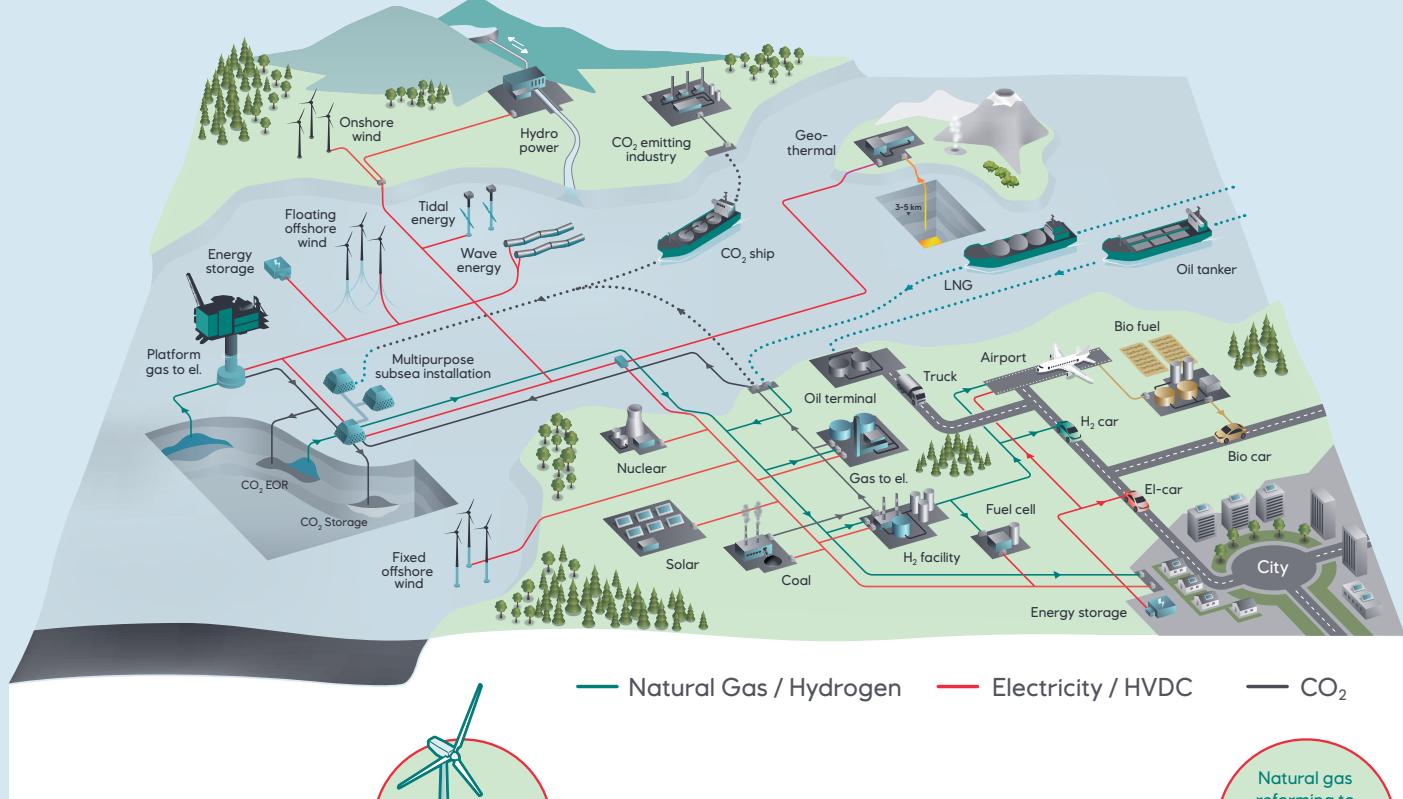
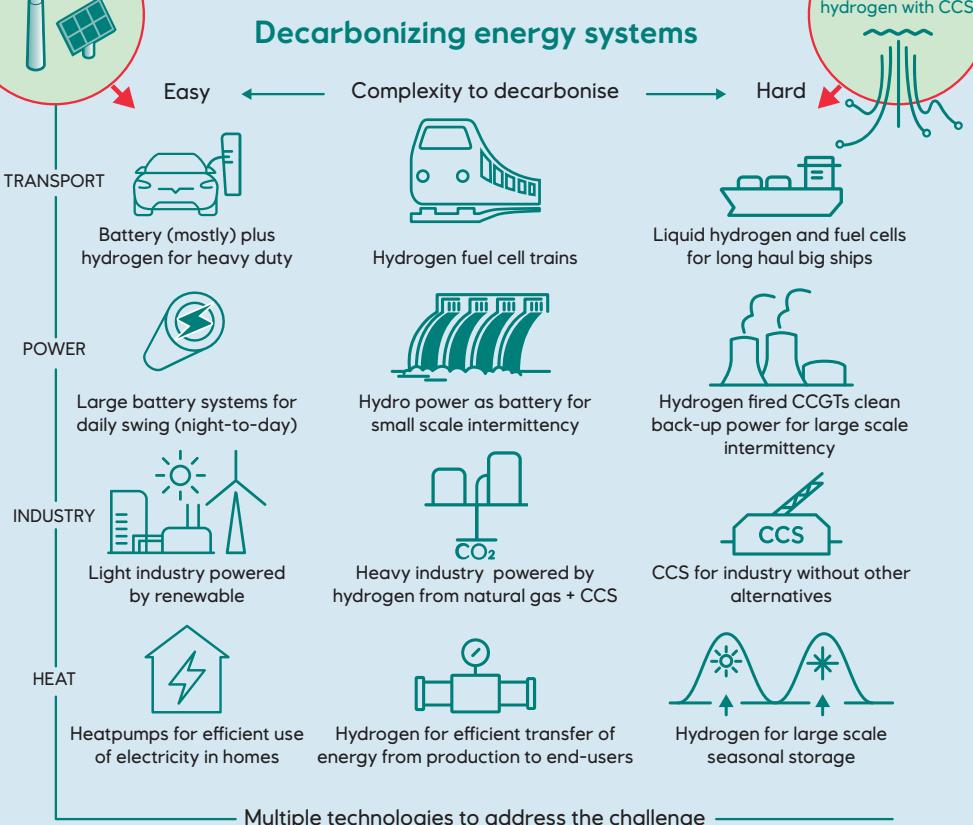


