

Nagpur, India

Water sector audit enables efficient use of water and energy resources in Nagpur



A comprehensive water sector audit done by the Nagpur Municipal Corporation (NMC) in 2005 resulted in recommendations for improvement at two levels: water distribution and water supply energy efficiency to increase the efficiency of the treatment plants. This audit was the basis for a water sector energy efficiency master plan adopted by the NMC in 2006 and resulted in an innovative and successful initiative for the reuse of waste water in thermal power plants in 2008.

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Abstract

Identifying the water supply and distribution sector as a major area for potential improvements in both efficiency and scope, the Nagpur Municipal Corporation (NMC) began a comprehensive water sector efficiency program in 2005. The first step in the program was the complete assessment of the performance of the sector. The NMC hired an external consultant and began the audit at two levels: for water sector performance and for water sector energy efficiency. The audit was undertaken at five water treatment plants (WTPs) and two pumping stations.

Nagpur was one of the 63 cities selected to be a part of the Jawaharlal Nehru National Urban Renewal Mission (JnNURM) which was launched by the Indian Government in 2005. Funds made available through the mission enabled Nagpur to implement the recommendations for leak reduction and improvement of energy efficiency. To ensure that the progress made through these initiatives would be continued, the NMC incorporated the findings of the audit into a water sector energy efficiency master plan. The NMC's initiatives in the water sector contribute towards their commitment to reducing their energy consumption in municipal services.

The importance of energy in the water sector

Nagpur's expenditure for pumping, distribution and treatment of raw water before distribution as well as the operation and maintenance of the water treatment plants accounts for almost 20% of the NMC's annual municipal expenditure (950 million INR in 2008), with annual revenues of only 450 million INR. At the same time, the sector accounts for over 60% of the carbon emissions generated through municipal services. The NMC had a total availability of 625 million liters per day (MLD) of raw water in 2005, of which it had the capacity to treat and supply 470 MLD to the city. However, billing records reflected sales amounting to only 241 MLD, clearly demonstrating the need for increasing efficiency and reducing water losses. The bills for energy consumed by the water treatment and pumping stations are paid by the NMC to the state electricity board based on the rated capacity of the equipment, therefore increasing the need for the NMC to obtain more water for the same expenditure.



Population / Land area
2,052,606 (2001) / 218 km²

Municipal budget
Approx. 5.07 billion INR (2008-09)
(€ 82 billion)

Local economy
Industry, orange cultivation, trading

Role of city in region
Commercial center in the state of Maharashtra



An ICLEI Initiative

ICLEI supports and strengthens local governments which promote the generation and supply of renewable energy and energy efficiency in the urban environment.

Case Study

The Nagpur context

Nagpur is the largest city in central India and the third largest city by population in the state of Maharashtra. It serves as the seat of the winter session of the Maharashtra state government. In addition to its importance for political and geographical reasons it is also a major education center. It is known in India as the ‘City of Oranges’ because of the large production of oranges in the region. Located in the center of India, the city is well connected to other major cities through an extensive network of highways, railways and air traffic.

The Local Renewables project

The Local Renewables Model Communities Network (or Local Renewables project) aims to support and strengthen local governments in promoting sustainable energy and to become model cities in their national and regional contexts. This international project (2005-2010) connects leading cities to cooperate in sharing their expertise and experience in the fields of renewable energy (RE) and energy efficiency (EE). Thus, the project is a key component of ICLEI’s Local Renewables Initiative.

Special support for participating model communities in India (Bhubaneswar, Nagpur and Coimbatore) and Brazil (Betim and Porto Alegre) was possible due to generous funding from the German Federal Ministry for Economic Cooperation and Development (BMZ) through the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH.

The European Resource Cities of Bonn, Freiburg, Milan, Växjö and Malmö have highly developed renewable energy and energy efficiency strategies which they were happy to share.

The ICLEI offices for South Asia (Delhi), Brazil (Sao Paulo) and Europe (Freiburg) gave continuous guidance and organized the exchange among the cities.

www.iclei.org/local-renewables

Photo: Nagpur Municipal Corporation



A zero mile marker in Nagpur indicates the geographical centre of India.

