Prepaid Water in Lusaka: Case Study

Overview
Lusaka, the capital city of Zambia, has a population of about 1.3 million people and about 50,000 water connections. The city is highly differentiated spatially by income; low-income households (about 60 percent of the city’s population) live predominantly in informal and formalizing peri-urban settlements in the west, where they rely mainly on communal standpipes, kiosks, and private wells. Across the rest of the city, about 30,000 customers have conventional meters.

Following earlier pilot programs, in 2013 Lusaka Water and Sewerage Corporation (LWSC) embarked on an ambitious installation program across prepaid standpipes, individual domestic connections, and institutional customers. It intends to make prepaid meters the default technology wherever possible, and aims to install 69,000 Standard Transfer Specification (STS)-compliant individual prepaid meters by 2019 (Photo 1), plus more than 1,000 prepaid standpipes. The president’s residence was one of the first to be fitted with a prepaid water meter when installation was scaled up in mid-2013, and more than 14,000 prepaid meters were installed in the first year of the new program.

Customer responses have been mainly positive. Most customers own connections such as prepaid meters because they can manage consumption better and avoid high bills, debt shock, and disconnection. There is demand for more vending sites, and for those who owe arrears, some unhappiness that 40 percent of their credit purchases are top-sliced to pay off past debt.

Lessons
Big water savings are likely for the utility. Reduced consumption and strong incentives to fix on-plot leaks may allow longer hours of supply, higher water pressure, and more water to serve new customers.

Verify the network before starting prepaid meter installations, including checking that pipelines do indeed lie where they are believed to be, and identifying and rectifying vulnerabilities. The reduced consumption that usually accompanies prepayment will raise the water pressure and reveal vulnerabilities in the network that could increase leaks and nonrevenue water (NRW).

Wherever possible, upgrade the network to support 24/7 supply before installing prepaid meters. Supply interruptions introduce grit and air into the system, which impair the performance of prepaid meters and cause customers to complain that the meters are “stealing” their credit.

Building customer acceptance of prepayment requires significant resources. Some utility staff may argue that available funds are better spent extending services to new areas, rather than on interacting with people who are already serviced. However, the value of vast investment in prepayment can be compromised if customers do not understand the tariffs and charges, are not confident using the meter, or feel they were consulted inadequately before installation.

Give particular attention to explaining charges and the tariff structure to customers. Consider introducing a fixed rate per unit of volume, rather than a rising block tariff. Where customers have previously had conventional meters, alert them to the possibility those old meters may have underread. This would amplify that measured consumption may be higher with the more accurate new meters, and they therefore may pay more.

Why the utility introduced prepayment
Through prepayment, Lusaka Water and Sewerage Corporation (LWSC) aims to improve payment levels to fund its operations, streamline revenue management, reduce the cost of doing business, and strengthen water demand management.
Improving revenue collection is a key consideration. The overall collection rate ranges from about 85 percent for domestic customers to below 35 percent for some government customers, and the utility is owed substantial arrears. More than USD 20 million is still outstanding even after the Ministry of Finance settled about USD 37 million in overdue payments from government customers in early 2013. These outstanding funds are not available to extend coverage and upgrade existing services, and erratic cash flows constrain the operations of the utility significantly. In the past LWSC has had to write off bad debt, but it has found that the debt cycle just repeats itself. By adopting prepayment, the utility hopes to mark a break with the past and find a firmer financial footing to meet its service challenges.

The city faces formidable service challenges. Lusaka is one of Africa’s fastest growing cities, and population growth is outstripping its available water supplies. The city relies on groundwater for roughly half of its supply, with the balance pumped 60 kms from the Kafue River up a head of 300 m. There are few overhead reservoirs, and particularly in peri-urban areas, continuity of supply is affected by frequent electricity outages. LWSC schedules the supply to ensure that water is available during the hours of peak demand, and average daily supply is between 17 and 20 hours. NRW is over 45 percent, with leaks from aging networks contributing significantly to the total.

Enhance customers' awareness of how they use water, and improve payment levels. At least a third of Lusaka customers with their own connections pay a fixed nonvolumetric tariff, with the rate determined by whether the area is categorized as low, medium, or high income. The utility associates fixed tariffs with often-inefficient water use, and says they offer customers few incentives to attend to leaks or dripping taps.

