

Company profile

RAG Austria AG



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The company

RAG Austria AG is Austria's largest gas storage company – making it the country's biggest energy storage provider – and one of Europe's leading gas storage facility operators. The company develops pioneering energy technologies that act as partners to renewables. Its portfolio of business activities also includes gas production, supply and trading, as well as the use of gas as a transport fuel.

In 2018 Rohöl-Aufsuchungs AG, Austria's oldest-established exploration, production and gas storage company with a history stretching back 80 years, was split into two new businesses: RAG Austria AG and RAG Exploration & Production GmbH. RAG Austria AG focuses on the core gas storage business, as well as developing and expanding the use of cutting-edge energy technologies. Operations also extend to gas production, supply and trading, as well as the use and marketing of gas as a transport fuel.

RAG Austria AG is playing a vital role in achieving Austria's ambitious climate goals, and in the sustainable stewardship of the country's raw material and energy supplies. Without the energy in RAG's storage facilities, phased decarbonisation would not be possible, so they are key to future energy security.

RAG Austria AG is committed to maximising quality and maintaining its strong long-term commercial performance by leveraging its longstanding subsurface engineering expertise, wide-ranging technological capabilities, high environmental and safety standards, and collaborative and transparent corporate culture. The company's success reflects its ability to innovate, and to spot and capitalise on new trends and business opportunities. RAG's goal is to provide its customers with safe, efficient, environmentally friendly and affordable energy and gas storage services – sustainably and responsibly.

A decarbonised future will require massive, seasonally flexible energy storage capacity. All this is provided by RAG.

Energy-ready for the future

Gas storage facilities are the lifeblood of security of supply. With total storage capacity of about six billion (bn) cubic meters (cu m) of natural gas, RAG is Austria's largest gas storage company, and one of Europe's leading storage operators. The storage business is the company's mainstay. About half of all the gas reservoirs discovered in the RAG's 80-year history have been converted into gas storage facilities up to now, and this figure will rise in the next few years as RAG makes good on its vision of sustainable raw material production, delivering a decisive boost to security of supply in Austria and Europe as a whole.

Securing energy supplies for the future that can provide energy sustainably and affordably, while also reducing greenhouse gas emissions and improving energy efficiency, is one of the biggest challenges facing the world today. The energy carrier of the future can only be gas – methane and hydrogen. The advantages are obvious: gas is inexpensive, clean and efficient. It can ensure that climate targets are met, and it is a partner to renewables that is itself renewable. Gas can be manufactured from wind, solar and biomass energy, and in the form of liquefied natural gas (LNG) and compressed natural gas (CNG) it helps reduce carbon dioxide (CO₂) emissions from transportation directly.

Rethinking gas

For RAG, focusing on gas, an energy carrier that is highly versatile and promising, means looking at it from a new perspective. Conventional natural gas, which will continue to play an indispensable role in energy

supplies, is only one aspect of this. The other is "green gas" – biogas (or biomethane) made from waste materials, and synthetic gas produced using power-to-gas technology. The Underground Sun Storage and Underground Sun Conversion projects developed by RAG have opened up the unique proposition of storing large volumes of gas produced from renewable sources – such as solar and wind power (synthetic methane and hydrogen) – seasonally and carbon-neutrally underground

"RAG's success story is based on constant technological innovation, a continuing high level of expertise, and its stable shareholders of energy supply utilities."

for withdrawal whenever they are needed. This turns RAG's gas storage facilities into energy storage facilities, creating a link between the gas and electricity sectors so that they work together still more closely.

In contrast to electricity, gas can be stored securely and transported over very large distances without losses, out of sight, in a well-established underground transmission network. Gas already has a broad range of applications, underpinning safe, efficient and sustainable energy supplies. It is used to generate electricity and heat, and in transportation as Liquefied Natural Gas (LNG) and Compressed Natural Gas (CNG).

Responsibility

RAG will continue to make a major contribution to Austrian energy supplies and storage, as it has throughout its history, and to fulfil its economic function. This includes observing strict safety standards, and implementing all our projects in close consultation with land-owners, residents, public authorities, customers and employees. Our mission is to use the natural resources entrusted to us carefully and responsibly, to the maximum benefit of society.



The future of energy

Providing secure, sustainable, competitive and affordable energy for all is a major challenge, and is essential to economic growth and prosperity in Europe.

