Wastewater: From Waste to Resource

The Case of Durban, South Africa

Wastewater Reuse for Industrial Purposes

Context

South Africa is a water-scarce country. Durban, the third biggest city in the country and one of the main commercial centers, depends both on the availability of water resources and proper sanitation services for its sustainable economic and social development. During the 1990s, Durban was facing a sewage capacity constraint. The existing infrastructure could not cope with the growing population and the economic development of the city.

The municipality had to invest in new infrastructure to increase wastewater collection in order to avoid negative impacts on its citizens and the environment. Durban's first option was to invest in a new marine outfall pipeline. However, the costs of the infrastructure were very high, and the city considered alternative solutions to prevent large increases in the costs of wastewater disposal in the area.

Through a public-private partnership (PPP), the municipality successfully implemented a wastewater recycling project for industrial purposes. This project is an example of sustainable wastewater management with multiple environmental, economical, and social benefits for the region. In addition, the project is the first of its type in South Africa and became an exemplar of a solution that considers wastewater as an asset rather than a liability to be disposed of.

PHOTO 1. Durban Water Recycling Plant

Source: Water Institute of Southern Africa.

Solution

Instead of increasing the capacity of the existing marine outfall pipeline in the city's Southern Wastewater Treatment Works (SWTW) to discharge primary treated wastewater to the ocean, Durban explored the possibility to further treat it and reuse it

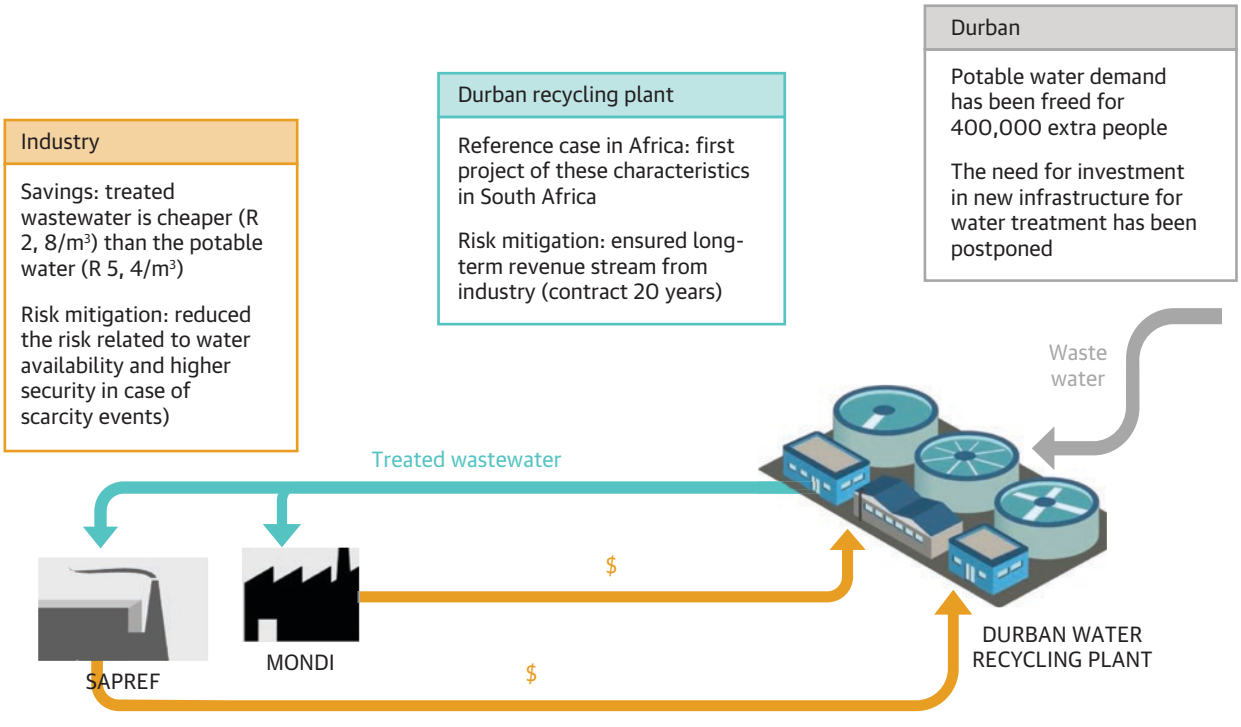
CHALLENGE
• South Africa is a water-scarce country. • Durban is the third largest city in the country and one of the main commercial centers. Its population is growing fast. • The city faces limited water resources in the city, with sanitation capacity reaching its limits.
OBJECTIVE
Diversify water supply sources, incorporating alternative sources of drinking water, and invest in sanitation and wastewater infrastructure for the city.

