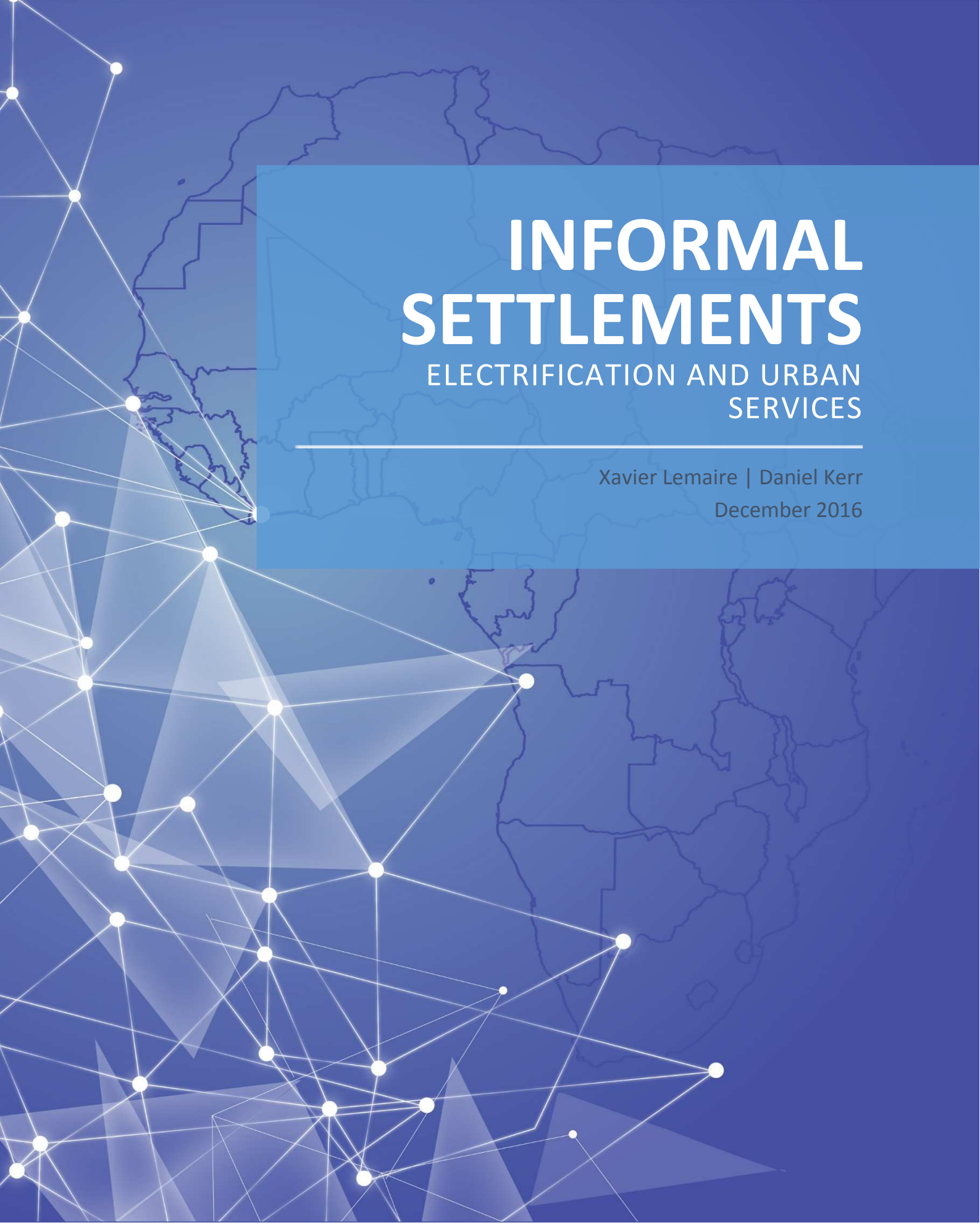

INFORMAL SETTLEMENTS

ELECTRIFICATION AND URBAN SERVICES

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Supporting Sub-Saharan Africa's Municipalities with Sustainable Energy Transitions

FOREWORD

Urban populations in Sub-Saharan Africa are forecast to grow at a high rate in the coming decades. Housing and urban services development is failing to keep up with the rapid urbanisation of Sub-Saharan Africa, and as such informal settlement development is rapidly increasing: providing urban services to these informal settlements is an issue that needs solutions at a local level.

Informal settlements are generally defined as those without a formal right of land to the location in which they are situated. However, this does not mean that informal settlements cannot be fixtures of the urban landscape, with some "slum" areas of cities such as Mumbai having endured for over 60 years. Servicing these informal settlements can be challenging: lasting legacies of large-scale informal electricity connections and electricity theft leaves local electricity authorities ill-disposed to formalise these areas, and structural difficulties such as geography and urban form can hamper efforts to formalise other urban services.

This concept note aims to introduce the main themes around the issue of informal settlement development in the developing world, with a particular focus on electrification and informal settlements, and providing other formal urban services such as water and sanitation. Formalisation of informal settlements, bringing them within the sphere of formal urban services by the municipality, is also discussed, as are a number of case studies from varied developing world contexts.

