Services along the hydrogen value chain

Storage:

Cavern storage (H_2 and CO_2)

HydroHub

H_2 competence @ HydroHub

Our services run along the entire value chain in the hydrogen industry – from generation through transport and storage to use in various fields of application.

Energy generation

Renewables (e.g. wind, solar)

Conventional power plants

Geothermal

H_2 generation

Electrolysis

Seawater desalination plants

Reforming processes

Methane pyrolysis

Distribution/transport

Electrical grid

Pipelines

District heating

Intelligent networks

Refuelling stations/ filling systems

Tankers (lorry, train, ship)

Storage

Battery storage

Gas tanks

Cavern storage (H_2 and CO_2)

Pressure vessels

H_2 hydride storage

Consumption/use

Fuel cell system

Methanol synthesis unit

Carbon capture and utilisation

Mobility (e.g. e-fuels)

Reconversion to electricity

Power to gas (gas, heat, liquid)

Industrial applications (e.g. refinery)

H_2 competence @ HydroHub

We give comprehensive support to hydrogen projects and offer a broad spectrum of services in the concept/planning, production, operation and decommissioning/disposal phases.

Concept/planning

We support you from the start with research and project planning measures and specific tasks. Already at the conception phase, we are there at your side with feasibility studies, strategic and financial consultation and a broad range of organisational and technical services. Alongside concept creation with consideration for legal, technical and economic conditions, we take on the task of analysing the requirements and support you in the process of determining feasibility through basic and design planning all the way to the approval process.

Production

For over 150 years, it has been one of our tasks to analyse and manage technical sources of risk. With our wide range of specific services, we are thus able to offer you competent help in the integration of hydrogen technologies into the industrial value chain. Our range of services runs from fact-finding and construction through project management, administering documentation and operator's obligations, basic and detailed process engineering all the way to project support through geological, environmental and engineering services during the production process.

Operation

We support frictionless operation with our extensive range of services and our primary goal of optimising operational reliability and preventing damage. Our services support you in the implementation of your operating strategies and in the accompanying optimisation, maintenance and upkeep concepts. Our safety-oriented process with operational monitoring and the creation of damage-limitation concepts contributes, in the final account, to establishing hydrogen in the popular conception as a safe and controllable technology.

Decommissioning/disposal

Just as we are there for you in the first concept phase, we are also at your side at the decommissioning phase, providing all the required services for dismantling and disposal – including project management and comprehensive services to handle your operational obligations. We create concepts to the current legal requirements, standards and regulations and support you in identifying, analysing and avoiding the potential risks of your intervention.

Cavern storage and its potential for the hydrogen economy

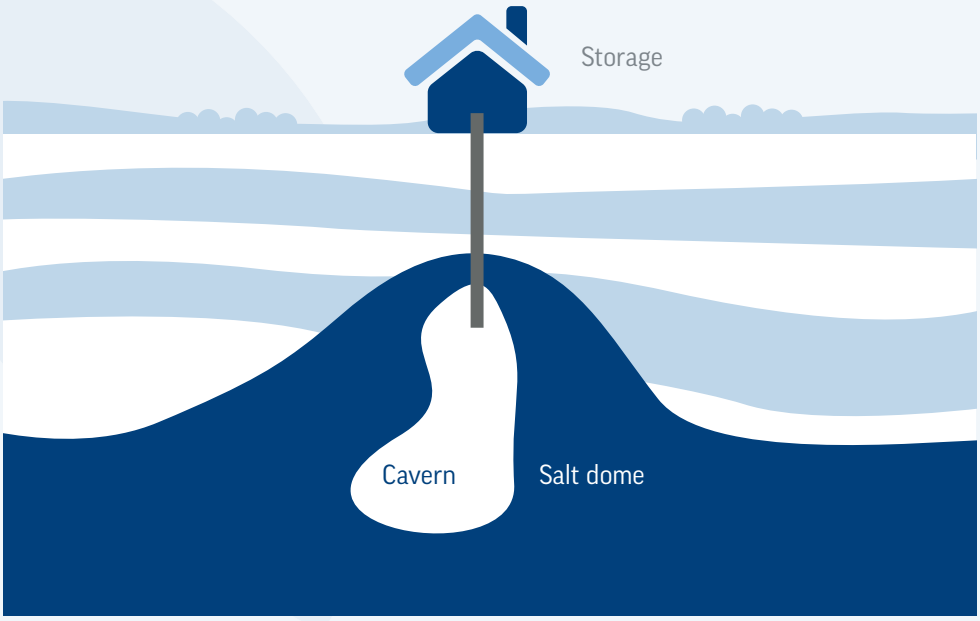
With the setup and development of the hydrogen economy, underground storage can make an important contribution to ensuring stable supplies of renewable energy. Cavern storage in the empty spaces of salt domes has long been a reliable form of storage e.g. for natural gas, and part of an infrastructure that clearly needs to grow so that hydrogen can be stored at relevant orders of magnitude and made usable as needed. The first H_2 research caverns are currently serving to help set up model regions in which green hydrogen is gained by means of power-to-gas, stored and distributed.

