Task 42 – Underground Hydrogen Storage Newsletter

Editorial

Dear Reader,

Welcome to the first external newsletter from Task42 on Underground Hydrogen Storage (UHS) as part of IEA's Hydrogen Technology Collaboration Program and further referred to as TCP-Task42. With this and next newsletters we will provide you with regular updates and proceedings on deliverables and events established by our Task. In this first newsletter we will inform you on recent highlights including the 2022 Hydrogen Summer School and the autumn 2022 TCP-Task42 workshop which took place at the premises of the Clean Hydrogen Partnership. We will also provide a preview on our upcoming UHS Technology Monitor Report and meet some of our experts. But let us first start with a brief general background on TCP-Task42 and an introduction to our community and its position in the Hydrogen TCP framework.

TCP-Task42 represents a global community of 54 organizations and more than 190 experts from industry, research, science and policy who are dedicated to realize and implement UHS as a technically, economically, environmentally and societally viable technology in the future sustainable energy system. We have started in January 2022 and our activities are scheduled to continue until December 2024. Our main objective is to help accelerate the demonstration and implementation of UHS in salt and rock caverns and in porous reservoirs such as depleted hydrocarbon fields and saline aquifers. We do that by integrating the latest scientific insights obtained from modelling studies, lab experiments and field tests carried out by in-house and commissioned projects and by implementing and translating these scientific proceedings into practical guidelines and best-practices for UHS development and commercial operation. Our key strength is the direct collaboration and synergy between academic, industrial, governmental and R&D organizations.

TCP-Task42 is subdivided into 6 subtasks which cover the full spectrum of challenges from geological research and engineering to economic evaluation and societal embeddedness. Each subtask is led by experts from different international organizations. In our newsletters we will regularly highlight experts and organizations from our community.

We hope that you enjoy learning about our activities via this newsletter and we invite you to join our Linkedin Group to stay updated and to receive the next newsletters. In case you have a question then please contact the TCP-Task42 via the email address IEA-TCP-UHS@tno.nl.

H2 Conversion & Contamination

Impacts of reservoir and fluid processes on quality and recoverability of stored H_2

Surface Facilities & Wells

Concepts, designs and materials for safe and effective storage of H_2

Storage Integrity

Integrity and stability of subsurface reservoirs and seals under H_2 storage operations

Economics & System Integration

General concepts for techno-economic integration and upscaling of H_2 storage in the future energy system

Storage Performance

Estimation, ranking and optimization of H_2 injection, production and storage capacities

Planning, Regulation, Safety & Society

Tools, guidelines and best practices for safe and responsible subsurface H_2 storage development and societal embedding

Technology Monitor Report

Future energy scenarios foresee a prominent and growing role for hydrogen as a clean and flexible energy carrier in multiple sectors of the energy system (e.g., electricity, industry, heating, transport). Variable energy production and consumption (e.g., wind/solar and heating) will require flexibility and balancing at hourly, daily and inter-seasonal timescales. It is expected that a demand for large-scale hydrogen storage will emerge which exceeds the capacity of typical surface-bound energy storage technologies. The increasing dependence on hydrogen within our society and the lower predictability of production will increase the demand for measures that secure supply. The predicted upscaling, diversification and growing variability on timescales from days to months can only be maintained with the inclusion of large-scale storage of hydrogen on a scale that is comparable with or even larger than current underground storage capacities for natural gas and oil.

The Technology Monitor Report emphasizes the connection between international research and emerging industry developments in order to define the state-of-art and to evaluate the requirements and boundary conditions for demonstration and implementation. The report considers all geological options for hydrogen storage in underground cavern and porous spaces and discusses techno-economic challenges such as the potential geochemical and microbial impacts on quality and recoverability of hydrogen, storage integrity, performance of storage operations, site selection, design criteria for surface facilities and wells and cost aspects relevant for development and operations. Last but not least, the report introduces a framework for assessing the conditions to improve the societal embeddedness of underground hydrogen storage through the various stages of its development and implementation.

