

## INCLUSIVE INNOVATIONS

# Formalizing the Electricity Grid Connection

*Innovations and effective community outreach transform slum residents into legal customers and provide them with reliable and safe electricity*

### HIGHLIGHTS

- Multi-stakeholder engagement (utilities, municipal and government bodies, consumers and NGOs) is crucial to design a solution that brings in 10,000 to 300,000 new customers in urban informal settlements.
- More paying customers enhances the financial viability of the utility, reduces electricity theft and ensures better quality of services provided.
- Innovative metering technology, multiple tariff options, and mobile payments helps lower costs and match payments with users' income flows.



### Summary

The rapid rate of urbanization has outpaced the development of infrastructure in cities all over the world, resulting in the proliferation of informal settlements in densely populated areas, especially in low-income countries. People living in such informal settlements often get access to electricity by tapping the grid through illegal connections, overpowering the grid, and causing blackouts in electricity supply.

As a result, utilities experience losses. In response, some companies forged new approaches to expand their user base and promote legal, safe, and reliable electrification. These approaches are based on a multi-stakeholder dialogue, set up to ensure participation of all relevant stakeholders, and new technologies that reduce operating costs and reduce risk of customer default.

### Development Challenge

According to the 2015 World Energy Outlook, more than 1.2 billion people live without access to electricity, which corresponds to 17 percent of world's population. The electrification gap is greatest in Sub-Saharan Africa, where 634 million people lack access to reliable electricity resources. The region's electrification rate stands at 32 percent (59 percent in urban and 17 percent in rural areas). While the rate in developing Asia is considerably higher (86 percent), given the sheer population size of some Asian countries (particularly India), more than 526 million people lack access to electricity in Asia (the overall electrification rate in India is 81 percent—urban 96 percent and rural 74 percent). While urban electrification rates are substantially higher than rates in rural areas, rapid urbanization trends will continue to pose significant challenges to municipalities and other public authorities.

Electricity is essential to spur economic growth. Furthermore, access to electricity is particularly important to human development, as certain basic activities—such as lighting, refrigeration, running household appliances, and operating equipment—cannot easily be powered by other forms of energy. Moreover, sustainable provision of electricity can free large amounts of time and labor and promote better health and education. The major barriers to urban electrification include low household



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incomes, low consumption levels, and inappropriate pricing and subsidy schemes providing perverse incentives to electricity providers. Theft and illegal connections are common in urban slums and informal settlements, where residents do not qualify to be legal utility customers.