for industrial purposes. Mondi, a paper industry, and SAPREF, an oil refinery, expressed interest in receiving the treated wastewater. The goal of the project was to treat around 48 million liters per day (approximately the 10 percent of the city's wastewater) and achieve an acceptable quality for industrial reuse: 85 percent of the treated water would go to Mondi, and the rest to SAPREF.

In order to be able to supply recycled water to the two industrial users, the municipal water utility (Ethekwini Water Services [EWS]) needed to upgrade the existing activated sludge process, build a new tertiary wastewater treatment plant, refurbish the high-level storage tank, and install a reclaimed water reticulation system. One complexity of the project was that Mondi required high-quality water, given that it is used to produce fine paper.

Given the technical complexity, cost, and risk of the project, the municipal utility opted to implement

FIGURE 1. Durban Wastewater Recycling Project and Benefits



Note: Treatment plant image is by Tracey Saxby, Integration and Application Network, University of Maryland Center for Environmental Science (ian.umces.edu/imagelibrary/).

Total Investment: R 72 million	
Equity from Durban Water Recycling (DWR) stakeholders	R 14 million
Development Bank of Southern Africa loan[a]	R 34 million
Rand Merchant Bank loan	R 24 million

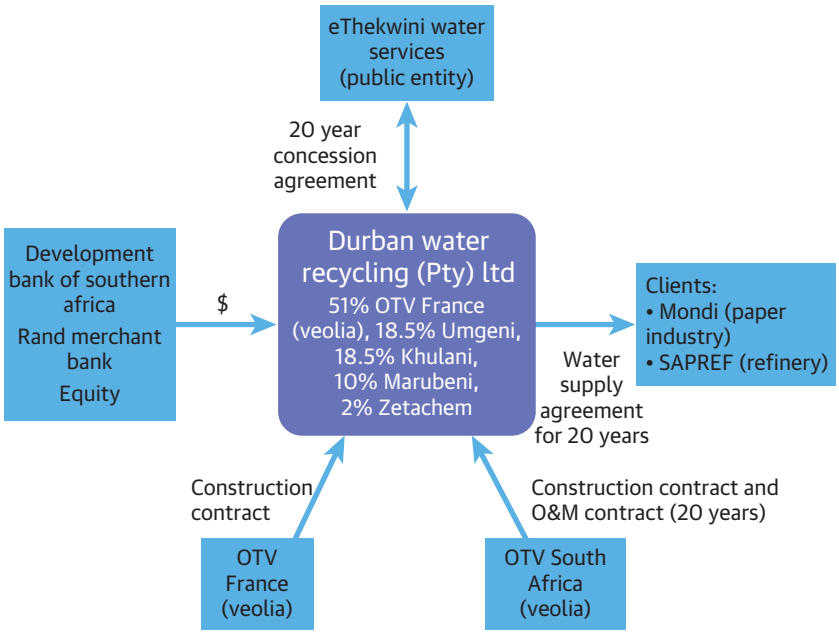
a. Includes a French Export Credit Facility emanating from a protocol signed between the French government and the South African government.

the project under a PPP. After an international biding phase, Durban Water Recycling (DWR), a consortium led by Vivendi Water Systems (Veolia), was chosen to finance, design, construct, and operate the tertiary wastewater treatment plant at SWTW under a 20-year concession contract. The municipal utility would still be in charge of the preliminary and primary wastewater treatment at SWTS, and the effluent from the primary settling tank would be sent to the plant operated by DWR to be treated and then be sold to the industrial users.