Provision of water to poor households at lifeline tariffs that are more cost-effective is seen as good for the utility, and securing access to water beyond the hours that tap attendants work. A majority of peri-urban residents draw their water from communal standpipes, and tap attendants collect payment from users. The utility pays tap attendants 40 percent of the revenue they collect on sales at a life-line tariff. Although this is an important source of income for the tap attendants, who are mostly women, utility representatives say this is not cost-effective: both the average tariff and the life-line tariff are subecononic, and deducting a further 40 percent for collection compounds this. The utility complains further of “pilfering” by attendants who do not declare all sales. It believes that prepaid standpipes will be more cost-effective to the utility, over and above offering customers greater convenience.

Government guidelines also played a role. In June 2013, the secretary to Zambia’s Cabinet issued a memorandum requiring all
government institutions to adopt prepayment as soon as possible. Funds allocated to each ministry or entity to pay for water services are often used for other purposes, and the Ministry of Finance is no longer willing to settle these bills at the cost of other needs. Installations began at the State House in Lusaka, which is where the president lives, to signify endorsement at the highest level.

**Implementation of prepaid meters**

**Prepaid meters on individual domestic connections**

LWSC first piloted prepayment for individual customers in 2007, when two types of prepaid meters were installed on the connections of a thousand middle- and low-income customers in the suburb of Libala. This area had 24/7 water supply, but low water pressure averaged about 0.7 bar.

**One type of meter used a smartcard for loading credit.** The local supplier went out of business within the first year and could no longer provide support when faults arose. LWSC was able to remove the prepayment components from the meters and use them as postpaid meters, with conventional meter reading and billing (Photo 2).

**The second type of meter in the pilot, which used a Dallas iButton for transferring credit,** presented a range of technical faults. The meters were initially calibrated to require at least 1 bar of pressure or the diaphragm would restrict flow. Once they were reset to cope with 0.5 bar, they performed better. But batteries needed replacing within months, valves jammed for no apparent reason, some credit purchases did not register properly on the meters, and leaks caused software errors. The meters were not reparable locally and had to be returned to the factory. Spares and expertise had to be flown in from South Africa at significant cost. By the third year, an estimated 60 percent of the meters were delivering free water because the valves had jammed open. Customers’ main complaint was the distance to the nearest (and only) credit vending site, but said their consumption was lower because they were more aware of the unit cost after prepayment, and they enjoyed spending less on water.

The pilot program underscored the need to avoid proprietary hardware, plan for future billing and vending systems, and explore systems that complied with international compatibility protocols. After close interaction with ZESCO, the national electricity supplier with several years’ experience of prepayment, LWSC opted to pursue a new prepaid water system that would allow it to piggyback off vending infrastructure already developed for prepaid electricity. This would
cut costs and offer customers more convenient credit purchases, as they would be able to buy prepaid water and electricity from the same place, or from home by mobile phone.

In 2012, LWSC issued the first of several tenders for an initial total of 22,500 prepaid meters, and specified they should be STS-compliant and equipped for automatic meter reading. They also insisted that tenderers included a particular make of mechanical meter within the device, so that if the prepayment components failed, the meters could still be read and used for conventional billing. Installation began in three small urban centers served by LWSC—Luangwa, Kafue, and Chongwe—where most customers were not metered and paid a modest fixed tariff. Household consumption dropped significantly when prepaid meters were introduced, as customers adjusted to the new volumetric tariffs and began to use water more conservatively.

The combination of volumetric tariffs and upfront payment changed customers’ behavior rapidly. Taps were no longer left running while washing the dishes and doing laundry, baths were shallower, and showers were shorter. Previously neglected leaks and dripping taps were fixed (Photo 3). The wider impacts were profound. In Luangwa, the hours of daily supply doubled from 12 hours to 24/7. In Chongwe, reduced consumption in prepaid areas allowed the utility to extend coverage and sell water to customers in new areas. In Kafue, the increased water pressure raised the network leakage ratio so greatly that some areas where prepaid meters were being installed became water logged; work was halted, and funds had to be found to upgrade parts of the network. Today, Kafue has 24/7 supply for the first time in decades, and new customers are being served.

Applying the lessons from the small towns, installation in Lusaka concentrated on areas with 24/7 supply. But even nonroutine supply interruptions can affect the performance of the mechanical meter in the prepaid devices significantly, because grit can jam the valve and air can spin the counter, draining credit rapidly without delivering water. Air valves and strainers can mitigate this, but the cost and operational burden of installation and maintenance is high.

There were mixed responses to prepayment from Lusaka customers. As one customer put, “Prepaid is good for a small family, but a fixed tariff is good for a big family.” Some customers who previously had metered connections found themselves paying more, because their previous meters were old and underread. But the majority said they now use less water and spend less on water, because they are more conscious of their consumption and try to use less.

