



Gas storage facilities

Good reasons for gas

Natural gas is the ideal match for renewables

There is no way of saving up wind and sunlight, but natural gas certainly can be stored. As a result it can be used to even out the unavoidable fluctuations in renewable energy output. This applies to homes, where natural gas heats the water when the sun goes in. And it goes for public power supplies. The wide swings in renewable electricity feed-in to the grid call for complementary technologies that respond quickly and flexibly to supply shortfalls. In short, natural gas is opening the way for the renewable energy age. It is the natural partner for renewables.

Natural gas is climate friendly

Natural gas is the conventional energy source with the best climate performance. It releases 25% less greenhouse gases than oil and 30–35% less than coal when burnt, and is virtually dust free. Natural gas already plays a big part in keeping down CO₂ emissions. Transportation by safe pipelines that are hidden from view significantly reduces environmental impacts as compared to competing energy sources. Fortunately, the world has vast natural gas reserves, and in the longer term it will also be possible to manufacture gas from renewable energy forms.

Natural gas is highly efficient and economic

Modern domestic condensing boilers have efficiencies as high as 98%. And natural gas is also an excellent fuel for power generation. Combined cycle gas and steam turbine generating stations are among the most efficient conventional power plants. In combined heat and power configurations they deliver efficiencies of 90%.

Natural gas is safe

From the field development stage through to transportation, storage, and use to generate heat and power, natural gas is a model of safety.

Natural gas is the key to supply security

Natural gas plays a key role in Austrian and European energy supply security. Austria's gas comes from domestic production and imports under long-term contracts with reliable partners. Austria has a well developed pipeline grid, and due to its geographical location it is linked to the rest of the European grid by large transit systems.



Company profile

RAG has been a major contributor to Austria's energy supplies for over 75 years

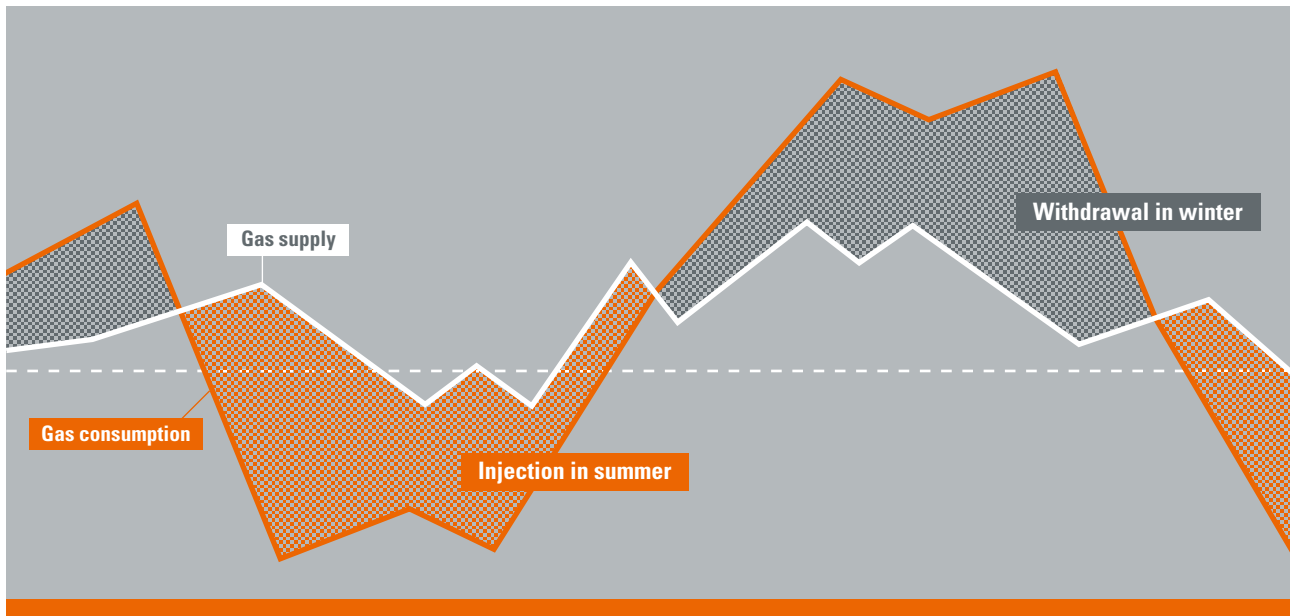
Since its formation in 1935, RAG has produced over 15 million metric tons (mn t) of crude oil and 24 billion cubic metres (bn cu m) of natural gas at its Austrian fields. In addition to its concessions in Austria, RAG has recently acquired exploration properties in Bavaria, Hungary and Poland.

