Tackling Delivery Challenges and Managing Complexity in Infrastructure Development

Case Studies from the Global Delivery Initiative
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Foreword

Closing the infrastructure gap across the world is acknowledged as a pressing priority for international development efforts. Chris Heathcote, CEO of the Global Infrastructure Hub, recently examined the data in the Global Infrastructure Outlook, an online tool produced by that organization. He sums up the growing need, and the worldwide gap, this way:

By 2040, the global population will grow by almost 2 billion people – a 25% increase. Rural to urban migration will continue, with the urban population growing by 46%, triggering massive demand for infrastructure support. [...] Outlook forecasts that global infrastructure investment needs to reach $94 trillion by 2040 to keep pace with profound economic and demographic changes across the globe. [...] Add the UN Sustainable Development Goals (SDGs) of universal provision of clean water, sanitation, and electricity, and the total cost rises to $97 trillion. [...] The analysis reveals a shortfall in needed spending of $18 trillion – 19% of the forecast need.¹

But money alone will not close the infrastructure deficit to bring safe roads, clean water, and reliable power to the people who need them. Practitioners on the front lines of development work know well that challenges arising in implementation – from capacity bottlenecks and coordination problems among stakeholders, to the need to adapt project design and the imperative to navigate political and cultural currents – can often hinder or derail projects. Infrastructure is no exception to this tendency.

While knowledge on the “how” of tackling these challenges exists, it tends to be tacit knowledge that is rarely written down or systematized. Moreover, this vital body of experience is fragmented across individuals, project teams, organizations, and countries.

The Global Delivery Initiative was created to address the challenge of knowledge fragmentation by bringing practitioners together to share their experiences on delivery challenges, build a shared language to talk about implementation, and to co-create an evidence base of delivery know-how.

The promise of this initiative lies in catalyzing the flow of delivery know-how across organizations, helping practitioners learn how previous delivery challenges have been overcome in order to avoid repeating past mistakes – and ultimately to achieve greater development impact.

This promise is why our respective organizations have championed GDI over the past three years as founding members and continue to press forward with GDI’s agenda.

Therefore, we are pleased to introduce this collection of delivery case studies. It has been prepared to accompany the 2018 GDI Annual Conference. This year’s theme is “How to Tackle Delivery Challenges and Manage Complexity in Infrastructure Development.” We are grateful to our colleagues in the Ethiopian Ministry of Finance and Economic Cooperation for hosting the conference in Addis Ababa, which has brought together a wide range of practitioners and policymakers to discuss delivery challenges and complexity in infrastructure projects, with a special focus on African experiences and perspectives. This partner-based dialogue aims to help participants learn from one another on how to address delivery challenges.

This collection brings together nine cases of infrastructure projects that confronted and effectively addressed delivery challenges during implementation. They cover a broad range of sectors (water, power, transportation), and are drawn from countries as diverse as India, Kenya, China, Colombia, South Africa, and Korea. And they are presented in multiple formats: full length case studies that trace the twists and turns of implementation experiences, and shorter Delivery Notes that zoom in on delivery challenges and how they were overcome.

We hope that readers will find these stories intellectually stimulating and inspiring. And we hope that you will find in these pages insights that can help to overcome delivery challenges in infrastructure projects across the globe.

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The Delhi Metro: Effective Project Management in the Indian Public Sector

Overview

The Government of India (GOI) and the Government of the National Capital Territory of Delhi (GNCTD) formed the Delhi Metro Rail Corporation Ltd (DMRC) in May 1995 to provide a rail-based transport system that would alleviate Delhi’s ever-growing transport congestion and vehicular pollution. The construction of the Delhi Metro started on October 1, 1998, and the first Delhi Metro was inaugurated on December 24, 2002. Construction has four scheduled phases, and the first phase of the rail system was completed in 2006, three years ahead of schedule. The system is scheduled to be completed in 2021, at which point it will cover 245 kilometers. Currently, three functioning lines connect central Delhi to east, north, and southwest Delhi. DMRC is responsible not only for construction of the system but also for its operation and maintenance. DMRC has expanded its reach beyond Delhi as well, serving as the project consultant for a wide variety of metro and monorail projects across India and beyond, including projects in Dhaka (Bangladesh), Jakarta (Indonesia), and in Lucknow, Ahmedabad, Nagpur, Pune, and a number of other Indian cities. Moreover, the Delhi Metro is clean, punctual, and well maintained, a point of pride among Delhiites that showcases aspirations for a modern transportation system (Joseph 2013).

Key Contextual Conditions

Delhi, the capital of India, and a key political, cultural, and commercial hub, is one of the fastest-growing cities in the world. The population of the city is expected to reach 23 million by 2021 from the current estimated population of 13 million people. Population growth led to expansion beyond the core of the city, but the absence of rail options pushed transportation to the roads. As the population grew, traffic increased, along with associated problems such as traffic jams, pollution, and accidents. These problems were exacerbated by poor drainage systems and flooding on some stretches of road.

Development Challenge

Delhi’s roads have faced problems such as congestion, pollution, and increasing numbers of automobile accidents since the mid 1990s. To improve both the quality and availability of mass transport and to alleviate issues associated with Delhi’s congested roads, the GOI and GNCTD sought an effective solution in the form of a nonpolluting rail-based mass transit system.

Addressing Delivery Challenges

This section elaborates how DMRC addressed some of the delivery challenges recognized in similar large scale and complicated infrastructure projects, such as (a) complicated project design, (b) overall institutional arrangements,
(c) challenges in imparting or acquiring new skills needed, (d) identification and selection of appropriate stakeholders for engagement, and (e) challenges stemming from unviable project financing arrangements.

- **Project design.** In India, major infrastructure projects are often stalled because of lack of funds, political interference, lack of professionalism and accountability, property disputes, and corruption. To preempt these kinds of problems prior to the commencement of the project, the DMRC attempted to put in place effective systems to ensure the smooth progress of the project. To ensure strong leadership, Elattuvapalip Sreedharan, a technocrat with a long history of service in the Indian Railways (IR) and a reputation for completing projects on time and within budget, was appointed as the chairman of DMRC. Second, collaboration and cross-learning with Japanese partners was made an integral part of the project design. DMRC engineers were encouraged to learn tunneling technologies, management ethos, and value for time, as well as other management techniques from their Japanese counterparts. Finally, the DMRC rejected the idea to link its project’s design with existing IR systems. DMRC’s reasoning for this was based on its recognition that the purpose of IR was quite different from a metro system, with vast coverage stretching across India for long-distance travel. Interchangeability with IR was seen as diverging from core principles of an urban transport system.

- **Institutional setting.** The DMRC board of directors has absolute freedom to make technical decisions and depends on the government principally for funding and land acquisition. This arrangement has proven effective in reducing interference from politicians and bureaucrats. For example, in the initial phase, the first key task DMRC faced was to select a general consultant to provide a team of foreign and Indian experts contracted by DMRC who would help to implement the project, working on project design, contract tender, and supervising construction. A Japanese firm, Pacific Consultants International, and its joint venture partners were found to be most technically qualified for the job, and DMRC issued an acceptance letter. However, vested interests within the government urged DMRC to withdraw the letter of acceptance, arguing that other bidders were cheaper. DMRC defended its decision because the selection process followed the guidelines laid out by JICA. Those guidelines allowed them to accept only the bid of the bidder with the highest technical rank, with an exception only if the financial estimate of this bidder was unreasonably high. This decision definitely helped the initial phase of the project because the selected consultant team not only acted as a useful bridge between DMRC and JICA, but also had necessary technical and management expertise and especially knowledge of tunneling technologies, management ethos, and value for time. Also, DMRC could use the consultant and JICA’s opinion as an excuse to be free from political and bureaucratic influences.

- **Skill transfer.** To strengthen its own technical expertise and human resources, DMRC made sure that its staff members were central to the project and did not rely overly on general consultants. Beginning in phase 1 with a view toward implementing subsequent phases, DMRC was able to reduce its dependence on external experts in phase 2 by deploying its personnel in consulting services and allowing them to have relevant technical experience from the start. Moreover, DMRC established a training institute to pass on technical expertise from its own personnel to implementers of new metro projects in India. DMRC also disseminated its knowledge and technologies through consulting work on new metro projects both in India and outside the country. These efforts allowed DMRC to effectively accumulate technical expertise and systematically leverage it to establish a strong reputation.

- **Stakeholder coordination.** The importance of effective stakeholder coordination is apparent in the need to coordinate with other agencies during construction of underground sections of the metro. The ground had to be excavated, but beforehand a complicated network of water supply and sewerage pipes needed to be shifted or diverted. Cooperation and communication with other government agencies in charge of these utilities were necessary to get their buy-in and participation. In some cases, these other agencies were reluctant to cooperate, and this delayed construction in stretches of ground utility infrastructure because utilities could not be shifted. To solve this problem, instead of requesting that utility agencies shift pipes and wires, DMRC offered to take the responsibility for the work. This approach allowed DMRC to retain control of this work while also involving other agencies through the preparation and submission of detailed plans for approval. To increase collaboration, DMRC at times recruited retired personnel from utility agencies to meet with their former colleagues. The result was that work speed increased and that DMRC was able to ensure that disturbances to the public were minimized.
Project finance. Globally, most urban metro projects were financially unviable because the fares could not be fixed solely on a commercial basis. If fares were set too high, passenger numbers would remain low as some users were priced out, thus defeating the very purpose of setting up the system. Therefore, the concerned governments generally bore the capital costs of a metro system. To avoid such a situation, the Delhi metro project was conceived as a social sector project. This allowed a significant portion of the project cost to be funded through a soft loan provided by the Japanese government through JICA (former Japan Bank for International Cooperation). The financial loan extended by JICA to the project, which made up 60 percent of funding required for phase 1. The rest was contributed by GOI and GNCTD through equity. Also, over the years, DMRC had earned a substantial amount through consultancy and real estate business and through external projects. During the 2014–2015 fiscal year, the total revenue generated by DMRC was Rs. 3562.27 Crores (US$555.35 million) inclusive of income from traffic operations, real estate, consultancies, and external projects.

Lessons Learned

A strong leadership and vision are key to successful implementation of such large and complicated infrastructure projects. Much of the credit for the success of Delhi metro project goes to one man, Elattuvalapil Sreedharan, the first managing director of the DMRC. He was a key agent of change with a well-deserved reputation for fearlessness and incorruptibility. At DMRC, he created a work culture of punctuality, integrity, professional competence, and social responsibility. His long-term vision in human resource development helped to shape DMRC’s recognized brand and encouraged building systems for financial sustainability.

An important part of DMRC’s success was a strategic approach to transparency and media engagement. DMRC was fully aware of what the media might be interested in and what kind of repercussions negative press coverage of such a high-value project would have on public opinion. Delhi Metro, therefore, consciously built its rapport with the media. In fact, public relations was an area that DMRC strategically addressed from its early stages of implementation. And this was done without spending heavily on advertising. DMRC’s public relations team engaged with the media to keep the public informed and to project a positive image to society in order to build confidence in the project. This was itself a departure from the norm because earlier railway and urban transport projects in India typically did not give much importance to public relations. DMRC was able to establish a reputation of honest and transparent organization in the eyes of the public. Even in the face of adverse situations, such as the accident in July 2009 during phase 2 construction, DMRC was very open and transparent with the media and was available to respond to any queries that arose. By engaging with media outlets as a conduit to the public, DMRC was able to have a voice in public discussions, thus presenting aspirations of the metro as a transformational force for Delhi and offering the metro as a point of pride for Delhites.

Another key aspect worth highlighting is DMRC’s taking responsibility for the diversion of utility infrastructure, which relied on good stakeholder coordinator and buy-in from other agencies. In other projects, large-scale infrastructure implementers can use a similar technique of taking on the responsibility for the shift of utilities, thereby eliminating unwanted time loss in construction. Furthermore, by reducing the time required for civil works, the Delhi Metro project ultimately reduced the time the public was inconvenienced.
Endnotes


2. JICA’s financial loan (called an official development assistance loan) is a low-interest and long-term concessional fund. The loan is provided to developing countries to assist their effort in tackling development issues.

Bibliography


Leveraging Public-Private Partnership Projects to Modernize Infrastructure: The Case of Chile

Context
On its return to democracy in the 1990s, Chile’s economy was growing at a rapid pace. But like many countries in the region, it had chronically underinvested in infrastructure during the economic doldrums of the 1980s. Roads, ports, and highways were decades old and inadequate for the growing economic activity. Also, from 1982 to 1992, private car ownership had grown by 45 percent to a total of 1.3 million vehicles (National Institute of Statistics, various years). Congestion and traffic accidents nearly doubled during that period. The Chilean government recognized the need for significant economic investment, particularly in roads and highways, to ensure continuing economic development. However, the government did not have sufficient capital or the technical know-how to carry out public works projects at the scale required.

Development Challenge
The challenge for Chile was to build cost-effective infrastructure projects to help maintain rapid economic growth.

Intervention
Considering its fiscal constraints, the Chilean government designed a pioneering program of concessions and private capital investments to modernize its aging infrastructure. This public–private partnership (PPP) system sought to increase investments in infrastructure without increasing taxes or depriving the government of funds to deliver promised social sector investments in health care, education, and housing. The need for a modern and efficient infrastructure was recognized as critical to expansion of the export-based industries that had propelled the country to a sustained 6 percent annual average rate of gross domestic product (GDP) growth by 1990.

To deliver on the PPP program, the Chilean Ministry of Public Works was tasked with managing infrastructure concessions through a system of competitive bidding, in partnership with other government agencies. The public works ministry was responsible for assessing the profitability of projects, appraising risk, determining penalties for breach of contract, and supervising construction and completion of bids. The PPP program was later managed specifically by a dedicated PPP unit, with 300 staff members with specialized expertise in legal, environmental, and engineering issues (IGC 2011). Infrastructure projects were also evaluated by the Chilean Ministry of Finance to validate their financial and environmental viability. In 1991, those tasks and responsibilities were codified into a regulatory framework with the passage of Special Decree No. 1946, the Concessions Law (Lorenzen, Barrientos, and Babbar 2004).

Since creation of the PPP program, the Chilean government has worked with the private sector on 50 PPP projects costing US$11 billion dollars (IGC 2011). The PPP program has significantly improved the country’s infrastructure, creating modern airports, highways, and jails and building more than 2,000 kilometers of roads throughout the country.
Delivery Challenges

This delivery note analyzes key implementation challenges and examines how they were overcome.

- **Lack of regulation and legislation.** With the launch of the PPP program, Chile’s government intended for most of the needed funding to come from domestic capital markets. The plan was to support the growing local economy and simplify contract and procurement processes. However, the country’s financial regulatory framework constrained capital uptakes and inhibited financing for PPP infrastructure projects. In particular, prudential regulations related to portfolio diversification prevented the country’s banks from investing more than 15 percent of their capital in infrastructure projects. Given the capital requirements for larger projects, such as dams and cross-country highways, project bidders were discouraged from or unable to compete in early concession rounds without international financing, limiting the diversity of project proposals and increasing the risk of higher costs.

- **Cumbersome reporting and supervision systems.** Despite the Chilean Ministry of Public Works purview over infrastructure projects, the presence of multiple government stakeholders in the design, planning, and implementation of PPP projects complicated the projects’ review and approval. Multiple agencies had to coordinate with each other to assess the financial merits and environmental safeguards of any given project. The bidding procedures and concessions needed to be closely coordinated with the Chilean Ministry of Finance. Likewise, the Ministry of Planning played a critical role in the creation of bids and infrastructure priorities for the country. Although thorough, this supervision matrix increased the risk of delays and of potential safeguard oversights that could result in strong public opposition or costly contract renegotiations.

- **Inefficient procurement mechanisms.** In the early stages of the PPP program, the complexity of early engineering projects and PPP bids led to the approval of projects affected by revisions and delays. Unclear institutional arrangements and lack of risk assessment during procurement forced the Chilean government into costly renegotiation efforts for several contracts. Moreover, although many PPP projects in Chile—particularly highway projects—generated sufficient revenue to pay for themselves, some ultimately required government subsidies to operate successfully.

Addressing the Delivery Challenges

The following steps were undertaken to mitigate the delivery challenges related to **lack of regulation and legislation:**

- To achieve its ambitious infrastructure goals through the support of PPPs, the government of Chile recognized the limitations of its legal framework for local investments. In 1995, the government introduced a series of financial-sector reforms designed to promote greater participation from local banks and institutional investors in national concession projects. The changes expanded the pool of domestic financing entities and increased the lending limits on infrastructure projects as part of a lender’s capital reserves (Lorenzen, Barrientos, and Babbar 2004). In addition, the government began releasing infrastructure bonds to crowd in investments from institutional investors (pensions funds and insurance companies) that, up to that point, had limited participation in companies not listed on the stock exchange.

- In 1999, the Chilean government established a mechanism to provide exchange rate insurance for debt raised by concessionaires in foreign capital markets. That move was intended to protect local concession bidders who were capable of attracting capital from international markets from the risk of foreign exchange fluctuations (IMF 2004).

The following steps were undertaken to mitigate the delivery challenges related to **cumbersome reporting and supervision systems:**

- In 1999, a special unit called the Coordinación General de Concesiones was created in the Ministry of Public Works to streamline the concession process for PPP projects. The new unit was divided into three departments covering projects, construction, and operation. The unit’s departments would also take care of sundry issues related to environmental, sociological, and engineering matters and do liaison work with corresponding ministries, depending on the project. The new unit was also responsible for producing detailed design and engineering studies during the tendering of PPP projects, with a view toward promoting greater participation from smaller firms and increasing competition.
Over time, the government of Chile has given more autonomy to the Ministry of Public Works to update the bidding processes, depending on the infrastructure project. Despite these advances, concessionaires have expressed the need for greater support in contractual matters during project implementation, which usually still requires approval from several government agencies.

The following steps were undertaken to mitigate the delivery challenges related to inefficient procurement mechanisms:

- In 2010, the Chilean government passed a revised PPP law that sought to limit and regulate the renegotiation of contracts, which by some estimates had affected an average of 24 percent of the country’s PPP projects (IGC 2011). The government also increased the robustness of its institutional safeguards in the aftermath of a high-profile corruption case on a PPP project. The improvement also sought to introduce greater cost-benefit analysis into the design stage of PPP proposals.
- Moreover, to ensure that PPP programs and bids are aligned with the government’s fiscal priorities, a Ministry of Finance officer with veto power was permanently assigned to the Ministry of Public Works to further ensure the financial viability of projects (IGC 2011).

References


Gautrain Rapid Rail Reduces Carbon Footprints, Commuter Agonies; Connects Johannesburg–Pretoria Corridor

Context

The province of Gauteng occupies 2 percent of South Africa’s landmass yet generates nearly 40 percent of its gross domestic product and houses two major cities and a major airport. Historically, the province and its public transport developed unevenly, ushering a culture of private cars and unsafe, unreliable rail transit. Road congestion leads to limited economic productivity, living standards, and tourism.

The juxtaposition of Gautrain’s multibillion-dollar budget with less well-supported essential social services and poverty reduction measures evoked public anger and media criticism. Of 700 community meetings in 2002, all were volatile and precipitated strong local political opposition and negative media. Residential pressure groups filed five court cases and pressure was exerted on South Africa’s parliament (Jensen 2014). Economic mobility and efforts to combat urban sprawl were lost in the fury of the moment.

Development Challenge

The challenge for Gauteng was introducing transit-oriented development around a new rapid rail system.

Intervention

The Gautrain is a public-private partnership that uses state-of-the-art rapid rail to connect Pretoria, Johannesburg, and Johannesburg International Airport, with a feeder system of metropolitan and dedicated buses. Trains travel 160–180 kilometers per hour on the 80-kilometer network. Departing from past rail practices, Gautrain runs on electricity and international standard gauge tracks, which safely and reliably accommodate high speeds (Bohlweki Environmental 2002a, 2002b).

Gautrain trains take 35 minutes between the central business districts of Pretoria and Johannesburg and 15 minutes between Johannesburg International Airport and Sandton Station. The services offered are “Premium” for commuters and “Premium Plus” for international travelers (with luggage space on trains and anticipated flight check-in at the Sandton Station).

As one of 10 Spatial Development Initiatives of the Gauteng government, the project reinforces the national transport infrastructure and stimulates economic growth, development, and jobs. At the local level, it attracts private motorists to rail travel and alleviates congestion, promotes tourism, and contributes to urban revitalization and sustainability.

Delivery Challenges

This delivery note analyzes key implementation challenges and examines how they were overcome.
Awareness and communication strategy. Accustomed to unsafe and unreliable public transport, the public and local politicians initially expressed deep distrust of high-speed trains. Media coverage reinforced local reactions, omitting international experience with similar trains.

Stakeholder engagement. In the minds of the Gautengs, using rapid rail to link economic, political, and air transport centers did not initially add up to individual or community socioeconomic gains.

Addressing Delivery Challenges
The following steps were taken to mitigate the delivery challenge related to awareness and communication strategy:

- Designed a narrow, well-scoped media campaign to break a self-reinforcing cycle of negativity among local politicians, the public, and the media.
- Crafted a few clear takeaways: Gautrain introduces world-class safety and reliability; reduces severe road congestion; stimulates economic growth, development, and job creation; contributes to and helps sustain urban revitalization; and benefits individual Gautengs.
  - Gautrain ridership has replaced an estimated 21,300 daily car trips, reducing the carbon footprint of travelers by 52 percent per trip (Gautrain Management Agency 2015).
  - Gautrain sustained 121,800 local jobs between 2006 and 2012 and increased government revenue by an estimated SAR 5 billion (Gautrain Management Agency 2015).
- Pinpointed interested and affected parties and potential passengers: Included were economically active commuters; car owners unwilling to use public transport; younger, more affluent households; airline passengers; interested and construction-affected parties; and government and private sector decision makers.
- Created a granular stakeholder map, linking strategic issues, affected stakeholders, and media contacts.
  - Allocated substantial resources: for example, SAR 250,000 was dedicated to media research and monitoring and SAR 100,000 to media interventions when railway construction began.
- Identified the media: community, provincial, national, international; trade, technical, consumer, business.
- Built initial relationships by taking 19 print journalists on a 10-day tour of Paris and London to experience those cities’ public transit maintenance yards, manufacturing sites, control rooms, and public transit–revitalized neighborhoods (London’s Canary Wharf and Docklands).
- Funded two episodes of “Carte Blanche,” an influential television program: one at the height of public criticism of Gautrain about public transit in New York, Paris, and London and another a year into Gautrain’s construction.
- Conducted ongoing formative and evaluative research, as well as monthly adjusted media tactics and messaging.
  - Two construction site visits by 60 journalists produced immediate positive coverage equivalent to SAR 12 million.
  - Electronic construction updates were sent to journalists, and journalists were provided access to, and download capacity for, a database of high-resolution construction photographs and artists’ impressions of the project.
  - Small groups of media were briefed on specific issues; the project’s leader, the marketing and communications director, and—when needed—a lawyer and a master executive council member attended the briefs and answered questions.

The following steps were taken to mitigate the delivery challenge related to stakeholder engagement:

- An environmental impact assessment proved an ideal mechanism to explain development gains accrued to the community and to learn from the community how to better design the project for their needs.
- Extensive preparatory activities were undertaken:
  - Consulted the Gauteng Department of Agriculture, Conservation, Environment, and Land Affairs as well as the authorizing department for regulations, specialists, and stakeholders.
  - Conducted site surveys and inspections, consultations, and information and literature reviews; synthesized information and ranked its significance.
  - Retained Bohlweki Environmental (Pty) Ltd, a predominantly black-owned Gauteng consulting company for the environmental impact assessment.
- The public participation process, which is mandatory under South African law, was well modeled and well executed—cultivating a paradigm shift in the rail transit sector.
Website (http://www.gautrain.co.za/about/eia-emp/eia/) provided background information on the environmental impact assessment process and allowed parties to register their interest in the project, ask questions, and provide comments.

**Background information document (briefing paper).** Distributed to all parties and made available at all Open Days (public hearings) throughout the assessment period, the briefing paper had information on the assessment process, the proposed project, and the consultants. It also had a sign-up sheet for parties to register their interest and receive future project communications.

**Formal meetings.** Conducted with specific groups of key stakeholders, the meetings started after the Open Days and continued for the duration of the environmental impact assessment. Stakeholders were grouped by formal associations and by specific interests in the project. This platform gave stakeholders the means to join to raise specific issues and concerns and to obtain more information.

**References**


Bus-Rapid Transit Systems as Cost-Effective Transportation Alternatives: The Case of TransMilenio, Bogotá

Context
Driven by economic growth and rural displacement, the population of Bogotá, the capital of Colombia, grew dramatically throughout the 1990s. This rapid growth put a strain on existing transportation services, resulting in heavy congestion, excessive travel times, and elevated levels of noise and air pollution. Inner city trips—averaging an hour and 10 minutes—took place mainly by private vehicles that used 95 percent of available road space and were involved in over 52,764 accidents in 1998. Bus systems were privately owned and poorly run, with lax safety standards and uneven service routes, which discouraged the use of mass transportation. Furthermore, competition between different bus operators resulted in an oversupply of bus seats that further contributed to issues of congestion and air pollution.

Development Challenge
The challenge for the city of Bogotá was developing a public transportation system capable of providing accessible, affordable, and environmentally friendly services in order to combat congestion, reduce pollution, and meet the needs of its growing population.

The Intervention
In 1999, the city of Bogotá created a new public company called TransMilenio S.A., tasked with the implementation its transportation strategy and the creation and management of a new bus rapid transit system (BRT) of the same name. The system was designed to improve travel times, reduce congestion, and lower pollution levels across the city. Learning from the implementation lessons of other BRT lines in the region (notably in Quito, Curitiba, and Mexico City) the city commissioned feasibility studies that created buy-in for the new bus system and positioned TransMilenio as a financially viable component of its new mobility strategy. They argued strongly in favor of this option due to its lower capital investment and maintenance cost in comparison to light rail or metro systems. Working with the existing Instituto de Desarrollo Urbano (the Institute of Urban Development—IDU), the national Ministry of Transportation, and local bus operators, the Mayor’s Office of the city of Bogotá launched a public-private partnership designed to modernize and improve its mass transit systems. Now, over a decade in operation, TransMilenio covers 112 kilometers throughout the city, servicing over 2.2 million passengers a day. It is credited with a reduction of 92 percent of traffic deaths in areas where it operates and a decrease of 40 percent of air pollutants across the city.
Delivery Challenges

This delivery note analyzes the following key challenges the project faced during implementation and examines how they were overcome:

1. **Challenges creating stakeholder engagement:** Satisfying the needs of all stakeholders was a complicated proposition for the mayor’s office. Aligning the expectations of the urban planning department, national regulators, and the bus company owners and bus drivers who rented from these companies was politically fraught and time consuming. Obtaining buy-in from existing local transit providers was particularly challenging due to their distrust of fellow operators, whom they regarded as competitors, and to instinctual opposition to any regulation that could impact their profits. In addition, local government officials were unfamiliar with, or skeptical of, BRT systems and expressed interest in more traditional heavy rail systems, which were viewed as more modern and signifiers of a “world class” city.

2. **Lack of operational financing mechanisms:** Despite a lower price tag compared to other transportation systems, Bogotá did not have the capital to fund the creation of TransMilenio. Like many other cities in the developing world, the mayor’s office had to contend with the national government local elected bodies to obtain funds through taxes and loans to finance sizable infrastructure costs. In addition, there was no regulatory framework for a bidding and contracting system to regulate the concession of operating contracts for ticketing and route management.

3. **Overambitious objectives:** Providing service quality at high capacity is an ongoing challenge for TransMilenio. Numerous protests, some violent, have taken place since 2002 due to increases in fares and complaints of poor service.

Addressing Delivery Challenges

The following steps were undertaken to mitigate the delivery challenges:

The following steps were undertaken to mitigate the delivery challenge of **stakeholder engagement**.

- Reaching out early in the planning stages to the different transportation stakeholders in the city (bus operators, Urban Planning Office, Ministry of Transport, Municipal Governments) enabled the mayor’s office to create strong buy-in for the creation of the TransMilenio BRT system. International cooperation and knowledge exchange activities with regulators from cities that had successfully implemented BRT systems were key to explaining the advantages vis-à-vis other systems. An objective cost-analysis and timeline for the project also provided political incentives for local officials eager to show new projects in one election cycle. The inclusion of local bus operators proved to be particularly critical in preventing protests, creating a fair pricing system, and connecting underserved routes. In addition, strong coordination with the different actors was crucial in raising awareness of the program to the larger public, complementing extensive media campaigns, and creating momentum for its implementation and use.

The following steps were undertaken to mitigate the delivery challenge of **financing mechanisms**.

- Unlike many public transportation systems around the world, the TransMilenio system is run without any operational subsidies. Operating as a public-private partnership, it created an efficient organizational arrangement, in which the public sector provided infrastructure investments financed by fuel and local taxes, while the private sector managed its bus fleets, fares, and ticketing systems within an agreed upon framework. Having a shared vision with all government stakeholders helped the mayor’s office pass new fuel taxes that provided over a third of the early capital requirements for the BRT infrastructure. In addition, the implementation of a competitive and open bidding system prevented favoritism and encouraged competition. The arrangement provided an incentive for private sector operators to expand services, while moving the bus market from small independent operators to larger, more formal enterprises competing for concessions. The result has been a financially sustainable, safer, and more efficient public transportation system at a fraction of the cost of similar systems.
The following steps were undertaken to mitigate the delivery challenge of overambitious objectives.

- Despite the TransMilenio’s many achievements, in recent years the system has become a victim of its own success. Population growth for the city of Bogotá has outpaced the creation of new routes and stations, while low frequency of connecting peripheral buses has increased wait times during rush hour. In the first months of operation, over 90 percent of surveyed city residents expressed praise for the system, but more recent surveys show approval by much lower margins. The government of Bogotá is aware of these challenges and has begun adding extra buses along its busiest routes. The national government has also expressed support for the disbursement of additional grants to continue the expansion and upkeep of the system.

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Solving Complex Technical and Institutional Problems to Improve Urban Traffic Flow in Wuhan, China

Executive Summary

This study focuses on the south-central Chinese city of Wuhan, and examines how the municipal government undertook initiatives to upgrade traffic management, thereby improving traffic flows in congested corridors. In Wuhan, the total number of passenger cars grew from about 470,000 in 2002 to 740,000 in 2006 and then to 1.3 million in 2010. However, household car ownership, at 0.22 per household, is still one-third that in Beijing and thus has the potential to grow further. In the early 2000s, urban infrastructure in general and transportation in particular had lagged far behind the city’s development. Traffic congestion had become a pressing issue. The local government in Wuhan needed to tackle both the challenge of traffic congestion and the associated problems of air pollution and road safety.

Traffic in China has traditionally been mixed—automobiles, motorbikes, and bicyclists all sharing the same road space. When vehicle ownership is low, such a mixture can still function well, but when vehicular traffic becomes the dominant share, conflicts among various modes can bring about gridlock and severe congestion. Separating the different modes has been a major task in traffic management. The present case study examines the implementation process of traffic management improvements in Wuhan, covering the period 2000–2013.
It examines the transportation and organizational issues posed by rapid urbanization and motorization. In Wuhan, improving traffic management included eight components: a pedestrian program, a nonmotorized vehicle program, a bus priority measure, intersection channelization and traffic facilities, area traffic control (ATC), road safety, road-user education, and road-marking equipment.

This study focuses on two of these components, area traffic control and intersection channelization. It examines Wuhan’s traffic challenges, and how it overcame them as it adopted a complex technical system and had to coordinate among several agencies to facilitate implementation. Twenty-nine interviews were carried out in 2013 with implementers of these two processes to improve traffic. See the annex for the full list of interviewees. The case study also shows how Wuhan effectively used foreign assistance to benefit from international experience.

The case study addresses two questions:

- How should the analytic capacity needed to design and implement complex technical services be organized?
- How should interagency responsibilities and relationships be changed to implement complex technical systems?

The two components of the case offer several lessons on implementing complex technical services. In addition to handling the technical challenges, the case points to the necessity for adjusting organizational and institutional arrangements.

Lessons from Implementation of Area Traffic Control

An area traffic control system can improve traffic flows at major intersections by synchronizing the traffic lights at the intersections, based on their real-time traffic flows, to minimize the overall waiting time. The implementation of ATC in Wuhan has reduced traffic congestion and contributed to a more orderly traffic flow. By the time the third ATC system was operating, traffic speed on average improved by 11 percent, delays at intersections were reduced by 28 percent, and vehicles made 19 percent fewer stops before they passed an intersection—measurable evidence that the system was changing motorists’ behavior.

Lessons from Implementation of Intersection Channelization

Intersection channelization refers to the separation or regulation of conflicting traffic movements into definite paths of travel by traffic islands or pavement marking to facilitate the safe and orderly movements of both vehicles and pedestrians. The implementation of intersection channelization has reshaped the review procedure on road projects in Wuhan. Typically, a road project is reviewed at two stages. Stage one is a planning review of the macro aspects of a project, while stage two is a design review of the construction details. In Wuhan, the Traffic Management Bureau (TMB) normally attends stage two, but following the intersection channelization program initiative, the TMB has been increasingly invited to the stage-one planning review as well, and its input during stage one has been taken into account. As such, the involvement of TMB in the review process of all stages ensures that traffic management aspects will be better taken into account in major road projects.

Underpinning the implementation of both interventions was the development of technical capacity. A more specialized capacity was developed to address intersection channelization, where implementation was accompanied by the participation of the Wuhan Engineering Design and Research Institute as the major designer for all channelization projects.

Introduction: Dealing with Rapid Motorization

Motorization began to take off in China in the 1990s, with the pace picking up after 2000. In the south-central Chinese city of Wuhan, this evolution has been relatively slower than in the major coastal cities, but the pace is still astonishing. Wuhan’s population grew by 1.2 million from 1990 to 2000 and by another 1.5 million from 2000 to 2010—a 40 percent increase in 20 years. The growth of the built-up area has been even more dramatic, swelling from 275 km² in 2002, to 440 km² in 2006, to 586 km² in 2011, effectively adding the size of the U.S. city of Philadelphia in just 10 years.

Motorization has been similarly dramatic. In 1982, China built only 3,428 cars, but by 2010 that figure had soared to 18 million. China is now the world’s
largest automobile producer and consumer. In Wuhan, the total number of passenger cars grew from about 470,000 in 2002, to 740,000 in 2006, to 1.3 million in 2010. Yet, household car ownership in Wuhan, at 0.22 per household, is still one-third that in Beijing and thus has the potential to grow even more. This indicates an increasing need to manage traffic and invest in infrastructure.

**Development Challenge: Reducing Traffic Congestion and Attracting Investment**

With an increasing number of cars on the roads, traffic congestion had become a pressing issue in many major cities in China, including Wuhan. Accordingly, infrastructure investment has been one of the top priorities for many local governments. The emphasis on transportation infrastructure also goes beyond just congestion mitigation: it is also critical for economic growth.

