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Current developments and examples of sustainable energy technologies

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Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Heat from the depths

Geothermal energy as an energy technology of the future in Austria

As a renewable energy source, geothermal heat has the potential to play a key role in climate-neutral heating. Austria's potential for harnessing geothermal heat and the possible ways it could be used in pioneering energy concepts are currently being studied and tested in various pilot projects.

GeoTief "pulse vehicle" for taking seismic measurements in the Vienna region, photo: Wien Energie/Christian Hofer

Geothermal heat

Technologies and potentials for the energy supply of tomorrow

District heating and hot water supply account for around a third of Austria's energy consumption and some 20% of its CO_2 emissions.[1] If the country is to meet its target of achieving climate-neutrality by 2040, then the "heating transition" – the shift to renewable energy sources in the heating sector – needs to be accelerated. Alongside biomass technologies, district heating and direct solar energy, geothermal energy also has the potential to become a major component of the energy system of the future.

Heat strategy for Austria

Representatives of all nine federal states are currently working together with the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) and the Federal Ministry of Finance (BMF) to formulate a heat strategy for Austria. In accordance with a resolution by state energy ministers, backed by state governors, the target of decarbonising the heating of buildings (residential and non-residential) by 2040 is to be met by switching to renewable energy sources. This shift to renewables will involve biomass, solar energy, geothermal energy and ambient heat, amongst other sources. The heat strategy for Austria prepared by the federal government and federal states is also to focus on further reducing energy consumption.

HARNESSING HEAT FROM THE EARTH

The term "geothermal heat" refers to the heat energy that is stored below the solid surface of the planet in layers of rock and earth and in underground reservoirs of water. Geothermal energy technology is a sustainable, environmentally friendly way to harness these heat sources. The heat stored underground can be used to provide heating and cooling, to generate electricity or in combined heat and power (CHP) plants and is particularly suited to local energy supply concepts. The technology is also becoming increasingly important for the seasonal storage of heat underground. Essentially, a distinction is made in geothermal heating between low-temperature applications (source temperature <30°C), which are generally supported by heat pumps, and direct heat applications with temperatures over 60°C.

NEAR-SURFACE GEOTHERMAL ENERGY

Near-surface geothermal energy involves heating or cooling energy being generated from the top layers of earth and rock using geothermal probes or surface collectors or by making direct use of the thermal groundwater. This can go down to a depth of roughly 400 meters, with temperatures around 30°C. Geothermal probes and collectors are pipeline systems containing circulating water that enable heat to be extracted from or fed into the soil. This is then coupled with a heat pump system to provide district heating and hot water or to cool buildings. If there is a body of thermal, i.e. heated, groundwater near the surface (outside groundwater source protection zones), then this heat can also be utilised directly. Geothermal heat can thus help to replace fossil fuels for providing heating and cooling.

Photos: stock.adobe.com

Economic effects

A study [2] by the Energy Institute at Johannes Kepler University Linz assessed the effects of investing in renewable energy sources on economic growth and employment. A scenario involving additional growth of around 3 TWh per year in the years until 2030 was considered for near-surface geothermal energy. Taking into consideration the assumed expansion trend and the resulting investments and substitution of fossil energy imports, this indicated that over 12,000 new jobs could be created along with an extra EUR 0.9 billion in GDP by 2030. The simulations for hydrothermal energy assumed additional growth of 2.1 TWh in the years until 2030 for both seasonal heat accumulators and the use of naturally occurring hot springs for direct heating and electricity. This would result in over 2,000 new jobs and an extra EUR 0.1 billion in GDP in 2030.

[1] https://faktencheck-energiewende.at/fakt/ohne-waermewende-keine-energiewende
[2] Economic growth and employment from investing in renewable energy sources, JKU Linz Energy Institute, Linz, October 2020

DEEP GEOTHERMAL ENERGY

Deep geothermal energy systems draw heat from a depth of around 1,500 to 5,000 meters, where temperatures can exceed 60°C. There are two types: hydrothermal systems, which transport the energy stored in warm to hot thermal water, and petrothermal systems, which exploit heat from rock strata far below the surface that carry little or no water. The heat from deep underground can be used to generate both heat and electricity. With a hydrothermal system, hot water is transported to the surface up a deep well. The thermal energy passes through a heat exchanger and into a district heating network, for instance, before the cooled water is fed back underground. A petrothermal system requires tightly packed strata of sedimentary or crystalline rocks far below the surface at temperatures in excess of 150°C. The heat inside the hot rock is harnessed by breaking open a large number of small fissures in order to create channels through which water can be pumped. The heated water that circulates through this newly created system of fissures is brought up to the surface through a supply well and transported back into the reservoir rock via an injection well.