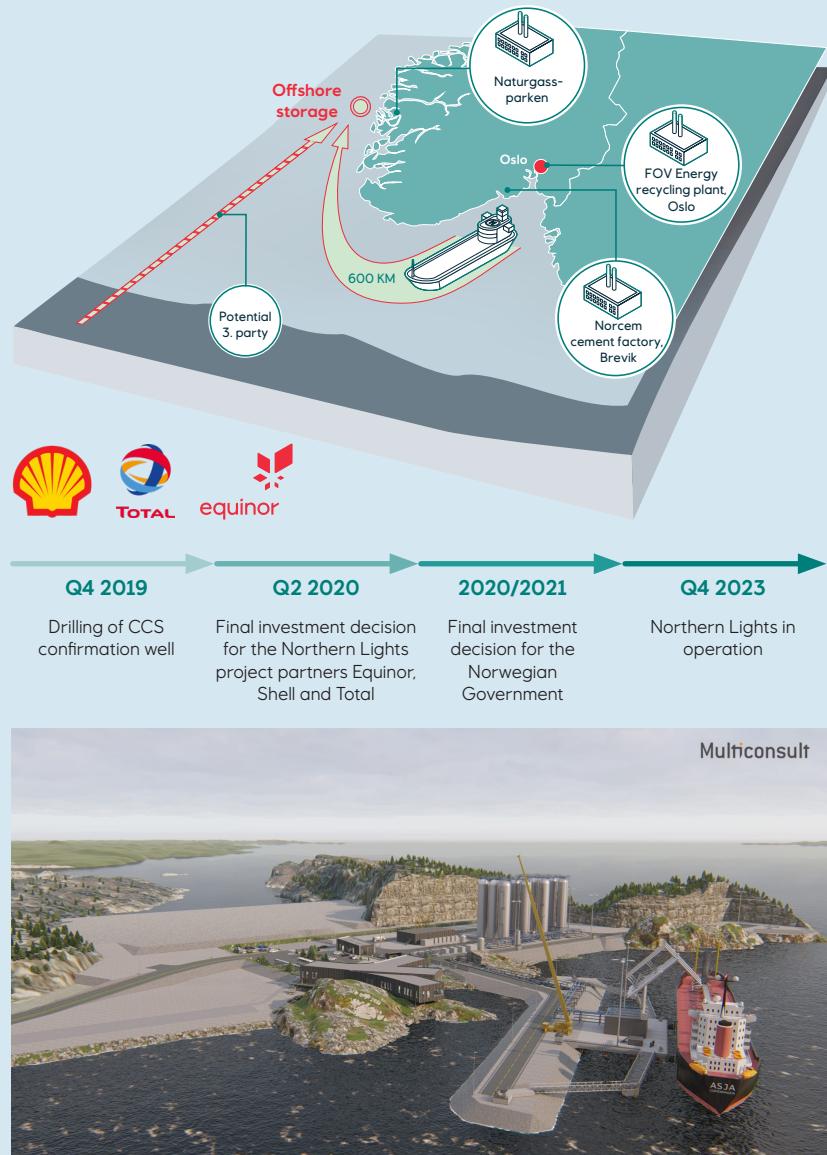
# Low carbon solutions



The climate challenge needs to be solved and all sectors within the energy economy need to be decarbonized rapidly and cost effectively. Repurposing existing infrastructure to carry low carbon energy makes sense. CCS and large scale hydrogen solutions enable us to decarbonize the energy system from the difficult end already now rather than waiting for renewable technologies to develop significantly.

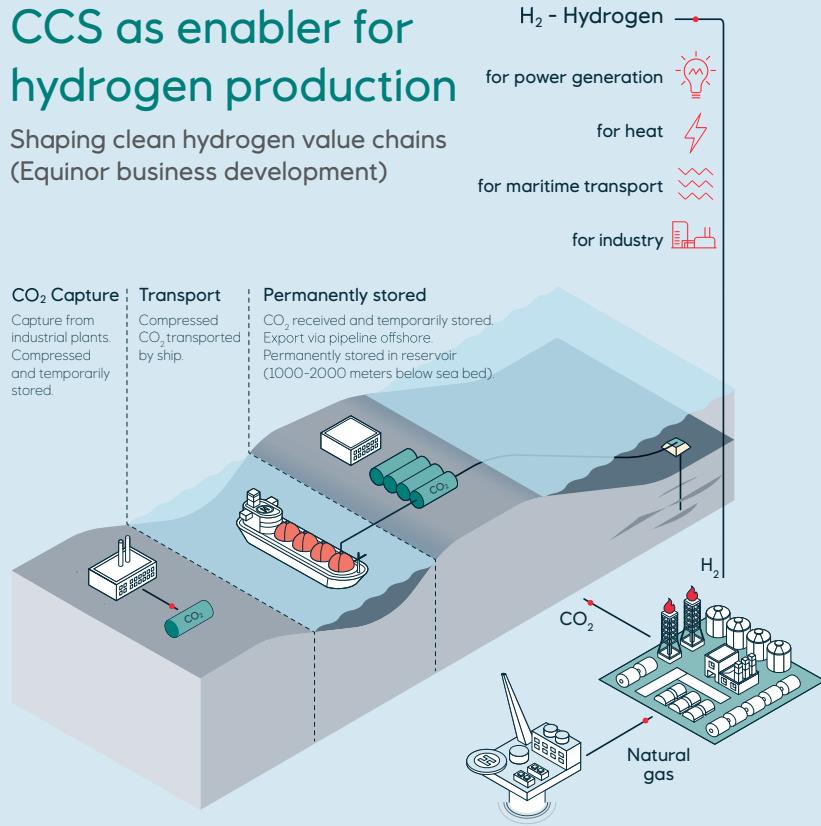


## Northern Lights



## CCS as enabler for hydrogen production

Shaping clean hydrogen value chains  
(Equinor business development)



## A European CO<sub>2</sub> transport and storage network

The Northern Lights project is part of the Norwegian full-scale CCS project. The full-scale project includes capture of CO<sub>2</sub> from industrial capture sources in the Oslofjord region and shipping of liquid CO<sub>2</sub> from these industrial capture sites to an onshore terminal on the Norwegian west coast. From there, the liquified CO<sub>2</sub> will be sent by pipeline for permanent storage 3000 meters below the seabed of the North Sea.

