STORAG ETZEL
Energy Storage Solutions

ENERGY.
SUPPLY.
SECURITY.

STORAG ETZEL

OVER 50 YEARS OF SUPPLY SECURITY THROUGH OIL AND GAS STORAGE IN ETZEL

The operating plants are concentrated in the south field of the Etzel cavern storage facility

The cavern site is ready to tackle the challenges of the future. In addition to storing fossil fuels, the leading – and only independent – cavern operator in north-west Europe is preparing to store hydrogen underground.

WHO WE ARE – A SUMMARY

At the Etzel site in East Frisia/Lower Saxony, **STORAG ETZEL** builds, maintains and leases large-volume underground storage capacities for natural gas and crude oil. The Etzel cavern storage facility is located in the middle of the northern German energy hub approximately 20 kilometres south-west of Wilhelmshaven and connected to the only German deep-water port.

In 1971, the enterprise received the contract to construct the caverns for storing crude oil in the Etzel salt dome and to operate the above-ground facilities on behalf of the Federal Republic of Germany. In 1993, the cavern operating company was privatised; in 2005 it took over ownership of the cavern storage facility and expanded it to its current level of significance.

Since 2007, the site has been developed to become one of the largest oil and gas storage sites in Europe.

In addition to the 75 caverns currently in existence, a further 24 storage caverns can be created in the Etzel salt dome.

Lessees of the caverns are well-known energy trading companies for gas and oil as well as oil stockpiling organisations from various European countries. In Germany, as in Europe, there are hardly any comparably favourable conditions to construct caverns for the safe storage of energy resources.

The Etzel site is ready for the future:
In addition to storing fossil fuels such as crude oil and natural gas, renewable sources of energy can also be kept in caverns, e.g. by converting surplus electricity into hydrogen (H_2) or synthetic natural gas (SNG, i.e. methane). The operator **STORAG ETZEL** has already successfully converted oil caverns to gas storage in the course of its operating history.

In view of the ongoing energy transition and in the interest of decarbonisation, the conversion of underground storage facilities from gas and/or oil to hydrogen is currently being investigated.

THE BEGINNINGS

In the early 1960s, as oil-exporting countries were beginning to form the OPEC cartel, European countries with few natural resources became acutely aware of their dependence on oil as a source of energy. As early as 1966, this development led to the German government's decision to establish a so-called "federal crude oil reserve" (Bundesrohölreserve), intended to provide a 90-day stockpile in times of crisis.

FROM A FEDERAL COMPANY TO A HIGHLY EFFICIENT SERVICE PROVIDER

Over 50 years ago, **STORAG E**TZEL (then still known as the federal company IVG) was awarded the contract to create underground storage facilities in Etzel for 10 million tonnes of oil for the legally required federal crude oil reserve and to operate the above-ground facilities on behalf of the Federal Republic of Germany. After privatisation in the 1990s, IVG took over ownership of the cavern storage facility. In 2016, the well-established, medium-sized company was renamed **STORAG E**TZEL and given corporate independence.

ADVANTAGES OF THE ETZEL SITE

In the 1970s, after thorough exploration of the underlying geological conditions, the Etzel salt dome with its mushroom-shaped structure was selected for the project. The Etzel salt dome is around 12 kilometres long, five kilometres wide and rises from a depth of more than 4,000 metres to 750 metres below the earth's surface. In Europe, there are practically no comparably favourable places for constructing storage caverns.

The location was also the ideal choice because of its proximity to the North Sea and the Niedersachsen jetty (Niedersachsenbrücke) in Wilhelmshaven, which is only 25 kilometres away and Germany's only deep-water port, where the oil arrives by tanker. At the same location, seawater is extracted to flush out the caverns and the resulting brine is discharged back into the North Sea. Initially, 33 caverns with a height of up to 500 metres were planned. After preparatory infrastructure work on the pipelines and the pumping station, the brine-pumping operation began in autumn 1973. The filling of the caverns with a cavity volume of 13 million m^3 was completed in 1977.

