need to keep faith with those governments that sign onto a necessary program of reform and aggressive action.

### The adaptability of the IDF and support from international experiences

The IDF concept can be adapted to the diverse circumstances of low-access countries with their range of power-sector structures and regulatory regimes. In countries with vertically integrated utilities, for instance, distribution unbundling is not necessary to implement the IDF, since only a clear definition of the rights and obligations of the concession is needed, along with agreement about the method of remuneration. Although there is yet to be an example of a jurisdiction that has combined all the defining features of the IDF, each feature has been implemented successfully *somewhere*, providing a rich base of experience from which to draw lessons.

A key feature of the IDF concept is that the three available modes of electrification—grid extension, mini-grids, and standalone systems—are deployed within a single planning regime and placed on a level playing field. With notable exceptions (e.g., the unfolding case of Rwanda), these modes of electrification have been deployed in a largely uncoordinated manner and with the involvement of different entities, which has tended to lead to competition rather than complementarity. Ideally, a comprehensive integrated planning methodology would identify the least-cost mix of electricity delivery modes; an IDF-compatible entity would ensure that the plan is implemented effectively; and dedicated policies and regulations would be implemented to address the interaction between on- and off-grid solutions, as well as tariff-setting.

Morocco's universal rural electrification program is an example where some of these conditions were followed. Key features of the program included the use of all modes of electrification—on-grid, mini-grid, and standalone systems—and coordination by the state-owned utility (ONEE). While grid extension and mini-grids were developed by ONEE, well-defined territorial concessions were devised for private companies to install and maintain solar systems in remote areas.[50] The utility-led program raised access rates from 15% to 95% in less than 15 years[51] and was also able to leverage substantial public financing from DFIs. Several conditions specific to Morocco facilitated these positive outcomes: the ability of the utility to exploit cross-subsidization between urban and rural consumers, favorable macro-economic development indicators, as well as the presence of a financially and technically sound utility.

In countries where near-universal electrification has been achieved, but the reliability and quality of service is poor, the IDF concept can provide a path forward. Partnering the incumbent distributor with an external investor can provide resources for several purposes: to improve local reliability and quality of service with strategically located local generation and storage; to implement new approaches to customer engagement that are made possible by technologies for metering, payment and communication; and to leverage diverse sources of private capital.

Distribution PPPs offer a potential model for scaling up private investment in distribution and for improving the financial and operational performance of distribution companies. There have been various attempts in this direction over the past decades, including privatization in large parts of Latin America in the 1990s and, more recently, in Nigeria and Ghana; and distribution franchises, mainly in India. Nevertheless, experience with distribution PPPs in low-access countries remains limited, but the examples of Tata Power Delhi Distribution Limited (India) and Umeme (Uganda) showcase the potential of this model.

The Tata Power Delhi Distribution Limited (TPDDL) is one of three distribution companies serving India's national capital. In the early 2000s, the service territory of the state-owned distribution company was divided into three distribution areas to be served by companies with private sector participation. Tata Power won the bid for the 25-year license for one of the areas, and existing distribution assets and liabilities were transferred to a holding company. The holding company divested 51% of its equity to TPDDL, which was created with a clean balance sheet. Over its first 15 years, TPDDL invested over $984 million in upgrading infrastructure, reducing distribution losses by 85%, increasing network length by 128%, and significantly reducing waiting times for new connections, meter replacement, and bill complaint resolutions. This has led to a substantial increase in TPDDL's customer base, from 700,000 to 1.6 million customers, and the company has recorded financial profits every year since 2010.[52]

The example of Umeme, in Uganda, showcases how distribution PPPs can attract capital from institutional investors and the public markets. In 2005, the main distribution grid was transferred through a 20-year concession to Umeme Ltd. Umeme Ltd. was originally owned by Eskom, the South African state-owned utility, and Globeleq, a leading IPP in Africa. In 2006, Globeleq increased its ownership in Umeme from 56% to 100%, and in 2009, Globeleq's stake was entirely transferred to Actis, a multi-asset investor. In that same year, Umeme raised additional funds from IFC; in addition, Umeme received a partial risk guarantee (PRG) for a line of credit, backstopping certain payment obligations of government-related entities under the privatization agreement, and political risk insurance from MIGA. Between 2009 and 2012, Umeme managed to reach all its targets for investment, connections, collections, and distribution loss reduction. Aiming to diversify its shareholder base, Umeme released nearly 40% of its shares to the public on the Uganda Securities Exchange (USE), raising $65 million. As of 2015, Umeme had over 5,500 shareholders, including institutional investors such as Investec Asset Management and T. Rowe Price.

The examples presented here demonstrate that different aspects of the IDF have already been implemented in various contexts with positive results for service quality and for the financial and operational performance of distribution companies. Though results from some countries where parts of the IDF concept have been adopted are encouraging, the outcomes of adopting a complete IDF approach for low-income, peri-urban and rural communities have yet to be fully established. This is an important area for further Commission deliberation and study.

50 Choukri *et al.* (2017), Renewable energy in emergent countries: lessons from energy transition in Morocco, Energy, Sustainability and Society, Springer Berlin Heidelberg, Berlin.

51 Islamic Development Bank (2013), From darkness to light: rural electricity in Morocco, IsDB Success Stories, Islamic Development Bank, Jeddah.

52 Tata Power Delhi Distribution Limited (2017). Concept Note on Power Distribution Reform Framework.

# Chapter 3:
# **Bulk Electricity Supply**

Despite our primary focus on last-mile distribution, we recognize that generation and transmission infrastructure are both critical to a well-functioning distribution system. In many developing countries, low demand and inadequate cross-border interconnections constrain the utilization of energy resources on a regional basis and limit the efficiency and cost-reduction opportunities available from scale. Large centralized power plants, a transmission network infrastructure sized to meet national and cross-border needs, and effective collaboration between countries in planning and operation via power pools are all necessary ingredients of reliable and affordable wholesale electricity supply. Achieving such wholesale electricity supply greatly enhances the viability of grid distribution, both by making electricity affordable to more consumers and by reducing a frequent reason for consumer frustration and non-payment of electricity bills. In this sense, eliminating dysfunction in distribution must go hand in hand with eliminating dysfunction in bulk electricity supply.

This dysfunction is largely related to poor governance and enforcement, and therefore can be eliminated without substantial capital investment. Such investment will follow naturally when it is clear that new transmission lines will be used efficiently and power plants will be dispatched predictably. Given the time necessary to implement solutions at scale—frequently a decade or more for transmission networks and power pools—actionable recommendations are urgently needed now.

This chapter addresses some of the bulk supply issues and challenges identified in Chapter One and discusses specific policy and regulatory approaches that have been proposed, and in some cases implemented, to address these challenges. Here we start with centralized generation and transmission, and end with their necessary integration at scale in regional power pools.

## 3.1 CENTRALIZED GENERATION

Expanding generation capacity accounts for the largest share of the estimated overall cost of achieving universal electricity access. As noted in Chapter One, private-sector financing will be crucial to bridge the existing investment gap. Often private financing requires structural reforms to provide an entry point for independent power producers (IPPs), backed by appropriate legislative and regulatory action. A number of country- and project-specific factors are known to influence IPP investments.[53]

At the country level, important factors include political and economic stability; a clear policy framework; transparent, consistent, and fair regulation; and coherent power sector planning and competitive bidding practices. At the project level, important factors include favorable financing conditions, confidence in the creditworthiness of the off-taker, a secure and adequate revenue stream, and access to instruments for mitigating financial risks.

Effectively catalyzing greater private investment in generation depends on country- and technology-specific risk–return profiles. In 2018, two-thirds of all new power capacity added worldwide was from renewable energy technologies.[54] In Africa, solar PV accounted for 42% of new IPP capacity additions; another 37% came from other renewables including wind, hydro, biomass, and geothermal. This follows from the rapidly improving cost-competitiveness of renewable energy technologies. Given the magnitude of their power needs, developing countries have continued to pursue fossil fuel-based generation and IPP frameworks have been adapted accordingly to attract private-sector investment. As financial institutions seek to divest from fossil energy,[55] steps are needed to provide a pipeline of low-carbon projects. The next section discusses key drivers of investment in generation and some of the instruments being deployed to address investment barriers.