USE IN AUSTRIA

Some 90,000 geothermal heat pump systems are currently in operation in Austria, generating a total of around 2.3 TWh of heat (including the electrical part of the heat pump). There are also ten heat generation plants in the country at present that make direct use of naturally occurring bodies of thermal water, generating roughly 300 GWh of heat in total. Two sites also use heat to generate electrical energy in the amount of some 2.5 GWh_{el}.[3] Cooling is also playing an increasingly important role amongst the low-temperature geothermal energy applications, although no corresponding market figures are yet available. Petrothermal energy generation requires significant research, and no pilot plants have yet been set up in Austria.

POTENTIAL BY 2040

According to various studies, the following amounts of heat could technically be generated from geothermal energy in Austria in the years until 2040[4]:

- **Near-surface geothermal energy:** 15 TWh from low-temperature geothermal energy applications, including heat accumulators. This will be limited by the availability of open spaces for the installation of geothermal energy systems and of specialist service providers (drilling companies, planning firms)
- **Deep geothermal energy:** 9.2 TWh from high-temperature geothermal energy applications, including heat accumulators. This includes using hot springs that have already been identified as well as setting up initial pilot systems to exploit hot rocks that carry little or no water (hot dry rock technology).

As well as using geothermal energy to generate heat, it is estimated that 0.7 TWh_{el} of electrical energy could be produced by CHP plants.

In this edition, we present some current projects for the exploration of geothermal energy in Austria from the programmes adopted by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology (BMK) and the Climate and Energy Fund. ●

[3] Geological Survey of Austria, www.geologie.ac.at
[4] Verein Geothermie Österreich, www.geothermie-oesterreich.at
[5] www.iea.org/reports/energy-technology-perspectives-2020

“Geothermal energy is an incredibly versatile yet sleeping energy giant that now needs to be woken up. The IEA's 2020 Energy Technology Perspectives[5] show that climate-neutrality cannot be achieved by 2050 without harnessing geothermal energy to provide heating and cooling for homes, buildings and industry. Likewise, Europe's Green Deal can only be implemented if geothermal energy is both more widely used and more integrated into local, regional and national energy systems, especially in combination with underground energy storage. Research and innovation help to cut costs, increase value added and bring more industry players to the development and utilization of geothermal energy. Austria has strong national competences in the geothermal value chain, which can also be deployed on the international stage. And, conversely, Austria's key players can learn lessons quickly and efficiently from the experience gained at European and international level so that geothermal energy can play its role to achieve a climate-neutral Austria.”

Photo: private

Gunter Siddiqi

(former) Energy Research at the Swiss Federal Office of Energy and Chair of the IEA Renewable Energy Working Party

Photo: private

Gregor Götzl

Geological Survey of Austria (GBA),
Hydrogeology & Geothermal Energy Department

The Geological Survey of Austria is involved in various ongoing projects researching the use of geothermal energy in Austria. What role can geothermal heat play in ensuring sustainable heating in the future?

What makes geothermal energy particularly effective is its versatility: it can be used in thermal processes ranging from under 10°C (cooling) to over 150°C (generating electrical energy). However, sustainable and environmentally friendly heating makes by far the largest contribution to the energy supply. Geothermal energy has also begun to play a much more important role in large-scale seasonal heat storage in recent years.

There are several significant areas of application as far as sustainable heating is concerned:

> Air conditioning for larger buildings or renovated properties with thermal loads of over 20 kW

> Connecting up several buildings or whole sites into so-called anergy networks, in which geothermal energy – particularly geothermal probes – are used primarily as seasonal heat storage systems

> Environmentally friendly cooling using geothermal energy, with the waste heat generated subsequently recovered for use in heating

> Conventional heating networks supported by geothermal energy at temperatures ranging from 50°C to 100°C in conurbations

> High-temperature geothermal energy storage systems (up to approx. 90°C) in combination with conventional heating networks (geological heat accumulators)

> Efficient CHP combined with geological heat accumulators (where there are hot springs over 100°C)

One particular application scenario involves reusing redundant oil and natural gas probes, especially since there are currently more than 1,000 of these wells left in Austria. The heat, thus generated could be used, for example, in agriculture (e.g. for heating greenhouses).

How can the existing resources be best used? Where do you see the greatest need for more research and development?

The use of geothermal energy has a high application potential, particularly in urban areas, as this technology takes up little space on the surface and does not generate any emissions (exhaust gases, noise or waste heat). All forms of geothermal energy can also be combined with heating and cooling networks. Therefore, there is a need for R&D to improve the integration of geothermal energy into urban heating and cooling concepts. Besides technological developments (e.g. low-carbon, space-saving drilling techniques), this includes above all the development of planning and analysis tools to be able to manage the resource of geothermal energy in urban areas in the best possible way and minimise environmental impacts. A suitable legal framework also needs to be created to accompany the research.