## Business Model

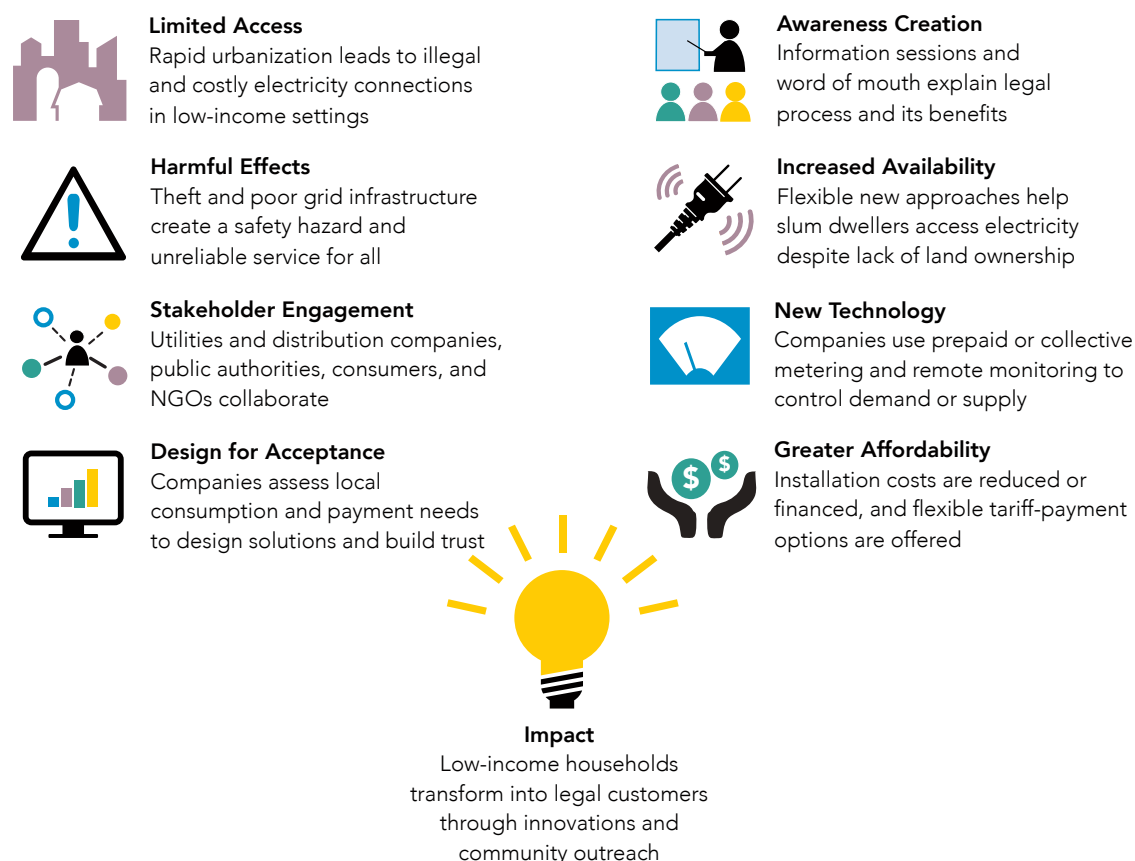
### Components of the Model

The business model consists of three main components: (1) multi-stakeholder dialogue to increase trust and social capital among different stakeholders; (2) new connections provided (and often subsidized) by the power utilities; and (3) new technologies improving fee collection rates among the new customers. To cater to the low-income segments, distribution companies introduce modifications to their traditional electrification approaches.

A social compact comprised of various stakeholders, such as local residents, NGOs, and public authorities must be developed to build awareness about legal connections and promote trust-based relationships and thus ensure acceptability (and sustainability) of the designed solutions. The upfront cost for a new connection, which could be prohibitive for low-income customers, is subsidized, reduced, or financed by the distribution companies. Finally, the changes are also matched by tailor-made technical approaches, such as prepaid or collective metering and remote monitoring among others, to improve fee collection, reduce operating cost, and decrease the risk of default.

Solutions have predominantly emerged from among distribution companies that have been privatized or operate under public-private-partnership models, although there are also a few cases of public sector initiatives. The distribution companies have done so either to meet legally binding coverage targets and quality-of-service requirements, or they simply set these up to reduce commercial losses.

*Figure 1. Features of models that formalize electricity access in low-income neighborhoods*



## Cost Factors

Major costs associated with setting up of these models are borne by the utilities and power distribution companies. In collaboration with representatives of the civil society and NGOs, they cover the cost of setting the social contract. At times, these initiatives are supported by governments or international donors and development agencies. The distribution companies also cover the cost of expansion of the existing grid as well maintenance and operations. Finally, to ensure affordability of the new electricity connections to low-income customer segments, these connections are often subsidized (or cross-subsidized by electricity prices paid by other customer segments).

## Revenue Streams

The revenue streams under these models are similar to those of regular electricity grid connections—users pay for the amount of electricity provided. However, the payments and multiple tariff options are made more flexible to address the needs of low-income customers. These models also use new technologies to reduce the cost of monitoring and the risk of default, such as collective metering, remote monitoring, or prepaid electricity. Collective meters are useful in cases where consumers lack the ability to pay individually. Pre-paid electricity allows customers to buy as much as they can afford through purchase of electricity credits. Mobile payments enable users to clear their bills without travelling far or without having a bank account. Remote monitoring of meters helps in observing demand patterns and controlling power supply from remote locations.