### Establishing a policy and regulatory framework that enables generation investment

Many power systems in developing countries retain most elements of the traditional integrated monopoly utility structure, although several have established mechanisms to facilitate IPP participation in generation. Setting up independent system operators and regulators is an integral part of the reforms needed to create an equitable, rules-based playing field.

Sound planning, procurement, and contracting practices for new generation are needed to attract private-sector investment, along with simultaneous improvements in the performance of distribution utilities as the main off-takers.[56] In developing countries, generation investments still largely happen via long-term power purchasing agreements (PPAs). Therefore, the integrity and transparency of the investments has to be protected, and contract structures have to clearly define the allocation of risks and rewards, as well as the rights and responsibilities of stakeholders.[57]

Competitive bidding processes have been used to solicit private-sector participation, typically with build–own–operate or build–own–operate–transfer arrangements. Such processes have been instrumental in the deployment of utility-scale renewable energy projects in developing countries.

Well-designed and robust PPAs are critical for establishing secure, long-term revenue streams for IPPs, thus reducing risks for private investors and facilitating access to financing under favorable conditions. A 'bankable' PPA would have a long-term agreement with a creditworthy off-taker over a time horizon that allows debt servicing and provides for risk-equivalent returns for investors. It would also contain aspects such as the distribution of responsibilities between stakeholders, the quantity and price of power to be procured, capacity charges, tariff indexing and escalation, the denomination of the settlement currency, and arbitration for dispute resolution.[58,59]

To create a robust framework for generation investments, efforts are underway to develop standardized templates for PPAs and other key contracts. The World Bank, for instance, has developed sample PPAs for fossil-fuel power plants and renewable energy projects.[60] To facilitate solar investments, the Terawatt Initiative and the International Renewable Energy Agency have undertaken a Global Solar Energy Standardization Initiative that provides standardized contract templates covering not only PPAs, but also supply agreements, operation and maintenance agreements, finance facility agreements, and project development guidelines.[61]

### Addressing off-taker risk

The attractiveness of the generation sector to investors relies on the existence of creditworthy power purchasers. While structural reforms are being implemented to improve the technical and financial performance of distribution utilities, concurrent measures must be introduced to mitigate risks for IPPs. Where the off-taker is a utility with a poor credit rating, a sovereign guarantee might be required to shift investment risk to the government.[62] Depending on the fiscal position of the government and its ability to take on large sovereign debt, this option may not be effective for driving investments at scale in the power sector.

Novel models to address off-taker risks are emerging. The firm Africa GreenCo, for instance, has proposed to act as an intermediary off-taker, buying renewable energy from small to medium IPPs through take-or-pay PPAs and selling the power to utilities and private off-takers through long-term contracts, while also executing short-term trades for adjustments within the Southern Africa Power Pool. Africa GreenCo would assume the credit risks of utilities, thereby allowing for lower tariffs.[63] A similar approach has been adopted in India, where the implementing agency for solar and wind energy projects acts as an intermediary between IPPs. To cover the risk that buying entities delay or default on their payments, and to ensure timely payment to developers, the government has set up a payment security mechanism that covers three months of energy payments.[64]

### Designing risk mitigation instruments

Multilateral development banks and development finance institutions (DFIs) have introduced a wide range of risk-mitigation instruments and insurance products to address country- and project-level risks and catalyze private-sector infrastructure investments in developing countries. World Bank guarantees are tailored to provide credit enhancement and direct risk mitigation for lenders and project developers. MDBs/DFIs, export credit agencies, and private insurers may also provide complementary insurance products.[65]

Technology-specific risk mitigation instruments are often also needed to address specific investments. The Green Climate Fund recently approved a de-risking package for geothermal development in Indonesia that combines several instruments, from concessional loans to convertible bonds and grants, to finance 600–900

53 Eberhard *et. al.* (2016), *Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries*. Washington, DC: World Bank.
54 IRENA (2019), *Renewable Energy Capacity Statistics Series*. IRENA, Abu Dhabi.
55 IEEFA (2019), *Over 100 Global Financial Institutions Are Exiting Coal, With More to Come*, Institute for Energy Economics and Financial Analysis, http://ieefa.org/wp-content/uploads/2019/02/IEEFA-Report_100-and-counting_Coal-Exit_Feb-2019.pdf.
56 Eberhard et. al. (2016), *Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries*. Washington, DC: World Bank.
57 Rademeyer, G. (2016), How can Independent Power Producer (IPP) investments be accelerated on the African continent?, Norton Rose Fulbright, https://www.insideafricalaw.com/publications/how-can-independent-power-producer-ipp-investments-be-accelerated-on-the-african-continent.
58 *Ibid*.
59 Nehme, B. (2013), *PPAs and Tariff Design*, Presentation at the Renewable Energy Training Program, https://esmap.org/sites/default/files/esmap-files/ESMAP%20IFC%20Re%20Training%20World%20Bank%20Nehme.pdf.
60 The World Bank's online Public-Private Partnership Legal Resource Centre has available template Power Purchase Agreements and Energy Purchase Agreements.
61 IRENA and TWI (2019), *A Guide to Open Solar Contracts*, IRENA and Terrawatt Initiative, Abu Dhabi.
62 Rademeyer, G. (2016), How can Independent Power Producer (IPP) investments be accelerated on the African continent?, Norton Rose Fulbright.
63 Hajduka, A. (2019), "GreenCo Overview: June 2019" Presentation at Florence School of Regulation.
64 MNRE (2019), *Payment Security Mechanism Guidelines for VGF Schemes*, New Delhi, https://mnre.gov.in/sites/default/files/webform/notices/sec.pdf.
65 Eberhard *et. al.* (2016), *Independent Power Projects in Sub-Saharan Africa: Lessons from Five Key Countries*. Washington, DC: World Bank.

MW of geothermal capacity.[66] Climate financing from the Climate Investment Funds has also been used to support exploratory drilling and steam-gathering infrastructure at geothermal sites with high resource potential in Tanzania.[67]

DFIs are also beginning to offer comprehensive market activation solutions that combine advisory services, financing, guarantees and insurance against political risk. The World Bank Group's Scaling Solar program is an example. This program focuses on attracting global developers in markets that would otherwise be considered too small. By standardizing processes such as PPAs and government support agreements across countries, the program seeks to develop a pipeline for attractive solar projects. Zambia's first competitive auction under the Scaling Solar program attracted global developers and resulted in the lowest tariff on the continent.

### Unlocking financing

The measures discussed so far can help support a robust pipeline of investment-ready projects. However, a closer examination of possible sources of financing is warranted to identify measures that can catalyze generation investments on the scale needed to achieve universal access. Given limits on available public financing, new instruments are being designed to leverage additional private capital and develop a financing ecosystem that is sustainable over the long term. Blending concessional funds with funds from DFIs and other entities that are investing on commercial terms has demonstrated important potential for enhancing the financial viability of projects and unlocking private financing. DFIs have established a working group to set common standards for implementation and to review the merits and adequacy of these blended approaches.

Blended finance has been applied in island states, which often have high power tariffs, low reliability of supply, and limited access to long-term financing for infrastructure development. For Samoa's first IPP project, for instance, the Asian Development Bank (ADB) provided a long-term concessional loan on a limited recourse basis to help fill a gap in the project's capital structure and improve its financial viability. Similarly, in Cambodia, the ADB provided long-term concessional debt to finance the country's first utility-scale solar IPP.[68]

## 3.2 TRANSMISSION

The volume of investment needed to develop and upgrade transmission infrastructure is rising as power systems grow and power flows increase. Africa alone is estimated to require as much as $4.3 billion of annual transmission investments until 2040.[69] Most countries still finance transmission directly from utility revenues or government budgets, while others rely on concessionary DFI financing or grants from donor countries.