Further R&D is needed on the construction of geological heat accumulators and the application of petrothermal technologies (e.g. hot dry rock). The major benefit of petrothermal energy is that it is less dependent on the geological environment, particularly the presence of hot springs, and could be used to complement the traditional hydrothermal energy in the future. There is still a lack of pilot and trial systems in Austria for both high-temperature geological heat accumulators and petrothermal energy generation. It is important to set these up over the next ten years.

Manage_GeoCity

Using geothermal heat efficiently in urban spaces

Led by JOANNEUM RESEARCH,[1] the Manage_GeoCity project devised a method for the coordinated use and management of near-surface geothermal heat based on the model region of Graz. In urban areas, the presence of numerous heat sources (e.g. waste heat from underground urban structures) often causes the subsurface and groundwater to heat up, which can impair groundwater quality. At the same time, this underground heat offers significant potential for heating and cooling in towns and cities. Extracting heat for heating and cooling purposes also has a cooling effect. However, the uncoordinated use of geothermal heat by many different small systems quickly results in mutual interference and inefficient, unsustainable management.

Manage_GeoCity focused on heating and cooling applications as well as the seasonal storage of heat in urban areas. Its analyses considered groundwater flows, different geological conditions, heating and cooling requirements, the heat produced by solar panels and industrial waste heat, and options for seasonal underground heat storage.

CASE STUDIES FROM THE GRAZ MODEL REGION

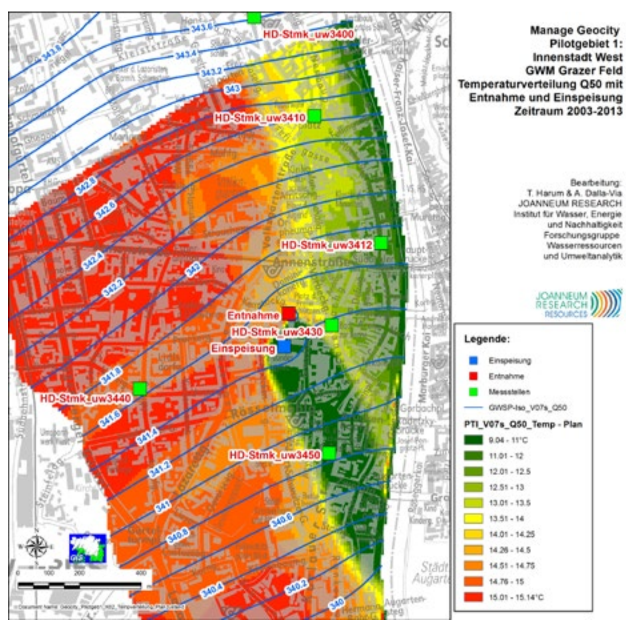
Underground zones presenting favourable conditions for near-surface geothermal heat without water extraction and for the use of thermal groundwater were identified in the Graz model region. Analyses of heating and cooling requirements were carried out in three case studies, and the heating and cooling potential of the subsurface was compared and evaluated from a technical, economical and environmental perspective. Simulations made it possible to analyse the extent to which extracting and storing heat would influence underground temperatures. The method also takes account of any existing thermal load underground as well as the underlying water management conditions, thus laying the foundations for geothermal heat to be used efficiently and sustainably in urban areas. It can be taken as the basis for future usage and management plans and applied to other towns and cities.

[1] **PROJECT PARTNERS:**
JOANNEUM RESEARCH Forschungsgesellschaft mbH (project management), Grazer Energieagentur Ges.m.b.H.

OUTCOME OF THE PROJECT

The results of the simulations for the two case studies involving groundwater-based geothermal energy show that using heat pumps for heating purposes can cool the groundwater significantly. The case study involving a field of geothermal probes revealed only a limited impact on the surrounding soil, with no major changes in temperature within a 50-meter radius. The environmental assessment makes it clear that, in the case of heat pump systems, the way the electricity is produced has a decisive influence on total greenhouse gas emissions. Scenarios using the Austrian electricity mix (with a high percentage of renewable energy) indicate a 75-85% reduction in greenhouse gases compared with fossil-fuel heating systems. Further optimisation of the systems is necessary to improve efficiency in terms of both investment costs (e.g., number and depth of the geothermal probes) and the temperatures required to heat buildings, which have a major influence on heat pump efficiency and thus on electricity costs. ●

https://nachhaltigwirtschaften.at/resources/sdz_pdf/berichte/schriftenreihe-2018-35-manage-geocity.pdf



Temperature distribution in pilot zone 1 with water extraction and feed-in, Image: JOANNEUM RESEARCH

"Pulse vehicles" for carrying out 2D seismic measurements in the regions of Vienna and Groß-Enzersdorf, photo: Wien Energie/Christian Hofer

GEOTIEF

Studying the potential for harnessing geothermal energy in the Vienna Basin

Implemented by Wien Energie together with numerous partners from science, research and industry,[1] the GeoTief project is concerned with systematically studying and measuring the geological subsurface in the Vienna Basin. GeoTief is Austria's largest geological research project and is regarded throughout Europe as a shining example of integrated research in this sector. The aim is to put a figure on the potential value of deep geothermal energy for heating the greater Vienna area and thus aid decision-making for future heating projects.