## Financial Viability

Despite the increased costs associated with the expansion of backend infrastructure, design of tailored technologies, and intensive operations and maintenance activities, these projects have been able to break even and become profitable. EVN Bulgaria's bill collection rate improved from 3 percent to over 85 percent in the Roma community where the program was instituted<sup>1</sup>. After the introduction of prepaid meters, the number of Electricidade de Moçambique (EDM) customers in Mozambique more than doubled in four years; the collection rate improved from 75 percent in 1995 to 94 percent in 2005, and total distribution losses decreased from 43 percent to 18 percent.<sup>2</sup>

## Partnerships

The electrification of informal settlements and slums requires engagement of all relevant stakeholders.

*Urban residents:* Slum electrification programs and payment compliance require the active involvement of communities to understand their willingness and ability to pay, and the barriers for establishing legal connections. PN Energy fostered strong links with local communities in Cape Town starting from the conceptualization stage. PN Energy educated the communities about the program and its benefits and set up community-based customer service centers, staffed by local residents, to attract vendors of prepaid electricity within the community.

*Local intermediaries:* Some utilities also experiment with appointing local community members as intermediaries to increase penetration of legal connections, expand operations and maintenance support, and raise collections rates. In Casablanca, LYDEC employed "street representatives" from the local community to manage and coordinate daily operations and provide technical support and distribution to users. Each street representative acted on behalf of twenty households—they collected payments to settle invoices based on each household's respective consumption. EVN Bulgaria established cash payment kiosks within the Roma neighborhoods, so that residents did not need to incur extra cost and time for traveling to billing locations that were further away.

*NGOs and CBOs:* NGOs and CBOs help in building trust and confidence, mobilizing the community to understand their rights and obligations, linking utilities to slum dwellers and raising government awareness. Their activities include helping place the subject of electrification and utility services on

the public agenda, educate slum dwellers, collect dues and promote accuracy in billing. They also identify community leaders and help convert former fraudsters into future electricity consumers.

## Implementation: Delivering Value to the Poor

### Awareness

Companies raise awareness through holding regular information sessions and distributing information materials about the process for getting a legal connection and its benefits. Such information also spreads through word of mouth. They further educate users about efficient use of electricity to help manage their household budget. Awareness raising is often conducted in partnership with NGOs and CBOs that enjoy community trust. However, for lack of such partners, the Philippine utility MERALCO facilitated establishment of “household associations”—comprising of community members—to manage payments for extension of distribution lines, and take over the responsibility for the system within the slums<sup>3</sup>. EDC-AES created “energy roundtables,” which helped understand community needs and became a platform for building awareness.

### Acceptance

Utilities need to gain an understanding of the reasons for the existence of illegal connections, specific consumption patterns, payment arrears, and why some areas are not properly served. This understanding is achieved by reaching out to community leadership and other stakeholders, such as NGOs and CBOs operating within the community. Discussions with the communities and understanding of their needs leads to the creation of trust and social capital.

EDC-AES, in Caracas, Venezuela, hired a team of 20 social workers to establish a relationship with the community, promote its initiative to legalize electricity connections and persuade residents about its benefits<sup>4</sup>. Prior to that, EDC-AES employees received a hostile treatment from the residents. EVN Bulgaria identified and mobilized community leaders, and employed people from the community to create an interface with the Roma community to understand their key concerns and necessities<sup>5</sup>.

