

# Energy Efficient Cities Initiative

## GOOD PRACTICES IN CITY ENERGY EFFICIENCY

### Mostar, Bosnia and Herzegovina – Post-Conflict Water and Sewerage Rehabilitation Project

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Project title	Mostar Post-Conflict Water and Sewerage Rehabilitation Project
Sector	Water and Sewerage
Type of project	Water infrastructure rehabilitation
City and country	Mostar, Bosnia & Herzegovina
City population	128,448 (2007 estimate)
Capital cost/initial investment	US\$15 million
Energy reduction	40% (3.8 MWh/year)
Project status	Completed (2005)

## Project Summary

Between 2000 and 2005, Mostar Water and Sewerage Utility (MWSU), a city-owned water and sewerage services provider in Mostar, Bosnia & Herzegovina, rehabilitated selected pumping stations and portions of distribution networks in a post-conflict environment. The challenges of project implementation were considerable following the civil war that had destroyed both the city's infrastructure and its pre-war institutions. In the course of the project period, financial losses were turned into profits, collections of bills improved from 50 to 75 percent, water connections increased by 9 percent, and annual energy use was reduced by 40 percent.

Prior to the project, MWSU was a divided and war-damaged utility suffering large financial losses. The ethnic conflicts of 1992-1995 damaged several water treatment plants and reservoirs supplying suburban areas. The war led to the split of MWSU in two separate utilities: the Eastern utility serving the Bosniaks and the Western utility for the Croats. Both utilities collected, on average, less than 50 percent of their bills in 1998, and had a combined financial loss of KM2.3 million (US\$1.3 million).<sup>1</sup> Given this precarious financial position, and lack of government support, the utilities had to cancel necessary maintenance of their systems. Consequently, service deteriorated substantially with water leakages estimated at up to 80 percent of water produced.

In response, the Governments of Bosnia & Herzegovina and Mostar City decided to merge the two utilities and rehabilitate their systems. The Government mobilized a US\$15.02 million capital investment fund to rehabilitate MWSU's water and sewerage infrastructure. The fund financed replacement of several pumps at selected pumping stations, construction of gravity-fed transmission mains, rehabilitation of distribution networks, and implementation of an in-house active leakage detection program.

The project demonstrated that a public water and sewerage utility can effectively improve service quality, financial performance, and energy efficiency (EE) through rehabilitation in a post-conflict environment. With the experience gained from the project, MWSU received another US\$8.9 million funding from the Global Environment Facility (GEF) for further improvements. The demonstration effect of this successful project motivated other utilities and ministries in Bosnia and Herzegovina to request MWSU assistance in managing donor-funded projects.

<sup>1</sup> The local currency in Mostar is Konvertibilna Marka (KM). US\$1 = KM1.78 (1998)

## 1. Introduction

Mostar, a city and municipality in Bosnia & Herzegovina, was a prosperous industrial and tourist center during the era of the Socialist Federal Republic of Yugoslavia. At that time, Mostar's economy relied on aluminum industries, tobacco factories, agricultural production, and tourism. The city was named after guardians ("mostari") of an old bridge, "Stari Most", a landmark that was declared a world heritage site. The bridge connects two parts of the city over the Neretva River, which originates in Bosnia and flows through Croatia. Mostar residents—made up of Bosniaks, Croats, and Serbs—were supplied with piped water by a single and profitable utility, the Mostar Water Supply and Sewerage Utility (MWSU).

The ethnic war between 1992 and 1995 destroyed much of the city infrastructure and led to the shutdown of nearly 90 percent of the city's industrial capacity. It damaged the water and sewerage infrastructure of the Mostar Water and Sanitation Utility (MWSU). Water treatment plants and reservoirs supplying suburban areas fell out of service, forcing residents and refugees located in these areas to rely on standpipes and water trucks. The war divided Mostar residents: Bosniaks were now living in the Eastern part of the city and Croats in the Western part. Along with the ethnic division, MWSU was split into two utilities: the Eastern utility serving the Bosniaks and the Western Utility serving the Croats. The two utilities had different water tariffs: the Eastern utility's residential water tariff was KM0.68/m<sup>3</sup> (USD\$0.382), which was 75 percent higher than the Western utility's KM0.38/m<sup>3</sup> (USD\$0.213) tariff. The tariff difference was mainly due to the existence of a profitable construction unit within the Western utility. The construction unit operated as a national construction firm and constituted a significant source of revenues in addition to water sales. In contrast, the Eastern utility relied entirely on water and sewerage sales as sources of revenue, requiring a higher tariff to cover its costs.