Many countries have successfully introduced private-sector participation in the development, operation, and maintenance of transmission infrastructure. Private companies finance a large share of transmission investment in North and South America, and in Europe. Privately financed transmission has also been introduced in some developing countries, particularly in South Asia (e.g., India, Philippines) and Latin America (e.g., Brazil, Chile, Peru). India, for example, had attracted $5.5 billion in private transmission investment up to 2015.[70] In sub-Saharan Africa, by contrast, private-sector participation in transmission has been modest, although it has attracted recent interest. The Transmission Company of Nigeria, for instance, is laying the groundwork for public–private partnerships (PPPs) to upgrade the country's transmission infrastructure.[71]

66 GCF (2019), "GCF supports Indonesia's energy transition with de-risking geothermal development, Green Climate Fund", www.greenclimate.fund/news/gcf-supports-indonesia-s-energy-transition-with-de-risking-geothermal-development.
67 AfDB (2017), "Tanzania wins US$21.7 million from Climate Investment Funds to advance geothermal exploration and transform its energy sector," www.afdb.org/en/news-and-events/tanzania-wins-us-21-7-million-from-climate-investment-funds-to-advance-geothermal-exploration-and-transform-its-energy-sector-17202/.
68 Derived from the joint report of the DFI Working Group on Blended Concessional Finance for Private Sector Projects (2018), https://think-asia.org/bitstream/handle/11540/9043/dfi-blended-concessional-fiance-report.pdf?sequence=1.
69 World Bank (2017), *Linking Up- Public-Private Partnerships in Power Transmission in Africa*, Washington DC.
70 *Ibid*.
71 Okafor, C. (2018), "Nigeria: TCN Mulls PPP to Upgrade Transmission Network", https://allafrica.com/stories/201808230538.html.



As noted in Chapter One, weak private investment in transmission in developing countries results from the absence of enabling policy and gaps in regulation (for example, relating to construction agreements, cost-sharing arrangements, and right-of-way permits) and unmitigated country-specific risk. The business model is known and viable, and standardized transmission projects can be designed and financed with private capital based on revenues generated.

### Modes for private-sector involvement

In most developing countries, transmission continues to be financed and managed by a public entity. Government ownership often dominates in the financing of cross-border interconnection projects. Sharing options have commonly been used wherein government-owned entities finance the infrastructure on their side of the border (e.g., the Mozambique–South Africa and the Ethiopia–Kenya interconnections). State-owned utilities have sometimes established a special purpose vehicle (SPV) to finance interconnections: an example is the SPV MOTRACO, which was formed by ESKOM (South Africa), EDM (Mozambique), and SEC (Swaziland).

Generally, there are four typical models for private-sector participation in transmission:[72]

- **Complete privatization**, in which a private entity owns the transmission network. This model is implemented through disinvestment or by offering equity in capital markets for a government-owned transmission business. In this model, the private owner has the exclusive right and obligation to develop transmission in its area of operation. Developing countries that have adopted this approach include Argentina and Chile.

- **Whole-of-grid concessions**, in which private entities have many of the same rights and responsibilities of ownership, but for a limited period. Governments often implement this approach through a competitive tender and a concession contract. This approach has been tested in Cameroon, Mali, and Senegal, where national governments have retained a large share of ownership. Whole-of-grid concessions have not produced significant transmission investments but they have yielded large operational benefits.

- **Independent power transmissions (IPTs)**, in which private owners assume the rights and obligations associated with a transmission line, or a package of several lines. In most cases, governments have implemented this model by tendering a long-term contract, with payment dependent on the availability of the line. This approach has been used in developing countries, including Mexico, Peru, Brazil, Chile, and India.

- **Merchant investment**, in which private entities build and operate a single transmission line ("merchant line") to obtain economic rents by purchasing cheaper power at one end of the line and selling it at the other end at a higher price. Alternatively, a contract is signed prior to the construction of the line between the investor and the future beneficiaries of the line. This model has been used only rarely.

Hybrid public–private models are also possible. Utilities can set up an Special Purpose Vehicle (SPV) with third-party equity participation, such as in the case of SIEPAC in Central America. India has also used this approach, allowing private entities to bid in transmission tenders in their own right, or to form joint ventures with the state-owned central transmission utility (PGCIL).

IPPs have also invested in short transmission lines to connect to the grid; these investments are generally bundled with the generation project. The IPP developer may own and operate the transmission line under a long-term contract, or transfer the line to the system operator or government-owned transmission utility once the line is commissioned.

The most appropriate model for private-sector participation depends on the local context, although IPT tenders are seen as a promising model for national and regional-level investments. IPTs have led to substantial private investments and significant cost savings. Similarities in the risks faced by IPT investors and rapidly growing IPPs also make the IPT model attractive as a mechanism for attracting private-sector investment in transmission.[73]

72 World Bank (2017), *Linking Up- Public-Private Partnerships in Power Transmission in Africa*, Washington DC.
73 *Ibid*.

### Applicability of IPT tenders

Transmission is a regulated activity involving assets that should be determined based on centralized planning and remunerated through a cost-reflective revenue requirement and performance-based incentives. The construction and ownership of transmission infrastructure could be allocated to investors through competitive bidding processes. As we have seen, the IPT model can utilize different PPP structures, most commonly build–own–operate–transfer (e.g., Brazil, Peru, India) and build–own–operate (e.g., Chile).

In a competitive bidding process, private entities bid an annual payment based on the project's availability performance. As with IPPs in generation, a clear understanding of the revenue stream for investors and a tariff that ensures risk-equivalent returns is crucial to increase private-sector financing. In Peru, earlier IPT contracts were based on costs, drawing both on bids submitted by the private sector and on the regulator's model. The introduction of new legislation, which aimed to ensure that payments reflected prices from the winning bid, led to a sharp increase in private investment, from $10 million in 2003 to around $300 million in 2010.[74]

A key challenge for implementing the IPT model in sub-Saharan Africa is the financial weakness of the power sector, which currently inhibits the recovery of transmission costs needed to provide required returns to private investors. One option to address this challenge is to use revenue escrow arrangements to ring-fence consumer payments. Where escrow arrangements are deemed insufficient to make a project bankable, governments may also have to use government and multilateral guarantees to back payment obligations to IPTs.

Legislation, licenses, and other legal instruments will have to be amended to allow for multiple transmission providers. Meanwhile, concessional finance has to be adapted to the IPT model, in the same way that debt and equity support has been extended to IPPs. Depending on local conditions, different project structures (e.g., purely private, SPV) will need to be tested, along with different payment structures. In addition, in-house capacity will need to be developed as part of transmission service agreements (TSAs) to identify projects, design tenders, evaluate bids, and award contracts.

### Planning and financing transmission projects

Long-term and timely planning is important given the lead-times associated with developing and commissioning transmission infrastructure. Coordinated power sector planning, which is often based on a long-term, least-cost approach, generally covers demand forecasts, generation, transmission planning, and investment needs. Depending on the country context, several agencies may be involved. In Kenya, for instance, the Energy Regulatory Commission is responsible for planning; the state-owned utility, Kenya Power, owns and operates transmission infrastructure; and the Kenya Electricity Transmission Company designs, constructs, and maintains power lines.

Responsibility for transmission planning may also vary depending on the planning timeframe. In India, long-term planning is undertaken centrally under the Central Electricity Authority, which issues a national electricity plan every five years with a five-to-fifteen-year perspective. Shorter-term transmission planning is undertaken by the Central and State Transmission Utilities.

In the specific case of power pools, coordinated planning among individual pool members is critical. The Southern Africa Power Pool (SAPP), for example, develops regional generation and transmission expansion plans that identify major transmission projects. Power pool market structures can also inform future transmission investments. In the SAPP, the day-ahead market provides transparency on the frequency and materiality of network congestion across the region.

While providing attractive project structures for private-sector participation in the transmission sector is one part of the solution, another is to unlock financing at the scale necessary for investment-ready projects. Project finance structures can allow state-owned utilities to raise additional capital by creating SPVs to ring-fence the cash flows associated with a project. Under this type of structure, the government's guarantee on payment does not make the government's fiscal position worse. Rather, it ensures that revenues generated from the project are not used for other debt services or expenditures. Private financing allows the state-owned utility, or the government, to pay competitive and cost-reflective transmission prices.

As has been the case with generation IPPs, concessional financing will play a crucial role in reducing the overall cost of financing and "crowding-in" private capital. At present, most concessional financing for transmission is delivered through state-owned transmission companies. Multilateral and bilateral DFI lending policies need to be adapted to support IPTs, along with adequate credit enhancement instruments where the need arises.

Indeed, to ensure fair competition in a tender process, it is important that all participating actors compete on equal footing. In India, private entities have raised concerns over the participation of state-owned PGCIL in IPT tenders, since PGCIL has access to low-cost funds and government support. PGCIL has won about 40% of the contracts auctioned so far on a competitive tariff basis, arguably because it is able to cross-subsidize transmission projects with the help of the low-cost, AAA-rated debt it can raise through its cost-plus assets.[75]

IPTs show promise for attracting private-sector investment in transmission. However, this approach has to be pursued cautiously and is appropriate only in countries that have adequately prepared the way for IPTs in the manner described in the preceding section. The implications of PPP models in terms of cost-of-service delivery and the efficiency of service provision need to be studied, and, finally, tailored approaches need to be designed depending on country context.