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IDENTIFYING THE PROBLEM

INFORMAL SETTLEMENT DEVELOPMENT AND URBAN PLANNING

The growth in urban populations in the developing world has rapidly overtaken the capacity of national and municipal governments to provide formal housing and servicing to the urban and peri-urban population. As a result, the growth of informal settlements in urban areas of the developing world has been high. The electrification of informal settlements in developing cities often differs to that of peri-urban areas, and can have specific dimensions associated with the settlement itself, such as the effect of population density and location, as well as formal electricity services in the vicinity. Peri-urban areas can be “formal” in terms of settlement construction and utility access from an initial design phase, and then dealt with through normal electrification procedures, rather than in specific programs. However, peri-urban areas in much of the developing world, particularly Sub-Saharan Africa, remain underserved. [16]

Peri-urban areas of developing countries, i.e. settlements situated around the urban, densified core of a city, tend to be common sites for informal settlement development [3]. This can be due to land availability, with settlements emerging in locations previously undeveloped on the periphery of urban centres, or due to convenience in terms of access to the urban core for employment. The majority of population growth in newer informal settlements in an urban area can come from migration from rural areas; population growth from foreign immigration is also high in the developing world. In spite of this, far from being temporary settlements number of informal settlements develops over time to become established quarters of an urban area.

PERI-URBAN ELECTRIFICATION AND GRID EXTENSION IN DEVELOPING COUNTRIES

Electricity grid extension has been dominant in the sphere of extending electricity services to un-serviced communities in the developing world, with national governments focusing on grid extension projects over off-grid development projects as a method of electrifying urban areas.

Extending the electricity grid of a city to provide service to an informal settlement raises a number of challenges, both for municipal planning and electricity authorities, as they are being settled by individuals on an ad-hoc basis, with limited oversight in terms of developing a cohesive settlement with urban services as a designed-in feature. Extending the electricity grid to these settlements in these circumstances can therefore be difficult as the geography of the settlement may make for instance the construction of domestic, low-voltage lines or central pylons more challenging, leading to increased expenditure and complexity in terms of servicing these settlements.

Indeed, ad-hoc planning procedures and informal growth patterns as the population of informal settlements increases tend to lead to settlements that are sprawling and low-density, as well as limited in designed-in space for urban services, such as waste collection, sewerage, and electricity supply. This limits the ability of municipal authorities to easily upgrade informal settlements to receive formal urban services: upgrading informal settlement is often more costly than in planned settlements.

Furthermore, the legal status of an informal settlement can be a barrier to any formal municipal authority from attempting to service the settlement. Settlements that exist on land that is already owned by the local authority or by another entity, for example a property developer, often have a tenuous or lacking legal status from the perspective of municipal service authorities. This lack of a formal legal presence can prevent municipal service authorities from attempting to engage with informal settlements due to a lack of a mandate.

ELECTRICITY THEFT AND ILLEGAL CONNECTIONS

Due to the difficulties that municipalities often face in providing electricity services to informal communities in developing cities, rates of electricity theft among residents of these communities are often high. These illegal connections can take the form of distributing electricity to several households from one legal connection, or through directly tapping into medium-voltage electricity line to distribute at a local level. As of 2011 it was estimated that 40% of the Sub-Saharan African urban population live in informal settlements, and of these informal settlement dwellers, some 50% make use of an illegal electricity connection. [16] [17].

Example of an illegal electricity connection in South Africa. From [11]

The levels of electricity theft in informal settlements are a major barrier to efforts to provide formal electricity services to these settlements. Electricity authorities in the developing world often have constraints in terms of financing, and illegal electricity connections can severely impact revenue streams for the electricity authority. Losses from the electricity network can be categorised under technical losses, such as line or substation failure, or other causes directly attributable to the electricity distributor, and non-technical losses, such as electricity theft, which are commercial losses. Non-technical losses such as electricity theft are more prevalent in developing-world countries than in OECD nations, as shown in the table below.

Country	Estimated NTL's in 2007	PPP per capita 2007
India	20% to 40%	2,700
Philippines	3.5%	3,300
Indonesia	5.5%	3,400
Jordan	3% to 5%	4,700
Jamaica	13.2%	4,800
China	10%	5,300
Thailand	0.32%	8,000
Brazil	0.5% to 25%	9,370
Turkey	6% to 64%	9,400
South Africa	~ 10%	10,600
Venezuela	12.74%	12,800
Russia	10%+	14,600
UK, Aus, US	0.2% to 1%	> 30,000

Relationship between levels of non-technical electricity losses (NTL) and economic prosperity at purchasing power parity (PPP) per capita 2007. Adapted from Electricity Regulatory Authority of Uganda (2011) Study on Distribution Losses and Collection Rates by Umeme Ltd. From [17]

From the perspective of electricity authorities, the revenue loss from electricity thefts can have severe impacts on their balances and cash flows. These thefts can have a significant impact on electricity development as a lack of revenue security impacts the ability to service communities across the board, informal and formal.