Hydrothermal energy, i.e. the use of hot springs deep below the surface, is a local, renewable and environmentally friendly thermal energy source and can be harnessed as a feed-in system for district heating networks that is capable of providing baseload power. The City of Vienna's strategies (e.g. its Energy Framework Strategy 2030[2]) name hydrothermal energy as an important sustainable technology for the future.

POTENTIAL FOR SUPPLYING HEATING

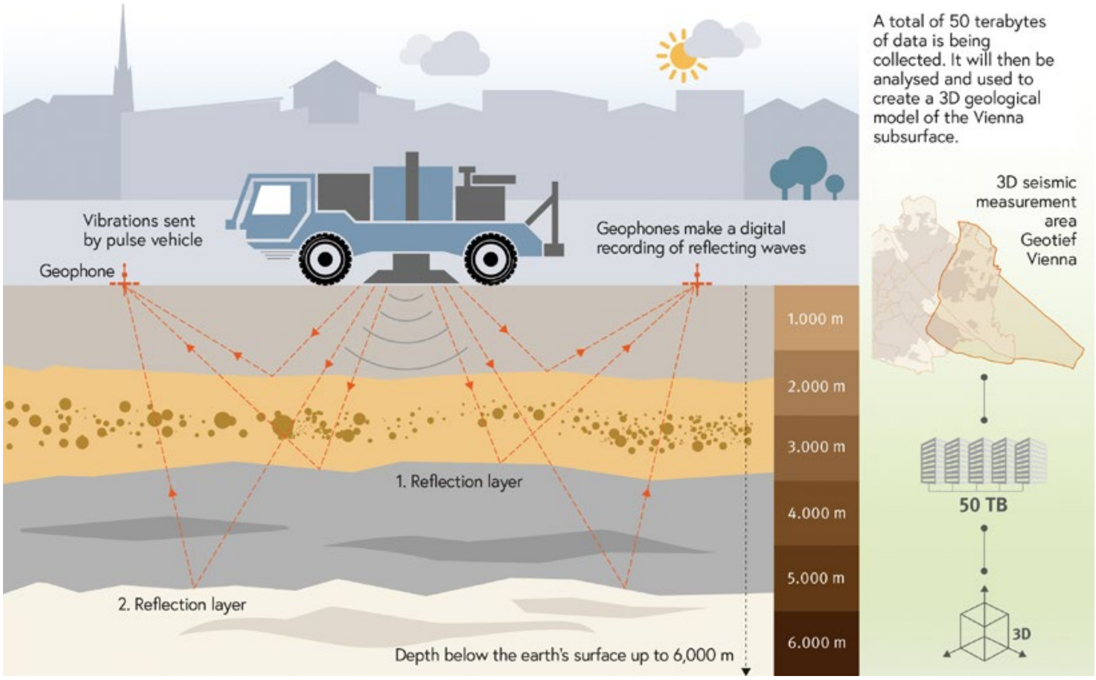
The Vienna Basin is believed to hold between 40% and 60% of the estimated usable capacity of this form of energy in Austria (450-700 MW of thermal energy).[3] At the same time, the Vienna conurbation is home to one of the biggest district heating networks in Europe. Geothermal energy could play a major role in further increasing the percentage of district heating generated from renewable energy sources and making Vienna's existing district heating network even more efficient and sustainable. Wien Energie has set itself the target of installing 140 MW of geothermal energy by 2030, enough to supply 135,000 homes and save up to 260,000 t CO_2 per year. The GeoTief project creates the scientific basis to underpin this ambition.

SEISMIC MEASUREMENTS

At the heart of the project are two phases of seismic measurements. As part of the GeoTief BASE (2D) project, seismic 2D measurements were taken in a densely built-up urban area in 2017 to explore the deep subsurface in detail – the first time this had been done in Austria. Building on this, the follow-on project GeoTief EXPLORE (3D) conducted comprehensive 3D seismic measurements in autumn 2018. These measurements were only done on the Earth's surface.

