C2C Coast to Coast Climate Challenge

Too Much or Not Enough: Groundwater as a Resource

Note on Solutions to Groundwater Challenges presented during the International Water Association Congress and Exhibition 2022

7. October 2022

regionmidtjylland midt

Colophon

Publisher	Coast to Coast Climate Challenge
Date	7. October 2022
Title	Too much or not enough: groundwater as a resource Note on Solutions to Groundwater Challenges presented during the International Water Association Congress and Exhibition 2022
Pages	9

Table of contents

Note on Solutions to Groundwater Challenges presented during IWA 2022

How are European stakeholders ensuring clean drinking water during more recurrent dry periods where rivers, lakes and storages dry-out, and how can safe drinking water provision be combined with energy production? This summary note collects best practices from projects attending the International Water Association Congress and Exhibition 2022.

One deliverable in the subproject on Groundwater (C3) is a report on projects working with groundwater as a part of a technical study trip in Europe. The Coast to Coast Climate Challenge (C2C CC) partnership was intended to go to meet the TOPSOIL partnership during the planned study trip to Belgium in May 2022. However, due to the final unavailability of the TOPSOIL project management team, and no other alternatives identified, the study trip instead focused on holistic water catchment planning, management of drought and urban rainwater management in collaboration with local communities.

Figure 1: The C2C CC secretariat at IWA

In its place, a detailed exploration of methods and tools to handle challenges connected to groundwater has been carried out during the International Water Association (IWA) Congress & Exhibition in Copenhagen on the 11. to 15. September 2022. At the congress, the C2C CC was represented at a well-visited booth and during multiple sessions and workshops.

The event attracted more than 8,000 water professionals, making it the largest IWA congress thus far. The purpose of the congress is to bring together all levels of water professionals to showcase, discuss and contribute to an innovative and robust development within the water sector. Overall, the congress covers the whole water cycle, however, a primary focus was on the challenges related to groundwater; both in terms of excess, flooding, pollution and potentials for energy production. This document contains an overview of projects and tools focused on groundwater management and aims to gather a diverse selection of possible solutions.

1 Combining energy production and groundwater purification

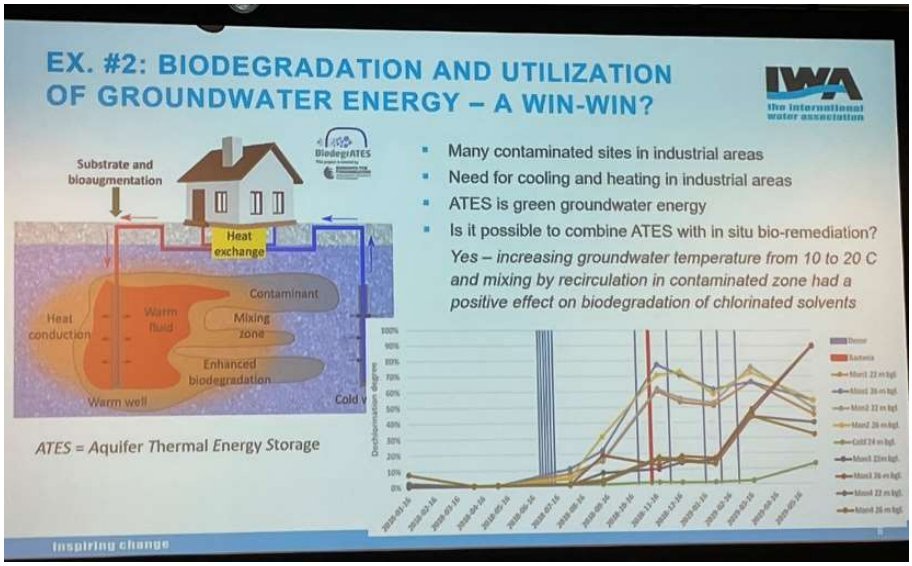

Figure 2: Slide from IWA presentation on BiodegrATES.

During the session "Bottom-up resilience planning across the water cycle", the project BiodegrATES presented the use of green groundwater energy in combination with bio-remediation to provide a win-win solution that combines energy production with safe drinking water provision.

The project is called 'BiodegrATES - In situ contaminant Biodegradation meets Aquifer Thermal Energy Storage'. It is supported by the Independent Research Fund Denmark and will take three years to complete. The project investigates and develops technology to generate heating and cooling by using groundwater while providing clean drinking water.

In an Aquifer Thermal Energy Storage (ATES) plant, cold groundwater is pumped up and used to cool buildings in the summer. The pumped up water absorbs the heat of the buildings via a heat exchanger and is subsequently pumped into and stored in underground aquifers. As much as 80 percent of the stored energy can then be used to heat the buildings during the cold winter months.