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Background to the case: The NMC began pilot initiatives in the water sector to reduce leakages in 1997. In 2000, the city prepared a water sector master plan with 30 year projections for water supply and sewage levels. The main objectives of this master plan were to:

- plan for augmentation of water supply;
- suggest viable solutions to existing issues; and
- identify potential improvements for leak reduction.

As part of this comprehensive program to improve the efficiency of Nagpur’s water supply system, the NMC began an audit of its water sector in 2005.

Water system efficiency audit: In 2005 Nagpur was able to treat 470 MLD of water. However, billing records reflected sales amounting to only 241 MLD. These figures indicated that large losses were taking place in the transmission and distribution of the water. Audit results indicated leak detection and reduction were necessary. A team of external consultants was appointed to conduct the audit.

Municipal waste water reused for thermal power generation

Fresh water is a scarce resource in Nagpur: Of the 530 million liters (2008-2009) of water supplied in Nagpur every day, approximately 425 million liters were generated as sewage. However, the NMC has only one sewage treatment plant (STP) with a capacity to treat 100 million liters per day (MLD) of waste water. Over 325 MLD of NMC's waste water is therefore released untreated. In addition, the NMC has estimated that the demand for water has risen by 35% over the past decade (1998-2008) and it is expected that a future increase in population and proposed projects and activities will result in an increase in water demand in the city.

Power generation's demand for water: In order to produce electricity for the city of Nagpur, thermal power plants owned and operated by the Maharashtra Generation Company Limited (MahaGenCo) use large amounts of water for generating steam. In Nagpur, fresh water is used in these power plants.

An alternative source of water needed at power plants: In order to conserve fresh water resources, treated waste water can be used in irrigation and industrial processes. As an initiative under the JnNURM scheme, Nagpur was selected by the government of Maharashtra as the site of a pilot project to demonstrate this. With the technical assistance of USAID, the project focused on the reuse of municipal waste water.

A new water treatment plant will cater to a new power plant: A larger application of this same idea will be undertaken by a public-private partnership between the NMC and the electric company MahaGenCo under the JnNURM scheme. MahaGenCo, through a Memorandum of Understanding signed in 2009 with the NMC, will assist the NMC in building a new treatment plant to cater to the 110 MLD water requirements of a new power plant being constructed by MahaGenCo. The programme is to be executed with MahaGenCo paying the NMC's share of the project costs (30% of a total project cost of 1.31 billion INR). The project will ensure a regular source of water to the power plant, while also providing the NMC with revenue from MahaGenCo (150 million INR per year, or 2.42 million EUR per year) for use of the city's treated waste water.

Potential savings through the waste water reuse scheme:

- With the construction of the new water treatment plant to provide the water required by MahaGenCo's proposed power plant, fresh water resources for up to an additional 600,000 citizens (110 MLD per day) will be freed up in the next ten year period.
- Reducing the distance the water being supplied to the power plant travels, from 40 km to 15 km, would drastically reduce the energy necessary to distribute the water.

The NMC was nominated for the Government of India's 'National Urban Water Awards' in the category of Public-Private Partnership in 2008 for this initiative. This recognition as an innovative, multi-benefit approach to energy and water conservation is motivating for the city and its partners.

Main recommendations from the audit: The main recommendations from the audit include:

- reduction of transmission/distribution losses through replacement of pipelines;
- reduction of loss due to leakages through awarding a performance based contract to a private contractor for maintenance and improvement of the water treatment plant;
- installation of bulk meters at raw water intake points; and
- recommendation of a policy to improve water supply and distribution services to the urban poor.

Implementation of recommendations: In 2005, the JnNURM was launched by the national government of India. Nagpur, chosen as one of the 63 mission cities, prepared a comprehensive city development plan. The water sector audit was submitted as a detailed project report for implementation under the program. The funds made available to Nagpur through the mission enabled the implementation of recommendations. This implementation of recommendations was kicked off with a demonstration project for 15,000 water connections through a 24x7 maintenance and operation contract with a private company. The water supply sector energy efficiency plan was then submitted as a project under the national mission and received funds for its implementation in 2006-2007. By the end of 2009, the recommendations had been completely implemented.