A key benefit of prepayment, cited by many survey respondents and focus group participants, was that prepayment removed anxiety about receiving water bills they could not afford. More than a third (36 percent) of survey respondents said they had previously been disconnected for nonpayment. Some said they had received high bills they could not afford, but with prepaid, “you pay for exactly what you consume.” Another said, “You know exactly how much you can use, not like before where you never knew how much you would owe.”
A big benefit of prepayment is that customers notice quickly when they have a leak, because their credit drains rapidly. This can be alarming, and can prompt complaints that the meter is malfunctioning, but it is preferable to what usually happens with a leak on a postpaid meter. All too often the leak is only noticed when the meter is read weeks or months later. This is often the reason customers get bills they cannot pay, and can result in debt shock and debt cycles that they struggle to escape, over and above disconnection.

Prepaid standpipes
LWSC installed 38 prepaid meters on communal water points in 2011 as a pilot project in peri-urban settlements. Once the water supply is improved and more vending points are provided, prepaid meters will offer customers longer hours of supply at lower tariffs. Tap attendants, whose hours of supply are lower than customers demand, run most standpipes. Outside of these hours, users have to source from a neighbor, a shallow well, or an unauthorized reseller who charges two to five times more than the utility tariff for water from a standpipe.

When the first prepaid standpipes were introduced, tap attendants were retained initially to show users how to use the meters and help those who did not have tokens. But three years later, tap attendants are still being used to sell water from standpipes equipped with prepaid meters because most are not working properly. The utility’s costs have increased because LWSC now pays both for the prepaid meter and a tap attendant to sell water.

The main reason for the poor performance is that water supply in the peri-urban settlements relies on groundwater pumped from boreholes; the electricity supply is erratic and there is little storage capacity. Consequently, the water pressure is lower than the prepaid meter can tolerate, and frequent supply interruptions introduce grit and air into the system and cause malfunctions. Faulty tag readers and weak batteries compound these problems. Many of the prepaid meters have now been bypassed at the standpipe, and tap attendants collect cash payments for every container that is filled (Photo 4).

LWSC plans to drill additional boreholes to improve the water supply, and intends to introduce 500 additional prepaid standpipes in 2014. In the interim, prepaid standpipes that are out of order add to the length of the queues at alternative points.
Institutional customers

LWSC has installed 196 bulk prepaid meters on government and commercial customers’ connections in Lusaka since May 2013. Sites now equipped with prepaid meters include the president’s residence, various ministries, police and army barracks, schools, clinics, and a prison. The meters are operated with a smartcard and user interface that is mounted inside the building (Photo 5).

In mid-2013, the Ministry of Local Government and Housing issued an instruction to all Zambian water utilities to install prepaid meters on all government properties so that they do not get into arrears. Soon after this the Secretary to the Cabinet issued a memorandum requiring all government agencies to install prepaid meters. Prepayment for institutional customers in particular significantly improves LWSC cash flows and reduces bad debts from large customers that are often slow to pay.

Implementation has raised a number of unanticipated challenges. Low water pressure initially compromised the performance of some meters, but once those leaks were repaired, consumption at some sites fell by two-thirds. This, in turn, increased network pressure and resulted in a higher network leakage ratio.

Long-term neglect of maintenance at many sites has given rise to extensive internal leaks, such that even large purchases of prepaid credit can be exhausted within days. This problem is particularly evident at army and police barracks, college residences, and apartment blocks, and flags unresolved questions about where responsibility lies for the cost of repairs. Government pays ministries an allocation for running administration buildings, but for residential complexes, it now pays civil servants an allowance directly, and it is up to them to pay their bills. However, this arrangement does not address how the cost of repairs will be met.

Prepayment for schools and prisons is particularly controversial if it jeopardizes the continuity of water supply. At issue is that those who suffer the consequences of cut-offs when the credit runs out are seldom those responsible for payment. LWSC is now making
provision for special short-term credit advances for large prepaid customers to provide continuity of supply.

Several large customers, meanwhile, have their own supplementary boreholes and say they may opt to use these boreholes exclusively if they cannot raise funds to address repairs. If they do, LWSC would lose significant revenue. If adopted more widely by large volume consumers, it could compromise the main source of Lusaka’s water.

**Monitoring and management**

All individual prepaid connections are equipped for automatic meter reading, and the utility performs fortnightly drive-by data collection. The utility believes fortnightly monitoring is necessary to find evidence of tampering, leaks, and faults sooner. The timing is aligned with the monthly billing cycle for postpaid meters, so prepaid and postpaid sales and consumption data can be collated, and so information can be shared promptly with the utility’s NRW department.

