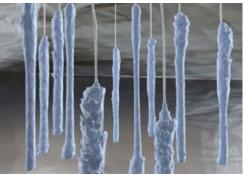
#### STORAG ETZEL

**Energy Storage Solutions** 

## ENERGY. SUPPLY. RELIABILITY.







Large volume crude oil storage in caverns



# WE ARE READY



as operator build and manage oil and gas caverns in Northern Germany – with more than 50 years of experience



Acting on behalf of German institutional investors (insurance industry, pension funds etc.)



caverns for oil and

51 caverns for gas +

potential of 24

new caverns

Connected via pipeline to deepwater port of Wilhelmshaven



**STORAG E**TZEL is one of the largest independent storage companies in Europe and offer sustainable storage solutions.

e build, maintain and lease bulk underground storage capacity for gas and oil since 1971 in the salt dome Etzel near Wilhelmshaven. Tenants of the caverns are well-known energy trading companies as well as oil stockholding organizations of various European countries. With a storage volume of more than 10 million cubic meters spread over 24 caverns, **STORAG E**TZEL is one of the largest crude oil storage facilities in Europe. The storage facility has an approved expansion potential to a total of 99 caverns. The cavern facility is connected to the gas grid and via our oil pipeline to Wilhelmshaven. Around 1/6 of Germany's gas reserves are stored in Etzel.

#### **OIL STORAGE**

In the early 1970s, after extensive underground exploration, the Etzel salt dome was chosen for the construction of salt caverns due to its favorable conditions.



he salt dome is approximately 12 kilometers long and five kilometers wide, extending from a depth of over 4,000 meters to 750 meters below the surface.

The site's proximity to the North Sea and the Niedersachsen jetty in Wilhelmshaven, located 25 kilometers away, was a key factor. Sea water from Wilhelmshaven is used in the solution mining process to create caverns in the Etzel salt, with brine produced and transferred back to the North Sea.

The decision to establish a strategic oil reserve was made in the 1970s to ensure a continuous energy supply in the event of future political crises or natural disasters in oil-producing areas. **STORAG E**TZEL, one of Europe's largest crude oil storage company, has 24 caverns with a total capacity of around 11 million cubic meters for long-term storage. The stored crude oil is available to stockpiling organizations of various European states during energy crises, serving as part of Germany's national reserve.





Caverns are artificially leached into a salt dome. They have a capacity of 2 super tankers



The oil caverns are used by stockholding institutions and commodity traders



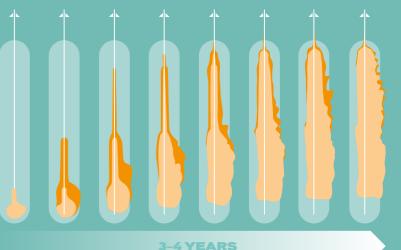
Total pipeline capacity to WHV up to 6000 m³/h



Injection and withdrawal rate approx. 350 m³/h per cavern

#### Formation of caverns

- The naturally occurring salt underground is dissolved by the introduction of water.
- The salt saturated water is transported to the surface,
- The resulting cavities the caverns - can be used to store oil, gas or hydrogen.









#### **CAVERN VOLUME ILLUSTRATED**



A typical cavern in Etzel can have a geometric cavity volume of up to

800.000 m<sup>3</sup>



corresponds to the capacity o more than two supertankers

# VALUABLE BENEFITS



The oil storage in caverns combines a structural cost advantage with outstanding efficiency, safety, and environmental friendliness.

he use of underground caverns not only enables a cost-effective infrastructure but also sustainable operational management. An outstanding feature is the extremely low volume loss rate, thanks to specially designed caverns that ensure precise and secure oil storage, minimizing resource losses. In contrast to conventional tank farms, we make a stand against quality losses by avoiding evaporation effects, guaranteeing the unchanged quality of stored oil.

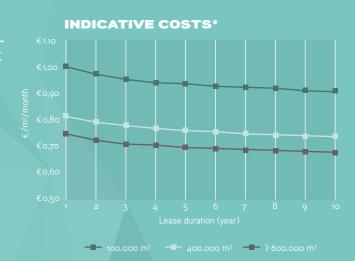
The safety of our underground storage not only minimizes the above-ground attack surface but also creates a robust protective environment for the stored oil. Our offering is rounded out by a higher capacity compared to conventional solutions. Overall, our oil storage in caverns represents a sustainable solution for efficient, secure, and environmentally friendly oil storage.