**Delivery Challenge: Designing and Implementing Complex Traffic Systems under Conditions of Rapid Growth**

Traffic management is a function performed by local governments in China. The initial tasks include defining traffic rules and ensuring that automobile drivers, motorcyclists, bicyclists, and pedestrians adhere to them. Before 2000, there was often a single, simple approach to road rules: installation of traffic lights. Rapid motorization in China has radically transformed this traditional practice of traffic management into a multifaceted intervention. In Wuhan, improving traffic management included eight components: a pedestrian program, a nonmotorized vehicle program, a bus priority measure, intersection channelization and traffic facilities, area traffic control, road safety, road-user education, and road-marking equipment.

This study focuses on two of these components, which illustrate some of the key challenges of implementation. Each combines a highly technical activity with the need to assess and influence citizen behavior: area traffic control and intersection channelization. The former shows the struggle to adopt a complex and expensive technical system, using significant foreign assistance, while the latter highlights implementation issues.

The case study addresses two questions:

- How should the analytic capacity needed to design and implement complex technical services be organized?
- How should interagency responsibilities and relationships be changed to implement complex technical systems?

The questions attempt to address key organizational and behavioral issues that can accompany the implementation of complex technical systems. Thus, although the data and lessons learned all come from a traffic management perspective, similar questions may be relevant to other urban services, for example, housing development, environmental regulation such as air pollution control, and public infrastructure development.

**Contextual Conditions: Infrastructure and Transportation Investment in Wuhan**

**Geography of Wuhan**

Wuhan is a city built on the banks of two rivers, the Han and the Yangtze (see map 1). The rivers make for natural divisions within the city, especially in separating the Hankou District from the Hanyang District. In any citywide initiative, the separation offers the opportunity for traffic management innovations in one district to occur without affecting the other portions of the city.

**The Evolution of Urban Infrastructure Investment**

In the early 2000s, urban infrastructure in general and transportation in particular lagged far behind Wuhan’s development. Traffic congestion had become a pressing issue in many other major cities in China as well. Infrastructure investment was understandably one of the top priorities for many local governments. Total investment in urban infrastructure in Wuhan grew tenfold in about 10 years, from less than US$1 billion in the early 2000s to nearly US$11.2 billion in 2013.

**Features of Transportation Investment**

This wider context reflects three features of urban transport planning and investment in China, which also
apply to Wuhan: it is supply driven, physically oriented, and vehicle-centric. The first refers to the increasing system capacity to meet transportation needs and to mitigate congestion. In the early stage, this included investing primarily in roads, highways, bridges, and tunnels and in the latter stages expanded to public transit systems such as subways, light rail, or bus rapid transit.

Being physically oriented highlights the fact that transportation investment in China, including Wuhan, has often focused on the “hard” part of physical infrastructure instead of on the “soft” aspects of capacity building and policy making. Local decision makers might not fully understand the value of the “soft infrastructure,” or local institutions may not have the capacity and infrastructure (for example, data, models, and the like) to invest in it.

The third feature, vehicle-centric planning, means that transportation planning and policy making often put vehicles ahead of people (pedestrians and cyclists). Motorized vehicles (cars, trucks, and so forth) are often perceived as modern and superior transportation technology, while motorcycles, bicycles, and walking are viewed as inferior. This vehicle-centric approach has a special meaning in Wuhan because it is one of the three bases of China’s automobile industry. There is a strong local interest in protecting this industry and not limiting the use of cars.
Local Institutional Capacity for Transportation Management

Regarding institutions, all local governments have established a traffic management bureau (TMB). These bureaus are effectively units of the traffic police, as all TMB staff members are police officers in uniform. TMBs in China are responsible for vehicle registration and inspection. However, a TMB normally does not regulate street parking and focuses only on motorized and nonmotorized traffic on urban streets. Within a municipal government, the TMB is usually under the supervision of the Police Department. A deputy director of the Police Department usually serves as director of the TMB. In that sense, the TMB is not a high-profile agency. However, because traffic is such a pressing problem, approaching crisis in most major cities, the TMBs have become increasingly important. They are quite visible to the general public and are often called on by local leaders for solutions. However, traffic management and congestion mitigation involve many other government agencies as well. If a TMB proposes to expand a street sidewalk because it is too narrow, forcing pedestrians to jam traffic lanes, the construction itself should be done by a Construction Commission. If roadside trees are affected, approval from the Park Department is required. If the red line has to change, the Planning Department should be involved. If street vendors are seen to be contributing to the problem, the Urban Administration Bureau should become involved. If the change affects bus lanes or stops, the Transportation Commission should be consulted. In addition, the Treasury Department, Land Resource Department, Development and Reform Commission, electricity and utility companies could all be involved, depending on the specific project.

In some cities, due to the increasing importance of traffic management, the TMB has been upgraded to become a Traffic Management Commission, a coordination unit with representatives from all related agencies. The TMB in Wuhan was upgraded from the lower-ranking traffic management team in 1989. As of 2013, it had around 2,700 staff members, of which 2,000 were field traffic police and 700 were on the management team. At the same time, before 2000 traffic management in Wuhan had been weak. Its TMB was young, and the signal system was outdated. About 20 percent of signaled intersections did not have red lights. The TMB had sought an upgraded signal system but was unable to afford one due to the city’s financial constraints. Outreach to the general public was minimal, and traffic management was often not on the radar of local decision makers for major investments in transportation infrastructure.

Financing

The Chinese government provided almost US$1 billion to finance the Wuhan Urban Transport Project. In addition, since 2004 the World Bank has supported a variety of initiatives for Wuhan, including traffic management, road network development, public transport, road maintenance, environmental management, and capacity building and technical assistance. It has provided financial, conceptual, and institutional support to the government’s initiative and has also facilitated cooperation between Wuhan’s TMB and other relevant agencies.

Tracing the Implementation Process: Wuhan’s Traffic Management System

This study focuses on two components of the Wuhan Traffic Management System that illustrate some of the key challenges of implementation: area traffic control and intersection channelization. Both were implemented during the 2000–2013 period (table 1).

Implementing Area Traffic Control Systems in Wuhan

An area traffic control system can improve traffic flows at major intersections by synchronizing the traffic lights at the intersections based on their real-time traffic flows and minimizing the overall waiting time. ATC systems have been widely adopted worldwide since the 1970s, but such systems were still rare in China up to the 1990s. Two barriers to their installation in China have been cost and complexity. ATC systems are usually expensive, and historically most cities in China (including the largest ones) have not had the financial resources to import and install such systems. The technology involved is also complex: the installation, calibration, and maintenance of an ATC system are often beyond local capacities.

The earliest ATC systems in China were often the result of foreign government loans and technology from the same country. Beijing completed its first citywide ATC system in 1995 using a British government loan and the British
SCOOT technology. Shanghai imported the Australian SCATS system in 1986. Guangzhou used the same technology and built a small system for 50 intersections in 1993. The Australian system was subsequently expanded with the aid of a loan from the World Bank. In Wuhan, the initial adoption of ATC systems was piecemeal, and early efforts were confined to small geographic areas.

**First ATC System in the WEDZ**

The Wuhan Economic and Technological Development Zone (WEDZ), a 14 km² newly built-up area in Hanyang District, installed a small ATC system at 16 intersections. The WEDZ was established in 1991 to attract export-oriented businesses and has focused on the automobile industry. The WEDZ is semi-independent from the Wuhan municipal government. For example, the WEDZ has its own Traffic Management Bureau, independent from the municipal TMB. The WEDZ was able to install its ATC system in the Wuhan area for several reasons:

- As a successful economic development zone, WEDZ had sufficient financial resources to install a small ATC system in 2000.
- As a newly developed area, it had constructed a completely new road network and was willing to explore a modern traffic control system.
- The WEDZ was willing to embrace new ideas from abroad and to serve as a pilot zone for Wuhan (for example, on road traffic management).

However, the WEDZ and its Traffic Management Bureau faced an obstacle: they lacked the capacity to evaluate various technical solutions and select contractors. The WEDZ decided to engage with the Wuhan TMB for technical assistance, which was an important inflection point. The TMB had been in contact with a Spanish firm, which had approached the TMB to sell its technology. The Spanish ATC technology was one of the few technologies available in China during the early years. As such, the TMB recommended the Spanish firm and its technology to the WEDZ because it was the only option that the TMB had at that time, and the TMB wanted to test the technology before fully embracing it. The system was completed in 2000.

**Second ATC System in Hankou District**

While the WEDZ was building its small ATC system, another opportunity arose for Wuhan. The Spanish government was in contact with the municipal government regarding a possible loan to the city. In the 1990s, most government loans available to China were from Spain and Japan. A loan for US$500 million from Spain was secured for traffic management. However, the loan was considered too small for a citywide ATC system. Therefore, a district-level ATC system was proposed, with a one-to-one local matching fund. Because the Hankou District is separated from the rest of the city by two major rivers, the TMB selected it as the target district for the Spanish ATC system. Installation started at 195 intersections in 2003 and was completed in 2005.

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1 SCOOT stands for Split Cycle Offset Optimisation Technique.  
2 SCATS stands for Sydney Coordinated Adaptive Traffic System.

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Table 1 Overview of Area Traffic Control Systems and Intersection Channelization in Wuhan, China

<table>
<thead>
<tr>
<th>Year</th>
<th>Milestone</th>
<th>Year</th>
<th>Milestone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>The WEDZ was established to attract export-oriented businesses.</td>
<td>1984</td>
<td>Dadongmen intersection gave priority to left-turn traffic, a feature of channelization.</td>
</tr>
<tr>
<td>2002</td>
<td>Small ATC installed in WEDZ.</td>
<td>2001–07</td>
<td>German expert visited Wuhan as part of the China-Germany exchange program.</td>
</tr>
<tr>
<td>2003–05</td>
<td>Spanish ATC installed in Hankou District; started at 195 intersections in 2003 and was completed in 2005.</td>
<td>2001</td>
<td>Wuhan implemented its first formal channelization at the intersection of Xinhua Road and Jianshe Avenue.</td>
</tr>
<tr>
<td>2004</td>
<td>World Bank board approved first Wuhan urban transport loan.</td>
<td>2002</td>
<td>The World Bank’s support began under the auspices of the Wuhan Urban Transport Program.</td>
</tr>
<tr>
<td>2007–09</td>
<td>World Bank-funded ATC system installed.</td>
<td>2010</td>
<td>Contract signed for fourth ATC to be implemented in Hankou District.</td>
</tr>
</tbody>
</table>

**Note:** ATC = area traffic control; WEDZ = Wuhan Economic and Technological Development Zone
The second ATC in Hankou was the result of a bidding process that led to a contract for the best Spanish technology available at that time. The training of local staff on system operation and maintenance was, however, quite limited.

**Third ATC System with Support from the World Bank**

World Bank involvement in Wuhan’s transportation initiatives started after 2000. In 2002, Wuhan initiated talks with the World Bank for an overarching transport program, the city’s first lending engagement with the Bank. This project gained Board approval in March 2004. Road construction begun in 2003, which was possible because the loan included some retroactive financing. The ATC system, which did not become operational until July 2007, was completed in April 2009. Delays were due largely to two factors: first, the government of Wuhan focused on the Spanish system’s installation in the Hankou District until its completion in 2005; second, due to the unfamiliarity of the Bank with the local bidding procedure, the bidding process took much longer than expected. The city government and the TMB prepared the bidding documents with assistance from the World Bank and administered the bidding process. Wuhan TMB visited Guangzhou, where a similar system was already installed and in operation, and learned from that city’s experience. The Wuhan TMB also sent two teams to Germany and the United Kingdom for training.

The initial World Bank–financed ATC system included 274 traffic signals throughout Wuhan (excluding Hankou). The initial approach was to install one set of traffic signals per block. However, the project team soon noticed that street blocks in Chinese cities are much longer and that it was both time-consuming and difficult for pedestrians to cross the street. The Bank proposed installing additional traffic signals in the middle of the blocks. Officials worried that this would slow traffic, but when this system was tested, it proved not to be the case, as signals were synchronized and did not slow down the traffic flow. The number of traffic signals was therefore expanded to cover 426 signals. This was a clear example of an adaptation made due to the context. Many other Chinese cities have now adopted the practice of installing midblock signals.

This third ATC system, manufactured by Simons, was based on the British SCOOT technology, which was the latest technology but required a number of adaptations to fit the local context. By this point, there were more options available in the Chinese market, and the British system was chosen based on an international competitive procurement process. The technology needed to be calibrated to local traffic patterns. For example, the “green wave” function, in which traffic lights are coordinated to turn green in sequence and enable a smooth traffic flow, is prevalent in many cities in the European Union (EU) and the United States; however, it does not work well in China because its blocks are normally much longer than in other countries. The typical speed of 35–40 kilometers per hour in the EU or the United States is also not applicable in most major Chinese cities. The SCOOT technology is also a closed system that has difficulty in accommodating new traffic patterns as they emerge from the past pace of urban expansion and motorization in Wuhan.

**Fourth ATC System: Returning to the Hankou District**

Based on lessons learned from earlier experiences, the Wuhan TMB was looking for an open system to replace the Spanish ATC system in use in Hankou District, using the second phase of World Bank funding. The TMB wanted the new system to be easy to modify, upgrade, and integrate with other traffic and transportation systems in the city. The TMB learned a great deal from the whole process. For example, training on system software should occur simultaneously with the installation of the system, instead of after the completion of the installation. During the operation of the third system, the TMB gradually learned how the system could be adapted to cope with local traffic patterns. However, the TMB also realized that even though the Simons ATC system might have been an open system in theory, openness is very hard in practice. Modification and upgrade are always more complex and expensive than one might expect. All these lessons should certainly benefit the design and installation of the fourth ATC system in Hankou in the near future.

ATC systems are expensive and technologically complex. Originally, Wuhan did not have access to the full resources needed and so followed an ad hoc approach to implementation. This approach relied on taking advantage of serendipitous opportunities when they presented themselves rather than on strategic planning. The result was a piecemeal process and a fragmented system, not only...
in scope and coverage but also in the types of technology adopted. The inefficiencies inherent in this approach have been apparent: the first ATC system in the WEDZ was installed in an area with only light traffic; the second system in Hankou rapidly became dysfunctional and had to be replaced entirely just seven years after its completion; and the third system is relatively rigid and cannot keep up with the dramatic changes of traffic in Wuhan.

A number of inefficiencies remain. Currently, when data are exported from the system, the exporting has to be done manually, which is quite complex and demanding. Simons, the manufacturer of the third system, did not accept all the requests from the TMB. For example, the TMB requested that a function should be added to count down the last nine sections before a traffic signal changes. According to the TMB, when the manufacturer agrees to any upgrades, it tends to charge a high price, which presents an obstacle to modifications.

Ten years after the first ATC system was installed, the TMB finally has a clear sense of the preferred system and has the chance to implement it, but only for one district (Hankou) instead of the whole city. The city will have several distinct sub-ATC systems for an indefinite time. The piecemeal, fragmented approach nevertheless demonstrates an adaptive effort by Wuhan and by the TMB in particular. From the first to the fourth ATC system, there is a clear learning curve and a set of feedback loops in which previous experiences inform subsequent iterations.

Effect of the ATC System in Wuhan

To assess the effect of ATC on traffic, Wuhan University of Technology conducted an experiment measuring three traffic outcomes, during periods when the ATC system was deliberately in or out of operation: average speed, delay at intersections, and the number of stops needed to pass through an intersection. The experiment was conducted in April 2009 on 22 street segments for two weeks. In the first week of the experiment, the ATC system was on, while in the second week it was turned off. Over the two weeks, 11,800 observations were collected. Table 2 compares the three outcomes with and without the ATC system.

When the third (WB-funded) ATC system was operating, traffic speed on average improved by 11 percent, delays at intersections were reduced 28 percent, and vehicles made 19 percent fewer stops before they passed an intersection: measurable evidence that the system was changing motorists’ behavior. Although the ATC may have a significant and positive impact on traffic congestion overall, the experiment also recorded large variations among the street segments. In one segment (Minzhu Road at Xiaodongmen and Hongshan Plaza), traffic was typically so congested that the ATC system could not handle the traffic load and was frequently switched to manual function, with the signal operated by traffic police. In another segment (Yingwu Avenue), the traffic was heavily mixed, and the number of stops and delays actually became worse without it.

Despite these earlier findings, four years after completion of the ATC, the general belief in Wuhan and the TMB is that the third ATC system has not performed at the expected level. Wuhan, like many Chinese cities, has a large volume of pedestrian and bicycle traffic, often mixed with vehicular traffic. Pedestrians and cyclists may conflict with vehicular movements, and the ATC system is often unable to measure pedestrian and bicycle volumes and to account for them. For example, most intersections do not have a red-green light combination for right-turning vehicles or a “no turn on red” signal, so that vehicles making the right turn and crossing pedestrians often confront each other. The Wuhan ATC system performs better in newly developed areas at the urban edge, where vehicular traffic dominates, and less well in the urban center. This has been an issue for the ATC systems in many Chinese cities. ATC systems perform better in a few Chinese cities, such as Chongqing, Dalian, Qingdao, and Xiamen. These cities are mountainous and do not have much bicycle traffic on their streets. Currently, the TMB in Wuhan also relies on the data collected from electronic toll collection and real-time video cameras in addition to the ATC to manage the traffic signals.

<table>
<thead>
<tr>
<th>ATC status</th>
<th>Average speed (km/h)</th>
<th>Stops (number)</th>
<th>Average delay at intersection (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>26.77</td>
<td>0.47</td>
<td>13.40</td>
</tr>
<tr>
<td>Off</td>
<td>23.72</td>
<td>0.56</td>
<td>17.20</td>
</tr>
<tr>
<td>Improvement (%)</td>
<td>11.39</td>
<td>19.23</td>
<td>28.35</td>
</tr>
</tbody>
</table>

Note: km/h = kilometers per hour; s = seconds
Implementing Intersection Channelization in Wuhan

A second component of the implementation process of traffic management improvements in Wuhan is considered here: implementing intersection channelization. Intersection channelization refers to the separation or regulation of conflicting traffic movements into definite paths of travel by traffic islands or pavement marking to facilitate the safe and orderly movements of both vehicles and pedestrians. When traffic islands are used, it is physical channelization. If only marking is used, it is called facility channelization. Figure 1 illustrate a three-way intersection without channelization and with physical and facility channelization.

First Generation of Intersection Channelization, 2000–02

Channelization is an intersection design standard that became popular in Europe and North America after the 1950s. In China, the concept of channelization also appeared quite early, but implementation has always lagged, probably due to the limited vehicle traffic before 2000. In Wuhan, the first bridge on the Yangtze River in the 1950s already channelized certain traffic lanes at the entrance intersection. In 1984, the Dadongmen intersection gave priority to left-turn traffic, a feature of channelization. However, channelization was rare nationwide until the end of the 1990s. Before 2011, the only national road design standard that covered intersections focused on elevated multilevel intersections for expressways and was not sufficient to inform the intersection design for urban roads.

With rapid economic growth, traffic congestion had become a big problem in Chinese cities by the late 1990s. Change began in 2000 when China’s Ministry of Public Security (MPS) launched the national Smooth Traffic Project. The project comprises a set of programs and policies to improve traffic management and encouraged the TMBs from major cities to adopt them. The MPS also evaluates the implementation of the project and ranks the cities as being outstanding, very good, good, or satisfactory. The evaluation is based on six criteria, including equipment and facilities, which covers intersection channelization. To be evaluated as satisfactory, the percentage of channelized intersections should be at least 40 percent; 60 percent earns an evaluation of good, 70 percent is very good, and 80 percent is outstanding.

However, even with pressure coming from the national government, acceptance of intersection channelization by the local TMBs took time. In Wuhan, the Design Institute initially lacked sufficient technical preparation on channelization. A transport expert from Germany was a major help in that process. The expert, part of the China-Germany exchange program, stayed in Wuhan from 2001 to 2007. Wuhan’s Construction Commission hired the German expert for an initial two years, before providing a two-year extension. The Transport Planning Institute subsequently hired the expert for another two years. The expert helped the institute purchase microsimulation software and evaluate the effects of channelization through simulation.
Backed by the positive simulation results, Wuhan implemented its first formal channelization at the intersection of Xinhua Road and Jianshe Avenue in 2001. According to the TMB, traffic capacity at the intersection increased by 75 percent from 4,000 vehicles per hour to 7,000 vehicles per hour after channelization, although details were not available from either the TMB or the Design Institute. Many stakeholders including the TMB were initially concerned that channelization would take away road space from motor vehicles (see figure 1b and 1c). This early success was important to the widespread adoption of channelization. The deputy mayor also visited the site, endorsing channelization in public and ordering related agencies to work together to move forward.

However, the first generation of channelization was limited in several respects. First, the approach was focused on improving motor vehicle capacity and speeds over the whole urban road network but paid scant attention to nonmotorized traffic. Second, it was disconnected from the ATC signal system despite the fact that channelization is indispensable to it. For example, without intersection channelization, the ATC sensor may not pick up the turning information on vehicles, so that the data collected become inaccurate in estimating traffic flows. Third, channelization was viewed as a minor measure and often implemented as part of a larger road construction or rehabilitation project. Accordingly, stand-alone channelization was rare.

**Second Generation of Intersection Channelization, 2002–10**

When Wuhan began planning for the ATC system in Hankou, channelization was part of the discussion, given that ATC requires the separation of motorized and nonmotorized traffic. However, the accompanying Spanish government loan was not sufficient to support a channelization program, and Wuhan (and the TMB) did not have the financial resources to channelize major intersections in Hankou. According to the estimates by the Wuhan Treasury Department, channelizing intersections costs on average about RMB 1 million each. The major intersections could cost RMB 2–3 million, including traffic lights: the costs of channelizing the several hundred major intersections in Wuhan would thus be significant.

The World Bank’s support, beginning in 2002 under the auspices of the Wuhan Urban Transport Program, came at a fortuitous time and marked a key benchmark for the channelization efforts. This support raised the profile of channelization and enabled the municipal government to leverage more funds and make channelization one of the eight components of the traffic management program. With the Bank’s support, in March 2002 the TMB was able to propose channelizing 74 intersections, of which 32 would be physical channelizations. By July 2002, the number had increased to 350 intersections. The finalized project included 274 intersections, of which 46 were physical channelizations. Most of the physical-junction channelization schemes were proposed for Hankou to complement the forthcoming Spanish ATC system.

World Bank experts also advised on the design of channelization. The earlier channelization projects had focused on vehicle movement, not pedestrians and cyclists. The Bank team, however, emphasized nonmotorized traffic from the outset, which was an important shift in emphasis. After numerous discussions between October 2001 and December 2002, the TMB proposed new design principles for channelization: it would focus on tightening intersections, channelizing vehicles, and bringing stoplines forward. It did not entail intersection widening. After the specific channelization design was completed in 2003, the Bank provided comments and helped with the revision. The actual design of the first 23 intersections began in August 2003, and by 2010, some intersections had been channelized throughout Wuhan.

The key features of the new channelization design included the following:

- Physical channelization (and planting) to provide a safe refuge for pedestrians to cross the road.
- Reduction in the uncontrolled areas at an intersection to cater to pedestrians with no loss of capacity for vehicles.
- Physical islands to channelize turning traffic into short, direct paths to clear the junction quickly.
- Stoplines brought forward to minimize clearance times.
- Multiphase traffic signals with special pedestrian signals (which run in parallel with vehicle signals with no conflict) to enhance efficiency for vehicles and safety for pedestrians.
The implementation of channelization following the World Bank’s involvement seemed too slow to the TMB, especially after 2002 when a new infrastructure financing system had been established. Wuhan launched a major campaign around road building and acquired sufficient funding to carry out many road projects. Because most of the money had been raised by the government, it could move more swiftly than had been possible through the World Bank–funded project. Eventually, most of the channelization sites were completed by the local fund, independent of the Bank initiative, as part of road construction or rehabilitation projects. For example, by November 2003, 11 intersections in Hankou had already been channelized. By the time the World Bank project was approved by the Board, an additional 17 physical channelizations and 130 facility channelizations had nearly been completed. In contrast, stand-alone channelizations—not attached to any road projects—were delayed significantly. Stand-alone channelization is often more complex than other channelization projects. Although most other channelization projects had been completed by 2005, nothing happened to the four stand-alone channelizations until 2007. By March 2008, two had been completed and another two were under construction. All four were completed in 2010. This outcome reflected the different attitudes of the local government toward major road projects, in contrast to the relatively “minor” adaptations at intersections.

Traffic Capacity and Safety

Intersection channelization is intended to improve traffic capacity and safety and to simplify traffic flows. However, it is very difficult to evaluate these outcomes in the Wuhan case: none of the start and completion dates were recorded for the channelization sites attached to a road project. It is difficult to separate the effect of channelization from that of the entire road project. For stand-alone physical channelization, the expectation is that the outcome should be positive and significant, but there are too few to establish data on the traffic patterns before and after the channelization. One single accident may completely change the safety record at these intersections from year to year. However, even without the data on traffic patterns, the channelization effects may become evident from viewing the sites themselves. Photograph 1a and 1b show the situation before and after intersection channelization at one of the sites.

Before, the junction was inefficient and unsafe. There were no clear paths for vehicles to travel through the intersection, and turning vehicles chose their own paths under the flyover piers. Traffic signal stoplines were set far back, resulting in long clearance times. Pedestrians crossing the wide carriageway had no safe refuge in the center and had to negotiate disorderly turning traffic that could run between any of the flyover piers. Because the pedestrian phase was not long enough to cross in

<table>
<thead>
<tr>
<th>Photo 1 View of the Intersection of Jiefang Avenue and Jiefang Park Road before and after Channelization</th>
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<tbody>
<tr>
<td>a. Before channelization</td>
</tr>
</tbody>
</table>

...
one stage, pedestrians became stranded among the traffic. After the channelization, pedestrian flows have been separated from vehicle traffic. The long walk in an uncontrolled area is divided into several short crossings connected by pedestrian refuges, significantly reducing pedestrians’ exposure to vehicular traffic.

Another important sign of improvement is the reduction of field police officers at channelized intersections. According to the TMB, before channelization, one major intersection normally needed two or three traffic police officers to guide traffic. One of them had to stand right in the middle of the intersection, facing traffic from all directions (photograph 2). This was not only unsafe but also unhealthy, given the noise and pollution, particularly in bad weather. After channelization, a single traffic police officer has often been sufficient. Before channelization, a citywide cadre of 125 traffic police officers usually had to be on site during peak hours. This number fell to 70–80 after channelization. Not only has the number of police needed changed, but also their field tasks differ. Field traffic police now focus on accident management and drunk driving instead of being preoccupied by the basic order of traffic, as they were before. Thus, the apparent improvement has led to reduced traffic congestion and more orderly traffic—and possibly fewer traffic accidents at the channelized intersections.

Despite the general acceptance of, and praise for, channelization, design and management could be still improved in many ways. For example, fences at some intersections are too long to allow vehicles to change lanes into traffic channels. Right-turning traffic lights are often signaled by a flashing yellow light, which can create conflict with crossing pedestrians, a condition that could be addressed through a switch to a red light–green light combination.

The channelization projects in Wuhan (Bank or non-Bank sponsored) have contributed to the emergence of a new local and national design standard for intersections. Wuhan has become a front-runner in creating design standards for intersections in China due to the presence of strong transportation programs at the local universities. University researchers were heavily involved in the making of the National Standard for Urban Transportation Planning and Design (GB 50220-95) issued in 1995. However, this standard did not cover many of the urban road intersections. A national standard specific to urban roads was in preparation back in the mid-1990s but was delayed significantly after numerous rounds of consultation nationwide. The standard was finally adopted in 2011 (GB 50647-2011). The influence of the local standard seems to have spilled over to other major cities as well, such as Shenzhen, Guangzhou, and Nanning; all these cities adopted a standard similar to Wuhan’s before the issuance of the national standard.

Lessons from the Wuhan Traffic Management Project

The two components of the Wuhan traffic management case offer several lessons on the implementation of complex technical services. In addition to technical challenges, the case points to the importance of the associated organizational or institutional developments needed, as elaborated below.

How Can the Analytic Capacity Needed to Design and Implement Complex Technical Services Be Organized?

The examples of intersection channelization and area traffic control both show the importance of developing technical capacity. The more specialized capacity was developed to implement intersection channelization, where application was accompanied by the emergence of the Wuhan Engineering Design and Research Institute as the major designer for all channelization projects.
Initially, Wuhan’s Design Institute was reluctant to accept the task because the new type of channelization was unfamiliar to its staff members. In addition, channelization design costs more, but the institute could charge only what it charged for its other domestic projects. The initial design was rejected by the TMB several times before it was finally accepted.

The Design Institute now trains its staff members at the local universities and augments channelization practices by conducting channelization projects. Staff members have learned new techniques of road and intersection design and have become better prepared professionals. The Design Institute has also begun to benefit from its experience with channelization. In 2012, it established a traffic division and is now the leading agency in this field nationwide. When the consulting market began to emerge, the technology spilled over to other firms through staff transfers. At present, Wuhan has an active consulting market with more than 100 transportation and infrastructure consulting firms. Most are capable of designing the new type of channelization.

A broader capacity developed in relation to ATC, where expertise is needed to cover the “soft” aspects of data collection and analysis of traffic patterns in addition to the “hard” aspect of physical infrastructure. The local governments were willing to spend billions of dollars on road construction but were reluctant to spend several million dollars on data collection and research that might be critical to the construction project. Wuhan’s experience illustrates the growth of the necessary organizational capacity in traffic management; these patterns may be relevant for related technical services beyond traffic management.

In traffic management, to understand how well a “soft” element has been developed in a locality, it is necessary to ascertain whether and when a transportation planning institute was established and when and how often a regional travel survey is conducted. A travel survey is the foundation of a regional transportation model that plays a key role in transportation project evaluation and cost-benefit analysis.

Table 3 lists these two indicators in several major cities in China. It shows that many major cities established a transportation planning institute after the 1990s. Except for a small minority (for example, Beijing, Guangzhou, and Shanghai), most cities conducted their first household travel survey after 2000. Given that it takes time to process the data and calibrate a regional transportation model, for many major cities—including Wuhan—these technical tools were probably not fully used for transportation planning and policy making until the mid-2000s. When the World Bank project started in Wuhan in early 2000, the city’s experience with using household travel data for planning was limited.

In another example of boosting capacity in Wuhan, since 2010 the TMB has worked with a local university

<table>
<thead>
<tr>
<th>City</th>
<th>2010 population (million)</th>
<th>Year transportation planning institute established</th>
<th>Years of travel survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chengdu</td>
<td>7.4</td>
<td>1986*</td>
<td>2009</td>
</tr>
<tr>
<td>Guangzhou</td>
<td>11.1</td>
<td>1986</td>
<td>1984, 2005</td>
</tr>
<tr>
<td>Hefei</td>
<td>3.3</td>
<td></td>
<td>2013</td>
</tr>
<tr>
<td>Jinan</td>
<td>4.3</td>
<td></td>
<td>2011</td>
</tr>
<tr>
<td>Nanjing</td>
<td>8.0</td>
<td>1996</td>
<td></td>
</tr>
<tr>
<td>Qingdao</td>
<td>4.6</td>
<td></td>
<td>2002, 2010</td>
</tr>
<tr>
<td>Wuxi</td>
<td>3.5</td>
<td></td>
<td>2003, 2013</td>
</tr>
<tr>
<td>Xi’an</td>
<td>6.5</td>
<td></td>
<td>2000, 2011</td>
</tr>
</tbody>
</table>

Note: A transportation unit is stationed within the local planning institute. The unit itself may not have the full capacity to conduct the regional survey and develop a transportation model. Empty cells indicate nonexistent or missing data.
to develop a training course in traffic management. The course is taught twice a year and targets TMB staff members at the mid-managerial level. Training also occurs internally within the TMB and focuses on language capability (primarily English) and traffic management.

**How Might Interagency Responsibilities and Relationships Be Changed to Implement Complex Technical Systems?**

The examination of channelization offers the main lessons on interagency responsibilities and relationships. The channelization experience has reshaped the review procedure on road projects. Typically, a road project is reviewed at two stages. Stage one is a planning review of the macro aspects of a project, while stage two is a design review of the microconstruction details. The TMB normally attends stage two, but its input is advisory only; the Construction Commission, which administers the whole review process, does not need to follow the TMB's suggestions, although it often does. Given that channelization is quite technical and affected by some macro aspects of the project, the TMB has been increasingly invited to the stage-one planning review, and its input at stage one has also been afforded greater weight.

The wider involvement of the TMB in the review process ensures that traffic management is taken into account in major road projects. For example, road construction and traffic management have traditionally been largely disconnected. The Construction Commission planned, designed, and constructed the road and then delivered it to the TMB without any surface markings or signals, which the TMB subsequently prepared itself. In the new process, marking and traffic management facilities are planned, designed, and constructed at the same time as the road. As a result, road projects administered by the Construction Commission that once dealt only with materials and labor are now beginning to include traffic lights and other equipment in one package.

Other institutional changes also have occurred. Road projects were traditionally administered by the Construction Commission, which oversaw the Park Department, the Planning Department, the Urban Administration Bureau (UAB), the Sanitation Department, and others. The likely conflicts among these departments can be better managed by the commission if it administers channelization. Stand-alone channelizations are administered by the TMB, because such small projects are outside the realm of the Construction Commission.

Many agencies oversaw a portion of the stand-alone physical channelization, but none have had full ownership. The TMB normally deals with road markings, not the physical construction. Indeed, Wuhan is the only place nationwide where the TMB alone carries out physical channelization. The UAB is responsible for the maintenance and repair of facilities, such as fences or safety islands. It has conducted between 10 and 20 maintenance projects each year at a total cost of RMB 1 million. The Park Department handles the planting inside the safety island or on the sidewalk. When the TMB assumed ownership of the channelization project, it had to foster coordination that had not existed before. The process was not straightforward. For example (as seen in figure 1), the sidewalk moved outward and probably removed a portion of green space, as happened in Wuhan. At the intersection of Luotu Road, the Park Department refused to remove plants for the channelization. This delayed the process by almost six months. At the intersection of Xiaodongmen, channelization required the change of the red line, and it took some time before the Planning Department revised its plan to allow it.

Resistance to the new type of channelization procedures occurred even within the TMB. The district police brigades were concerned about the loss of traffic space. The general belief at that time was that the wider the intersection, the better the traffic flow. To overcome this resistance, the TMB commissioned the China Management Science Research Institute to model the proposed design using a microsimulation program, assisted by the German expert mentioned earlier. This simulation showed that the design would not only improve pedestrian safety but also increase capacity.