The Eastern and Western water utilities were operating with deficits and deteriorated infrastructures. With the difficult economic conditions after the war, the largest water consumers—army, hospitals, factories, and households living in multi-family apartment buildings with a single water meter—were not paying their water bills. Consequently, the two utilities collected, on average, less than 50 percent of their bills in 1998, and had a combined financial loss of KM2.3 million (US\$1.3 million). Given this dire financial position and the lack of government subsidies, utilities could not pay their electricity bills. They were forced to cut back required maintenance of their infrastructure systems, which continued to deteriorate after the war. As a result, about 2,300 liters were leaking daily through customer connection pipes—over 15 times the same type of leakages reported in U.K. Further, 41 percent of customers had intermittent daily water supply (Table 1).

**Table 1: Characteristics of the Western and Eastern water and sewerage utilities (1998)**

Characteristics	Western Utility	Eastern Utility
Average water production	18 million m <sup>3</sup> per year	15 million m <sup>3</sup> par year
Customers*	22,300 residential and 3000 public/industrial	
Residential water tariffs	KM 0.38/m <sup>3</sup> (US\$0.21/m <sup>3</sup> )	KM 0.68 m <sup>3</sup> (US\$0.38/m <sup>3</sup> )
Industry water tariffs	KM 0.77/m <sup>3</sup>	KM 1.85/m <sup>3</sup>
Collection rates	Less than 50 %	
Net losses	KM 894,000**	KM 1,929,000
Unaccounted for water	Up to 80%	
% of customers with continuous daily water supply	Less than 59%	

\* The number of customers was a rough estimate because the continuing movement of war refugees returning to their homes makes it difficult to have a precise figure.

\*\* The Western Utility's construction unit earned about KM 1,265,000 in 1998.

## 2. Project Description and Design

Utility reunification and enhanced governance framework. The Government of Bosnia & Herzegovina and the authorities of Mostar city decided to reunite the two utilities. The reunification would enable a more efficient use of resources, leading to cost savings for water utilities. The reunified utility would have access to all raw water sources, remove boundary valves separating the two distribution networks, and tap into the comparative advantages of the former utilities, allowing more efficient water resources management, network hydraulic flow, and infrastructure operation. The reunification would also promote social equity and a more balanced city development. All residents, businesses, industries, and municipal institutions, regardless of their location across the city, would be billed at the same water tariffs. The reunification process began in 1997 with consultations between government officials, Mostar city authorities, and management of the two water utilities. Concerns over job cuts as part of the reunification were expressed during the consultations. As a result, the parties postponed staff reductions given the high unemployment rate and very few post-conflict job opportunities and froze new hiring. In April 2000, Mostar City Council, representing interests of both Bosniak and Croat communities, voted to merge the Eastern and Western utilities, paving the way for registering a single water and sewerage services provider.

The City Council considered delegating the management of water supply and sewerage services to an international private operator. This option faced fierce opposition from the former utilities and threatened to split the utility merger. Also, the City Council felt that it would not receive attractive bids from experienced international private operators given the risky business climate, the political uncertainty in the region after the war, and the war-damaged infrastructure. As an alternative, the City Council chose to improve MWSU's governance framework so that it would operate under commercial principles.

The City Council and MWSU defined a new governance framework. They agreed on their respective responsibilities and signed a memorandum of understanding (MOU). Under the MOU, MWSU received a greater level of autonomy. It was responsible for managing water and sewerage services daily, investing in water and sewerage infrastructure, increasing water availability, improving collections and reducing water leakages. A management board

composed of professionals representing various sectors of Mostar was established to head MWSU and report to the City Council, the owner of MWSU's assets. The Council agreed to facilitate MWSU's efforts to collect revenues by timely paying water and sewerage bills of institutions under its governance—hospitals, schools, and administration buildings—and by providing subsidies for low-income customers—female-headed households, refugees,—unable to pay their bills. The memorandum also included provisions for setting uniform water tariffs and disconnecting non-paying customers. An exception to this provision was given to the army and hospitals.