Water sector energy audit: The NMC extended the water audit by including a study on the energy usage of the water supply and distribution system in Nagpur. The pumping and distribution of the water supply to the city is done through

An energy policy for Nagpur – the first of its kind in India

Nagpur and Bhubaneswar were the first cities in India to adopt a city wide energy efficiency and renewable energy policy in 2007 as a key step within the BMZ/GTZ funded project Local Renewables Model Communities Network (LR Project).

Excerpts from the Nagpur city energy policy demand:

- 3% reduction in conventional energy consumption at the city level from 2005 levels by 2012;
- 20% reduction in conventional energy consumption in municipal operations and services from 2005 levels by 2012; and
- promoting renewable energy applications such as solar water heaters for residential and commercial usage.

Award nominations for Nagpur

The NMC was nominated in the category of 'Technical Innovation' for the Government of India's National Urban Water Awards in 2008 for their focus on water sector energy or 'Watery Projects'.

In addition, The NMC won second place in the category of 'Public-Private Partnership' for the Government of India's National Urban Water Awards in 2009 for this initiative to provide 24x7 drinking water to their citizens.

www.waterawards.in

seven pumping stations. These stations and the distribution network contribute 78 million kilo watt hours (kWh) to the city's energy consumption every year, resulting in an annual energy bill of 210 million INR (3.39 million EUR). Energy bills for these services are paid to the Maharashtra State Electricity Board by the NMC based on the rated capacity of the systems, and not on actual consumption, meaning that the NMC pays a fixed amount to power the systems. Increasing the efficiency of these systems to get a larger volume of water for the same costs therefore was of high importance.

Timeline of this project in Nagpur

2000: NMC 30 year master plan formed

2001: state government circular to conduct audit published

2005: NMC begins audit

2006: NMC joins JnNURM

2006-07: water sector audit submitted under the JnNURM as a detailed project for funds

2008: other water sector reforms initiated through public-private partnership (24x7 water supply pilot and waste water reuse scheme)

2007-2009: implementation of recommendations for water audit

Results of the project

Water sector audit: The audit of the water sector revealed the following:

- an increase in the amount of water supply from 470 MLD to 530 MLD;
- cumulative monetary savings of 60-80 million INR (approximately 1 million EUR) per year through the replacement of water pipelines with mild steel pipelines that are more durable and reliable;
- agreement with private contractor to maintain and improve the existing WTP resulting in savings of approximately 22 MLD of water; and
- installation of bulk meters at raw water uptake points to reduce the volume of unaccounted for water resulted in savings of 25 million INR (400,000 EUR), exceeding earlier savings estimates.

Water supply energy efficiency: Since the NMC pays for energy consumption in its water supply sector based upon the rated capacity of the machinery in the pump houses and not based on the actual energy consumption, the main improvements as a result of the implementation of the recommendations made after the audit were through increased efficiency. This was brought about mainly through proper maintenance and repairs. These interventions are expected to cause the following improvements:

- pumping efficiency increase up to 80-85% (up from a previous maximum efficiency of 64%);
- annual monetary savings amounting to 16 million INR (250,000 EUR);
- total increase in the NMC water supply by 40 MLD; and
- annual energy savings of over 9.7 million kilo watt-hours (kWh).

Lessons learned

Every development project needs a clear-cut vision: The NMC developed a strong framework for water sector reforms in 2000 with the preparation of the water sector master plan. This master plan allowed the city to undertake projects with the bigger picture in mind, as the master plan outlined future projections of usage and detailed monitoring and maintenance procedures.

Interventions with multiple benefits are best: The water sector energy audit enabled the NMC to identify methods of water and energy conservation while at the same time improving their services and providing services to a greater population.

