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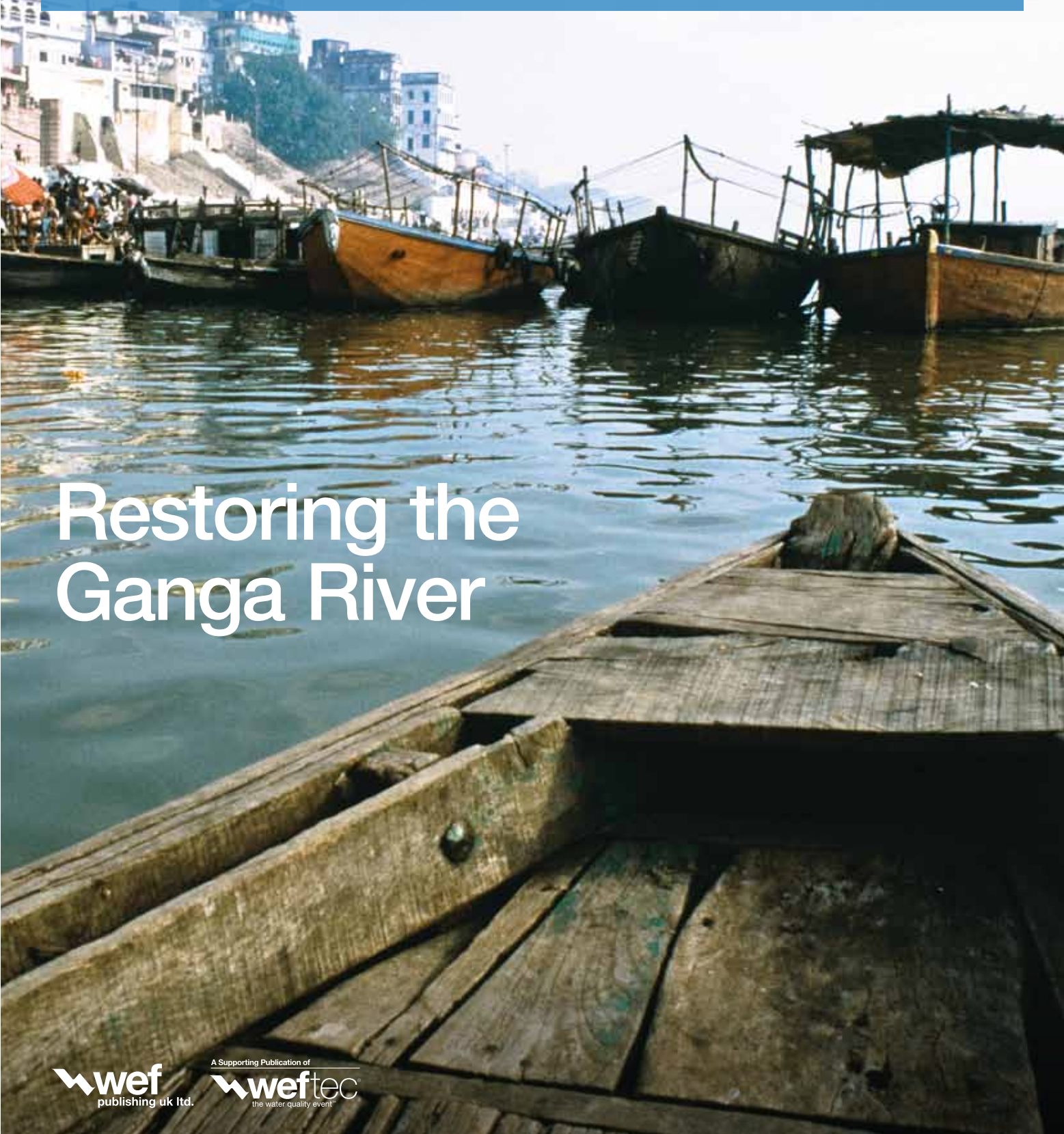

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Energy efficiency audits reveal potential savings

Energy audits carried out at 15 water and sanitation service providers in Latin America and the Caribbean region revealed major sources of energy waste and identified ways to increase energy efficiency, particularly in pumps and motors. **Ramón Rosas Moya**, an independent consultant to the Inter-American Development Bank (IADB), reports on the project findings.

Energy costs have emerged as a major financial burden for water and sanitation service providers in Latin America and the Caribbean, particularly in countries where electricity is generated primarily from fossil fuels. To gain a better understanding of potential savings from investments in energy efficiency, the Inter-American Development Bank (IDB) provided technical cooperation grants to carry out energy audits at 15 regional service providers.

The preliminary findings of the completed audits offer a useful snapshot of the source of energy waste in water and sanitation operations, energy efficiency measures to be implemented, potential savings to be achieved, return on investment of such measures, and the amount of greenhouse gas emissions (GHG) that may be avoided with energy efficiency measures. Results were also included from two other energy audits of water companies in the Mexican cities of Lerdo and Matamoros that were not carried out as part of the IDB project.