Investment project preparation: With this enhanced governance framework in place, MWSU began preparing an investment plan for service improvements. It considered constructing new primary and secondary wastewater treatment plants as well as associated sewer collection networks to reduce untreated wastewater discharges into the Neretva River, a major source of raw water for many water utilities in Bosnia and Croatia. Further assessments revealed that the expected benefits would be low. Most wastewater discharges from MWSU were diluted in the river and did not significantly affect the quality of raw water for downstream water utilities. The assessments indicated that industrial discharges were a greater pollution threat. In addition to the low benefits, the construction costs were high—about US\$97 million. Due to the combined high costs and low benefits, MWSU rejected the construction of wastewater plant and network.

MWSU decided to rehabilitate the existing infrastructure. It identified urgent repairs to restore water service for suburban areas and refugee camps and facilitated water metering. To maximize the efficiency of the water supply and sewer networks, the repairs needed to be complemented with investments. But MWSU's ability to develop cost-effective investments was limited. MWSU hired an international consulting firm to help identify and prioritize cost-effective investment measures. The firm analyzed the water and wastewater networks and recommended a number of measures to reduce water leakages.

Investment project implementation: The Government of Bosnia & Herzegovina mobilized a US\$15.02 million capital investment fund, partially financed by a World Bank loan, to finance urgent repairs and improve water and sewerage services within MWSU's system. MWSU established a project implementation team (PIT) staffed with civil engineers and financial officers that had been working within the two former companies for many years. The PIT implemented urgent repairs. Most of the required works and good supplies were competitively tendered. The PIT also recruited experienced experts to supervise selected works.

Pumping stations and pipes rehabilitation. To serve suburban areas, including refugee camps, where water treatment plants and transmission mains were damaged during the war, MWSU rehabilitated a number of pumping stations and replaced 50 km of transmission mains and distribution pipes. The pumping station rehabilitation involved replacing outdated and oversized pumps by more energy-efficient ones, installing bulk water meters and automated valves where necessary, and upgrading electricity panels and wires. At the Radobolje water source, MWSU replaced two 40-year old mains with a new gravity-fed one that supplied spring water to a reservoir in the city. It also replaced leaky pipes of selected secondary distribution networks in city areas including Orlac, Bijelo Polje, Rades, Humi and Gradina. The rehabilitation of pumping stations and distribution networks along with the greater use of gravity supply led to reduced energy use and less water leakages.

Water leakage reduction. To optimize the water supply network, MWSU prepared an action plan based on recommendations from the network analysis and modeling study conducted by the international consultants. It implemented some of the measures of the action plan such as establishing district metered areas (DMAs) in the parts of the distribution network where leakages were thought to be high and operating an active leakage detection program. DMAs were established by installing boundary valves, meters, and pipes to delimit portions of the distribution network, creating micro networks that could be isolated hydraulically. This enabled MWSU to implement an active water leakage reduction program that involved setting up and training dedicated teams, purchasing equipment – pressure and flow loggers, ground microphone, correlator, and software – monitoring night water flows, and pinpointing and repairing unreported water leakages.

Service improvements. MWSU carried out other measures to improve water quality, billing, and utility capacities. It applied new procedures for monitoring water quality and installed security fences at a number of well fields and storage facilities to protect water quality. MWSU also replaced 6 km of sewer pipes and purchased equipment to clear obstructions that had accumulated over a decade. It implemented computerized information systems for billing, accounting, and maintenance. The staff installed 4,000 domestic water meters. MWSU's capacity was strengthened. Staff was trained on financial, technical, and commercial practices; management attended training and seminars on modern management practices of water and sanitation utilities and went to study tours to visit other better-performing water utilities. MWSU also renovated its buildings and was equipped with computers and maintenance vehicles.

Parallel institutional measures. The Mayor, Deputy Mayor, and City Council of Mostar worked in close collaboration with MWSU's management board to facilitate the project implementation. In January 2001, the City Council approved a new organizational structure, proposed by the management board. The new structure merged the former two utilities' technical, financial, legal, and administrative units; established a new unit responsible for managing the network by areas; and created new Deputy Manager and Deputy Head of unit positions. All management positions were filled through a transparent and internal competitive process. Staff salaries remained the same. A floor was added to the utility headquarters building to relocate more personnel. In addition to the organizational restructuring, the City Council enacted harmonized tariffs. Before the new tariffs took effect, MWSU had carried out intensive consumer education campaigns to explain upcoming service improvements and needed tariff harmonization, which was implemented in 2002. For the first time since the war, all households, industries, institutions, regardless of their location in Mostar, were billed the same water tariffs: KM 0.76/m<sup>3</sup> (US\$0.43/m<sup>3</sup>) for households, KM 1.44/m<sup>3</sup> (US\$0.81/m<sup>3</sup>) for industries, and KM0.87/m<sup>3</sup>(US\$ 0.49/m<sup>3</sup>) for public institutions.