Conducting the audit early was an advantageous strategy: The NMC took the initiative by identifying key areas for investment in order to improve urban infrastructure and reduce energy consumption before the JnNURM was launched, such as in the water supply and distribution sector. Thus, once the mission was launched and funding became available, the city was prepared to take immediate action.

State or national governmental assistance is necessary in order to fully implement initiatives: Municipal corporations in India have extremely limited sources of revenue and large expenditures. National financial assistance through programs such as the JnNURM allowed the NMC to implement a scheme that benefited millions of citizens.

Importance of preparation of master plans: Once the water sector audit was complete, the NMC prepared a water supply sector master plan, outlining future projections of usage and detailing monitoring and maintenance procedures. Such master plans are important documents for cities to have when decision makers change frequently and irregularly. The NMC has since made it a point to have a master plan for all their schemes and programs.

Importance of an external consultant for each project: External consultants lend a heightened level of transparency to the process of conducting an audit. External consultants allow cities to see their operations from a different perspective, bringing up innovative solutions that may not be immediately apparent.



Mild steel pipeline being installed in Nagpur's water supply system

City energy report to understand Nagpur's energy consumption patterns

Following the successful completion of the water supply energy audit, the NMC took the next step and undertook a comprehensive citywide energy assessment.

In 2006, energy consumption data was collected from sectors including street lighting, transportation, water pumping system, residential, commercial and industrial sectors.

Using the energy consumption levels of 2005-2006 as a comparison baseline, data from 3-4 years prior to the time of the audit enabled the city to analyze trends and prioritize actions.

The data, compiled by the municipality as a city energy report in the Local Renewables project, was updated every year for four years.

The data collected in Nagpur was also used for a Carbon Emission Inventory and a City Energy Status Report, published in the report 'Energy and Carbon Emissions Profiles of 54 South Asian Cities' (2009). The report was published by the ICLEI South Asia Secretariat under a project implemented in Nagpur and 53 other South Asian cities within the framework of the 'Roadmap of South Asian Cities and Local Governments for the post-2012 global climate agreement and actions' project.

For more information, please contact ICLEI SA or the NMC.

Credit: Nagpur Municipal Corporation

Funding for Development

The Jawaharlal Nehru National Urban Renewal Mission (JnNURM), launched by the Ministry of Urban Development of the Government of India in 2005, aims to 'encourage reforms and fast track planned development of identified cities. The focus is on efficiency in urban infrastructure and service delivery mechanisms, community participation, and accountability of urban local bodies/ parastatal agencies towards citizens' (JnNURM Mission Overview, MoUD).

The Mission has three basic elements:

- integrated development of infrastructure services by providing adequate funds to meet the deficiencies in urban infrastructure services;
- provision of basic services to the urban poor by improving the delivery of civic amenities and provision of utilities; and
- Adoption of wide ranging urban sector reforms.

The Mission enables cities to undertake these reforms through equal funding from central, state and local governments.

