

ENeRG GEO ENeRGY

2nd European Underground Energy Storage Workshop organized by ENeRG

A comprehensive 2nd European Underground Energy Storage Workshop (UESW) was recently organised by the ENeRG network, the COST Action Geothermal-DHC and EuroGeoSurveys, and sponsored by AVALON International Corporation (Gold Sponsor) and DEEP.KBB (Silver Sponsor), to foster innovative solutions for sustainable underground energy practices. The Workshop was dedicated to the memory of ENeRG colleague from the Czech Geological Survey, Vit Hladik, who contributed enormously to the organisation of the first workshop and initiated the second one.

The event, held over two days in Paris on 23-24 May 2023, brought together 50 researchers and industrial stakeholders from 25 countries, including the EU, Norway, the UK, Turkey, Albania, North Macedonia, and the USA, to deliberate and exchange insights into the latest advancements in underground energy storage technologies and research.

The workshop included five engaging sessions addressing the current technological status and research needs for the

development of the subsurface energy storage technologies, as well as critical challenges, opportunities, and solutions in the realm of underground energy storage. Sessions 1 and 2 were held on May 23, and Sessions 3, 4 and 5 on May 24. Alexandra Dudu, President of ENeRG (GeoEcoMar, Romania), opened and chaired the Introductory Session 1. The participants focused on the remembrance of their dear colleague Vit Hladik, recalling their collaboration with him in numerous projects and networks. The session continued with an introductory lecture on "Carbon neutral technologies and need for energy storage" and presentations on the COST Geothermal DHC as well as CCS activities performed in the USA by AVALON International Corporation.

Session 2, which was chaired by Barbara Merson (OGS), was entitled "Advances in deployment of underground energy storage". The session included five presentations from industry and research on hydrogen storage in salt caverns – status and future potential, opportunities and particularities of underground ammonia

storage, storage of hydrogen in aquifers using CO₂ as cushion gas, and presentations on the PilotSTRATEGY and CCUS ZEN projects.

Session 3, chaired by Alexandra Dudu and Kazbulat Shogenov, bore the title "Challenges for underground energy storage". Six talks were given about the CO2SPICER and GSEU projects, as well as the synergies between CCS and large-scale hydrogen storage. The second part of Session 3 focussed on challenges and particularities of energy storage in salt caverns.

Sessions 4 and 5 were organised by the COST Action Geothermal-DHC and chaired by Jessica Maria Chico (University of Torino, Italy) and Vasiliki Gemeni (HAEE, Greece).

Additionally, during the breaks, six posters were presented and discussed.

The workshop was coordinated by Eleonora Manoukian, the ENeRG secretary.

A consensus was reached at the conclusion of the 2nd European Underground Energy Storage Workshop to continue collaborations, pursue additional research initiatives, and advance sustainable underground energy storage innovations in support of a greener and more sustainable future.

A number of the UESW participants also attended the HyStories Conference in Paris on 25-26 May
<https://hystories.eu/final-conference>.

More about UESW participants and their presentation can be found on the ENeRG website <https://energnet.eu/workshops/2nd-european-underground-energy-storage-workshop-2/>

Alexandra Dudu
ENeRG President
GeoEcoMar



Figure 1. Workshop organizing committee and participants in Paris, May 2023.

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Geothermal Direct Use in Ukraine

Geothermal Direct Use in Ukraine is a one-year project coordinated by **Verkis hf. company** and funded by the Icelandic Sustainable Development Goals Partnership Fund. The partners are **NGO "Geothermal Ukraine"** and **ISOR**.

The project's goal is to identify and

- One district heating project
 - One industrial or tourism (e.g. balneological) project
 - A combination of the two options listed above
- The potential of geothermal resources has already been examined in part, and the study will rely heavily on already published scientific articles, reports, and

and for some Transcarpathia deposits it is equal to 7-8 °C/100 m. Geothermal wells with a depth of 550 m to 1.5 km are deemed easily accessible here. Wells enable the extraction of mineralised water with a temperature range of +23–61°C. At a depth of 0.5 km, the average temperature ranges from 13 to 70°C, while at a depth of 3 km, the temperature ranges from 70 to 145°C. Geological and geophysical data at depths of up to 6 km show that the temperature of rocks in the Transcarpathia reaches 230–275°C (an anomaly of 210°C was recorded at 4 km depth).

The critical focus will be on conducting a preliminary selection for a subsequent feasibility study into the re-purposing of plugged and abandoned O&G wells for geothermal uses.

The project output will be up-to-date research and a pre-feasibility report for each location, including compiled data from the resource assessment and the technical concept, preliminary cost estimates and recommendations on the next stages for the commercial implementation phase.