We are your partner for your journey from using fossil gases towards an economy relying on renewable energy and thus, to a great extent, on hydrogen. Our specific experience in the field of the subterranean storage of gases helps municipal and industrial actors to fulfil their security of supply obligations. With the most modern analytical methods and competent specialists, we are at your side to carry out your project safely and successfully, and to help you benefit from subsidies as available. Do get in touch.

Cavern storage in Germany

Millions of years ago, the drying up of former seas and deformation of the earth's crust led to the formation of massive underground salt formations in some regions of Germany, particularly the north, each up to several thousand metres in extent. As one of the world's largest producers of rock salt and potassium salts, Germany thus has access to extensive, artificial caverns created during salt extraction.

Because of their petrophysical properties, rock salt caverns are naturally sealed, meaning that they have been used for decades as high-capacity, cheap storage for natural gas, crude oil and its derivatives, pressurised air and other gases. The transition from fossil energy media to renewables makes the conversion of existing caverns and the addition of new ones necessary.



Use as H_2 stores

Caverns allow rapid access to the stored material, with an average cavern of 60 m diameter and 300 m height achieving a working gas volume of 100 million standard cubic metres (in the case of hydrogen, at a filled pressure of 175 bar, that would provide stored energy of 300 GWh). With these numbers in mind, the conversion of existing caverns and creation of new ones could massively promote the use of hydrogen. To this end, the caverns must fulfil the same requirements made of natural gas caverns:

- sufficient capacity to balance out seasonal and time-related consumption fluctuations
- ability to cover load peaks (peak shaving)
- ability to cover short-term supply bottlenecks
- economic efficiency of operation

In Great Britain and the USA, salt caverns have been used for a long time to store hydrogen. In Germany at present, the first H_2-research caverns are being put in place as promising real-life laboratories of a sector-coupled energy infrastructure.

CO_2 as cushion gas

In cavern storage, a so-called “cushion gas” is needed to maintain geomechanical stability. It is also used to generate the minimum required storage pressure to ensure optimal extraction and deposition of the working gas. Depending on the depth and geological composition, this is between 150 and 200 bar. In hydrogen storage, CO_2 takes on this function as a markedly heavier gas. It makes up around a third of the entire volume, meaning the working gas can thus take up two thirds of the maximum storage volume.

Our services

We support you from the very start in considering legal and technical conditions and are there for you to create risk analyses and exploration concepts and even manage the entire project. To this end, we offer you comprehensive services in the fields of consulting, engineering and training – in all phases of the project at hand:

	Concept/ Planning	Production	Operation	Decommissioning/ Disposal
Creation of concepts to current legal requirements, standards and regulations	●			●
Creation of failure concepts (fire, explosion protection, consideration of the consequences)	●			
SIL studies to determine the reliability requirements of the safety control technology	●			
Consultation on and drawing up of measures for internal emergency protection	●			
Consultation on ageing management	●			
Creating requirements specifications	●			●
Creating technical specifications	●			●
Creating commissioning and periodic inspection concepts	●			
Technical due diligence	●			
Technical, financial and legal due diligence (with external partners)	●			
Weak-point analysis, identification and analysis of potential risks	●			●
Creation, consultation on staggered power system protection plans, protection tests	●			●
Conception and consultation (commissioning, periodic inspection) of isolated networks including the incorporation of e.g. decentralised generator units, electrolysers and any necessary storage facilities (on and offshore)	●			

	Concept/ Planning	Production	Operation	Decommission-ing/ Disposal
Creation of risk analyses to determine the potential risk of intervention	●			●
Creation of risk analysis and hazard assessments	●			●
Creation of safeguarding concepts	●			●
Consultation, evaluation of electrical and mechanical safeguarding systems	●			●
Consultation, evaluation on installation and operation of alarm receiving stations	●			●
Consultation, evaluation on determination of intervention measures by guarding/security company or police	●			●
Consultation, evaluation on determination of administrative security measures	●			●
Technical advisory services	●			
Project management and document administration	●	●	●	●
Creation of exploratory concepts:	●			
○ collation of *a priori* information: geological maps, existing measurement data etc.	●			
○ If purposeful: re-analysis of geophysical measurements with subsequent reinterpretation for a geological model	●			
○ Creation of an earth-science-based exploratory concept: geophysics, particularly with seismography and borehole geophysics, determining measurement geometry, simulation/assessment of the measurement results based on the proposed geological model of the bedrock through coverage schemes, seismic wave coverage and synthetic seismograms	●			
Execution of works in the field of exploration:	●			
○ Approval processes: support and consultation on official processes to execute exploration measures	●			
○ Execution of the geophysical exploration of the surface of the earth: aerogeophysics, gravimetry, 2D/3D/4D seismography, seismic refraction, accompanying vibration measurements to DIN 4150, quality control, field processing and data analysis	●			
○ from boreholes: seismic tomography, VSP (vertical seismic profiling), 3D borehole radar, standard borehole geophysics	●			

