

Water in Circular Economy and Resilience (WICER)

The Case of Phnom Penh, Cambodia

Improving Operational Efficiency and Reducing Nonrevenue Water

This case study is part of a series prepared by the World Bank's Water Global Practice to highlight existing experiences in the water sector. The purpose of the series is to showcase one or more of the elements that can contribute toward a Water in Circular Economy and Resilience (WICER) system. This case focuses on the experience of Phnom Penh, Cambodia. Two of the main pillars of a circular economy are resource efficiency and zero (or minimum) waste. By significantly reducing water losses and improving operational efficiency, the Phnom Penh Water Supply Authority (PPWSA) is embracing circular economy principles toward a more sustainable future.

Context

Phnom Penh is the capital city of Cambodia, which, like other countries in the region, has experienced rapid population growth, urbanization, and economic development over the last three decades. The city's population grew from less than 1 million in 1993 to around 2.1 million people in 2019, accounting for 14 percent of the total population of the country (Census 2019).

The city's population growth rate is 3.2 percent, nearly triple the national average. The city's geographical area has more than doubled since the late 1990s. This rapid growth and expansion have led to challenges in the provision of water supply.

The Phnom Penh Water Supply Authority (PPWSA) is the water service provider for the capital city. In 1993, PPWSA was a poor-performing utility serving only

25 percent of the city's residents and covering only around 40 percent of the city's neighborhoods. Water quality was generally not fit for consumption, and supply was intermittent, adding up to around 10 hours a day. Water treatment plants were operating at only 45 percent of their installed capacity due to degraded facilities resulting from decades of neglect and frequent electricity shortages, and revenue from tariffs covered only half of operational expenses. The rate of nonrevenue water (NRW) reached as high as 72 percent, most of it caused by leaky pipes, low bill collection rates, and illegal connections across the city.

Solution

In order to provide better water services, a utility improvement program was introduced by the government in 1993. This case study highlights the key interventions undertaken that resulted in PPWSA becoming a world-renowned utility, as its operational efficiency improved over the course of more than a decade of reform and capacity building.

The utility improvement program aimed to turn the utility around and improve the quality of its water supply service to customers by improving operational performance through the reduction of NRW and by increasing coverage. It focused on a number of key areas, including: (1) mandated metering of existing customers and the creation of a customer database to improve revenue collection; (2) rehabilitation of the water supply network and production facilities, and, later, efforts to increase production capacity and expand the network through massive infrastructure investment; and (3) improvements in the PPWSA's governance structure that allow the utility to operate like a business.

Nonrevenue Water Reduction

Reducing NRW by lowering water losses and increasing revenue collection has been the core focus of PPWSA since the start of its utility improvement program.

Lower water losses were achieved thanks to efforts across multiple fronts. First, major infrastructure investments were needed to replace old pipes in a state of disrepair and to restore production facilities operating below their optimal capacity. Second, PPWSA launched a campaign to register all water consumers in the city to build up a customer database and to build public support for legalizing and paying for water supply connections. The campaign enabled PPWSA to install meters in every household, along with the implementation of strict measures against illegal connections—disciplinary measures against staff engaged in illegal connections and the strict application of a water disconnection policy for customers—and the provision of support to poor households through subsidized connections. As a result, all connections were metered by 2000. Third, the distribution network was divided into 42 district metered areas (DMAs) equipped with pressure and flow rate data transmitters to detect big leaks in the system. Fourth, a leak repair team was set up to function 24/7 with the mandate to detect and repair water leaks and avoid water theft for each DMA. One notable innovation undertaken by PPWSA was the implementation of an internal service contract in 2001 with the leak repair team—its own staff—with clear performance metrics and rewards. A target for water losses reduction was set for each team within its respective zone (each zone covering several DMAs), upon assessing water losses at baseline. The reduction in water losses in each zone would be the basis for determining the financial reward, following a set of principles that was transparently communicated to the utility's staff. This approach significantly contributed to the reduction of NRW from 35.5 percent in 2000 to single-digit levels in 2005.

In addition to reducing physical water losses, efficiency improvements in bill collection helped reduce NRW. The bill collection ratio jumped from 48 percent in 1993 to 99 percent in 2005, and was being maintained at that level up to the year 2020. As PPWSA achieved a high rate of metered connections, it also focused on

regulating water meter reading and bill collection. For example, it set up a system for ensuring the transparency of meter readers—(the utility staff responsible for meter reading, delivering bills to customers, and reporting any irregularity caused by leakages on a customer’s property, meter malfunctions, or illegal connections). Incentives and disciplinary measures were implemented by which performance targets were set for each meter reader, both in terms of the amount of revenue collected (against the billed amount) and the number of customers paying the bill. The higher the collection rate, the higher the bonus. Moreover, punitive measures were also put in place against collusion in meter reading and illegal connections, desk readings, and other inappropriate behaviors. This has significantly changed the working culture within PPWSA. PPWSA also invested in professionalizing the workforce through a technical capacity-building program in which each staff member has received on average 12 days of training each year. In addition, a stronger human resource policy was also put in place to retain talent including an eight-year remuneration plan, the introduction of a best performance award, medical benefits, and financial support to staff facing financial difficulties. An independent disciplinary committee was also established to transparently implement disciplinary measures in case of staff misconduct.