The energy audits revealed that the main problem is low electromechanical efficiency (combined motor and pump efficiency) in equipment operation caused by different reasons. Among the most frequent ones are inadequate pump specifications, change in operating conditions, and a lack of predictive maintenance.

The flow, pump head, and electric power must be directly measured in situ using the specific measuring equipment appropriate in each case. The degree of efficiency that can be expected from the equipment will basically depend on two factors: equipment capacity and pump type. Table 1 presents the efficiency reference values that can be expected as a function of capacity and pump type.

Electro-mechanical efficiency is determined by the following equation: $(Q \times H \times \rho \times g) / P$ in which ηem = electro-mechanical efficiency; Q = flow (m^3/s); H = pump head (mwc); ρ = specific weight of fluid (kg/m^3); g = acceleration of gravity (m/s^2); and P = electric power (W).

Many organizations lack a structured preventive and predictive maintenance program. Some water and sanitation providers carry out preventive and predictive maintenance practices, but they are not structured, while only corrective maintenance is performed on equipment in most cases. The energy audits revealed that the main problems caused by the lack of good maintenance practices were high temperatures in starter and switch connectors; capacitor banks out of service or only partially operating; and grounding systems in poor condition.

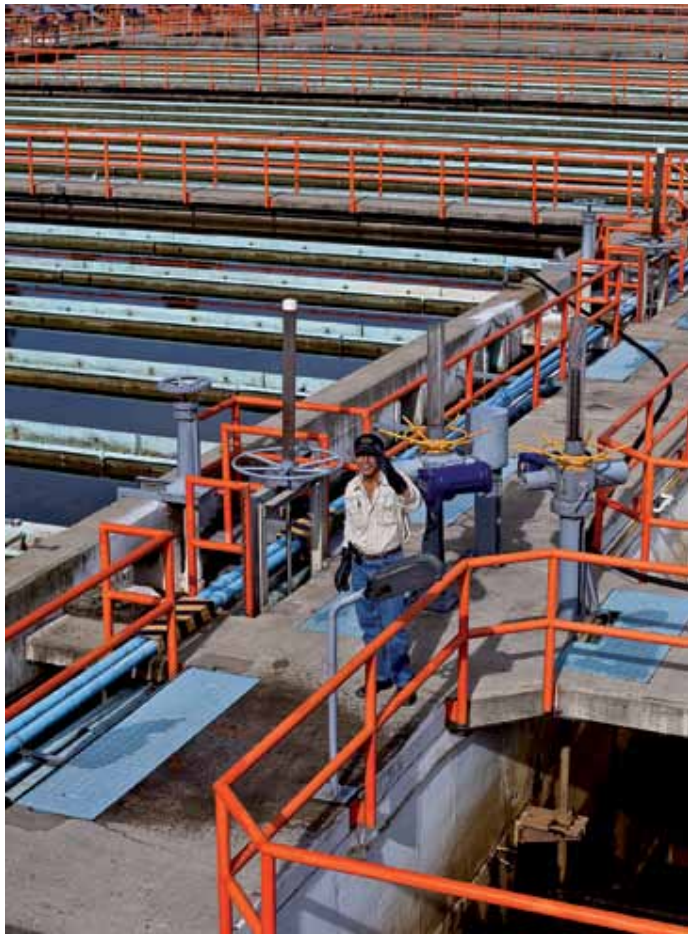
Saving measures identified

Several kinds of energy-saving measures were identified based on the audit results. The largest savings can be achieved by replacing pumps, improving the electro-mechanical efficiency of pumps and motors, and increasing maintenance, which amount to 77 percent of the total saving potential identified. The use of variable speed drives accounted for five percent of the savings identified. Figure 1 shows the principal saving measures and the percentage each of them represents in the total savings.

The average saving potential for all of the companies audited is 23 percent. The highest savings rates were identified at: Water & Sewerage Corporation, Bahamas (39%); Matamoros, Mexico (39%); and Suriname Water Supply Company, Suriname (37%). The Federal District Sanitation Company in Brazil and Nicaraguan

Table 1: Reference Efficiencies

	Expected Efficiency	
Capacity (HP)	**Horizontal and vertical turbine pumps**	**Submersible pumps**
1 a 3	52 a 60	40 a 45
3 a 10	60 a 65	45 a 52
10 a 20	65 a 70	52 a 58
20 a 30	70 a 74	58 a 64
30 a 100	74 a 78	64 a 68
> 100	78 a 81	68 a 70



Sedimentation tanks at the Manantiales Water Treatment Plant in Medellin, Colombia. Photo by Christopher Jennings