For decades, seismic measurements have been carried out all over the world in order to explore the geological structures and rock strata that exist beneath the surface. Reflection seismology is a technique used to map the depths and geometries of the boundaries between geological strata in the interior of the

[1] **PROJECT PARTNERS:** Wien Energie (project management), AIT Austrian Institute of Technology GmbH, Geological Survey of Austria (GBA), Geo5, Heinemann Oil (HOL), University of Leoben, OMV, RAG Austria AG, University of Vienna, University of Salzburg, Central Institute for Meteorology and Geodynamics (ZAMG)
[2] https://www.wien.gv.at/stadtentwicklung/energie/energierahmenstrategie-2030.html
[3] GeoEnergie 2050, http://www.energieforschung.at/projekte/700/potenzial-der-tiefengeothermie-fuer-die-fernwaerme-und-stromproduktion-in-oesterreich



3D seismic measurements, image: Wien Energie/APA-Auftragsgrafik

Measuring sensors, or "geophones", are placed across the entire area being measured, and then left in situ for around eight weeks, photo: Wien Energie/Christian Hofer

Earth. Seismic measurements allow the subsurface to be studied in a similar way to echo sounding. Vibrations are sent deep into the Earth along roads and paths. The signal is reflected underground and recorded by sensors set up close to the measuring vehicles.

ANALYSING THE DATA

The data from the seismic measurements – some 50 terabytes' worth – is currently being scientifically evaluated in a two-year analytical phase. Additional tests and surveys are being carried out at the same time, including some in old wells and at the surface. The water-bearing rocks beneath Vienna are similar to those found in the Limestone Alps (Kalkalpen) mountain range south of the city (e.g. Hohe Wand). Scientists from the University of Vienna, the Geological Survey of Austria and the German Research Center for Geosciences (GFZ Potsdam) are therefore analysing rock samples from the range and from local stone quarries at the surface in order to study the properties of these rocks in the subsurface (e.g. their permeability to water).

All information and data are being incorporated into a 3D geological model that provides an accurate picture of the subsurface and will enable potential sources of hot water (location, size, depth, etc. of potentially water-bearing strata) to be identified and analysed. The model is expected to be unveiled in autumn 2021. ●

www.geotiefwien.at

"Wien Energie is one of the biggest investors in climate protection. We'll be investing half a billion euros in expanding renewable solutions over the next five years and will be undertaking investments worth EUR 1.2 billion in climate protection projects by 2030. Heating is a key lever in this process, as it contributes 40% of CO_2 emissions. So Wien Energie is focusing very strongly on the increased decarbonisation of district heating. Exploiting existing waste heat and geothermal energy offers the most potential in this regard."

MICHAEL STREBL
CHAIRMAN OF THE BOARD OF MANAGEMENT, WIEN ENERGIE

Photo: Wien Energie/Stefan Johann

SEP

Spatial energy planning for the heating transition

The heating market is undergoing a transformation. Technological innovations, new building regulations and targeted subsidies are accelerating the development and use of renewable technologies in the heating sector and the gradual replacement of fossil-fuel systems. Little attention has been paid to date to the issue of energy in spatial planning processes. Planners, investors and political decision-makers lack structured information on renewable heat sources available locally and realizable technological systems at a site. Another key task is to coordinate the deployment of the various technologies to avoid parallel infrastructures (no other technologies in heating network areas) and mutual interference (e.g. overexploiting areas of geothermal potential). The heating transition will only succeed if each and every location is using the most suitable technology. Integrating energy-related aspects into the spatial planning processes is a key for the coordination of energy transition.

SPATIAL ENERGY PLANNING: A REAL GAME-CHANGER

This is where the SEP – Spatial Energy Planning project comes in, a partnership between the federal states of Vienna, Styria and Salzburg being implemented as part of the "Green Energy Lab" innovation laboratory.[1] Led by the Salzburg Institute for Regional Planning and Housing (SIR), partners from the various states (state governments, state capitals and individual flagship municipalities) are working together with Austrian research institutions[2] to lay all the necessary foundations for introducing spatial energy planning. The aim is to be in a position to harness the potential harboured by all forms of renewable energy and make the best possible use of the available resources and infrastructure. To this end, an innovative online information system has been developed that enables spatial and energy-related data and information to be made available and linked together. The first phase of the project focused on the heating sector. Spatial energy planning has the potential to become a real game-changer in this field and provide a substantial boost to the integration of sustainable heating technologies and the development of new market and business models.

AN INNOVATIVE PLANNING TOOL

The central tool is the ENERGIEatlas, a GIS-based online application that supplies layers of cartographic information on energy requirements, energy supply infrastructure and potential for renewable energy supplies. Linking many different sources of basic data (up to a three-digit number in each federal state) with robust scientific models and methods creates an innovative, comprehensive basis for planning. This can map individual buildings in its smallest resolution as well as other entities such as sites, municipalities, regions and states in a consistent manner. Building on this, an application was integrated that facilitates