Given a positive final investment decision by the Norwegian Government and project partners in 2020, the Northern Lights Project is scheduled to be operational in Q4 2023.

The Northern Lights project will be first of a kind globally where CO<sub>2</sub> is captured in one location and stored permanently in another. The flexibility of transporting CO<sub>2</sub> by ship opens the option of collecting CO<sub>2</sub> at any harbor in Europe. In other words, any industrial site which up until now had a goal of managing their CO<sub>2</sub> emission but did not have a credible solution can now focus on capturing the CO<sub>2</sub> and the Northern Lights partnership will be available to collect the CO<sub>2</sub> at the port, transport it and store it permanently.

Building on more than 23 years of operations with safe CO<sub>2</sub> storage on the Norwegian Continental Shelf, the Northern Lights Project will be a major contribution to realize a European network for CO<sub>2</sub> transport and storage.

## CCS is a key element in the transition to a low-carbon society

As a global leader in CCS and a major gas supplier to North-Western Europe for many decades, Equinor is committed to lead in shaping sustainable solutions for a low carbon future.

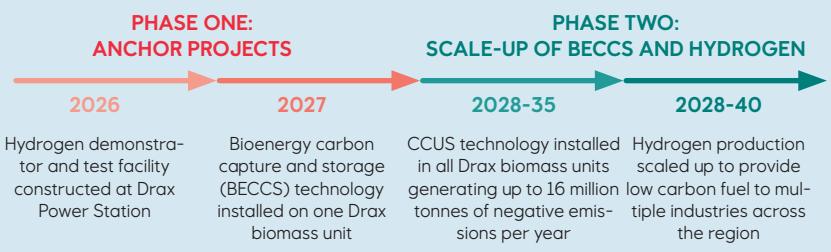
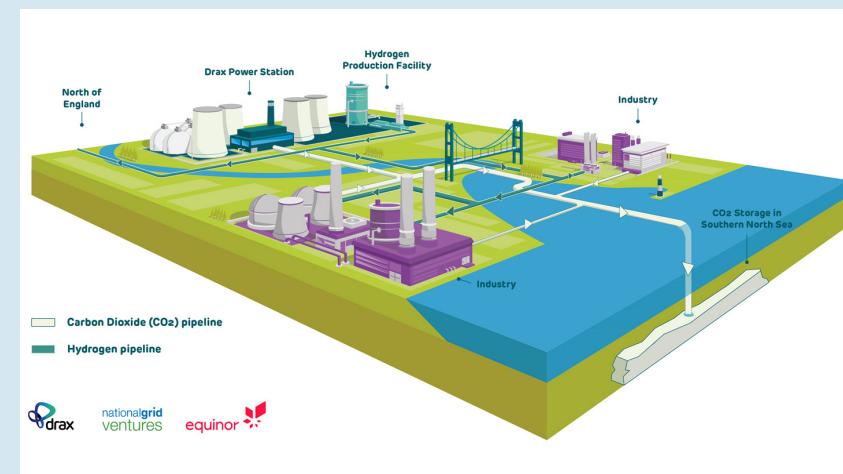
Equinor is currently exploring new energy concepts by reforming natural gas to clean hydrogen or ammonia, while capturing and storing the CO<sub>2</sub>. This is done in partnerships with companies within the value chain who share a similar desire to take a leading role in the energy transition to meet future climate targets. We are designing several demonstrator projects within the power, industry, transportation and heat sectors, creating confidence in the technology and documenting the cost picture, hence creating political drive to come up with the policies that will enable us to scale-up for full implementation.

## Zero Carbon Humber, UK

The Zero Carbon Humber campaign was launched with the aim to build the world's first zero carbon industrial cluster and decarbonize the North of England, in partnership with Drax Group, Equinor and National Grid Ventures, CATCH and The Humber Local Enterprise Partnership.

