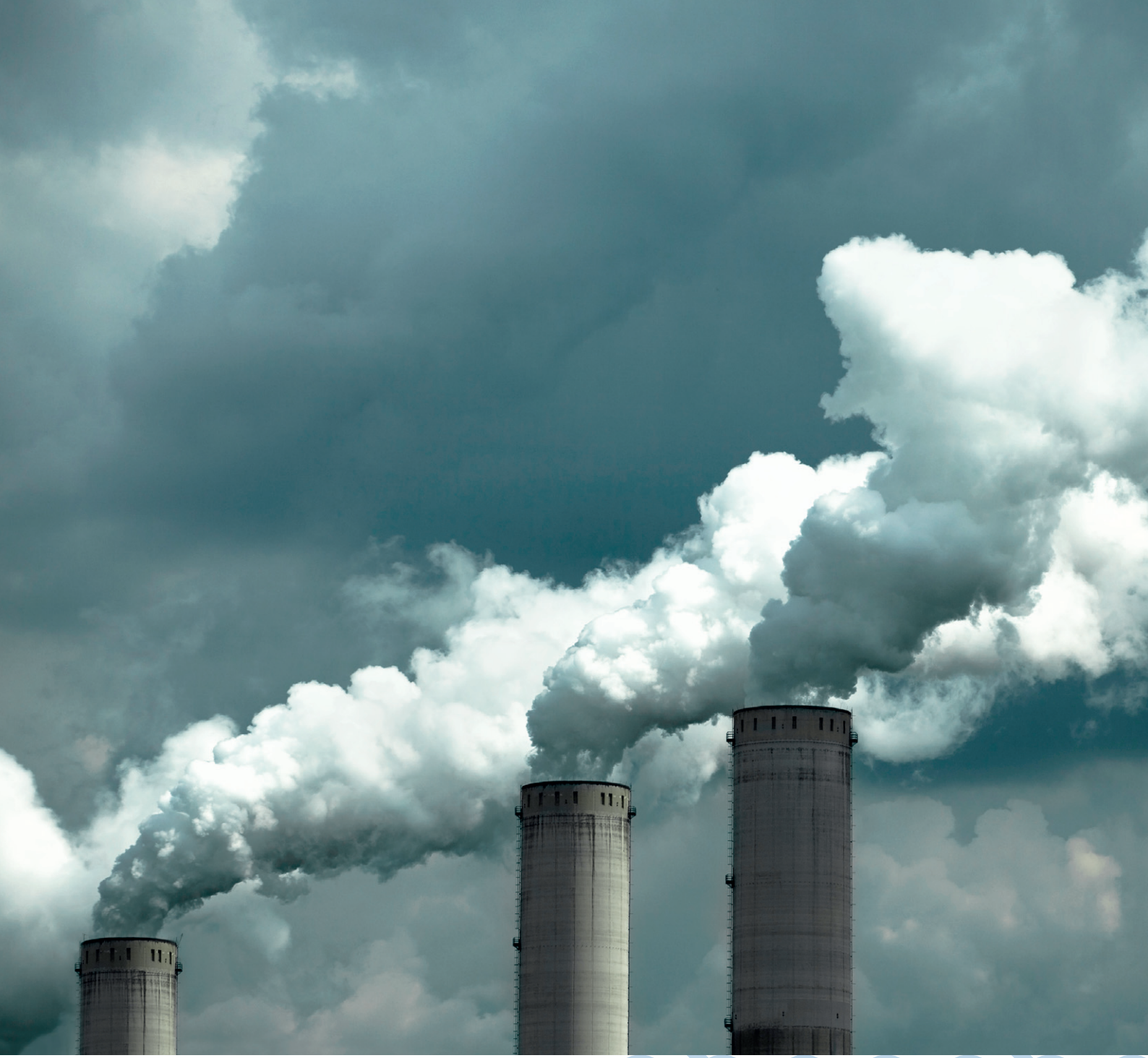

Services along the hydrogen value chain

Usage/application:

Carbon capture and utilisation (CCU)

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.

Carbon Capture and Utilization (CCU): Using CO_2 as a raw material

During the transition to a low-carbon economy, CCU offers the opportunity to reduce the CO_2 emissions of energy-intensive industries both actively and productively. Its goal is the use of CO_2 as a raw material. By separating out CO_2 from exhaust and using it in hydrogen-based manufacturing processes, new value chains can be created in which high-quality products such as green methanol, ammonia or other high-value chemicals are produced.

The beneficiaries of CCU would above all be large CO_2 emitters in the iron, steel and chemicals industry that are strongly dependent on fossil energy sources, but also carbon, wood and biomass power plants and waste incineration facilities.