### Accessibility

Lack of legal status of most slum dwellers is a crucial barrier to power access in slums and informal settlements. Legal ownership of land is usually a prerequisite for a new electricity connection and flexible and innovative approaches are required to overcome this barrier. In the slum electrification program started by the Ahmedabad Electric Company (AEC) in Ahmedabad, India, the local municipal corporation played a facilitating role by issuing 10-year non-eviction certificates, which granted the informal settlement households legal status and security of tenure sufficient for a new connection.<sup>6</sup>

### Affordability

The slum residents are often viewed as non-paying and defaulting customers. On the contrary, these residents do spend a significant share of their incomes on energy, albeit toward connections from local illegal operators or alternate energy sources (kerosene, candles, or batteries). Two aspects related to making electricity affordable among the target customers are:

- *Lowering and financing installation cost:* Companies use methods for lowering the individual connection costs, facilitating financing to help consumers pay, and helping overcome the high entry cost of obtaining electricity connections. For instance, LYDEC in Morocco installed collective meters for households that could not afford individual connection. EVN Bulgaria partnered with a microcredit organization to facilitate a one-year loan for customers to meet the upfront investment.
- *Flexible bill payments:* The billing system and payment options are adapted to consumers’ financial constraints, cash flow cycles, and payment capacity. EDM uses prepaid metering systems, which allow its customers to decide how much they are able to consume and spend on electricity. It also reduces the cost of billing and collections for EDM.<sup>7</sup>

## Results and Cost-Effectiveness

**Scale and reach.** Since most of the projects are implemented by large utilities, the number of customers reached per project is usually quite high. EDM was able to increase its customer base by 130,000 households by using prepaid meters across various regions in Mozambique.<sup>8</sup> In the Philippines, more than 300,000 households were either regularized or connected to the grid for the first time by MERALCO. This was done by bringing distribution lines to the perimeter of slums<sup>9</sup> from where the households were allowed to install their own wiring to reach their homes. This helped overcome issues related to “right-of-way” on land with disputed ownership, thus reaching out to a wider population in the slums.

Most of the interventions have originated out of larger distribution companies with operations across multiple geographies. However, tailored approaches are undertaken to incorporate local socioeconomic factors into the solutions. EVN took the learnings they made in Stolipinovo to improve their operations in other Bulgarian cities.

**Improved outcomes.** Legal electricity connections result in reduction of accidents. In all cases where households were illegally connected by tapping electricity lines, exposed wires and improper handling posed a major fire and personal health hazards. Regularization of slum electricity connections also entails community-wide security benefits by reducing crimes through the installation of street lighting.

**Cost-Effectiveness.** For end-users, it is often cheaper to have a legal connection as table 1 demonstrates.

*Table 1. Comparison of costs of legal and illegal electricity connections*

Example	End-user costs
AEC, Ahmedabad, India	For legally connected households in Ahmedabad, consumption was about 36 kWh per month, costing around USD 3. For consumers with an illegal connection, the same level of consumption cost twice as much, around USD 5 per month because of rates charged by middlemen for an illegal connection. <sup>10</sup>
PN Energy, Cape Town, South Africa	PN Energy was able to bring down the average cost of a connection from almost USD 975 to USD 328–522 after experimenting with several options, such as prepaid meters and flat rate tariffs among others. <sup>11</sup>
Rio Light, Rio de Janeiro, Brazil	Lower tariffs for low-usage customers and subsidies for connections lowered connection costs to about USD 12, implying a 42 percent discount over the regular charges. Further, the program had a microfinance component to cover these expenses and did not press charges for participating customers’ prior illegal connections. <sup>12</sup>

Regular electricity supply also helps households in saving the repair and maintenance costs of appliances that may be incurred due to damage caused by irregular electricity supply. Furthermore, most of the programs have been accompanied by community sensitization programs about reduction in electricity consumption and managing household budgets.

In 2005, the average consumption per EDM customer dropped from 148 kWh to 124 kWh following public awareness campaigns. In the case of MERALCO, the disposable income of program beneficiaries increased substantially-- after legalization their monthly bill ranged from USD 4 to USD 14, compared to USD 40 to USD 200 with illegal service providers.<sup>13</sup> One of the major impacts of these programs has been that households are able to engage in more income-generating activities and access other basic services such as banking, since a legitimate electricity bill is usually accepted as a sufficient proof of residence and payment history.