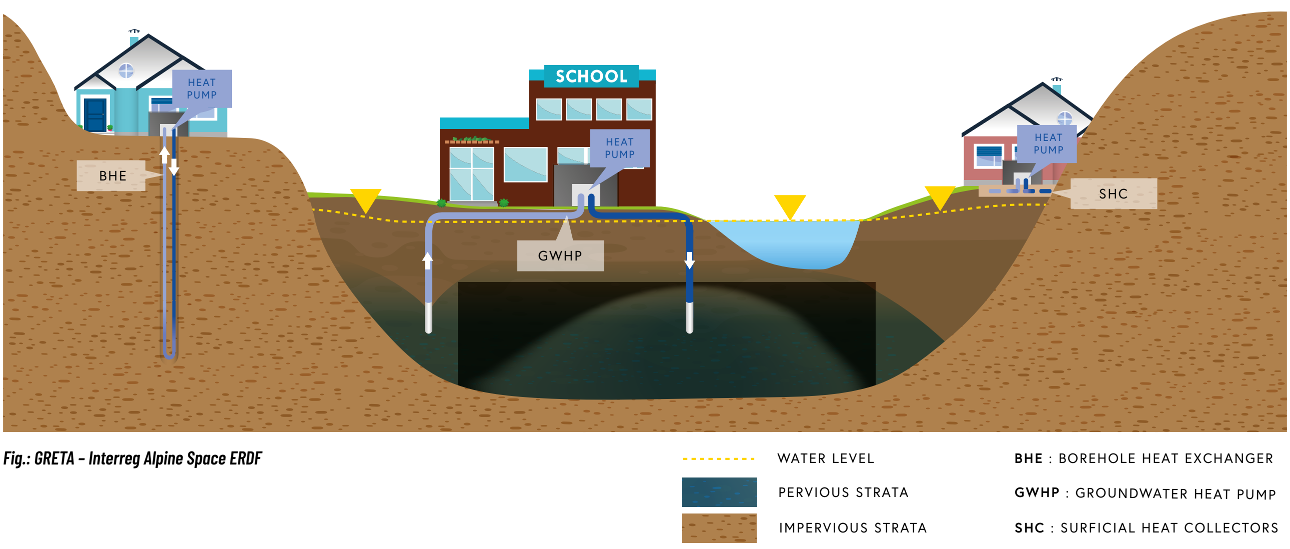
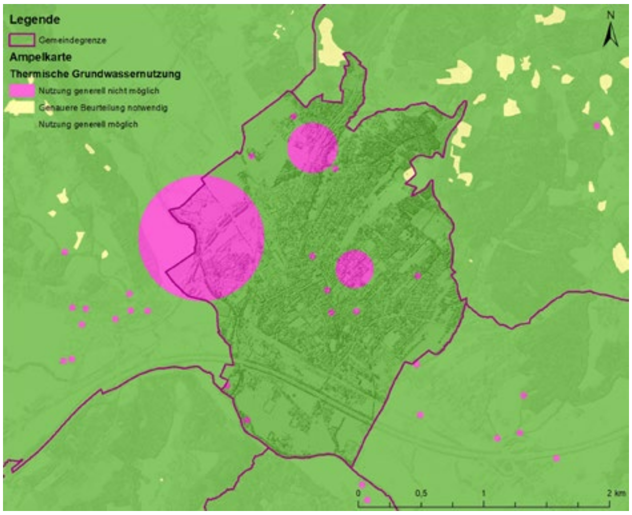
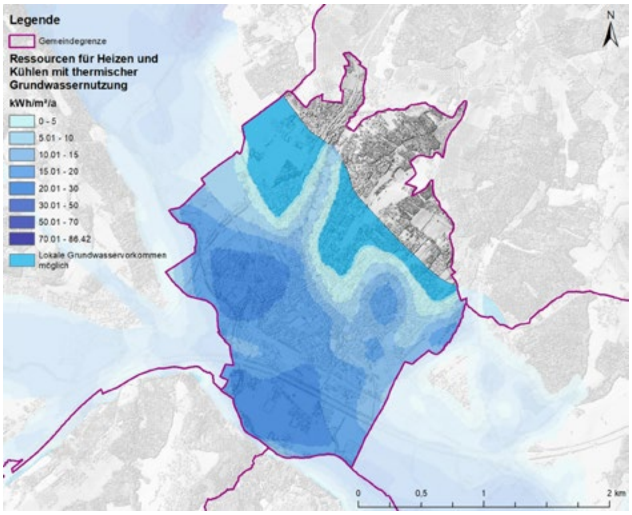


Fig.: GRETA – Interreg Alpine Space ERDF





The traffic-light map groups together possible reasons preventing a near-surface geothermal energy system from being set up and indicates locations where they can generally be used (green), where additional information is needed (yellow) or where geothermal heat cannot be used as a general principle (pink). The maps include, for example, karstable rocks, possible landslides or mining areas. Pictures: Geological Survey of Austria (GBA)

automated queries and analyses for specific administrative processes. This will provide effective support to site development work, spatial planning and the development and monitoring of energy strategies in the future. With the completion of the first phase of the project, all features for the heating sector are set to be available in June 2021.