The companies will work together to:

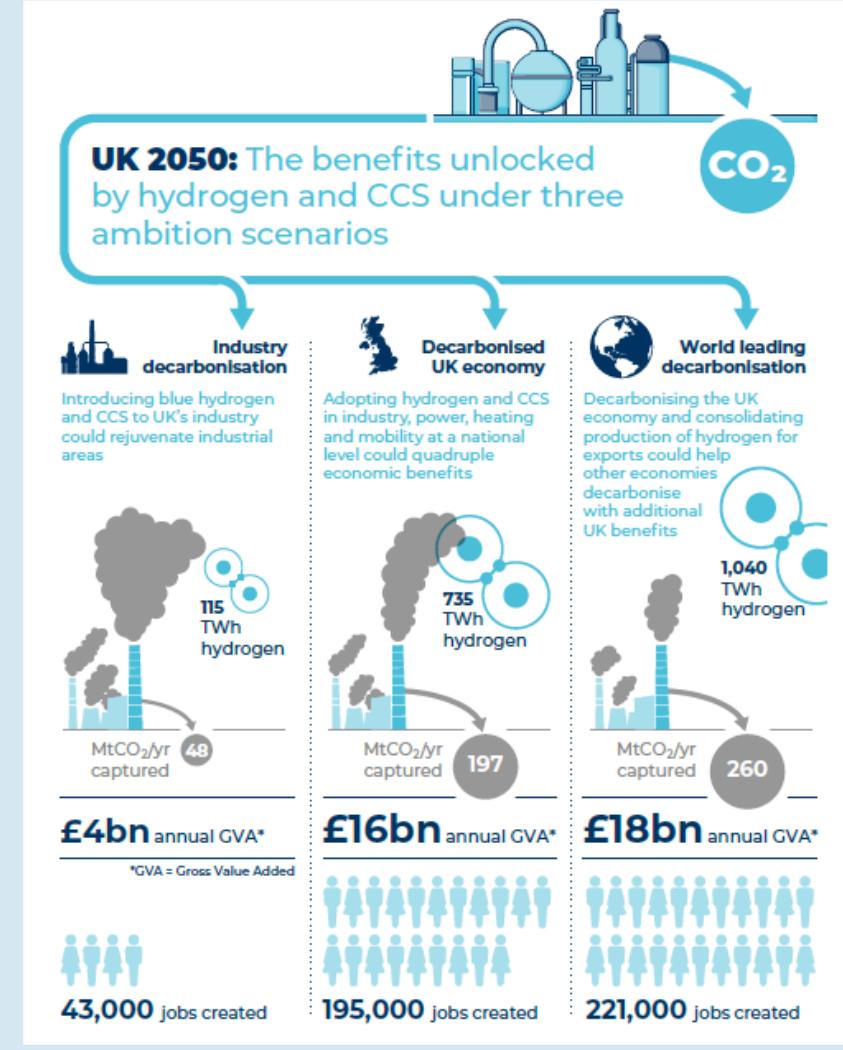
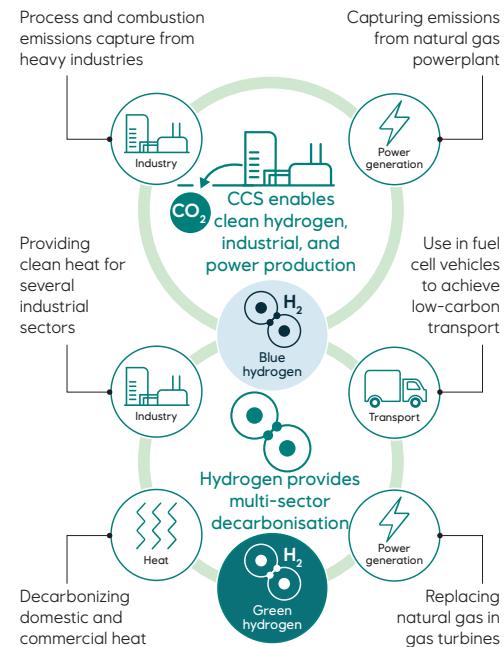
- Explore the opportunity to scale-up the innovative bioenergy carbon capture and storage (BECCS) pilot project at the Drax Power Station in order to create the world's first carbon negative power station in the 2020s.
- Explore the potential development of a large-scale hydrogen demonstrator within the Drax site by as early as the mid-2020s - in line with the CCC's recommendation that hydrogen should be produced at scale in at least one industrial cluster by 2030.
- Explore the strategic opportunities in developing a cutting-edge hydrogen economy in the region.



## Creating a hydrogen market

The right technology at the right scale, at the right time!