# SENEFITS

STRUCTURAL COST ADVANTAGE, INCLUDING SIGNIFICANTLY LOWER OPERATING COSTS

NO QUALITY LOSSES (DUE TO EVAPORATION AS IN TANK FARMS) HIGH SAFETY (MINIMAL ABOVE-GROUND ATTACK SURFACE) AND HIGH CAPACITY

EXTREMELY LOW VOLUME LOSSES



The chart indicates the expected costs for oil storage in the caverns. Lease agreements commence from one year, with a minimum quantity of 100.000 m³. On one hand, rental costs decrease with longer lease durations. On the other hand, larger quantities of oil lead to a lower leasing price.

## FIT FOR FUTURE

Crude oil and natural gas are expected to continue playing a crucial role in the energy sector and crisis stockpiling in the medium term.

imultaneously, the energy industry is transitioning towards an increased reliance on renewable energy sources and the development of a hydrogen-based economy. **STORAG E**TZEL is well-prepared for both scenarios, possessing storage capacities for oil and gas, actively researching future hydrogen storage in Etzel, and exploring the potential to convert and provide existing caverns for hydrogen storage in the medium term.



3,9

**bn. m³**Working Gas Volume at max. cavern pressure – about 1/6 of Germanys reserves

11

mio. m³
Oil Stock Capacity –
Largest oil stock
in the EU

**≈15** 

mio. m³
Future Storage Capacity
in 24 Caverns –
Etzel still has potential
for expansion



Hydrogen (H<sub>2</sub>) is recognized as the energy carrier of the future, allowing for the extended gaseous storage of renewable energy, such as electricity generated from wind or solar sources.

s an independent cavern operator, **STORAG E**TZEL aims to advance research and development in underground large-scale hydrogen storage.

Through initiatives like the H2CAST Etzel research project and subsequent development projects, participation in the "Energy Hub – Port of Wilhelmshaven" initiative, **STORAG E**TZEL seeks to drive progress in the field. Simultaneously, these efforts aim to demonstrate the suitability of the salt caverns in Etzel as large-volume hydrogen storage facilities.



- - Planned/Under Construction
- Hydrogen Repurpursed (Core Net Planned)
- - Hydrogen New (Core Net Planned)



H,CAST



## **OUR HISTORY**

1970s



Resolution on the set-up of the federal crude oil reserve

- Construction of the surface facilities in Etzel and longdistance pipelines to
   Wilhelmshaven
- Start of drilling operations for 33 oil caverns for longterm storage
- First oil crisis and Sunday driving ban
- Second oil crisis

1980s

**1981** Completion of oil filling process with 8.5 million m<sup>3</sup>

- First oil storage contract with the German national petroleum stockpiling agency (EBV)
- **1986** Contract with Statoil for storage of natural gas in Etzel for the first time to ensure security of supply in Central Europe
- Conversion of oil caverns to gas operation
- Fall of the Berlin Wall



1990s

1993 Commissioning of the first gas storage facility:
The Etzel Gas-Lager; construction of the Emden-Etzel Pipeline and initial filling of eight caverns with gas
1995 Connection of the Etzel Gas-Lager facility to the North Sea pipelines
Europipe I and the NETRA supply network

- Other Western European stockpiling agencies enter into lease agreements:
   Building of additional oil caverns
- Site status
- **1998** 31 oil caverns, 9 gas caverns (560 million m<sup>3</sup> of working gas)
- Discharge and sale of the German federal crude oil reserve followed by a corresponding increase of volume in stock by EBV

2000s



Acquisition of the Etzel cavern facility from the German government in

#### 2005

- Expansion of the EGL to include 10 conversion caverns (1.3 billion m³ of working gas)
- **2006** Start of planning of further expansion of the cavern site; introduction of the Bunde-Etzel Pipeline
- Demand for gas storage grows sharply due to EUwide liberalisation of the gas market; development of Etzel from crude oil storage facility to one of the largest gas storage locations

**2010s** 

with gas;

Commissioning of three new gas operating facilities (EKB, FSG Crystal, ESE) and the Bunde-Etzel Pipeline in **2011/12**;

- Gradual handover of the first new caverns to the tenants and initial filling
- Oil stockpiling for institutions from Germany, the Netherlands, Portugal and Belgium; over 10 million m³ of oil put into long-term storage
- Opening of the Etzel cavern visitor center
- Status in 40th anniversary year 2011: 52 caverns
   (23 for oil, 29 for gas)
- Energy turnaround in Germany towards renewable energies

2020s

Commissioning of the last of 34 new caverns; expansion for the time being

- Completion of the program to ensure the long-term integrity of the pipelines in the southern field for oil operations
- Cavern inventory status2017

75 caverns (24 for oil, 51 for gas)



 Completion of the work programme on all oil caverns to improve well integrity till end of the decade



**FUTURE** 



Cavern storage of renewable energies in addition to oil and gas; the location and the Etzel cavern facility are being made "H2-ready."

This initiative is aimed at ensuring sustainable supply security with carbon-free energy for our future



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