Figure 1: Variable speed

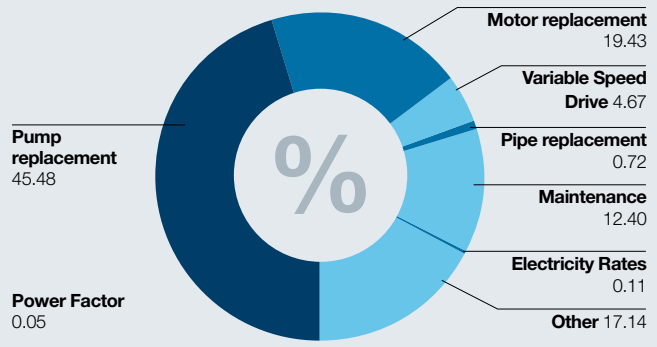


Figure 2: Behavior with Variable Speed Drive

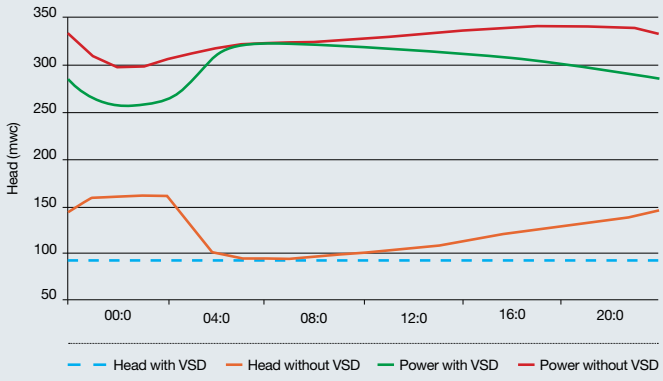


Table 2: Service providers participating in IDB-financed energy audits

Company	Country	Year
National Administration of Aqueducts (ANDA)	El Salvador	2006
Nicaraguan Company of Aqueducts and Sewage Systems (ENACAL)	Nicaragua	2008
Water & Sewerage Corporation (WSC)	Bahamas	2009
Barbados Water Authority (BWA)	Barbados	2009
Federal District Sanitation Company (CAESB)	Brasil	2009
Costa Rican Institute for Aqueducts and Sewage Systems (AyA)	Costa Rica	2009
Guyana Water Inc. (GWI)	Guyana	2009
Metropolitan Center for Drinkable Water (CAMEP)	Haiti	2009
National Water Commission of Jamaica (JNWC)	Jamaica	2009
National Water and Sewage Institute (INDAAN)	Panama	2009
Suriname Water Supply Company (SWM)	Suriname	2009
Empresa de Agua de la Ciudad de Guatemala (EMPAGUA)	Guatemala	2009
Argentinean Water and Sanitation (AySA)	Argentina	2010
Corporación del Acueducto y Alcantarillado de Santo Domingo (CAASD)	Dominican Republic	2010
Empresa Pública Social del Agua y Saneamiento (EPSAS)	Bolivia	2010

It should be noted that for countries with rather important hydroelectric generation, like Brazil, Costa Rica and Suriname, the amount of investment per tCO_2 that is avoided is higher.

Company of Aqueducts and Sewage Systems reported the lowest percentages of saving potential with both at 9%; however, pump operating efficiency was not analyzed as part of the energy audits carried out in the Brazilian and Nicaraguan operators.

Electromechanical efficiency offers the greatest opportunity for efficiency gains. According to the evaluation results, energy-saving potential depends on pump type and capacity. For example, the average efficiency of horizontal and vertical pumps with 0-30 hp is 36 percent, but this could be increased to 70 percent in efficiency. Or >100-hp horizontal and vertical pumps with an average efficiency of 62 percent, could increase to 78 percent.

The energy-saving potential of submersible pumps is similar. Submersible pumps of 0-30 hp with an average efficiency of 37.3 percent can be expected to rise to 57.93 percent, and >100 hp-submersible pumps could increase in average efficiency from 62.91 to 79.22 percent, according to the study.

In systems pumping directly into the network, variable speed drives can be used to control discharge pressure and reduce the power required. A comparison of required head and power shows that the variable speed drive maintains constant head and reduces power in contrast to cases without the drive.

The energy audits identified potential greenhouse gas (GHG) reductions to be 23,400 tons of carbon dioxide (CO_2). Extrapolating the sample results into the total number of equipment in each company, the total GHG reduction potential is 97,100 tCO_2/year.

Conclusions

The analysis of 12 energy audits, some that are still under completion, of drinking water and sewer service providers in Latin America and the Caribbean resulted in several conclusions.

- The average saving potential identified through the energy audits carried out in the IADB project is 23 percent.
- The highest saving potentials are obtained by replacing pumps operating outside their design parameters. Significant potential savings were not found by audits that did not analyze pump performance.
- The investments needed to implement the saving measures identified in the audits amount to US$ 18 million, with a payback period of 1.5 years.
- The establishment of energy efficiency programs in all the companies studied could potentially reduce greenhouse gases by 97,100 tons of carbon dioxide per year. Countries that rely more on thermal generation (using fossil fuels) could achieve higher reductions in greenhouse gas emissions than countries with more hydroelectric generation since this renewable energy source produces no greenhouse gases.

The outlet valve chamber at the Ricaurte wastewater pumping station, Aguas de Cartagena, Colombia.
Photo by Christopher Jennings