Alongside the utility improvement program, a tariff increase was introduced to cover the cost of operation and maintenance in the short term and to achieve full cost recovery in the medium and long term. The first tariff increase was introduced in 1997 with an average increase of 312 percent (from US\$0.06) after PPWSA became autonomous, requiring the utility to generate enough revenue to cover the costs of service and the service improvements that had been made. As a result, the collection rate reached 97 percent and around 90 percent of connections were metered. The second tariff increase was implemented in 2001 with an average increase of 115 percent, and has remained unchanged until now (2020). The fact that PPWSA

achieved such a low NRW rate that has continued across decades has allowed the tariff to remain the same since 2001 and still cover the full cost of service.

Policy, Institutional, and Regulatory Environment

It should be noted that at the early stage of the reform in the 1990s, there was limited regulation of the water sector; thus, most of PPWSA’s achievements can be largely attributed to self-regulation. In 1996, PPWSA became an autonomous utility, a state-owned enterprise operating like a business, with sufficient authority to develop its own payment structure and staff enhancement program to respond to the ever-increasing customer demand. The autonomous status of PPWSA was an important factor allowing the utility to undertake the needed reform that has brought its success to date. While working toward achieving financial self-sufficiency, PPWSA first focused on optimizing efficiency in its operations and improving the quality of service, instead of only increasing tariffs. Tariff increases were then carefully introduced in 1997 and 2001 after improvements in service were witnessed by customers and trust had been built.

The water supply and sanitation sector policy became available only in 2003 and included the provision of (1) a full-cost-recovery water supply tariff, (2) scope for private sector participation in the water supply sector, (3) support for increased connections among poor households through a connection subsidy, (4) financial autonomy to public water utilities, and (5) establishment of a water regulator. The legal framework to support the implementation of the policy has not been developed to date, however, constraining its full-fledged implementation. Considering the lack of a legal framework, several key ministerial regulations including the licensing of water service providers and setting of water supply tariffs have been established. Efforts to prepare a water supply law are ongoing, especially as Cambodia accelerates its efforts

to expand water supply access to meet the Sustainable Development Goals.

Financial and Contract Arrangements

At the early stage of its development, the development of water infrastructure in Phnom Penh had relied solely on official development assistance. Accessing commercial finance was impossible during the 1990s due to the poor status of the utility and the nascent condition of the country's financial market. In 1993, PPWSA started to receive international financial assistance from development agencies in the form of concessional loans and grants to rebuild its ravaged infrastructure and restore its services. Between 1993 and 2013, PPWSA received financial assistance estimated at US\$266.7 million (62 percent being from concessional loans) from multiple development partners including the World Bank, Asian Development Bank, French Agency for Development, Japan International Cooperation Agency, and United Nations Development Programme. The financial assistance contributed not only to the development of the utility's infrastructure, but also to capacity building and improved governance and management. While NRW reduction has been at the center of the utility improvement program, it is not possible to assess the amount of investment to be attributed only to this program.

Upon turning into an autonomous utility in December 1996, PPWSA was granted enough independence to develop its own payment structure, develop a human resources plan to motivate its staff, and utilize the revenue to pay for its infrastructure development and debt servicing. The utility was the first entity listed in the Cambodia Stock Exchange in 2012, which had three potential benefits: an injection of finance for investment projects; a strong framework to sustain good governance and transparency; and incentives to raise efficiency and profitability, transmitted through the stock price.

However, the impacts achieved through the listing have not been as anticipated. The sources of financing for most of infrastructure investment in PPWSA remain development partners, as Cambodia has been, until recently, still eligible for concessional loans. The tension between the public goal of reaching more people with low tariffs and motive to maximize profit for shareholders remains. The listing has, to some extent, promoted corporate governance with improved transparency using international accounting standards, that could open the possibility of further improvement in efficiency and the maintenance of a low level of NRW.

It should be noted that PPWSA's operating cost coverage has markedly improved over time from a low level of 66 percent in 1993 to 170 percent in 2019. The utility was able to reach full cost recovery in 2004.