Other barriers from the view of the electricity utility are the lack of capacity in controlling illegal connections post-electrification of some areas. If the utility electrifies some areas but not others, the risk increases that un-serviced households may use the proximity of a formal electricity connection to acquire an illegal connection, thus further increases non-technical losses. The danger exists indeed in increasing informal electricity connections if electrification programs only cover part of an informal settlement, giving readier access to the formal electricity grid for those seeking to connect illegally.

To reduce the level of electricity theft, authorities have then to devote more resources to removing illegal connections thus increasing price burdens on legal customers. This “vicious cycle” has been observed in many communities and settlements with high levels of informality in the developing world, for example Gauteng municipality in South Africa, and Mumbai municipality in India.

Approaches to solve this issue vary across Sub-Saharan Africa, but favour focusing electrification efforts by scaling projects to encompass larger un-serviced areas to reduce this risk. [11] [15] Some countries such as Uganda have also tackled this problem through reducing turn-around times for the construction of new connections to reduce the opportunity for illegality, as well as instating mandatory auditing of meter installations to check integrity. Other countries, such as the Philippines, have instituted new connection technologies at an urban level to reduce the ease of creating illegal connections, in the form of elevated, central metering clusters [5] [7].

Khayelitsha Township, Cape Town, 2008, with maypole-style electricity pylons visible. Photo: Chell Hill

SAFETY HAZARDS

Safety is another major concern when dealing with informal communities reliant on ad-hoc, illegal electricity provision. A particular risk is the fire hazard that illegal electricity connections present: a lack of access to equipment (wiring, fuses, junction boxes etc) that has been tested for safety, as well as the potential for misuse in terms of drawing excess current, leads to an increased risk of electrical fires with illegal connections. This fire hazard is exacerbated by the nature of the built environment in informal settlements more generally: these settlements are often high-density, with limited space between houses and little in the way of planned firebreaks.

For example, Cape Flats informal settlement in Cape Town has a population density ranging from 3,520 to 46,520 people/square km); informal settlements, in Karachi in Pakistan, have densities higher than this still, with 1,500 – 3,500 people per hectare of land in the densest informal settlements, approaching millions of people per square km. [18] This high-density construction also

limits the ability of municipal fire authorities to respond to emergencies that develop in informal settlements, further compounding the issue. This safety hazard can actually pose an incentive for utilities not to electrify informal settlements, given the risk of culpability in cases of property damage or injury/loss of life resulting from an informal electricity connection.

Fire in Kya Sands informal settlement in Johannesburg, South Africa on Nov 11, 2015. Photo from HALO Aviation, Twitter. Available at: https://twitter.com/HALO_Aviation/status/664434701420072960/photo/1?ref_src=twsrc%5Etfw

Liability in case of death or injury from a fire or other hazard related to an illegal electricity connection is a factor that utilities consider in their approach to electrification of informal settlements. The risks to life and property when dealing with illegal electricity connections are manifold: apart from the clear risk of fire, electrocution is another danger, particularly to the unaware such as children. Uncertainty in whether utilities will be held liable for such an injury of death can be a deterrent to utilities in electrifying areas which are currently un-serviced, as well as involving themselves in the formalization of informal settlement electricity connections.

FORMALISATION AND SERVICING INFORMAL SETTLEMENTS IN PERI-URBAN AREAS

The nature of informal settlements and the urbanisation paths they develop through can be a barrier to acquiring a formal electricity connection for the household. Households which are constructed on illegally-settled land for example are often excluded from obtaining a formal electricity connection from the municipal authority by law, and providing a formal proof of address is a common prerequisite in the application process for new electricity connections [1].

However, even where formal electricity connections exist for informal settlements, for example in informal settlements that have been "formalised" and brought within the sphere of municipal servicing, continuing to maintain formal services through establishing new connections for new residents can be a struggle for the electricity authority. Population growth rates in informal settlements in particular are high and if housing development is not regulated and planned, the potential exists for barriers to develop to further extending electricity connection to new households.

Addressing this barrier for households is a complex issue: addressing the legality of settled land is a lengthy process, and acquiring a formal proof of address when outside of the formal urban services sphere is also difficult. Formalisation efforts can have a great impact on both of these issues: bringing newer informal settlements into the formal, legal urban services space means these households can apply for services from a stronger legal basis, with a formal address. In addition, municipal authorities apart from electricity can make efforts to formalise informal settlements, which can give the settlement the necessary legal position to overcome the barriers to obtaining an electricity connection. [2]

Appropriate metering is another constraint to formal electricity provision, including ensuring the meters used are not susceptible to tampering and developing capacity in the electricity authority to effectively meter and bill an ever-increasing customer base. [3] [9]

INFORMAL SETTLEMENT ELECTRIFICATION CASE STUDIES

SOUTH AFRICA – NATIONAL POLICY AND THE CITY OF CAPE TOWN ELECTRIFICATION OF BACKYARD DWELLINGS POLICY

South African informal settlement electrification policy has tried to address a significant and increasing problem. As of 2012 over 10% of the population of South Africa lived in informal settlements, with major urban centres reporting over 300,000 informal households each. Informal settlements are now recognised as an enduring feature of the South African urban landscape, and policy, instead of targeting the eradication of informality as it has pre-2010, now explicitly includes informal settlements recognised in official documentation such as policy guidelines, and in national electrification targets. These include the *Policy Guidelines for the Electrification of Unproclaimed Areas* from 2011, suggesting informal settlements are regarded in government as a continuing feature of the South African urban landscape. Governmental pressure for the change came in part from the 2010 Energy White Paper and subsequent work from the Department of Energy, in recognising that the Free Basic Electricity Allowance Policy, which allows the poorest consumers access to a lifeline electricity consumption tariff-free, had failed in improving access in the country's informal settlements.