## 3.3. POWER POOLS

Regional integration of power systems can be an effective way to create economies of scale for mobilizing private-sector investments, leverage synergies related to demand and supply, and advance economic integration. When properly designed and implemented, regional power pools can lower the cost of electricity supply and improve the quality of delivered electricity services, thereby driving socio-economic development. Power pools provide these benefits when they include regional-scale generation plants and adequate cross-border transmission infrastructure. These prerequisites can only be met under sound power pool rules and governance. Obviously, the cheapest and potentially fastest way to launch a virtuous circle of regional integration is by designing and implementing a sound power pool, which is mostly a legal institution.

Bilateral trade agreements and regional power pools are commonplace across all regions that face electricity access challenges, from Southern, West, East, and Central Africa to developing Asia and Central America. Yet their potential remains largely untapped due to technical and political barriers. A strong alignment of interest is needed among participating countries and external partners, including private entities and financing institutions that are willing to invest in regional infrastructures under the right conditions. National-level political commitment is needed to give executive responsibilities and resources to regional institutions, identify barriers and vested interests that impede progress, and build the capacity to regulate and operate regional systems.

As indicated in Chapter One, the main obstacles to achieving the benefits of well-designed power pools have been identified: ineffective regional governance and flaws in the rules for regional trading and network cost allocation. Both discourage investments in transmission infrastructure and regional-scale generation plants, especially when combined with a lack of trust among states, a lack of willingness to liberalize markets, concerns over the preservation of national autonomy and sovereignty, and a preference for bilateral contracts over regional agreements.[76]

As in the case of large generation plants and transmission networks, effective measures for

74 *Ibid.*

75 Singh, S. (2019), "Private power transmission companies move CCI, regulator against power grid pricing", The Economic Times, https://economictimes.indiatimes.com/industry/energy/power/private-power-transmission-companies-move-cci-regulator-against-power-grid-pricing/articleshow/69191201.cms?from=mdr.

76 Medinilla, A., Byiers, B. and Karaki, K. (2019), African power pools: Regional energy, national power, ecdpm, Maastricht, the Netherlands, https://ecdpm.org/wp-content/uploads/DP-244-African-Power-Pools-1.pdf.

improving power pools are known. The guiding principle in the design of a power pool is the single market paradigm—that is, the principle that a power pool must be as close as possible in its operation and planning decisions, transmission regulation, and governance to a single country. In practice, loss-of-sovereignty concerns and implementation issues limit the reach of this principle. The next two sections apply the single market paradigm to help analyze the two major obstacles—weak governance and flawed power pool rules—that have been encountered to date.

### Regional governance

In developing countries, governments often fail to bestow executive powers on regional system operators and regional regulators. While these two institutions exist within the four sub-Saharan African power pools, they lack the power to enforce transmission planning decisions. This institutional weakness inhibits harmonization in areas such as regional market trading rules and capacity mechanisms or the coordination of operating reserves.

Region-wide regulation is also necessary to mitigate critical risk factors in long-term contracts in multinational power pools, including regulations aimed at hedging price differences among countries, intervening in scarcity situations, and addressing uncertainty in the determination of transmission charges. Poorly designed or uncertain transmission charges make it more difficult to finance necessary investments in cross-border transmission network infrastructure.

In the European Union, the European Network of Transmission System Operators for Electricity (ENTSO-E) represents 43 transmission system operators from 36 EU countries. ENTSO-E is a legal entity and the *de facto* regional system operator for the EU Internal Electricity Market.[77] ENTSO-E has strong technical capabilities and is responsible for proposing grid codes and producing EU-wide transmission network plans.

As another example, the 1996 Framework Treaty for Central America's Regional Electricity Market (MER) established two strong regional institutions: The Regional Electric Interconnection Commission (CRIE in Spanish) as regional regulator and the Regional Operating Entity (EOR) as regional system operator. CRIE is mostly tasked with enforcing the legal and regulatory framework, driving the development and consolidation of the MER, and assuring the transparency and functioning of the regional market. EOR assures that regional dispatch is adequately performed, conducts commercial transactions, and prepares plans for generation and transmission expansion. MER member states worked with private investors to create a public–private company that built and owns regional interconnections.

By comparison, regional regulators for sub-Saharan Africa's power pools are understaffed and have limited executive power. Regional system operators are not required to undertake regional transmission planning and regional institutions have no enforcement power to implement a transmission network plan. This is an area where much improvement is needed—both in economic and human resources and in the definition of executive responsibilities—given the critical need to integrate the region's countries into functional power pools.

### Regional trading and cost allocation rules for transmission investments

As noted, the single market paradigm postulates that regional regulation should resemble regulation for a *single* system. When existing power pool rules fall short of this ideal, the efficiency and security of supply deteriorate. For instance, in the power pools of developing countries, current physical bilateral contracts distort the economic dispatch of generation and demand. Moreover, resistance to prioritizing security of supply at the regional level undermines contracts that specify dispatch priority for generators in emergency situations. This in turn inhibits investment in large power plants, depriving the power pools of economies of scale.

Sound transmission regulation is critical to successful power pools. The absence of sound, commonly agreed procedures to allocate transmission costs will deter potential investors as it increases the risk of not receiving sufficient economic compensation.

77 See https://www.entsoe.eu/about/inside-entsoe



Inadequate charges for cross-border transactions that use regional interconnections will stifle trade until sound transmission pricing rules are implemented. Power-pool-wide congestion management rules are needed to establish priorities in the efficient use of scarce network capacity.

Proven regulatory solutions exist to address these regulatory issues. The combination of experience from implementing the EU Internal Electricity Market (IEM), Central America's MER, the Indian and Australian National Electricity Markets, and regional transmission organizations (RTOs) in the United States,[78] with adaptations to reflect the conditions of power pools in emerging economies, could have great value. Rules, such as "beneficiary pays" or "transmission charges must not depend on commercial transactions", have been implemented in power pools and have universal validity.

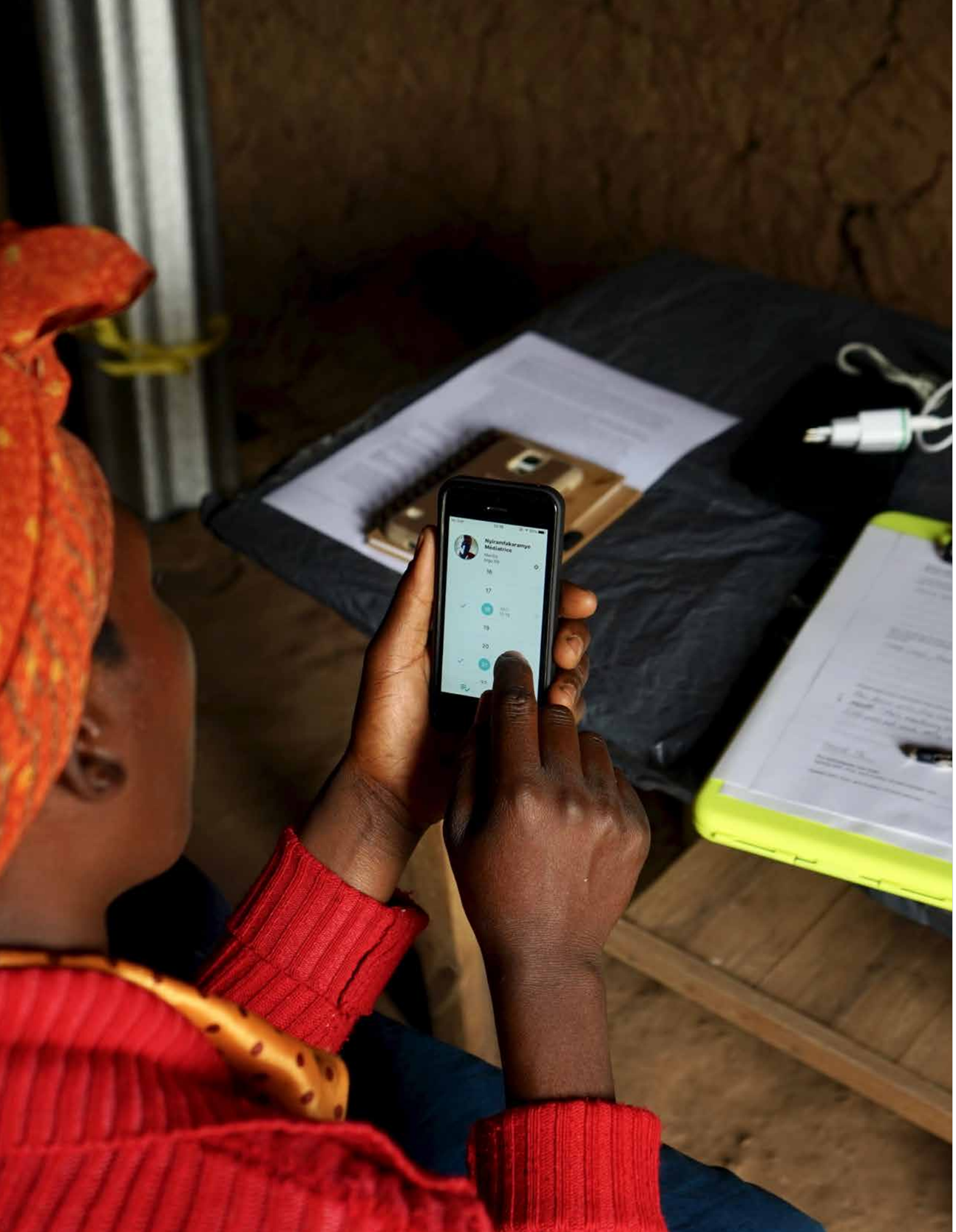
An interesting approach to develop and begin implementing effective regional regulation is "regulation by consensus." The first EU directive on the IEM, issued in 1996, was implemented this way. Given the inactivity of European governments at the time, a group formed by electricity regulators of member states, government representatives from some other states and major system operators, met in Florence in 1998 in an effort to begin implementing the directive. Called the "European Electricity Regulatory Forum" or the "Florence Forum", this group passed regulation by consensus, initially without formal approval at the EU level. Regulations approved in the Florence Forums were implemented immediately, and formalized years later in EU legal documents.