The technology monitor report is expected to be finalized and published through the website of Hydrogen TCP early March 2023.

UHS Summerschool

The 1st International Summer School on Underground Hydrogen Storage (UHS), as part of the 2022 workplan for TCP-Task42 and with support of the Dutch Ministry of Economic Affairs, took place in The Netherlands on July 11-14 in the Department of Geoscience & Engineering of Delft University of Technology and with nearly 300 hybrid participants from all around the world. It has been a unique multi-disciplinary multi-sectorial event, in which policy, regulation, and licensing, companies and enterprises, research and national labs, and surely universities were present to establish and advance a collective move in the subject of UHS. The summer school covered several aspects to enable UHS technology, from policy making and governance to operation and technology deployment and surely scientific advancements and remaining research questions across all related disciplines, and which all nicely link to the main topics of our TCP-Task42. The disciplines covered include new energy systems and hydrogen economy, and all geoscience disciplines of geochemistry, geo-microbiology, geology, geomechanics, geophysics and reservoir engineering. A short video about the 1st UHS summer school can be accessed via YouTube and which should give the impression that sharing view, wisdom, challenges and opportunities in the evolving field of UHS by the distinguished lecturers, panellists, contributors, and engaging & energetic participants contributed to a large extent to the success of this summer school

For 2023 a 2nd International Summer School on UHS is planned to take place, again in a hybrid setting, from 3 to 7 July 2023 at Delft University of Technology, the Netherlands. Details of the program will be announced early 2023.




TCP-Task42 Workshop Brussels 17-18 November 2022

International collaboration is key in Hydrogen TCP and all its tasks, and the best way to progress on our objectives is to engage with fellow experts in person. On 17 and 18 November TCP-Task-42 experts from Europe, United States and Australia and representing all disciplines joined our yearly workshop which focused on the establishment of the first UHS Technology Monitor Report and the preparation of next year's activities and deliverables. Both topics are presented in this newsletter. The Workshop was perfectly hosted and supported by Clean Hydrogen Partnership at their premises in Brussels.

The workshop was kicked-off by the Principal Adviser of the Directorate-General for Energy (Mr. Tudor Constantinescu) who provided a keynote addressing the European Commission plans and ambitions for the energy transition and the role and challenges for hydrogen and hydrogen storage in the sustainable future energy system. The Director and Project Officers at Clean Hydrogen Partnership elaborated on the position of underground hydrogen storage in their research agenda including the outlook for the three main UHS projects in their portfolio (HyStories.eu, HyUsPre.eu and Hypster-project.eu). During the two days of the workshop all experts engaged in discussions regarding the state-of-art of UHS and the requirements and recommendations to enable and support the development of demonstration and pilot projects. These ambitions are supported by bridging the academic research domains and the domain of operators and project developers. The highlights and outcomes of the workshop will be communicated when the report and further workplans comes out in the first quarter of 2023.

To conclude we would like to mention the great spirit and pleasant atmosphere during the workshop and the social program which strongly contributed to the community building. One of the highlights surely was the evening visit and private tour at the Natural History Museum of Brussels which holds the largest collection of dinosaur fossils in Europe. Truly a great experience!

Meet the experts

In this newsletter we present a short introduction on Curtin University's representative Sam Xie and on Orion Geomechanics' representative Richard Schultz and which are both active in the leadership of a subtask for TCP-Task42. We took the opportunity to exchange with both of them via three questions to understand better on their involvement in Underground Hydrogen Storage (UHS), why they have become active in TCP-Task42 with their organizations and what they are specifically looking out for.

Can you tell us more about your background, and your role and expertise on the topic of Underground Hydrogen Storage?

Richard: My background as principal of Orion Geomechanics LLC in Houston, Texas, USA includes academic, corporate, and consulting experience in the US and internationally. My approach applies geologic fracture mechanics and industry tools to address pressing issues in rock deformation, caprock integrity, and fault sealing related to underground gas storage and sequestration. UHS will be critical to the resilience of energy systems as renewables and hydrogen become a larger fraction of regional and global energy supplies. My goal is to advance energy security and sustainability, with UHS being a key part of that.

