GEO ENeRGY

The ESTMAP project: Energy Storage Mapping and Planning

The ESTMAP project was funded by the EC Horizon 2020 programme in 2015-2016 (http://www.estmap.eu/). The project consortium led by TNO included BRGM, CGS, ECOFYS and VITO. The project investigated the distributed potential to deploy large-scale energy storage across Europe and demonstrated how this information can be used for analysing future energy scenarios.

The project included three main elements: 1) collection and compilation of publicly available spatial information on existing energy storage sites and future storage potential (subsurface and above ground); 2) development and population of a harmonized spatial database that is capable of maintaining, integrating and disseminating this information; and 3) demonstration of how the database can be used for pan-European and regional energy system modelling studies. ESTMAP covered all types of storable energy carriers for gas-, heat- and electricity-related services. The project focused primarily on larger-scale technologies that are relevant for either centralized energy grids or national to local energy distribution networks (Fig 1).

Geological research institutes associated under ENeRG and EuroGeoSurveys collaborated as partners in ESTMAP to deliver available knowledge and information on subsurface-related energy storage development as well as characterization and evaluation of reservoirs potentially suitable for future storage development. Additional information was gathered from publicly available European databases. All collected data were checked for quality and consistency and integrated in a consistent, harmonized and documented ESTMAP database.

In the database, an energy storage site is described by two interlinked components: 1) the actual storage facility or storage plant that is connected to a grid or distribution network and operates intake, conversion and output of energy; and 2) one or more natural or artificial reservoirs that act as a physical containment for the energy carriers. These reservoirs can either be situated in the subsurface (porous formations, caverns, etc.) or above ground (lakes).

The ESTMAP database contains information on more than 4200 subsurface and above ground reservoirs and formations spread over 33 European countries. These reservoirs are either deployed for storage, or represent a potential for future storage development. In addition, information was gathered on approximately 700 existing or planned storage facilities. Each entry is characterized by a comprehensive set of attributes that describe the geographical, geological and physical aspects as well as the current utilization and assessed potential for various energy storage technologies (underground gas storage, hydrogen storage, compressed air energy storage, underground thermal storage and pumped hydro storage). In the subsurface, the dominant types of reservoirs are aquifers, hydrocarbon fields and salt formations (caverns). A detailed evaluation of the available data and storage potential is described on a country-by-country basis.

The ESTMAP database provides a first-time comprehensive overview of energy storage potential across Europe. The project has successfully demonstrated that this information can be used in energy system analyses, on both pan-European and regional levels. But maybe more importantly, by maintaining and upgrading the information, the ESTMAP database may become a common agreed standard for future energy modelling studies.

The evaluation of subsurface energy storage potential is still an evolving research area and the progress differs regionally. The ESTMAP project results help in identifying knowledge gaps and prioritizing new areas of research in order to achieve a more levelled and state of art insight of energy storage potential across Europe. Harmonization of assessment methodologies, implementation of common workflows across borders, as well as a more detailed and site-specific assessment of critical subsurface attributes are important aspects for improvement.

The ESTMAP team would like to thank all subcontracted partners for their essential contributions in collecting the crucial information and performing analyses.