### Harnessing the opportunities

The development of power pools requires alignment of interest among participating countries and external partners, including private entities and financing institutions that are willing to invest in regional infrastructures under the right conditions. National-level political commitment is needed to confer executive responsibilities and adequate resources on to regional institutions, to identify and help overcome barriers and vested interests that impede progress, and build capacity to regulate and operate regional systems.

Progress can be made by leveraging political momentum that has already been growing among African countries towards stronger regional integration. Collaborative efforts, guided by political action, are needed to reinforce regional institutions, promote capacity building, and foster improved market rules in line with well-established international practices. Identified gaps and opportunities can be addressed through expanded dialogue and analysis, facilitated by platforms, such as the Commission, playing a catalytic role.

78 Although it should be noted that US RTOs do not encompass different countries and face lesser integration challenges.



# Epilogue

This inception report, which coincides with the launch of the Commission, offers a preliminary fact set and situational overview that serves as a starting point for deliberations. In it, we offer a number of observations and working hypotheses to be tested and discussed. During the life of the Commission, we will develop a common understanding of the major hurdles the world faces in addressing energy poverty, set priorities, and articulate a vision and actionable recommendations to achieve it. We will offer findings and recommendations at the conclusion of the Commission's first year, in September 2020.

With just over a decade remaining to end energy poverty within the United Nations 2030 target set forth under the Sustainable Development Goals framework, the Commission will work urgently to define a new approach to electrification and to encourage and support governments, donors, public and private utilities, off-grid providers, and investors to embrace and act upon it. By facilitating the spread of electrification throughout the world, we seek to illuminate a path towards modernity, and in so doing foster economic and human development. By paving the way for increased private participation in the electricity sector, we aim to provide copious energy at a competitive cost and with high reliability for residential, commercial, and industrial uses and ultimately to accelerate sustainable economic development in low-access countries.

The areas that require our particular attention are those where cooperation among private, public, and international actors must be strengthened.

## THE ROLE OF THE COMMISSION

We have argued that there is a need for more private and concessionary capital across the entire electricity supply chain—i.e., from centralized generation and transmission, to last-mile distribution. However, we note that along this supply chain, *distribution* presents the biggest unmet challenge and is an area that invites fresh thinking about topics such as integrated business models, rural concessions, technological innovation, policy, and regulation. Absent substantial and coordinated efforts in these areas, underinvestment will persist.

To be sure, substantial investment in generation and transmission is badly needed, but it depends heavily on the existence of viable downstream utilities at the distribution level, as well as the efficient operation of generation resources at the national and regional levels—including regional power pools—and necessary institutional conditions at the country level.

The research team has thus far focused on two key areas where coordinated action is needed by the institutions represented on the Commission, and others.

**Distribution:** Creating a compelling and financeable framework for accelerated investment in on- and off-grid electricity distribution in low-access countries is critical. Such a framework should take advantage of the opportunity offered by new technologies, innovative business models and public–private partnerships to deliver universal access. We have advanced the concept of an integrated distribution framework (IDF) as a device to help shape rural electrification business models that blend conventional grid extension with emerging off-grid approaches. The IDF exploits the underutilized potential of deeper integration across three dimensions:

- The integration of the incumbent distribution company with privately funded entrepreneurs who bring with them a strong commitment to serve rural consumers along with additional capital, new technologies and energetic management.
- The integration of on- and off-grid service within a given region into a single territorial entity—signaling permanence and a commitment to universal access.
- The integration of electricity access with productive uses to promote economic development and stimulate further demand in a virtuous cycle.

**Wholesale trade:** Motivating investment in bulk electricity generation and transmission in low-access countries is critical to ensuring an affordable, adequate and reliable supply of electricity to national and subnational distribution utilities. In this regard, we have focused on opportunities to make significant progress at modest expense by bringing a much greater sense of urgency to long running efforts to build and improve the design and governance of regional power pools. We know from experience around the world that this will involve the following elements:

- Examining and improving the design and governance of existing power pools, with particular attention to the rules of trade, regional security of supply, planning and cost allocation of transmission network infrastructure.
- Building greater local expertise to improve the performance of existing power pools in the near term, while also paving the way for future investments in regional generation and cross-border transmission infrastructure.
- Winning the buy-in of political leaders. We hypothesize that the current international focus on achieving SDG-7 by 2030 opens a unique window of opportunity in which to harness political momentum and ongoing regional economic cooperation initiatives.

These priorities are linked in obvious and non-obvious ways, and the choices that governments of low-access countries face in addressing them effectively are complex. The Commission's near-term objective, therefore, must be to articulate an achievable vision for universal access that is responsive to the diverse, real-world challenges faced by low-access countries and that also provides a compelling roadmap for urgent efforts to overcome those challenges, particularly in the two key areas of distribution and wholesale trade. Our longer-term objective must be to help participating countries as they develop and implement universal access programs based on this vision. We will do this by clearly identifying the essential steps they must take and by mobilizing the many internal and external stakeholders who also have important parts to play—including many Commission members.

A number of areas of inquiry and effort seem especially important.

- Developing IDF business models—Along what lines should entities responsible for distribution be structured and regulated to ensure permanence and cost-efficiency, and yet provide room for innovation and competition for customers among on- and off-grid providers? What are practical pathways from the status quo to this future state that take into account the imperative to move quickly?
- Financing on- and off-grid access—Can and should insolvent utilities participate in IDFs? If it is necessary to do so, how can the debts of unprofitable or insolvent utilities be quickly restructured so that they can participate? Can the concession model help in creating a financially viable electrification business? How should direct and indirect subsidies be efficiently deployed across urban and rural electricity consumers, and on- versus off-grid suppliers? On what terms should on- and off-grid distributors compete to make them attractive to investors and also beneficial to consumers?
- Overcoming barriers to regional cooperation on bulk power supply—What changes must be made to power pool governance and structure to ensure efficient and predictable use of transmission and generation assets, and encourage new investment in such assets? How should the potential benefits of cooperation be demonstrated and communicated to political leaders?
- Efficiently managing and operating utilities—What systems and capabilities must be created within government agencies, regulatory bodies, as well as public and private distribution entities to plan and prioritize high-impact projects, and achieve efficient operations, low technical and non-technical losses, acceptable levels of reliability, and high bill collection rates across the entire electricity value chain?
- Achieving economic impact—What policies and programs should governments put in place to ensure that universal access to energy translates into improved economic well-being and increased opportunity? How can governments be supported with international expertise, concessionary finance, and private sector initiative? What services, besides electricity distribution, linked to economic impact such as equipment sales and service, should the entity responsible for distribution be required to offer?