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3 The demarcation between the UAB and the TMB is a subtle one. For example, for spills from trucks that transport construction waste on urban roads, cleanup is performed by the UAB, while any fines and the cancellation of transport certificates are the territory of the TMB. If a street vendor blocks a bike lane, the TMB can move them, but the fine is levied by the UAB.
What Traffic Planners Can Learn about the Science of Delivery from Wuhan’s Experience

The Wuhan case study offers traffic planners and related officials helpful insights into creating, delivering, and managing citywide transportation systems and their complex technology, especially under conditions of rapidly increasing urbanization and automobile ownership.

Area Traffic Control and Channelization Outcomes

The case study covers two components of traffic management in Wuhan, each of which has a major impact on the quality of life for people who use Wuhan’s roads, both motorists and people using nonmotorized transportation. In both cases, the system was designed with these improvements in mind and measured and evaluated in line with these goals. In the case of the first component—the implementation of ATC systems—a formal evaluation found improved traffic flow and reduced congestion. With regard to the second component—intersection channelization—field observations showed safer separation of pedestrian and vehicular traffic and a need for fewer police to guide intersection traffic.

Multidimensional Response among Agencies Involved in Traffic Management

The traffic management initiatives required a multisectoral and multidisciplinary combination of planning, engineering, and collaboration among agencies responsible for road construction, traffic police, road markings, facilities such as fences and safety islands, and plantings inside safety islands or sidewalks. In addition, Wuhan officials partnered with the World Bank to develop traffic management strategies and institutional capacities.

Techniques for Gathering Evidence for Designing the Systems

A number of techniques were used to assemble an evidence base to inform the design of Wuhan’s traffic management systems. These ranged from harnessing outside expertise (such as the German expert embedded with multiple agencies in Wuhan and collaboration with the World Bank team), to learning from past experiences, to performing evaluations and experiments to assess the impact of projects and guide work in these areas. This evidence base was key to creating systems that could address Wuhan’s particular needs.

Importance of Leadership

The Wuhan Traffic Management Bureau took a leadership role in the process, over time becoming more influential in the planning and implementation of major road projects than is typically the case, given the traditional dominance of road construction priorities. The channelization projects contributed to the emergence of a new local and national intersection design standard, specific to urban roads.

Adaptive Implementation

Implementation relied on shifting away from a supply-driven, physically oriented, vehicle-centric orientation, as well as on the gradual emergence of university-based institutions with the high-level analytical capacity to conduct regional travel surveys and computer simulations. These changes occurred over a period of time and in an iterative manner. In addition, successive experiences with traffic control systems afforded the municipal government the opportunity to learn and improve with each iteration. The size of the city, along with the high costs of installing new traffic control systems, meant that only smaller subsystems were installed. Such incremental changes enabled the planners to learn from each subsystem and to improve the designs for the newer ones.
## Annex  Names, Agencies, and Titles of Interviewees on Field Trips

### Field Trip 1, May 2013

<table>
<thead>
<tr>
<th>Name</th>
<th>Agency</th>
<th>Title</th>
<th>Date/Time</th>
</tr>
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<tbody>
<tr>
<td>Wei Li</td>
<td>Project Management Office</td>
<td>Deputy Director</td>
<td>May 28, pm</td>
</tr>
<tr>
<td>Mr. Zhang</td>
<td>Provincial Treasury</td>
<td>Unit Director</td>
<td>May 28, pm</td>
</tr>
<tr>
<td>Mr. Hu</td>
<td>Traffic Management Bureau</td>
<td>Director, Research Department</td>
<td>May 28, pm; May 29, am; May 30, pm</td>
</tr>
<tr>
<td>Mr. Tong</td>
<td>Traffic Management Bureau</td>
<td>Party Director, Research Department</td>
<td>May 29, am; May 30, pm</td>
</tr>
<tr>
<td>Lixia Xu</td>
<td>Project Management Office</td>
<td>Director, Business Development</td>
<td></td>
</tr>
<tr>
<td>Jin Qiu</td>
<td>Project Management Office</td>
<td>Procurement</td>
<td>May 30, am</td>
</tr>
<tr>
<td>Jun Zhou</td>
<td>Design Institute</td>
<td>Assistant Director</td>
<td>May 30, am</td>
</tr>
<tr>
<td>Mr. Chen</td>
<td>Traffic Management Bureau</td>
<td>ATC System Technician</td>
<td>May 30, pm; May 31, pm</td>
</tr>
<tr>
<td>Mr. Liang</td>
<td>Traffic Management Bureau</td>
<td>Texting Program</td>
<td>May 30, pm; May 31, pm</td>
</tr>
<tr>
<td>Mr. Shao</td>
<td>Design Institute</td>
<td>Director, Transportation Department</td>
<td>May 31, am</td>
</tr>
<tr>
<td>Mr. Wang</td>
<td>Design Institute</td>
<td>Director</td>
<td>May 31, am</td>
</tr>
<tr>
<td></td>
<td>Traffic Management Bureau</td>
<td>Accident Department</td>
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### Field Trip 2, June 2013

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<th>Name</th>
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</thead>
<tbody>
<tr>
<td>Mr. Shao</td>
<td>Design Institute</td>
<td>Director, Transportation Department</td>
<td>June 17, am</td>
</tr>
<tr>
<td>Mr. Li</td>
<td>Transport Planning Institute</td>
<td>Title unknown</td>
<td>June 17, am</td>
</tr>
<tr>
<td>Jing Lu</td>
<td>Transport Planning Institute</td>
<td>Title unknown</td>
<td>June 17, pm</td>
</tr>
<tr>
<td>Mr. Hu</td>
<td>Traffic Management Bureau</td>
<td>Director, Research Department</td>
<td>June 17, pm; June 20, am</td>
</tr>
<tr>
<td>Mr. Tong</td>
<td>Traffic Management Bureau</td>
<td>Party Director, Research Department</td>
<td>June 17, pm</td>
</tr>
<tr>
<td>Mr. Chen</td>
<td>Traffic Management Bureau</td>
<td>ATC System Technician</td>
<td>June 17, pm</td>
</tr>
<tr>
<td>Mr. Huang</td>
<td>Design Institute</td>
<td>Chief Designer</td>
<td>June 18, am</td>
</tr>
<tr>
<td>Ms. Xiao</td>
<td>Construction Commission</td>
<td>Director, Construction Management</td>
<td>June 18, pm</td>
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<tr>
<td>Ms. Gladys Frame</td>
<td>World Bank</td>
<td>ATC Expert</td>
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<tr>
<td>Jin Qiu</td>
<td>Project Management Office</td>
<td>Procurement Division</td>
<td>June 19, noon</td>
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<tr>
<td>Ms. Luo</td>
<td>Treasury Department</td>
<td>Deputy director, Finance Division</td>
<td>June 19, pm</td>
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<tr>
<td>Ms. Yu</td>
<td>Urban Administration Bureau</td>
<td>Director, Facility Management</td>
<td>June 19, pm</td>
</tr>
<tr>
<td>Xianyao Zhao</td>
<td>Wuhan University of Technology</td>
<td>Professor of Transportation</td>
<td>June 19, pm</td>
</tr>
<tr>
<td>Lixia Xu</td>
<td>Project Management Office</td>
<td>Director, Business Development</td>
<td>June 20, am</td>
</tr>
<tr>
<td>Mr. Li</td>
<td>Project Management Office</td>
<td>Party Director</td>
<td>June 20, am</td>
</tr>
<tr>
<td>Edward Dotson</td>
<td>World Bank</td>
<td>Former Task Team Leader (2002–06)</td>
<td>June 28, pm</td>
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Bibliography


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Using the Water Kiosk to Increase Access to Water for the Urban Poor in Kenya

**In Brief**

- **Development Problem:** Kenya needed to expand access to water and sanitation services to urban low-income areas consistently and efficiently on a countrywide scale.
- **Program Solution:** Kenya established a basket-funding mechanism through the Water Services Trust Fund to encourage investment by utilities in last-mile infrastructure using low-cost technologies, including water kiosks, yard taps, and sanitation facilities.
- **Program Results:** Pilot programs for water kiosks showed that shared facilities were accepted and welcomed by consumers. After scaling up, nearly 1.8 million people have gained first-time access to safe and affordable water services, and up to 429,000 people are scheduled to receive sanitation services by the end of 2016.

**Executive Summary**

Until recently, an estimated 8 million people living in Kenya’s fast-growing urban low-income areas were not served by the country’s water utilities. With the tacit acceptance of political decision makers, informal water provision, expensive and often unsafe, had become their only service option. Too often, plastic bags doubled...
as toilets. Inspired by state-of-the-art sector reform and the scaling-up approach taken in Zambia, Kenya began to overhaul its own water sector: pro-poor commitments were included in a new water policy and legislation, including the formalization of service delivery in low-income areas and socially responsible commercialization of utilities. Significant improvements have been achieved using unconventional solutions. The case study shows how Kenya is moving toward its goal of universal service, and the successes as well as the difficulties that were encountered along the way.

A major innovation of the reform has been the establishment of a pro-poor basket-funding mechanism, the Water Services Trust Fund (WSTF or the Trust Fund). The WSTF, and more specifically its urban financing window, has been instrumental in reaching out to the allegedly difficult-to-serve urban poor: nearly 1.8 million people have gained first-time access to safe and affordable water services through water kiosks and yard taps since 2008. Scaling up sanitation is accelerating, with about 120,000 people served over the last five years and that number set to rise to 429,000 by the end of 2016.

The WSTF is responsible for channeling investment funding to those utilities showing promise and commitment to serving all their customers, but it is far more than just a financial intermediary. Supported by a team of integrated, long-term Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) advisors, it promotes low-cost technologies, provides comprehensive support to the implementing utilities, maintains customized monitoring systems, and facilitates continuous institutional learning. For those development partners (DPs) who have committed funds, it also functions as a risk manager in an environment rife with corruption. Overall, the Trust Fund has proven to be an effective and efficient financing mechanism to increase access for the poor to formalized service provision with limited funds. The average cost for the last-mile infrastructure for water supply stands at €14 per beneficiary and comparable costs for sanitation have fallen to €24 per beneficiary, both representing good value for money.

The reform has prompted a shift from an almost exclusive focus on household connections as the only acceptable service option to a wider recognition of the need for locally adapted, low-cost technology mixes. With support from the German Development Cooperation, the WSTF was able to pilot water kiosks that were professionally managed by utilities. The feasibility, acceptance, and sustainability of low-cost technologies to scale up services could finally be proven in the Kenyan context. Overwhelmingly positive feedback meant they were ready to be rolled out across the country. Some DPs also realized that the conventional, large-scale project approach, with its limited implementation mechanisms, was partially responsible for preventing the scaling up of water and sanitation infrastructure in urban low-income areas. The WSTF not only funds the small and medium-size investments needed to reach the last mile of service provision, it also ensures their long-term financial, technical, and social sustainability.

The WSTF allocates investments using a competitive funding procedure. This procedure provides an incentive for utilities to submit sound investment proposals, execute funding in a timely manner, and ensure the construction of infrastructure in compliance with the new national standards. The latter are derived from toolkits that have been assembled by the WSTF to share lessons from the field, such as the tested technical designs and proven approaches for water kiosk management. Toolkits provide simple, hands-on guidance for the implementing utilities (as well as Trust Fund staff, contractors, and communities) and are updated to incorporate new insights.

With a team of long-term advisors, WSTF has been able to develop into a professional and trusted organization. GIZ’s advisory services emphasized coaching, on-the-job training, and strong partnerships, rather than just technical support. Advisors have helped foster positive relationships between key stakeholders (see annex A), for instance, instigating a successful South-South Knowledge Exchange and the well-received national strategic dialogues. As an outcome of this cooperation process, proponents of the scaling-up process developed a shared vision of their organizations as professional entities committed to delivering pro-poor services. The close collaboration of the financial and technical sectors—as provided by GIZ and the Trust Fund’s financing partners in Kenya—was critical to combining the funding of last-mile investments with the concept and capacity development activities that are necessary to scale up services.

Introduction

When Ruth Wanjiru arrived in Nairobi, the Kenyan capital, in 1983, she chose to live in Mathare, which was cheap and fairly close to the city center. As Mathare grew, it became more difficult to buy clean water, and there were not enough toilets for everyone. The settlement
Development Challenge: Ensuring Access to Water and Sanitation

“Water is life, sanitation is dignity”—the slogan sums up the development challenge faced by Kenya, which by the early 2000s held the dubious fame of being home to the biggest slum in Africa. The consequences of inadequate access to water and sanitation are particularly devastating in the urban context where high population density leads to the rapid spread of disease. In addition, in urban areas public and private water sources tend to be heavily contaminated and are often unsuitable for drinking.

Kenya does not stand alone in facing this problem or its scale. In most Sub-Saharan African countries 30 to 50 percent of the urban population have no access to safe water or adequate sanitation. Access to water through household connections in urban areas in Sub-Saharan Africa fell from 42 percent to 34 percent from 1990 to 2012, while access to other improved (but often unsafe) sources increased from 41 percent to 51 percent during the same period (WHO/UNICEF 2014). The estimated 150 to 250 million underserved urban people often live in low-income and sometimes unplanned areas, where poor living conditions exacerbate the consequences of inadequate access; they are far more likely to suffer from waterborne diseases, higher infant mortality, income loss, and lower productivity. Across the region, strong population growth and uncontrolled urbanization are accelerating the service gap, as governments are overburdened with attempts to expand public services, with a devastating impact on living conditions.

Despite this, most rural-to-urban migrants continue to settle in unplanned low-income areas, adding to the high population density and living with inadequate public services such as water supply and sanitation (WSS). Formerly planned areas frequently turn into settlements with an unplanned character as infrastructure development is outpaced by the high influx of new residents. In Kenya, a country of 45 million with an estimated growth rate of 2.7 percent per year, connecting a low-income area to existing large-scale, primary infrastructure and (2) the customer points of access (such as water kiosks, yard taps, on-plot urine diverting dry toilets [UDDTs] or ventilated improved pit [VIP] latrines, and public sanitation facilities).

1 Demographic data about Kenya can be found at the MajiData website, www.majidata.go.ke.
2 Access is the ability of consumers to use infrastructure (a water outlet or a toilet facility) that complies with the standards defined by the Human Right to Water and Sanitation and that is sustainably maintained and operated. The Human Right to Water and Sanitation was explicitly recognized by the United Nations in 2010. It sets minimum standards regarding the availability, accessibility, affordability, quality, and acceptability of drinking water and sanitation services.
3 Last-mile sanitation service provision refers to the connection of low-income area households to the service delivery chain. It consists of (1) secondary infrastructure (such as small-scale water storage or sludge management facilities)
a quarter of the total population resided in urban areas in 2013. Urban low-income areas (LIAs) in the 276 cities and towns in Kenya comprise a population of more than eight million people and are experiencing an above-average growth rate of 6 percent (GIZ 2013).5

**Delivery Challenge: Providing WSS Using Low-Cost Technology While Developing the Formal Sector**

Limited application of low-cost technologies by water utilities and tacit acceptance of informal service delivery by political decision makers, development partners (DPs), and utilities—exacerbated by trends beyond the influence of the water sector (notably uncontrolled urbanization and population growth)—conspire to maintain the status quo in urban LIAs. The delivery challenges consist of providing immediate access to WSS through the use of low-cost technology and the long-term development of a formal WSS sector.

**Insufficient Pro-Poor Orientation and Accountability of Public Institutions and Utilities**

Poor governance on the national and local levels, powerful vested interests, and legal uncertainty drove the "informalization" of urban LIAs. There were no clearly defined responsibilities or organizational structures in place to secure the provision of WSS. Public authorities and utilities lacked enforcement mechanisms and the incentive to expand services, and residents had no adequate means of expressing their needs and concerns.

Basic information on population and service coverage simply did not exist for these areas. Moreover, critical information to guide decision making on investment priorities, value for money of investments, and technology choice was unavailable. At the same time that DPs, governments, and utilities underestimated the willingness of potential customers to pay for services and to use shared facilities, the costs of connecting to formal networked services were prohibitively high. Prevailing misperceptions about the willingness to pay meant that opportunities to increase revenue of the water utilities were not exhausted.

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5 Low-income areas are settlements with poorly constructed houses or shelters where more than half of the residents live near or below the poverty line. Many grow into high population density areas within or around towns. They are often unplanned or were initially planned but degraded into an unplanned state.
perpetuating the lack of pro-poor orientation within utilities. The large numbers of ISPs cannot be regulated or monitored effectively. ISPs generally supply raw water that does not meet World Health Organization standards for microbiological and chemical quality. Customers are exposed to public health risks because minimum standards for service quality and for the human right to water and sanitation are not enforceable. Small private networks that supply only a couple of hundred connections (when they exist at all) cannot realize economies of scale and therefore have to charge more for the services they supply. Low-income customers regularly pay 10 to 20 times more for water of inferior quality, compared with regular users of formal utility services. In Nairobi, users of informal water points were paying on average between 8 and 20 times more per cubic meter of water than the “lifeline rate” offered to their more affluent neighbors with standard, private in-house connections, rising to a factor of nearer 100 during times of scarcity (Gerlach 2008).

This case study addresses four delivery questions:

- How was the emphasis in the Kenyan water sector shifted from an almost exclusive focus on household connections and toward technology mixes that included low-cost options?
- How did Kenyan institutions learn from the application of low-cost technologies and apply that knowledge to technical, social, and managerial issues?
- How did the Kenyan government and water utilities technically and financially roll out and sustainably operate low-cost technologies on a countrywide scale?
- How did the technical and financial components of assistance work together to support the service shift and the scaling-up process in Kenya?

Contextual Conditions

In Kenya, the shift to low-cost technologies to deliver urban water and sanitation services at scale has been part of far-reaching water sector reform that began in 2004. Annex B provides an overview of actions relevant to the case study.

Water Policy in Kenya

Past water policies in Kenya and the National Vision 2030 stipulated the provision of universal WSS coverage as important policy goals. In 2002, a new Water Act introduced an explicitly pro-poor focus to the Kenyan water sector. The new legislation provided a framework for reform implementation and addressed the institutional weakness that had contributed to the consistent underperformance of the sector—policy development was separated from regulatory functions and service delivery. As part of “whole of government” decentralization reforms, the responsibility for infrastructure development and WSS services was transferred to local government and regional Water Services Boards (WSBs). Actual service delivery was delegated to financially and managerially autonomous (i.e., ring-fenced) commercial public utilities. The utilities would operate according to economic objectives (aimed at cost recovery) and social objectives in line with the pro-poor sector policy. Their activities would be overseen by the Water Services Regulatory Board (WASREB), an autonomous body established to license WSBs (asset holders and developers) and regulate utilities. The new policy and legal framework further provided for the development of the WSTF, an institution dedicated to promoting investment in low-cost technologies and building operational capacity within utilities to manage pro-poor WSS services. Since 2010 adequate water supply and sanitation have been a constitutional right of all Kenyan citizens.

Cooperation of Development Partners in Kenyan Water Reform

Kenyan water sector reform has been heavily supported by DPs. Prior to 2002, German Development Cooperation had been assisting the Ministry by providing technical experts on a short-term basis to revise water legislation. Having gained experience in the Zambian water sector, these experts brought important lessons into the law-making process. These included the separation of sector functions and the establishment of the pro-poor WSTF. In the wake of the Water Act of 2002, the Ministry requested that Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) deliver policy advice to major decision makers in the sector (such as directors and the permanent secretary of the Ministry) and support the organizational development of the WSTF, WASREB, and various water and sanitation utilities on a long-term basis.

6 Since the constitutional reform in 2010, counties have gradually taken over the responsibilities of local government and the transfer of assets to the counties is in process.
Since 2003, the GIZ Water Sector Reform Programme has been providing technical advisory services and small financial contributions (for example, for water kiosk pilot programs) to its partner institutions. Four seconded long-term international and ten long-term national experts work in key sector institutions. They provide hands-on support to staff, primarily through coaching and on-the-job training, to encourage sectoral, organizational, and individual change. The current (fourth) phase of the program runs until 2016. Apart from GIZ, the German Development Bank (KfW) provides financial assistance and accompanying consultancy services to infrastructure works including primary networks, treatment facilities, and sewerage treatment plants in Kenyan secondary towns and now increasingly to the satellite towns of Nairobi. KfW also made financial commitments to the WSTF.

The main DPs are the World Bank, the French Development Agency, African Development Bank, and German Development Cooperation, which have provided funds of approximately €180 million annually since 2008 (and plan to continue to do so until 2020) for the urban water sector (such as the cities of Mombasa and Nairobi). Technical assistance by other DPs is mostly limited to consultancy services for measures linked to infrastructure investments. The overall investments of DPs in the urban water and sanitation subsector channeled through the WSBs have risen from €4.5 million in 2005–06 to more than €82 million in 2013–14, illustrating the increasing confidence in the sector reform and scaling-up process. In 2013–14, 96 percent of the total investments in the urban water and sanitation sector were made through overseas development assistance.

**Water Reform in Zambia**

Another important contextual condition was the comprehensive reform of the Zambian water and sanitation sector, which was perceived by other governments—Kenya among them—as state of the art and inspired their own reform approaches.

WSS reform in Zambia was initiated by the National Water Policy of 1994, which led to a new Water Supply and Sanitation Act in 1997. Zambia proceeded to establish a financing basket for urban WSS, the Devolution Trust Fund (DTF), to assist utilities in extending services to the population in urban LIAs. The DTF successfully supported the implementation of standardized—but locally adapted—low-cost technology to match the needs of low-income customers; notably, the use of water kiosks was adjusted to local conditions and integrated into the formalized service provision. Besides financing physical investments, the DTF has been supporting the implementation of sustainable kiosk management systems.

The DTF carried out a baseline study in all settlements of the urban poor, which led to the downward revision of water coverage figures in urban settings from 89 percent (as reported by monitoring carried out in accordance with the United Nations Millennium Development Goals) to 47 percent. The baseline study provided evidence that about three million people living in low-income areas had no access to safe water or proper sanitation in 2005. After a preliminary phase of testing, a competitive call-for-proposals procedure, and new low-cost technologies (including water kiosks), the DTF embarked on a program to scale up financing to all utilities in Zambia. Between 2006 and 2013, the DTF was able to finance water kiosks that serve more than 900,000 people, at a total cost of €15 million. DTF also assisted utilities in extending on-site sanitation to more than 15,000 people (GTZ 2008; NWASCO 2005).

**Tracing the Implementation Process**

**Chronological Sequence of Actions Taken to Address Delivery Challenges**

This case study analyzes how Kenya reinvented its water and sanitation sector to extend services to the country’s urban LIAs. Figure 1 offers an overview of the ongoing scaling-up process.

**Implementing the Pro-Poor Delivery of Urban Water Supply and Sanitation**

Policy and legislation put a priority on pro-poor service delivery, but utilities did not have the requisite regulatory incentives, technical know-how, or financial resources to expand water services to urban LIAs. Pro-poor regulatory tools helped create a pro-poor orientation, and the WSTF provided a scaling-up mechanism.

**What Provided the Impetus for Kenyan Utilities to Acquire a Pro-Poor Orientation?**

A major bottleneck prior to 2002 had been the lack of clearly defined obligations, standards, and accountability
mechanisms for urban water utilities. In addition, utilities were free to define their own service areas, which in practice often limited them to the area reached by their own network. The result was that many underserved low-income areas, even ones in the middle of towns (such as Kibera in Nairobi), were excluded when coverage was calculated. Utility managers showed little interest in low-income areas and therefore never assigned clear internal responsibilities or developed adapted strategies for expanding water and sanitation infrastructure there. ISPs had become the default—and accepted—service delivery mechanism in LIAs.

Following on from the pro-poor commitment contained in the Policy for Water Resources Management and Water Supply and Sanitation and the 2002 Water Act, a Pro-poor Implementation Plan for Water and Sanitation (PPiP) was launched in 2007 to put policy into action. The PPiP was designed to help sector stakeholders understand the provisions of the 2007 National Water and Sanitation Strategy that required a higher level of WSS coverage. Both stipulated the formalization of service delivery in LIAs and socially responsible commercialization of water utilities. The latter would now need to realign their priorities and, under the supervision of the newly established regulator WASREB, begin considering the residents of urban LIAs as potential regular customers, albeit with special circumstances requiring a departure from business as usual.

**Implementing the Pro-Poor Approach to Water Supply**

German Development Cooperation facilitated study tours to Zambia to introduce leading Kenyan decision makers—notably WASREB officials and Ministry directors—to socially responsible commercialization and autonomous regulation. As Patrick Mwangi, a Senior Water and Sanitation Specialist at the World Bank, stated: “Sector regulation is only justified if it can contribute to overcome sector challenges. But sector regulation cannot do the job alone; it needs the fertile ground of service provision with the potential for increasing professionalism and autonomy among service providers.” The long-term presence of GIZ in other countries, especially Zambia and Burkina Faso, provided a critical entry point for identifying and connecting relevant decision makers and stakeholders. Later on, the Kenyans’ advice would be sought by their counterparts in South

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**Figure 1 Chronological Sequence and Levels of Scaling Up Water Reform in Kenya**

<table>
<thead>
<tr>
<th>Reform of sector framework and pro-poor orientation of water utilities</th>
<th>WSTF as a key actor to scale up last-mile access solutions</th>
<th>Baseline on WSS in urban low-income areas</th>
<th>Gradual development of absorptive capacity of utilities and expansion/monitoring of access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framework</td>
<td>Paradigm shift from household connections to low-cost technologies</td>
<td>Formalization of last-mile services utilities</td>
<td>Pilot experiences to national standards</td>
</tr>
<tr>
<td>Cooperation</td>
<td>Commitment of development partner funds for WSTF €25m</td>
<td>Joint risk management by advisors and development partners (WSTF)</td>
<td>Peer-to-peer learning between 70 utilities</td>
</tr>
<tr>
<td>Organization</td>
<td>Development of pro-poor regulation (WASREB)</td>
<td>Organizational development of WSTF (call for proposals)</td>
<td>Development of pro-poor units in utilities</td>
</tr>
<tr>
<td>Individual</td>
<td>Training and coaching of WSTF/utility staff to apply processes and products to plan, implement, and operate infrastructure in low-income areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outcome</td>
<td>200,000 people access to water</td>
<td>1 million people access to water</td>
<td>1.8 million people access to water</td>
</tr>
</tbody>
</table>

| 100,000 people access to public sanitation | 20,000 people access to on-site sanitation → target 600,000 (2016) |

**Note:** DP = Development Partner; WASREB = Water Services Regulatory Board; WSTF = Water Services Trust Fund.
Sudan and Uganda, reinforcing the conviction of Kenyan decision makers that they were pursuing the right path.

GIZ supported Engineer Ombogo and the reform unit at the Ministry that he headed in the preparation of presentations and policy papers concerning the implementation of reforms and their anticipated outcomes, which he presented to CEOs and directors of the Ministry, WASREB, WSTF, and WSBs. Increasingly, NGOs and utilities also participated in these discussions, and since 2006, strategic dialogues—coupled with the South-South-Exchange initiated and organized by GIZ—have become a regular discussion forum organized by the Ministry and facilitated by GIZ.

In contrast to many DPs, financing agencies, and NGOs, GIZ pursued no agenda other than that of sector reform and never attached any conditions to its assistance. Thus, Engineer Ombogo and other champions perceived GIZ as an “honest broker” throughout the implementation of the reforms. The strategic dialogues helped the Ministry, WASREB, and later the WSTF develop their commitment to reform.

As a result of their discourse, the key reform stakeholders believed that extending the mandate of the more than 100 urban water utilities to include low-income areas had significant advantages. Utilities would realize economies of scale, could be held accountable through regulation, and could develop their management structures and technical capacity in order to deliver high-quality and affordable services. Providing WSS through utilities would avoid many of the shortcomings of informal service provision. Starting in 2006, WASREB redrew the services areas of utilities to include low-income areas and to consider water tariff options that would suit service provision in LIAs. The first steps to orient water utilities toward the poor and to make them fit for their role in scaling up had been taken.

The legal obligation of utilities to supply service to low-income areas raised several difficult questions, considering their past track record: Which unit within the utilities should be responsible for managing service in LIAs? How could pro-poor last-mile infrastructure be funded? How could utilities develop the know-how to operate in LIAs? Who could deliver the required support for this? How could WASREB encourage utilities to extend service into the LIAs and establish reliable monitoring systems to follow their progress? There were no easy answers, let alone a ready-made plan to get started.

**Meeting the Challenge of Bridging the Urban Water Service Gap**

One of the key innovations in the Water Act had been a pro-poor basket-funding mechanism, the WSTF, which resembles the DTF in Zambia. The use of basket-funding arrangements was supported by the international discussions on improving ownership, alignment, and harmonization of the delivery of overseas development assistance in the wake of the Paris Declaration on Aid Effectiveness. Two objectives had to be reached. First, projects had to be anchored within existing sector institutions in order to ensure capacity building and commitment to the program for sustainable development rather than implemented outside the national framework. Second, the projects should be implemented nationwide with common standards and funds disbursed according to merit.

Participating in the South-South Knowledge Exchange with their Zambian colleagues and seeing the impact of the DTF convinced the Kenyan Ministry and Engineer Ombogo that the WSTF could play a key role in enabling utilities to construct and operate last-mile infrastructure and low-cost technologies on a large scale to bridge the urban service gap. To this end, an urban financing window called the Urban Projects Concept (UPC) was set up within the WSTF in 2006, specifically to fund small and medium-size investments in urban LIAs.

**Making the WSTF Attractive to Financing Agencies**

Because the Kenyan water sector relied heavily on overseas development assistance for infrastructure development, the government turned to the DPs for funding commitments. However, many DPs were skeptical whether the WSTF would make a difference and whether their funds would be efficiently spent. They feared the misuse and embezzlement of funds “given away” to a national institution. In addition, many DPs perceived the pro-poor focus of the WSTF as a constraint. In contrast to the traditional way of disbursing large sums for first-mile investments and contracting with consulting firms for implementation, the focus on

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7 For example, financing agencies frequently advocated highly contentious public-private partnerships, NGOs often favored informal or small-scale community service provision, though some simply tried to work around a system they had little influence over.

8 Other financing windows invest in water resources management and rural water supply and sanitation. In the remainder of this case study, UPC and WSTF are used interchangeably.
last-mile infrastructure would require numerous small and medium-size investments. WSTF investments would require greater management input from financing and implementing agencies (in this case, utilities) to steer the investment measures in low-income areas successfully, and high flexibility and longer time frames for disbursing funding. This proposed financing mechanism for LIAs ran counter to the philosophy of many DPs and their preference for disbursing large tranches of funding within a fixed and limited time frame.

Based on its previous experience with German Development Cooperation, the Ministry requested GIZ to support the organizational development of the WSTF. Anxious to make the WSTF more attractive for financing agencies and development banks, the Ministry was tempted to extend its mandate to include first-mile investments. GIZ insisted, however, on retaining the focus on last-mile investments to ensure that smaller pro-poor investments received priority and attention. In addition, the discussions with the CEO of the DTF in Zambia confirmed that the pro-poor mandate had been critical to the success of the DTF. In order to preserve the initial concept of the WSTF, its CEO prepared funding proposals for various financing agencies. Supported by GIZ, they approached the KfW and the EU (and, at a later stage, the Bill and Melinda Gates Foundation [BMGF]), which showed some interest in the WSTF approach. They explained the advantages of the WSTF for pro-poor financing compared with the way investments had been implemented in the past.

Many DPs remained doubtful about basket funding for last-mile infrastructure because of risks linked to corruption and the anticipated slow pace of implementation. The DPs recognized, however, that if funding were pooled in a large generic basket fund without a specific pro-poor focus, attention would sooner or later be diverted to large investment projects at the expense of last-mile projects. The WSTF board, with support from GIZ, submitted a funding proposal to the EU and succeeded. After verifying the program’s feasibility, German Development Cooperation through KfW also made a financial commitment. Having secured support for WSTF from these two important financing agencies, GIZ began the organizational development of the Trust Fund through a team of international and national experts, complemented by a KfW-funded financial consultant.

**Launching the Urban Financing Window**

As soon as the funding commitments from KfW and the EU were obtained, the board of trustees of WSTF was convened. The partners fully agreed on the need to “keep the organization lean and the number of staff limited” in order to keep the overhead costs low and maintain the confidence of the DPs in the efficiency of the WSTF. A panel supported by an independent consultant contracted by GIZ recruited permanent national management, technical, administrative, and financial staff for WSTF on a merit basis. To this day, the urban financing window of WSTF employs only six staff members. The institutional setup of the urban financing window of WSTF, including its interlinkages to DPs, GIZ, and the utilities, is depicted in figure 2.

As a next step, the WSTF proposed pilot programs to test low-cost technologies. Installation of water kiosks and yard taps, which in Zambia and Burkina Faso had proven to be effective in reaching the urban poor, would provide the necessary first-hand evidence and experience on improving the delivery of safe drinking water to poor urban citizens in Kenya.

**Tackling the Growing Demand for Drinking Water: Piloting of Water Kiosks at Scale**

**Prior Experience with Water Kiosks in Kenya**

Prior to the reform, water kiosks had a negative connotation in Kenya. Before their visits to Burkina Faso and Zambia, even key champions of the reform, such as board members of the WASREB and directors at the Ministry like Mr. Gakubia and Mr. Ombogo, were not certain that water kiosks would be an appropriate technology and business model to supply drinking water in LIAs. Existing water kiosks in low-income areas in Kenya were poorly managed by informal service providers, mostly small-scale NGOs or private operators. Frequently, they were “hijacked” by local gangs or cartels, exploiting customers through exorbitant prices. The kiosks were generally unhygienic and not well maintained. There was no quality standard for the drinking water sold. Water kiosks were widely associated with informal service delivery, which was what the new policy and the WSTF were designed to overcome.

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9 Overall, the WSTF employs 55 staff members, including those in its rural and water resources financing windows.
Lingering doubts about the kiosk model—and shared facilities in general—were summed up by the chairman of the board of WASREB in 2006: “It is evident that water kiosks don’t work in Kenya.” The Ministry, WASREB, utilities, and WSTF wanted to see evidence and tangible examples of the contrary.

**How Was the Water Kiosk Pilot Program Implemented?**

In order to demonstrate the feasibility of the kiosk concept, the WSTF and GIZ team randomly selected three medium-size utilities for pilot testing. With GIZ financing, the utilities would test the construction materials, technical designs, management model, and social marketing tools—based on the kiosk models in Burkina Faso and Zambia—necessary to make a water kiosk work.