Besides oil and gas exploration, natural gas storage is a core business for RAG. Over 30 years' experience, and ongoing expansion of its activities in this area have made RAG one of Europe's leading storage operators. Our storage facilities serve both domestic and foreign customers, making a significant contribution to security of supply in Austria and the whole of Central Europe. Our portfolio of business activities also includes crude oil emergency stockholding, gas trading and transportation, and the development of renewable energy sources such as geothermal.

Our extensive experience, our highly trained and motivated workforce, and our world-class safety and environmental standards have made RAG one of Austria's most successful companies.

Gas storage facilities have an important job to do:

Balancing demand and maintaining supply security



About 83% of the natural gas consumed in Austria is imported (mainly from Russia and Norway). The size of the deliveries is about the same throughout the year, and domestic production (approx. 17 % of supply) is also at roughly constant rates. However, gas demand is much higher than supply in winter, and peaks in cold weather, so storage is needed to fill the gap.

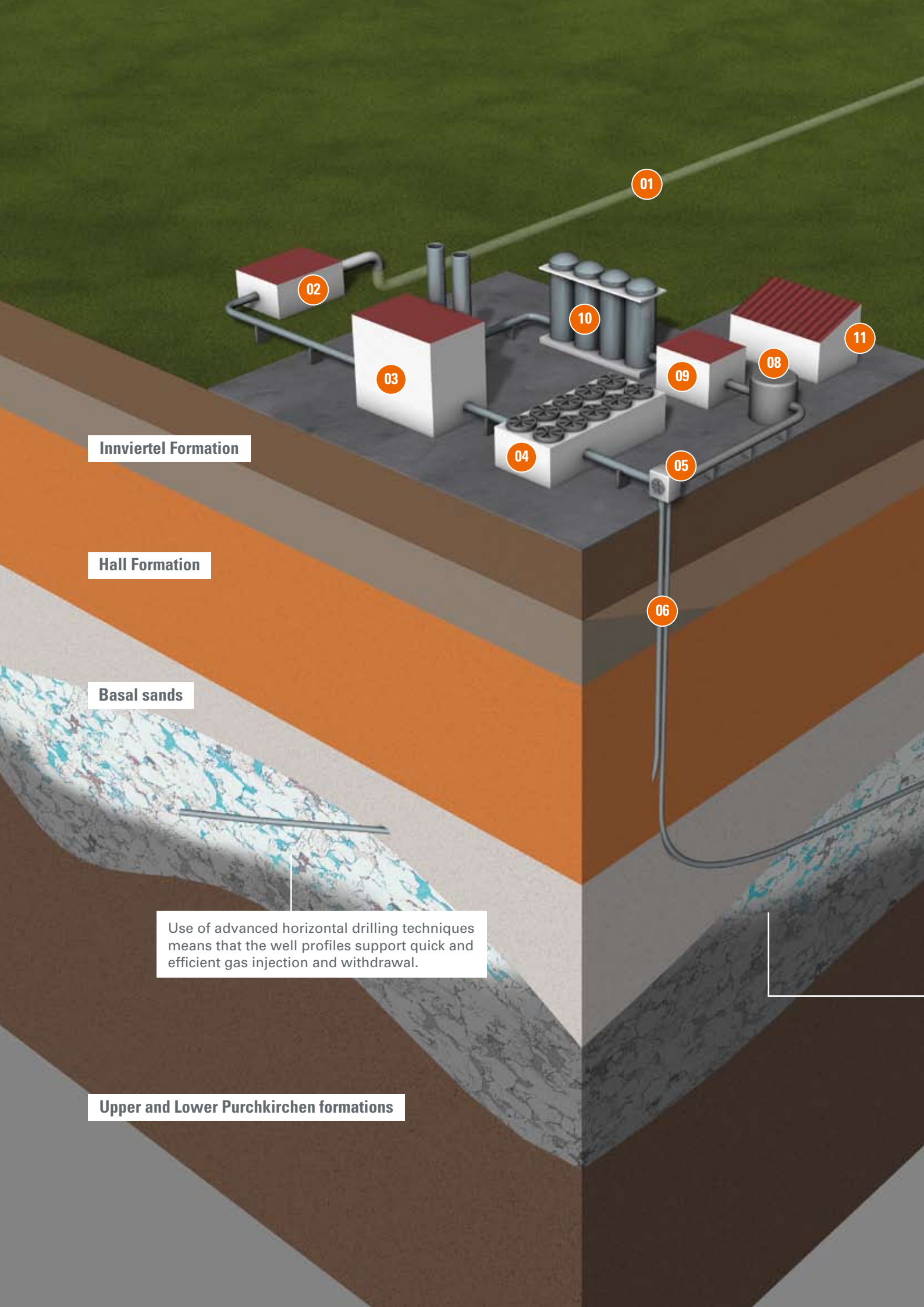
Gas storage facilities perform this seasonal balancing function for the gas supply companies by enabling surplus gas to be injected in summer for withdrawal in winter. This means that they compensate for peaks in demand (e.g. on cold days) and any supply outages (e.g. due to interruptions in shipments to Austria, or maintenance work).