### **3. Cost, Financing, Benefits, and Impacts**

Project costs and financing. The total cost of the rehabilitation fund and various system improvements was US\$15.02 million. The project was financed from a US\$13.09 million IDA credit from the World Bank and a US\$1.93 million fund from the Government of Bosnia & Herzegovina. MWSU disbursed US\$9.6 million for capital investments and US\$5.42 million for technical services and operating expenditures.

**Figure 1. Photos of Project Execution**

**Benefits and impacts.** The overall results of the project were substantial (Table 2). MWSU improved its financial performance, reversing a KM3.62 million operating loss in 2001 to a KM24.8 thousand operating profit in 2004. With the replacement of portions of old leaky distribution networks and implementation of an active leakage detection and repair program, water leakages were reduced. The share of city residents with continuous daily water supply increased from 59 percent in 2001 to 75 percent in 2004 and 2,400 additional new customers were connected. This service improvement combined with MWSU's enhanced collection procedures and metering campaigns increased revenue collection from less than 50 percent, prior to the project, to 61 percent in 2004 and 75 in 2005. Moreover, MWSU's energy use was reduced by 40 percent, declining from 9.4 MWh in 2001 to 5.6 MWh kWh in 2004 due to pump upgrades and replacements, greater use of gravity-fed water, and water leakage detection and repairs. The energy savings translated into an estimated US\$128,400 annual electricity cost savings.

**Table 2. Project's Key Results**

Key indicators	Baseline (2001)	Achieved (2004)
Net revenues	KM 3,621,805 (loss)	KM 24,818 (profit)
Collections	Less than 50%	61% (but 75%)
Electricity consumption	9.4 MWh	5.6 MWh
Water connections	27,200	29,600
Share of population with continuous water supply	59%	75%
Unaccounted for water	80%	60%

Source: Project implementation completion report.

Cost-benefit analysis. Although a cost-benefit analysis of the entire project was not conducted, the EE investments were deemed cost-effective in the medium term. The simple payback period of the EE investments was estimated at 8.6 years (Table 3). This was evaluated using the annual electricity cost savings (US\$128,000/year) and investments that had energy-saving impact<sup>2</sup> (US\$1.106 million) based on data from project documents. This represents a conservative estimate, as some of the costs had benefits beyond EE and many of the benefits accrued went beyond mere energy savings (i.e., increased revenues from collections).

**Table 3. Simple Payback of EE Investments**

Cost-effectiveness of EE Measures	
Benefits: Average annual electricity savings	US\$128,400/year
Pumps replacements and leaky pipes rehabilitation	US\$1,106,000
<ul style="list-style-type: none"> <li>➤ Pump upgrades + gravity use = US\$0.308 million</li> <li>Leaky pipes replacements + Active leakage control = US\$0.798 million</li> </ul>	
Simple Payback	8.6 years

## 4. Project Innovation

Using service improvement goals to unite two ethnically-divided utilities was innovative. The project dedicated significant efforts to bring together two post-conflict communities – Bosniak and Croats – to improve water and sewerage services. This was challenging, risky, and unusual, but yielded a number of benefits. With the new organizational structure, MWSU has appointed the best performing staff at key management positions; adopted the best procedures for maintenance and billing; and optimized the hydraulic efficiency of the two water supply networks. The merger also helped to mobilize funding. For instance, the Government of Norway, one of the donors in the water sector in Bosnia & Herzegovina, waited for the utility merger to fund, in parallel, works that provided water to Mostar by gravity, further reducing electricity costs associated with pumping. It further supported post-conflict reconciliation. The merger offered an example of successful interethnic collaboration and contributed to alleviate post-conflict inequities through the harmonization of water tariffs across the city.

<sup>2</sup> Since the project documents do not specify investments dedicated to implement EE measures, EE investments were estimated by determining and adding up contract amounts to procure works, goods, and services related to (1) pumps replacement, (2) leaky pipes replacement, (3) active leakage control, and (4) greater use of water supply by gravity. The project's average annual electricity savings were estimated equal to the pumping costs reductions.