Gas is a guarantor of secure, sustainable, affordable and competitive energy supplies. These four factors are the keys to the success of the energy transformation.

Conserving resources, boosting efficiency, enhancing storability, reducing dependency on imports and expanding the use of domestic energy sources are central issues for Europe's energy sector – and we must pay close attention to them.

The global energy business is in a ferment of change. It is of course for a sustainable energy system that will limit climate change. The challenges faced globally and in Europe are immense. Security of supply, as well as efficiency and affordability, must be delivered along with decarbonisation and the move to green technology. This can only be achieved by a huge collective effort, for which the EU's Energy Union strategy and the 2015 UN Climate Change Conference in Paris have laid the groundwork.

Ambitious targets

Both Austria and Europe as a whole have set themselves ambitious energy and climate targets. The goals contained in Austria's "#mission 2030" climate and energy strategy include the expansion of renewable energy generation, a 36 % reduction in greenhouse gas emissions by 2030, and carbon-free energy supplies by 2050. With the right strategy, we can meet these goals.

The energy transformation represents a paradigm shift in terms of sustainability, to be achieved by greater energy efficiency, more complete integration of renewable energy and the reduction of greenhouse gas emissions.

Reducing energy consumption at the same time as decarbonising the energy mix does not simply mean conserving resources – it demands appropriate improvements in efficiency, and enabling renewable and conventional energy sources to work together. The gas industry can make a significant contribution. Gas offers economically viable climate action in all areas; it is the guarantor of supply security, sustainability and competitiveness. The success of the energy transformation depends on these factors working together. Paired with the expansion of renewable energy sources, gas offers a huge opportunity for reducing CO₂ emissions that is affordable and available immediately. Its versatility and flexibility means that gas – and increasingly renewable green gas – offers a secure and sustainable supply of energy using existing infrastructure (the gas grid, storage facilities,

Our vision for 2050

Austrian households that use gas heating can be supplied with 100 % renewable gas. If the potential for biogas generation (from residual materials) and production of synthetic gas (from electricity surpluses) in Austria is fully exploited, in 2050 these will meet the entire heating demand (gas central heating and district heating) of all households in Austria – carbon-neutrally.

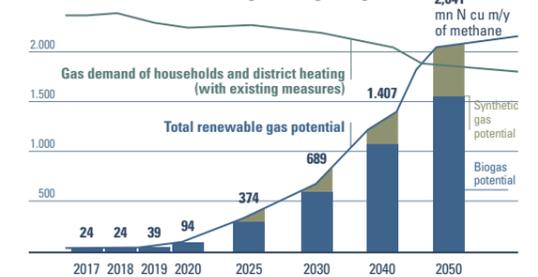
gas heating systems and gas-fired power stations), and can underpin affordable, socially acceptable and rapid action to combat climate change.

Security of supply

The energy transformation can only succeed if security of supply is guaranteed. Highly developed gas infrastructure, including storage facilities, means that enough energy is always available. Austria's high storage capacity provides security: with total capacity (working gas volume) of 8.3 bn cu m, the country's storage facilities can hold more than 100% of its annual needs. Barely a single other EU member state has such high storage capacity relative to its consumption.

Sustainable heat supplies with green gas

In around 30 years, it will be possible to supply all Austrian households that use gas with green gas.



Source: Austrian Association of Gas and District Heating Supply Companies (FGW)

Innovations

As energy consumption continues to rise worldwide, intensive research and technological breakthroughs are essential if today's ambitious climate change targets are

“Green gas not only has vast potential, it’s sustainable, affordable and storable. In other words, it is the enabler of the energy transformation.”

to be attained. Recent studies show that although large-scale decarbonisation represents a considerable challenge, rapid technological progress makes it feasible, and it also represents an economic opportunity. These structural changes in the energy sector present an enormous opportunity for innovative

technologies, services and ideas.

For some time now RAG has been working on promising solutions that address the changes in energy policies and the energy sector. These efforts are based on three pillars.

- Increasing gas storage capacity, which plays an important part in strengthening security of supply in Austria and Europe, and in supporting the expansion of renewable energy sources;
- Promoting decentralised, renewable, energy-efficient energy generation that exploits all potential synergies, and extends from heat generation and geothermal projects to natural gas vehicles;
- Green gas and the development of sustainable, cutting-edge technologies such as power-to-gas, which makes it possible to manufacture synthetic – and thus sustainable - gas from wind and solar energy.

