CASE STUDY

RENEWABLES NETWORKING PLATFORM

Mine water for renewable energy

Heerlen (NL) gave new life to disused mines!

The Summary

Thanks to the Minewater project of the municipality of Heerlen, a low-temperature district heating system was launched in October 2008, under the European Interreg IIIB North West Europe programme and the 6th Framework Program project EC-REMINING-lowex. In the recent years, the projects Minewater 2 and 3 further enhanced the system performance.

The Context

In the twentieth century coal mining was the most important economic activity for the Eastern mining region and Heerlen in particular. The Dutch government dug a vast system of mine passages in and around Heerlen for the extraction of coal. Tens of thousands of miners and their families and those in related sectors lived from the mining industry. Heerlen had 3 main mines: Oranje Nassau I, III, and IV. After the closure of the mines in the period 1965 - 1974, the tunnels filled with groundwater, which was heated by the earth naturally. The deeper in the earth, the higher the temperature of the water. **The mines became a water reservoir that remained unused for many years.** In 2005, with support from the EU and the governmental agency Agentschap NL, five wells were drilled and an underground piping system of approximately 8 kilometres was built to allow for the water to circulate. In 2008 the **first mine water geothermal plant in the world**, Gen Coel in Heerlerheide, was put into operation and the first connection serving approximately 30,000 m² of indoor space was established. Not long after followed the connection to Statistics Netherlands (CBS) buidlings, with 22,000 m² of indoor space.

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The Challenges

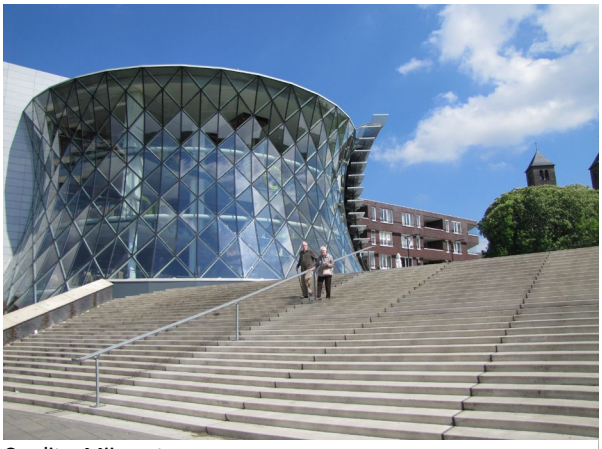
The leading incentive for the municipality of Heerlen to initiate the Mijnwater project was the **rehabilitation of the region**. After the coal mines had been closed and the industrial environment had been dismantled, the region faced a period of economic, social, and cultural decline. This context of factors is common in other former mining areas.

The **social historical context and approac**h was a key-factor for the **social acceptance** of the project. Old mine workers were actively involved in the project: during the planning stage, they were consulted to identify wells location.

Thanks to their valuable knowledge, it was discovered where exactly you needed to drill in order to bring the water to the surface.

Financing these new kinds of regional-based energy provisions is a complex process. Many financial institutions are not yet capable of adequately estimating the risks of these developments. Nevertheless, thanks to step-by-step expansion and proof by result, Mijnwater was able to build up financial trust. In order to continue to grow, new customers and new investments will be needed

Another challenge was finding contractors able to design and implement such an innovative grid. This required **very specific insight on integral operation and energetic performance**. In the past 10 years Heerlen incurred in consistent money loss because of improper design and failing commissioning. That is why references and experience with 4 DHC grid installations are now a mandatory requirement for any service procured by Mijnwater B.V.



Credits: Mijnwater.com

The Model

The renewable energy source has served as a heat source (for heating) and heat sink (for cooling) since 2008. The station is divided into two sections. 825m deep mineshafts provide access to underground mine water at a temperature of 35°C. The water is used for heating purposes and is then conveyed at 17°C to other mineshafts, where it is stored before being used as a coolant. The water, collected from five wells, is transported via an underground exchange station and pipe network and supplied to the connected locations in Heerlen.

Heating and cooling water with geothermal energy reduces consumption of fossil fuels. Energy is only required for pumping and circulating the warm and cold water. This energy can be generated using thermal solar panels. As a result, the CO2 emissions are negligible. Also geothermal sources are not affected by climate or weather. The energy is available year round, day and night. The installations require little space and cause no nuisance or disturbance for the surroundings. Most of the technical equipment is located underground.

The independent **company Mijnwater B.V.** was established in 2013, with the municipality of Heerlen as main shareholder, in order to further develop the project in its territory. Mijnwater B.V. has taken over all mine water-related activities from the municipality of Heerlen and operates as a social enterprise. It will continue to deliver mine water to the existing and future customers.

In 2014 the Mine water project was upgraded from a pilot system to a smart grid in heating and cooling with a full scale hybrid sustainable energy structure called Minewater 2.0 and 4 new connections in 2013 - 2014.

In 2015 in total 500 000 m2 floor area was provided with mine water. An independent pipe network delivers both heating and cooling water to the connected clients. Transfers of residual heating and cooling capacity from incoming return water to other outgoing pipes takes place in underground exchange stations equipped with heat exchangers and pumps. In this Minewater 2.0 system the water in the mines, whether warm or cold, now just serves as a storage reservoir. The most important element of the system is the **exchange of heating and cooling capacity** between businesses and lessors of residential and commercial buildings.

The Clients

All citizens of Heerlen benefits from a better quality of life thanks to the emission reduction brought by the geothermal energy project.