As a first step, the GIZ and WSTF team reviewed the kiosk system with utility management. Together they chose several pilot low-income areas for each utility, where one or two kiosks would be constructed and a kiosk operator would be recruited. Construction was tendered to local craftsmen, and GIZ, WSTF, and the utilities jointly monitored the construction and operation of the kiosks and how customers perceived them. The utility managers appointed dedicated staff to work on the pilot and to ensure the operation and maintenance of the kiosks.
Results of the Water Kiosk Pilot Program
In 2008, GIZ commissioned a survey of 400 users in the pilot low-income areas on the impact of the WSTF water kiosks (WSTF 2010). The results, which were presented by the utilities in a forum attended by many water utility representatives, were overwhelmingly positive: In Rongai, for instance, where a large majority of respondents had previously relied on untreated surface water sources, about 88 percent of the target group had shifted to the new water kiosks operated by the utility.10 The respondents reported much better water quality, shorter waiting times, improved hygiene at home, and significantly reduced expenditures on drinking water.

All this had been achieved with an investment of about €12 per beneficiary. Demonstrated feasibility, high cost-effectiveness, and popular acceptance finally convinced Ministry officials, utility staff, and the directors of the WSTF and WASREB that shared facilities and low-cost technologies—such as the water kiosk—can and should play critical role in the process of scaling up WSS delivery in Kenya. With key sector champions on board, the WSTF management took up the kiosk as a standard product to be provided by all water utilities.

Making the Sector Fit for Scaling Up: Development of the WSTF into a Key Agent for Rolling Out the Water Kiosk System
It was not clear however, how WSTF could ensure consistent quality if the kiosk systems were constructed and operated by a multitude of utilities, contractors, and craftsmen across the country. WSTF had neither the required standards and tools of the kiosk system nor the technical capability to roll out the system on such a large scale even if they did. Most of the team members realized that the process of scaling up would be long and difficult. Patrick Onyango, a senior GIZ expert from Kenya, stated: “Although the idea of up-scaling should be part of every pilot measure there is still a long way to move from piloting to a fully-fledged and successful up-scaling program; to make it work we need implementing instruments guiding all actors involved in planning, constructing, and operating toilets and water kiosks in the poor urban areas.”

To implement low-cost technologies consistently and efficiently on a countrywide scale and prevent the embezzlement of funds allocated for last-mile investments, WSTF developed ‘standardized products’ (e.g., water kiosks, yard taps, and public toilets), process standards, and a robust risk management system for the scaling-up process.

Development of the Toolkit for Urban Water Supply
From the pilot it became clear that the utilities needed extensive support in all areas of design, construction, and operation of low-cost infrastructure. Ideally, they would have access to all available documentation, including planning spreadsheets and technical drawings, to help them plan, construct, operate, and monitor a water kiosk system.

The first Kenyan “toolkit for urban water supply” was a detailed summary of all the experience gained from the pilot studies and served as the basis for national standards and uniform implementation. There are now toolkits for urban public and household sanitation, and toolkits for last-mile access continue to be updated and refined as scaling up progresses. Every toolkit offers comprehensive support—from selecting appropriate technology mixes, through sustainable, community-oriented business and management models, to the social marketing mechanisms that will secure participation by the intended users.11

During the water kiosk pilot program the WSTF technical team and the embedded GIZ advisors worked closely assembling the knowledge that produced the toolkits, and ensured the flow of information to WSTF management, the Ministry, and WASREB. A sound balance between desk work and work on site enabled WSTF technical staff to enhance their understanding of their tasks. Gradually they became able to take over the process of developing and further refining access solutions.

10 A second survey carried out in 2010 provided further evidence that the population largely accepted the new water kiosks introduced by utilities.

11 Toolkits support Trust Fund and utility staff, local consultants, community members, and facility operators. Standard designs are complemented by detailed implementation guidance. Toolkits focus on appropriate mixes of low-cost technologies and shared facilities, addressing the specific requirements of low-income areas. They introduce business and management models for last-mile infrastructure, which make it financially attractive for a utility to sustainably operate the infrastructure and enhance the utility’s commitment and experience as well as the involvement of the local community. Finally, they contain social marketing concepts, which enable participatory planning, secure hygienic use of infrastructure, and promote acceptance in the community. The toolkit for public sanitation projects under the WSTF is available at the Sustainable Sanitation Alliance website, www.susana.org/en/resources/library/details/1273.
This led to strong ownership and awareness within the WSTF of the complex conditions in low-income areas and how water utilities function. The continuous interaction of utility and Trust Fund staff (in regular meetings and site visits) was key for the sound application of the toolkits in the scaling-up process. Both WSTF and utility staff learned lessons in this process, and the portfolio of standard products of the Trust Fund expanded over the years to respond to the dynamic demand from low-income citizens.

The First Call for Proposals to Invest in the Program
Once the toolkit for water kiosks was complete and ready for application, WSTF issued the first public call for proposals in 2009. All utilities—with the participation of the target groups in the low-income areas—were invited to submit proposals for last-mile investment funding. Eligible applications would be chosen based on a careful assessment against previously published technical, financial, and social quality standards. The team braced themselves for a muted reception, fearing that the competitive selection process would fail for lack of interest in the comparatively small investments on offer.

The technical manager of the WSTF’s urban financing window breathed a sigh of relief when he received one investment proposal after another from water utilities across the country. By the deadline, 20 utilities had submitted proposals. Two important points had been proven: the concept was attractive to utilities, and they appreciated the importance of low-cost technologies. This was a very promising sign, but it was not to be taken for granted. WSTF upheld its motto that “quality mattered more than quantity.” Accordingly, 10 of the proposals were referred back to the utilities for revision and deferred to the next call round.

The investment proposals of the remaining 10 utilities were enough to begin the scaling-up process. In the following months, 62 water kiosks and 92 yard taps were constructed across the country. After completion, kiosk operators were recruited and trained by the WSTF and utilities, and kiosks were integrated into daily utility operations. In order to ensure that the planning, construction, and operation of the water kiosks met the WSTF guidelines and toolkit provisions, the WSTF technical team—supported by field monitors (local consultants employed by WSTF)—carefully observed and reported on technical, social, and financial performance of the newly built last-mile infrastructure.

Monitoring was designed to mitigate corruption risks and to ensure that kiosks would not be taken over by informal service providers.

The outcome of this first call round was very encouraging, both for the WSTF and for its financing partners: 160,000 people received access to safe drinking water supply.12 Confidence in the WSTF was growing. An important lesson, which would be confirmed in the following rounds of calls for proposals, was that medium-size utilities would be important players in the scaling-up process. Even though they had not been “spoiled” by DPs with larger grants and loans, they had sufficient capacity to prepare sound investment proposals and manage the kiosk systems in a professional manner.

What Made the Funding Partners of WSTF Confident That Their Money Was Well Spent?
The efficiency of WSTF operations and the prevention of fund embezzlement were supported by strong formal provisions, which were defined in the act and statutes of WSTF—an indication of the high corruption risks typically associated with infrastructure investments at that time. The Trust Fund had been designed as an autonomous sector institution with a board of directors making decisions, staff hired in the open labor market, and a mandate to attain a high level of self-financing. Autonomy was important to board decision making, management decisions, human resources, and financial management. WSTF needed protection from political interference from the Ministry and separation from the financial management of the WSBs that were responsible for first-mile, large-scale investments and where anecdotal evidence of corruption was strong. Contrary to standard practice in other Kenyan public sector institutions, WSTF’s human resources management allowed nonpermanent employment contracts, setting an incentive for staff performance and promoting integrity. This was supported by internal and external auditing provisions.

Further assurance was provided by the procedure for the competitive call for proposals, which guaranteed an efficient and needs-oriented allocation of funding. It was one of the first to be developed by WSTF with GIZ support—a lesson from Zambia. The WSTF also

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12 Kiosks are designed to comfortably serve relatively large numbers of users. According to the pilot experience, an average of 300–500 people per day can be served per water tap at a water kiosk. The kiosk is generally equipped with three taps and on average covers an area of one to two square kilometers depending on the density of the settlement. Each yard tap serves 20–30 people.
developed its own simple but comprehensive information system to ensure transparency and the objectivity of its investment decisions. The UPC Information System provides up-to-date data on the level of compliance of utilities during implementation of past projects to help determine future eligibility. Data are constantly fed into the system. By 2014, the WSTF team, backed by about 20 field monitors, was checking progress and compliance during construction on a quarterly basis, following up with annual checks on operations. Information on eligible and compliant utilities receiving WSTF funding was forwarded to the DPs.

Maintaining the Professionalism of WSTF
Even though the WSTF was established against a backdrop of decentralization reforms, it was subject to pressure for politically motivated funding allocations. As a GIZ advisor remembers, the conduct and decisions taken by some board members were not always professional. There were some attempts to interfere with WSTF management for personal or political interests, such as by influencing recruitment decisions in favor of relatives or based on tribal background. Board members tried to politically exploit funding decisions by manipulating lists of approved investment measures. In one case, a board member seeking political office argued in favor of certain investments in order to secure votes during the upcoming regional election, completely ignoring the Trust Fund’s quality- and equity-related funding conditions. Although these were typical risks associated with processes of resource allocation, they put the reputation of WSTF as a professional institution at stake, endangering the trust and confidence of financing partners, government, and the public.

When the first list with manipulated investment proposals arrived on the desk of a DP in 2010, the integrated GIZ advisors, who also take part in the meetings of the board’s investment committee, acted decisively to save the credibility of the WSTF. They supported the coalition of honest board and staff members in providing information on the manipulated proposals to the DPs, which was critical to avoid the WSTF’s drifting off course. The EU and KfW duly rejected the list and demanded strict compliance with the published technical and financial criteria for investment approval. Honest board and staff members, with their objections validated, submitted a clean list of proposals to the DPs, which was then approved.

The integrated GIZ advisors were integral to backing employees and coalitions within WSTF who had a shared vision of developing WSTF into a professional organization. They helped to retain motivated staff and to monitor the calls for proposals, evaluation of proposals, and subsequent decision making and implementation. The close coordination between GIZ and the DPs has proven to be important; when other means of mediation or facilitation seemed futile, the funding commitments from DPs functioned as a carrot and stick for stakeholders.

Figure 3 provides an overview of some of the key processes that led to sound organizational performance of the urban financing window of WSTF. Support for the development of process standards and the organizational structures and systems became effective because of additional, complementary situational actions. The situational actions resulted from the day-to-day interaction between the long-term technical advisors and staff and decision makers of WSTF, and helped to mitigate risks and bottlenecks for the delivery capacity of WSTF to handle last-mile infrastructure investments.

Approaching Scale: More Utilities Learn to Deliver Services in Low-Income Areas with Low-Cost Technologies

Subsequent Calls for Proposals
Since 2009, six calls for proposals have been issued. Fifty utilities submitted investment proposals in 2013. More than 250 investment measures, generally consisting of water kiosks, public toilets, and additional small to medium-size investments to connect an area to a larger network were successfully implemented. According to the monitoring operations described above, about 80 percent of the infrastructure was still in good operational order several years after completion of the original investment. The close technical support to the utilities provided by the WSTF technical team and field monitors created “learning loops” within the utilities: the quality of proposals improved and the technical know-how of utilities on planning, construction, and managing the water kiosks and other outlets was expanded. After each round of calls, WSTF organized workshops for utilities to exchange their experiences, and toolkits were updated.

13 County governments naturally favored equal allocation of funds to all regions. This approach would, however, entail the risk of financing projects that would be at high risk of failure or corruption.
An important lesson learned from the process was that utilities needed to develop full ownership of their last-mile infrastructures and water kiosk systems. The example of the Nairobi Water Company illustrates that commitment from utility top management is not sufficient. In this case, the manager responsible for low-income areas did not support the expansion of services to Mathare (Anna and Ruth’s home settlement). As a result, the water kiosks were not managed with the required supervision and control and were either not open or received no water.

To set an incentive for the utilities to carefully plan any investment in water kiosks and to ensure the kiosks’ professional management, WSTF created a blacklist of utilities that repeatedly disregarded the Trust Fund’s standards and procedures. WASREB has been supportive of WSTF’s efforts to help utilities extend service provision to LIAs and to expose especially the large utilities that are still hesitant to serve the poor. Building toilets and employing informal service providers to remove the sludge was strictly regarded as a household responsibility.14

Water and sanitation subsector professionals are better able to provide the support poor households need to construct and maintain toilets according to national minimum standards, especially when the support is linked to subsidies. With additional financial assistance from the BMGF, which provided another US$7 million into WSTF for infrastructure development, the Trust Fund was able to offer a choice of on-plot sanitation or household toilets under the Up-Scaling Basic Sanitation to the Urban Poor (UBSUP) program.15 The BMGF managers were convinced by the performance of WSTF and in 2012, BMGF funds were used to pilot the implementation of decentralized wastewater treatment

14 Of course, this is absurd; the poor who struggle to pay for their daily water cannot afford toilets, let alone sludge removal, or there would be no such thing as flying toilets.

15 UBSUP was also financed by KfW, which provided US$10 million. BMGF also provided US$3 million to GIZ for technical assistance to help the WSTF to develop UBSUP.
facilities, collection systems, and shared on-plot toilets with three utilities.

The toilets were financed and constructed by landlords or householders, who would receive a fixed subsidy from the Trust Fund upon completion of the facility in the form of a cash transfer. At the end of this pilot program, the WSTF and GIZ team were caught by surprise: Instead of the 600 planned toilets, 2,000 had been constructed. Most households complied with the prescribed technical standards. These first results proved that households and landlords in particular were willing to pay for adequate sanitation services and accept part of the financial responsibility. Small entrepreneurs, who operated informally before, could be transformed into local sanitation entrepreneurs, collecting and transporting faecal sludge from the households. The pilot programs also raised awareness for the need to invest in sanitation and enhanced the policy dialogue between the ministries responsible for health and water.

Following this success, WSTF is now planning to support utilities in developing viable and functioning systems for wastewater and solid waste collection and decentralized wastewater treatment facilities, especially in areas where there is no sewerage network. About a third of the country’s water utilities submitted funding applications for on-site sanitation, and out of these applications about 20 utilities were accepted for funding. Successfully implementing the decentralized sanitation infrastructure will be the greatest challenge for the WSTF in the coming years.

**Monitoring Service Coverage Improvements in Low-Income Areas**

While the scaling-up process was gathering momentum, GIZ advisors became increasingly concerned about the fragmented information available in the sector. Until 2011, sector reports on service coverage in low-income areas relied on paper-based estimates or very broad and insufficient water-related census data. Before the creation of WSTF, none of the national institutions in the sector showed much interest in the coverage in LIAs. Meanwhile, WSTF had adopted a practice of aggregating the investment-specific information for the various utilities between the calls for proposals, which did not provide the necessary level of insight.

WSTF staff and GIZ advisors recognized that a professional assessment of the services in low-income areas was overdue. Without updated and comprehensive data, it would be difficult to ensure that further funds would be effectively used and to persuade decision makers to continue their support for scaling up. There was a real risk that interest in scaling up would be lost. Furthermore, without a reliable baseline, it would be impossible to convincingly track progress made in the sector. The WSTF needed a system of documenting progress in low-income areas measured against the situation at the outset of the programs and also against the rapid growth of demand due to urbanization.16

Another indication of the need for an improved database was the seemingly endless discussion about the number of dwellers in Nairobi’s Kibera slum before 2007, which a number of publications labelled as the “biggest slum in Africa.” Rapid assessments carried out by WSTF staff and GIZ advisors never estimated its population at above 200,000, far from the “over 1 million poor” claimed elsewhere. A departure from old attitudes was backed by the new sector legislation and statutes, which contained accountability provisions that forced the sector institutions, including the Ministry, WASREB, WSTF, and utilities, to record more extensive performance data and reporting the data to the public. Much of the work of the new sector institutions would hinge on the quality of available data. With motivated staff and IT-based systems, they were well placed to address the information gap. In the case of WSTF, the information demanded by BMGF, KfW, and the EU provided another impetus to create a reliable and credible database. GIZ advisors encouraged WASREB and WSTF to publish the new data and spark discussions in the sector and among the wider public on how to extend services to the urban poor.

Based on the notion that sound data are critical for choosing technology and investments, and with the consent of national decision makers, technical advisors of the German Development Cooperation and other partners initiated a baseline study covering all urban LIAs in Kenya in 2011. For the first time, it was revealed that about eight million people live in more than 2,000 low-income urban areas in Kenya. Demonstration meetings promoted by GIZ helped stakeholders understand

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16 Sector reform, including scaling up through the WSTF has helped to reverse a negative trend toward an increasing number of underserved in urban areas, but it is still far from eliminating the backlog of the millions of underserved accumulated over the last decades.
the critical importance of information to improving services, as it would inform decisions on investments and technology by taking into account the demand and needs of the target population.

The baseline data was later transferred to a permanent, updatable database (MajiData). MajiData did not account for the funds received by the DPs, however, and the WSTF developed UPC-IS, which supports financial management and the collection of data on implementation progress and the operation of infrastructure. UPC-IS reports submitted to the DPs contain, for example, cost-beneficiary ratios. Now both MajiData and UPC-IS are increasingly used as important, nationally embedded tools by WSTF, the Ministry, WASREB, and utilities to manage the scaling-up process and report to the public on progress. Together with the WASREB’s Water Resource Information System, they have contributed to increased transparency and accountability in the sector, one of the significant achievements of the water sector reform.

<table>
<thead>
<tr>
<th>Category</th>
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<td>Year operation started</td>
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<tr>
<td>Number of staff</td>
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<tr>
<td>Commitments from development partners and donors</td>
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<td>Operational efficiency (disbursements/overhead cost)</td>
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<td>Number of calls for proposals</td>
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<tr>
<td>Water supply</td>
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<tr>
<td>Sanitation</td>
<td>5</td>
</tr>
<tr>
<td>Access</td>
<td></td>
</tr>
<tr>
<td>Number of residents with access to safe drinking water supply</td>
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<td>Water supply</td>
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<td>Number of water kiosks</td>
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<td>Number of yard taps</td>
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<td>Sanitation</td>
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<tr>
<td>Number of household toilets (UDDTs, flush, VIP latrines)</td>
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<tr>
<td>Number of public sanitation facilities</td>
<td>56</td>
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<tr>
<td>Length of sewerage network</td>
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Source: Data extracted from UPC-Information System, WSTF, December 12, 2014.
Note: UDDT = urine-diverting dry toilet; VIP = ventilated improved pit.

Evidence of Development Outcome for Citizens

The scaling-up approach has achieved significant improvements for large numbers of Kenyans. About a fifth of the urban low-income population have been reached with last-mile investments funded through the WSTF. Nearly 1.8 million residents have gained first-time access to safe and affordable water services through water kiosks and yard taps since 2008. Scaled-up sanitation is accelerating, with about 120,000 people served since 2009, and that number is set to rise to 429,000 by the end of 2016.

The institutional performance and outcomes of the urban financing window of the WSTF are summarized in table 1 and figures 4 and 5. The Trust Fund has proven to be an effective and efficient financing mechanism to increase access for the poor to formalized service provision with limited funds. The average cost for last-mile infrastructure for water supply stands at €12 per beneficiary, and comparable costs for sanitation have fallen to €24 per beneficiary—both representing good value for money. Moving the poor from informal to formal service provision constitutes the biggest jump of improvement in the ladder of service levels.

Scaling up has touched many aspects of consumers’ lives: households save substantial amounts of their income, incidences of waterborne disease have declined, hygiene is improving, and the burden of fetching water, usually the task of women and children, is significantly reduced.

GIZ commissioned household surveys to capture the beneficiaries’ perceptions of changes in their living conditions once formalized water kiosks were provided by utilities. Acceptance is very high: Almost all respondents of a Greater Nairobi survey were reportedly using WSTF-funded water kiosks by 2010. The 2013 WSTF survey in

17 Unlike many other access statistics, these figures have been verified through specially developed information systems embedded in to the standard processes of UPC and take into account the agreed minimum service criteria.
18 This takes into account the total cost of technical assistance, capital for the last-mile investment, and operation of the financing mechanism (that is, Trust Fund overhead), but excludes investments in large-scale, first-mile infrastructure.
19 This includes subsidies of approximately €16 per toilet built, construction of decentralized treatment facilities, the costs of technical cooperation, and all other project-related costs. It does not include the financial contribution of the households for the construction of the toilets.
20 Evidence can be found in the results of various surveys carried out in the target areas. Quotes in this chapter are drawn from various reports (WSTF 2010; Ojwang et al. 2014; GIZ 2014).
the towns of Lodwar, Malindi, and Nakuru concluded that 80 percent of the interviewees were satisfied with the service coverage in their area, and 82 percent rated the reliability of drinking water service provision as “good” or “fair” (WSTF 2013).

**Direct Savings**
All kiosks sell water at regulated prices, with customers across the country able to buy water at a fixed price of K Sh 2 (€0.02) per 20 liters. Others, like John Ochieng Ngutu from Rhonda, a low-income area of Nakuru, have had their plots connected to the utility water system for only €25, and are saving approximately K Sh 2,500 (€25) on their monthly water bills over informal service provision. Before, “getting a water connection was a nightmare with costs of K Sh 115,000 (€1,100) to be paid to the council,” Ochieng Ngutu recounts.

**Improved Water Quality**
Surveys generally report high confidence in kiosk water quality. In Rongai and Athi (settlements in Greater Nairobi just south of the capital), for instance, the share of households treating water before use had dropped from 71 percent to 38 percent and from 64 percent to 38 percent, respectively, by 2010. Residents from Nakuru concurred, commenting that they no longer needed to buy water purification tablets.

**Improved Hygiene and Reduced Waterborne Disease**
Households appreciate being able to keep clean and healthier, with a reduced incidence of waterborne disease confirmed by health professionals. Jane Otieno, a public health officer in Rhonda, Nakuru, notes fewer outbreaks of typhoid, for example, freeing money patients would previously have spent on medication. She is pleased to report that, “In addition, our dispensaries have received a much better water supply, which greatly improved hygiene in our stations.”

**Shorter Waits and Travel Distances**
The task of rising early, walking long distances, and waiting at water points would generally have fallen to the women and children of a household. Much like Anna in Mathare, the vast majority of kiosk users now report that distance and time spent was reduced (for example, by more than 90 percent in Athi and Rongai) after the introduction of WSTF kiosks. “I always felt that I supported child labor when being obliged to let my children fetch water,” admits one father from Rhonda, who is now happy that he can

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21 Kiosk users can now buy about two cubic meters of water for the same price that household customers in more affluent parts of the city are charged for the lowest consumption block (six cubic meters), a vast improvement in overall fairness.
send them to school instead. Seen through the eyes of a girl from Mathare, life has become happier: “Water kiosks have made it easy for me . . . . I am not late for school [and] now I have more time to play and do my homework.”

**Better Security**

For many families, security is a major concern. Ochieng Ngutu is relieved he no longer needs to fear his daughters will come home pregnant from traveling long distances to fetch water. In Athi River and Rongai, where water kiosks were deliberately installed in central and open locations, more than 80 percent of survey respondents now perceive an improvement of security. The controlled management of kiosks and public toilets strongly discourages harassment, which particularly benefits women.

**Income Opportunities**

In addition to the direct and indirect savings enjoyed by households with access to safe and affordable water, kiosks have helped create further opportunities. Stephen Mbugua, a kiosk operator from Mathare, explains that he makes money by selling a few household essentials in addition to water. Women, who run an equal share of the water points, public sanitation facilities, and public toilets, appreciate the regular income they earn as operators and from the small businesses they can run alongside.

Although no formal surveys of sanitation improvements have been carried out so far, anecdotal evidence suggests these are equally valuable to and valued by residents of low-income areas.

**Lessons Learned**

The following section details the most important lessons drawn from the case study.

*How was the emphasis in the Kenyan water sector shifted from an almost exclusive focus on household connections and toward technology mixes that included low-cost options?*

Despite internal political pressure to expand services to urban low-income areas, in an environment with a high rate of urbanization, universal access to water and sanitation through conventional household connections alone would remain out of reach in the medium term. Existing lower-cost alternatives would need to be explored. Inspired by the scaling-up approach taken in Burkina Faso and Zambia, Kenya enacted a formal pro-poor sector framework.

Director Ombogo of the Ministry and the CEOs of WASREB and WSTF became champions of the pro-poor reform. A South-South Knowledge Exchange was coupled with national strategic dialogues in which stakeholders developed a deeper understanding of the importance of low-cost technologies to reach the last mile. The pro-poor policy framework enabled the WSTF, with support from German Development Cooperation, to pilot water kiosks that were professionally managed by utilities. The feasibility, acceptance, and sustainability of low-cost technologies to scale up services could finally be proven in the Kenyan context. The outcomes, together with the equally successful trials of low-cost sanitation options that followed, convinced decision makers and utilities that a new way forward had been found.

In the course of the reform, some DPs also realized that the focus on household connections as well as their own standard implementation models for investment prevented the scaling up of water and sanitation infrastructure in urban low-income areas. The combination of the WSTF’s autonomy and the presence of GIZ advisors as informal risk managers created confidence that WSTF was developing into a credible funding mechanism for last-mile infrastructure.

*How did Kenyan institutions learn from the application of low-cost technologies and apply that knowledge to technical, social, and managerial issues?*

WSTF used the lessons it learned from the successful water kiosk pilot programs to create a “toolkit for urban water supply.” The initial intention was to share the tested technical designs and proven approaches for kiosk management and provide simple, hands-on guidance for the implementing utilities. The toolkits also ensured uniform implementation of low-cost technologies across the country. From the outset, pilot projects were undertaken with a view toward transforming tried and tested programs into national standards.

The various tools have been—and continue to be—updated based on the experience of the 70 utilities currently implementing investments funded through WSTF. Likewise, the WSTF’s product portfolio was

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22 Toolkits now exist for urban water supply, urban public sanitation, and urban household and on-site sanitation.
expanded following steps similar to those used for
the water kiosk. Pilot projects were initiated for yard
taps, public toilets, and household toilets, and those
experiences (such as what material to use or how to
convince households to invest in sanitation) were
assembled into new toolkits, which were rolled out
through the calls for proposals.

The frequent field visits of WSTF staff and close
collaboration with the utilities were important to
developing a common understanding of how low-cost
infrastructure can be successfully operated and integrated
into utility operations. Scaling up places high demands
on utilities and WSTF staff, who need to keep learning
and adjusting the use of specific tools (such as guidelines,
posters, checklists, and reports) as well as the overall
monitoring and operation of low-cost infrastructure.

Regular feedback workshops with the utilities have been
critical in this regard.

Although the scaling-up concept and specific tools have
reached a mature stage, covering all technical, social, and
managerial aspects of last-mile service delivery, there will
always be room for improvement.

How did the Kenyan government and water utilities
technically and financially roll out and sustainably
operate low-cost technologies on a countrywide scale?

The major innovation in Kenya which made scaling up
possible was the WSTF, an explicitly pro-poor financing
mechanism. The combination of competitive funding
allocation of last-mile investments and strong technical
support and standards for low-cost infrastructure such
as water kiosks, secured the support of some DPs.
Recognizing this approach as a beneficial addition to the
conventional, large-scale project approach, they diverted
some of their funds to WSTF.

The Trust Fund has been instrumental in channeling
investment funding (about €23.8 million to date) to those
utilities showing promise and commitment to serving
all their customers. The competitive funding procedure
proved to be a good incentive for utilities to submit
sound investment proposals, execute funding in a timely
manner, and ensure the construction of infrastructure in
compliance with the new national standards.

But WSTF is far more than just a financial intermediary.
It functions both as a risk manager for the DPs and as an
agent to build the capacity within utilities to serve low-
income areas. Beginning with the first pilot projects,
WSTF has been facilitating continuous institutional
learning and knowledge transfer. Support offered by
WSTF (through the comprehensive toolkits), as well as
the follow-up (through strict monitoring), has been
critical in ensuring financially and technically sustainable
construction and operations.

How did the technical and financial assistance work
together to support the service shift and the scaling-up
process in Kenya?

With a team of long-term advisors, WSTF could develop
into a professional and trusted organization and set about
realizing the joint vision of “helping to provide water and
sanitation services to all urban low-income areas.” The
strong influence of the integrated GIZ technical experts
was not limited to strengthening the WSTF’s internal
processes (such as the call for proposals procedure),
systems for monitoring, and human capacities. Advisors
also helped foster positive relationships with key external
stakeholders.

The close collaboration between the financial and technical
assistance—as provided by GIZ and the Trust Fund’s
financing partners in Kenya—was critical to combining
the funding of last-mile investments with the concept and
capacity development activities that are necessary to scale
up services. Furthermore, close coordination between
the financial and technical sectors was key to managing
political, fiduciary, and operational investment risks.

Technical advisors understood the internal functioning of
WSTF and noticed the interference in the decision-making
process. Honest WSTF board members and staff formed
an informal coalition with their GIZ advisors, which made
it possible to avoid embezzlement of funds in the allocation
of investments and enhance the confidence of DPs and the
government in the Trust Fund.

Future Questions to Be Addressed

Even as the scaling-up process is in full swing, it is
hampered by unresolved challenges and some
misperceptions that are remarkably persistent. There are
a number of issues that need to be addressed to extend
and consolidate the successful effort to date:

• The underestimation of consumers’ ability to pay
  for services in low-income areas is still widespread,
  despite evidence to the contrary.
• Baseline information is critical to the scaling-up
  process and to guiding the prioritization of last-mile
  investments. Experience has shown, however, that the
  continuous updating of data is difficult to achieve.
• The Kenyan sector framework does not yet provide for the clustering (systematic merging of utilities in one region or area, where efficiency and cost recovery of service provision can be substantially enhanced through economies of scale) of the more than 100 participating utilities, which is a prerequisite for the urgently needed economies of scale. Although decision makers acknowledge that the size of a utility matters for its effective operation, clustering efforts have encountered resistance from some stakeholders, such as board members of utilities with vested interests.

• There are ongoing difficulties with informal service providers. Although no longer legally recognized, ISPs have not been fully integrated into formal utility systems or replaced.

• Despite its success in expanding coverage in urban areas, WSTF remains unattractive to DPs and domestic funders. The growing financing gap cannot be bridged by solely relying on funds from DPs. Local revenue and resources have to be channeled into the WSTF to make it sustainable in the long term. The new draft water act currently foresees a surcharge to water bills as a possible source of financing for WSTF.

• WSTF must secure organizational performance and governance once the embedded advisors withdraw. The formal safeguards coupled with the integrity of the CEO and managers are key in this regard and show promising trends.

How the Case Study Informs Science of Delivery

The emerging framework of the science of delivery identifies five elements that are important factors for meeting delivery challenges in the development context.

Relentless Focus on Citizen Outcomes

• The MajiData database and the UPC-IS targeted investments toward urban poor residents; they supported the matching of technology choice with the preferences and socioeconomic circumstances of poor citizens.

• The expansion of utility WSS services has proven that households accept low-cost technologies, are willing and able to pay for safe drinking water services, and will invest in household sanitation.

• One of WSTF’s key criteria used for the prioritization of investments is the number of beneficiaries reached. The robust monitoring of each investment measure over a minimum of five years ensures that completed infrastructure will be operational and used.

• The WSTF implementation support and toolkits for utilities address the social aspects of infrastructure extension to secure user acceptance and participation and promote positive health outcomes.

Multidimensional Response

• National institutions (the Ministry, WSTF, and WASREB), 70 water and sanitation utilities, local communities, and external partners (GIZ, KfW, EU, and BMGF) collaborated in the scaling-up process. Contracted by the utilities, the local private sector and communities are involved in the construction and operation of water kiosks and public sanitation facilities.

• Backed by high-level political commitment, the partnership between WSTF and embedded GIZ technical advisors was critical to convince DPs to make financial contributions to WSTF.

• Key national decision makers were involved through the South-South Knowledge Exchange in preparing to change from an exclusive focus on conventional household-level access to a mix of technologies, including low-cost options. A wide range of stakeholders was engaged and won over through dialogues led by the head of the Ministry’s reform unit and the successful pilots of low-cost technologies funded by GIZ.

Leadership for Change

• GIZ technical advisors and the decision makers of key institutions have been working to improve organizational policies, processes, and systems. As an outcome of this cooperation process, proponents of the scaling-up process developed a shared vision of their organizations as professional entities committed to the delivery of pro-poor services. This cooperation was often more important than mere technical advice.

• Learning events, including field visits, workshops, and utility peer-to-peer learning, promote the wide sharing of experience with the implementation of WSTF-funded investment measures.

Evidence to Achieve Results

• The South-South Knowledge Exchange and the sharing of evidence by Zambia and Burkina Faso were key to learning from practices elsewhere. Seeing
evidence that water kiosks could be an access solution that is accepted by low-income customers was critical for Kenyan policy makers.

- The visible impact of the DTF in Zambia strengthened the belief of the CEOs of WASREB and WSTF in a pro-poor financing mechanism. It helped foster a vision of how to scale up access to water and sanitation services in Kenya.

- The experiences of piloting low-cost infrastructure for the poor were incorporated into toolkits that were repeatedly updated. The pilot programs enabled the creation of countrywide standards applicable to all investment measures. Technical designs, business models, and social marketing tools are developed and updated by the WSTF technical staff based on knowledge acquired during implementation and frequent field visits.

- Robust monitoring of implementation of investment measures by WSTF (including field visits for verification of progress) and monitoring of operation of infrastructure over five to eight years secure a strong focus on evidence and outcomes during the scaling-up process.

Adaptive Implementation

- The call-for-proposals procedure allows for the flexible disbursement of funding from WSTF to water utilities according to their absorption capacity. The amount of last-mile investment funding during each round of calls is determined by the quality of project proposals of the utilities rather than ex ante defined “disbursement plans” or tight project timelines. Funds which are not used during one round of calls can still be disbursed during the following ones. The experience of WSTF has shown that utilities learn how to plan, implement, and operate last-mile infrastructure gradually (i.e., their absorption capacity increases over time).

- GIZ support is oriented toward the needs of the partner institution, in this case, WSTF. Long-term GIZ technical advisors adapt to the increasing levels of professional capacity of WSTF staff and the increasing complexity of organizational processes. German technical cooperation permits flexibility during the implementation of three-year program phases. The inputs and activities of a GIZ program are not fixed at the beginning of implementation, but can be continuously adapted to partners’ needs and political dynamics.

- Although this case study addresses a basket-funding mechanism for the scaling-up process in Kenya, the Trust Fund’s procedures, structures, business models, and technical designs may be relevant for other types of funding mechanisms.