Did you know that you, too, benefit from RAG's storage services?

The stocks held in storage reservoirs mean that all users – from industrial consumers to households – can depend on natural gas for reliable, environmentally friendly energy supplies.

Apart from their traditional function as a means of evening out seasonal demand swings, gas storage facilities now have an increasingly important role as part of the wider energy mix. They are the key to the use of renewable energy sources such as wind and solar for electricity generation. The higher the share of renewables in the power mix, the larger are the gas stocks that must be held in reserve to enable standby generating stations to kick in whenever unfavourable weather conditions prevent wind turbines or solar arrays from producing electricity. Today's large gas inventories and electricity from gas-fired power stations even out the increasingly sharp fluctuations in power supplies resulting from the growing contribution of unstable renewable energy sources.





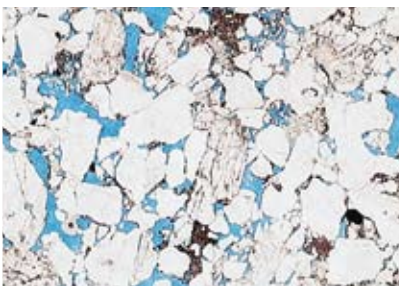
How gas storage facilities work

- 01 Pipeline link to public grid
- 02 Metering station
- 03 Compressor
- 04 Cooling unit
- 05 Wellhead
- 06 Well
- 07 Reservoir
- 08 Preheater
- 09 Pressure reduction station
- 10 Dryer
- 11 Control room building

Gas reservoir

07

Pores in the thin section



Thin sections of the reservoir rock reveal the mineral grains that make up the gas-bearing structure. The gas is stored in the pores between the grains – which show up blue on the thin section – and is withdrawn from them.