## 5. Lessons Learned

The project demonstrated that a public water utility can improve water services and financial viability without involving international private operators. The decision to not delegate management to a private operator and to improve the governance framework was a successful approach for the post-conflict setting. Also, the project scope was appropriate, focusing on improving operational efficiency through leaks repairs, plant rehabilitation, and enhanced collections, rather than adding new wastewater treatment. This paved the way for future investments. The project also leveraged local expertise. It was implemented by seven MWSU senior employees with no salary increase. Most of the contracted activities were performed by local enterprises that delivered works meeting international quality standards, which helped keep costs under control. It also created and saved local jobs in a city where unemployment rose following industry shutdowns after the war.

Mostar city's commitment to improving water and sewerage services and reuniting the divided utility was essential to the project success. The city brought together the two ethnically-divided utilities around the same table to discuss means to improve services while promoting lasting peace. It delegated appropriate autonomy to MWSU, held frequent meetings with the MWSU management board to solve issues, and supported tariff harmonization with public hearings and publicity. The city also sought guidance and funding from the World Bank, which was perceived as a neutral and competent third party because of its success in assisting and funding the reconstruction of the "Stari Most" bridge, a highly symbolic cultural heritage site.

Improving collections in a post-conflict environment can be costly and time-consuming. MWSU had to sue many industries to collect overdue debts and current bills. Even though some industries were going through a privatization or had been restructured into different entities, recording water consumption was not modified. For example, MWSU's biggest debtor, a former military equipment manufacturer that had been privatized into eight different companies, refused to pay the old debts and current bills, arguing that there was only one meter for the eight companies. MWSU had to modify the connection scheme, install additional meters, and pursue collection discussions out of court as settling lawsuits takes three to four years and can be costly. The same problem was faced with households living in apartment complex buildings with only one common meter to record overall consumption. MWSU also had to initiate talks with City Council to improve a communal law that prohibits cutting off army facilities and hospitals. With such technical and legal barriers, improving the utility's financial sustainability required time.

## 6. Financial Sustainability, Transferability, and Scalability

MWSU's financial improvements are likely to be sustained following the project. The upward trend of financial improvement should continue. Further reduction in water losses was expected with plans to establish more district metered areas, extend active leakage control to the entire distribution network, and install GIS systems to reduce illegal connections. MWSU's improved bottom line has been further strengthened with the enhanced capacities gained from the project. Financial officers, civil engineers, and procurement officers who constituted the PIT returned to work at their respective departments, bringing in increased expertise.

The project was scaled up; MWSU's expertise was transferred to other water utilities. Having successfully prepared and managed a World Bank-supported project, MWSU has acquired experience that helped attract financing to scale-up improvements. After completing the project, MWSU received a US\$8.9 million grant from the Global Environment Facility to reduce pollution from municipal sources into the Neretva and Bosna rivers. Also, in 2004, MWSU received a US\$1 million loan under a World Bank-financed Urban Infrastructure and Service Delivery project to upgrade its sewerage collection and treatment system. Citing its success, other water utilities and infrastructure-related ministries in Bosnia & Herzegovina that have contracted with international financial institutions for financial assistance have solicited and received technical assistance from MWSU.

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3. *The World Bank. Procurement Plan of the Mostar Water and Sanitation Project. January 2004.*
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5. *The World Bank. Implementation Status & Results of the Mostar Water and Sanitation Project. ISR # 6,5,4,2. January 2004.*
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## ANNEX: CITY AND PROJECT PROFILE

### CITY PROFILE

1. Name of the City	Mostar
2. Area	1,175 km <sup>2</sup>
3. Population	<b>128,448</b> (2007)
4. Population Growth Rate	0.02%
5. GDP of the City	K M 817 million
6. GDP Growth Rate	0.27%
7. GDP per Capita	K M 6361 (2007 estimate)

### PROJECT PROFILE

1. Project Title	<b>Mostar Post-Conflict Water and Sewerage Rehabilitation Project</b>
2. Sector	Water and Sewerage
3. Project Type	<b>Water infrastructure rehabilitation</b>
4. Total Project Capital Cost	US\$15 million
5. Energy/Cost Savings	3.8 MWh/year (from 2001 to 2004)
6. Simple Payback	8.6 years (for EE investments)
7. Project Start Date	December 12, 2000
8. Project End Date	June 30, 2005
9. % of Project Completed	100%

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