jnnurm.nic.in

Replication

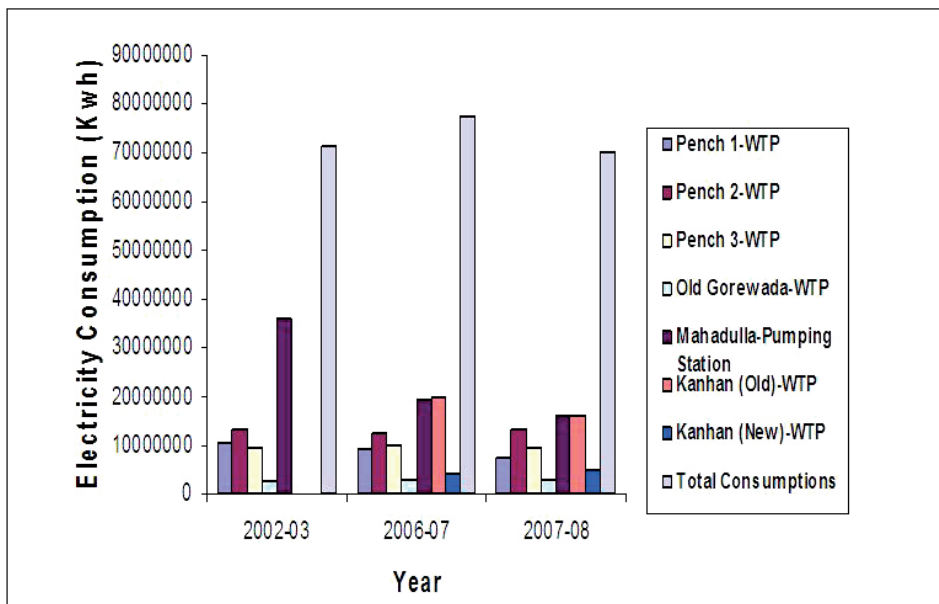
Nagpur is committed to the process of assessment before action. Understanding their water sector operations thoroughly enabled the city to identify the most appropriate interventions and helped with priority setting of the interventions required. Thus, in its logical and sound approach the program is easily replicable by other local governments. According to the Indian Ministry of Urban Development, Aurangabad, Thane and other JnNURM cities in India have adopted the Nagpur model for audits and action. Therefore, the replication of projects of this sort is possible for local governments with the help of external consultants.

In April 2010, an exchange event was held for the cities of Nagpur and Coimbatore in Coimbatore as part of the Local Renewables Model Communities Network project. During this time, the cities were able to exchange information and experiences about various initiatives being undertaken by each in the field of renewable energy and energy efficiency. The NMC's experiences of the water sector energy audit were of great interest to Coimbatore, and helped to formulate their tubewell energy audit. The exchange meeting was organized by the Coimbatore Renewable Energy and Energy Efficiency Resource Center.

Credit: ICLEI South Asia



The NMC shares its experiences of undertaking a water sector energy audit at a presentation to the Coimbatore Municipal Corporation.



Energy consumption of different water pumping stations in Nagpur show a decline in consumption after implementation of recommendations in the audit.

Having initiated the pilot project on waste water reuse in Nagpur to test the effectiveness of using treated waste water for non-potable applications, the national government of India is planning to develop a national level policy on waste water reuse based on Nagpur's successful experiences.

Budget and Finances

The initial pilot audit of the water sector was undertaken entirely by the NMC, and funds from JnNURM covered the comprehensive audit. For implementation of recommendations, the total cost of the project as submitted for JnNURM funding was 280 million INR (4.5 million EUR), which has been divided amongst the NMC, the Maharashtra state government and the Indian national government.

Local Renewables project materials

India

Bhubaneswar, Nagpur and Coimbatore City Completion Reports

Case Study # 108: Pioneering renewable energy and energy efficiency application in India's municipal health sector in Bhubaneswar

Case Study #109: Installation of energy efficient lighting at the Lord Lingaraj Temple in Bhubaneswar

Case Study # 110: Water sector audit enables efficient use of water and energy resources in Nagpur

Case Study # 111: Reducing carbon emissions while improving Coimbatore's municipal public services

Brazil

Betim and Porto Alegre City Completion Reports

Case Study # 112: Solar heaters in low income housing estates: Energy and financial savings in Betim

Case Study # 113: Stakeholder involvement groups for Local Renewables in Betim and Porto Alegre

Case Study # 114 Portuguese: Energia Solar é Incentivada em Lei sobre Compensação Vegetal em Porto Alegre

Case Study # 115 Portuguese: Cemig leva Eenergia Elétrica elétrica chega à a comunidade de baixa renda com apoio do CRER Betim

Global

Case Study #104: Freiburg, Germany: Long-term strategies for climate protection in Green City Freiburg

Case Study # 116: Växjö, Sweden: Becoming Fossil Fuel Free with citizen and stakeholder involvement

Case Study # 117: Milan, Italy: Improving the district heating system with RE and EE

Further case studies about energy efficiency and renewable energy in India, Brazil and the European Resource Cities, as well as city completion reports for the Local Renewables project are available on the project website.

www.iclei.org/local-renewables

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