RAG's gas storage facilities

Puchkirchen/Haag

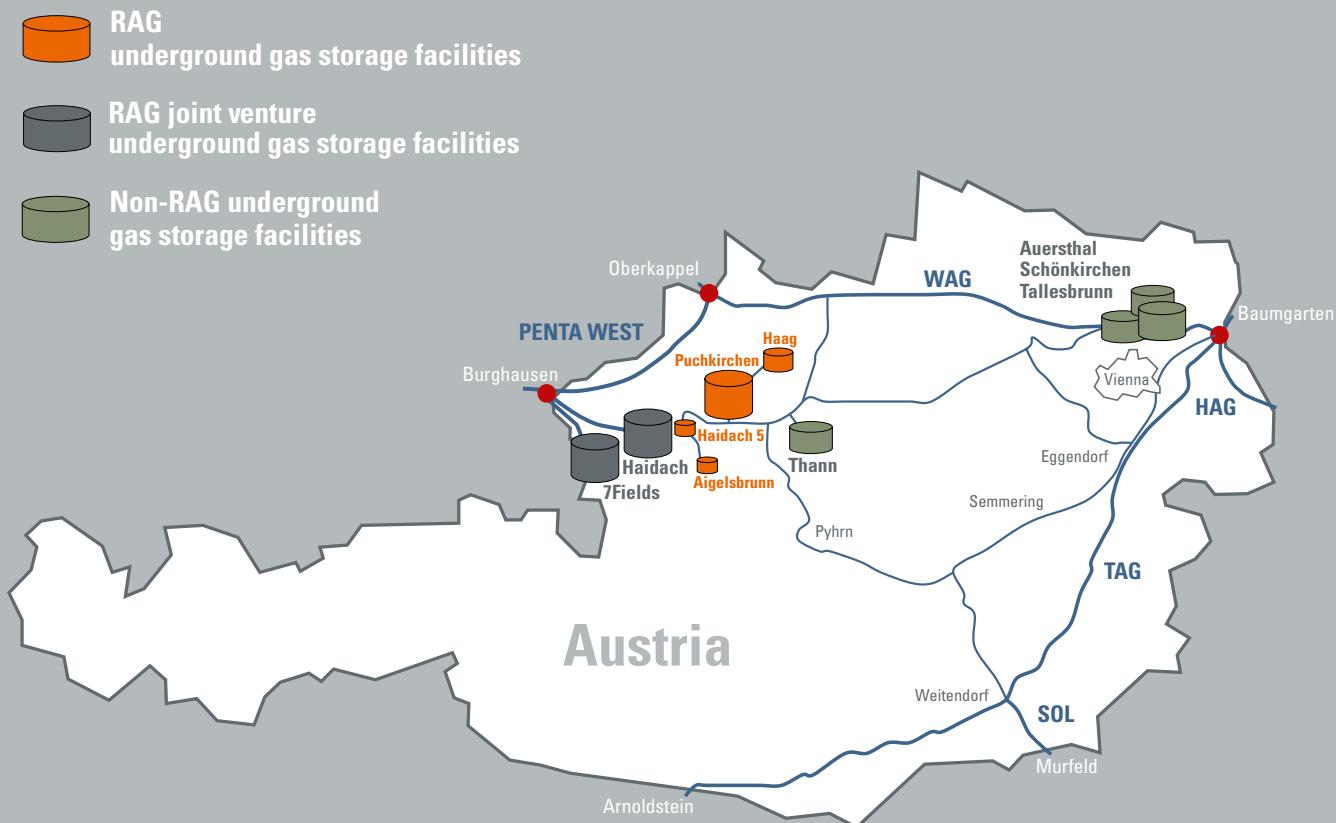
Areas of the reservoirs	6 x 2 km / 5 x 2 km
Reservoir depths	1,100 m / 1,000 m
Working gas volume	approx. 1.1 bn cu m
Max. withdrawal capacity	520,000 cu m/h
Max. injection capacity	520,000 cu m/h

Aigelsbrunn

Area of the reservoir	1.5 x 1 km
Reservoir depth	1,350 m
Working gas volume	approx. 100 mn cu m
Max. withdrawal capacity	50,000 cu m/h
Max. injection capacity	50,000 cu m/h

Haidach 5

Area of the reservoir	0.5 x 1 km
Reservoir depth	1,450 m
Working gas volume	approx. 16 mn cu m
Max. withdrawal capacity	20,000 cu m/h
Max. injection capacity	20,000 cu m/h