## Scaling Up

### Challenges

A common barrier to all programs has been the lack of legal status of most slum dwellers—lack of land tenure and title, which are necessary to secure a legal connection. A significant proportion of the slum population might be deemed ineligible because of lack of tenure or inability to resolve tenure issues. Technological upgrades and modifications to, and extension of, infrastructure may require large investments by the utilities. The private distribution companies, operating on a commercial basis, weigh this against the return on their investment. In the case of slum communities and informal settlements, the breakeven time horizon is much longer and therefore can become less of a priority.

Furthermore, a key success factor for this model is the implementation of tailored approaches. Replication has been impeded by differences in the socioeconomic, geographic, and legal challenges among different communities, making a universal approach for electrification and legalization difficult to design. Overcoming these barriers calls for a more localized approach to meet the circumstance of each community, which may be time-consuming and expensive.

### Role of Government and Public Policy

Electricity utilities were privatized in many countries during the 1990s and 2000s. The private distribution companies expect to operate on a commercial basis; however, service provision to poor urban residents, who consume low levels of electricity and have limited ability to pay, may not be cost-effective. To service these customers, new regulatory and legal treatment and government support are particularly needed.

Common to most cases that succeeded in expansion was a strong motivational push by governments to set targets for improving the living conditions of the urban poor and to establish regulations for non-technical losses. Distribution companies were also allowed to experiment with innovative measures with respect to tariffs and payment options, and were also able to receive financing support in some cases.

**Multi-stakeholder dialogue.** Key to the success of the outreach, is the initiation of a multi-stakeholder dialogue between the utilities, intermediaries, consumers, and government. This dialogue is needed to open communication, build trust and awareness, and hence facilitate behavior change.

**Regulatory and policy frameworks.** Legal frameworks should meet the needs of distribution companies working in the difficult conditions encountered in poor areas. For instance, slum residents do not usually own the land or have a fixed land tenure. Legitimizing such consumers and connections, and solving land ownership problems requires a supporting legal framework. Furthermore, clear goals and policy objectives are needed with regards to slum upgrading and electrification to improve grid access. The city of Ahmedabad in India set a goal to eliminate and/or upgrade all slums by 2013. As a response, the Ahmedabad Electric Company in India set out to electrify all slums in Ahmedabad by 2010. The company conducted surveys to determine the level of subsidies that would make the project affordable to new customers. The local municipal corporation played a facilitating role by issuing 10-year non-eviction certificates, which granted the informal settlement households legal status and security of tenure sufficient for a new connection.

**Tariff flexibility and targeted subsidies:** Electricity tariffs are usually regulated by the governments. Allowing different tariff and payment options, such as prepaid or collective meters, provides distribution companies with enough flexibility to experiment with solutions adapted to electricity provision in slums. Subsidies may also be needed for consumers who lack the ability to pay. These subsidies need to be well targeted so that benefits reach only those who are eligible for support. They



also need to be efficient wherein just the right amount of subsidy is delivered to cause the desired demand and payment response, curtailing market distortions.

**Supporting infrastructure:** Slum electrification may require upgrading or modifying of the existing distribution infrastructure. For instance, introduction of prepaid meters and remote monitoring need significant backend infrastructure modifications, which may possibly require financing and/or subsidizing of the programs.