This allows RAG to support the goals of the Energy Union and the Paris Climate Change Conference, as well as making an important contribution to sustainable, secure and affordable energy supplies.

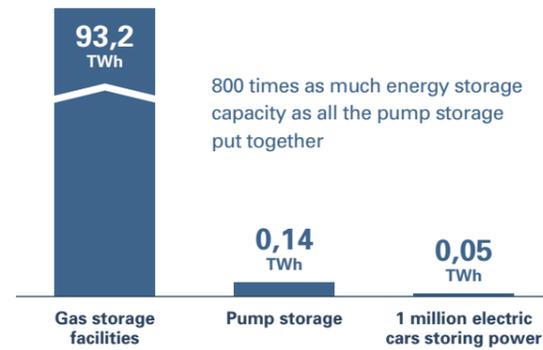
Green Gas

Green gas – meaning renewable gas – can be biogas, generated from plant residues and other waste, or synthetic gas produced from excess electricity generation using power-to-gas. This means power generated from renewable sources can be converted into gas – hydrogen or methane – so that excess solar and wind energy is not

Gas storage facilities

When the wind blows steadily and there is plenty of sunshine, renewables often produce more electricity than is needed. Power-to-gas enables such surpluses to be recovered and stored, in the form of green gas, in Austria's storage facilities – the country's biggest “battery”. All the other storage concepts (pump storage plants and batteries) offer only a fraction of the storage capacity presented by gas storage facilities.

Gas storage facilities – the country's battery



Source: RAG

lost, but can be carried over from summer to winter, stored and made available when needed. The infrastructure is already in place – green gas can be injected into Austria's nearly 43,000 km gas network, and held in gas storage facilities. These natural underground gas reservoirs, which can hold more gas than is consumed in Austria in a year, are being upgraded to prepare them for their future role. The existing infrastructure can therefore be used as the “battery” of the energy transformation, and provide the necessary back-up for the volatile renewables.

Both biogas and synthetic natural gas are completely carbon neutral, and therefore climate friendly.

75
TWh

The gas grid

Some 75 terawatt hours (TWh) of energy in the form of natural gas is transported out of sight, underground on a 43,000 km long network.

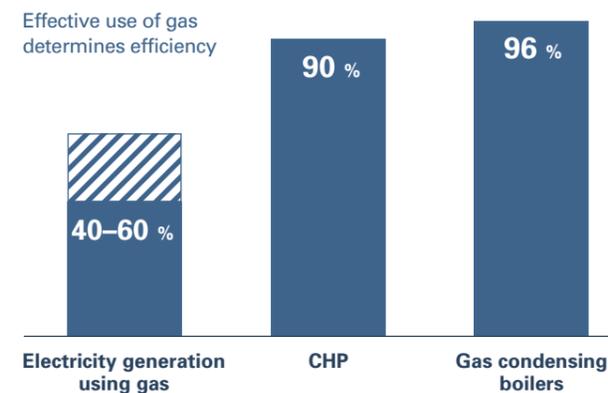
Many studies show that using existing gas infrastructure and power-to-gas technology can help to significantly reduce the system costs entailed in the energy transformation. It can remove the need to build additional high-voltage power lines, as well as saving consumers money since they can continue to use existing gas central heating systems.

Two key advantages of green gas are that it is flexible and dependable. It is always available, even if the wind doesn't blow and the skies are overcast, providing climate

friendly energy for power generation, heating and transportation all year round, 24 hours a day – just as needed. It possesses the same excellent qualities as the conventional natural gas that has supplied us with energy for decades, and it is renewable, too.

Another benefit of gas is its high efficiency: in combined heat and power (CHP) plants, where thermal energy from gas is used to generate heat as well as electricity, efficiency is close to 90 %. And if gas is used in a condensing boiler, efficiency of 96 % can be achieved.

Gas convinces by high efficiencies



Source: Austrian Association of Gas and District Heating Supply Companies (FGW)

Working together, natural gas and green gas represent the only realistic prospect for achieving climate targets while safeguarding security of supply.

“According to our forecasts, by 2050 all Austrian household gas consumers can be supplied in full with green gas, opening the way for sustainable heating.”