Joint venture gas storage facilities

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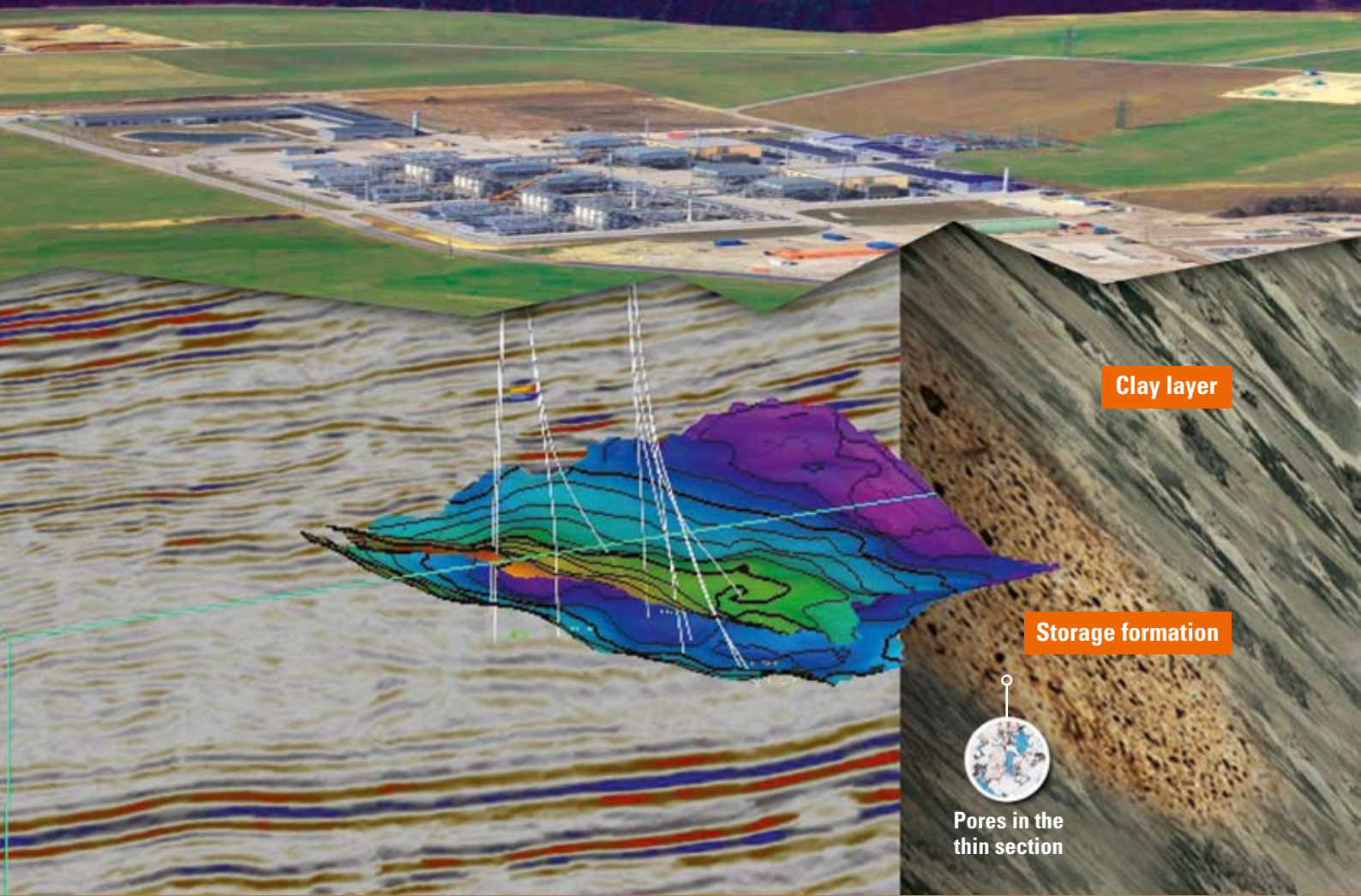
Joint venture between Gazprom export, WINGAS and RAG (operator)

Area of the reservoir	3.5 x 5 km
Reservoir depth	1,600 m
Working gas volume	approx. 2.6 bn cu m
Max. withdrawal capacity	1,100,000 cu m/h
Max. injection capacity	1,000,000 cu m/h

7Fields

Joint venture between E.ON Gas Storage and RAG (operator)

Reservoir depth	1,300 – 2,300 m
Working gas volume	approx. 2.1 bn cu m
Max. withdrawal capacity	1,080,000 cu m/h
Max. injection capacity	720,000 cu m/h



Clay layer

Storage formation

Pores in the thin section

What is an underground gas storage facility?

Austria has geological structures that are ideal for gas storage. RAG has been using former gas fields for this purpose since 1982. Employing natural gas reservoirs formed long ago is the safest and most environmentally friendly energy storage method of all.