ANNEX A Stakeholder Map as of August 2015
ANNEX B  Timeline of Water Sector Reform in Kenya

1990s Pilot of socially responsible commercialization with three utilities
1999 Policy for Water Resources Management and Water Supply and Sanitation, which initiated the reform process
2002 Passage of Water Act. Provisions include:
   · Separation of subsectors for water resources management and water supply and sanitation
   · Separation of sector functions (regulation, service provision, and policy development)
   · Decentralization of water supply and sanitation service delivery responsibility to urban water and sanitation service providers (utilities)
2004 Water Services Regulatory Board (WASREB) commences operations
2006 Water Services Trust Fund (WSTF) begins urban financing and plays a key role in supporting the expansion of WSS services by utilities to urban LIAs and providing the required funding to implement low-cost technologies at scale
2007 National Water Supply and Sanitation Strategy for the implementation of key sector principles such as
   · Poverty orientation
   · Cost recovery and ring-fencing of sector income
   · Regulated service provision with minimum standards
2007 Pro-Poor Implementation Plan for Water Supply and Sanitation
2008 National Vision 2030, stipulating the goal of “universal WSS service coverage”
2008 Financing commitments to WSTF by KfW (€5 million) and the EU (€10 million) to support scaling up of water supply and public sanitation
2009 First call for proposals for water kiosks and public toilets (20 utilities responding)
2010 Access to drinking water and sanitation are established as fundamental rights in the new Constitution of Kenya
2011 Financing commitment to WSTF by BMGF (US$7 million) to support scaling up of on-site sanitation to reach 429,000 people by
2010–11 MajiData database provides a complete picture of WSS access in urban LIAs for the first time
2014 Sixth call for proposals under the WSTF-UPC for water kiosks, yard taps, public toilets, secondary infrastructure, and, for the first time, on-site sanitation; 70 utilities participate
Results as of December 2014
   · Nearly 1.8 million low-income residents have gained access to safe drinking water
   · 120,000 low-income residents have gained access to adequate sanitation
   · 70 (out of 100) water utilities across the country operate low-cost technologies in urban LIAs
   · Overall investment in last-mile WSS services during 2009–13 by WSTF totals €23.8 million (compared with an investment of €373 million in first-mile WSS infrastructure not channeled through WSTF during the same period)

ANNEX C  Interviewees and Affiliated Organizations

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<th>Interviewee name</th>
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<tr>
<td>Doreen Mbalo, Carol Ngesa</td>
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Modern Energy Services in Low- and Middle-Income Countries
How to Facilitate Sustainable Access to Electricity

In Brief

- **Development Challenge:** About 18 percent of the world’s people were without access to modern energy services in 2011. The problem is particularly severe in Sub-Saharan Africa, where two-thirds of the population lack access to electricity.

- **Development Solution:** Using a market-based approach, Energising Development (EnDev) facilitates access to modern energy services for people in 24 low- and middle-income countries in Africa, Asia, and Latin America.

- **Program Results:** Globally, EnDev has helped almost 13 million people obtain access to sustainable energy since 2005. In Kenya alone, for instance, EnDev has provided some 3.56 million people with access to improved cookstoves.
Executive Summary

How can strategies and technologies be developed to provide poor people in remote areas with sustainable access to modern energy? What lessons can be learned from the experience of Energising Development (EnDev),¹ which facilitates access to modern energy services for people in 24 low- and middle-income countries in Africa, Asia, and Latin America?

Since 2005, EnDev has helped 12.95 million people obtain sustainable energy. This case study examines how it did so. It contrasts three interventions—in Kenya, Mali, and Mozambique—in order to learn from its successes and failures.

The cases address three main questions:
1. How can last-mile deliveries be designed to expand services to a large number of people in rural areas?
2. How did implementers develop potential solutions when confronted with unexpected delivery bottlenecks?
3. How did implementers ensure the sustainability of their projects, especially when confronted with delivery bottlenecks?

EnDev follows a market-based approach in most of its activities. It helps small and medium-size enterprises increase their market opportunities in order to create sustainable local energy markets. These businesses operate in villages, where they tackle the "last mile" by directly engaging with households, especially in remote, rural areas. EnDev also adopts a performance-based approach to identify the most efficient way to target beneficiaries. These diffusion structures make the EnDev approach unique in development cooperation.

In addition to studying successes, the case study examines EnDev’s failures. It shows how it modified projects where the measured welfare gains of citizens turned out to be substantially lower than expected. EnDev’s original approaches for photovoltaic-driven communal battery-charging stations in Mali and microhydropower in Mozambique, for example, proved unsuitable. In response, EnDev Mozambique closed the microhydropower component and is trying to find a way to end the project in Mali. Both experiences were painful, but scaling down cost-intensive and inefficient projects and reallocating funds to other projects and countries allows EnDev to concentrate on more successful projects.

The case study shows how EnDev deals with both successes and failures, reporting them transparently and measuring their impact and performance. The delivery insights are intended to serve as an inspiration to all donors active in the field of access to modern energy technologies and energy services, who can learn from the implementation of results-based approaches and promote more flexible implementation of programs.

Introduction

About 18 percent of the world’s people were without access to modern energy services in 2011, and at least 2.6 billion lacked clean cooking facilities. Modern energy services are crucial to human well-being and to economic development; lack of access to modern energy services adversely affects health, restricts opportunities for income-generating activities, and widens the gap between the rich and the poor. For these reasons, the UN World Summit on Sustainable Development in Johannesburg in 2002 underlined the importance of energy and placed access to affordable and reliable energy as a prerequisite for meeting the Millennium Development Goals.

Energy poverty is a pressing issue in Sub-Saharan Africa, where more than 620 million people—two-thirds of the region’s population—are without access to electricity (OECD and IEA 2014). The situation is especially dire in rural areas.

Two key delivery challenges prevent countries from translating technical solutions into results on the ground. First, most governments lack the resources to address all of their vast development needs simultaneously. They therefore channel their limited financial resources to other development sectors, such as health and food security. Second, within the energy sector, rural access and cooking energy are given less priority than large infrastructure projects in urban areas. Moreover, even where they would like to address the problem,
governments often lack the technological know-how and implementation structures to improve rural populations’ access to modern energy services.

Given these constraints, how can strategies and technologies be developed to provide poor people in remote areas with sustainable access to modern energy? The delivery challenge lies in how to structure “last-mile” strategies to reach beneficiaries.

The Energising Development (EnDev) program facilitates access to modern energy services in 24 low- and middle-income countries in Africa, Asia, and Latin America, with minimum energy poverty ratio (no access to electricity and/or improved cooking system) of 30 percent on the national level. At least half of its funds are committed to Least Developed Countries. Funded by the Netherlands, Germany, Norway, Australia, the United Kingdom, Switzerland, and most recently also Sweden, this impact-oriented initiative promotes the supply of modern energy technologies to poor households, social institutions, and small and medium-size enterprises. By June 2014, it had provided access to electricity or improved cooking technologies to more than 12.95 million people.

EnDev does not simply connect households and institutions to power. It applies results-based incentives that are intended to maximize the impact of energy access by taking into account energy use and target group demand. The selection process for measures it supports combines competition with needs assessment and focal areas, as defined by its donors. This competitive approach allows for a rapid scaling up of successful activities and flexible reallocation of funds across countries based on performance. Experiences with the program show that competition among projects and technologies stimulates local contributions and leads to cost efficiency.

EnDev employs a mix of approaches and technologies, and its activities differ across countries and projects. Through its global activities and positive impact, the program has built a treasure trove of experience, knowledge, and competence in the energy sector.

EnDev Success Factors

EnDev builds on a strong results-based approach, pursues rigorous monitoring and impact assessment, and focuses on long-term sustainability:

**EnDev’s results-based approach** combines a results-based approach with competition and flexible allocation of funds. EnDev encourages competition among projects, technologies, and strategies. To achieve long-lasting results, EnDev follows a market-based approach for most of its activities. While at the global level, EnDev has a clearly defined global outcome goal and a global budget, country goals and budgets remain flexible. The overall budget contains a budget to finance promising pilot projects at the country level and a budget dedicated to scaling up successful projects (demonstrating high outcomes and effects together with high cost efficiency). EnDev’s financial mechanism comprises financing pilot projects for 2–3 years, rough guidelines determining where funds are to be disbursed, and an accumulation of successful projects. Its dynamic organizational structure allows for additional donors to join. As such, EnDev is an example of successful donor harmonization.

Projects at the country level are evaluated based on the cost of access per person with access to modern sources of energy. On average, €20 is allocated per person for sustainable access to energy. Hence, country-specific measures compete with one another. In order to identify projects that promise success, EnDev supports projects that can prove successful strategies (performance), meet criteria determined by a needs assessment, and match focal areas defined by financiers. This approach allows implementers to quickly and efficiently scale up successful activities and be flexible in reallocating funds among countries according to performance.

**Rigorous monitoring and evaluation** is a fundamental requirement for the results-based approach. Showing that many poor people in various countries have gained access to energy is a challenge, particularly when they live in remote areas, dispersed over wide territories. But without credible data about a project’s progress, the program cannot validate the impact of activities, confidently reallocate funds, or make good management decisions. EnDev invests about 5 percent in monitoring and evaluation. It conducts baseline studies before project intervention and systematic impact studies after program beneficiaries gain access to modern energy. Every six months it looks at results and updates its data.

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2 Technologies include photovoltaic systems, microhydropower plants, improved cookstoves, biogas plants, and digesters. The choice of technology depends on the situation in each country. In areas close to power grids, EnDev facilitates grid extension or densification. In remote areas with no access to a central grid system (and no plans to be connected to the grid in the near future), it supports decentralized or mini-grid energy solutions.
Each country has its own way of counting beneficiaries. Through this continuous and detailed monitoring system, every person provided with access can be traced or sales specified and attributed to certain areas (see EnDev’s outcome monitoring procedure (figure 1) in annex A).

EnDev also measures impact and sustainability of energy access. Measuring sustainability is complex. Only figures that can be fully attributed to EnDev are reported. Hence, EnDev takes into consideration the “replacement factor” (the fact that, for various reasons, people do not keep using modern energy services), the “windfall gain factor” (the fact that some households would have gained access to modern energy services without EnDev), and the “double energy factor” (the fact that some households and social institutions were already benefiting from another modern energy service).

**Long-term sustainability is a core criterion** for activities supported within the EnDev framework. Special attention is paid to the broader developmental impacts of the energy activities implemented. EnDev measures are not limited to providing and installing technical equipment. EnDev aims to ensure that systems have the necessary resources to work in the long term and that market structures are in place for dissemination.

Therefore, it is essential to ensure there are people on location who are able to solve technical problems, as well as consumers who can pay for services after EnDev support ends. Finding technical and market solutions that are suited to the local context is critical. Ownership and local contributions are important indicators of the successful and long-lasting implementation of energy systems. EnDev activities clearly focus on energy services and resources that are reliable, affordable, socially acceptable, and environmentally sound.

This case study contrasts interventions in Kenya, Mali, and Mozambique, to learn from failures, successes, and scaling-up models. Because of differences in technologies

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Figure 1 EnDev Kenya’s Solar Component Approach

- Identify potential solar entrepreneurs in rural areas
- Train and build their capacity
- Link the entrepreneurs to dealers or distributors
- Distribute products in rural areas

- GIZ
- Solar companies
- GIZ Energy centers
- Trained LMEs
- Create awareness
- Monitor
- Increase access to finance
- Improve enabling environment
- Enhance technical/after-sales service

Source: EnDev Kenya 2014c.

Note: EnDev Kenya (a) creates a value chain within the stove sector by providing linkages between producers and distributors and (b) links supply and demand by raising awareness, by increasing access to finance and by enhancing technical/after-sales services for the clients.
applied, the phases of project processes, and contextual conditions, the three project experiences cannot be fully compared with one another. The case study nevertheless highlights features and priorities that are inherent to the EnDev program and that might be of special interest for the Global Delivery Initiative.

In tracing the implementation of the three EnDev activities, the case study addresses the following research questions:

1. How can last-mile deliveries be designed to expand services to a large number of citizens in rural areas?
2. How did implementers develop potential solutions when confronted with unexpected delivery bottlenecks?
3. How did implementers ensure the sustainability of their projects, especially when confronted with delivery bottlenecks?

Contextual Conditions

Energy poverty is a major development challenge, especially in Sub-Saharan Africa. Although EnDev is active in 24 low- and middle-income countries in Asia, Latin America, and Africa, its focus is on Sub-Saharan Africa. This section describes the most relevant conditions and trends in Kenya, Mali, and Mozambique.¹

Energy Situation in Kenya

The energy sector in Kenya is dominated by petroleum and electricity, with wood providing the basic energy needs of rural communities, the urban poor, and the informal sector. Traditional biomass accounts for 97 percent of Kenya’s domestic energy requirement and is used mainly for cooking. Annual firewood demand is about 3.5 million tons, and annual supply is estimated at about 1.5 million tons. This deficit leads to high rates of deforestation in both exotic and indigenous vegetation, resulting in desertification, land degradation, and potentially droughts and famine.

The health of people doing the cooking, mainly women and girls, is a serious concern. Two-thirds of Kenya’s people—most of them living in rural areas—are exposed to indoor air pollution, resulting in an estimated 14,300 premature deaths a year. The risks to both the environment and health are largely attributed to cooking with three-stone fires, which is both inefficient and polluting.

The proper use of biomass energy is not the only energy challenge Kenya is facing. Kenya has an electrification rate of just 23 percent nationally and a mere 5 percent in rural areas. The government aims to have all villages connected by 2022. It remains questionable whether households will find the means to afford the (relatively high) connection and running electricity costs.

However, Kenya has high insolation rates with an average of six to seven peak sunshine hours a day. In rural areas, solar power may provide leeway. In 2012, the government zero-rated the import duty and removed the value added tax on renewable energy equipment and accessories. Kenya now has one of the most active commercial photovoltaic (PV) system markets in the developing world. Stand-alone PV systems represent the least-cost option for electrifying homes in rural areas, especially the sparsely populated arid and semiarid lands.

Energy Situation in Mali

Despite substantial oil (and uranium) reserves in the north of the country, Mali remains fully dependent on imports for fossil fuels, which cost the country 16 percent of the national budget, increasing by 10 percent a year. Biomass plays the dominant role in the Malian energy balance, mainly in the form of wood and charcoal for domestic use.

Total annual electricity production is used mainly to electrify urban and peri-urban areas: the national utility serves some 60 urban municipalities through the national grid. With a third of its 16 million people living in urban areas, approximately a quarter of the Malian population is provided with electricity (59 percent in urban areas and 14 percent in rural areas).

Mali’s energy policy aims to contribute to the country’s sustainable development by making energy services available to as many people as possible. The government set a rural electrification target of 55 percent by 2015. So far, rural electrification has been achieved through mini-grids or individual systems. The quantity, quality, reliability, and affordability of rural access are often questionable. Diesel generators still supply most off-grid electricity, although PV-generated electricity is becoming

¹ Facts and figures on the energy situation in the three countries come from Energypedia, a wiki-based platform for collaborative knowledge exchange on renewable energy and energy access issues in the context of development cooperation. The platform includes more than 3,300 free articles contributed by the growing community of about 4,300 registered users, comprising energy practitioners, experts, academics, and other interested parties.
increasingly available. National electrification policies are not yet sufficiently developed and implemented to respond adequately to the rising demand for electricity. The rural electrification strategy of Mali’s Agency for Domestic Energy and Rural Electrification (AMADER) focuses on the creation of a private sector in which local public-private partnerships take a lead role in the electrification process. It seems vastly overburdened by the task of providing most of the off-grid power to more than 700 rural communes (11,000 villages) with access to electricity. National institutions have neither the capacity nor the resources to implement the ambitious programs and there is also a lack of local capacity. Considering the country’s high rate of poverty, sheer size, and low population density, covering large parts of Mali by the national grid cannot be expected for a long time.

Against this background, the country’s potential for renewables is high. Mali has significant solar, wind, and hydro energy potentials, which have not been exploited. The recent trend in solar power, and especially the price of PV panels, is vital for EnDev’s project in Mali. When the EnDev project started, PV panels were relatively expensive and small solar systems (PicoPV) were virtually nonexistent. With the recent drops in PV panel prices, PV-generated electricity, ranging from PicoPV devices to several PV power plants, is becoming increasingly available.

**Energy Situation in Mozambique**

Access to electricity in Mozambique is among the lowest in the world, especially in rural areas, where only 1 percent of the population is supplied. Many district capitals depend on expensive and often unreliable power generation with diesel generators. The situation of the overwhelming majority of rural areas is even worse: most households, rural schools, health centers, and administrative posts have no access to electricity. Forest resources satisfy more than 85 percent of total domestic energy requirements and more than 95 percent of energy supply in rural areas. It is estimated that 16 million cubic meters of forestry resources are burned every year to meet rural energy requirements.

The energy sector is critical for Mozambique’s economy, because energy exports to Southern African countries make up a large share of total foreign exchange earnings. The focus is on large hydro projects in the Zambezi Basin to produce power for export to South Africa and for industry. In recent years, this effort has been complemented by export-oriented natural gas and coal exploration.

Mozambique has considerable but underexploited energy resources, including natural gas, coal, hydro, oil, solar, biomass, and wind, with an estimated hydropower potential of 12,000 megawatts. The market situation of hydropower technologies and services is still at a very incipient stage. In the case of micro and pico hydropower, only some components are available, which makes prices prohibitive for communities and households. There is strong potential for the local manufacture of water wheels and pico turbines, although the market is still very limited and local services tend to be expensive.

Mozambique is a vast country, in which the majority of the population lives in rural communities dispersed throughout the provinces. Energy solutions must consider this reality and combine the rollout of the national electricity grid with off-grid solutions for remote areas, using sustainable biomass, solar, and hydropower resources.

**Tracing the Implementation Process**

**EnDev Kenya**

EnDev Kenya focuses on facilitating access to clean energy for the rural population by promoting improved energy-efficient cookstoves and PicoPV systems, using a market approach. Promoting improved cookstoves for household use was one of EnDev’s first projects. As part of an early household energy project (1983–94), German development cooperation implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) invested in the development of a stove sector. About 28 producer groups produced and distributed some 500,000 stoves, at an annual rate of about 50,000. After the project ended, the production rate dropped to 12,000–14,000 stoves a year (EnDev 2012). The decline reflected organizational, pricing, and transport problems.

In 2005, GIZ was involved in an agricultural program, together with the Kenyan Ministry of Agriculture, called Private Sector Development in Agriculture (PSDA). PSDA was asked to include EnDev in its activity portfolio. From 2005 until 2009, EnDev Phase 1 was implemented as component of the bilateral PSDA program. After 2009 until today in Phase 2, EnDev Kenya is implemented as

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5 GIZ was known as Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH before it merged with Deutscher Entwicklungsdienst (DED) and Internationale Weiterbildung und Entwicklung (InWEnt).
a country intervention of the global EnDev multidonor program. Before starting its activities, EnDev conducted an assessment of what remained of the previous GIZ program on energy and cookstoves, as it had used approaches similar to the ones EnDev planned to implement (EnDev Kenya 2014b). It found the following:

- The stoves were of low quality and suffered from technical problems.
- Training was not conducted systematically.
- Production capacity was very limited.
- Market structures were barely in place, and almost no marketing was done. Stove production centers would wait for customers to purchase their products, as they were used to the Ministry of Agriculture purchasing and marketing their products.
- Production centers with ambitions to expand their activities could not do so because of lack of access to finance.

EnDev Kenya addressed each of these problems by introducing a market approach with capacity development support. It is trying to overcome the delivery challenge of expanding services to a large number of people in rural areas by encouraging small and medium-size enterprises to engage in the improved cookstoves sector. Marketing of the improved cookstoves aims to support the rural population in accessing clean energy services in a sustainable manner by making the stoves available, accessible, and affordable. This emphasis stems from the recognition that households are more likely to adopt products when they actively chose them themselves. Under EnDev, households decide to buy a stove, at a price that is affordable for a large part of the target group yet profitable for the producer. The intention is to develop a sustainable market for modern cooking devices by supporting sustainable production and marketing while focusing on education and awareness.

The predecessor Private Sector Development in Agriculture program aimed at value chain development within the Kenyan agricultural sector. EnDev Kenya adopted the same fundamental idea of market-based private sector development. EnDev Kenya encourages small and medium-sized enterprises to increase their market opportunities by producing or using improved cookstoves. This is realized by building the technical, organizational, and business capacity of stove producers, marketers, builders, and installers following the value chain approach, aiming at full commercialization of production and marketing activities.

EnDev Kenya creates a value chain within the stove sector by providing linkages between the people involved in producing the ceramic liners and inserts and the people who install and market the stoves. Initiating this market required two simultaneous interventions: raising awareness by informing people about the advantages of modern stoves to increase demand and training enough stove builders and installers who could then meet this demand.

**Raising Awareness**

Many people in Kenya’s rural areas are not aware of the dangers of cooking with biomass (wood, animal dung, and crop waste) and of the positive effects of improved cookstoves, which reduce the emissions of traditional wood stoves. EnDev provides sensitization and information at local public meetings (called barazas) that bring the entire community together and by organizing field days or information desks at markets. It also targets tea and coffee growers, who usually employ several thousand workers. EnDev also promotes stoves at annual agricultural shows at the district level. Stove producers, installers, and marketers play a big role in sensitizing potential consumers. All of these activities have been very successful. A 2011 study revealed that 97 percent of people were aware of the advantages of improved stoves, despite not using them (EnDev 2012).

**Building Capacity**

EnDev Kenya’s approach is strongly oriented toward mobilizing and involving local resources, authorities, and initiatives to transfer their knowledge and skills to appropriate actors on the supply side. Its close cooperation with the Kenyan Ministry of Agriculture allows for wide outreach through its agricultural extension network. Together with the Ministry of Agriculture and local representatives, EnDev selects the people to be trained during public gatherings and occasions, such as barazas, using various selection criteria. Selected individuals receive training that lasts for four or nine days (depending on the stove type).

EnDev Kenya expands its reach through train-the-trainer programs. It is working with 50–60 trained trainers, who are contracted on a fee basis. These trainers are stove producers who displayed good technical and communication skills. Whenever there are new technical developments, trained trainers are retrained before they conduct training with stove producers on the ground. In
this way, acquired skills remain within the community, bringing the service closer to the people.

Overall, these hundreds of stove builders and marketers are the driving forces behind the project’s success; by June 2014, 2,415 active stove builders were reportedly active, marketing their products in their own interest of income generation. Stove builders compete with one another to win customers. EnDev Kenya also offers entrepreneurship and business training to stove builders who perform well.

The uniqueness of this delivery model lies in the fact that it enables EnDev Kenya to overcome last-mile delivery bottlenecks. EnDev’s stove producers are active in the villages and bridge the last mile by directly engaging with households, especially in rural and remote areas. EnDev Kenya is also able to collect monitoring data at the household level to provide evidence of the development outcomes for clients.

Delivery Insights, Outputs, and Results

EnDev Kenya’s cookstove activities have been very successful: project implementation can be seen as a showcase for good project management and well-established delivery structures. There have been no reports of serious delivery bottlenecks, changes in policies, or moments when implementation moved critically forward.

Success partly reflects the program planning and implementation structure: the country office in Nairobi centrally manages the project. EnDev’s activities in the stove sector are divided into western, central, and northern clusters. The three cluster managers lead teams that directly interact with stove operators. These teams are also responsible for monitoring and training. The large contingent of employees involved in project activities enables micromanagement, another success factor in project implementation.

The EnDev Kenya team and EnDev headquarters regularly assess the project’s progress, with the help of its extensive monitoring system and additional external evaluations (feedback loops). The EnDev team sees these feedback mechanisms as part of good project management, as every evaluation issues recommendations and operations are adjusted accordingly.

As one example, stove construction has been adapted to use more durable materials (fired bricks) to increase the stoves’ lifespan. Although doing so increases the unit cost per stove, slowing the rate of stove uptake, this adaptation favors quality and sustainability (adaptation).

EnDev Kenya has set its interventions on the right track toward sustainability by making pragmatic decisions in the early phases of the project and then coherently following a demand-driven strategy that limits its interference in the market. The sustainability of its cookstove activities looks promising, as its efforts are transforming into self-sustained development of local markets. Because of high demand, the project has been scaled up several times. Since the start of the project, there has been a steady increase in the number of households, social institutions, and enterprises using improved cookstoves. As of December 2013, 3.56 million people had benefited from improved stoves, about 20 percent of the target population.

Responding to a lack of commitment at the national level, EnDev Kenya addressed the delivery gap in energy access and contributed to initiating a market for modern cooking devices. As a result, stove production has become a real business model. By December 2013, the project had contributed to the creation of more than 2,780 private businesses. The stove business has created employment in the production, marketing, and installation segments, increasing incomes.

An ongoing concern is replacement, a central sustainability criterion. In 2014, an external evaluation revealed that 90 percent of the surveyed households using improved stoves did not need to replace their stove yet. Of the 10 percent who did need to replace their stoves, only 44 percent actually did so. It is worrisome that more than half of households whose stoves stopped functioning properly discontinued usage even while the EnDev project was still ongoing. EnDev Kenya has been alerted to monitor and tackle the issue of replacement by stressing consumer education.6

It is not yet clear whether the EnDev approach to stove technology is sufficient to sustain local markets, as established structures are likely to cease when operations end. Stove vendors may find it increasingly difficult to gain sufficient numbers of customers to maintain their businesses. However, this shall be assessed in a market sustainability study in 2016, which will focus on the market dynamics in so called “pull-out areas”—counties

6 A follow-up study found that three-quarters of people who did not replace their EnDev cookstove went back to traditional stoves; the remaining quarter replaced it with another improved stove. The main reasons given for not using an EnDev unit were that the EnDev stove could not accommodate different pan sizes, breakdowns were frequent and repair costs high, and the stove was too difficult to operate.
where the coverage rate was 70 percent and higher, so that EnDev decided to pull out with their activities and observe how stove businesses maintain their structures.

In 2014, EnDev Kenya began moving to new project areas (scaling up to new regions). This effort coincided with its exit from areas with a good saturation of stoves (“pull-out areas”), where EnDev no longer directly intervenes but still collects reports from stove builders through the Improved Stove Association of Kenya (ISAK) for monitoring purposes (map 1).

EnDev Kenya emphasizes the following factors as the main success factors behind its approach:

- Its stoves are adapted to customs in rural areas and use locally available material.
- Its stoves are affordable: depending on the type, material, and size, they cost about €3–€20.
- Technical support people are accessible and available; they live in the community and build capacity at the local level.

In addition, Kenya provides a favorable context for the EnDev cookstoves program. It has densely populated target areas, high purchase power compared with other Sub-Saharan countries, and a very active informal sector, in which many people are looking for job opportunities.

**Promoting Solar Energy for Rural Households**

Since mid-2012, EnDev Kenya has focused on energy for lighting activities and supported access to modern lighting by promoting high-quality, affordable, and efficient PicoPV systems. These systems provide good-quality lighting and basic electricity services, such as mobile phone charging and powering of small radios and entertainment devices. To provide quality products, EnDev requires that the systems supported have to be Lighting Africa tested and qualified.

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**Map 1 Distribution of Stoves in the Kenyan Project Areas, June 2014**

*Source: EnDev Kenya 2014c.*
EnDev Kenya aims to establish and strengthen sustainable and commercially viable supply and distribution models for PicoPV products, particularly in rural areas. Its efforts include capacity development for last-mile entrepreneurs, the linking of these entrepreneurs to financing institutions, contributions to ongoing discussions on policy and regulation, and networking with other stakeholders.

When the project started, there was no distribution network or way to reach out to very remote villages. Distributors were simply not interfacing with retailers. EnDev Kenya, including GIZ and Stichting Nederlandse Vrijwilligers/Netherlands Development Organization (SNV), were well positioned to fill this gap because of their established cookstove networks. Adding the PicoPV component to existing stove activities reaped synergies. Stove actors were trained to work as last-mile entrepreneurs for solar products. The EnDev cluster managers identified among the cooperating stove actors those who had the capacity to also sell solar products. Most stove actors were interested, because it allowed them to offer other products to consumers they were already in contact with. By June 2014, some 60 percent of the 400 EnDev-trained PicoPV retailers were also involved in the EnDev cookstove component.

Solar energy is a completely different business from stoves. Solar lanterns are much easier to sell, which implies stronger competition among retailers. Monitoring revealed that until 2014, more than 65 percent of solar products acquired and sold by last-mile entrepreneurs in rural areas cost less than €20 apiece (simple products with limited service). Accessing financing to purchase the more expensive solar products remains a challenge. EnDev’s market mechanism is not yet assurred, but monitoring reported a steadily increasing number of entrepreneurs taking up solar energy as a business as well as the number of products sold. However, to date the number of last-mile entrepreneurs has not reached a critical mass.

**EnDev Mali**

When the project Electrification Communale (ELCOM) was planned in 2008, rural electrification in Mali stood at roughly 3 percent, PV panels were relatively expensive, and PicoPV was virtually nonexistent. Mali’s Agency for Domestic Energy and Rural Electrification (AMADER) seemed vastly overburdened by the task of providing off-grid power to most of the residents of the more than 11,000 villages with access to electricity. Households that could afford a battery for basic electrification often had to undertake long journeys to charge their batteries in the nearest town. Charging was often done poorly, jeopardizing the batteries’ life span.

Because the national grid will not be available in most rural areas for a long time, EnDev Mali focused on providing energy for lighting and household applications for private households in rural municipalities through PV-driven communal battery-charging stations. At that time, mini-grids could not be run economically in the relatively small villages concerned, and PV panels were still more expensive than batteries, making ownership of PV panels for rural households unlikely. Installing individual systems and operating them on a fee-for-service basis would have benefitted only a few households.

EnDev Mali promoted 50 solar battery-charging stations in 17 rural municipalities in southern Mali. Additional solar home systems for rural social institutions, such as administrative buildings and town halls, clinics, and schools, were set up in the same villages. These projects were carried out in close cooperation with local communities. The municipalities contributed 10–20 percent of the initial investment costs (in cash or in kind), with the remaining 80–90 percent covered by EnDev. The stations remain communal property, operated on a fee-for-service basis and contracted to a private operator, selected by the communal authorities from among local competitors. The technical setup of the systems installed is fairly simple: with a basic module consisting of a 65 Wp PV panel, a 70 or 100 Ah battery (giving roughly two days of autonomy), and a matching regulator, various social infrastructure facilities were electrified, based on their needs. Up to five modules were installed in some establishments. On the demand side, and depending on the type of infrastructure, some lamps, fans, a refrigerator to store vaccines in a clinic, and/or an inverter with some sockets (for printers and computers in city halls) might be installed.

The operational model assigned private operators to ensure technical maintenance and financial management of these stations. A fixed percentage of the revenues achieved from the operation of battery-charging stations is deposited in a communal maintenance fund to cover costs for the repair and replacement of hardware at both the

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7 EnDev Kenya’s solar component is implemented in cooperation with SNV Kenya, because the governing board preferred to get implementing agencies other than GIZ involved.
battery-charging stations and social institutions. Under this concept, the operators' commercial interest is linked with public interest; through the battery-charging stations household electricity supply is integrated with public service delivery. This "mix" was thought to be the gateway to, and incentive for, acceptance of this service among the village population and a key factor for ensuring its long-term sustainability for operation and maintenance through a participatory checks and balances structure. With revenues from battery charging as the sole source of income for operation, repair, maintenance, and replacement of hardware at the battery-charging stations, as well as the social institutions, economic viability required fairly high utilization of the battery-charging stations.

During project implementation, the approach turned out to be unsuitable, as real conditions were somewhat different from the assumptions made during planning. Although in some stations the needed usage rate was achieved, demand turned out to be much lower than expected, as was soon revealed by EnDev's monitoring system (pain point). The main reason for this development were the market and price developments in the solar energy business, which undermined the rationale for battery-charging stations (inflection point). As the prices of PV panels declined rapidly, customers who previously could afford only a battery could now often also afford a PV panel, creating their own individual system, leaving the battery-charging stations unused. The drop in the prices of PV panels also reduced the costs of battery charging elsewhere (in the neighborhood, for example). With PV panels becoming more widely available, competition increased, necessitating price adaptations at the battery-charging stations, which in turn increased the economic risk for the underlying business model. The demand-driven rationale for battery-charging stations quickly became obsolete.

Other factors also contributed to the model's failure. The system provided for an intrinsic incentive for operators not to report charged batteries, because it enabled battery-charging station technicians to pocket the unreported revenues. Although EnDev Mali addressed the issue by installing data loggers, the problem was hard to combat. Another problem was that battery-charging stations were insufficiently dynamic: many stations opened up briefly in the morning to receive batteries, after which they closed, missing out on potential clients. EnDev Mali addressed this issue by converting the stations into energy kiosks, where additional energy services were available.

Overcoming these delivery bottlenecks would not have been sufficient to stave off the effects of declining demand caused by the low costs of PV panels. A revision in EnDev's market approach to ensure the project's sustainability was needed.

For its next phase, EnDev tried to reorient its focus and develop potential solutions by introducing small PV devices (solar lanterns and small plug-and-play individual systems) for sale at battery-charging station counters. Over time, the stations that had been erected earlier will be converted into multiservice energy kiosks (adaptation), and PV diesel hybrid mini-grids will be set up in larger villages.

In the project’s third phase (2014–17), ELCOM’s strategy shifted toward wider support of the distribution of PicoPV in rural areas and conversion of battery-charging stations into multiservice energy kiosks. In the first half of 2014, the transformation of some stations into energy kiosks started with the introduction of solar lamps to increase usage and thereby their functionality and profitability of these establishments. This approach did not fully consume the surplus of energy produced. In addition, villagers had no significant interest in buying solar lamps, particularly given their traditional consumer behavior of visiting local markets or interacting with mobile vendors rather than using the newer retail industry in the villages to buy solar devices over the counter (key inflection point).

As the project in Mali was still in its infancy, when it became evident that price developments in the solar energy business led to low demand for battery charging, the number of originally planned charging stations (50) was not scaled up. The project was not able to design last-mile deliveries to expand services to a large number of people in rural areas.

EnDev Mali is now trying to find strategies to exit the project in a sustainable manner. The charging stations remain communal property; together with

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8 Because of the Mali crisis and the need to hire new staff, the project was temporarily suspended and project activities paused for about two years.

9 During the first two phases of ELCOM, 36 schools, 36 health centers, 17 city halls, and 84 solar street lamps were electrified and installed with stand-alone PV/solar home systems. As suggested in the operational concept, electrifying social institutions should improve the living conditions of the population and strengthen the local government’s performance and legitimacy. Incidental impact monitoring suggests that the quality of communal services benefited from the provision of electricity. However, the revenues of the battery-charging stations did not suffice to support the replacement of hardware. Infrastructure providers are advised to raise fees and/or make their own contribution for the eventual replacements of batteries, inverters, and solar panels, and installations generating power for key public buildings.
the municipalities, EnDev Mali is trying to identify additional communal energy needs to ensure a third option of sustainable use of the stations’ energy facilities and buildings (behavior change). Business models that use the buildings and the power generated by the stations were tested. Refrigerators were installed for commercial use (storage and sales of meat, dairy products, and cool drinks), and a 220-volt system was installed that allows for DC phone charging. As an additional option, the community should incentivize local businesses (such as hair salons) to use the power generated by the stations. This will put the communities in a position to use the business rental takings to cover the repair and maintenance costs of the solar equipment.