The municipality benefits from the project in different forms: it has an economic advantage thanks to its shares in the Minewater company but also it gained international visibility thanks to the project. In March 2015 Mijnwater B.V. received the "European Geothermal Innovation Award 2015", showcasing excellence in development of the most intelligent applications of geothermal energy.

The clients of the company. Currently, the company provides renewable energy to dwellings, offices, elementary schools, supermarkets, a nursery and a sport facility, all connected to the Mijnwater grid. One of the important advantages connecting to the Mijnwater grid is the provision with renewable energy and the improved sustainability performance of the building for the client. In the Dutch law (Building code) the minimum energetic performance of new buildings is defined, however individual measures are not specified. The building owner has the choice either to improve the insulation or to utilise a greener energy supply. Thanks to Mijnwater, intensive and less efficient investments in the building design can be avoided.

The Money

The first phase of the Minewater project was set up as part of the **INTERREG** project in 2008. Multiple parties recognized the value of the project and thus the initial investment was largely covered with national and European research funds coming from the **6th Framework Program**.

The national agency Agentschap NL also contributed to the project financially.

In order to become an attractive choice for potential customers, Mijnwater apply a **price reduction** of about 10% compared to conventional solutions. Also, the company is owned by the municipality, so any profit is returned to the community. The city is thinking about **crowdfunding**, to raise investment and involve the local population.

The Mijnwater business case is based on **a long-term investment** with a time horizon of 20–30 years for installation components and of 50 years for pipes and construction works. Thus, investment in a Mijnwater infrastructure is a long-term strategy.

Due to a decision strategy based on integral total cost of ownership (TCO) and supply security, investing in a sustainable hybrid geothermal grid seems to be highly preferable to investing in gas infrastructure and/or replacing conventional heat grids.

The Replication Potential

Heerlen demonstrates that traditional mining regions can become champion of renewable energy. The city went from being a renown coalmining area to being internationally awarded for its impressive efforts in the field of geothermal energy.

Cluster grid applications such as the one of this project are used in combination with low temperature geothermal sources (mine water in this case) and can be applied in general with other sustainable heat and cold energy sources (e.g. waste heat from data centres and closed greenhouses). The technologies used by Mine Water are general applicable for all types of exergy based energy infrastructure systems.

Credits: Mijnwater

The Impact

The company Mijnwater B.V. is gaining more and more international renown for its innovative 'demand-supply' system. Along with other resources, such as solar energy (solar thermal and

photovoltaic), wind energy, biomass energy, buffering, together with a modern control system, it is possible to generate an optimum yield. The hybrid pipe network transports the relatively warm and relatively cold water where the customer needs it.

Mijnwater B.V. contributes to a **65% reduction of CO2 emissions** for the heating and cooling of the connected properties in the region. Thanks to the continued development of the system, mine water energy is now an essential part of the municipality of Heerlen's 2040 renewable energy master plan and has been included in the Parkstad Limburg Energy Transition (PALET) statement of ambition for the Parkstad Limburg region.

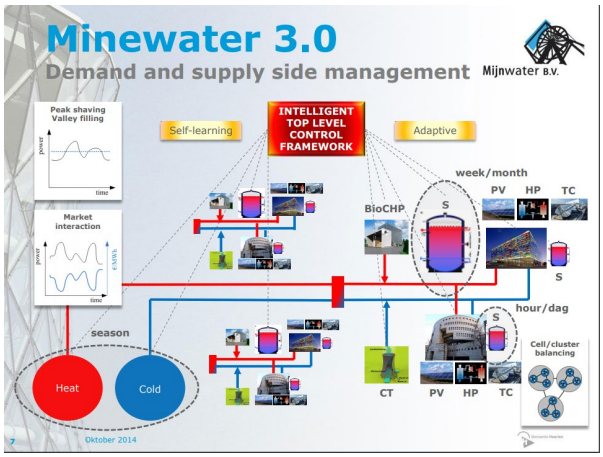
In addition to environmental gains, there are four more aspects that strengthen the region:

- ✓ Energy independence;
- ✓ Local employment through investments in the local region financed by a reduction in energy bills;
- ✓ Anchoring acquired knowledge and expertise to strengthen local educational institutes and become an attractive region for skilled potentials;
- ✓ Long-term assurance regarding energy costs, since a main part is caused by fixed start-up investments and no longer depends on fluctuations on the oil market.

Mijnwater, as operator of a full-scale mock-up site, lays the foundation for the creation of an expert centre and serves as incubator for the development of hydraulic thermal smart grids. It also attracts knowledge-intensive and innovative business to Heerlen.

The Figures

- ✓ 7 connections in place
- ✓ 500 000 m2 of indoor space connected to the system;
- ✓ 65% reduction of CO2 emissions for the heating and cooling of the connected properties;



The Next Steps

The grid has been developed and expanded over the past 10 years. All the connections are continuously optimised and adjusted if necessary. Every new connection means an adjustment and fine tuning of the overall (technical) concept. Every new connection also means getting closer to a **CO2 neutral region**.

Mijnwater B.V. is already working on additional developments with the project Minewater 3.0. Researchers are working on a demand-based system that recognizes patterns of demand over time. Energy requirements could consequently be accommodated on the basis of factors such as weather forecasts and customers' demand, making it possible to utilize other hybrid energy sources as efficiently as possible. By adding additional intelligence (such as time-awareness) system performance can be boosted even more.

To continue to grow, new customers are necessary and new investments will be needed. The aim is to provide sufficient mine water energy for a total of 800 000 m2 of indoor space by the end of 2018. This will enable the connected buildings to reduce their CO2 emissions by 65%.

The generated knowledge will be used for future projects in the area, but also for collaboration with other European regions.

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