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TNO

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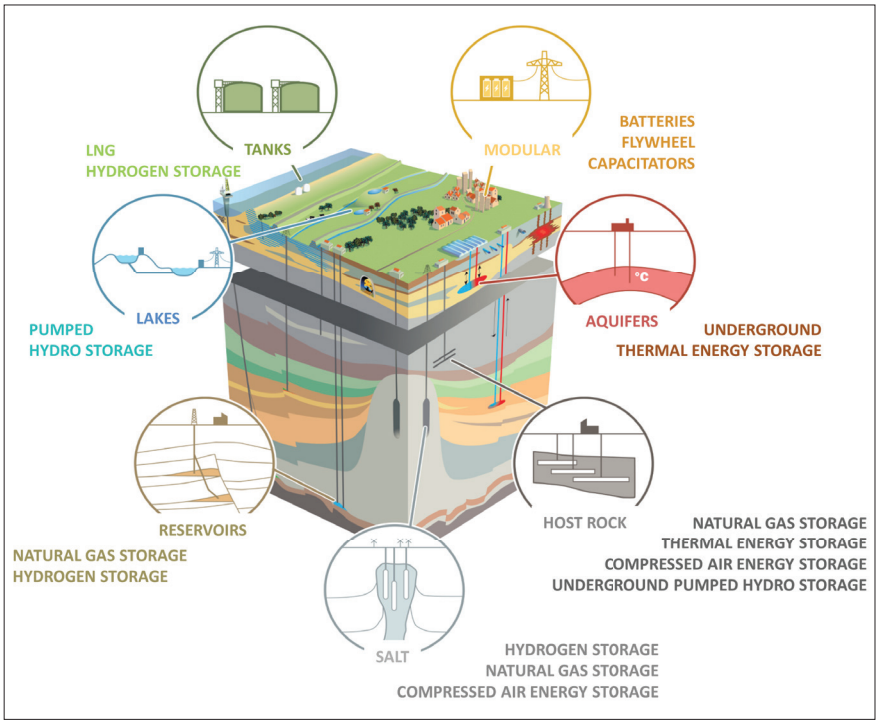

Fig.1 Subsurface and above-ground energy storage technologies

The Newsletter content

THE NORDIC CO_2 STORAGE ATLAS

As a part of the NORDICCS project (Nordic Competence Centre for Carbon Capture and Storage), an atlas ranking potential Nordic storage sites has been created. The atlas identifies 20 suitable sites, with the most promising sites located in Norway, and concluded that the Nordic region has substantial storage capacity in aquifers.

The web-based Nordic CO_2 storage atlas was published in November 2015. It comprises an extensive storage site database based on geological data from the Nordic region. The atlas can be used as a basis for planning future CCS infrastructure and to support decisions on how the Nordic region can manage their CO_2 reduction targets towards a carbon neutral Nordic region in 2050.

Extensive sedimentary basins with storage potential are situated in a band around the Scandinavian peninsula from the Baltic Sea, through Denmark and along the Norwegian coast, whereas, the shallow sedimentary basins in Finland are not considered appropriate for CO_2 storage (Fig. 2). In general, the storage capacity associated with hydrocarbon fields is minor compared to storage in aquifers, but late stage production may gain from CO_2 injection improving the production of oil (EOR, Enhanced Oil Recovery). In Iceland, the storage potential is not related to sedimentary basins, but to chemical bounding in porous basalts.

In order to create this storage atlas, an extensive collection of geological data for potential storage sites was merged in a GIS (Geographic Information System) database. The database contains outlines and locations of sedimentary basins, storage formations, storage units, storage traps, hydrocarbon fields, seal formations and mineral trapping storage areas.

A ranking procedure based on the collected data for reservoirs and seals, has resulted in selection of the most prospective Nordic storage sites. The characterisation and ranking of storage sites were based on four main categories: reservoir properties, seal properties, safety/risk and maturity/data coverage.

Based on the Nordic CO_2 storage atlas the total mapped CO_2 storage capacity for Denmark, Norway and Sweden is 134000 Mt. The storage capacity related to saline aquifers is 120000 Mt, with 22000 Mt in Denmark, 94600 Mt in Norway (72800 Mt in the North Sea) and 3400 Mt in Sweden. The total number includes 14000 Mt in hydrocarbon fields, with 2000 Mt in Denmark and 12000 Mt in Norway. It should be emphasised that the storage capacities are regarded as qualified theoretical estimations based on volumetric calculations of the available pore space and a storage efficiency factor. Improved geological data and reservoir modelling work will be needed to narrow the uncertainties for the storage capacity estimate.

In Iceland an alternative method is being developed and tested as a part of the CarbFix project (www.carbfix.com) where the CO_2 is dissolved in water during injection into basaltic rock formations. Once dissolved in water, the CO_2 is no longer buoyant and does not migrate back to the surface. Basaltic rocks are reactive and contain over 25 wt% Ca, Mg and Fe-oxides. The CO_2-charged water accelerates both the metal release from the basalt and subsequent formation of solid carbonate minerals such as calcite ($CaCO_3$), dolomite ($CaMg(CO_3)_2$), magnesite ($MgCO_3$) and siderite ($FeCO_3$) for long term storage of CO_2.