The project partners also plan to conduct potential energy demand and market analysis, as well as participate in dialogue



Figure 2. Location of three regions in Western Ukraine studied for direct use of geothermal energy.

assess prospective geothermal direct use applications in three of Ukraine's most promising regions: Transcarpathia, Lviv and Ivano-Frankivsk (Fig.2) The fundamental concept is to identify the most promising geothermal areas and conduct a pre-feasibility study for geothermal direct use projects. The three projects are expected to cover the following direct geothermal energy applications:

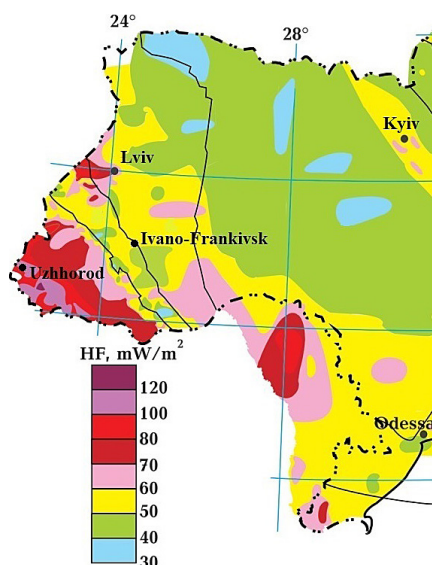


Figure 3. Distribution of deep heat flow values.

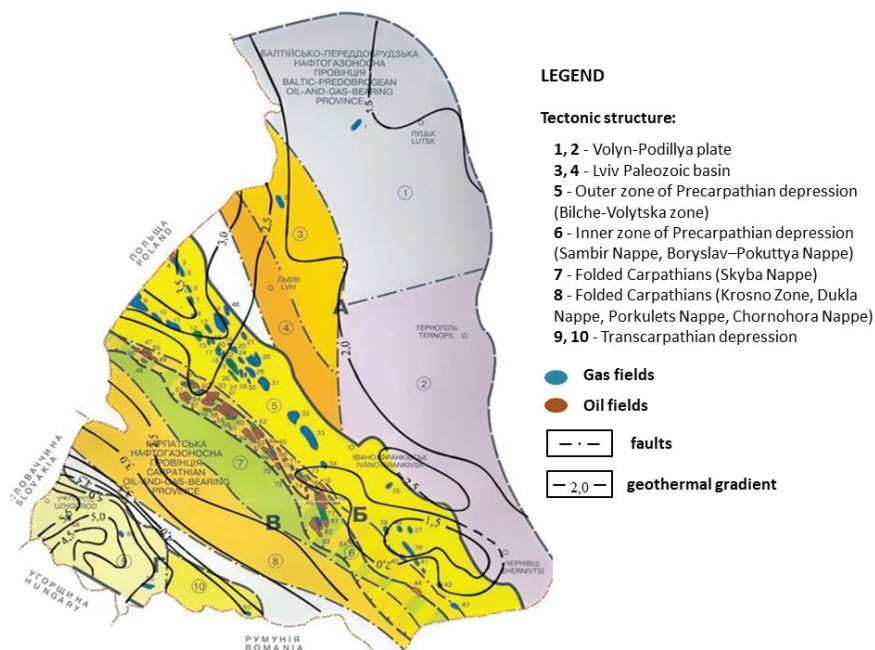


Figure 4. Average geothermal gradient distribution in Ukraine's Western region.

actual subsurface data from geothermal, oil and gas (O&G) fields/areas.

Considering the high temperature geothermal conditions of Ukraine's Western areas, the deep heat flow value reaches 130 mW/m² (Fig.3), the average geothermal gradient is 5 °C/100 m (Fig.4),

with local stakeholders. In the long run, the project findings are seen as a tremendous chance for clean energy development and may have a favourable impact on Ukraine's industrial and economical growth.

Taras Popadynets, Head of the Board
Yuliia Demchuk, Board member

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International Master Course on CO₂ Geological Storage

The International Master Course on CO₂ Geological Storage (<https://web.uniroma1.it/masterco2/en>), is an Initiative of the EU project ENOS (Enabling Onshore CO₂ Storage in Europe) (<http://www.enos-project.eu/>), organised by the University of Zagreb and the Sapienza University of Rome, which are both members of ENeRG. The course ran in the academic year 2022-2023 with the support of CO2Geonet (www.co2geonet.com), European Network of Excellence on CO₂ Geological Storage, and the participation of several European research institutions: GEUS (Denmark), Heriot Watt University (Scotland), Sotacarbo (Italy), TalTech University (Estonia), NORCE (Norway), ETH Zurich (Switzerland), and Evora University (Portugal).

The goal of the Course has been to provide the participants with the scientific and technical knowledge required for the successful storage of CO₂ in geological formations.