In the Netherlands in particular, ATES plants are becoming common, and the geological conditions in Denmark imply that there is a great deal of untapped potential for this type of installation. However, one challenge when it comes to using the technology on a wide scale is that the groundwater, especially near cities, can contain pollutants from past industrial activities, factories, petrol stations and the like. BiodegrATES will therefore combine groundwater heating with biotechnology to clean the groundwater in situ. This is done by means of biodegradation of pollutants, which is even more effective when it occurs at high temperatures. The project is collaborating with the Capital Denmark Region to implement and test the installation in Denmark.

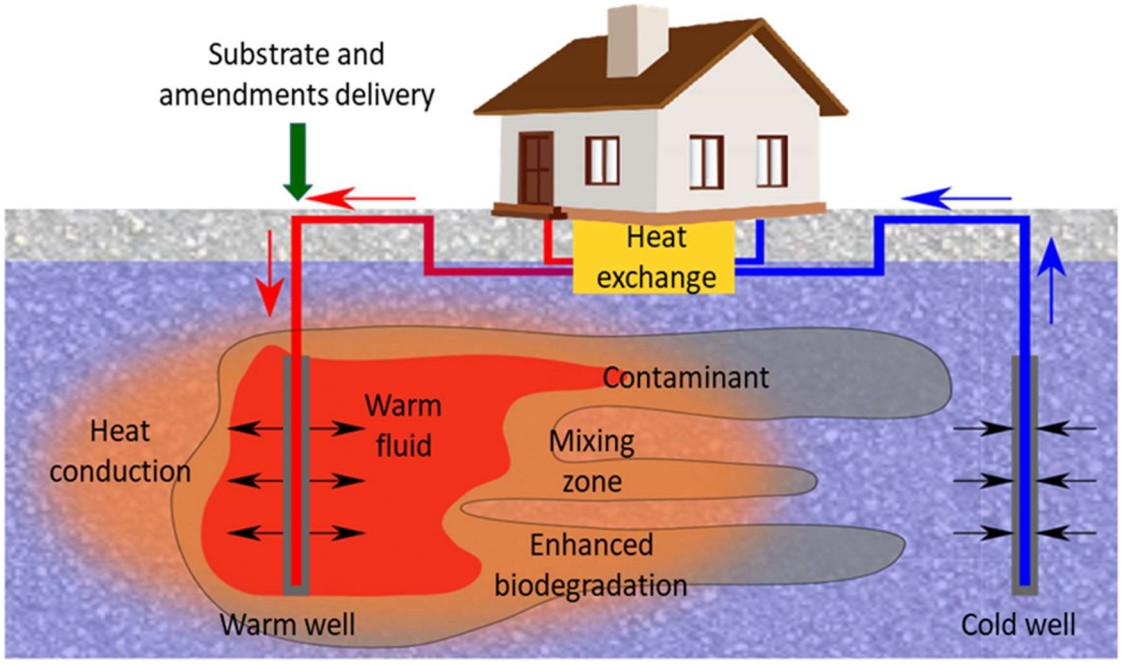

Figure 3: In an ATES plant, cold groundwater is pumped up and used to cool buildings in the summer. By combining the production of heat and cooling with biodegradation of pollutants, groundwater can be cleaned in situ.

2 Brackish water as drinking water resource

The main freshwater source for the Dutch water utility company Dunea is the Maas River. However, due to extreme drought and intrusion of salty water (partly owing to rising sea levels), the freshwater provision is threatened.

Groundwater lenses occur where freshwater floats above denser saltwater. Brackish water in these lenses is a promising new resource to supplement coastal freshwater reserves, reducing seawater intrusion and creating a buffer during periods of drought. The Dutch LIFE FRESHMAN project aims to demonstrate the effectiveness and cost-efficiency of a novel method to enlarge and safeguard freshwater availability. Furthermore, the method will be a way to produce drinking water and safeguard biodiversity and ecosystems while creating a buffer for extreme drought conditions.

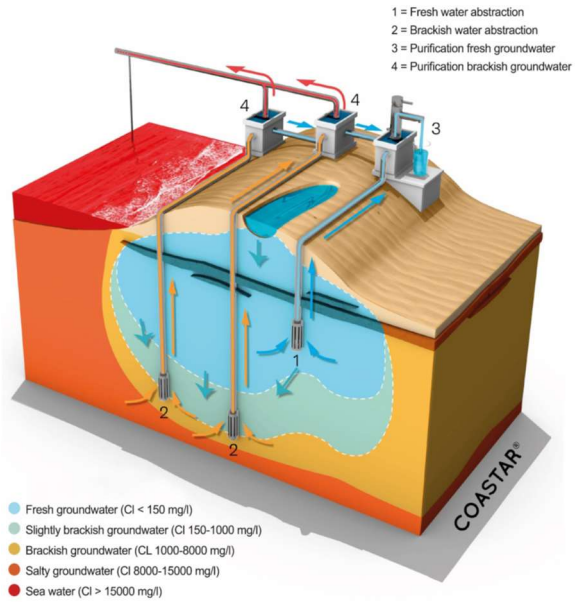

Figure 5: LIFE FRESHMAN is using brackish water as a drinking resource to supplement freshwater reserves.

