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Reducing Water Loss in Developing Countries Using Performance-Based Service Contracting

A major challenge facing water utilities in the developing world is reducing water loss caused by leakage, theft, and improper billing. The difference between the amount of water put into the distribution system and that billed to consumers is known as “non-revenue water” (NRW).

The worldwide cost of NRW is conservatively estimated at \$15 billion/year. More than a third of losses occur in the developing world, where some 45 million m³/day are lost through leakage—enough to serve nearly 200 million people—and close to 30 million m³/day are delivered but not invoiced.¹ These challenges seriously affect the financial viability of water utilities and limit their capacity to expand services, especially for the poor.

A high level of NRW normally indicates a poorly run utility that lacks technical and managerial skills. Experienced operators, through well-managed performance-based contracting, can provide the missing skills.

The case for reducing NRW

Each year in the developing world, utilities’ commercial losses of water are equal in value to a quarter of the total annual investment in water supply. They also exceed the amount that the World Bank lends every year for water projects in devel-

oping countries. A sizeable portion of the loss is caused by fraudulent activities and corruption—such as illegal connections, fraudulent meter reading, or meter tampering.

Reducing NRW to just half the current level in the developing world—a realistic target if both commercial and physical losses were tackled—would deliver important benefits. Every year an additional 8 billion m³ of treated water would be available to ser-

Three components of non-revenue water

Commercial losses are caused by under-registration on customers’ meters, errors in data handling, and water theft.

Physical losses are leakage from the system and overflows from storage tanks.

Unbilled authorized consumption includes water used by the utility for operational purposes, water used for firefighting, and water provided free to certain groups.

¹ In the developing world, the utilities covered by the International Benchmarking Network for Water and Sanitation Utilities www.ib-net.org lose an average of 35 percent of their water each year through NRW losses, an amount valued at US\$5.8 billion.

This note reports key messages and findings from “The Challenge of Reducing Non-Revenue Water (NRW) in Developing Countries—How the Private Sector Can Help: A Look at Performance-Based Service Contracting,” by William D. Kingdom, Roland Liemberger, and Philippe Marin, published by the World Bank in 2006 (WSS Sector Board Discussion Paper 8). The complete paper can be downloaded from www.worldbank.org/water.

vice customers, and 90 million more people could gain access to water supply, without increasing pressure on scarce water resources. Water utilities would gain access to an additional US\$2.9 billion in self-generated cash flow, allowing them to become more efficient and sustainable. Fairness among users would be promoted by acting against illegal connections and those who engage in corrupt meter-reading practices. And thousands of jobs would be created to support labor-intensive leakage-reduction activities.

Why utilities struggle with NRW—and how the private sector can help

The weaknesses of water utilities in developing countries are many: weak governance and poor financial management; political and economic constraints on managers; shortages of management and technical expertise; and deteriorated infrastructure.

The private sector can help in many ways, through public-private partnerships (PPP), service contracts, and subcontracting. Benefits can include:

- New technology and training to use it
- Better incentives for performance
- Creative solutions for program design and implementation
- Qualified human resources
- Flexibility in performing field work
- Investment.

Performance-based service contracting (PBSC) is a relatively new approach under which a private firm contracts to implement an NRW reduction program. The firm is paid for services and offered incentives to meet targets. The applicability of PBSC depends on local circumstances, and contracts have to be adapted to how much risk the private sector will take in a given country. With proper government oversight, PBSC can generate immediate operational and financial benefits. However, it is not a substitute for instituting the broader reforms necessary to promote sector sustainability.

Case studies: reducing lost water and increasing revenue

We studied four PBSC projects and evaluated them on six dimensions:

- *Scope.* What is the role of the private contractor? What are the NRW reduction targets?
- *Incentives.* How is the performance-based element of the contract structured?
- *Flexibility.* To what extent can the private sector influence design and implementation?
- *Performance indicators and measurement.* How is NRW reduction measured?
- *Procurement/selection.* How is the contractor selected?
- *Sustainability.* What happens upon PBSC completion? Does the contract ensure transfer of knowledge to the utility?

Selangor, Malaysia: the largest NRW reduction contract to date

In 1997, the Malaysian state of Selangor (and the federal territory of Kuala Lumpur) faced a water crisis. An estimated 40 percent of the water produced was not invoiced, and leakage was estimated at 25 percent, or around 500,000 m³/day—enough to serve three million people.

Selangor's water utility accepted an unsolicited offer to reduce NRW. The contract specified a target for NRW reduction within a given time, in return for a lump-sum payment. The contractor had full responsibility for design and implementation.

Incentives for achieving targets included penalties for noncompliance and a performance guarantee. The contract included establishing district metered areas (DMAs), pressure management, leak detection and repair, identification of illegal connections, and customer meter replacement, as well as the supply of all equipment and materials. The contractor was free to choose where to conduct reduction activities.

Phase 1 of the contract showed how a private firm operating under a performance-based service contract can efficiently reduce NRW losses. Performance actually exceeded targets: Twenty-nine DMAs

were established, with average savings of 400m³/d in each; around 15,000 meters were replaced. The cost was US\$215 per m³/d.

A second, larger contract was awarded to the same company, with an ambitious target of 200,000 m³/d in NRW reduction—never before attempted under a PPP arrangement.