The technologies to implement the carbon capture process are, however, cost and energy-intensive, and are largely in the incipient stages of development. It must be added that chemical processes require the availability of green hydrogen and that biological processes are often limited with regard to location and exploitation. Considering the efficiency of CO_2 utilisation pathways must thus be carried out holistically within the framework of lifecycle assessments with a view to investment costs, overall CO_2 carbon balances, CO_2 binding duration and the quantity and value-creation potential.

We are your partner in the development of CCU projects which, with the goal of setting up an innovative CO_2 circular economy, can also benefit from subsidies. With the most modern analysis methods and competent experts, we are at your side to carry out feasibility studies, support the process technology and help you from the point of plant construction to operational optimisation. Do get in touch.

Carbon capture: the process to separate out CO_2

Technologies to separate out CO_2 are above all developed for the energy sector, chemicals and metals industries. These largely use fossil fuels such as coal and natural gas and emit exhaust containing a large proportion of CO_2. The following processes are used in pilot plants:

- CO_2 scrubbing (post-combustion capture)
- Coal gasification (pre-combustion capture)
- Combustion in an oxygen atmosphere (oxyfuel)

Alongside the basically positive outcome of CO_2 separation, all processes also have negative effects. These are largely made up, alongside the costs, of a loss of efficiency in power plants. Our experts will consider these aspects in their feasibility studies and elsewhere, helping you in this way to make the right decisions. The other efficiency criteria include the CO_2 separation rate, the purity of the CO_2 extracted and other effects on the environment and the process path.

To supplement the named processes, the possibility is also being researched of having CO_2 filtered directly from the ambient air using chemical absorbers (DAC – direct air capture). This is currently only at a prototype stage, with high technical expenditure and equally high costs.

The projects that want to test CCU at scale include the North-CCU Hub in the Dutch/Belgian North Sea Port. A consortium of actors from industry and research is to show, with the aid of European subsidies, what potential CCU has for the decarbonisation of energy-intensive industries and the development of a circular CO_2 economy.

Utilisation: use of CO_2 as a raw material

The manufacture of urea from CO_2 and ammonia and its use in fertilisers and fodder or in the chemicals and pharmaceuticals industry is a classic example of the successful use of CO_2 as a raw material, also because through this process CO_2 is bound chemically in such a way that it is no longer released into the atmosphere during the life-cycle of the material.

Within CCU, a series of reuses for CO_2 is being investigated. Promising possibilities, say, for the manufacture of base materials for the chemicals industry or to gain methane, methanol and synthetic gas, are offered by CO_2 electrolysis with green hydrogen in electrochemical membrane reactors. Also under investigation is the use of CO_2 and green hydrogen to produce dimethylether (DME), an eco-fuel for self-igniting motors. Likewise, desulphurised, pure CO_2 can be used as a source of food for microorganisms by the aid of which biofuels, base chemicals such as formic acid and biodegradable plastics such as polyhydroxyalkanoate can be manufactured.

Our services

Whether it's the planning and implementation of a CCU value chain for an individual company or cross-sectoral consortium, with comprehensive services in the fields of consulting, engineering and training, we support industrial and academic actors in the following phases of the project in question:

	Concept/ Planning	Production	Operation	Decommissioning/ Disposal
Feasibility studies: conception and arrangement of the design parameters for the technical process, evaluation of the technical process, simulation of the technical process; determination of capital expenditure (CAPEX), operating expenditure (OPEX), emissions	●		●	
Civil engineering	●			
Investigation of the plant and process safety: executing HAZOP process analyses, risk assessments (work area/process-related), TRBS inspections by authorised personnel (vapour and pressure), safeguarding reporting, functional safety, SIL (safety integrity level) calculations, fire and explosion protection, safety and failure concepts, smart inspection and monitoring, revision cycle extension, legally compliant documentation	●		●	
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	●			

	Concept/ Planning	Production	Operation	Decommissioning/ Disposal
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	●			
Basic engineering for the technical process: planning process technology, i.e. creating mass flow diagrams, piping and instrumentation diagrams (P&IDs), mechanical drawings of tanks, columns etc., EI&C technology, concrete construction, 3D steel and piping design, HAZOP, fire and explosion protection etc.		●		
Detailed engineering for the technical process: Detailing of the basic engineering		●		
Plant construction: acquiring equipment and subcontractors, monitoring production and delivery, monitoring assembly (concrete construction, steelwork and piping, containers, EI&C etc.), construction supervision, commissioning, training the operating personnel, performance tests, documentation		●		
Operational optimisation of a process plan: modelling relevant chemical and physical processes for the design of reactor concepts (kinetics, heat transfer, hydrodynamic system behaviour, dispersion effects). targeted process simulation for an energy-optimised mode of operation (Linnhoff/pinch analysis), design and application of thermal and mechanical separation procedures in the distillation/rectification sectors, gas scrubbing/absorption, stripping/desorption, vacuum drying, separation, classification and sorting processes, consultation, troubleshooting, energy efficiency and optimisation			●	

HydroHub

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