*Table 2. Selected companies involved in electricity grid connection for BoP*

Company	Country	Solution description
Ahmedabad Electric Company	India	Slum electrification in partnership with the NGOs, local government, and residents.
<a href="#">EDM (Electricidade de Moçambique)</a>	Mozambique	Pre-paid metering and regularization of slum-based illegal customers.
<a href="#">EVN, The Projekt Stolipinovo</a>	Bulgaria	Mix of multistakeholder dialogue, technical innovations, and targeted investments to upgrade the grids, electrify the communities, and increase bill collection.
<a href="#">Lydec</a>	Morocco	Community-based power delivery wherein LYDEC builds the grids and sells electricity to representatives who in turn act as bill collection intermediaries.
<a href="#">MERALCO's Depressed Area Electrification Program</a>	Philippines	Slum electrification by bringing distribution lines to the perimeter of slums and allowing residents to draw their own wiring to their houses from the perimeter.
<a href="#">National Electricity Corporation</a>	Sudan	Prepaid meters to improve the grid access and allow consumers the flexibility to make payments.
<a href="#">PN Energy (JV between ESKOM and EDF)</a>	South Africa	Prepaid metering systems and ready boards for easy grid connection and allow consumers the flexibility to make payments.
<a href="#">The Barrio Eléctrico Initiative, AES</a>	Venezuela	Converted illegal electricity consumers into paying customers by improving the customer relationships, enhancing service quality, and introducing innovative distribution and billing practices.

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# Profile: EVN Bulgaria

*Building trust to improve the supply of electricity in a Roma Community in Bulgaria*

## Challenge

In 2005, when EVN ([www.evn.at](http://www.evn.at)) assumed responsibility for providing electricity to the city of Plovdiv, Bulgaria, it inherited neglected electricity infrastructure in Stolipinovo, a run-down quarter populated by 60,000 people, mainly Roma families and poor Bulgarians. The business practices adopted by the previous distribution company had created an environment of distrust among the Roma, which resulted in unrest and vandalism, payment rates of just 3 percent, and network-related losses of 40 percent.



Demand for reliable electricity in the area was actually strong, and only a small share of residents lacked the money to pay their electricity bills. The low payment rate reflected unwillingness to pay, which emanated from discriminatory practices by the previous utility. The key challenge for EVN was to create a trust-based relationship.

## Innovation

EVN counteracted the traditional stereotypes regarding the Roma community. It adopted a new model based on the assumption that the most important precondition for the community to pay the bills was equal and nondiscriminatory treatment as customers. A combination of ongoing dialogue, technical innovations, and targeted investments helped the company find a solution that was acceptable to all stakeholders.

Key community leaders were engaged to help EVN understand the expectations and concerns of the community and design a program that addressed them. Recruiting local Roma residents as employees opened new channels of communication. NGOs built awareness about reduction in electricity consumption and decreased monthly costs through pamphlets, talks, and information sessions. For existing customers, the company introduced debt rescheduling plans based on mutual agreements. EVN also gained new customers, connecting households that had previously relied on stolen power.

EVN also worked with the district's legal authorities, because many of Stolipinovo's inhabitants were not legally registered and had no leases for their homes, making it impossible to connect them to the national grid. The local authorities legalized the status of Stolipinovo's inhabitants, enabling the connections.

EVN installed new individual metering systems (as opposed to the collective metering system used previously), which allow paying customers to receive uninterrupted power supply even if others default. By installing the electricity meters at eye level, EVN enabled residents to monitor their consumption—and it established that they were being treated in the same manner as other customers. The previous meters had been installed on five- to six-meter high poles to avoid manipulation, not at eye level as in the rest of Bulgaria. EVN made additional investment in repairing and upgrading the grid and transmission substations to keep technical losses in check.



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### Impact

The Stolipinovo project increased the reliability of the energy supply, reduced energy consumption, lowered energy expenses, and improved payment behavior. Between 2007 and 2009, EVN installed almost 187 kilometres of upgraded electricity network and 17 refitted transformer stations and connected about 6,400 new and retrofitted households to the grid through meters that can be read remotely by means of a wireless connection. Increased trust raised the collection rate from just 3 percent to more than 95 percent, and network-related losses fell from 40 percent to just 5 percent. Energy in the community is no longer stolen.

A total of 26,000 local residents benefited from the project. They receive uninterrupted supply as long as they make regular payments on their electricity bills. EVN also signed 3,800 agreements for rescheduling old debt over a period of five years and facilitated small loans for the poorest residents, who could not meet the start-up cost of a new connection (about USD 250).