Informal settlements in South Africa are categorised according to the suitability of the site they occupy for electrification (see table next page). Sites which are on suitable land for settlement (defined by the geographical as well as legal characteristics of the site) are most likely to be subsidised for electrification by the government.

Settlement Category	Condition/Status	Response
Category 1	On suitable land (complies with the set criteria) and is likely to go through in situ upgrading.	Will be subsidized for electrification.
Category 2	Settlements that do not need immediate relocation and will therefore go through the process of regularization which is pre-formalization (providing basic services with plans to relocate in the future).	Will be subsidized if the settlement is not to be relocated within the next 3 years.
Category 3	On unsuitable land (do not comply with the set criteria, areas such as on dolomite land, in toxic areas, or in a dangerous area) and need relocation.	Settlements that have been there for a reasonable amount of time will be considered on a case by case upon application by the Department.

Categories of informal settlement in South Africa, as defined by the Department of Energy. From Gaunt et al. (2011) [11]

Lower categories of settlement are those on unsuitable sites for permanent settlement, including toxic or illegal sites. Cases of this nature are dealt with individually by the Department for Energy, and take into account the settlement's longevity and permanence at the current site, as well as the potential for relocation and upgrading. [11]

In cities such as Cape Town, there is a widespread occurrence of informal settlements in the outdoor areas of formal properties in townships, where the occupier (or tenant) of the formal settlements has allowed others to establish informal settlements on their property. These dwellings do not have direct access to the urban services available through the city, and are therefore reliant on access to services, including electricity, through the occupier of the formal dwelling. This can be on a commercial basis, and can result in the exploitation of the informal property dwellers, for the profit of the formal property dwellers.

The development of these informal properties alongside formal land has put constraints on the municipality, both in terms of safety and in terms of financing. Multiple electricity connections running through a connection to the distribution grid that was intended for a single property significantly increases the risk of overloading the connection, which can lead to failures in supply as well as the potential for electrical fires. Financial constraints placed upon the distribution entity by these connections include electricity theft, if the connection to the backyarder property is an illegal one, and the additional financing burden of replacing components and distribution lines from overloaded connections.

A unique case in South Africa is the City of Cape Town's "backyarder" electrification policy. As of March 2015, a draft policy for the electrification of these "backyarder" properties was produced by the City of Cape Town Electricity Department, although the issue of backyarder electrification has been addressed by the city for the past five years. This policy sought to provide directives for the formal servicing of informal "backyard" households in the city, in an effort to bring the inhabitants within the formal urban services sphere. This servicing is to be in the form of subsidised electricity supplies through a pre-paid meter, with a 40 amp single-phase electricity connection provided to the informal households. This electrification program is to be undertaken in conjunction with a distribution network upgrade plan for areas of the city where a number of new connections is to be made.

Two pilot projects have been undertaken to assess the viability of addressing the backyarder electrification issue. The first was targeted at the Factreton residential, and in addition to electrification in partnership with a private engineering consultancy in the city, made provisions for the placement of refuse bins and a communal toilet and water standpipe for council rental properties in the area. This multi-service approach sought to upgrade the informal properties in the township to bring them within the formal urban services sphere, as well as upgrade the services provided to the formal residents of the area. The electrification component consisted of new connections to 1,517 erven (plots of land) in the area, as well as 188 backyarder properties on formal council rental stock. The Factreton project was completed by February 2014, and following the success of the project, the Hanover Park residential area of the city was chosen as a follow-on project recipient, providing connections to a further 3,281 erven, and an estimated 1,360 backyarder properties. [4] [6]

FORMALISING ELECTRICITY SERVICES IN MUMBAI, INDIA

Urbanisation in India has continued at a rapid pace over the last 20 years, and as such the growth in informal settlements in some of the country's larger cities has been very high. Mumbai is somewhat of a unique case in terms of the electrification of informal settlements, as somewhere between 70 and 90 percent (depending on the settlement) of informal settlement residents have access to electricity. This is in part due to the density of the city, with more inhabitants closer to either formal or informal connection infrastructure, as well as the enduring nature of some of the city's informal settlement districts (up to 60 years in some cases), and their having been targeted by previous electrification programs. However, these electricity connections are in majority unofficial, and of a low quality, providing only a basic level of service. These informal electricity connections are also illegal in nature, and impact both the ability of the municipal electricity authority to provide services on a formal basis through affecting revenue streams, and the quality and safety of the formal electricity services, through overloading of the electricity distribution network.