Financial and Contractual Agreements

The total cost of the project (construction for the new tertiary plant, purchase and upgrade of the municipal utility assets used for the project and needed piping system) was around R 72 million (see table 1). The private sector provided the entire funding needed for the project. DWR also undertook the risks of meeting the water quality needs by the two industrial users. Therefore, the municipal utility did not incur any extra capital cost for the taxpayers. The guaranteed demand for treated wastewater from the two industrial users made the project economically attractive and allowed DWR to undertake the investment risks.

FIGURE 2. Stakeholder Diagram for Durban Water Recycling



Source: World Bank based on Vivendi Water.
Note: O&M = operations and maintenance.

Project Details

- Build-own-operate-transfer (BOOT) contract, 20-year concession (until 2021)
- DWR pays to the municipal utility the annual management fee and a fee for the lease of the land, and a levy per cubic meter to reflect the cross-subsidization income from the industrial users
- Water purchase agreements with Mondi and Sapref

Benefits

For Durban

- The sale of treated wastewater to the industry has freed enough demand of potable water to supply 400,000 extra people in the city.
- As a result, the need for investment in new infrastructure for water treatment has been postponed.
- Foreign investment has allowed introduction of the latest technology in water treatment to the South African market.

For the environment

- 10 percent reduction of wastewater discharged into the ocean, mitigating pollution impacts
- Indirect augmentation of drinking water resources

For the industrial clients (Mondi and Sapref)

- Savings: treated wastewater is cheaper (R 2, 8/m3) than the potable water used previously (R 5, 4/m3)
- Risk mitigation: reduced the risk related to water availability (agreed price for the next 20 years and higher security in case of scarcity events)

For Veolia

- Reference case in Africa: first project of these characteristics in South Africa, receiving several awards

Other

- For the WWTP: The extra revenue stream from treated wastewater fees covers almost all operation and maintenance costs.
- Industry in South Africa now sees wastewater as a potential resource, given the success in Durban.

PROFILE

NAME

Durban Water Recycling plant

LOCATION

Durban, South Africa

SIZE

47,500 m^3/day (capacity)

MAIN INNOVATIONS

Integrated wastewater management plan

Multi-quality recycled water

Innovative contract agreement and finance

TECHNOLOGY

Secondary treatment: conventional activated sludge and secondary sedimentation tanks

Tertiary treatment: lamella settlers, addition of polialuminium chloride (PAC), dual media filtration ozonization, Granular Activated Carbon (GAC) Adsorption, and chlorine disinfection

Key Factors for Success

- **Support and leadership of the local government and local municipal utility**
- **Stakeholder engagement and compromise**
  - Four independent organizations (EWS, DWR, Mondi Paper, and Sapref) are involved in the project, and their cooperation and coordination have been crucial for the day-to-day operations and for the overall success of the project.
- **Innovative institutional arrangements and agreements for the management and execution of the project**
  - The involvement of two big industrial clients (Mondi and Sapref) insured a constant demand of treated wastewater and a revenue stream for the WWTP.
  - 20-year concession project, the first PPP of its kind in South Africa
  - Clear bidding rules and definition of responsibilities
- **Identify local opportunities**
  - Both Mondi and Sapref are located near the WWTP (Mondi at 200 meters), which has lowered the costs of the pipe system to the end users.
  - Reuse of existing infrastructure, upgrading it for the new purpose
- **Quality and timing of the construction**

- **Multiquality of wastewater tailored for the different uses (fit to purpose) and consistent quality of the treated wastewater**
  - The treatment technology has been personalized for the project, ensuring that quality requirements for the industrial processes of Mondi and Sapref are met.
- **Technical innovation**
  - The wastewater treatment technologies implemented for the project are quite standard, but the innovative combination of the different steps makes the project unique, and ensures that the recycled water meets the quality standard of the industrial clients.

Lessons Learned

The case of Durban is an example of a successful and innovative PPP to improve the sustainability of wastewater management, minimizing environmental impact and having multiple benefits for the community. The city was able to convert a challenging situation into an opportunity, leveraging the local conditions and innovative thinking that resulted into a win-win solution for all stakeholders. The project shows that if the right stakeholders are involved and committed, it is possible to achieve the principles of circular economy.

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