BMZ Federal Ministry for Economic Cooperation and Development

Future-Makers. Building the future. Let's join forces.

Published by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Climate Change Mitigation in the Water Sector

Background

The provision of drinking water and the treatment of wastewater require tremendous amounts of energy, the production of which is responsible for high amounts of CO_2-emissions. The water sector is increasingly recognising its high potential to reduce energy demand and thus contribute to the overall goal of climate change mitigation.

Mitigation Strategies

The processes of water extraction, distribution and treatment offer various options to reduce carbon emissions (Figure 1). Below, these measures and their respective potential for CO_2-reduction are described in more detail.

Increased Energy Efficiency

The four most effective measures for increased energy efficiency are: (i) installation of energy-efficient pumping systems, (ii) reduction of non-revenue water (NRW), i.e. leakage, metering errors and water theft, (iii) metering of water consumption, and (iv) system monitoring and regulation, potentially with automation. Installing energy-efficient pumps and matching them to the system requirements can save 10-30% of the energy demand in both water supply and wastewater treatment. In a project in South Africa, reduction of water losses saved about 1.5 t CO_2 for every 1000m³ reduced. Metering of consumption, system monitoring and automatic control of various system components, such as pumps or fans, can lead to 12-30% less energy consumption especially in water supply. Overall, through systematic energy optimisation, up to 50% of the energy demand could be reduced in water supply and wastewater treatment. However, a decrease of 20% is a more realistic scenario.

> The Water Authority of Jordan (WAJ) is the largest electricity consumer in Jordan, using about 15% of Jordan's total electricity production. GIZ is supporting WAJ to improve the energy efficiency of their pumping operation.

Energy Production

Water supply and wastewater utilities generally have three options for energy production: energy generation from biogas from anaerobic wastewater treatment plants, heat recovery from wastewater, and use of hydropower.

Biogas Energy Production

> The treatment plant Strass (Austria) produces an energy surplus of 8%.

Biogas electricity has an enormous potential to contribute to carbon neutral wastewater treatment. At present, German wastewater treatment plants cover about 25% of their energy demand by use of biogas. This number shall be doubled in future, leading to annual savings of 1,100,000 t CO_2/a. Several examples show that in combination with high energy efficiency, wastewater treatment plants can cover almost 100% of their energy demand.

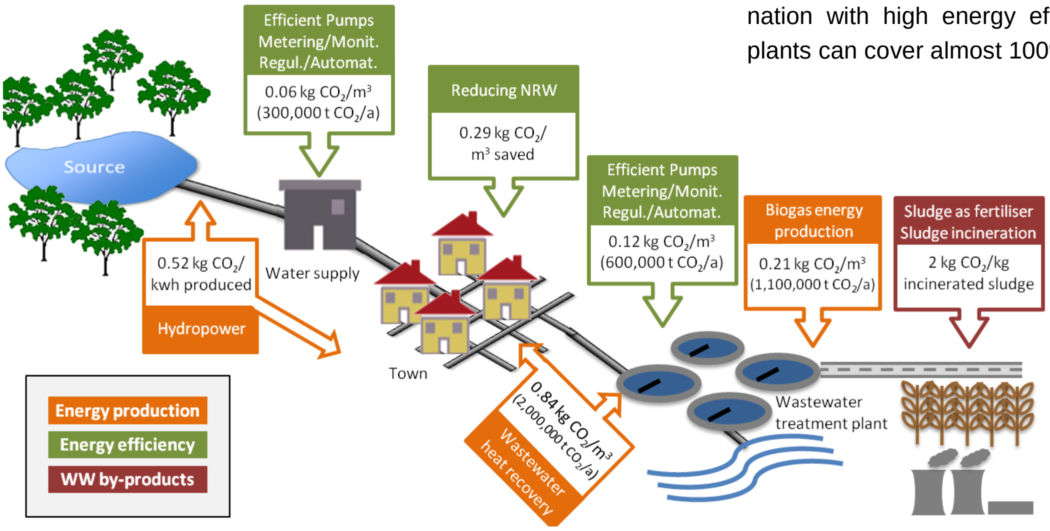

Figure 1: Measures for CO_2-mitigation in the water sector and rough estimations of potential CO_2 reductions in the German water sector (based on studies of the German water sector and the German CO_2 emission factor of the 2011 national energy mix).