On a regulatory basis, the Indian federal government is committed to universal access to electricity through the Electricity Act of 2003, and the Mumbai municipal government has been the major

actor in the sector to date. However, this act only makes provisions for delivery to the street-level metering point, and not to households, putting a significant burden on households in terms of costs to acquire an electricity connection. The cost of obtaining a formal electricity connection was found to be the second-most negative factor affecting 3,000 surveyed informal households in Mumbai in 2011, after the cost of regular electricity supply [1]

Informal settlements in Mumbai. Source: http://blogs.washplus.org/urbanhealthupdates/2012/12/gates-foundation-backs-scientific-study-of-urban-slums/

Responses from the surveyed households found that formally-supplied households paid on average USD8.34 (Rs555)/month for electricity, compared to USD3.87 (Rs257)/month[1] for informal supply. In addition to the cost barrier, municipal electricity authorities in India have been reluctant to engage in large-scale formalisation of electricity connections in more modern informal settlements due to the persistent threat of eviction from the land they occupy. In the case of Mumbai, households are only eligible for a formal electricity connection if they are in a notified slum, one that has been brought within the sphere of urban services of the municipality, so that the investment in electricity connection is a lasting one. [12] [14]

[1] Exchange rate as of 1.4.16 1 Rs = 0.015 USD.

There are a significant number of barriers associated with informal households in the municipality from acquiring a legal, formal electricity connection, ranging further than the more simple cost and legality barriers. In the survey of 3,000 households above, one of the key findings was that the influence of local community leaders and landlords is much more significant than assumed by the municipal authorities in Mumbai. 72% of the surveyed informal population acquire their electricity through such a person, and these community leaders were found to be highly influential in terms of making the decision for their local areas to apply for formalisation, not just in terms of electricity connections but other urban services and legal standing. However, they were also found to be a major point of resistance to formalisation activities, particularly if involved in the provision of urban services to the informal population of their community themselves. Involving these community actors in the electricity sector with formal municipal government efforts to provide electricity has been a key development of the Mumbai approach to electrification, and points to involving community actors in other informal settlement electrification programs for greater success. [1]

ELECTRIFICATION OF URBAN POOR COMMUNITIES IN MANILA, THE PHILIPPINES

The Philippines has a long and varied history in terms of electrification programs for poorer communities, in both rural and urban contexts. Given the geographical nature of the 2,000-plus island archipelago, rural and remote community electrification was high on the government's priority list in the 1990s, and the state was heavily involved in electrification programs at this time in conjunction with the country's largest distribution utility, the former parastatal Meralco.

The largest of these electrification programs in the 1990s was the Depressed Areas Electrification Program (DAEP)[2], which targeted 320,000 households across 229 areas in the country. One of the notable features of this program was the fact it was blind to the nature of the settlements it targeted: settlements on both formally-owned and land of contested ownership were targeted for electrification.

[2] "Depressed Areas" is a term used by the Philippines government to mean informal settlements.

Informal settlement in Manila. Source: philstar.com, http://www.philstar.com/nation/2016/01/15/1542886/dilg-relocate-26367-informal-settler-families-manila

However, since the early 2000s and the liberalisation drive within the electricity sector in the Philippines, the state has taken a diminished role in electrification programs, instead allowing Meralco to operate autonomously within that sphere, particularly within the bounds of Metro Manila and the wider National Capitol Region (Manila and its surrounding suburbs). The sole state policy acting at a national level in terms of servicing urban poor communities, exists in the form of a subsidised electricity tariff. Eligibility for this tariff is based on consumption levels of the household only, and only applies to residential beneficiaries, based on the assumption that poorer households will consume less electricity. Whilst this holds true in a significant number of cases, unintended beneficiaries of the subsidy include second-home owners due to consumption being low enough to qualify in the second household.

Meralco as the sole distribution utility following the country's Electric Power Industry Reform Act for the city of Manila, has the right under Article 6 of the Act to refuse electricity service to households with proof of a secure tenure. This was due to lobbying at the time of the Act from the company in order to preserve its neutrality in land tenure issues. However, this constrained the

utility in electrifying unserviced settlements. Meralco's solution to this was to bring other urban services-sphere actors into the electricity debate, most notably the local government-level *barangay* officials, as well as civil society groups such as NGOs. The involvement of these civil groups and local government officials has enabled Meralco to negotiate electricity service conditions for settlements that were previously outside of their legal remit, mainly through the local government mandate provided in the Urban Housing and Development Act of 1992 to provide "power and electricity and an adequate power distribution system" to their local area.