	Concept/ Planning	Production	Operation	Decommissioning/ Disposal
Evaluation and collation of all data available:	●			
○ evaluation of geological, geophysical and hydrogeological information	●			
○ Evaluation of the geophysical measurement data	●			
○ Interpretation with the involvement of all data	●			
○ Seismic attribute analysis	●			
○ Hydrogeological modelling, including thermal conductivity, rock pressure etc.	●			
Flow simulations, calculation of simulation models for material transport	●			
○ Creation of a 3D underground model: e.g. stratigraphy, fault zones, overlying rock, salt cap, dome incl. sides, structures within the salt dome	●			
○ Determination of geological suitability for cavern storage, assessment of the location	●			
○ Bore path planning	●			
Geomechanical modelling:	●			
○ Acquisition of rights, planning/route engineering for the supply lines	●			
○ Fissure/subsidence calculation	●			
○ Cavern design	●			
○ Influencing the integrity through mechanical aspects and infiltration	●			
○ 3D heat flow simulations (H_2 must be cooled) HEATFLOW	●			
○ 3D geochemical simulation (reaction of H_2 with rock)	●			
○ Geological/geotechnical assessment of sites and existing subterranean storage	●			
○ Environmental assessment of sites	●			
○ Development of monitoring and safeguarding concepts	●			
○ Fracturing behaviour of the rock salt when pressurised by hydrogen, natural gas, oil etc.	●			

	Concept/ Planning	Production	Operation	Decommissioning/ Disposal
Computer verification/structural mechanical simulations in plant construction: static and dynamic verifications to national and international regulations, analytical calculations and finite-element simulations (FEM), static/ dynamic load models, mechanical models, calculation of loads (stresses), comparison with material properties for load capacity of the component, evaluation and documentation of the results as a report, damage assessment and analysis	●	●	●	●
operator obligation management: conception of operator obligation management system, development of plant registers in the field of pressure vessels incl. determining test deadlines (hazardous materials), energy audits to EDL-G, introduction of energy management systems (EnMS), compliance-analyses	●	●	●	●
Fire protection: Creation of fire safety concepts and assessments, specialist construction management for fire protection, fire risk assessments, fire and explosion cause determinations, risk avoidance plans	●	●	●	●
Explosion protection: determining the safety parameters, explosion and fire protection assessment, explosion and fire protection for machines, for operators, tests on plants requiring monitoring	●	●	●	●
Construction of energy storage: pre-planning, acquiring rights, connecting pipelines to the energy store		●		
Construction supervision: quality assurance, deadline compliance, cost control, comparison with the actual geology encountered etc.		●		
Exploration (borehole geophysics, especially 3D borehole radar) and mapping of the cavern geometry with sub-contractors		●		
Geotechnical GeoMonitoring, geomeasurement systems: Soil movement, vibration etc., satellite-supported radar interferometry		●		

	Concept/ Planning	Production	Operation	Decommission-ing/ Disposal
Damage assessments and analyses of the causes of damage, creation of avoidance concepts			●	
Analysis and evaluation of damages and measures to prevent comparable faults			●	
Maintenance of breakdown statistics to assess operational reliability in comparable plants/components			●	
Analysis of electrical grids: e.g. short circuit, load flow calculations, efficiency and optimisation assessments			●	
Geomonitoring: satellite-supported monitoring of soil movement, radar interferometry, vibration, groundwater, rock pressure, rock mechanics, temperature, permeability (gas, water), gas monitoring			●	
Borehole cavern integrity: borehole geophysics (standard logging), 3D borehole radar, vertical seismic profiling			●	
Modelling and effects: analysing the consequences of ground motion with a regard to surface water bodies, ecology and settlement etc.			●	
Flow measurement: flow technology, flow speed			●	
Geomonitoring (seismic vibration, hydrogeological recording) during the production phase with safeguard			●	
Creation of risk analyses, safety concepts for operation: fire safety concepts, provision of a “SiGeKo” (health and safety coordinator) etc.			●	
Monitoring of technical parameters, wear parts etc. with the web-based safeguard system with the option of an alarm function			●	

HydroHub

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