The 15-module course provides an overview of cutting-edge CCS operations and research; it focuses on the technical and scientific considerations for CO₂ injection and safety monitoring, the exploration of critical processes in laboratory studies, and numerical modelling, and conclusively on sound and reliable storage capacity estimates, including the project economics and mitigation planning.

On the 7th of December 2023, the five students completed their studies with the final defence of their work at the Earth Sciences Department of Sapienza University. The event was held both online and in person.

The first student was Sitti Nur Asnin, who presented her work entitled "Extended application of Pressure Fall Off test to



Figure 5. Final defence of the Master Course in Rome, December 2023.

CO₂ storage", supervised by Jasper de Reus Adriaan, University of Zurich ETH, Switzerland. She was followed by Nikolina Bralic, who presented her work entitled "Options for geological storage of CO₂ in carbonate formations of the Adriatic offshore", supervised by Bruno Saftic and David Rukavina, Zagreb University, Croatia. The third student was Messie Moussa Mbou Kambou with work entitled "Assessing static modelling parameter uncertainties in the Lusitanian basin offshore pilot", supervised by Pedro Pereira, Júlio Carneiro University of Evora, Portugal. Then, Farnam Firouzbehi presented his work entitled "Synergy in combining CCS and geothermal energy production", supervised by Carsten M. Nielsen, GEUS, Denmark. The last student was Hassan Khaled, who presented his work "Well testing before CO₂ injection", supervised by Joshua Mugisha and Anton Shchipanov Norce Research Centre, Norway. All students successfully defended their theses.

The Commission, which was composed

of Professors Bruno Saftic, Sabina Bigi and Maurizio Battaglia, awarded the students with the Final Diploma of Professional Master in CO₂ Geological Storage.

The next edition is scheduled for the academic year 2024-2025, and the call for application will be announced in Spring 2024. The Master Course on CO₂ Geological Storage empowers students to become experts in a key field tackling global climate challenges, while also providing employment prospects and contributing to sustainable environmental practices and technology advancements. At the end of the course, successful students will be awarded a Diploma that will offer them with specialised knowledge and skills in the field of the CCS.

Sabina Bigi
Associate Professor,
member of CERI –
Sapienza University
of Rome, Italy



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 in the field of sustainable use of the underground for the energy transition.

ENeRG president is Dr. Alexandra Dudu, the Head of the CO₂ Geological Storage Department in GeoEcoMar (Romania), alexandra.dudu@geoecomar.ro

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Baltic Carbon Forum 2023

On the 12-13 October in Riga, almost 100 participants from 15 countries took part in the annual Baltic Carbon Forum 2023, which was organised by BASRECCS network.

The forum was attended by ENeRG members from TalTech, GEUS, SHOGenenergy, and PGI-NRI.

Participants from industry, academia, government, and non-governmental organisations (NGOs) explored global and local views on Carbon Capture, Transport, Use, and Storage advances.

A. Grasmane (Latvian Ministry of Climate and Energy), B. Gerrits (Global CCS Institute) and industry representatives (Wintershall DEA and SCHWENK Latvija) delivered keynote speeches. The current status of Carbon Capture, Use, and Storage (CCUS) in the Nordic and Baltic Regions was discussed by speakers from Equinor, the Danish Energy Agency and SINTEF, Norway. Regulations, Policies and Public Perception were the topics of talks by speakers from the Energy Policy Group, the Geological Survey of Sweden, and the Perspectives Climate Group. Bellona and Bioenergia gave a presentation on Carbon Capture and Storage (CCS) in the Industrial Sector. Recent breakthroughs in CCS were given by speakers from Abo Akademi University (Finland), INiG-PIB (Poland) and Kaunas University of Technology (Lithuania).



Figure 6. BCF2023 attendees in Riga, October 12-13 (Source: BASRECCS)

On the second day, Marginal Carbon and Riga Technical University presented on Commercialisation Models for CCS. NORCE, Teesside University and Silesian University of Technology gave presentations on Recent Advances in CCS.

Researchers from Latvia, Lithuania, Estonia, and Sweden gave poster presentations. K. Shogenov presented a poster entitled "New synergy concept of geothermal energy recovery, CO₂ and green hydrogen geological storage in the Baltic offshore structure". On the 13th of October, A. Shogenova, a member of the BCF2023 Organising Committee, convened the session and shared with Prof. A. Niemi (Uppsala University) the Short Course "Recent developments in CCUS implementation and research, with focus on Baltic Sea Region".

One of the event's conclusions was that Baltic countries must act quickly to enable CCS implementation in order to meet emission reduction targets, while maintaining their industrial base.

BCF2023 program and presentations are available here:

<https://bcforum.net/forum.php>

Conference proceedings could be read here:

<https://www.extrica.com/issue/bcf-2/contents>

Alla Shogenova
TalTech and SHOGenenergy



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