The RAISE program launched in 2011 by the utility was the first of the second-generation informal electrification programs undertaken by Meralco, which sought to electrify communities without increasing the level of electricity theft and illegal connections, as had been the case under the former DAEP. The main innovation in this program was the provision of elevated metering clusters for the 1,500 new electricity connections to households in the city, providing a central point of metering for the utility, elevated from the ground in order to reduce the chances of tampering. Financing for the RAISE program, which is ongoing as of 2015, is a complex issue involving the cooperation of many actors. These include Meralco itself as well as its social programs division, Meralco One, formerly the Department of Corporate Social Responsibility. The governmental Department of Social Welfare and Development is also involved in funding and planning for the RAISE program. Responsibility for wiring from the metering clusters to the households, finally, is borne by the end-users of the connection. [5] [15]

An elevated metering cluster, used to electrify informal settlements with less risk of tampering and illegality. Source: Meralco, "Delivering electricity to vulnerable communities", Asian Development Bank Asia Clean Energy Forum, June 19th 2009.

Some lessons can be learned from the Philippines case, particularly in the operations of Meralco in the country's dominant informal urban settlement space. Technological innovations such as the elevated metering clusters have been shown to alleviate growth in illegal electricity connections following formal electrification of an area. The blanket electrification approach that Meralco took to informal settlements in Manila has also been shown in this and other cases (such as the South African case above) to reduce levels of informality, providing every household (or metering cluster in the case of the Philippines) with a formal electricity connection, rather than selective streets or areas, increasing the accessibility to the formal network for those seeking to connect illegally.

ELECTRIFICATION OF URBAN POOR COMMUNITIES IN BRAZIL

The case of Brazil is a long-standing one in the sphere of servicing informal settlements. Since the 1970s Brazilian *favela* upgrading programs have endeavoured to reduce informality in terms of electricity access and provide a safer urban environment for residents. However, much as in the case of Mumbai, a lack of targeting of interventions - as well as legal and regulatory grey areas - has meant that informality in terms of urban services has continued and grown significantly. Pilot projects in Rio de Janeiro, for example, where levels of non-technical losses in electricity supply exceeded 40% in the 1990s, have experienced high levels of recidivism in terms of illegal electricity connections, despite investment in anti-theft technology. This lack of success shows that despite the benefits of legal electricity, without a supporting policy and regulatory framework to ensure electricity is affordable, and the legal electricity connection is the preferable option, illegal electricity connections will still be preferred by many informal settlement residents.

In terms of the legal basis for electrification, Brazilian Law no. 10,438, which came into force in April 2002, mandated electricity utilities to cover 100% of their service area. However, this was only enforced in the 2000s to cover distribution lines to the street level, usually via overhead cable. This had the net effect of increasing the accessibility of illegal electricity: access to overhead lines was relatively simple for creating new illegal connections. These connections were often using low-quality wiring and cabling, and power outages due to short circuits, as well as fires, were common in *favelas* at this time. [13] [15]

The Law was intended to allow electricity consumers in slum communities readier access to electricity by mandating the utility to service informal settlements if they fell within their service areas, at a national level across the country for the respective distribution utilities in major urban areas. However, the law was focused on the electricity utilities servicing slum communities, rather than addressing other barriers that residents of the *favelas* face in acquiring a legal electricity connection from the utility. Living outside of the formal social legal sphere is a major barrier to residents of informal settlements in the country; without formal identification, a formal proof of address, or a formal address, accessing basic urban amenities such as an electricity connection and postal services, or other services such as a bank account or telephone line, is usually impossible.

The Slum Electrification and Loss Reduction (SERL) Program was initially instituted in 2005 as a collaboration between the International Copper Association (ICA) and USAID. This project sought to engage slum communities and electricity utilities in order to electrify residents, as well as reducing non-technical losses, through partnering with electricity utilities and electrical component manufacturers.

Informal settlement in Salvador de Bahia, Brazil. Source:
http://blogs.washplus.org/urbanhealthupdates/2012/12/gates-foundation-backs-scientific-study-of-urban-slums/

The SERL project was unique in that it sought to address one of the major identified sources of failure for previous slum electrification programs: the lack of an enduring presence in an informal settlement, managing illegality as well as reducing barriers to formal electrification.

The pilot in Brazil, in the settlement of Paraisópolis in Sao Paolo, was a success, with 80% of the residents of the informal settlement joining the program, and being provided with a formal electricity connection, as well as energy efficiency equipment such as efficient lightbulbs. This efficiency factor is particularly important in the Brazilian case, where residents of informal settlements often have high per-household electricity consumption per year (up to 325kWh per month in Paraisópolis for example). This high consumption drastically increases the cost of formal electricity, and therefore the efficiency interventions have the dual effect of reducing the probability of reversion to the cheaper, illegal connection. [19]

This management of illegality at an active level, by having a lasting company presence in the form of offices or technicians in informal settlements, has the potential to be replicated in other informal settlement contexts. Illegality in electricity services, despite the different approaches involved on a global scale to acquiring an illegal connection, can have common, cross-cutting solutions. Regular management of legal electricity connections to ensure integrity has been shown in the Brazilian case, across many informal settlement contexts, to reduce levels of recidivism and ensure continued formal connection use.

Whilst the approaches taken in this project have not been further used, the Safe Electrification and Loss Reduction program in Mumbai from 2009 onwards, also implemented by the ICA and USAID in partnership with Reliance, Inc., a Mumbai distribution utility, was directly influenced by the results of this program.