The most feasible areas for CO_2 storage on- and offshore Iceland are the youngest formations within the active rift zone, which consist of highly porous and permeable basaltic lavas and hyaloclastic (glassy) formations (Fig. 2). These formations are younger than 0.8 M years and cover about 34000 km^2 onshore, which is about one third of Iceland and about 93000 km^2 offshore Iceland. It was estimated that this area could store up to 9000 Gt CO_2. Site-specific geological research and pilot studies are required for refining the concept. Offshore pilot scale projects should be considered as the next steps in evolving the method and revealing how much of this storage potential will be practical to use.

The NORDICCS project also compared static storage capacity estimates with estimates based on dynamic simulation for five selected storage sites. One of the main conclusions of these CO_2 injection simulations was that the dynamic capacity results were 33-58% lower than the static storage capacity calculations. The static capacities were based on a storage efficiency of 2-4% for large regional aquifer and 40% for traps. The dynamic injection simulations used a pressure safety margin on the cap rock allowing an increase of up to 85% of the lithostatic pressure. However, even considering the lower dynamic capacity estimates in the atlas, it is obvious that the Nordic region has substantial storage capacity in saline aquifers.

Link to atlas: https://data.geus.dk/nordiccs/

Karen L. Anthonsen
GEUS

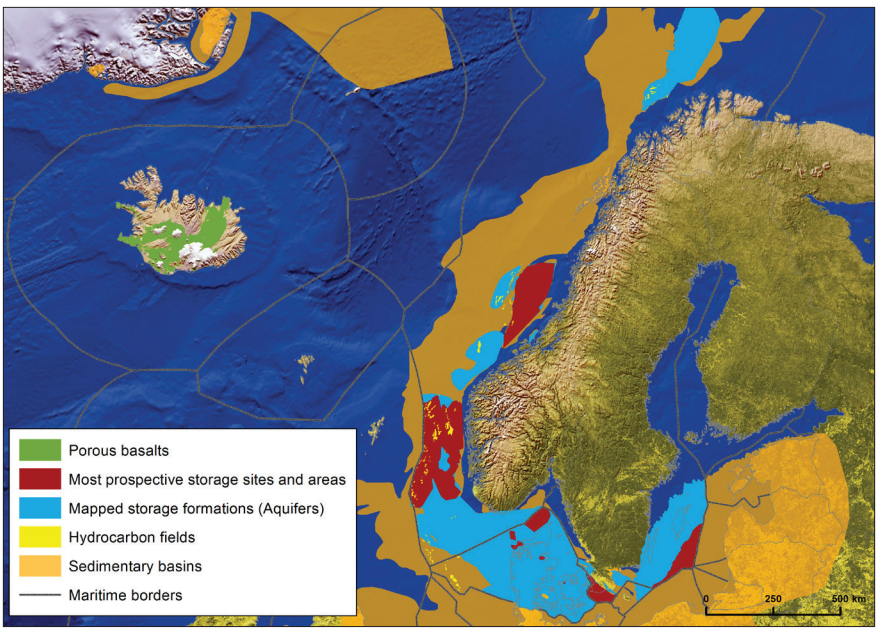

Fig. 2 The mapped Nordic storage formations (aquifers) in blue and the most prospective areas in red. The green areas on Iceland are the high porosity basalt areas

GEOTHERMAL ATLASES OF POLAND

The first studies on mapping of the geothermal potential of Poland were carried out in the 1990s at the AGH University of Science and Technology (AGH-UST) in Kraków (Górecki et al. 1990, 1995). The first atlas (Górecki et al. 1990) was devoted to analysis of hydrogeological parameters of the Lower Jurassic and Lower Cretaceous aquifers in the area of Polish Lowlands (northern and central Poland). The second one (Górecki et al. 1995) included the assessment of hydrogeothermal resources of the Mesozoic aquifers of the Polish Lowlands. Results of both of the atlases were utilized to propose locations of a number of geothermal installations in the Polish Lowlands, built in 1997-2005.