The gas in the depleted reservoirs that are now storage facilities, before they were produced, was trapped in the pores of the reservoir rock for millions of years. Layers of clay, several hundred metres thick, above the gas reservoir, prevented any gas from escaping, as they still do today, making underground storage extremely safe. Nature itself has proved this, since the original gas reserves never posed a hazard.

RAG converts gas reservoirs into storage facilities when most of the gas has been extracted. Natural gas is then pumped into the depleted structures, taking care not to exceed the original reservoir pressure.

The gas is fed into the reservoirs and withdrawn from them via wells. Surface installations are also required. These include compressors to inject and withdraw the gas under pressure, and equipment to dry and clean it before sending it on its way to consumers. All this process technology has been tried and tested over several decades, and is still being continuously improved. Our storage expertise makes a major contribution to gas supply security in Austria and Central Europe as a whole.





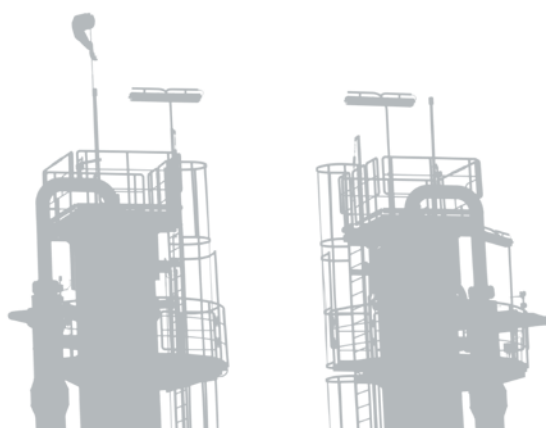
How gas storage facilities work

The storage facilities have compressors with electric drive systems or gas driven turbocompressors. Both types can be quickly started up when needed. The dryers and separators ensure that withdrawn gas contains no reservoir water and is on specification when it enters the Austrian and international transportation grids. State-of-the-art measurement and control technology, and sophisticated safety systems ensure that Austria and Central Europe receive reliable supplies of eco-friendly natural gas.

Cushion gas

Cushion gas is needed to keep the number of wells and the scale of the surface equipment to a minimum. Optimising the design of the storage facilities cuts operating costs, reduces the impact on the environment and minimises the disturbance in the vicinity of the surface installations. Some gas is always left in the reservoir as a “cushion”, and only the “working gas” above it is injected and withdrawn.

The cushion gas is a major investment when constructing a storage facility, but pays off because it permits high gas withdrawal rates due to the constant base pressure in the reservoir.







High tech

Ultra-modern equipment for maximum safety

The equipment at our gas storage facilities is state of the art, and is constantly monitored and maintained. The highly skilled staff in the central control rooms, which are manned round the clock, operate the facilities for optimum technical, environmental and economic performance, in line with local conditions. All of the plant is designed to shut down automatically at the first sign of a departure from standard operating conditions. Data is transmitted from the process units to a central control room, where their mode of operation can always be remotely controlled.

The ultra-modern technology ensures that all the official regulations are complied with, and in many cases the standards are exceeded. For example, noise emissions are kept to a minimum by enclosing all loud equipment; in some cases double sound insulation has been installed.

The entire safety management system at RAG's installations is based on audited processes. RAG was the first company in Europe to obtain Technisches Sicherheitsmanagement (TSM) certification from the DVGW (German Technical and Scientific Association for Gas and Water).



High care

Sustainability



High health and safety standards have long been an article of faith at RAG. Health, safety and the environment (HSE) always take precedence over purely economic considerations.

Our safety standards are world class. This calls for expertise and a strong sense of responsibility on the part of our employees and contractors. Top HSE performance is hard wired into our management structures. And SCC** certification demonstrates that our contractors, too, meet the strictest standard in the EU. We care deeply about the environment, and our efforts to protect it go far beyond the legal requirements. Our HSE philosophy has done much to help our activities gain acceptance from local residents and public authorities.

RAG plays a key role in maintaining secure supplies of natural gas and electricity to consumers in Austria and across Central Europe. Our mission is to ensure that your space and water heating, and power needs are reliably met even in the coldest winter weather, and that your gas keeps flowing without interruption.







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