CASE STUDIES – SIMILARITIES AND DIFFERENCES

Country	South Africa	India	Philippines	Brazil
Relative Income Level of Country (US$/Capita, 2013)	6,617.91	1,498.87	2,765.08	11,208.08
Barriers to Formalisation of Electricity Services	- Financial constraints on electricity utility - Existing illegal service infrastructures - Lack of clear regulation for electrification	- Financial constraints on consumer and utility - Electricity theft rates very high, number of informal settlements have 70-90% electricity access through illegal connections - Lack of lifeline tariffs for poorest - Lack of policy/regulation for reducing informality	- Lack of policy framework for to-household electricity - Existing informal infrastructure - Lack of path to legal recognition for informal households	- Lack of financial incentive to formalise - No policy for household connection - Legal barriers to formal household recognition - Very high per-household consumption (up to 325kWh/month) on illegal connections - cost barrier to formalisation very high
Success Factors in Informal Settlement Electrification	- Free Basic Electricity policy allows poorest access (50kWh/month free) - City of Cape Town Electricity Department investing in “backyarder” electrification - Municipal authorities creating pathways to formal household status through land tenure formalisation	- Community engagement with informal settlement leaders key to success - Formalisation through municipal authorities for combined electricity/water/sanitation activities	- Utility extending basic tariff access - Institutional cooperation in providing urban services between DoE, municipal authorities and electricity authority - Innovative approaches to formalisation and right of land from municipal authorities	- Electricity companies engaging communities in their cities and creating lasting company presences - Energy efficiency interventions (refrigeration, air conditioning) from companies in line with electrification providing co-benefits of formalisation

CONCLUSIONS AND POLICY RECOMMENDATIONS

In terms of developing solutions to the issue of electrifying informal settlements in urban areas of developing countries, there needs to be first an awareness of the context in which informal settlements exists, and their varying statuses in terms of legality, urban service provision, current electrification solutions and other factors. The case studies detailed above have highlighted the fact that there are still major barriers to informal settlement electrification in a variety of developing world urban contexts.

THE COST OF ELECTRIFICATION

Financing and capacity issues within municipal authorities are a barrier to the servicing of informal settlements with urban services, and electricity services in particular

One of the most common barriers reported through the literature is the costs associated with acquiring and maintaining a formal electricity connection for an informal household. This is true across a variety of country contexts, for example in both the Philippines and India. In addition to the high costs of formalising an electricity connection, the fact that informal and illegal connections are often either cheaper or free acts as a further disincentive to formalisation of electricity services for the household. Addressing the cost barrier for informal households, who are often at the lowest end of the economic spectrum in a municipality, needs to be a major consideration in the design of formal electrification programs for informal settlements.

From a utility and municipality standpoint, the costs of informal electrification are also a barrier. Levels of electricity theft in informal settlements are generally high, and as such these settlements constitute a significant source of revenue loss for the municipal electricity authority in question. In

addition, removing illegal electricity connections and providing formal electricity connections, to the required standard under law in informal settlements is often a costly process, and more expensive than doing so in formally-planned settlements. This can be due to the construction of the dwelling in question, or the geography of the settlement requiring new distribution infrastructure to service.

There are a number of approaches to addressing the cost issue. The City of Cape Town, for example, has taken the approach of freely providing formal electricity connections to some of the informal "backyarder" households in the city, bypassing the cost barrier for the end user. This approach functions in conjunction with the government-level policy of free basic electricity, providing a Free Basic Electricity Allowance of 50kWh/month to poor households. However, not all developing world cities may have the resources or regulatory support to address electrification in this way.

Addressing the issue of electricity theft in an inclusive manner, through formalisation and upgrading of illegal connections to formal, metered connections has proven to be a viable approach in terms of reducing electricity theft and the cost burden on the municipality. Municipalities such as Manila for example have taken a legality-blind approach when designing electrification programs in the past, directly reducing the incidence of electricity theft through providing a formal, metered connection, with a subsidised tariff rate for poor consumers in informal settlements supporting the installation, ensuring that poorer consumers do not revert to illegality as a cheaper alternative.

LEGALITY AND FORMALISATION INITIATIVES IN LAW

The question of legality of an informal settlement is one that affects urban service options that the settlement is eligible for. In the case of Mumbai above, over 20% of the 3,000 surveyed households reported a legal barrier to their acquiring a formal electricity connection, either through not having proof of tenancy for the land they occupy, or through a lack of a formal address. The issue of formality in address and tenure is also present in contexts such as Manila and Bangkok.

In terms of addressing the legality barrier to formal electrification, one of the most important factors is clarity in regulation and the mandate for providing urban electricity services. In the case of Mumbai the legal mandate for the provision of electricity services ended at the street level, with very little in terms of regulation for how households, either formal or informal, are to then gain access to the formal connection. Ensuring that there is a clear mandate for a municipal organisation to provide electricity services for households, then modifying the existing policy and regulatory structure within municipal law to allow this, would address a number of the legal barriers to informal settlements acquiring a legal electricity connection.