LWSC has set up a new prepaid metering department, with dedicated engineering, commercial, and technical staff to drive installation, provide technical and customer support, and analyze consumption data. Faults with prepayment require a quick response, because customers have already paid for their water and expect good service. The utility has developed and is now implementing revised standard operating procedures to streamline the way they do business, reduce response times, and process workflows more efficiently.

The new prepayment management system is not currently equipped to track internal management of customer queries. To get around this, LWSC opens accounts for all prepaid customers in its postpaid revenue management system, and tracks customer queries through the software’s customer care module.

**Vending**

LWSC currently runs three distinct vending systems for the three prepayment systems serving standpipes, individual residential meters, and institutional and commercial customers. These use three different types of credit transfer technology: a Dallas iButton, a numerical token and keypad, and a smartcard, respectively (Photos 6 and 7).

By mid-2014, customers with individual meters will be able to purchase credit from anywhere, 24/7, over their cell phones, and will receive their credit tokens by SMS. This will be followed shortly by access to a wide range of vending outlets currently dedicated to prepaid electricity.

Standpipe customers can currently load credit onto their iButtons from only one pay point, although utility staff make ad hoc monthly arrangements to collect the tokens from customers living further from that pay point, load credit, and return them on the same day. This mitigates the inconvenience and cost to customers of getting to a distant
vending site, but it means that those customers are without their tokens that day and cannot get water. The number of vending sites will need to be expanded significantly given that the number of new prepaid standpipes has been increasing rapidly since mid-2014.

Finance, funding, and revenue
LWSC is using loan finance to fund its new prepayment systems, and charges individual customers a monthly meter “rent” to help recover the capital cost. There are no external subsidies in the water tariff. The utility is under pressure to show improved performance efficiencies before any tariff increase is improved. The national regulator is concerned to ensure that the utility does not pass on the cost of internal inefficiencies to customers. There is, however, growing acknowledgement in Zambia’s water sector that LWSC’s tariffs are subeconomic and inadequate to meet the challenges of providing adequate services to its customers. Substantial investment in prepaid metering appears to be a costly alternative to avoiding a tariff increase or using other means to raise payment levels.

The standpipe prepaid tariff is marginally lower than the lifeline tariff for individual customers. The prepaid tariffs for individual connections are exactly the same as the postpaid volumetric tariffs: 2.4 Kwacha (USD 0.36) per kiloliter for the first 6 kiloliters, with very modest increases for further blocks. Water services payments are allocated 70 / 30 to water and sewerage.

All domestic customers pay a monthly meter rental of MZK 8 (USD 1.20), which is deducted from prepaid customers’ first credit purchase of the month. The cost of prepaid meters is significantly higher than for conventional meters, but Zambia’s regulator has not approved a proposal that prepaid customers pay a higher monthly meter rent.

Add 18 percent VAT and potentially a 40 percent deduction to pay off arrears, and a customer paying off arrears who buys water credit for 100 Kwacha (USD 15) would allocate just 30.80 Kwacha of that purchase directly to water. This buys a little over 13 kiloliters of water.

Many customers have expressed dissatisfaction with the large amount that is diverted to paying off arrears, and there is considerable confusion over how the rising block tariff works.

Zambia’s water regulator, NWASCO, maintains that prepaid users should know in advance exactly how much their credit purchase buys, irrespective of when in the monthly credit cycle they buy credit, and recommends a fixed tariff for prepaid customers. LWSC has responded by introducing a fixed tariff (6 Kwacha, or USD 0.9, per kiloliter) for institutional and commercial customers, and is considering a fixed tariff for prepaid domestic customers.

Prepayment for institutional and commercial customers consuming large water volumes is highly cost-effective to the utility and makes a substantial difference to its cash flows; improved revenue here can help subsidize services in low-income areas. But heightened
awareness of consumption and a greater emphasis on repairing leaks translates to lower usage and reduced revenue for the utility, whereas fixed costs are relatively inflexible. To optimize the trade-off between optimizing demand management and revenue income, the only commercial customers the utility is targeting for prepayment are those who pay late or not at all.

The available data suggests that prepayment for individual domestic connections is only cost-effective at high volumes. Without significant tariff increases or external subsidies, prepaid standpipes are unlikely to be cost-effective because of low revenue income.

**Summary**

LWSC is implementing an ambitious program to install prepaid meters as the default for individual domestic connections, institutional customers, and standpipe users. The majority of meters are STS-compliant, which will soon allow customers to buy credit by cell phone, over the Internet, or from a range of vendors already equipped for selling prepaid electricity. To date, the performance of some of the meters has been compromised by interrupted water supplies and low water pressure. The utility is confident nonetheless that lower average consumption from individual connections and better payment levels will enable it upgrade its networks and improve the quality of services to all.