Heat Recovery from Wastewater

Wastewater generally has a temperature above 12°C. By installing heat pumps in sewer pipes (min. runoff >15l/s), about 1.5 kwh can be produced per m³ runoff. In Germany, this could reduce annual carbon emissions by about 2 million tonnes. The same method can be applied directly at wastewater treatment plants.

Hydropower generation

Turbines can be placed all along the water supply and wastewater system, i.e. within water pipes instead of pressure breakers, and before or after a treatment plant. However, the suitability of these measures depends much on the local topography.

The As Samra treatment plant in Jordan covers 98% of its energy demand by wastewater hydropower and biogas electricity.

Secondary Wastewater Products

The nutrients contained in wastewater, mainly phosphorus, nitrogen and potassium can be used in agriculture to substitute the energy-intense production of artificial fertilisers.

The co-incineration of de-watered wastewater sludge in power station and cement plants can substitute mineral fluels.

Important considerations

- For efficient biogas electricity production, wastewater treatment plants should cover more than 10,000 capita. Smaller treatment plants could take their sewage sludge to semi-centralised biogas plants.
- Anaerobic wastewater treatment as well as decentralised sanitation systems require much less energy and have lower operational costs compared to centralised activated sludge treatment. Thus, they can be a particularly adequate solution in developing countries.
- The Nexus approach helps climate mitigation measures to be more ‘water smart’ and less energy intensive aiming to avoid damaging consequences for food production and other vital ecosystem services.

Co-benefits

- For many utilities, the economic advantages should be an important driver for investments in energy-efficient technologies, as typical payback periods are often below two years.
- Through reduced energy costs in water supply, customers can benefit from lower water tariffs especially when cross-subsidies favouring the poor are established.
- Lowering the energy demand of water utilities makes more energy available for other sectors.
- Reducing NRW leads to increased water availability, lower operational costs for utilities and the protection of water resources including their ecosystem functions.

Outlook

By combining the various presented options, CO_2-neutrality can already be achieved in wastewater treatment. However, treatment plants coming close to this target are still the exception. Looking at the whole process of water supply, carbon neutrality is much more difficult to reach. In areas where hydropower production is not feasible, a CO_2-surplus must be offset by wastewater treatment plants, which is currently hardly feasible. Nonetheless, due to its many positive effects, CO_2-neutral water supply should be regarded as a vision that is worth striving for.

References

BMZ (2011): BMZ Spezial: Wasser – Schlüssel zur Anpassung an den Klimawandel. In print.

Fricke, K. (2009): Energieeffizienz kommunaler Kläranlagen. Umweltbundesamt Deutschland: Dessau-Roßlau

Haberkern, B., M. Werner, U. Schneider (2008): Steigerung der Energieeffizienz auf kommunalen Kläranlagen. Umweltbundesamt Deuschland: Dessau-Roßlau.

Hoff, H. (2011): Understanding the Nexus. Background Paper for Bonn2011. Stockholm Environment Institute, Stockholm.

Remy C., B. Lesjean, A. Hartmann (2011): Die Methodik der Ökobilanz zur ganzheitlichen Erfassung des Energieverbrauchs in der Abwasserreinigung. In: KA Korrespondenz Abwasser.

Ingle, R. et al. (2012): Links between sanitation, climate change and renewable energies. Sustainable Sanitation Alliance (SuSanA)

Published by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Registered offices
Bonn and Eschborn, Germany

International Water Policy and Infrastructure
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany

E: wasserpolitik@giz.de
http://www.giz.de/Themen/de/3625.htm

Responsible editors Philipp Feiereisen, Dr. Lisa Oberkircher

GIZ is responsible for the content of this publication.

Layout GIZ

As of August 2012

On behalf of Federal Ministry for Economic Cooperation and Development (BMZ)

Division Water, Energy, Transport