Formalisation and tenure is a complex issue, and one that needs to be addressed collaboratively between the municipal planning and housing authorities, and the body in charge of municipal electricity provision. In cases such as Bangkok and Mumbai, the formalisation of address and the provision of electricity services have been a key gateway to the provision of other formal urban services, for example municipal waste, education, healthcare and others, to an informal household. Ensuring that there is a path to formality for informal settlements implies that there is also a path to formal urban services, through the majority of existing legislative frameworks for service provision in developing world municipalities.

REFERENCES

[1] Mimmi (2014) From informal to authorized electricity service in urban slums: Findings from a household level survey in Mumbai. *Energy for Sustainable Development*, Vol. 21, pp. 66 – 80.

[2] Fonseca & Schleuter (2013) Novel approach for decentralized energy supply and energy storage of tall buildings in Latin America based on renewable energy sources: Case study - informal vertical community Torre David, Caracas, Venezuela. *Energy*, Vol. 53, pp. 93 – 105.

[3] Bekker et al. (2008) South Africa's rapid electrification programme: Policy, institutional, planning, financing and technical innovations. *Energy Policy*, Vol. 36, pp. 3125 – 3137.

[4] City of Cape Town (2015) *Electrification of Backyard Dwellings Policy*. Available at: https://www.capetown.gov.za/en/PublicParticipation/Documents/HYS_Eectrification_of_Backyard_Dwellings_Policy_Eng.pdf

[5] Mouton (2015) The Philippines Electricity Sector Reform and the Urban Question: How metro Manila's Utility is tackling Urban Poverty. *Energy Policy*, Vol. 78, pp. 225 – 234.

[6] ESI Africa (2014) *Practical Lessons and Success Story of City of Cape Town's Unique Backyarder Project*. Available at: http://www.esi-africa.com/practical-lessons-and-success-story-of-city-of-cape-towns-unique-backyarder-project/

[7] Mawajje, Munyambonera and Bategeka (2012) *Uganda's Electricity Sector Reforms and Institutional Restructuring.* Available at: http://ageconsearch.umn.edu/bitstream/150239/2/series89.pdf

[8] Space Syntax (2010) *Slums and informal settlements: An evidence-based approach to sustainable upgrading and development*. Available at: http://www.spacesyntax.com/wp-content/uploads/2012/03/Space_Syntax_Informal-settlements-brochure.pdf

[9] Mehrotra (2012) *Cape Flats, Cape Town.* Available at: http://blogs.newschool.edu/epsm/2012/05/24/cape-flats-cape-town/

[10] de Watter & Wattel (2007) *Safe electricity for slum residents: a pilot project in Paraisópolis, Brazil*. Available at: http://www.leonardo-energy.org/sites/leonardo-energy/files/root/pdf/2008/Interview_Glycon_Garcia.pdf

[11] Gaunt et al. (2012) *Informal Electrification in South Africa – Experiences, Opportunities and Challenges*. Available at: http://www.cityenergy.org.za/uploads/resource_116.pdf

[12] Baruah (2010) Energy Services for the Urban Poor: NGO Participation in Slum Electrification in India. *Environment and Planning C: Government and Policy* 2010, vol. 28, pp. 1011-1027.

[13] UN-HABITAT (2012) *Enhanced Energy Access for the Urban Poor: Best Practice Casebook*. Available at: http://mirror.unhabitat.org/downloads/docs/Enhanced%20Energy%20Access%20for%20Urban%20poor%20Best%20Practice%20Case%20book.pdf

[14] USAID/GPOBA (2008) *Improved Electricity Access to Indian Slum Dwellers Project, Operations Manual*. Available at: http://www.gpoba.org/sites/gpoba/files/OperationsManual/OM%20-%20India%20Mumbai.pdf

[15] USAID (2004) *Innovative Approaches to Slum Electrification*. Available at: http://pdf.usaid.gov/pdf_docs/Pnadb219.pdf

[16] Putti (2011) *Energy Access for Poor in Urban and Peri-Urban Areas – An Emerging Challenge*. World Bank/ESMAP. Available at: http://siteresources.worldbank.org/EXTAFRREGTOPENERGY/Resources/717305-1327690230600/8397692-1327691245128/Urban_and_Peri_Urban_Challenges_AEI_Workshop.pdf

[17] Electricity Regulatory Authority of Uganda (ERA) (2011) *Study on Distribution System Losses and Collection Rates by UMEME Ltd*. Available at: http://www.era.or.ug/index.php/statistics-tariffs/2013-11-27-16-54-30/doc_download/23-umeme-distribution-loss-study

[18] Satterthwaite (2011) *Upgrading Dense Informal Settlements*. Available at: https://lsecities.net/media/objects/articles/upgrading-dense-informal-settlements/en-gb/

[19] USAID/International Copper Association (2009) *Transforming Electricity Consumers into Customers: Case Study of a Slum Electrification and Loss Reduction Project in São Paulo, Brazil*. Available at: http://pdf.usaid.gov/pdf_docs/Pnado642.pdf

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