NEAR-SURFACE GEOTHERMAL ENERGY

Spatial energy planning can deliver significant added value for making greater use of the potential afforded by geothermal energy in Austria. The ENERGIEatlas maps the various options for harnessing near-surface geothermal energy using three kinds of systems: borehole heat exchangers, groundwater heat pumps and surficial heat exchangers. This sector falls within the remit of the Geological Survey of Austria (GBA), which boasts an extensive database and significant specialist expertise gained from numerous projects both within the country and further afield.

The GBA is using newly developed methods that allow energy resources and limitations to near-surface geothermal energy to be estimated accurately right down to specific plots of land. Content is presented in the form of maps and, via a query function, as a report, thus providing a compact summary of all relevant information on each individual location. Potential restrictions on the use of near-surface geothermal energy are displayed visually using traffic-light maps (separated into borehole heat exchangers, groundwater heat pumps and surficial heat exchangers) and in the location query function. The SEP tools enable the functionality for geothermal energy to be utilised in the planning process.

AN UPGRADABLE SYSTEM

As part of the SEP project, a scalable system was created that planners, investors, political decision-makers and citizens will be able to use in future and that can be transferred to other federal states and regions. Comprehensive information on the potential for near-surface geothermal energy is already available for Vienna and the state of Salzburg.

Digitalising the underlying information has opened up a highly promising pathway over the past few years that offers huge potential for further development. The example of geothermal energy shows how all manner of different areas can tie in with it. In the project itself, meanwhile, the second phase will begin from summer 2021 onwards. In the next three years the power and mobility sectors will be integrated and cities from other federal states will participate as "followers". ●

https://waermeplanung.at

[1] SEP is a project under the umbrella of the "Green Energy Lab" innovation laboratory, a research initiative for sustainable energy solutions and part of the Austrian "Flagship Region Energy" innovation campaign.
www.greenenergylab.at

[2] **PROJECT PARTNERS**:
SIR – Salzburg Institute for Regional Planning and Housing (project management), Energieagentur Steiermark GmbH, Grazer Energieagentur GmbH, UIV Urban Innovation Vienna GmbH, Vienna University of Technology - Energy Economic Group, Graz University of Technology - Institute of Thermal Engineering, AEE INTEC, e7 Energie Markt Analyse GmbH, RSA Research Studios Austria iSpace, Vienna City Council, Government of the State of Salzburg, Building department of the City of Salzburg, Grödig town council, Municipality of Bergheim, Municipality of Zell am See, Government of the State of Styria, Building department and Environmental office of the City of Graz, Energieregion Weiz-Gleisdorf GmbH, Municipality of Kapfenberg

The absorber tubes are pulled into the borehole. On the left are the fibre optic cables that are also pulled in and compressed in the process, photo: SANBA project

SANBA

Using geothermal energy to store heat in local low-temperature grids

In the SANBA project, led by the AIT Austrian Institute of Technology,[1] a local low-temperature heating and cooling (LTHC) grid[2] was developed for the Martinek military camp in Baden, near Vienna, which was abandoned in 2014. A new urban quarter with residential, commercial and office buildings could be constructed on the 40-hectare site, which is owned by the Ministry of Defence. This will require renovating the listed buildings. The key idea behind the renovation is to supply the district with energy from locally available sources via a local low-temperature network.

Near-surface geothermal energy could also be used besides industrial waste heat produced by processes at the nearby NÖM AG dairy as well as photovoltaic and solar thermal energy. The potential and possible restrictions on geothermal drillings and thermal groundwater use at this site were analysed during the research work, focusing on the seasonal storage of the industrial waste heat.

STUDYING THE SUBSURFACE

The geoscientific site assessment considered a wide range of existing information, such as geological maps, drilling information, profile sections, existing water rights in the local area, etc. Field and laboratory measurements provided additional data. Two exploratory boreholes (one 150-meter-deep flush-drilled hole and one 30-meter-deep core-drilled hole) were drilled on the land of the nearby dairy and two geoelectrical measurements were carried out on the military camp site. The exploratory drillings are used to record the geological profile, while geoelectrical measurements allow the material, porosity and water saturation of the subsurface to be identified. A dense, fine-grained clayey material typical for the Vienna Basin was found throughout the entire borehole depth.

To find out about the thermal properties of the subsurface, a borehole heat exchanger (BHE) was installed and a so-called thermal response test (TRT) was carried out, with which the effective thermal conductivity can be determined. For this purpose, the subsurface is heated evenly using copper wires encased in cables. Installing an extra fibre optic cable allows depth-resolved temperature measurements to be taken in situ. All the information was used to create a 3D model of the subsurface as well as for numerical modelling. Various heat input and extraction scenarios were simulated for a BHE thermal storage system with 96 180-meter probes in order to analyse the thermal impact on the subsurface in the vicinity of the BHE field.