The decision in favour of a strategic oil reserve had already been confirmed in 1973. When the first oil crisis occurred due to the rapid increase in crude oil prices, it also led to an economic recession and temporary bans on Sunday driving. Even in the event of further political crises in the Middle East

State of the art: gas cavern well heads in Etzel

1970s

- Decision of the federal government to create the "federal crude oil reserve"
- IVG becomes trustee for the German federal government in 1971
- Above-ground facilities built in Etzel and long-distance pipelines (seawater, brine, oil) laid to Wilhelmshaven
- Drilling and brine operations begin to construct 33 large-volume caverns designed for long-term oil storage
- *First oil crisis with Sunday driving bans*
- *Second oil crisis*

1980s

- Oil filling ends with 8.5 million m³ in 1981
- First oil storage contract with the German Oil Stockpiling Association (EBV)
- 1986: First contract with Statoil for the storage of natural gas in Etzel to ensure supply security in central Europe
- Oil storage caverns converted for gas
- *Fall of the Berlin Wall*

1990s

- Etzel gas storage facility (EGL) commissioned in 1993; Emden-Etzel pipeline built and eight caverns first filled with gas
- IVG privatised
- Connection to North Sea pipelines completed: as of 1995, Etzel energy storage facility connected to Europipe and the NETRA supply network
- Other western European stockpiling associations also lease storage capacity: further oil caverns constructed
- Facility status 1998: 31 oil caverns, 9 gas caverns (560 million m³ available gas)
- Federal crude oil reserve outsourced and sold; German EBV stocks simultaneously replenished

2000s

- Etzel cavern storage facility acquired from the German federal government in 2005
- EGL expanded to include 10 converted caverns for 1.3 billion m³ of available gas
- 2006: Planning begins to further expand the cavern field; Bunde-Etzel pipeline initiated
- Demand for gas storage grows strongly due to EU-wide gas market liberalisation; Etzel developed from a crude oil storage facility to one of the largest gas storage sites
- Cavern funds launched

and natural disasters in the oil-producing regions over the next few decades, the crude oil reserve in Etzel could have ensured a continuous supply of energy. In 2022, securing the supply of energy commodities once again became an issue because of the Russia-Ukraine war.

40 YEARS AGO, THE SIGNIFICANCE OF NATURAL GAS IN THE ENERGY MIX INCREASED

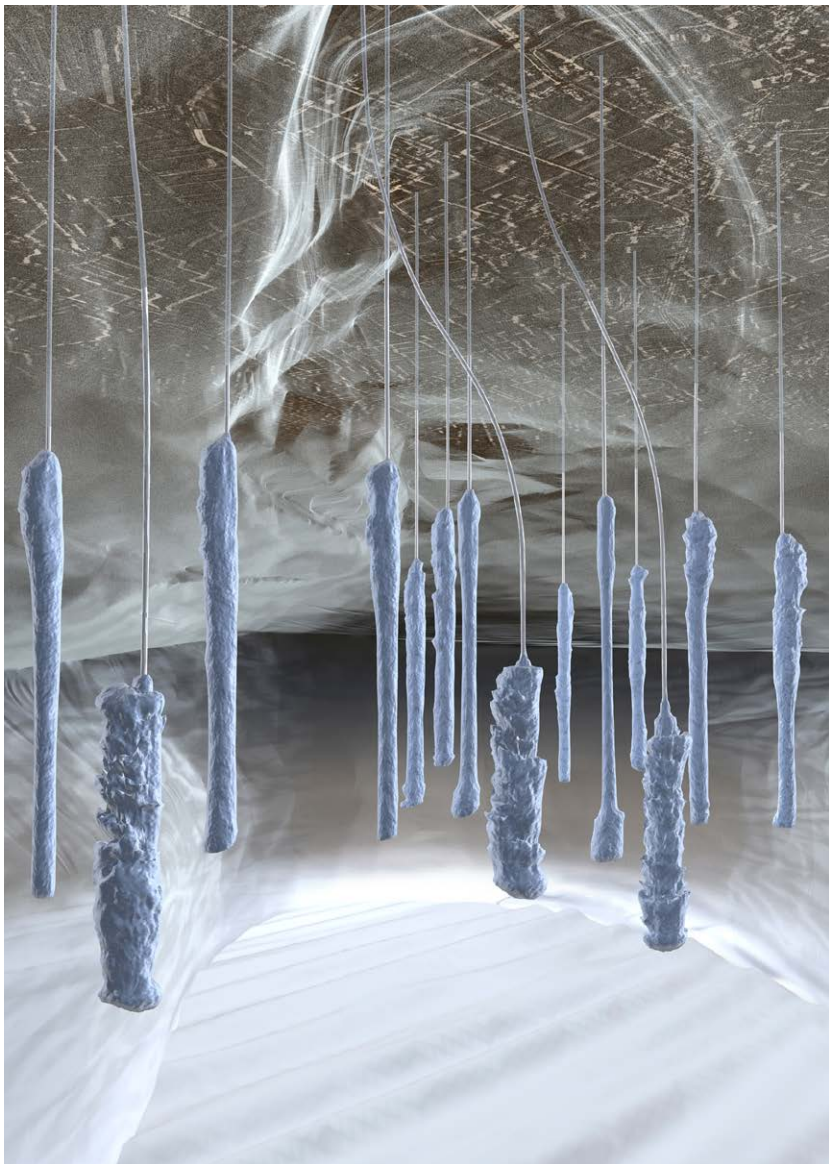
Since the 1980s, natural gas consumption in Germany has risen dramatically and long-term supply contracts have been concluded between producers and German energy supply companies. To be able to supply gas even in the event of pipeline interruptions, in 1986 the Norwegian oil and gas producer Statoil secured storage caverns in Etzel by contract. For this reason, nine existing caverns were initially converted for gas storage with an available gas volume in excess of 500 million m³.