In 2006 further studies on regional mapping of the geothermal potential of Polish Lowlands, completed by AGH-UST and PGI-NRI, were published. The studies included mapping and hydrogeothermal resource assessment for the Mesozoic and Paleozoic aquifers (Górecki 2006). The assessment of geothermal resources covered approximately 80% of the territory of Poland and the methodology of the atlas of geothermal resources in Europe (2002) was utilized. The aquifers from the Lower Cretaceous to the Middle Cambrian were covered. For most of the aquifers a comprehensive suite of maps was produced (working scale 1:500000, published in 1:2000000 scale), including maps of aquifer geometry & parameters, unit static resources (heat in place; GJ/m^2), potential discharge of wells in the aquifer, unit disposable resources (MJ/m^2) and thermal power of geothermal doublets (MW).

As a continuation of that work, atlases of geothermal resources in the Western Carpathians, Carpathian Foredeep and Eastern Carpathians were elaborated by AGH-UST in cooperation with experts from various R&D institutions, covering areas of southern and southeastern Poland (Górecki 2011, 2012, 2013).

In 2014 MEERI PAS, AGH-UST and PGI-NRI published the atlas on the possible use of geothermal resources in combined heat and electricity production in binary systems in Poland (Bujakowski et al. 2014). Several areas of Poland, where hydrogeothermal resources of temperatures sufficient for binary systems (>90° C) are available, were studied in the atlas and production scenarios were proposed.

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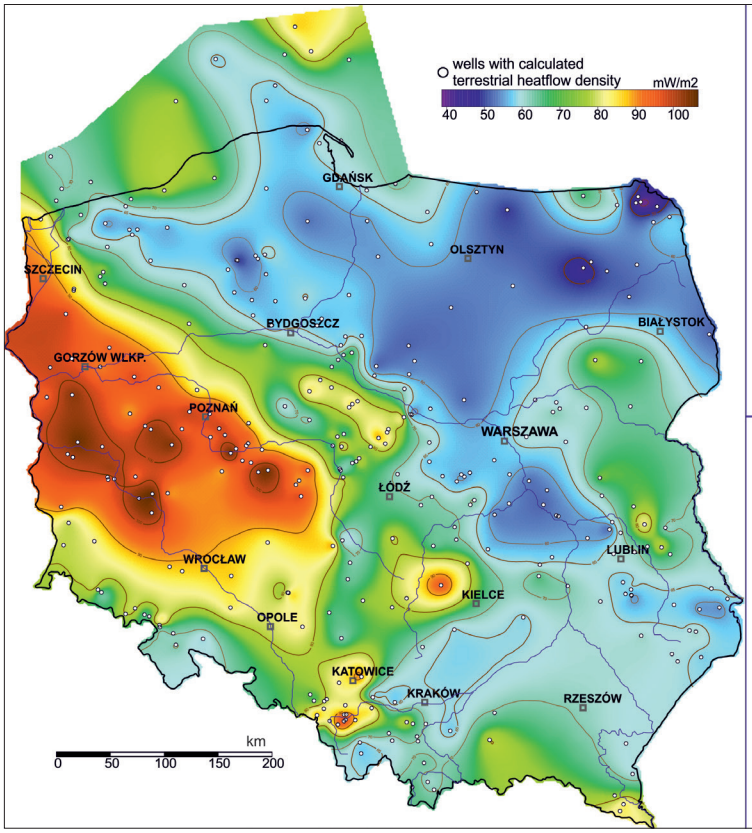