EnDev Mozambique

EnDev Mozambique is involved in grid densification, improved cookstoves, pico and microhydropower plants, and small plug-and-play PV systems. Its experience with hydropower is of special interest, because it highlights a painful learning experience in the attempt to promote sustainable access to modern energy services.

The EnDev hydropower component works in Manica province (in central Mozambique, along the Beira corridor), where geographic and climate conditions were assessed as favorable for implementing up to 20 micro-hydropower mini-grid sites, providing access to electricity for unconnected villages. The basic technology was not new to the region; the use of small and micro-hydropower generation dates back to colonial times. One local nongovernmental organization (NGO) that was already active in the field of hydropower was identified as an implementing partner for the microhydropower component. The regional capital Chimoio hosted a local metalworking industry that was integrated into EnDev’s approach to produce simple turbines locally.

EnDev Mozambique promoted a commercial operator model in which the future local operator of the mini-grid and power plant obtains financing for the hydropower plant, mini-grid, and related productive use installations. Financing was expected to come from local banks or the rural renewable energy agency (Fundo de Energia [FUNAE]). EnDev had originally aimed for a maximum 50 percent grant share of the entire investment cost. However, the project did not succeed in getting local banks interested in the sector. Priorities in FUNAE regarding hydropower have varied over time and have not resulted in financing opportunities for mini-grids.

Implementation of the EnDev activities was delayed, because the communal counterparts were unable to raise their 50 percent of financing. To overcome this challenge, the local NGO working with EnDev Mozambique in implementing the hydro component channeled EnDev funds and provided the necessary financing through a revolving fund setup. This solution was a backup in the absence of commercial financing. Project implementation started in 2007, with the first newly constructed microhydropower sites reported in the monitoring system in 2010.

EnDev supported a total of 16 microhydropower sites. The project provided both financing and capacity development support to 11 sites with total installed capacity of 226 kilowatts. In addition, EnDev provided capacity development for pico hydrosite of 2.5 kilowatts entirely financed by a private investor. As a result of cooperation with the international NGO (Practical Action), four additional hydropower sites, with a total capacity of 74 kilowatts, were added.

During project implementation, the original approach turned out to be unsuitable, because the reality was different from assumptions made during planning. There were compelling reasons to question the design and sustainability of this approach (pain points):

- Working through a local NGO did not work out as planned. Despite training, the NGO lacked the administrative and technical capacities it was originally believed to have had (although it was highly skilled in socioeconomic and community mobilization competencies). Therefore, EnDev Mozambique abandoned the cooperation in 2014 (organizational change).
- Local co-funding from national sources did not materialize, and government ownership for promoting microhydropower varied. The interest of cooperation partners FUNAE and Belgian Technical Cooperation (BTC) shifted toward larger hydro systems, which require substantial investment capital and are not covered by EnDev’s technology portfolio.
- The project did not succeed in interesting local banks in the sector, despite constant engagement and initially expressed interest.
- The aim of keeping investment costs as low as possible (at an average of $30,000 per site of 20–30 kilowatts) proved unsustainable. This low-cost approach was originally established to achieve a maximum 50 percent grant share provided by EnDev in the commercial operator model. It turned out that the grids of
all sites needed improvements and rehabilitation after five years of operation. The low-cost approach had resulted in low quality of manufacturing materials and technical installation of the microhydropower sites.

Decision makers became aware of these issues over time:

- From the beginning, in 2007, EnDev Mozambique gave the local NGO much responsibility for project implementation. Because of its technical capacity constraints, a local technical advisor (EnDev staff) supported the project. Knowledge of the NGO’s very limited administrative capacities for accounting and financial reporting was disregarded for a long time. EnDev’s local project officers first identified these shortcomings and problems in 2010, after which the NGO was closely monitored. Eventually, EnDev Mozambique commissioned a consultant to develop a concept for balancing the administrative shortcomings (inflection point).
- At both EnDev Mozambique and headquarters, this new awareness motivated staff to scrutinize other responsibilities the NGO had assumed (such as its capacity to monitor output and outcome indicators). In 2013 and 2014, EnDev Mozambique conducted extensive work on verifying outcome figures and the financial status of the microhydropower sites, and it evaluated the work done by the NGO. As a result, previously reported outcome figures, especially in the field of productive use and social infrastructure, had to be reduced (inflection point).
- By June 2014, 6 of the 16 microhydropower sites were not working because of technical problems. They were excluded from the reported outcome figures. EnDev Mozambique also identified necessary rehabilitation interventions directly with operators. Rehabilitation was needed in 4 of 11 sites, and minor investments were needed in the rest. The grids of all sites needed improvements, which are already being implemented by operators who are receiving training and financial support from EnDev.
- These technical problems were reflected by the monitoring system. Hydropower is the most expensive technology in the EnDev program. Hydro activities in Mozambique were about one-tenth as cost-efficient as the average hydro projects in the global EnDev program. Compared with the other technologies promoted by EnDev Mozambique (grid densification, improved cookstoves, and small PV systems), average per capita costs for microhydropower were very high. This effect was eased by high cost-efficiency in the remaining components. It was the task of the country manager at headquarters to constantly alert the project manager to these unbalanced distributions of costs.
- As a result of various bottlenecks in the delivery chain and the absence of long-term financing options for private investments in hydropower mini-grids, EnDev decided to end its involvement in the hydro sector in Mozambique. The decision to fully exit the sector was made by EnDev Mozambique and headquarters after repeated and intensive discussions and analysis of different scenarios.
- Further EnDev involvement in the microhydropower sector in Mozambique is not expected. Experiences have been documented in an internal lessons learned study and are being discussed with other projects engaged in providing support to mini-grids and hydropower within EnDev and GIZ in general (behavior change).

Now that a clear picture of the technical status of the hydro sites is available, the remaining activities focus on making the operation of existing sites technically and financially sustainable. EnDev will ultimately facilitate and finance technical improvements of the 16 hydro sites and focus on further capacity building of operators in maintenance to ensure their long-term operation and sustainability. The hydro component is expected to fully close by December 2015. EnDev engagement in Mozambique continues and has shifted to the successful and cost-efficient components promoting grid densification, improved cookstoves, and small solar systems.

**Lessons Learned**

**Designing Last-Mile Deliveries to Expand Services to a Large Number of Citizens in Rural Areas**

To initiate self-sustaining local energy markets that will be independent of EnDev and other donors in the long run, EnDev helps local small and medium-size enterprises increase their market opportunities. These cooperation partners are active in the villages. They challenge the last mile by directly engaging with households, especially in rural and dispersed areas.

EnDev’s delivery activities, such as training entrepreneurs, financing, and monitoring implementation, are very detailed interventions that tie up considerable
personnel and financial resources. This close and comprehensive implementation might not be undertaken through national sector policies and corresponding implementers. Furthermore, close cooperation with small-size enterprises that challenge the last mile in rural areas is unusual in development cooperation. Because of the high personnel and financial costs, comparable diffusion structures are hardly used by international development agencies.

EnDev handles these constraints of micromanagement with its performance-based approach, through which the program identifies the most efficient way to target beneficiaries. It identifies beneficiary groups appropriately (demand-driven) and ensures that the budget is spent efficiently. This approach enables the program to scale up successful projects.

The same idea of market-based private sector development showed success in EnDev’s activities in the stove sector in Kenya. As of December 2013, 3.56 million people had benefited from EnDev’s improved cookstoves, and the project had contributed to the creation of more than 2,780 private businesses. Adding the PicoPV component to the existing stove activities yielded synergies.

**Developing Potential Solutions When Confronted with Unexpected Bottlenecks**

The case study illustrates positive project management in Kenya, where interventions were set on the right track and no serious delivery bottlenecks or changes in policies were reported. The comparably large contingent of employees involved in the project activities was a key success factor. Staff are available in the field, and responsibility is delegated to plan and implement activities within the three regional clusters. If required, staff are encouraged to quickly adjust individual approaches. Following this strategy of general flexibility, dedicated and competent people and their corresponding individual interventions and decisions determine success. Thanks to this flexibility, delivery bottlenecks are followed by nonbureaucratic adjustments of the project approach.

In Mali and Mozambique, individual interventions and decisions, followed by adjustments of the project approach, were not sufficient to critically shift the project (or component in the case of Mozambique) toward positive outcomes at an early stage. These experiences suggest that the projects’ processes are not generally applicable to other contexts. It is very important to support appropriate technical and market solutions that are suited to the specific local context, to continuously scrutinize market demand, and to closely and continuously monitor project processes.

**Ensuring the Sustainability of a Project When Delivery Bottlenecks Emerge**

Sustainability is one of the guiding criteria of the EnDev Partnership. With its goal of creating self-sustaining local energy markets, EnDev’s scaling-up model aims to become redundant in the long run.

The outcome figures of the Kenyan improved cookstove project are impressive, but it is still unclear whether EnDev’s approach is sufficient to sustain the local market. Stove actors may find it increasingly difficult to gain sufficient numbers of customers to maintain their businesses, especially in regions with good stove saturation, once EnDev no longer conducts direct interventions. An ongoing concern about sustainability is the replacement rate, which is being monitored closely and tackled by providing consumer education.

After several project adaptations, EnDev Mali is in the process to come up with strategies to exit the ELCOM project in a sustainable manner. Together with the community, EnDev Mali is trying to identify additional energy needs to ensure sustainable use of the battery-charging stations it constructed.

EnDev is also disengaging from microhydropower in Mozambique. Because of various delivery bottlenecks, EnDev decided to close down this component; further involvement in the Mozambican hydro sector is not expected. Its remaining activities focus on making the operation of existing sites technically and financially sustainable. The project will continue to work in Mozambique on the other components.

Both projects/components ended painfully. But the possibility of scaling down cost-intensive and ineffective projects and allowing for the reallocation of funds to other projects offers EnDev the opportunity to concentrate on successful projects.

This mechanism of reallocating funds based on performance also reduces the risks inherent in investments made with small and medium-size enterprises. Starting with the financing of promising pilot projects and stepping up well-performing projects...
positively affects EnDev’s risk management as a global program, as failures and ineffective projects can be balanced with well-performing approaches.

This case study cannot answer the question of how the vast engagement of EnDev affects national policies or implementation structures to improve access to modern energy services at the national level. Unlike other donor institutions though, which directly support national stakeholders and corresponding ministries, EnDev influences government policy by working on implementation that directly results in access at the field level (bottom-up approach); influencing national policies is a secondary goal of EnDev. Moreover, it focuses on establishing economically sustainable energy solutions, mainly for rural communities, and giving local producers and customers a voice. Furthermore, the EnDev program documents its practical experience and approaches, allowing its donors and others in the sector to engage in political dialogue on an informed basis.

How the Case Study Informs the Science of Delivery

This case study examines the five elements that should be considered when evaluating a program along the Global Delivery Initiative delivery know-how:

Relentless Focus on Citizen Outcomes

The global EnDev program facilitated access to electricity or improved cooking technologies for more than 12.95 million people between 2005 and 2014. As an example, as of 2013, 3.56 million people had benefited from EnDev’s improved cookstoves in Kenya. The case study also reveals failures and modifications of projects where the measured welfare gains of citizens turned out to be substantially lower than expected during project planning.

Multidimensional Response

For most activities, EnDev follows a market-based approach. The most important stakeholders are therefore the local small and medium-size enterprises or operators for which EnDev tries to increase market opportunities.

Raising awareness by informing final beneficiaries about the advantages of the new technologies is central to the program. The involvement of national institutions is heterogeneous. EnDev Kenya uses the extension network within the Ministry of Agriculture to promote improved cookstoves and cooperates with the national stove association and the Clean Cooking Alliance of Kenya. The program’s main focus is on providing sustainable access to modern energy services rather than forming multisector partnerships or engaging in multidisciplinarity.

Evidence to Achieve Results

EnDev’s detailed monitoring system delivers evidence about projects’ progress. Without these data, the program could not validate the impact of activities or confidently reallocate funds. Successful approaches are scaled and transferred across countries. As new interventions are pursued as small-scale pilots, EnDev also commits to experimentation with innovative approaches.

Leadership for Change

As a global program, EnDev is highly committed to creating and sharing knowledge among its 24 cooperation countries. The cultural diversity represented in the program is a key for innovation. As a constantly learning institution, it is able to cope well with both successes and failures, to report them transparently to its governing board, and to measure impact and performance. Sharing experience and learning are viewed as key to success.

Being in the field with a project team encourages delegated responsibility to plan and implement activities among staff in the field offices and fosters a bottom-up approach to planning. Learning events such as technical and strategic meetings among field offices and headquarters staff also promote the sharing of implementation experiences in the field. As the program is primarily locally driven, leadership of national actors is not a central tenet of the EnDev program.

Adaptive Implementation

The three projects showcased exhibited flexibility by addressing delivery bottlenecks with appropriate adaptations or scaling-up models. With its flexible reallocation of funds between technologies and countries
based on performance, EnDev supports the most efficient, effective, and sustainable projects in the field. It is generally not bound by strict policies, guidelines, treaties, or bilateral agreements with partner countries, which allows for flexibility and nonbureaucratic changes. EnDev’s multidonor governing board does not prioritize national interests over its overarching goal of providing individuals, social institutions, and small and medium-size enterprises in developing countries with modern energy technologies.

Annex A  EnDev’s Outcome Monitoring Procedure

1. Data collection on target group level by partners
   - List of customer/beneficiaries from NGO/salesman or counting of beneficiaries in villages
   - Beneficiary must be identifiable (minimum information: full name and address; if possible, GPS data)

2. Data quality control by country project
   - Spot checks in the field and plausibility checks of gross figures
   - Data transfer to EnDev Head Office through wiki entries and excel files

Annex B  People Interviewed

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<thead>
<tr>
<th>Name</th>
<th>Title</th>
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<tbody>
<tr>
<td>Carsten Hellpap</td>
<td>Program Director, Energising Development Partnership (EnDev), Germany</td>
</tr>
<tr>
<td>Verena Brinkmann</td>
<td>Coordinator Kenya, EnDev, Germany</td>
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<tr>
<td>Bernhard Herzog</td>
<td>Coordinator Mali, EnDev, Germany</td>
</tr>
<tr>
<td>Marco Hüls</td>
<td>Coordinator Eastern and Southern Africa (Mozambique), EnDev, Tanzania</td>
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Bibliography


GIZ operates throughout Germany and in more than 130 countries worldwide. Their registered offices are in Bonn and Eschborn. They have 16,410 staff around the globe, almost 70 percent of whom are employed locally as national personnel. There are also 785 development workers currently carrying out assignments for GIZ. In addition, CIM—which is jointly run by GIZ and the German Federal Employment Agency—places experts with local employers. At the end of 2014, GIZ had concluded subsidy agreements with 481 integrated experts, while 473 returning experts were receiving financial support and advice. GIZ’s business was more than €1.9 billion as of December 31, 2013.

© 2016 Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). GIZ implemented this project on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ). All rights reserved. The findings, interpretations, and conclusions expressed in this work do not necessarily reflect the views of GIZ. GIZ does not guarantee the accuracy of the data included in this work.
In Bangladesh, around 80 percent of the population live in rural areas, which are strongly deprived of access to electricity. This situation has significant impact on the living conditions and possibilities for income generation of the population. The National Energy Policy of 2002 commits to "bring the entire country under electrification by the year 2020." The Infrastructure Development Company Limited (IDCOL), a state-owned nonbanking financial institution that administers financing for rural energy and renewable energy development projects, launched the Solar Home System (SHS) program. SHS would provide cost-effective electricity to the rural population of Bangladesh. The SHS program was designed to contribute to the improvement of living conditions and a decrease in poverty.

Program Results: Approximately 3 million SHS have been installed in off-grid rural areas of Bangladesh, serving about 9 percent of the total population. In rural areas the rate of people with access to electricity is up to 40 percent from about 25 percent at the beginning of the program.

Executive Summary

In Bangladesh, around 80 percent of the population live in rural areas, which are strongly deprived of access to electricity. This situation has significant impact on the living conditions and possibilities for income generation of the people.
The research was carried out by reviewing project documents and carrying out interviews with people involved in the program, particularly from IDCOL. It was found that both IDCOL and the POs face a number of implementation challenges, particularly in assuring a high technical quality of the installed SHS and in managing credit risks and dealing with loan defaults by the customers. A further challenge lies in coordinating the installations of SHS with grid expansion activities in order to avoid redundant electrification solutions and hence, a misallocation of resources. Also, ensuring environmentally and socially sound disposal of used SHS batteries has proven to be all but trivial.

Despite certain difficulties in overcoming the mentioned challenges, all in all, the program has been very successful. By April 2014 a good 3 million SHS had been installed in the off-grid rural areas of Bangladesh. KfW contributed to the financing of 444,000 SHS.

One of the principal factors that contributed to this success is the unique financing and service scheme where installation and maintenance of the SHS but also the extension of loans and collection of payments are done by local POs. For this reason this study focuses to a certain extent on their role and capacities in implementing the program.

Introduction to the Case Study

Access to electricity in Bangladesh is one of the lowest in the world. In 2005, only 30 percent to 35 percent of the country’s population were connected to the electricity grid. However, without electricity, possibilities for generating income and improved access to education and health services are made difficult, and with a per-capita income of only US$400 per year (2003), Bangladesh was among the poorest and least developed countries in Asia. Rural areas, where around 80 percent of the population live, were particularly disadvantaged, with only around 25 percent of the population in those areas having a grid connection (delivery gap). An increase in electrification was urgently needed in order to contribute to economic development and, hence, combat poverty, especially in rural areas which relied mainly on traditional subsistence farming. This can be described as being one of the principal development challenges which needed to be overcome in order to contribute to ending poverty and enhancing the quality of life of the Bangladeshi population.
Delivery Challenges

Bangladesh faced four delivery challenges in improving access to electricity in rural areas:

- **Lack of financing.** Funds were needed for the initial purchase and installation of SHS, and credit financing would have to be arranged to make loans to customers to purchase the systems.

- **Limited technical knowledge and capacity.** Specifications for SHS would have to be written and sources of supply found. Companies and their employees would have to be trained in the installation and maintenance of SHS.

- **Institutional weaknesses that delayed the rapid increase of electrification.**

- **Adjustment to existing energy policy.** Bangladesh’s energy policy (together with the financial and technical support of donor institutions) was focused primarily on grid extension. However, it is estimated that only about 70 percent of the rural population can be electrified through grid extension at a reasonable cost. It was clear that under this policy the very rural population living far away from the national grid would be left out. Therefore, stronger financial and technical support for off-grid electrification was required.

The delivery challenge that prevented the government of Bangladesh from achieving quick and sustainable results in this area can be described primarily as a performance gap consisting of a lack of financing means, technical knowledge and capacities, as well as institutional weaknesses which delayed a rapid increase of electrification (particularly off-grid). On the other hand, a design gap in the government of Bangladesh’s energy policy could also be identified: The country’s electrification efforts (together with financial and technical support of numerous donor institutions) were focusing primarily on grid extensions. However, it is estimated that only up to 70 percent of the rural population could be electrified through grid extensions at reasonable costs. With such a policy it was clear that particularly the very rural population living far away from the national grid would be left out. Therefore, stronger financial and technical support for off-grid electrification solutions was required.

Against this background, in 2003 the Infrastructure Development Company Limited (IDCOL) launched its Solar Home System (SHS) program. IDCOL is a state-owned non-banking financial institution that administers financing for rural energy and renewable energy development projects. From 2007 on the SHS program was supported by KfW aiming to contribute to the provision and usage of 100,000 SHS in regions with difficult access in Bangladesh. By pursuing this objective, modern electricity services were to be provided to the population in rural areas of Bangladesh while relying on climate-friendly, renewable energy in a cost-effective way and with involvement of the private sector. By supplying electrical energy for lighting, communication, information technology, as well as for productive uses, the SHS program intended to contribute to the overarching developmental goal of improving the living conditions of the rural population and decreasing poverty.

This case study covers the steps taken related to the service delivery, namely the organization and implementation of the SHS program, as well as its outcomes. Although the delivery processes are strongly influenced by the particular contextual conditions described, the main lessons learned are believed to be potentially applicable also to other similar projects and situations. Against this background, this case study will not only describe the service delivery processes and outcomes of the program, but it will be guided by the following three core research questions:

**Question 1:** What are the main factors that promote successful implementation of SHS programs?

**Question 2:** Which specific challenges or difficulties did the program face and what can be learned from these experiences?

**Question 3:** Which factors promoted or hindered the transition of IDCOL’s program to a commercially viable market for SHS and which challenges needed to be overcome?

Revisiting the SHS program and analyzing the guiding questions above within this case study contribute to gaining knowledge and giving useful insights which may be applied in the implementation of future development programs.

**Contextual Conditions of the Case Study**

It is a generally accepted fact that energy is one of the basic ingredients required to alleviate poverty and socioeconomic development. In Bangladesh this counts
especially for rural areas, where 80 percent of the population live, and which therefore play a major role in terms of agricultural production and other economic activities as well as everyday life. However, Bangladesh's National Energy Policy (NEP) of 1996 stated as one of the shortcomings of past energy development programs that “adequate attention has not been given to meet the total energy needs of rural areas.” The policy document points out that “for overall national development there is a need to pay special attention so that the energy needs of rural areas for subsistence and productive requirements (e.g., agriculture, industries, and transport) are met on a sustainable basis.” Against this background it was defined as one of the primary objectives of the NEP “to meet the energy needs of different zones of the country and socioeconomic groups.” An updated version of the NEP in 2002 added a further objective with regards to electrification, specifically “to bring the entire country under electrification by the year 2020,” which is in line with the Government of Bangladesh's Vision and Policy Statement of February 2000.

To support this ambitious goal, several donors (especially ADB, USAID, and DFID) have been supplying considerable amounts of ODA financing for the extension of distribution grids. However, due to the remoteness and low consumer density of many rural areas, major electrification through grid expansion is not a financially viable option. On the distribution level alone, the initial investment costs per household connection in rural areas are estimated at US$240 to US$400. In order to reach also the last 30 percent of the rural population these costs would be considerably higher yet. Many rural electricity cooperatives which have been brought to life under the Bangladesh Rural Electrification Program (of the Bangladesh Rural Electrification Board, BREB) in order to expand distribution systems are in fact making losses. Against this background, the Government of Bangladesh decided to focus increasingly on decentralized electrification solutions based on renewable energies. In fact, concerning the increased use of renewable energies, the NEP of 2002 states: “Priority will be given to the rural areas where national grid expansion is expensive. This will reduce the pressure on the demand of commercial power supply and will help to avoid costly grid expansion and will also keep environment pollution free.” Furthermore, the NEP points out that “innovative new financing opportunities including microfinancing may be utilized to attract private capital to supplement the energy deficiencies in the rural areas and thus to fulfill the aspiration of the poor people.”

These developments led to the start of the Solar-Home System (SHS) Program in 2003, which is being implemented by IDCOL. By April 2014 a good 3 million SHS had been installed under the program in the off-grid rural areas of Bangladesh. IDCOL has a target to finance 6 million SHS by 2017, with an estimated generation capacity of 220 MW of electricity. KfW contributed to the financing of 444,000 SHS.

In fact, the program has been so successful and demand for SHS has become so high that in recent years a parallel and unregulated market for SHS has established itself. In this market products of lesser quality are being offered and environmental standards (for example, for the disposal of used batteries) are not being applied. This presents a big challenge for IDCOL's program and puts in jeopardy the sustainability of SHS promotion and use in Bangladesh.

Finally, in 2008 Bangladesh enacted the long-awaited Renewable Energy Policy (REP) which also emphasizes the role of renewable energies for rural electrification, and in 2013 (after many years of preparation) the new Sustainable and Renewable Energy Development Authority (SREDA) came to life, whose task it is to support the implementation of the REP.

**Tracing the Implementation Process**

**Previous Experiences with SHS Prior to IDCOL's Program**

Bangladesh had already had some experiences with SHS prior to the start of IDCOL's program. From 1997 until 2003 approximately 11,000 SHS were established in off-grid areas largely on a subsidy basis. Implementation was carried out by Grameen Shakti, BRAC Foundation, and several other nongovernmental organizations (NGOs), most of which are also involved in IDCOL's SHS program. Apart from that, BREB and the Local Government Engineering Division also implemented around 900 SHS pilot projects. Although these early projects were only successful to a limited extent, IDCOL did learn about the organizations implementing the solar programs and the technology being used and therefore could benefit to some degree from these previous experiences.
Launch of the IDCOL SHS Program

IDCOL launched its SHS program in 2003 aiming to ensure access to clean electricity for the off-grid rural areas of Bangladesh and to thereby contribute to the Government of Bangladesh's goal of reaching 100 percent electrification by 2020. The program started out as a part of the Rural Electrification and Renewable Energy Development Project (REREDP) funded by the World Bank and the GEF. The major component of REREDP was grid electrification, however US$33.7 million was also made available for the dissemination of SHS, which was to be implemented by two parallel approaches by BREB and IDCOL. While BREB pursued a fee-for-service approach with a total funding amount of US$8.8 million IDCOL's approach was based on an ownership model and total funds of US$24.9 million. The aim for BREB's component was to install a total of 14,000 SHS while IDCOL was to achieve 50,000 systems, both to be achieved by June 2008.

In the fee-for-service model, an energy service company (ESCO) carries out the investment in SHS and sells the electricity produced at a fee to the consumer. The ESCO remains the owner of the hardware and is responsible for installation, maintenance, and repair including the replacement of components such as controllers and batteries. The end user pays a connection fee and a regular fee—usually monthly, though a fee per kWh is also possible. The end user pays as long as the energy service is delivered and never becomes the owner of the system. However, the end user usually owns the wiring, lamps, and appliances, which are covered by the connection fee.

In the ownership model, on the other hand, a supplier sells the SHS to the end user, who enters into a credit arrangement with the supplier. The ownership of the system is transferred to the consumer when the loan is completely repaid. The suppliers are in charge of maintenance and repairs, which guarantees a higher level of technical expertise. The ownership model was chosen by IDCOL as it was believed to offer better chances of being translated into a sustainable business model, due to closer involvement of the consumers through their actual ownership of the systems. In fact, IDCOL was able to implement its component much quicker than BREB, who got stuck in lengthy procedures of coordination and procurement and could advance only very slowly. While BREB just managed to achieve the goal of 14,000 SHS by June 2008, IDCOL had reached its aim of 50,000 SHS almost three years ahead of schedule. BREB did not further pursue any activities to disseminate SHS following the completion of the REREDP, whereas IDCOL continued on the basis of the ownership model and with the support of several additional donors, and the program is still running very successfully today. It is generally assumed that, at least for the specific case of Bangladesh, the ownership model has advantages in comparison to a fee-for-service approach. Mainly this is due to the simple fact that households prefer to be the actual owners of the systems that are installed on their roofs. This ownership creates a feeling of responsibility and leads to increased caretaking of the systems.

The Concept of IDCOL's SHS Program

The basic mechanism of IDCOL's SHS program is that IDCOL provides a combination of grants and loans to a number of partner organizations (POs), which pass on the financing means to end users, procure and install the SHS, and provide after-sales service. The users

Partner Organizations

Local partner organizations (POs) are the key players in implementing IDCOL's SHS program. On the one hand they are in charge of passing on the loans to the customers and collecting the installments. On the other hand they are responsible for technical installation of the SHS and carrying out maintenance services. Today the program includes 47 POs with a total of around 5,800 field offices and roughly 70,000 employees all over the country.

The POs vary largely in size and monthly installation rates with Grameen Shakti (GS) being by far the largest one, accounting for about two thirds of all SHS installations under the program. In fact, GS is currently one of the largest and fastest-growing rural-based renewable energy companies in the world. Apart from promoting SHS, GS is also involved in the distribution of improved cooking stoves, biogas plants, and organic fertilizer in Bangladesh. GS has set up 45 Grameen Technology Centers (GTCs) under a pilot program to scale up its capacities and train solar technicians.
themselves have to make a down payment of 10 percent of the total costs of the SHS. IDCOL is in charge of overall project management and monitoring, defining the regulations for loan disbursement to the POs, and setting the technical standards for SHS components and installations. However, the POs are the key players in the program, as they are responsible for technical installation and maintenance services as well as for loan disbursement and installment collection. In order to assume part of the financial risk involved and “prove their commitment,” the POs have to contribute a share of the costs of the SHS which is also passed on to the consumers as part of the loan (about 20 percent of the loan amount).

The POs face a number of challenges which need to be properly dealt with in order to successfully implement the program. These are:
- Installing SHS only in those regions which will not be serviced by the electricity grid in the near future
- Assuring high technical quality of the installed SHS
- Implementing an appropriate credit risk management in order to reduce the amount of loan defaults by the customers

IDCOL too has to face several implementation challenges:
- Selecting appropriate POs and ensuring sufficient knowledge and capacities on their side
- Monitoring technical and financial performance of the SHS and POs and implementing procedures for improvement
- Implementing and enforcing quality standards for SHS as well as regulations for disposal of used batteries

These challenges will be revisited below.

The strong point of the program lies in the fact that the POs have a permanent presence in the rural areas, and perform any required maintenance free of charge throughout the duration of the loan when they collect the monthly payments at the customers’ homes. In case any urgent problems arise in between installment collections, the POs will send a representative to carry out the corresponding maintenance or repair works as quickly as possible. If any components fail, the outlet of the partner organizations is less than 15 kilometers away, and a replacement can be easily obtained. After the end of the three-year loan period there is the option of signing a maintenance contract with the PO including regular maintenance visits at a cost of about US$4 per year. However, most customers prefer having maintenance and repairs done only when urgently required and paying the nominal cost for each individual service. PO representatives are generally available most of the time for these customers. Components whose guarantee period is longer than three years (e.g., five years for batteries, 20 years for the solar panels) will continue to get repaired or replaced at no cost to the customer beyond the three-year loan period.

The customers can opt for a 24- or 36-month loan period. To date most have chosen the latter. The POs provide loans with a 6 percent interest rate to the customers. The SHS itself is used as collateral in case the loans are not repaid. Refinancing of the program is made possible via soft loans (with a duration of 8 to 10 years) supplied by IDCOL to the POs. IDCOL receives the required funds from the government of Bangladesh, which in turn receives them from the donor community. The level of grant subsidies was to be reduced over time and eventually phased out with increasing number of systems installed with the intention to transition to a commercially viable SHS market.

Initially the program included SHS consisting of PV modules with a capacity ranging from 30 to 75 Wp. Additionally, the systems include a battery, charge controller, cables, installation materials, and lamps. With such a system it is possible to operate about 4 lamps and a black-and-white TV for more than 4 hours per day. Since numerous households were not able to make a down payment of 10 percent for this type of system, starting in the second half of 2008, IDCOL started offering also SHS with a rated power below 30 Wp in order to enable poorer households with lesser financial means to be electrified also. For even poorer households IDCOL is currently considering to also include smaller systems, i.e., pico solar with a capacity of 3 to 5 Wp.

**Beyond the REREDP and KfW Contributions**

As already mentioned, IDCOL has continued with its SHS program beyond the duration of the REREDP. In addition to the World Bank and GEF several other donors joined the program, namely GIZ, ADB, DFID, GPOBA, IDB, JICA, KfW, and USAID. IDCOL maintains a separate account for each participating donor in order to keep the individual contributions well separated. While disbursing grants and loans to the POs, the respective funds are recorded under the corresponding...
donor account. In fact, IDCOL’s centralized database has the possibility of depicting the source of funding for each individual SHS.

KfW’s contribution was based on a cofinancing scheme with GIZ, which was also supplying grants funded by the Dutch Government in the scope of the Energising Development program. Today, GIZ is still working together with IDCOL in areas such as technical advice on SHS component quality and battery recycling.

In detail, KfW’s financial contribution was to be split up between the different components as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Euros (million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment grants for SHS</td>
<td>4.6</td>
</tr>
<tr>
<td>Refinancing facility for SHS</td>
<td>9.7</td>
</tr>
<tr>
<td>Investment grants for productive use pilot projects</td>
<td>1.0</td>
</tr>
<tr>
<td>Consultancy services</td>
<td>0.7</td>
</tr>
<tr>
<td>Contingencies</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>16.5</strong></td>
</tr>
</tbody>
</table>

The 100,000 SHS that were to be implemented with the help of KfW’s contribution were to be financed as follows:

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Euros (million)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant from KfW</td>
<td>4.6</td>
<td>14</td>
</tr>
<tr>
<td>Loan from KfW</td>
<td>9.7</td>
<td>30</td>
</tr>
<tr>
<td>Loan from IDCOL</td>
<td>8.9</td>
<td>28</td>
</tr>
<tr>
<td>Loan from POs</td>
<td>4.8</td>
<td>15</td>
</tr>
<tr>
<td>Users’ own contribution</td>
<td>4.1</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>32.1</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The time plan for KfW’s involvement was based on the assumption that 2,500 SHS could be installed per month. However, it soon became clear that actually more than 6,000 SHS were being installed per month, and so the number of 100,000 SHS was reached after just about one and a half years in the third quarter of 2008.

However, since other donors (especially the World Bank) were providing considerable loan resources, only the grants from KfW’s financing contribution were needed for these 100,000 SHS. In fact, since there was a shortfall of grant support from other development partners, in 2009 the KfW refinancing facility was transformed into investment grants as well. By doing so it was eventually possible for KfW to contribute to the installation of 440,000 SHS instead of the initially planned 100,000 systems, though with a smaller contribution to each installed system. By 2012 the investment grants had been fully disbursed and corresponding activities by KfW came to an end. As of April 2015, KfW’s contributions in the area of pilot projects for productive use have also been fully disbursed. About €1 million for these projects has been used for the installation of several commercially operated PV irrigation systems as well as two PV-diesel hybrid mini-grids. However, these projects will not be further analyzed in the scope of this study, which focuses on the SHS component.

**Steering of IDCOL’s SHS Program**

From the very beginning on steering of IDCOL’s SHS program has been carried out by an Operations Committee comprising representatives from IDCOL and all of its POs. The committee meets once every month in order to look after the operational and business aspects of the program, coordinate activities of the individual POs and take strategic decisions. Participating development partners are also invited to attend the monthly meetings. Specifically the tasks of the Operations Committee are to:

- Review project implementation status,
- Resolve issues/disputes relating to project implementation among and between the POs, equipment suppliers, etc.,
- Propose and implement policies relating to the promotional activities, quality assurance programs, etc.,
- Review compliance status of the POs relating to collection efficiency, environmental safeguards, after-sales services, maintenance and repair, etc.,
- Decide about financing terms, i.e., interest rate, tenor, as well as amount of subsidy, and
- Ensure better coordination among the POs in implementing the program.