Sam: I am a Lecturer and interdisciplinary researcher at Western Australian School of Mines: Minerals, Energy and Chemical Engineering, Curtin University. I specialize in fluid-rock interactions, reactive transport, and rock flow dynamics for applications in grain-scale fracture mechanics, Underground Hydrogen Storage and CO_2 Geological Storage. My goals of my research are to: 1) enable large-scale underground hydrogen storage to be viable, accessible, and affordable in Australia and worldwide, 2) capture and sequestrate CO_2 at subsurface to reduce carbon footprint, through engagement and collaborations with industry stakeholders, academics, and policy makers.

Why do you consider it to be of importance that you and your organization are participating in this TCP-Task42 on UHS?

Richard: Various regions of the world are shifting to an increased use of renewables that will also involve UHS; these regions are moving at different rates and are motivated by different drivers, such as market forces, national energy security, and governmental priorities. As a result, knowledge sharing of research and engineering advances among research groups, and in-ground operating experience, often remains scattered and siloed. In addition to technical consulting, Orion Geomechanics LLC and I work to bridge these siloes by facilitating interaction between broad sets of stakeholders including companies, academia, non-profits, and government.

Sam: Energy storage is a must to balance the clean energy supply and demand for the world to transition away from fossil fuel. Underground Hydrogen Storage appears to a promising means, providing scalable and large-scale energy storage capacity. TCP-Task42 has been building up an international collaboration platform on UHS across industry stakeholders, academics, and policy makers worldwide. Participating in this TCP-Task42 on UHS is a great opportunity to learn and contribute to international community and thus enable underground hydrogen storage to be technically and economically viable at industrial scale.

What would be the main achievement for TCP-Task42 to your opinion?

Richard: Perhaps the most important product would be the creation and dissemination of a simple, non-technical set of guidelines, screening criteria, workflows, and expectations that could be applied worldwide, as a context for stakeholders such as companies, regulators, and the public to understand the benefits and risks of UHS in their respective regions. Accompanying this would be more detailed, technical workflows that could be used once an initial "go/no-go" decision is made and resources committed to the technical evaluation and development of promising UHS projects.

Sam: I have pretty much the same opinion as Richard. To me the main achievement would be enabling and accelerating underground hydrogen storage at industrial scale through development of roadmaps, technical screening tools, techno-economic analysis reports. Meanwhile, it is also important to identify areas which require further academic research to de-risk the application of UHS. Moreover, our task would also provide pathways at international level to outreach for educational purpose.

Outlook for 2023

With our roadmap for 2023 and 2024 we will continue our activities and contribute to the validation and demonstration of underground hydrogen storage. In 2022 we have emphasized the state-of-art and key challenges for UHS development by bringing together experts from academic, industrial, governmental and technical research organizations across the globe. Now we will further shift towards the practical requirements for actual demonstration and development.

First of all, we will initiate our second main Task Report which follows up on the findings and recommendations of the first report (in prep.). In this second report we expect to provide practical building blocks and guidelines in the form of exemplary development schemes for different geological and operational settings. These insights will among others be established by science-to-industry workshops focusing on e.g., well designs for UHS, gas treatment, risk identification & management and more. We will further progress with our activities on the societal embeddedness of UHS by testing our insights with real pilot and demonstration cases and analogues in e.g., natural gas storage. Our experts aim to define standards for geochemical and microbial sampling and laboratory analysis in order to improve the comparison and application of results from experimental studies and to establish tools evaluating reservoir impacts. There is a strong incentive to investigate approaches for subsurface monitoring of hydrogen and to advance and validate numerical models.

Besides the already planned 2nd International Summer School organized by Delft University of Technology, we have several other online and live events in view in which we will present our proceedings and where we will engage with the UHS community. These events will be announced via our communication channels, and we are looking forward to meeting you in such events and exchange experiences and latest insights.