Creating freshwater buffers and reducing dependence on climate-change sensitive freshwater sources, such as surface water, is key to increasing resilience in drought-prone coastal zones. The objective of the project's innovative technique is to enlarge groundwater lenses in coastal zones by combined infiltration of freshwater and extraction of lower-level brackish groundwater. The enlarged lens acts as both a strategic freshwater storage solution and as a barrier against saltwater intrusion. The aim is to treat the extracted brackish water using reverse osmosis to create a new drinking water source.

3 Machine learning monitoring unintended water in sewer pipes

As part of the session "Data driven modelling at city scale", the DRAINman project presented how the project has supported the accumulation of knowledge on the sources of unintended water running in the sewer system. Unintended water refers to other sources of water beyond sewage water that is seeping into sewer pipes. This includes shallow groundwater but also rainwater as well as "faulty connected water" - for example a private rainwater pipe that has been connected to the public waste water line.

Figure 4: Preben Dam Simonsen presented the DRAINman project at IWA. Picture by Charlotte Sinkbæk Schow.

Based on the pipelines beneath Tranbjerg near Aarhus, the project has mapped the water and its sources in the sewer system using sensors, 'datacrunching' and machine learning. The result of the monitoring is the realisation that as much as 54 percent of the water in the sewer pipes is unintended water with 14 percent being faulty connections. In Tranbjerg, as much as 300.000 m³ groundwater is seeping into the sewer pipes on a yearly basis. The project's results make it possible to advance the use of digital tools to monitor the different sources of water in the sewer system, and thereby improve the management of the pipes. Based on machine learning model, which will be used by Aarhus Utility to plan and maintain sewer pipes to reduce the level of unintended water in the systems, the model will allow water utilities to understand the water in the pipes to a larger extent as well as be able to monitor the sources of unintended water in the system. The model can be integrated in existing planning tools, such as REHAB-IT and HOMIS.

The DRAINman innovation project has just concluded after three years and the project partners Aarhus Vand A/S, NIRAS, DHI, GRUNDFOS, Wavin Group, Per Aarsleff A/S and Aalborg University have worked together to support digitalisation of the water sector. The project was funded by the Danish Environmental Agency and the Environmental Technology Development and Demonstration Program (MUDP). The project results show how knowledge of the sources of unintended water can qualify and improve the actions taken to reduce the overall stress on sewer pipes and utility facilities.

4 Providing safe drinking water in rural Mediterranean regions

Another project is LIFE SPOT with the overall objective to develop a new treatment process that makes it possible to remove nitrates and micro pollutants from polluted groundwater and hereby ensure drinking water of good quality. The method is aimed at rural areas where the water supply is limited and thus, the pilot is applied in the Mediterranean region. This way, the project is promoting the sustainability and resilience of rural areas engaged in agriculture and the tourism sector.

One consequences of continued growth in population is the rising demands for safe food and water. To produce more crops, the use of pesticides and fertilisers is increasing which has a negative effect on soil and water conditions. An alternative is the use of livestock manure. However, this poses risks of nitrates and antibiotics in the soil which can have negative consequences by polluting groundwater resources. The LIFE SPOT project is developing a method of using microalgae and cork to reduce water pollution. At a pilot plant, the project is demonstrating the feasibility of MA-cork technology for the treatment of water from polluted wells with nitrates (removal index 60-80%) and anthropogenic chemical contaminants (index removal 60-100 %) to provide safe drinking and potable water in rural areas. With the project, the goal is to develop a new treatment process to be able to remove nitrates and micropollutants from polluted groundwater to produce drinking water of good quality.

Another project represented at the IWA Congress 2022 included the initiative engaged with incorporating sustainability into the planning, design, construction and operation process of existing groundwater treatment plants. The sustainability assessment method covers both building and groundwater treatment operation. HOFOR (Greater Copenhagen Utility), NIRAS and COWI have developed a list of possible initiatives for a more systematic documentation of sustainability efforts, including technical aspects such as dismantling and recycling and social aspects such as consumer safety and working environment.

5 Summary: International Knowledge Exchange and Network

The IWA Congress and Exhibition brought together international water professionals across municipalities, water utilities, knowledge institutions, businesses, consultants, politicians and regional and state authorities to exchange knowledge and discuss challenges related to water. The

abovementioned projects are a selection of initiatives engaged with groundwater protection, purification or preservation that can be an inspiration for the development of new projects and partnerships in Denmark.

Coast to Coast Climate Challenge
Regional Udvikling, Region Midtjylland
Skottenborg 26, 8800 Viborg
https://www.c2ccc.eu/