Apart from the Operations Committee there is a PO Selection Committee in charge of selecting POs through a fair, transparent, and competitive process. The PO Selection Committee was also founded at the very beginning of the program. The major criteria were agreed upon by IDCOL and the development partners and include a fully developed business plan, adequate staffing, staff qualification and technical/microfinance experience, minimum size (number of beneficiaries of MFIs), etc. The PO Selection Committee is headed
by the Director General of the Bangladesh Institute of Development Studies, a nodal research organization of the country. Other members include representatives from the NGO Affairs Bureau, the Economic Relations Division, and the BREB. The Palli Karma Shohayak Foundation is also represented, a nonprofit company with the principal objective of providing funds to various organizations for their microcredit programs with a view to helping the poor. While in the beginning of the program there were only five POs, the number has risen to a total of 47 today, and a few more POs are currently in the selection process. The total number of branches of the POs amounts to about 5,800 throughout the country.

Finally, the SHS program also includes a Technical Standards Committee (TSC), which was formed at the very beginning of the program with the task of setting forth the technical specifications and standards of solar equipment to be used under IDCOL's program. Furthermore, the committee is responsible for approving solar equipment based on its meeting the required technical specification and criteria and reviewing product credentials of dealers. Grant and credit support is restricted to only those systems which have been officially approved by the TSC. The committee comprises reputed technical experts in the RE sector from universities, engineering departments of govt., and IDCOL.

**Coordination with Grid Extension**

In order to prevent that SHS be installed in rural areas also about to receive a connection to the power grid, it is of utmost importance to coordinate the activities of the SHS program very well with the government's grid extension plans. Against this background the Implementation Agreement between KfW and IDCOL obliged IDCOL to assure through “appropriate agreements with the POs” that they would install SHS only in areas that had not yet been connected to the power grid and where such a connection could not be expected in the near to medium-term future.

Generally, it is BREB that is responsible for grid expansion in rural areas of the country and it has elaborated a Master Plan with details of the intended grid extensions. However, according to IDCOL, the POs of the SHS program do not have access to that plan. Even the deputy CEO of IDCOL, with whom extensive communication was carried out in the scope of this case study, says that he has not seen the Master Plan since “it is not available in the public domain.” Possibly it is kept confidential in order not to cause commotion in the rural population (because some areas shall be connected before others). Only recently has IDCOL written to BREB requesting to share the grid expansion plan and is currently waiting for a response. It is currently not clear if the Master Plan is being followed or not. In light of this situation, it is difficult for the POs to know where and when the grid will be expanded.

Still, the rules of IDCOL's program define that in case the electricity grid is extended to a location of a SHS within 6 months of installation, then the value of that system is deducted from subsequent eligible disbursements to the POs. It is therefore the POs who carry the risk of the grid being extended to regions where they are active and who suffer from financial losses if the grid extends sooner than expected. Up to now, out of a total of approximately 3 million SHS there were about 95,000 cases where the electricity grid was extended within six months of installation, which corresponds to 3.2 percent of all installed SHS. If the grid extension plans of BREB were made available to the POs, this number could certainly be significantly reduced. Furthermore, if a grid extension happens within five years of the installation of a SHS the customer has the right to sell it back to the PO at a reduced price. However, experience shows that returning of SHS due to grid expansion is not common, since people tend to keep the system as a backup for the frequent times of grid outages.

**Recycling of Used Batteries (and Solar Panels)**

Another important issue was the disposal of used batteries, which through the lifetime of a SHS need to be replaced several times. Under IDCOL's SHS program the manufacturers are required to provide five years of warranty for batteries used in systems with a capacity of 30 Wp and above and three years for smaller ones. It is the responsibility of the POs to collect expired-warranty batteries from the users and return them for recycling. In reality, most batteries are used well beyond their warranty period as they are still functional. In fact, IDCOL has a team of 10 full-time inspectors to check the status of expired-warranty batteries. So far, only about 4 percent of inspected batteries had actually been returned for
recycling since they were still working satisfactorily after the warranty expired.

Recycling of batteries means mainly that the lead and, in particular, lead oxides are processed to pure lead for further use as raw material again. Other components such as the plastic casings are also separated and reused. It is the recovery of the lead in the batteries and the potential spilling of acid that are harmful to environment and health if respective procedures are not being followed. However, a significant fraction of used batteries were initially being dismantled and refined under uncontrolled conditions (mainly by recycling the lead and lead oxides in open charcoal fires, a process called smelting) in the informal recycling sector. This caused significant harm to the environment (lead dust deposits) and health of workers and neighbors. Since by ignoring environmental and health standards recyclers in the informal sector have lower costs, they are able to offer the highest prices for used lead acid batteries, which again was an incentive to sell used batteries to the informal sector. By the end of 2012 according to a report by KfW's monitoring consultant, it is estimated that a significant share of SHS batteries were not being recycled correctly in the formal sector.

Against this background, in 2013 IDCOL introduced incentives under which the POs receive US$5 for collection of each expired-warranty battery and the recyclers receive an equal amount for eco-friendly recycling of each battery. In order to receive the incentive, the battery recycling facilities are required to be certified under ISO 14001 (Environmental Management) and OHS 18001 (Workers Health & Safety). This incentive is available for 200,000 recycled batteries, so it is intended as a temporary measure and not a permanent subsidy. To date about 35,000 batteries have been recycled under this incentive mechanism and so far it has increased the rate of batteries recycled in the formal sector by IDCOL-approved recyclers to 70 percent. Furthermore, POs cannot replace old batteries with new ones without collecting the former. This avoids sale of used batteries directly by the users to the informal sector. IDCOL also provides a soft refinancing facility so that customers can buy new batteries in installments. This refinancing facility is also not available unless the old battery is collected and recycled. The customers themselves receive a salvage value amounting to 24 percent of the cost of a new battery from the POs, which is deducted when an expired-warranty battery is replaced by a new one. Together it is expected that these incentives will further raise the share of SHS batteries which are properly recycled in the formal sector.

Concerning the disposal or recycling of the solar panels themselves, a concept has not yet been developed by IDCOL. Since the required warranty for solar panels is 20 years it seems “too early to consider this issue at the moment” and work on developing mechanisms and regulations for eco-friendly disposal of solar panels shall begin at a later time into the program.

**Technical Monitoring of SHS and Quality Assurance**

Since the beginning of the SHS program IDCOL has been carrying out a strict monitoring and quality assurance program in which it maintains 12 regional offices across the country in order to carry out inspections of the technical quality of SHS installations. It is a donor requirement that IDCOL inspects and verifies the quality of 50 percent of the installed systems before extending the grants to the POs, thereby linking the grants to the quality of the installations. In fact, about 50 percent have actually been inspected to date, but IDCOL’s own goal is to eventually inspect all installed SHS. IDCOL has continuously increased its inspection staff and today there are 144 inspectors, each of them capable of inspecting more than 350 systems a month, which adds up to a total number of over 50,000 monitored SHS per month. Still it will be difficult, if not impossible, to achieve inspections of all SHS installed under the program. Furthermore, initially problems were observed in data processing with long processing times and losses of data. However, according to IDCOL, these limitations have been mitigated by now, having decentralized the inspection department into regional offices with online submission of data to a centralized database with adequate backup support.

In addition to IDCOL’s own monitoring and quality assurance program, KfW also carried out a monitoring program in which a technical review of SHS (as well as a review of financial performance of the POs which will be described later on) was carried out. KfW’s monitoring program was implemented by a consulting firm in the years from 2007 to 2012. The consulting assignment was implemented in three phases (covering not the entire period, but having some gaps in between), and a total of 11,371 SHS were monitored, which corresponds to
Negligible observations such as shading or wrong angle of the solar module, which can be corrected locally. Observations that need attention such as the use of inferior quality wire or components not eligible to the technical standards. Installation deficiencies (problems) which require immediate repairs to prevent technical failure of the SHS, such as damage to or bypassing of the charge controllers.

In the first monitoring phase (June 2007 to May 2009) 1,598 SHS were monitored and it was found that 4 percent of all monitored systems had installation deficiencies, 27 percent of the systems resulted in observations that needed attention, and for 10 percent of the systems only negligible observations were made. This means that 59 percent of the SHS were installed correctly. According to the TOR of the first phase of the assignment, the monitoring procedures provided only a snapshot of the systems’ status shortly after their installation. Therefore, the consultant proposed that in future monitoring also older systems should be included in order to assess how the technical performance changes over time. Critical times in the systems’ life cycle were seen to be at the end of the loan and maintenance period after three years as well as with the end of the batteries’ lifetime. An intensive monitoring of sample SHS covering at least a five-year period after installation was recommended.

This recommendation was implemented in the second monitoring phase (November 2009 to February 2011) where out of a total of 6,082 monitored SHS now only 4,890 were "new systems" (date of monitoring less than twelve months after installation) and 1,192 were "old systems" (date of monitoring more than 24 months after installation). This corresponds to a share of new systems of about 80 percent. Unfortunately, the consultant’s monitoring reports do not mention how old exactly the "old systems" were. Therefore, it remains unclear if these were still within the loan and maintenance period and the batteries’ expected lifetime. The overall results for this phase showed a decrease in technical performance of the systems with now 7 percent of the systems having installation deficiencies, 72 percent with observations that needed attention, and 4 percent with negligible observations. Hence, the number of correctly installed systems without any observations had dropped from 59 percent in the first phase to only 17 percent in the second phase. On the one hand this was due to the older systems included in the samples simply having a larger number of technical issues, which underlines the importance of proper and frequent maintenance. On the other hand it was clearly observed that also the technical performance of newly installed systems had become worse compared to the first monitoring phase. This led to the consultant making the recommendations to the TSC that it should impose standards for the wiring installation (like maximum cable length and cable diameters, quality and mandatory use of connectors, or correct wiring of charge controllers). In consequence, in the second half of 2010 such a checklist for the installation was then issued by the TSC to all POs.

The third monitoring phase (April 2012 to December 2012) then showed that the POs’ more stringent briefing in fact had a positive impact on the technical performance of the inspected SHS. In this phase, out of a total of 3,691 monitored systems, 2,764 were new ones and 927 were old systems. This corresponds to a share of new systems of about 75 percent, so the number of included old systems was now slightly higher than in the second monitoring phase. Furthermore, the definition of new systems had been changed to having a date of monitoring less than six months after the installation. So, compared to the second monitoring phase, the inspected systems were on average slightly older. Like in the second phase, again 7 percent of all monitored systems had installation deficiencies, but the number of systems with observations that need attention was reduced to 55 percent. The number of systems with negligible observations remained small at 6 percent. This means that 32 percent of all monitored systems were flawless, which is almost double the amount compared to the second monitoring phase. In spite of these improvements from the second to the third monitoring phase, the amount of flawless systems was still quite low, with only about one third of all inspected SHS. Against this background the consultant emphasized once more that the focus of the SHS program should lie on the quality of installation and not only on installation rates. The final report highlighted the importance of proper initial installation work, which avoids further attention especially regarding wiring and cabling. Furthermore, the final report pointed out that the POs should inform their existing and new customers.
Solar Home Systems in Bangladesh

that bypassing charge controllers (which is sometimes done in order to be able to extract more energy from the batteries) significantly reduces the lifetime of the batteries and that in this case, customers cannot claim warranty. In summary, at the end of the entire monitoring period, the technical performance of the installed SHS was still not fully satisfactory. Apparently, still not all solar technicians of the POs were strictly following the defined installation procedures and there was still a number of customers bypassing the charge controllers. But it shall be emphasized that a positive trend toward improvement of technical performance of the SHS is evident.

Monitoring of Financial Performance of the POs

All POs are obliged to report their installation figures and financial details, such as collection efficiency and overdue collection rates, to IDCOL on a monthly basis. Hence, the program is transparent in terms of financial performance of the POs. Still, KfW’s monitoring program also included visits to a number of field offices of the POs in order to verify the reported numbers. The monitoring results revealed significant discrepancies between the collection efficiency reported by the POs to IDCOL and the sample audits carried out in the POs’ field offices. In the first monitoring phase up to mid-2008, the reported collection efficiency (percentage of due payments which have actually been made) was above 95 percent for all POs while the collection efficiency actually found at the visited field offices was far less, sometimes even below 50 percent. The reasons for these differences are not fully clear, but it is assumed that wrong numbers were deliberately being reported to IDCOL. A possible explanation is that according to IDCOL’s rules, systems installed by branches which fail to ensure an overall collection efficiency of at least 80 percent can be excluded from financing through IDCOL. In principle, POs could also be (temporarily) excluded from the program on account of insufficient collection efficiency, but so far this has not happened.

This situation was financially worrying, since it was found that POs were hardly able to collect any overdue debt. On the one hand, the reasons could be seen in simple financial inability of the customers to pay their installments. On the other hand in some cases it was also unwillingness to pay due to customers not being satisfied with the quality of the SHS installments. Consequently, the overdue portion of the portfolio was growing constantly in comparison to the regular portfolio, and the overall credit risk was rising. In order to improve this situation, IDCOL and the consultant facilitated a workshop for POs in April 2008 about credit risk mitigation techniques. Furthermore, the consultant supported IDCOL in the development of risk management guidelines.

While in the aftermath of the workshop and development of guidelines the numbers reported by the POs to IDCOL reflected reality better than before, the reality itself did not instantly develop very much for the better. The consultant’s final report from the third monitoring phase, which ended in December 2012, states that “Financial management of the program is a major concern in the consultant’s opinion. The results of the financial monitoring are highly worrying and, as has been pointed out at various occasions, put in danger the overall good results of the program.” Roughly 25 percent of the visited field offices still had delinquency rates of 30 days exceeding 50 percent, meaning that over half of the portfolio was paid considerably late and could be considered as nonreceivable amount. However, finally borrowers pay up in the end, even if it is after the 30-day threshold defining nonperforming loans, as evidenced by the overall collection efficiency of more than 90 percent. Another 25 percent of field offices showed delinquency rates between 10 percent and 50 percent, which is also considered as being too high in the context of sound financial management. Apparently, the fact that the SHS themselves act as collateral could not be considered to be sufficient, as massive removal of SHS for reasons of nonpayment have not been tested and would present serious challenges to the POs. The monitoring results of the economic performance of the POs indicate that there were significant deficiencies in the implementation of the financial risk management guidelines which had been developed with the support of the consultant. The last monitoring report concluded that “the build-up of credit risk within the SHS program is enormous” and “the economic sustainability of the entire SHS program is in danger.” The urgent recommendation of the consultant to IDCOL was therefore to strictly enforce the financial risk management guidelines within the POs by enforcing, for example, sanctions such as the temporary exclusion of POs from the program if their collection efficiency drops below 80 percent.

IDCOL’s own initiatives to improve collection efficiency encompass a number of measures. For one,
IDCOL has initiated its own monitoring of collection efficiency by regularly auditing the financial numbers of the POs. Inspections of PO field offices are carried out on a random sampling basis and to date IDCOL's collection efficiency auditors have inspected 2,893 branches of the POs, which corresponds to about 50 percent of the total number. Furthermore, IDCOL pursues to improve loan repayment by the customers through insisting strictly on delivering quality products and services so as to at least reduce customers’ dissatisfaction as a motive for not repaying loans. Finally, IDCOL has also advised the relevant government and local government offices to assist IDCOL's POs in recovering loans, should this be required. According to IDCOL, by implementing these improvement measures, the overall collection efficiency reached today lies at 90 percent. Although 10 percent of the loan repayments by the users are outstanding, the POs all pay back their loans to IDCOL.

Clean Development Mechanism

In 2012, and with the support of the World Bank, IDCOL's SHS program was registered as eligible under the Clean Development Mechanism (CDM). This means that the reduced emissions of greenhouse gases by using renewable solar power for electrification can be sold as Certified Emission Reductions (CER). It is expected that by 2016 around 400,000 CERs will be generated which are being sold at a current price of € 9 per CER. Of this amount 75 percent goes to the POs and 25 percent is retained by IDCOL as fee. While broken down to the individual SHS this additional income may be minimal, it still represents an incentive to the POs and therefore contributes to the further success of the program.

Results of IDCOL’s SHS Program

IDCOL's SHS program is considered to be one of the most successful programs of its kind in the world. By April 2014 about 3 million SHS had been installed under the program in off-grid rural areas of Bangladesh. As a result, 13 million beneficiaries are getting solar electricity, which is around 9 percent of the total population of Bangladesh. Today, Bangladesh's overall electrification rate lies at around 60 percent. In rural areas the rate of people with access to electricity is up to 40 percent from about 25 percent at the beginning of the program. Of the rural population that today has electricity access, about one fourth is being supplied by SHS which were installed in the course of IDCOL's program. While to date full commercialization has been achieved for SHS over 30 Wp, this is not the case of systems below 30 Wp. However, these subsidies have been strongly reduced from US$90 per system at the beginning of the program to currently US$20. Reaching full commercialization of these systems remains a core aim of the SHS program.

Up to April 2014, more than 65,000 SHS were being installed every month under the program. Considering that at the start of KfW’s involvement in the program monthly installation rates of 2,500 systems were assumed, this must be considered as being an astonishing development with exponential growth rates. The reason for this rapid development lies in the fact that demand for SHS was simply much higher than initially expected. Furthermore, for the POs it was a very profitable business especially due to the rapid decrease in prices for SHS. This was caused on the one hand by general technological advances in the PV industry. But on the other hand, the price reductions were a result of an increase in the number of participating suppliers and of including local shares in the value chain. While initially all SHS of the program were imported at relatively high cost from a limited number of suppliers, as the program expanded, more and more suppliers got enlisted. Many local manufacturers started producing components, i.e., batteries, charge controllers, etc., and some suppliers started assembling their PV modules locally. Local assembly of PV modules and local manufacturing of solar batteries was actually supported financially by IDCOL due to a temporary lack of equipment supply in 2007. As a result of these developments, huge competition among the suppliers set in, which influenced the cost reduction as well as the availability of equipment. Due to these developments, the POs were seen to massively promote the SHS program, which again fueled demand.

In fact, IDCOL's program has been so successful that numerous entrepreneurs, many of them former employees of the program’s POs, have launched their own businesses to disseminate SHS apart from IDCOL’s program. However, the SHS offered in this market are considerably cheaper and of lesser quality. Furthermore, battery recycling in this market is likely to happen largely in the informal sector, something that IDCOL has strongly been trying to avoid and counteract. Due to the low price of the SHS in this market, there is a great demand, and in fact latest numbers show that the monthly installation rates in IDCOL's program have
been reduced to about 40,000 systems. It remains to be seen which market will dominate in the future and it can only be hoped that IDCOL’s efforts for introducing technical and environmental standards will not dissolve in the medium to long term. Currently, IDCOL is working in collaboration with SREDA to adopt a national standard for solar equipment to prevent pervasive expansion of poor-quality products in the unregulated market outside IDCOL’s program. Both SREDA and IDCOL have also undertaken awareness raising campaigns to discourage people from buying poor-quality products. In any case, IDCOL has a target to finance a total of 6 million SHS by 2017, with an estimated generation capacity of 220 MW of electricity, and it can be expected that the program will continue on a good path toward reaching this goal.

Lessons from the Case Study

This case study reveals a number of lessons about implementing off-grid electrification programs, particularly for the dissemination of SHS. These lessons are now reflected in the responses to the three research questions posed at the beginning of the case study:

**Question 1: What are the main factors that promote successful implementation of SHS programs?**

Clearly, one of the principal factors that made IDCOL’s SHS program so successful is the unique financing and service scheme where installation and maintenance of the SHS but also the extension of loans and collection of payments are done by local POs. Offering technical and financial services “out of one hand” ensures that customers are not “left alone” after system installation, and the regular debt collection activity leads to a continued relationship with the customers. This combination of technical and financial services is the critical element that is missing in many other countries where programs for the dissemination of SHS have been or are being implemented.

Naturally such a scheme relies critically on strong and capable POs. These must have the technical qualifications for delivering SHS installations and maintenance and repair services. Furthermore, the POs need to have knowledge in matters of credit risk mitigation and management in order to maximize their collection efficiency. Building capacities in both areas usually needs to be supported through respective training measures, especially when a program sees such strong growth rates as IDCOL’s SHS program and there is a corresponding need to continuously increase staffing of the POs. Applying rigid qualification procedures in the selection process of POs is equally important in order to ensure their general suitability.

Pursuing a high level of quality of the equipment, installations, and technical services is a further element which is of high relevance for successful implementation of SHS programs, not only because this will ensure a long lifetime of the installed systems, but also because the resulting customer satisfaction has significant impact on their willingness to repay the loans. One instrument in achieving this is the definition of strict and detailed specifications and performance requirements for the SHS and maintenance procedures. A further component is carrying out independent technical inspections of the systems and linking the provision of grant support to the achievement of a sufficient level of quality. The requirement of long warranty periods for equipment components (e.g., 20 years for panels, 5 years for batteries, 3 years for charge controllers) but also the obligation of the POs to establish post-warranty support structures also contribute to achieving and maintaining a high level of quality of the installations. Finally, it is necessary to also inform and educate the users in order to prevent improper handling of the SHS such as bypassing charge controllers, which leads to battery damages.

Another challenge that could be observed was that technical performance of the SHS has not been fully satisfactory throughout the course of the program. The last monitoring report of KfW’s consultant still identified 7 percent of all monitored systems having installation deficiencies and 55 percent with observations that needed attention. Due to the enormous demand and rapid growth of the program it was hard to ensure a high level of technical capacities with all POs and their technical staff. Furthermore, due to lack of better knowledge many customers were bypassing the charge controllers, which significantly reduces the lifetime of the batteries. This underlines the importance of accompanying POs and consumers with extensive activities for training and education.

Finally, for the specific case of Bangladesh, applying an ownership model has proven to be more successful than a fee-for-service approach. Mainly this is due to the fact that households prefer to be the actual owners of the systems that are installed on their roofs, and that this ownership creates a feeling of responsibility and leads to increased caretaking of the systems.
Question 2: Which specific challenges or difficulties did the program face and what can be learned from these experiences?

A program for off-grid electrification can only be successful in terms of maximizing access to electricity if it is well coordinated with activities for grid expansion. In the case of the SHS program in Bangladesh neither IDCOL nor the POs have so far had access to the grid expansion plan of the BREB and it is hard to comprehend why obtaining access has not been pursued at an earlier stage in the program. If necessary, the government should be involved in order to oblige BREB to share its grid expansion plan in order to avoid SHS installation in areas which are about to be connected to the electricity grid.

Another challenge that could be observed was that technical performance of the SHS has not been fully satisfactory throughout the course of the program. The last monitoring report of KfW’s consultant still identified 7 percent of all monitored systems having installation deficiencies and 55 percent with observations that needed attention. Due to the enormous demand and rapid growth of the program it was hard to ensure a high level of technical capacities with all POs and their technical staff. Furthermore, due to lack of better knowledge many customers were bypassing the charge controllers, which significantly reduces the lifetime of the batteries. This underlines the importance of accompanying POs and consumers with extensive activities for training and education.

Finally, ensuring environmentally sound recycling of used SHS batteries has proven to be a tedious and lengthy process, since initially the larger share of batteries was disposed in the informal sector. By introducing strict regulations and incentive schemes, IDCOL was able achieve significant improvements, but still a significant share of batteries are being recycled outside of the official scheme. The example from Bangladesh makes clear the outstanding importance of defining regulations and finding suitable mechanisms for their enforcement.

Question 3: Which factors promoted or hindered the transition of IDCOL’s program to a commercially viable market for SHS and which challenges needed to be overcome?

The aim of any subsidized program should be to reduce the subsidies over time and transition to a commercially viable, demand-driven (and not subsidy-driven) market. Announcing gradually decreasing subsidy levels itself can trigger the exploration of existing cost reduction potentials and result in decreased prices for SHS. However, cost reductions, and thereby a reduced need for subsidies, can and should also be promoted by other means.

In IDCOL’s SHS program this was achieved through the promotion of local manufacturing and assembly of SHS components. The resulting competition significantly contributed to cost reductions of the systems, making it possible to continuously reduce the level of required subsidies. In fact, the cost reductions that were achieved and the resulting increase in demand motivated numerous entrepreneurs to found their own businesses for the dissemination of SHS outside of IDCOL’s program. Since this parallel market is not regulated like IDCOL’s program, the SHS offered do not have to fulfill any regulatory requirements such as quality, environmental, and health standards. Therefore it is also possible to produce these SHS at clearly lower cost than the SHS which are disseminated by IDCOL, and subsidies are not required at all.

While the creation of a self-sustaining market is, in principle, a desired outcome, it needs to be pointed out that the SHS offered in this parallel market are of lesser quality. Furthermore, battery recycling in this market is likely to happen largely in the informal sector with all associated damages to the environment and health.

In order to counteract these effects, which eventually are a result of the program’s own success, IDCOL is cooperating with the Sustainable and Renewable Energy Development Authority (SREDA) in order to implement a national quality standard for solar equipment and carrying out awareness-raising campaigns in order to discourage users from buying poor-quality products.

How the Case Study Informs the Science of Delivery

The emerging framework of science of delivery (SoD) identifies five elements that are seen as important factors enabling SoD approaches. The findings of the present case study with respect to those five elements are as follows:

Focus on Measurable Welfare Gains of Citizens

The monitoring activities of IDCOL and KfW have so far focused on counting the number of SHS installed, carrying out technical inspections of the quality of the installed
systems, and overseeing financial performance of the POs. To the knowledge of the author of this study, monitoring of actual welfare gains of the beneficiaries has not been carried out by either party. However, according to KfW’s latest progress report, evaluations of the program carried out by the World Bank do point out the most relevant impacts achieved by the program. These include a general improvement of living conditions through increasing the reliability and quality of lighting (and other appliances): improved lighting extends the time of day which is available for education/learning as well as household and productive activities and operation of radios, TV sets, and charging of mobile phones allows for an improved access to information. Furthermore, the replacement of traditional lamps through SHS leads to a reduction of health hazards as well as environmental damages.

**Multisector, Interdisciplinary, Multistakeholder Approaches and Partnerships**

IDCOL’s SHS program involves a very large number of different stakeholders from various sectors. These include a total of 47 POs, numerous manufacturers of SHS equipment, recycling companies for used batteries, as well as a number of international donors. Coordination of the respective stakeholder contributions within the Operations Committee of IDCOL’s SHS program has been essential to managing such a complex initiative.

**Use of Evidence to Inform Experimentation, Learn, Adapt, and Measure Results**

Both IDCOL and KfW carried out extensive monitoring activities throughout the course of the program, the results of which triggered the implementation of measures for improvement. An example would be the monitoring of collection efficiency achieved by the POs resulting in workshops on credit risk mitigation techniques. Continued monitoring showed that the taken measures had effect and that collection efficiency could be improved. This procedure of measuring, taking action, and measuring again was also followed in the field of technical performance of the SHS where improvements could also be achieved. However, the experience from IDCOL’s SHS program shows that such learning processes can be lengthy and that improvements often only occur step by step.

**Change Management, Leadership, and Learning from Practitioners**

Previous to IDCOL’s SHS program, Bangladesh’s electrification efforts (together with financial and technical support of numerous donor institutions) focused primarily on grid extensions. However, it eventually became clear that for at least 30 percent of the rural population the costs of grid extensions would be prohibitive and that this part of the population would be left out. The realization of this situation triggered a decisive change in thinking which led to considerable efforts to promote off-grid solutions through SHS. IDCOL’s SHS program was initially launched under the Rural Electrification and Renewable Energy Development Project (REREDP) funded by the World Bank and the GEF, who thereby played a leading role in this change process.

**Being Adaptive, Flexible, and Iterative When Implementing Solutions**

The program has needed to adapt flexibly to a changing environment on several occasions and being able to do so has been an important factor for its success. Above all, it was necessary to react to a demand for SHS that exceeded all expectations. This led to a ramp-up of human resources and significant increase in the number of POs as well as support to local manufacturing and assembly of components due to a temporary lack of supply. Another significant change in the program’s environment is the creation of an unregulated parallel market for SHS, which has triggered actions by IDCOL in order to enforce quality standards also outside of its SHS program.
KfW has been helping the German federal government achieve its goals with respect to development policy and international development cooperation for more than 50 years. KfW’s role in the field of German development cooperation is that of an experienced bank and an institution specializing in development policy. On behalf of the German federal government, primarily the Federal Ministry for Economic Cooperation and Development (BMZ), KfW promotes and supports programs and projects that mainly involve state actors in developing and emerging economies—from their conception and execution through to monitoring their success.

To get closer to projects and programs in partner countries, KfW has regional offices in almost 70 countries in addition to offices in Frankfurt, Berlin, and Brussels.

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How to Expand Rural Area’s Power Supply in 1966–1978 through Rural Electrification Project

Abstract

This case study examines the Republic of Korea’s Rural Electrification Project, which was carried out by the Korean government and Korea Electricity Power Corporation (KEPCO) between 1966–1989. The main purpose of this project was to achieve the nationwide electrification by offering long-term, low-interest loans to the beneficiary villagers. These loans were to be used for the construction of distribution facilities to rural residents who were regionally and financially disadvantaged, and not on large-scale transmission facilities, which would diminish return on investments. The Rural Electrification Project was a pioneering project intended to bring the benefits of electrification to rural areas; to use this to upgrade the education, culture, health, and hygiene in these areas, and to develop the economy by increasing the productivity of these rural residents. As was originally planned, the electrification project made incredible progress in Korea within 10 years. Although there were still approximately 50,000 households without electricity on islands and in remote regions, the project was galvanized again in 1983, leading to an electrification rate of 99.8 percent by 1987. This was deemed an impressive success.

The Rural Electrification Project greatly improved rural incomes with special crop cultivation and livestock businesses, which proved to be commercially successful. The achievements of Rural Electrification Project can be summarized as economic effects that contributed to an increase in rural residents’ incomes, in
addition to social effects that improved their quality of life and mental well-being. The economic effects refer to the economic benefits generated using electric power, such as the improvement of agricultural technologies that led to an increase in labor productivity, and income increases through rural factory operations. Improvements in agricultural productivity achieved using electricity were also noteworthy.

**Introduction**

Commercial electricity was first introduced to Korea in 1897, and was first supplied to major cities and industrial regions for lighting and industrial power. Many rural communities, however, were still without electricity in the 1960s.

In the late 1950s, in the aftermath of the Korean Civil War, the Korean government received extensive aid from the United States. Knowing that U.S. aid would not last indefinitely, the government drafted their first five year economic development plan, focusing mainly on infrastructure expansion to enable future growth. This included aspects such as coal and electricity, as well as revenue increases in rural areas through the scaling up of farm produce, among other things. This case study examines a program to provide a particular piece of this infrastructure: Rural Electrification Project, which was carried out by the Korean government and Korea Electricity Power Corporation (KEPCO) between 1964 and 1987. The case examines how the project was implemented, overcoming certain delivery challenges, and the effects that this successful program of electrification ultimately had. From a situation in which only 25 percent of households had access to electric power in 1964, and only 12 percent in rural areas, electrification rates stood at 98 percent by 1979, and 99.8 percent by 1987.

During the early 1960s, rural electrification received attention from the administration of then-president Park Chung-Hee. Park had long believed in the importance of rural development, and was said to be inspired to pursue electrification by the quality of life in rural villages of West Germany during a visit to that country in December 1964. As such, he ordered ministers to begin the Rural Electrification Project as soon as he returned to Korea. With laws enacted in December 1965 regulating the governmental financing of electrical facility construction projects, the Rural Electrification Project was accelerated.

During the 1960s, large scale investments in major cities led to a widening rural-urban divide, characterized by a concentration of wealth in a small number of people as well as serious income inequality between urban and rural households. This was due to a population concentration in urban areas to meet the increased demand for labor, and a rural exodus where citizens moved to the cities for new opportunities. Therefore, rural electrification, as a part of social overhead capital, was seen as an urgent challenge to be for balanced development of Korea.

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**Table 1: The Number of Households and Electrification (as of the end of 1964)**

(Unit: 1,000 households)

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Served Households</th>
<th>Un-served Households</th>
<th>Electrification Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4,035</td>
<td>1,027</td>
<td>3,008</td>
<td>25.5</td>
</tr>
<tr>
<td>Rural Area</td>
<td>2,653</td>
<td>318</td>
<td>2,335</td>
<td>12.0</td>
</tr>
<tr>
<td>Urban Area</td>
<td>1,382</td>
<td>709</td>
<td>673</td>
<td>51.3</td>
</tr>
</tbody>
</table>

**Table 2: Korean Economic Indicators After the Civil War, 1953**


<table>
<thead>
<tr>
<th></th>
<th>1953</th>
<th>1962</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Capita GNP (USD)</td>
<td>67</td>
<td>87</td>
<td>288</td>
</tr>
<tr>
<td>GNP (mil-USD)</td>
<td>1,356</td>
<td>2,304</td>
<td>9,459</td>
</tr>
<tr>
<td>US-Aid (mil-USD)</td>
<td>194</td>
<td>232</td>
<td>1,068</td>
</tr>
<tr>
<td>Saving Rate (%)</td>
<td>8.8</td>
<td>3.2</td>
<td>14.6</td>
</tr>
</tbody>
</table>

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The electrification project changed not only the labor environment and way of life, but also the economic scale of rural communities. Yet even as electrification proceeded successfully, additional measures were required to adjust policy to meet the goals of the project. Electricity use required tremendous costs for external distribution, as well as indoor distribution and expansion construction. Thus, total construction costs were quite burdensome for rural individuals and the governments.

Development Challenge

The government was able to supply electricity by 1964 under the Power Resources Development Project. Prior to the Rural Electrification Project, 88 percent of rural residents did not have electric lighting. Therefore, the Rural Electrification Project aimed to build basic electrical facilities to supply power to rural areas. However, the remote countryside villages were at a disadvantage, with higher investment costs for supply facilities, low profitability, and technical problems with distribution. At the time, developing the rural communities, which accounted for over 60 percent of the total population, was seen as being essential for the country’s balanced development and economic growth.

In May 1964, as part of rural electrification, KEPCO considered implementing the Rural Electrification Project to increase its revenue. Meanwhile, the company relaxed its controversial facility construction criteria for external wiring, and took measures to save construction costs. The new criteria were approved by government authorities and incorporated.

On April 23, 1965, the Korean government announced the Rural Electrification Project scheme. National efforts were made with combined loans of 100 million KRW—300 million KRW from government and 200 million KRW from the Industrial Bank of Korea, on the basis that KEPCO prepared details of the project such as: target area selection criteria, construction codes, and guidelines for loan repayment.

The government announced its long-term Rural Electrification Plan, scheduled to be completed by 1979. At the end of 1969, there were about four million households in South Korea, with approximately two million of those without electricity, indicating an un-electrification rate of 50 percent. It was clear that, despite having made significant progress, further efforts would need to be made.