## NEXT STEPS AS A COMMISSION

Having staked out some initial claims and hypotheses as a starting point, we will now reflect, seek the input of our experts and others, refine our solutions, and work toward an actionable consensus. Our central mandate is to identify and address the barriers to achieving universal, economically impactful electrification. And here our main concerns are access and sufficiency, affordability and reliability, and the ways and means available to diverse stakeholders to address these concerns—hence our emphasis on promulgating a new model for rural distribution, while also seeking economies of scale in generation and transmission through regional integration.

We propose to establish subcommittees, corresponding to each (or several) of the above areas of inquiry, comprised of commissioners, experts from within their organizations, as well as outside experts when appropriate. These subcommittees will be supported by our research team, whose role will be to author working papers, briefs, and data for the benefit of each subcommittee, and ultimately to synthesize subcommittee findings in the form of a final report. The team will also solicit input from others—notably investors, private bankers, project developers, technology firms, NGOs, and government leaders—whose knowledge and experience we will rely on extensively. The report, culminating in a suite of recommendations to be taken up in a subsequent implementation phase, will be made public in September 2020.

Recommendations will be organized and presented in the form of a comprehensive package of reforms and actions that is supported by the diverse membership of the Commission and that low-access countries can pursue, irrespective of their initial starting point, to achieve universal access. This will mark the conclusion of the Commission's first year of work, and the launch of an audacious drive overseen by the Commission to achieve universal electrification within the coming decade.

As we are not an academic study group, but rather a unique and wide-ranging community of stakeholders in electrification, representing the international development banks, private investors, utility leaders, policy makers, philanthropists, project developers and entrepreneurs, and diplomats, it is not lost on the Commission that in addition to the governments of low-access countries, our advice will partly be directed at ourselves.

Many commissioners represent institutions that are already working to end energy poverty. We intend to complement their work, and hope that our deliberations will lead to even more cooperative action, new partnerships and new investments in specific countries. By doing so, we will electrify hundreds of millions of people, and as we accelerate the pace of universal electrification so too will we accelerate the end of extreme poverty.

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# Annex: **Concessions**

As national utilities continue to struggle to escape financially unsustainable business models and cycles of regular bankruptcy and bailouts, the new momentum in the energy access sector has sparked growing interest in the development of innovative governance models to restructure the distribution sector and accelerate electrification. An estimated $52 billion of investment is needed per year to reach universal electricity access by 2030—a figure that far exceeds the $30 billion committed in 2015-2016[79] and that is out of reach for public agencies. As a result, increased attention is being paid to business models that can attract private capital under socially, politically, and economically sustainable terms.

A possible answer is to bridge the financing gap by leveraging the resources of the private sector through so-called public-private partnerships (PPPs). Electricity concessions, constituting one particular form of PPPs at the interface between state-led programs and private sector-driven approaches, have been implemented in various forms—mostly in sub-Saharan Africa—with more or less success. Hosier *et al*.[80] identify more than 200 electricity concessions of varying nature and scope in about 15 sub-Saharan African countries, from small mini-grids to national utility concessions. Twelve countries have attempted to implement concessions and have either canceled existing concessions or abandoned implementation plans.

The stories of successes and failures of utility concessions yield invaluable feedback on the potential of this approach to revive the distribution sector and achieve universal energy access. A detailed analysis of past experiences in concessions shows that while such approaches have already generated positive results in restoring financial viability to previously financially ailing distribution utilities, utility concessions have had limited to no impact on energy access. However, recent studies show that concessions may also make unprecedented contributions towards energy access provided that electrification becomes part of flexible concession agreements that prioritize the financial sustainability of the distribution sector.

**Electricity concessions: a promising middle ground between private-sector-driven strategies and approaches led by state-owned utilities**

The World Bank defines a concession as "any arrangement in which a firm obtains from the government the right to provide a particular service under conditions of significant market power."[81] While such arrangements "need not involve the private sector, since governments can award concessions to public enterprises," concessions are usually granted to privately owned firms for the reasons mentioned above.

Concessions have mainly been implemented in two different forms. In the leasing model (or *affermage concessif*), the private contractor takes responsibility for the exploitation and maintenance of assets, as well as bill recovery, while the public sector retains ownership over all existing assets and remains responsible for new investments. Under strict concession agreements, the private contractor is responsible for operating, maintaining, and expanding its assets according to pre-defined terms, with the obligation to return all assets to the public sector at the end of the concession period.

79 Sustainable Energy for All (SEforALL) and the Climate Policy Initiative (CPI)2018. Understanding the Landscape – Tracking Finance for Electricity and Clean Cooking Access in High-Impact Countries. License: NonCommercial-NoDerivatives 4.0 International (CC BY-NC-ND 4.0).
80 Hosier *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World Bank, Washington DC.
81 Kerf, Michel, R. David Gray, Timothy Irwin, Celine Levesque, Robert R. Taylor, and Michael Klein (1998), *Concessions for Infrastructure: A Guide to Their Design and Award*, World Bank, Washington, DC.



Hosler *et al*. classify rural electrification concessions into four broad categories, namely solar home system concessions, mini-grid concessions, rural zonal concessions, and national utility concessions, and provide insight into the factors that determine success for each concession model.

**Solar concessions: an outdated framework?**

The main purpose of solar home system concessions is to provide fast and flexible electrification solutions for populations for which grid extension or mini-grids are not viable solutions, either technically or economically. In practice, experience has shown that the solar home system (SHS) concession model, which in Africa has been implemented only in South Africa and with limited results,[82] may not show much promise for private-sector involvement in future electrification projects.[83] Natural competition in the solar sector, as well as the dynamism of the fast-growing stand-alone solar systems companies currently operating in more than 30 African countries, may soon render SHS concession agreements obsolete.

The SHS concession model could, therefore, hardly be recommended as a promising option. The level of subsidies required and the difficulty of adapting these subsidies to different SHSs and populations renders the administration of such concessions hard to manage from a public perspective. Governments should focus on establishing well-designed subsidy schemes that create a level playing field among different electrification technologies while ensuring that regulators establish adequate frameworks for independent solar companies and other entities to install, maintain, and possibly finance SHSs.

**Mini-grid concessions: high potential despite limited results to date**

Mini-grids typically provide service in areas where demand level is low, and the costs of extending the national grid to reach the area either are prohibitively high or cannot be financed on time. Most mini-grids remain small and operate in remote areas. Mini-grids have been developed in many low-access countries by independent entities under a *laissez-faire* model (i.e., private initiative, no territorial concession, direct negotiation between developer and community on tariffs, licensing exempted under a certain capacity). This is not the subject of this section, which focuses on two kinds of concessions: bottom-up (where governments and rural electrification agencies call for proposals to electrify unspecified areas at a certain service standard) and top-down (where those governments and agencies pre-define the concession areas and invite proposals under prescribed conditions).

The development of most mini-grid concessions has long followed an informal or "bottom-up" model.[84] Once adequate frameworks and subsidy models have been established by public agencies—most of the time by a consortium of ministries and the local electrification agency or fund—local projects are proposed to attract interested private operators.

Tenenbaum *et al*. (2014)[85] report that while a few African countries actively encouraged private mini-grids, adequate regulatory frameworks were still absent at the time, creating significant confusion, especially concerning subsidy and eventual grid connection regimes. More recently, several countries have introduced dedicated policies and regulations to address key issues related to mini-grid development, including licensing, tariff setting, main grid arrival, and financial support. Their effectiveness has been limited, but efforts are being made and continue in countries like Nigeria.[86] Despite the proclaimed objective of several African countries to actively support mini-grid concessions, adequate regulations and institutional frameworks remain elusive. An average of four to six years elapsed between the development of national laws for mini-grid concessions and the awarding of the

82 Solar home concessions have been implemented in South America, for example, in Peru. https://energypedia.info/wiki/NAE_Case_Study:_Peru,_Concession_Model_for_Standalone_Systems#Effectiveness.
83 Hosier *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World Bank, Washington DC.
84 Hosier *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World Bank, Washington DC.
85 Tenenbaum, Bernard, Chris Greacen, Tilak Siyambalapitiya, and James Knuckles (2014), *From the Bottom Up: How Small Power Producers ad Mini-Grids Can Deliver Electrification and Renewable Energy in Africa*. World Bank, Washington, DC.
86 https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Oct/IRENA_mini-grid_policies_2018.pdf.

first concessions in Mali, Uganda, and Madagascar.[87,88,89]

In practice, small-scale mini-grid concessions have proved successful in attracting *local* private capital and skills. Most projects entailed private funding, which typically covered 10% to 60% of the total investment cost.