In addition to the existing operating plants of the crude oil storage facility, a gas operating plant, i.e. the Etzel Gas-Lager (EGL), was completed in 1993 and connected to the northern European pipeline network. The operational management of the EGL is the responsibility of **STORAG ETZEL** as the technical service provider. Between 1994 and 1998, the cavern storage facility was extended to include another six oil caverns, as other western European stockpiling associations leased space in Etzel on a long-term basis. In 2004, the first deviated wells were drilled from a centrally located cavern in Etzel; a principle that was to become the rule for expanding the gas cavern storage facility as of 2007. With the new caverns, the Etzel storage facility once again had approximately the oil storage volume originally specified.

STORAGE CAPACITY EXPANDED IN THE 2000s

The existing infrastructure and technical expertise at the site came into play when the Etzel storage facility was expanded as of 2006. Over the next few years, more than 30 gas caverns were added in the north field, while three new gas operating plants were installed in the south field at the same time. As a result, the cavern storage facility in the middle of northern Germany's energy hub has developed from a crude oil storage facility into one of the largest gas storage sites in the world.

In 2022, 75 caverns provided a geometric storage volume of some 40 million m³ for the safe storage of large quantities of oil and gas, which means the number of caverns has more than doubled since the 1970s. A total of 99 caverns have now been approved.



Our potential lies underground: illustration of actual caverns in the Etzel salt dome with vertical and deviated access boreholes