The long-term sustainability of the approach taken is not clear. Phase 1 included staff training, but the water utility failed to maintain improvements, and phase 1 zones reverted to contractor control in phase 2. Clearly, any NRW strategy must address the issue of what to do once the contract ends.

Bangkok: plugging leaks

Bangkok's Metropolitan Waterworks Authority (MWA) struggles to cope with demand from a fast-growing population. During the 1990s, as the system's supply swelled from 3.0 to 4.5 million m³/day, NRW rose dramatically, reaching a peak in 1997 (1.9 million m³/day, or 42 percent). System input was reduced to below 4 million m³/day. NRW then decreased and stabilized in 1999, although at a high level of 1.5 million m³/day.

Subsequent efforts decreased NRW by 30 percent to 1.3 million m³/day, even as system input increased to 4.2 million m³/day. The reduction can be traced to performance contracts that began in 2000 in three of Bangkok's 14 service branches.

Contract design for the three contracts differed significantly from the Selangor model. There was no leakage-reduction target, and payment was based in part on true water savings. Each contractor was free to undertake activities as it saw fit. Instead of a lump-sum payment, as in Selangor, remuneration consisted of: (a) a performance-based management fee to cover overhead, profits, and foreign specialists, (b) a fixed fee covering local labor, and (c) reimbursables for outsourced services, work, and materials—the largest part of the project's cost. This high proportion of reimbursables transferred a substantial amount of risk from the private to the public partner.

The contracts were a technical success: physical losses were reduced by 165,000 m³/day—enough to serve 500,000 residents. Cost efficiency, however, varied widely between US\$246 and US\$518 per

m³/day of loss reduction. And it appears that the contractors failed to put some systems in place for later use by the MWA. MWA has tendered a project for advanced network monitoring, DMA establishment, and other key tasks to redress this failure.

São Paulo: payments and collections

SABESP, the utility that serves the São Paulo Metropolitan Region, is one of the largest public water utilities in the world, supplying 25 million people. By 2004, it was incurring daily revenue losses of 1 million m³/day because the metering system was under-registering true levels of consumption. SABESP chose to address the problem by replacing the meters used by 27,000 large accounts. Five meter-replacement contracts were awarded. The contractors were responsible for analysis, engineering and design, and supply and installation of new meters. There was no upfront payment; contractors were to be paid based on the increase in billed volume. The contractor financed the entire investment.

Performance payments were chosen because the tasks of resizing and “flow profiling” the meters were the most critical activities in the contract. Given the high consumption of the customers concerned, proper calibration could significantly increase metered flows. By linking payments to the improved billed volumes, SABESP ensured that the contractor would focus on these critical issues.

The results were remarkable. The volume of metered consumption increased by some 45 million m³ over the contract's three years; revenues increased by US\$72 million. Of this, US\$18 million was paid to the contractors. The net benefit to SABESP was US\$54 million.

Dublin: upgrading a very old system

In January 1994, the City of Dublin faced a severe water shortage caused by decades of underinvestment in the distribution network and inadequate leakage control. Some 175 million m³—more than 40 percent of treatment capacity—were estimated to be leaking from the system every day. Several areas of Dublin had only an intermittent supply of water.

The Dublin Region Water Conservation Project, co-financed by the European Commission, was charged with reducing physical water losses. To meet the ambitious target—reducing leaks from 40 percent to 20 percent (from 175,000 to 87,000 m³/day) over two years—an experienced contractor was required.

In November 1996, eight consortia were invited to bid on the leak-reduction contracts. The contractor to be responsible for establishing DMAs, locating and repairing leaks, installing pressure-reducing valves, rehabilitating parts of the network, and training utility staff. Essentially a target cost contract expressed in monetary terms, the arrangement included bonus and penalty incentives.

A private UK water utility won the contract. Remuneration included a management fee, technical labor, and all leak-detection equipment, but excluded the cost of leak repairs, repair materials, and network rehabilitation, which were carried out through local subcontractors as reimbursables.

The accomplishments were significant. Five hundred small DMAs were created, covering the entire distribution network. Some 15,000 leaks were repaired, and about 20 km of mains replaced. Leakage dropped from 175,000 m³/day to about 125,000 m³/day—not the 20 percent target but sufficient to end the crisis. The cost of the contract was US\$750 for each cubic meter per day of water saved.

Training and capacity building led to substantial transfer of technology. The Dublin water utility now regularly controls leakage.

Lessons learned

It is possible to cut NRW losses by half in developing countries through well-designed reduction programs. That possibility should capture the attention of donors and developing-country governments.

Performance-based service contracts appear a viable way to reduce NRW losses, provided two essential elements are present: good contracts and realistic baselines. Contracts must clearly state all expectations and success metrics and should include guidelines concerning risk transfer, an indicator for leakage, and provisions for oversight by utility managers. Contracts should set viable targets and allow flexible responses to challenges and opportunities.

Good preparation is required, starting with a strategy to address the sources and magnitude of NRW over both the short and long terms. Opportunities for private sector participation can be identified during this stage. Once these are known, incentives should encourage the private sector to deliver reductions in the most cost-effective manner, allocating risk appropriately between the parties.

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