#mission 2030

Austria's climate and energy strategy commits it to the goals of the Paris Agreement and the EU's 2030 targets.

By 2050 the country aims to have created a modern, resource-friendly, decarbonised energy system.

- ✓ **Reducing greenhouse gas emissions**
Greenhouse gas emissions are to be reduced by 36 % from 2005 levels by 2030. Measures will focus on transportation and buildings.
- ✓ **Renewable energy**
The share of renewables in overall consumption is to rise to between 45 % and 50 % by 2030. The figure currently stands at 33.5 %. The aim is for all of Austria's electricity needs to be met by renewable energy sources by 2030.
- ✓ **Raising energy efficiency**
To permit continued growth in future, especially in the industrial sector, by 2030 primary energy intensity is targeted to improve by 25-30 % in comparison with 2015.
- ✓ **Security of supply is top priority**
The focus will be on existing highly efficient CHP plants as well as the necessary expansion and modernisation of network and storage infrastructure.

Flagship project: Production of green gas will be promoted as a major flagship project. Measures will include reduced costs for injection into the grid and tax advantages.

Source: BMNT, BMVIT – May 2018

Business areas



Production

RAG deploys advanced technology to produce eco-friendly natural gas with minimum impact on the environment, and researches and develops the production of renewable gas. Hydrogen made using wind and solar energy is converted into methane underground, in natural gas reservoirs, and large amounts of this gas can be stored. The company also continues to implement geothermal energy projects.

Storage

RAG stores large volumes of gaseous energy (methane and hydrogen) in natural underground reservoirs. The gas storage facilities operated by RAG, with a combined capacity of 6 billion (bn) cubic metres (cu m), are vital to security of supply in Austria and Europe. The company's storage capacity is marketed by its subsidiary RAG Energy Storage GmbH.

Supply

We provide our customers with reliable storage services, 24 hours a day, 365 days a year. We deliver flexible and import-independent supplies of our own natural gas and geothermal energy which are secure because they are domestically produced. In the sector of mobility, our liquefied natural gas (LNG) and compressed natural gas (CNG) filling stations offer environmentally friendly fuels.

Natural gas

Natural gas is by far the most environmentally friendly conventional energy source, and one of the most important worldwide. Expert opinion is unanimous that natural gas will not merely remain important, but that its role will grow.

Gas is fit for the future. It is low on emissions, innovative, in abundant supply, increasingly green, and set to become climate neutral over the long term.

Gas underpins our competitiveness and jobs. Only gas can assure Austria's future as a business and industrial location by providing climate friendly energy supplies that arrive precisely when and where they are needed.

Climate friendly natural gas has a pivotal role to play in the progressive decarbonisation of the energy system. The statistics show that gas is growing in importance. A forecast increase in consumption of almost 50 % worldwide by 2040 makes natural gas the fastest-growing fossil fuel. Its share of the energy mix will climb to 26 %, meaning it will replace oil as the world's most important energy source. This boom will principally be driven by the power generation and industrial sectors, while the expansion of LNG infrastructure will decisively improve its availability.

Revolutionary power-to-gas technology holds the key to affordable solar and wind energy transportation and storage, and thus to the constant availability of these energy sources. Gas has become indispensable not only in electricity generation, but also in heat generation – at cogeneration plants – and in the transportation sector as LNG and CNG. Natural gas, as an energy carrier, achieves a universality, which until then was the sole possession of crude oil and fully deserves its reputation as the energy source of the future.

	Global Consumption (Mtoe)		Shares (%)	
	2016	2040	2016	2040
Primary energy	13.276	17.983	100%	100%
By fuel:				
Oil	4.336	4.836	33%	27%
Gas	3.204	4.707	24%	26%
Coal	3.732	3.762	28%	21%
Nuclear	592	912	4%	5%
Hydro	910	1.241	7%	7%
Renewables	502	2.527	4%	14%

Quelle: BP Energy Outlook 2018

Gas's attractions are increased by currently competitive prices, high energy efficiency and highly developed existing infrastructure. It provides round-the-clock security of supply, which is crucial to the economy because of its importance to large industrial companies as well as small and medium-sized enterprises. The main consumer of natural gas in Austria is the industrial sector, accounting for 43 % of total demand. Gas is used to generate process heat or as a raw material in production. Natural gas is the most important energy source for Austria as an industrial location.