Mini-grid concessions have demonstrated very positive local impacts despite their limited geographic scope. Most importantly, field studies have shown robust involvement by local entrepreneurs and communities in the financing, installation, and maintenance of mini-grids, thereby unleashing local businesses and productive businesses, that are best suited to local contexts. The decentralized nature of mini-grids has proved well suited to local entrepreneurship and the involvement of communities.[90]

Several key challenges, however, now hamper the development of mini-grid concessions on a larger scale. In terms of financial viability, mini-grid concessions have demonstrated mixed results to date. Past experiences show that while most concessionaires usually raise adequate equity and debt to establish mini-grids and manage to recover their operating costs, current bottom-up models have limited the financial viability of these projects and their ability to maintain and expand their asset base.[91] First, the small size of most mini-grids prevents concessionaires from benefiting from economies of scale. Second, the bottom-up nature of mini-grid projects limits the ability of concessionaires to negotiate adequate, cost-reflective tariffs or well-targeted subsidy schemes (this should be properly addressed in a well-designed top-down concession scheme). Third (and directly related to the previous point), local populations are often unwilling to pay higher prices compared to grid-based services. In Mali, most mini-grids within a short distance from the grid had to be purchased by the national utility, which could charge grid tariffs to avoid local unrest.[92]

From a planning perspective, current bottom-up concession models suffer from a lack of coordination with larger-scale electrification projects and a structural inability to tap international funding sources. Most importantly, mini-grids are developed independently from each other, on an individual basis and following local requests.[93,94] Absent detailed pre-feasibility studies, common management and ownership, and large-scale integrated planning, mini-grids are unlikely to benefit from economies of scale and adequate subsidy schemes. Mini-grids also generally develop without grid connection clauses, thereby threatening the viability of these projects while the grid arrives. What is more, the local nature of mini-grids usually prevents mini-grid developers from tapping directly into international equity and debt financing, thus limiting them to public funding from government ministries or eventual rural electrification agencies or funds (if any).[95]

Despite these obstacles, the positive impact of mini-grids warrants focused attention to supporting their deployment in areas that are likely to remain unserved by the grid in the short or medium term. This entails improving access to international funding and private capital, developing well-targeted customer cross-subsidization schemes within the mini-grids, ensuring cost-recovery for developers and operators for long-term sustainability of supply via adequate subsidies, adopting transparent licensing, permitting and grid arrival clauses, and encouraging shared management and ownership.

87 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: Madagascar, Report to the World bank*, Castalia Advisory Group, Paris.
88 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: Uganda, Report to the World bank*, Castalia Advisory Group, Paris.
89 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: Mali, Report to the World bank*, Castalia Advisory Group, Paris.
90 Hosier *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World bank, Washington DC.
91 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: Mali, Report to the World bank*, Castalia Advisory Group, Paris.
92 *Ibid.*
93 *Ibid.*
94 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: Madagascar, Report to the World bank*, Castalia Advisory Group, Paris.
95 Hosier *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World bank, Washington DC.



**Territorial electrification concessions: unsuccessful to date but offering key lessons learned**

The territorial concession model was implemented in Senegal in the early 2000s, in the aftermath of the much-celebrated Moroccan national electrification program PERG (*Plan d'Electrification Rurale Global* in French). In contrast to the model adopted by Morocco, which relied on a state-owned utility to take the lead, Senegal opted for a zonal concession approach in which rights to provide electrical services were granted to external companies within preliminarily agreed-upon designated areas. While this program may have yielded limited results, key lessons about structuring concessions and the potential of zonal and national-scale concessions can be drawn from the Senegalese experience.

A first lesson is that cooperation between concessionaires and local incumbent utilities is critical. SENELEC proved unwilling to coordinate with contractors while extending its assets and did not sign off-take agreements to provide concessionaires with electricity, rendering grid extension-based projects infeasible in most regions. Second, implementing large-scale concessions takes time and requires extensive experience from an institutional, financial, and technical perspective. Senegal was first in developing territorial concessions, and the connections ended up taking place nearly ten years after the inception of the program. Third, sustained political support is indispensable in ensuring the design and implementation of concessions that run much beyond the typical five-year political horizon.

In sum, Senegal's experience with territorial concessions has been mixed but has yielded important lessons that could pave the way for successful zonal concessions in the future, provided that adequate institutional, planning, and regulatory measures are taken. The critical condition of local utilities, the recent development of fast-growing solar technologies, and the advent of GIS-based technologies may now allow countries to explore the potential of territorial concessions further.

**Utility-scale electrification concessions: a successful model that has yet to be applied to energy access**

Four national utility concession programs have been implemented in sub-Saharan Africa and were still in operation in 2015: Cameroon (ENEO), Côte-d'Ivoire (CIE), Gabon (SEEG), and Uganda (Umeme). All four were implemented with the idea of relieving the public sector from the burden of inefficient state-owned electric utilities and drawing on private resources to revive ailing distribution sectors by improving sector performance and ensuring financial viability. ENEO, CIE, and SEEG are all vertically integrated utilities, while Umeme is exclusively involved in the distribution sector. While overall experience with these concessions proved positive in terms of revitalizing previously financially unsustainable utilities, none of them were implemented to accelerate energy access and their impact on electrification might be limited to date.[96] However, the resilience and flexibility of the utility concession model provide ample room for adjustments and for the potential to integrate energy access into well-designed concession agreements without compromising utilities' financial sustainability.

Interestingly, Hosler *et al*. record that nine other sub-Saharan countries have attempted—unsuccessfully—to implement utility concession programs and still have not abandoned the idea, what confirms the difficulty of implementing efficient and financially sustainable concessions. Most of these experiences remain undocumented. However, the limited amount of information available shows that most of these attempts failed at the inception stage, during negotiations over tariff increases and the implementation of cost-reflective tariffs along with targeted subsidies.

## AN OVERVIEW OF CURRENTLY OPERATING UTILITY CONCESSIONS

All four concessions led to significant improvements in service quality and the financial condition of the national power companies. Absent any well-structured clauses about universal electrification, the impact of these concessions on energy access remains unclear.

In **Cameroon**, a 20-year utility concession was awarded to the privately-owned consortium AES SONEL (ENEO

96 Hosler *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World Bank, Washington DC.

since 2014) in 2001.[97] Annual performance targets for operational efficiency, reduction of losses, and network extension have been met while the financial viability of the company has been consistently maintained over the past two decades.[98] Maintaining the concession in operation has required significant public involvement. ENEO's viability, which is guaranteed by cost-reflective tariffs that remain among the highest in sub-Saharan Africa, is further safeguarded by increasing public subsidies that are aimed at filling the gap between frozen electricity tariffs and rising operating costs.[99] Recent events seem to call this statement into question.

In **Côte d'Ivoire**, the initial concession was awarded to CIE (or *Compagnie Ivoirienne d'Electricité*) to operate the assets of the vertically integrated utility for 15 years in 1990; the concession was subsequently renewed for another 15 years in 2005.[100] As in Cameroon, energy access projects remain almost exclusively financed through public resources, thereby allowing CIE to focus on operating, maintaining, and upgrading its current assets while also safeguarding CIE's long-term financial stability.[101]

In **Gabon**, a 20-year concession contract was awarded to SEEG (or *Société d'Energie et d'Eau du Gabon*) in 1997. A decade spent preparing the institutional, financial, and operational aspects of the concession agreement has allowed the country to operate on a single contract without major revisions for nearly 20 years.[102] SEEG's financial sustainability is assured by the company's ability to charge annually revised tariffs in most regions and to benefit from public subsidies for "social customers." SEEG's electrification mandate is confined to its concession perimeter, which extends within 400 meters of the existing grid. Long-term investments in grid extension that have payback periods over the duration of the concession are the responsibility of the public sector, which then returns assets to the utility. This strategy has allowed the national utility to connect 98% of customers in urban areas.