[1] **PROJECT PARTNERS**: AIT Austrian Institute of Technology GmbH (project management), NÖM AG, Vienna University of Technology - Institute for Energy Systems and Thermodynamics, ENFOS. e.U. – Energy and Forest, Research and Services, Institute of Building Research and Innovation ZT-GmbH, City of Baden/Energy Department, University of Leoben – Chair of Energy Network Technology, geohydrotherm GmbH, BauConsult Energy GmbH
Project consultants: The Austrian Ministry of Defence, represented by the Military Real Estate Management Centre (MIMZ), Austrian Federal Monuments Office

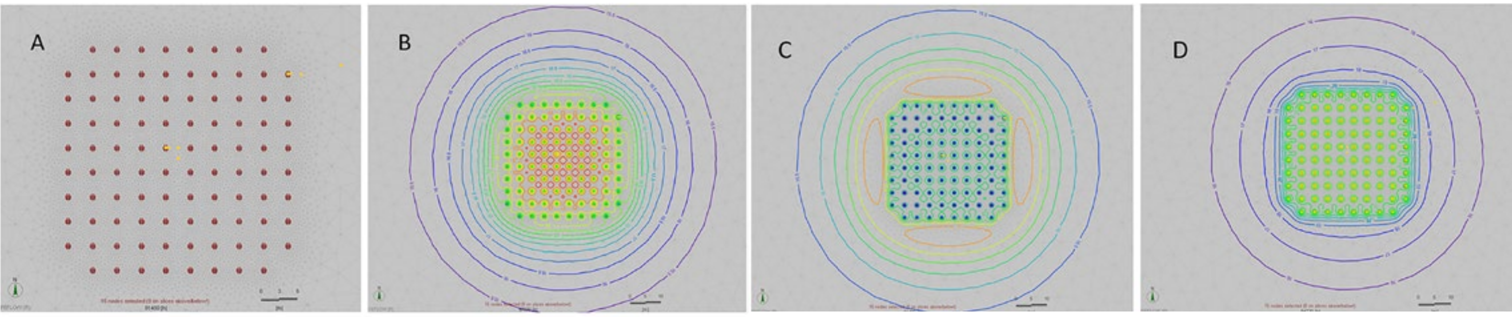
[2] Local low-temperature heating and cooling (LTHC) grids are pipeline networks that distribute low-temperature water (from 4°C to 30°C) between individual buildings or groups of buildings. The system can be used for heating and cooling using heat pumps as well as for seasonal heat storage. LTHC grids are opening up new opportunities for decentralised energy supply and forming local energy communities.

Second borehole on NÖM area in September 2020. It was core-drilled down to a depth of 30 m, photo: SANBA project

> **“Geothermal energy is a cornerstone in the renewable heating transition and a core component of low-temperature heating and cooling grids, particularly for seasonal underground heat storage. In order to fully tap the potential for geothermal energy and ensure the correct dimensioning and design of the geothermal systems, such as borehole heat exchangers, it is essential to have a precise understanding of all the subsurface parameters.”**

EDITH HASLINGER
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH, CENTER FOR ENERGY


Photo: AIT



Section through the BHE field model. A: position of the BHE and observation points (yellow). B, C and D: situation in the 10th year of operation on 1 January (midwinter), 15 April (end of heating season) and 31 August (midsummer), image: SANBA project

FINDINGS AND AREAS OF POTENTIAL

The tests revealed that the site only contained a shallow and non-productive groundwater in the topmost 10 to 20 meters below the surface and that local inhomogeneities and only a moderate level of hydraulic permeability meant that groundwater reserves could not be thermally used. No restrictions on the geothermal use of the subsurface with borehole heat exchangers were identified down to a planned depth of 150 meters. At deeper layers, a certain formation (Gainfarn Breccia) could potentially be encountered, which might be connected to the local thermal water resources.

The measurements done as part of the TRT showed an effective thermal conductivity of around 1.75 W/mK. The average temperature below ground prior to the tests was 13.3°C. The power and energy resources for the BHE field were calculated analytically based on the site-specific parameters. These calculations produced a specific output of 33 W/m and an area-based supply of 93 kWh/m^{2}a for a thermally balanced BHE field.

The entire LTHC grid could then be modelled using a specially developed simulation tool. The BHE field model and the calculated energy data, heat pumps, solar thermal energy, PV, battery storage systems and the prosumers from the local network (industry, buildings, etc.) were also integrated into the simulations. ●

www.nefi.at/sanba

SANBA is a project in the flagship region of the NEFI – New Energy for Industry, an innovative network of research institutes, technology providers and companies for developing key technologies for the decarbonisation of industry.
www.nefi.at


Dark grey, fine-grained clayey to silty material can be found from the top to the bottom of the borehole. It can be considered part of the marl series of the Tegel deposits in the Baden area in the Vienna Basin. The photo shows some of the cores extracted from the 30 m core-drilled borehole, photo: SANBA project

INFORMATION

Manage_GeoCity
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