Delivery Challenges

Shortly before the Rural Electrification Project was launched, KEPCO had begun planning for a similar project, aiming primarily to increase revenue. While neither a large-scale nor a countrywide project, details of project implementation were still prepared, and without any prior experience to refer to, government officials who were going to draft the nationwide Rural Electrification Project plan studied the KEPCO cases closely. Through this, they found some challenges:

1. How to draft long term development plans of electric power industry.
Korea did not have the resources for industrial development that are essential for national economic growth until the mid-1960s. This included technical expertise, experienced manpower, and a long-term development plan for any industry, including the electric power industry. This was a major challenge in the design stage and prior to launching the Rural Electrification Project.

2. How to fund rural electrification and ease the customers’ repayment burden.
This was also a major concern, considering the financial difficulties of Korea at the time, which included limited government finances, national capital shortage, and a dismal outlook on private investment. The government tried to build a strategy to gauge the potential that a customer could pay back a loan. However, rural society had a high unemployment rate, especially in wintertime, due to a lack of production facilities. Further, the per capita GDP is estimated to have been around US$50–70 in the early 1960s.

3. How to increase the number of households served with a limited budget.
With a limited budget, doubling or tripling the number of customers to be served in a short period time under existing KEPCO regulations and business practices was not likely to be attained. Therefore, a new approach to rural electrification, in terms of construction management on cost saving ways of working, would need to be developed.

4. How to prioritize the target area and/or villages.
Before the start of the Rural Electrification Project commencement in 1964, which area and/or villages should obtain electricity first was a great concern for the population, as this was a time when only a quarter of the population had electricity access at home.
National consensus was important to the success of the Rural Electrification Project, especially in regard to remaining within the specified budget. Thus, preparing optimal, fair, transparent, and reasonable criteria for the selection of areas and villages was very important.

**Tracing the Implementation Process**

**Legislation and Procedure of Rural Electrification Project**

On April 23, 1965, the Ministry of Commerce established the Rural Electrification Project scheme, announcing its intentions to bring electricity to isolated rural areas. For this project, the government needed loans totaling 300 million Won (KRW), with 100 million KRW from the government and 200 million KRW from the Industrial Bank of Korea. The industrial Bank of Korea was established in 1961, with a focus on special financial loans to small and medium enterprises (SMEs). KEPCO and the Government of Korea worked together to implement the project. KEPCO assigned facility criteria for external wiring plans, to fit the situation of each rural community, and it also established the Guidelines for Rural Electrification Project Loan Recovery to prepare for the project. KEPCO enacted these guidelines on November 6, 1965.

Having prepared the annual plan for project implementation, including securing a budget, the central government allotted money to local governments based on the number of un-served customers, with guidelines reflecting comments from interested parties for better

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**Figure 1: Implementation Procedure of Rural Electrification Project**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Management</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment and implementation of electrification scheme guidelines</td>
<td>Ministry of Commerce</td>
<td>Secures budgets, allocates funds to local governments, and delivers guidelines</td>
</tr>
<tr>
<td>Area selection</td>
<td>Local governments</td>
<td>Selects electrification target areas, based on the criteria</td>
</tr>
<tr>
<td>Survey &amp; Design</td>
<td>KEPCO</td>
<td>Surveys and designs the selected areas</td>
</tr>
<tr>
<td>Confirmation of project</td>
<td>Local governments</td>
<td>Secures a project scheme for the selected areas and reports it to KEPCO</td>
</tr>
<tr>
<td>Acquires materials</td>
<td>KEPCO</td>
<td>Acquires necessary materials</td>
</tr>
<tr>
<td>Power supply</td>
<td>KEPCO</td>
<td>Selects a contractor, and proceeds to construction</td>
</tr>
</tbody>
</table>

---

**Table 3: Implementation Procedure of Electrification Project**
and efficient project implementation. Using the selection criteria established by the national government, local governments then selected target villages. High priority was usually given to villages with factories for export or areas where people were even enthusiastic participation as a part of the Saemaul Movement. Some areas, which would be relatively more costly, were given low priority, such as smaller communities of less than 30 households, villages that cost over 40,000 KRW per household, or villages that need additional facility reinforcement construction for technical challenges. Selected villages would be informed as the electricity utility and local government paid the construction cost after receiving the bill. The electric utility prepared the project implementation, including design, procurement, and ordering construction, while customers were themselves responsible for the internal wiring of their home. Electricity was provided to the customers after project completion, and customers were expected to jointly repay the loan through collectively guaranteed agreement.

**Rural Electrification in Economic Five-Year Development Plan**

The Rural Electrification Project proceeded according to the key criteria and steadily moved toward full coverage of rural areas with electrification. Three particular phases will be traced here: the first stage of the program; the second, in which learning from the first phase was taken on board; and the third, which focused on reaching more costly and remote areas and islands, small villages, and other challenging locations.


At the beginning stage of the project in 1964, the electrification rate in the suburbs of major cities was no better than that of rural areas, and so the highest priority was given to collective villages around the cities, as this was seen as cost-effective. Priority was also given to areas seen as needing electrification urgently, for various reasons; for example, Kyungki and Kangwon provinces focused on areas that had been recently won back after the end of the Korean war in 1953.

Shortly before the completion of the first phase of the government's Rural Electrification Project in 1970, KEPCO created a special team to focus on rural electrification. This team's objective was, under government mandate, to streamline processes for country-wide rural electrification, implementing lessons learned and avoiding prior mistakes, during the subsequent decade.

KEPCO merged the Rural Electrification Department and the National Electrification Survey Committee (a temporary organization supposed to survey details of rural electrification completion) as newly named as 'Rural Electrification Headquarter in 1970. The goal was to better implement the project within the allotted limited budget before the scheduled time frame, under close cooperation with the government. Its responsibilities were as follows:

- To have a close cooperation with the government for target area selection;
- To survey and design aspects associated with electrification project, including electrification status;
- To secure and manage resources, such as: personnel, budget, etc.;
- To establish and implement measures for logistics, timely completion, and quality warranty;
- To implement measures to simplify procedures for effective and swift construction; and
- To encourage measures for timely completion.

KEPCO exercised extensive due diligence (some 12,000 working days over seven months from May 1970 to 1979) on such areas as how to prioritize target villages, how to accurately estimate costs, and how to set technical thresholds to optimize power supply.

**Phase 2: Rural Electrification Project (1971–1979)**

The second phase, called the Long-term Rural Electrification Project scheme, was announced by the central government on December 5, 1970. This scheme was based on KEPCO due diligence and aimed to complete electrification by 1979 through clear and strong political determinations that created numeric goals that should be achieved for every three years. Its ultimate goal was to reach 1.8 million households without electricity.
(not counting an additional 300,000 unserved households on islands and in deep valley areas) by 1979 (see Table 4 for the progressive schedule).

The first phase of this project, mainly financed by government financial funds and KEPCO’s budget, achieved notable increases in the number of households served, without requiring loans from abroad. This was helped by the fact that KEPCO had already prepared for rural electrification challenges, such as supply and transmission capacities shortages, before launching the project.

The Rural Electrification Project had expanded beyond just electric lighting by 1973, when more than half of rural communities had received electricity, and the government shifted policy direction to rural income increase through agriculture automation with electricity (like developed countries). The project was not just about improving the quality of life of rural residents by providing electric lights, but also aimed to promote rural modernization by increasing rural productivity and incomes with various applications of electric power for agricultural management. In addition, the rural labor shortages caused by urban industrialization urgently called for mechanization of agriculture.

Offshore islands were not prioritized for electrification because of the high costs and technical difficulties presented by these areas. However, by the late 1970s, these areas began to be prioritized. The ShinAn Island area, consisting of 23 small and medium-sized islands and heavily populated with 16,000 households, was a natural choice as the first offshore island electrification. This electrification was completed in May 1979, with the electricity from the mainland channeled through a marine cable since there was no capacity for generation in the island area.

### Phase 3: Rural Electrification of Deep Valley Area and Offshore Islands

On September 26, 1978, the government announced rural electrification of deep valley areas and offshore islands.

Almost all medium-sized villages were already served before middle of the 1980s, and small-sized villages of more than four households in mountainside and remote villages were supposed to be served next. A total of 19,600 households were served by 1991, since the scheme’s beginning in 1984, marking an electrification rate of 99.9 percent. Some offshore islands installed medium-sized generators when undersea cable connections proved impractical.

### Tackling Delivery Challenges During Project

Over the three phases of the Rural Electrification Project, different delivery challenges emerged and had to be confronted. This necessitated some adaptations by the government and KEPCO, as well as some planning in the design stage to overcome delivery challenges that were foreseen at that time.

### A. Long Term Development Plan of Electricity Industry Including Rural Electrification

Before developing its plan for generation and power delivery capacities expansion, KEPCO contracted some consulting services in the early 1960s, as a condition of receiving financial aid from USAID. Two assessments were performed, the first one by EBASCO Services Incorporated in 1964 and the other one by Burns &

<table>
<thead>
<tr>
<th>Table 4: Electrification Schedule (Unit: Households)</th>
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<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>Served Households</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Table 5: The Targeted Households in 1978</th>
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</thead>
<tbody>
<tr>
<td>Deep Valley Area</td>
</tr>
<tr>
<td>Offshore Islands</td>
</tr>
</tbody>
</table>
Roe in 1966. The recommendations, especially those related to transmission and distribution, became the foundation of Korea’s electricity industry and provided key suggestions increasing the size of voltage system capacities, and the establishment flexibility, procurement, and construction standard to secure quality insurance and constriction warranties. They recommended the introduction of a newly developed voltage system unifying five different voltage systems to a single system in order to increase the efficiency of power system construction and operation with less cost. This was in addition to a recommendation to establish a construction standard for every voltage system to secure quality insurance and construction warranties, and an extensive rural electrification project.

**KEPCO’s Capacity Improvement**

One of the most difficult challenges faced by the project was the development of a voltage system that was suggested by USAID. There were few world-wide precedents that would guarantee the performance of the system, and KEPCO had a different voltage system already in place. Ultimately, after a thorough review, KEPCO adopted the new system, resulting in many benefits, including lower cost for the construction of new electricity facilities, considerable reduction in losses, and increased quality and stability of electricity.

Apart from the benefit of newly developed voltage system, KEPCO benefitted from another windfall: reduced logistics cost. With the introduction of the newly developed voltage system, KEPCO ended up having only one type of voltage system rather than the five types that it had before. This meant that both manufacturers and electricity utilities no longer needed to make and reserve five types of facilities. Furthermore, this decreased manufacturing costs and operation costs. These changes marked considerable progress for KEPCO and enabled the company to provide customers with reliable electricity at a reasonable cost.

**B. Funding for the Rural Electrification**

From 1966 through 1970, Phase 1 of the Rural Electrification Project was mainly financed by both Korean Government funds and KEPCO’s budget. With the help of both increased savings and money remitted from abroad, there was a marked increase in the number of served households without loans from abroad. However, things changed due to the government policy change to complete rural electrification, including offshore islands and deep valley areas, before 1979. Customers demand for electrification increased as a result of the surprising changes of living convenience in served households.

**Raising Funding Resources: Remittances and Domestic Savings**

Korea, like many developing countries in the mid-1960s, suffered from shortfalls in investment funding at the incipient stage of economic development. Korean government policy attempted to capitalize on the resources of its population, encouraging workers to work abroad and send back remittances. Korean immigrants worked as miners and nurses in West Germany, as soldiers in Vietnam, and construction workers in the Middle East, sending remittances home that in some cases, reached around US$50 million annually. This accounted for about two percent of Korea’s GNP in the 1960s. Remittances, together with foreign aid and loans from multi-lateral development banks, became major sources of funding for development initiatives in Korea, including rural electrification.

Korea’s national savings rate increased very rapidly beginning in 1963, due to a national income increase, along with economic development and government-driven saving encouragement initiatives, to secure investment fund independently, under the long-term goal of creating a self-supporting economy. The government...
used following was to increase savings of the people. Some details are as follows:

- Encourage financial institutions, including commercial banks, to achieve a target figure, which was already set by government;
- Recommend that high ranking officials, including staff of state-owned companies, deposit 10 percent of pay in the bank;
- Allow contractors and/or suppliers to deposit some portion of their pay in the bank as a contractual obligation;
- Allow parties and/or persons to deposit some amount in the bank before issuing license, permission, approval, etc.; and
- Encourage every school to achieve its target figure, as already set by government.

And this allowed people to tap into their savings to pay for electrification.

These efforts to fund rural electrification were not limited to public funds. Some villages were eager to get electricity service earlier than others. To achieve this, they tapped into their own credit unions, such as the New Community Savings Account, and reduced project costs by paying part of this in advance with their own funds. This meant that they scored higher on the selection criteria and received electricity earlier, while lessening the burden on public coffers.

The project was also funded through loans from MDBs and foreign countries. In September 1971, the first loan of US$10.6 million was received from Asian Development Bank (ADB), earmarked for a transmission and substation capacities expansion. Two additional loans were received from Japan’s Overseas Economic Cooperation Fund (OECF) in 1975 and from the International Bank for Reconstruction and Development (IBRD) of the World Bank Group in 1976. While the first loan filled a critical gap in savings, the latter loans allowed for diversification and lowering interest rates.

C. Lessening Customers’ Burden in Terms of Loan Repayment

To lower the customers’ loan repayment burden, the generation and transmission construction costs not directly related to rural electrification were paid by the electricity utility. Wiring the houses themselves, however, was the customers’ responsibility, while the costs for distribution line construction (the main driver of cost) was shared by the utility and its customers. The utility paid around 5000 KRW (as of 1973) for every household, and the rest of the project costs were paid by customers through collectively guaranteed loan agreements.

Power was supplied to the village collectively, not per house. In order to prevent the nonpayment of the construction cost, a collectively guaranteed loan system was introduced so that all the residents would have to pay a portion of the construction cost.

At the time of rural electrification legislation, customers were designated to repay the loan in equal installments for 20 years with a year grace period, according to their collectively guaranteed repayment agreements.

The construction costs of distribution facilities, which were paid by the customers, varied depending on the distances between the power resources and the consumer regions, as well as the number of customers and circumstances of electrification regions. The average annual construction costs from 1965 to 1972 are shown in Table 6.

Revision of Loan Terms and Conditions to Ease the Burden

The enactment of the Rural Electrification Promotion Act on December 30, 1965, the national government the government to finance electrical facility construction, and the Rural Electrification Project came to be. However, it soon became apparent that loan terms would need to be revised to relieve burdens on the customers.

The initial terms of the loans included 7.5 percent interest rate and a 20-year repayment period. While this

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**Figure 3: Project Cost Assignment**

<table>
<thead>
<tr>
<th>Generation</th>
<th>Transmission</th>
<th>Distribution</th>
<th>Internal-Wiring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Utility</td>
<td>Utility</td>
<td>Utility, Customer</td>
<td>Customer</td>
</tr>
</tbody>
</table>
included a year-long grace period, this was still difficult considering residents’ income levels in rural areas. The government revised the law on March 3, 1967, extending repayment to 35 years, including a five-year grace period, to lessen the burden on low-income rural residents. This was further revised to a five-year grace period with 30 years of equal payments on May 22, 1968. During the five-year grace period, only the interest payments were required and after that, the principal and interest had to be paid in equal payments for 30 years. Payments were collectively levied in the monthly electric bills by KEPCO, under the Article 12 of the law. The repayment amounts varied, depending on the customer’s loan amount and the number of electric lights.

D. Strategic Project Management

Every possible way to minimize the project cost was introduced as the project was implemented: KEPCO drafted and introduced a construction code for rural electrification that had a smaller safety margin as compared to the general construction code, in addition to taking responsibility over the whole process of the project without hiring consultants.

Phase 2 of the project decided which village should be first selected. This selection was made not only by which areas were a priority, but also took into consideration the construction costs and reliable power supplies to customers, reflecting experience of the Phase 1. This helped to supply power, which helped to meet the technical threshold, and to reduce construction, operation, and management costs, after project completion.

Cost and Infrastructure Management

As is often the case in rural electrification projects, one of the most important aspects increasing the number of households served, doing it in a short period of time, and staying within a strict budget. KEPCO studied a variety of ways to reduce cost, drawing on consultations with EBASCO and Burns & Roe.

KEPCO played a dominant role in guiding the process from its early planning stages all the way through construction infrastructure.

The electrical equipment manufacturing industry was not strong enough to deliver all types of equipment in the late 1960s, and so a portion of the equipment had to be imported from advanced countries until the mid-1970s, when it became possible to substitute domestic equipment in place of imported. To lower the price of equipment, KEPCO wielded a bulk-purchase approach to not only foreign but also domestic manufacturers. This later contributed to a growth of the domestic electrical equipment manufacturing industry through investment and technical cooperation with advanced foreign manufacturers, leading to the sole use of locally supplied equipment. There were several tools and accessories newly developed for rural electrification, which also contributed to a lower project cost.

Further, the same approach was adopted in hiring construction companies to help lower the construction cost, while deploying more personnel in the project area for securing the construction performance warranty. This made some construction companies develop and/or adopt new construction methods to maximize their profit, while reducing construction cost. In some cases, villagers who were eager to receive electricity ahead of other villages contributed a portion of labor to the project in a sense of collaboration and support of one’s own village.

E. How to Prioritize the Target Area and/or Villages

Particularly in the Phase 1 period, as the project was just starting out, it was crucial that the criteria for target area selection be fair and carried out without favoritism toward particular villages. The local
governor was empowered to select the target area at his discretion, based on the development plan and staying within the limit of the allocated funds. So it was important for local government to follow transparent, clear, and fair criteria, and that at least one area of each city, county, and borough was included for a balanced project implementation. For this areas with sufficient demands, exceeding the break-even point of electricity utility should be considered. For the first phase of rural electrification, the criteria were as indicated in Table 7.

In Phase 2, while maintaining a fair and balanced approach, it was also crucial to serve as many households as possible with limited budget and time. The basic principle of area selection that local governors were to follow was a regionally balanced at getting electricity at approximately the same rate, with a return on investment and potential spread-effect of the project. The systematic criteria as as indicated in Table 8.

In September 26, 1978 Government announced rural electrification of deep valley area and offshore islands. These areas had their own specific criteria.

Almost all medium-sized villages were already served before middle of 1980s, and small sized villages of not less than five households in the deep valley area were supposed to be served next. Since the project’s beginning in 1984, a total 19,600 households were served by 1991, marking an electrification rate of 99.9 percent. Medium-sized generators were installed in some offshore islands that were not served through marine cables from the mainland.

<table>
<thead>
<tr>
<th>Table 7: The Criteria of Target Area Selection: The First Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Areas that electrification is possible without further installation of transmission and substation facilities.</td>
</tr>
<tr>
<td>□ Areas that the length of the construction zone are over one kilometer and less than eight kilometers.</td>
</tr>
<tr>
<td>□ Areas in which all villagers can afford the entire cost of internal wiring.</td>
</tr>
<tr>
<td>□ Areas with sufficient demands, exceeding the break-even point of electricity utility.</td>
</tr>
<tr>
<td>□ In accordance with development plan, local governors’ opinions are considered. (Example: all-weather farming complex model village)</td>
</tr>
<tr>
<td>□ Areas who electrical facilities were damaged during civil war.</td>
</tr>
<tr>
<td>□ Areas with city and county offices.</td>
</tr>
<tr>
<td>□ Exempted area: off-shore areas, deep valley areas, and downtown areas of big cities, such as Jongno-gu and Joong-gu of Seoul, and Joong-gu and Dong-gu of Pusan.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 8: The Criteria of Target Area Selection: The Second Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Paying off the budget shortfall of Phase 1.</td>
</tr>
<tr>
<td>□ Coast guard posts and vulnerable regions against blitzkrieg.</td>
</tr>
<tr>
<td>□ Fishing post of deep sea fishery for export.</td>
</tr>
<tr>
<td>□ Mining area and cottage industries (i.e., clothing, food production, etc.)</td>
</tr>
<tr>
<td>□ Areas with a county seat and/or ward office.</td>
</tr>
<tr>
<td>□ Areas around railway station and on both sides of the expressway.</td>
</tr>
<tr>
<td>□ Areas with government designated domestic industry villages for income increase.</td>
</tr>
<tr>
<td>□ Areas with damaged electrical facilities during civil war, as well as the frontline area of the civil war.</td>
</tr>
<tr>
<td>□ Areas with community-owned factories, to increase community income.</td>
</tr>
<tr>
<td>□ Island areas.</td>
</tr>
<tr>
<td>□ Areas with an average loan per capita lower than 40,000 KRW.</td>
</tr>
<tr>
<td>□ Villages with at least 30 households.</td>
</tr>
<tr>
<td>□ Areas without further reinforcement projects due to low voltage and/or capacity shortages of transmissions and/or substations.</td>
</tr>
<tr>
<td>□ Areas chosen by authorities for commitment to the New Community Movement program.</td>
</tr>
</tbody>
</table>
Lessons Learned

Rural electrification in Korea as a part of economic planning played a pivotal role in the economic development and balanced economic growth throughout Korea in the 1970s. Furthermore, it represents one of the most successful programs from that time period. This project, while poorly designed and organized at the beginning, was completed swiftly and successfully with strong government initiation and policy intervention.

A. Long Term Development Planning Before Project Launching

This project saw considerable delays and difficulties with coordination among all parties involved at the beginning. Better due diligence and long-term planning might have enabled more efficient and effective implementation of the project.

B. Encouraging Villagers’ Voluntary Participation

Villagers’ voluntary and active participation in the project, made possible by both incentive programs provided through officers and citizenship under the strong village-senior leadership over the whole process of the project, should be highly evaluated. The Saemaul Movement was an important aspect of this, as it raised ownership of project and participation of villagers with a sense of collaboration and support, and encouraged villagers to work on the electrification project. They did not spare their toil and efforts during project implementation, as they gave manpower freely and voluntarily for the construction of electrical equipment, such as transporting construction materials and erecting poles; additionally, they yielded their rights of way, paid construction bills under collectively guaranteed agreements, and more.

C. Strategic Planning in Selecting the Target Area and Demonstrating Impartiality

Target areas were selected by Provincial Governors, taking into account provincial development plans. This was coupled with clear criteria stipulated in the Rural Electrification Law, with a particular focus on regional balance and prioritizing low-cost areas. This clear set of criteria was important in showing villagers the impartiality of the project.

D. Developing Electricity Industry and Nurturing Manufactures

The project benefitted by the fact that most equipment came from domestic manufacturers, and that these manufacturers were encouraged to develop equipment and accessories only for rural electrification. Through this, KEPCO also nurtured the electrical equipment manufacturing industry, learning and adopting from imported equipment from overseas, localizing the imported equipment through investment, and technical cooperation with advanced foreign manufacturers afterwards.

E. Strong Political Leadership

This economic plan driven by government was supported by strong political leadership from the President. With rural electrification as a priority agenda, Korean government could put national resources together strategically and concentrate its efforts on the project, minimizing confliction among departments. Reviewing the progress of the project quarterly by his own hand and encouraging involved parties’ more efforts to place the project on schedule, then-President Park Chung-Hee contributed significant leadership to the success of the project.
Annex 1. Rural Electrification Promotion Act

[Effectuated on May 22, 1968] [Law No. 2015 partially amended on May 22, 1968]

Article 1 (Purpose)
This Act is aimed at improving the agricultural productivity and quality of life for rural residents by promoting electrification.

Article 2 (Definitions)
In this Act, a “rural area” refers to a village with most residents engaging in agriculture, regardless of the administrative district. In this Act, “electrical facility construction” means distribution (excluding transmission and substation) and internal wiring facility construction. In this Act, “electricity provider” refers to “Korea Electric Power Corporation.” In this Act, “unit construction” means electrical facility construction, recognized as collective construction by the electricity provider. In Article 6 Section 2, Article 7 Section 1 and 2, and Article 10 Section 2, “leader of local government” means Seoul Mayor, Pusan Mayor, and provincial governor. In Article 4 and 7 Section 3, and Article 11 Section 2, “leader of local government” means Seoul Mayor, Pusan Mayor, mayor, and county officer.

Article 3 (Construction Cost Payment)
The electrical facility construction funding shall be determined as the following: Distribution construction costs are covered by the electricity provider’s payment (with amount approved by the commerce minister, in accordance with the Electric Business Law Article 19), combined with financial or other types of loans. Internal wiring costs shall be covered by customers.

Article 3 Part 2 (Local Government’s Partial Construction Payment)
Local government can pay for part of the electrical facility construction costs.
[Added on March 3, 1967]

Article 4 (Project Plan)
The head of local government should collect service application forms and draft the next year’s electrification plan for unit construction; it should be submitted to the electricity provider via provincial governor by the end of February. However, Seoul and Pusan Mayors can directly submit the application forms to the electricity provider.

The electricity provider should draft a rural electrification project and funding plans for the next year, based on the plan of the previous clause, and submit them to the commerce minister by the end of April.

Article 5 (Funding Measures)
The government must deliberate on the rural electrification project and financing plans of the previous clause and appropriate the amount that requires financial funds in the next year’s budget. However, the loans must be included in the estimated expenditures with amounts greater than the projected kerosene tax revenues among the petroleum tax of the year.

<Amended on May 22, 1968>
In the financing plan of the previous clause, if the electricity provider is not able to pay the allocated amount, the government should introduce loans in order to cover the amount that exceeds the electricity provider’s ability to pay.

Article 6 (Construction Loan)
The loans of the Article 3 Section 1 shall be offered to the electricity provider. The loan debt of the previous clause is guaranteed by the head of local government. Electric customers subject to this Act have joint obligation for unit construction loan and interest payment to the electric provider. The loans must not be used for purposes other than the ones specified in this Act.

Article 7 (Notice and Funding Measures)
The commerce minister should notify the rural electrification and funding plans to the head of local governments when the budget is finalized, as set forth in Article 5 Section 1. Upon notice of the previous clause, the head of local government should notify the electric customers to collectively deposit their unit construction
payments with the electricity provider by February. Upon notice of the previous clause, the electric customers should collectively deposit their unit construction payments by the deadline and submit the certificate and service application form for each construction to the head of local government and electricity provider.

**Article 8 (Construction)**
When the electricity provider receives loan payments and requests for electrical facility, it must execute the construction of the year without delay, in accordance with the project plan, as set forth in the previous Article Section 3.

**Article 9 (Revision of Project Plan)**
If the electricity provider is not able to complete the facility construction with finalized budget under Article 5 Section 1, the reason should be reported to the commerce minister. If the reason is deemed valid, the commerce minister can change the project plan and transfer the construction cost to another unit construction.

**Article 10 (Funding Measures)**
The commerce minister can take necessary measures and supervise the loan usage and construction status. The head of local government can order the electricity provider to report on the loan usage and construction status when necessary.

**Article 11 (Repayment Period)**
Loans are payable with a five-year grace period and 30 years of equal payments.

The electricity provider must submit the loan repayment status of each customer to the head of local government each month.

**Article 12 (Payment Collection)**
Loan payment shall be collected by the electricity provider in the monthly electric bills. The electricity provider must repay the loan four times a year with customers’ payments and should report it to the commerce minister.

**Article 13 (Application of Other Laws)**
This Act shall not preclude application of the Electricity Business Law.

**Attachment <No. 2015, May 22, 1968>**
This Act shall become effective from the day of announcement.

*Enactment of Rural Electrification Promotion Act*
Due to the shortage of power generation and profitability issues with excessive facility cost, the rural electrification project has been delayed. However, since the Five-Year Power Resources Development Plan was expected to expand power supply, the Rural Electrification Promotion Act (Law No. 1737) was established on December 30, 1965, as legal devices to implement the Rural Electrification Project. The estimated budget was 440 million KRW each year, and there had been important Act amendments three times. The key points of the initially established law are as follows: construction cost shall be covered by the electricity provider and the government's financial funds for electrical facility construction; the head of local government and electricity provider should submit the next year's Rural Electrification Plan to the state government by the end of February; the government loan shall be provided to the electricity provider through financial institutions, and local government must guarantee the payment by obligating the customers to pay the loan as a joint debtor; government loan repayment period is 20 years; and government loan repayment shall be managed by the electricity provider by collectively levying the amount in the monthly electric bills.

*Amendment of March 3, 1967 (Law No. 1970)*
Although this Act was established to modernize the underdeveloped rural communities, it posed excessive burden on the residents when it was enforced. As a result, the rural electrification plan was rarely implemented, even though the target areas were selected. It led to the amendment of the Act, extending the grace and repayment periods, and reducing the burden of rural residents to achieve early electrification. The key points are as follows: part of electrical facility construction can be funded by local government, and loan principal and interest shall be paid with a five-year grace period and 30 years of equal payments.
Amendment of December 31, 1984 (Law No. 3781)
In order to effectively implement the Island Electrification Project, the installation and operation of off-grid generation facility were supported. Also, remaining payments of the moved customers were covered by the government, reducing the additional burden on the customers. The key points of the amendment are as follows: installation, management, and operation of self-generation facility shall be conducted and supervised by the head of local government; and the construction costs shall be covered by financial funds, local government subsidies, and the customers. Local government can subsidize the operation costs of self-generation facilities, while KEPCO is responsible for designing, supervising, and providing technical support for off-grid generation facility construction. Further, regular maintenance and management, as well as the operators’ education, are the responsibilities of KEPCO; KEPCO can take over off-grid generation facilities in regions, based on the criteria, and supply electricity; and moved customers’ remaining loan payments shall be covered by the electricity provider, or local and state government.

Amendment of January 13, 1990 (Law No. 4213)
This was to provide electricity to deep valley areas and offshore customers who had no power or had unstable power supply with off-grid generation facilities. Construction costs for distribution facilities of off-grid generation facilities shall be covered as follows: customers shall pay basic construction cost of 25,000 KRW and financial funds of one million KRW; and 50% of the remaining amounts shall be funded by the state and local government, and the other 50% by KEPCO. Operation cost of Island regions of at least 50 households with off-grid generation facilities shall be partially supported by KEPCO.
### Annex 2. Rural Electrification History in Korea

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 28, 1964</td>
<td>Ten members of National Assembly ruling party proposed “The Rural Electrification Promotion Act (Draft)”: Bill No.289</td>
</tr>
<tr>
<td>June 7, 1965</td>
<td>The Chairman of Commerce and Industry Committee asked for suggestions on the Act (Draft) by both the Finance Committee and the Home Affairs Committee</td>
</tr>
<tr>
<td>November 6, 1965</td>
<td>Draft Guidelines for Rural Electrification Project Loan payment (KEPCO)</td>
</tr>
<tr>
<td>December 9, 1965</td>
<td>The Chairman of Commerce and Industry Committee asked for examination of legality and wording of the Rural Electrification Promotion Act (draft) by the Legislation and the Judiciary Committee</td>
</tr>
<tr>
<td>December 30, 1965</td>
<td>Announcement of Rural Electrification Promotion Act (Law No.1737, with complete text of 13 articles)</td>
</tr>
<tr>
<td>March 1, 1966</td>
<td>Rural Electrification commencement with newly established executive bureau of KEPCO (Rural Electrification Department)</td>
</tr>
<tr>
<td>March 24, 1966</td>
<td>The Ministry of Commerce notified details on Rural Electrification: Overview of Rural Electrification Project, electricity supplying procedure from application to power supply, service application form, financial planning, and loan payment.</td>
</tr>
<tr>
<td>March 3, 1967</td>
<td>The first amendment of Rural Electrification Promotion Act (Law No. 1970, enactment of Article 3 Section 2, amendment of Article 11 Section 1)</td>
</tr>
<tr>
<td>May 22, 1968</td>
<td>The second amendment of Rural Electrification Promotion Act (Law No. 2015)</td>
</tr>
<tr>
<td>January 14, 1969</td>
<td>The third amendment of Guideline for Loan payment</td>
</tr>
<tr>
<td>March 16, 1970</td>
<td>Committee for another round of Rural Electrification Initiative nationwide</td>
</tr>
<tr>
<td>Nov 2, 1970</td>
<td>Loan application for Asian Development Bank (ADB)</td>
</tr>
<tr>
<td>December 5, 1970</td>
<td>Announcement of Rural Electrification Completion scheme: 2.5 million households with electricity by 1979, with exception to the almost 210,000 households of offshore and deep valley areas</td>
</tr>
<tr>
<td>March 19, 1971</td>
<td>Presidential address for Rural Electrification: Rural Electrification Completion to 70 percent by 1976</td>
</tr>
<tr>
<td>August 26, 1971</td>
<td>ADB loan approval</td>
</tr>
<tr>
<td>September 13, 1971</td>
<td>Signing of ADB loan agreement</td>
</tr>
<tr>
<td>January 18, 1972</td>
<td>Effecuation of ADB loan agreement: Borrower-KEPCO, Lender-ADB, Loan amount USD$10,600,000, and 7.5 percent annual interest rate with three-year grace period and 17-year repayment</td>
</tr>
<tr>
<td>May 24, 1974</td>
<td>Presidential address for Rural Electrification: Rural Electrification Completion by 1979 after the Presidential address</td>
</tr>
<tr>
<td>October 25, 1974</td>
<td>Exchange of MOU for Overseas Economic Cooperation Fund (OECF) between two governments</td>
</tr>
<tr>
<td>December 26, 1974</td>
<td>OECF loan agreement</td>
</tr>
<tr>
<td>January 1, 1975</td>
<td>The fourth amendment of Guidelines for Loan payment</td>
</tr>
<tr>
<td>February 14, 1975</td>
<td>Effectuation of OECF Loan Agreement: Lender-OECF, Loan Amount-360 million Yen, and 3.25 percent annual interest rate with seven-year grace period and 18-year repayment, with fixed amount payments of principal twice a year</td>
</tr>
</tbody>
</table>
February 14, 1975  World Bank (IBRD) loan application
April 1975  IBRD due diligence
July 1975  IBRD appraisal for Korea loan application
November 1975  Congressional consent for IBRD loan
January 1, 1976  The fifth amendment of Guidelines for Loan payment
March 19, 1976  Signing of IBRD loan agreement
June 4, 1976  Announcement of IBRD Loan Agreement: Borrower-Korean Government, Lender-IBRD, Loan amount-USD$18.1 million, 8.5 percent annual interest rate for general interest loans, 4.5 percent annual interest rate with seven-year grace period and 18-year repayment
April 5, 1978  Furthering rural electrification areas to off-shore and deep valley areas, with relatively low budget
August 10, 1978  Commencement of the first off-shore area electrification: ShinAn Island, south east of Korean peninsular
September 26, 1978  Off-shore and deep valley area electrification scheme
June 30, 1979  Completion of ShinAn Island electrification
September 6, 1979  Rural Electrification Scheme after 1981
October 2, 1979  The second off-shore area electrification, five big islands of western part in Korean Peninsular
January 12, 1980  Increase interest rate by 73.3 percent: from 7.5 percent to 13 percent
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———. “Power Demand and Sales Activities (Rural Electrification Activities)” http://www.kepco.co.kr.
———. 1980. “Island Region Electrification Project with Steel Tower and Submarine Cable.”
Rural Electrification Promotion Headquarter. 1971. “Status and Outlook of Rural Electrification Project.”
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