The project was also a financial success. Total investment (in construction, modernization, and rehabilitation of the distribution grid and equipment) of about USD 3.3 million took only two years to recoup.

### Scaling Up

The mix of a sociological and technological approach to overcome the trust deficit induced customers to pay and expanded the number of legal connections. The involvement of multiple stakeholders and substantial investment by EVN were key.

The policy and regulatory framework in Bulgaria did not provide the necessary backdrop for electrification and uplifting of the Roma communities. To provide connections to illegal buildings, EVN had to rely on a legal loophole.

# Profile: La Electricidad de Caracas

*Regularizing the purchase of electricity through the Barrio Eléctrico Initiative*



## Challenge

More than half of the residents of Venezuela's capital, Caracas, live in informal settlements. With neither security of tenure nor legal rights to their dwellings, they often cannot access legal electricity connections. The utility connects unplanned communities only if the municipal authorities commission the installation of power lines. The situation has led to the proliferation of electricity theft by tapping street lamps and an increase in the number of accidents caused by hazardous, non-standardized illegal connections.



A worker in Caracas repairs the grid, helping to ensure reliable service.

## Innovation

AES-EDC ([www.corpoelec.gob.ve/](http://www.corpoelec.gob.ve/)), the electricity company responsible for Caracas, launched the Barrio Eléctrico Initiative in 2003, after concluding that more than a simple inability to pay was responsible for energy theft. It hired social workers to establish a direct and friendly relationship with residents and community leaders and organized “electricity roundtables” to develop a participatory solution to the electrification problem in the slums. The social workers also built awareness about the initiative and persuaded residents of the benefits of legal electricity connection, informing them about potential savings on repairs of home appliances, which often broke down as a result of the poor quality of illegal service obtained by tapping cables. The process also involved relaxing the usual requirements for becoming a customer, given that slum residents did not always have titles to their dwellings.

The improved understanding about local needs, energy usage patterns, and residents' willingness to pay were taken into account in developing better targeted, more cost-effective solutions. A key innovation was the installation of collective meters, which give customers who are unable to afford the price of individual connections access to the grid. Community-based intermediaries were established to collect bills and provide maintenance support to customers. Prepaid meters were installed and local community service areas used to sell prepaid cards. AES also allowed payment delays for the poorest customers with irregular incomes and introduced lifeline tariffs, with a flat rate of USD 1.5 for the first 200 kWh for new, legally connected individual households.

## Impact

In 2006, formal electric service user coverage increased by 110,000 to 460,000 people across 16 communities in Caracas. The company held 176 electricity roundtables; installed 300 prepaid meters, benefiting 1,200 people; put in 233 collective meters, benefiting more than 11,000 people; and authorized 22 commercial agents, who collected about USD 15,000 a month. Introduction of greater flexibility in terms of payment mechanisms and improved quality of service turned many residents who had relied on stolen electricity into paying customers.

Accidents related to the misuse of electrical installations decreased and overall security improved with the installation of street lighting. Illegal connections entailed average annual expense per household



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*This series on Inclusive Innovations explores business models that improve the lives of those living in poverty. Editors are Elaine Tinsley and Cristina Navarette Moreno. Written and researched by Endeva UG and Ashley Insight.*

of about USD 100 in electrical repairs, and illegal reconnections cost USD 10–20 year. In comparison, a social tariff runs about USD 9 a year.

The newly legalized customers were able to operate businesses that required a reliable and stable supply of electricity. In addition, armed with utility bills, residents could now apply for services such as bank accounts.

### Scaling Up

To reach low-income consumers, AES-EDC made changes in its organizational and operational strategy to include illegal consumers as potential customers instead of shunning them. Combining technological upgrades with sociological approaches was the mainstay of the strategy and a key driver that helped revamp the perception of the company and improve acceptability among residents.