**Uganda**'s concession was awarded to Umeme Limited for 20 years in 2004. Umeme accounts for 95% of the country's distribution network, while small-size grid concessions serve 37,000 customers.[103] The main objective of the concession was to relieve public finances by revitalizing the distribution sector through loss reduction and increased bill recovery rates. Umeme's case is considered to be one of the most successful concession experiences in Africa. According to Hosler *et al*. (2017), system losses fell from 38% in 2005 to 21% in 2014, and bill collection rates increased from 80% to 99.1% over the same period. However, this success may stem from the absence of cash-intensive rural electrification requirements in the concession agreement.

Umeme's responsibility for energy access is limited to its concession zone, which extends within one kilometer of the existing grid.[104] Increasing electricity connections in rural areas was not one of the objectives set for the concessionaire. Extension of the grid into rural areas is currently financed by public entities and assets are later transferred to local concessionaires, sometimes operating within Umeme's operation zone, thereby limiting the potential for large-scale electrification projects.[105] The fragmenting of the distribution sector as a result of publicly financed grid extension has led to significant duplication of effort and may limit the potential for economies of scale.

97 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: ENEO Concession Cameroon, Report to the World bank*, Castalia Advisory Group, Paris.
98 *Rapports annuels* (2013 to 2017), ENEO, Douala
99 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: ENEO Concession Cameroon, Report to the World bank*, Castalia Advisory Group, Paris.
100 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: ENEO Concession Cameroon, Report to the World bank*, Castalia Advisory Group, Paris.
101 Hosler *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World Bank, Washington DC.
102 International Finance Corporation (2010), *Gabon: Société d'Energie et d'Eau*, Public-Private Partnership Stories, IFC, Washington DC.
103 Castalia (2015), *Evaluation of Rural Electrification Concessions in sub-Saharan Africa, Detailed Case Study: Uganda, Report to the World bank*, Castalia Advisory Group, Paris.
104 *Ibid.*
105 Hosler *et al*. (2017), *Rural Electrification Concessions in Africa: What Does Experience Tell Us?*, World Bank, Washington DC.



Uganda's electrification rate has thus followed a slow but steady upward trend, up from 9% in 2000 to 14% in 2016.[106] Around a third of Umeme's new connections have been made in rural areas.[107]

## THE NEXT FRONTIER: INTEGRATING ENERGY ACCESS INTO FINANCIALLY SUSTAINABLE UTILITY CONCESSION AGREEMENTS

While the four national utility concession programs have proved successful in restructuring distribution utilities from periodically bailed out companies to financially sustainable entities that can meet stringent service quality targets, energy access has remained beyond the scope of all concession agreements to date, with the result that there has been limited progress on this issue. However, experience shows that concessionaires in Cameroon, Cote d'Ivoire, Gabon, and Uganda have been willing to cooperate with governments, provided adequate supporting frameworks were implemented. A set of key lessons[108] could be derived from their experience that could prove helpful in the design of future concessions aimed at achieving universal energy access.

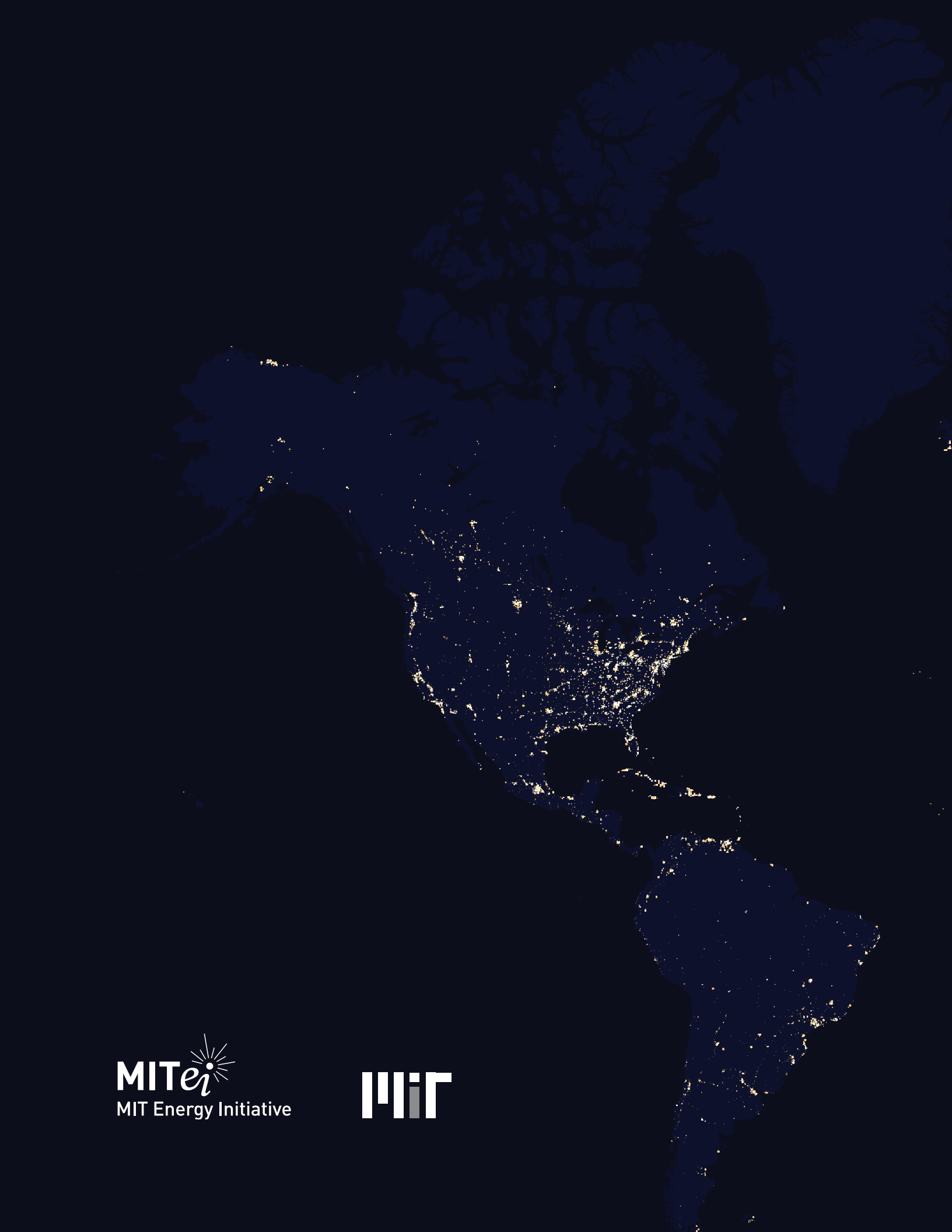
**First of all, utility concessions were not designed to address the challenge of energy access but may prove resilient and flexible enough to accommodate universal electrification requirements**. The experience of the four countries mentioned above shows that utilities were both willing and able to expand their concession area and engage in *well-targeted* electrification programs *within their area of action*, provided they were granted adequate guarantees, subsidies, and flexibility regarding the mode of electrification to be pursued (i.e., through grid extension, mini-grids, or SHS).

**Second, proactive political support plays a key role in the design and implementation of resilient concessions**. Such support can foster further institutional, financial, and operational cooperation between public and private stakeholders and will prove all the more important if energy access becomes part of concession agreements. A significant advantage of national utilities over smaller-scale concessions is the national utilities' negotiating power over public institutions and their ability to set up more favorable terms that are best able to support financially sustainable frameworks for action.

**Lastly, a significant challenge for the next decade will be to integrate a universal energy access mandate as part of concession agreements without compromising the financial health and performance of the concessionaire**. Energy access targets should be defined in a holistic manner that entails both connections and quality of service.

National utility concessions have unprecedented potential to disrupt the distribution sector, both by reviving ailing distribution companies and by empowering power companies to take on the daunting challenge of providing universal energy access—without compromising on service performance and financial sustainability. While most electrification efforts historically have focused on a limited concession zone surrounding the existing grid, national utility concessions have the geographic scope and resilience to engage in large-scale electrification programs and are best able to leverage all possible electrification technologies and modern planning methods using both bottom-up and top-down approaches.

106 *Ibid.*
107 World Bank World Development Indicators (accessed on July 5th, 2019).
108 As determined by Hosler *et al*. (2017).



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