Blue hydrogen technology is available at GW scale today, while green hydrogen is only at MW scale. Blue hydrogen could create the infrastructure backbone linking proven technology to end users, working as the anchor for green hydrogen, which in turn would have a direct route to market created through blue hydrogen infrastructure backbone.





## H21 North of England, UK

### Decarbonization of heat

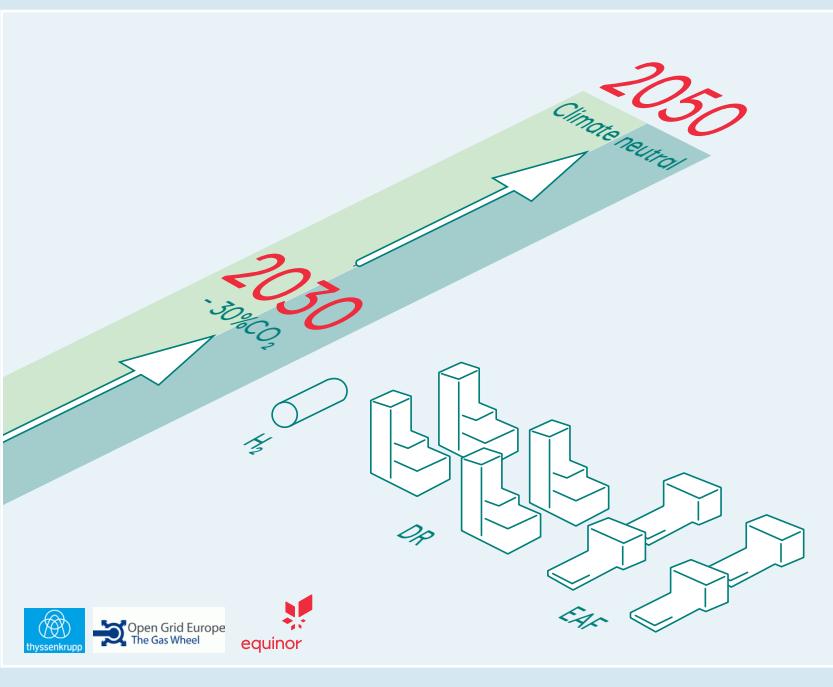
H21 is a concept to repurpose the gas network used for heating in the UK from natural gas to 100% hydrogen. The feasibility study was done by partners Equinor, Northern Gas Networks and Cadent. The project includes 85 TWh hydrogen production facility along with 8 TWh of interseasonal storage in salt caverns. The captured CO<sub>2</sub> will be transported offshore for permanent storage in deep reservoirs at a rate of up to 20 Million tons per year. The hydrogen will enter a specially designed transmission pipeline which will link to the existing natural gas distribution system, which will be repurposed to hydrogen. The project provides economic benefits of scale and is big enough to make a tangible impact on climate change obligations within a short period of time at lower cost than electrifying the sector.



## Magnum, Netherlands

### Decarbonization of power

Equinor, Vattenfall and Gasunie are evaluating conversion of a natural gas-based power plant into a hydrogen-powered plant. The Magnum gas power plant has currently three combined cycle gas turbines (CCGT) with a capacity of 440 MW each. One CCGT emits approximately 1.3 MTPA of CO<sub>2</sub>. In the first phase the project plans to convert one CCGT to hydrogen, to build a hydrogen plant and use the infrastructure for CO<sub>2</sub> transport and storage that Northern Lights will establish. This would allow to provide a clean flexible electricity as a back-up for solar and wind and help launch a large-scale hydrogen economy.



## Thyssenkrupp, Germany

### Decarbonization of industry

MoU with thyssenkrupp Steel Europe (tkSE), OGE and Equinor. Major decarbonization potential if we succeed in replacing coal with hydrogen as the reduction agent. The role of Equinor is to review different locations for hydrogen production and CO<sub>2</sub> management, OGE will consider alternative hydrogen transportation routes and tkSE focus on the conversion from coal to hydrogen at the plant. The technology is partly proven, but needs some further de-risking. The potential world-wide of applying this technology within steel-making would replace coal and open a natural gas market (as feedstock for hydrogen) of 400 BCM annually (almost equivalent to the European gas market) and reduce CO<sub>2</sub> emissions with 2.500 million tons annually (500x Northern Lights).