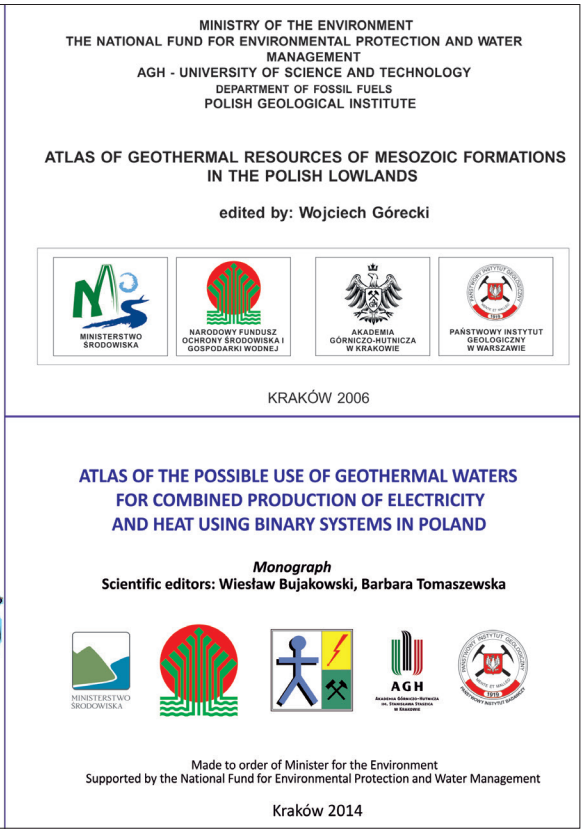

ENeRG – European Network for Research in Geo-Energy

ENeRG – European Network for Research in Geo-Energy is an informal contact network open to all European organisations with a primary mission and objective to conduct basic and applied research and technological activities related to the exploration and production of energy sources derived from the Earth's crust.

ENeRG president for 2016-2017 is Dr. Isabelle Czernichowski-Lauriol from BRGM, France. Contact: i.czernichowski@brgm.fr

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ENeRG website: <http://www.energnet.eu> is maintained by the Czech Geological Survey (CGS). Prague, Czech Republic.
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ENeRG Newsletter – GEO ENeRGY
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4th Sustainable Earth Sciences Conference

3-7 September 2017, Malmö, Sweden

To meet the challenges of present and future energy demand, the geosciences play an increasingly important role in the sustainable use of the Earth and its resources and in the conservation of our environment. Numerous technologies (storage of gases, geothermal, waste disposal, oil & gas, mining, etc.) use the subsurface – sometimes in synergy, sometimes in competition. The Sustainable Earth Sciences (SES) conference series, organized by EAGE - the European Association of Geoscientists and Engineers, is a relatively new initiative seeking to address these challenges by promoting the development of applied geoscience research and technology.

The Fourth SES conference, co-organised again by ENeRG, will take place from 3-7 September 2017 in Malmö, Sweden, building on the success of the previous editions in Valencia, Spain (2011), Pau, France (2013) and Celle, Germany (2015).

The SES 2017 conference will be co-located with the Near Surface Conference & Exhibition 2017, which will give all participants the opportunity to participate in both events and engage in the exciting developments in the emerging field of Sustainable Earth Science.

Important dates

Deadline Early Exhibition Rate	1 March 2017
Registration Open	1 April 2017
Deadline Call for Abstracts	15 April 2017
Deadline Early Registration	15 July 2017
Registration Closed	21 August 2017

Conference themes

The SES 2017 conference will bring together multi-disciplinary scientists working on different aspects of Sustainable Earth Sciences:

- Geothermal energy
- CO_2 storage
- Energy storage
- Hydrocarbon energy - environmental footprint
- Geological storage of hazardous waste
- Monitoring technology
- Modelling methods
- Environmental, economic and societal impacts
- Cross-technology topics

Call for Abstracts

The call for abstracts is open. The deadline for submitting extended abstracts is 15 April 2017. All abstracts must be submitted in standard format and will be peer-reviewed before final selection by the scientific committee.

Short courses & Field trips

The workshops & short course are scheduled on Sunday 3 September and the field trips on Thursday 7 September 2017.

Contact

For more information or enquiries please visit the event website: www.eage.org/event/ses-2017 or contact the EAGE Europe Office via nearsurface@eage.org.

EAGE
EUROPEAN ASSOCIATION OF GEOSCIENTISTS & ENGINEERS

CONFERENCE & EXHIBITION
NEAR SURFACE GEOSCIENCE'17
4th Sustainable Earth Sciences Conference

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