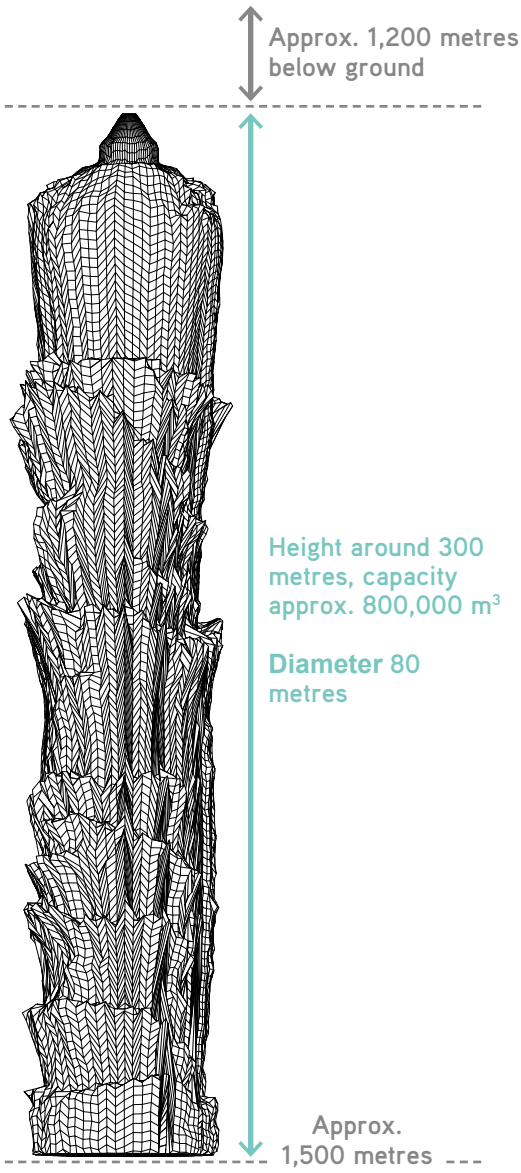


Illustration of a new standard-sized gas cavern

OWNERS OF THE CAVERNS

The caverns are owned by two cavern funds that were set up in 2008 and together they comprise the largest infrastructure funds in Germany. The investors are Germany-based companies from the insurance sector, pension funds and foundations.

STORAG ETZEL is the local operator of the caverns as defined under mining law and responsible for their operation. The enterprise owns the entire infrastructure required for operating not only the oil storage caverns, but also the caverns currently under construction.

THE LESSEES OF THE CAVERNS: A "WHO'S WHO" OF EUROPEAN ENERGY SUPPLY COMPANIES

STORAG ETZEL is the owner of one of the largest crude oil storage facilities in Europe and has storage capacity for over 10 million m³ of crude oil in 24 caverns at the Etzel site on a long-term basis. The crude oil belongs to oil stockpiling associations of various European countries and serves as a secure source of supply in times of national crisis. Oil traders have also increasingly secured themselves flexible cavern capacities in recent years.

Regarding gas, well-known European gas supply and trading companies lease the 51 gas caverns at the Etzel site. They are owners of the four above-ground operating plants as well as their technical and commercial operators. These contracts extend well into the 2040s.

2010s

Energy transition in Germany

- Three new gas operating facilities (EKB Storage, ESE-Erdgasspeicher Etzel, FSG Crystal) and the Bunde-Etzel pipeline commissioned around 2011/12, gas storage provided for further well-known German and European companies
- First new caverns gradually handed over to lessees and filled with gas for first time; new **STORAG E**TZEL office building completed
- Oil stockpiled for institutions from D, NL, PT and BE, over 10 million m³ of oil in long-term storage
- Cavern information centre opened and cavern advisory board established in 2010
- Programme launched to secure long-term availability of pipelines in south field
- Plant status for the 40th anniversary in 2011: 52 caverns (23 for oil, 29 for gas)
- In 2016, company headquarters relocated to Friedeburg, name changed to **STORAG E**TZEL I Neighbourhood festival "Info and Family Day" held
- Measures to reinforce gas production strings for new caverns completed ahead of time in 2016; 28 caverns reinforced
- Two new gas caverns completed in 2017, bringing total number of caverns in operation to 75 I Site operators present fire engine to municipality of Friedeburg, long-term agreement reached
- 25 years of EGL in 2018
- **STORAG E**TZEL invests around EUR 100 million in plant and operational safety between 2015 and 2020