Benefits

PPWSA is now a world leader in efficiency, after bringing down NRW from 72 percent in 1993 to 6.9 percent in 2013. PPWSA has managed to stay within the band of 6–9 percent of NRW up to 2020, even with a 15-fold increase in the number of its customers (as of 2019) and 24/7 supply. It is currently supplying water to 390,000 connections in the city, serving 97 percent of the population of Phnom Penh (census of 2019).

It was estimated that the reduction in NRW in PPWSA between 1993 and 2013 resulted in savings of US\$150 million (i.e., deferred investment in new plants to increase production) and US\$18 million in income that would have been otherwise lost due to NRW.

The minimization of water losses in the system has also helped PPWSA to be more resilient, as most of the water produced reaches customers. As the region is facing the consequences of climate change with frequent prolonged droughts, the efficient management of water resources is crucial, especially as PPWSA relies only on one source of water—the Mekong River.

Lessons Learned

Reducing NRW in PPWSA has been a backbone of the utility's turnaround program and the main action undertaken among efforts to adopt a circular economy approach. Multiple interventions were put in place to address NRW through physical intervention, governance and organization reform, tariff revision to achieve cost recovery, and mobilization of social support. From PPWSA's experience, we can highlight several factors that contributed to the success of the NRW reduction program:

- **Interventions are best sequenced for greatest impact.** While multiple interventions were implemented as part of the utility improvement process, the sequence of activities is worth noting. First, it started with the metering of existing customers, although infrastructure was not yet in good shape. Such early aggressive metering signaled to all customers that water supply is a service that needs to be paid for. Second, the utility gradually rebuilt the water supply service through major rehabilitation of its degraded network and production infrastructure to ensure that customers got what they paid for. Third, a governance reform was introduced to strengthen organizational performance and accountability. This phase has been recognized as an important turning point for the utility, setting the foundation for long-term sustainability. A tariff increase was also introduced in tandem with the governance restructuring to achieve the recovery of operational costs. Fourth, major expansion of the distribution network and production capacity took place after the utility's governance was better organized and operational efficiency had improved. The performance of PPWSA continues to improve, and over time has gained public recognition, which is key to the reform's success to date.
- **The autonomous status of a utility is important during reform.** The government decision to turn PPWSA

into an autonomous utility was an important milestone that allowed the utility to operate like an independent business without any political interference, pushing the utility to work toward achieving financial self-sufficiency, among which reducing NRW and improving efficiency were key.

- **The utility's success has depended on aggressive metering and community outreach.** PPWSA implemented a program to meter all connections by soliciting public support through community outreach and education and building up a customer database. At the beginning, public support was not warranted due to the erosion of trust in the utility's service. It took time for PPWSA to build trust among citizens through an incremental increase in the quality of service and the implementation of a system for handling complaints and feedback from customers that included an information desk and round-the-clock hotline to deal with customer's questions and reports, an increase in routine community outreach and education on safe water, and a mechanism for the on-site testing of water quality at customers' request. As a result, metered connections sharply increased from less than 13 percent in 1993 to 100 percent in 2000, and were being maintained at that level as of 2020.
- **Setting up DMAs and a dedicated team for leak repairs is invaluable.** Like many other utilities, PPWSA set up DMAs to control water losses, either physical or commercial. An additional ingredient of success is the internal service contract arrangement with the leak repair team in each DMA, where clear performance ratings and incentives were transparently spelled out and strictly implemented. Such an arrangement motivates the PPWSA staff to constantly detect and fix the pipe leakages in the distribution network. On average, the team has been able to respond to reported leakages within two hours.

- **Leadership focused on staff performance and discipline.** The success of PPWSA's reform is also due to its leadership, which paid much attention to harnessing staff knowledge and capabilities along with putting in place a clear performance framework and disciplinary measures. This approach has enabled staff at all levels to commit to the common vision of a utility supplying water to citizens sustainably. Ending illegal connections and accurately reading water meters were among the achievements made through the staff enhancement program.
- PPWSA's significant reduction of NRW over the past two decades exemplifies how **improving efficiency**

and minimizing water losses can strengthen a utility's financial status, delay the need for additional water treatment plants, and improve a utility's resilience to economic and, to some extent, climate shocks.

Background Documents

ADB (Asian Development Bank). 2006. "Pulling the Plug on Nonrevenue Water."

Biswas, A. K., and C. Tortajada. 2010. "Water Supply of Phnom Penh: An Example of Good Governance." *International Journal of Water Resources Development* 26 (20): 157-72.

Interview with His Excellency Ek Sonn Chan, former General Director of Phnom Penh Water Supply Authority. He is now the Minister Attached to the Prime Minister of the Royal Government of Cambodia.