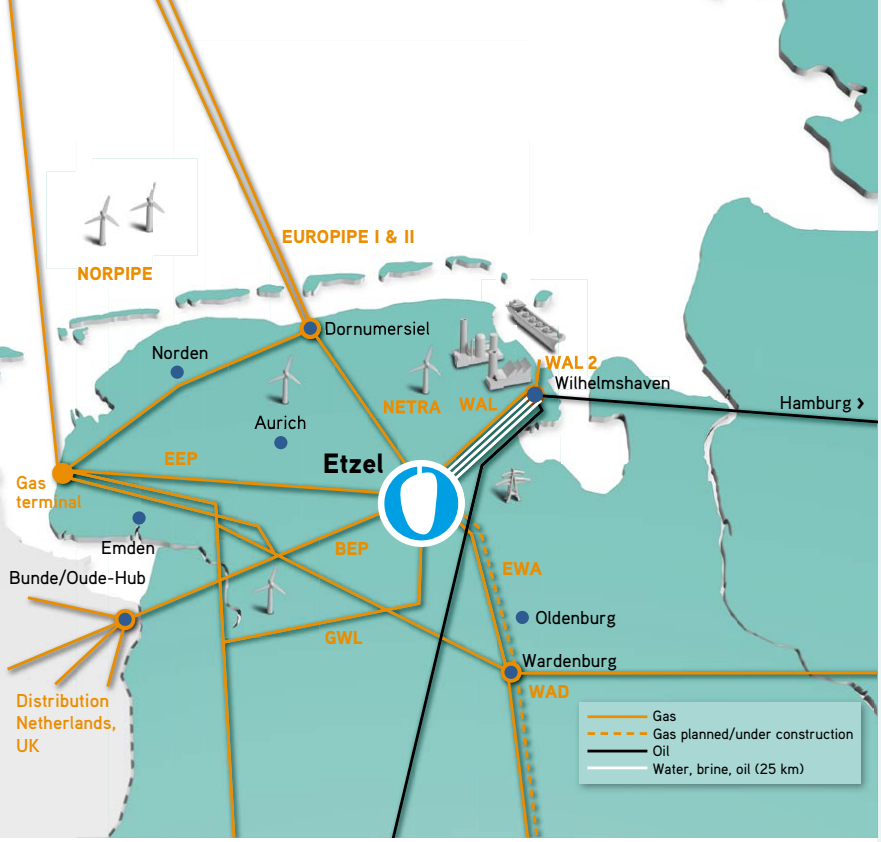
Performance check at the main pumping station, the "beating heart" of cavern construction and operations

THE ESTABLISHED OIL AND GAS STORAGE FACILITY WILL ALSO BE USED FOR RENEWABLE ENERGY

Today, the Etzel cavern storage facility not only ensures Germany's supply security, it also helps to cover the energy requirements of neighbouring European countries. Its strategically favourable location and good connections to Europe's oil and gas infrastructure makes it a practical success model in terms of European cooperation.

The underground storage of crude oil and natural gas has proven to be an extremely cost-efficient, reliable, flexible and environmentally friendly way of storing large volumes of energy.

The Etzel site: embedded in the East Frisian landscape



Well connected: efficient pipeline connection for oil and gas – and also fit for importing liquefied natural gas (LNG) and hydrogen (H_2) in future

CAVERNS SUITABLE AS FUTURE HYDROGEN STORAGE FACILITIES

Fit for the future:
Apart from fossil fuels, renewable energy can also be stored in caverns by converting surplus electricity into hydrogen (H_2) or synthetic natural gas (SNG, i.e. methane). **STORAG ETZEL** has already successfully converted caverns from oil to gas storage in the past; the conversion of gas and oil caverns for the future storage of hydrogen is now being examined.

With this aim in mind, **STORAG ETZEL** has launched the promising "H2CAST Etzel" research project. Our objective is to make the Etzel caverns "H2-ready" and therefore fit to store oil, gas AND hydrogen as we move forward into a new era.

2020s

Our future: oil, gas AND hydrogen!

- Over 16,000 people have visited our "Infobox" information centre I In 2020, **STORAG ETZEL** is acquired by one of the funds that already owned caverns at the site I Framework operating plan for the cavern facility approved for 50 years I Mission accomplished: cavern advisory board of **STORAG ETZEL** is dissolved after 10 years
- 2021: South field remediation completed I Impact management: first measures implemented I 50 years of the Etzel cavern storage facility I Plant status: 51 caverns for gas, 24 caverns for oil, a further 24 potential caverns have been approved and can be built short-term
- First section of "H2CAST Etzel" started – site to become "H2-ready" I Connecting pipeline (WAL) to the NETRA long-distance pipeline constructed near the Etzel storage facility I Ceremony of the 50+1 year anniversary held held in July 2022
- First time injection of H2 in 2022
- Many caverns will be fitted with new underground equipment by 2026/27
- *"Turning point" due to Russia-Ukraine war: focus again turns to supply security*

2030

- Outlook: In addition to oil and gas, hydrogen and synthetic natural gas based on renewable energy to be stored

STORAG ETZEL

Energy Storage Solutions

As one of the largest underground storage facilities for oil and gas in Europe, we have been a reliable partner to the energy industry – for over 50 years.

www.h2cast.com

www.**storag-e**tzel.de