Gas has the fastest-growing share of fossil fuel consumption, since it is undoubtedly the climate friendly, reliable, low emission alternative for power generation and other applications. Gas is an ideal and essential back-up for renewables due to its ability to compensate for swings in electricity supply and demand.

The advantages of gas

- ✓ Using gas for heat, transportation and power generation can lower emissions of carbon dioxide (CO₂) and other pollutants quickly and cheaply.
- ✓ Gas is the natural partner for renewables because of its flexibility when injected into existing storage facilities and the gas grid.
- ✓ Gas can be green: biomethane, hydrogen and power-to-gas mean that over the long term gas supplies will become carbon neutral.
- ✓ Gas has a key role to play in forward looking, climate friendly energy supplies. It can be easily and efficiently used for space and water heating, cooling and electricity generation, and as fuel for trucks and cars. Gas does not release any fine particulates when burned, making it the lowest-emission fossil fuel. And gas can be eco-friendly: biomethane is produced from biogenic waste, and synthetic gas is produced from renewable electricity and hydrogen (power-to-gas).

Natural gas production

Valuable energy on our doorstep: supplies of locally produced, eco-friendly natural gas play an important economic role, among their many advantages. RAG has been producing natural gas at fields in Austria for over 50 years.

Gas is vital to industry, district heating and power generation.

Austria's gas reserves play an important part in security of supply. In addition, gas production is a major growth driver for the economies of the regions where it takes place. About 15 % of the gas required by Austria is produced domestically. The remaining 85 % is made up of imports from the CIS and other countries. RAG contributes about 45 % of domestic production.

Domestic energy

RAG has been producing natural gas at fields in Lower Austria, Upper Austria and Salzburg for over 50 years, and today operates about 200 gas wells.

Supplies of locally produced, environmentally friendly natural gas play an important economic role, among their many benefits. We know exactly where the gas comes from, and that it is produced and transported according to the

strictest environmental and safety standards – and this reduces import dependence. Currently, Austria meets about one-sixth of gas demand from households, industry and power stations with domestic output. The biggest gas discovery in RAG's history was the 17.5 square kilometre Haidach field, near Strasswalchen, struck in 1997; today it is Austria's largest gas storage facility, with a capacity of 2.6 bn cu m.

State-of-the-art production technology

When a new gas field is identified by a 3D seismic survey and is developed, first a production string, reaching down to the bottom of the reservoir, is inserted into the production well, once it has been cased and cemented. For the gas to flow into the well from the reservoir, the casing and cement must then be perforated. A so-called "Christmas tree" that closes off the well is installed at the surface.

A downhole safety valve in the production string prevents the uncontrolled release of gas. The natural reservoir pressure, which can be several hundred bar, lifts the gas to the surface, where it travels from the wellhead to the treatment plant via a high-pressure pipeline. Depending on the reservoir type and the pressure depletion, anything up to 99 % of the natural gas in place can be recovered. The flow rate declines over time, along with the reservoir pressure. Because of this, additional production wells are required later in the life of a field to maintain the level of overall output.

Clean natural gas for consumers

Before the gas can be fed into the supply network it has to be processed. First, the produced formation water, liquid hydrocarbons and solids are separated out in drying plants. The remaining water vapour is then removed from the gas using glycol or adsorption agents. Finally, the pipeline-quality natural gas is fed into the network.

"Natural gas is by far the most environmentally friendly conventional energy source. It can be safely stored in very large quantities, and is ideal for transportation in existing underground pipeline infrastructure. Gas is a key factor in maintaining security of supply at all times."

The history of gas production in Austria

RAG recognised the potential of gas as an energy source as early as the 1960s. Until then, it had barely played any role in the Austrian economy. The first natural gas discoveries were mostly a by-product of oil exploration. Targeted gas exploration only became possible with modern methods such as 3D seismic surveys. Demand for natural gas was particularly strong in Upper Austria. When RAG encountered gas in Voitsdorf in 1963, it was possible to use it as an energy source for a large-scale industrial plant for the first time, launching the rapid development of natural gas in Upper Austria. Over a period of just a few years, RAG discovered and developed a number of small gas fields. The industrial enterprises in the Wels and Linz areas were potential large-scale consumers, and could be directly supplied with locally produced gas.

Over the past 40 years, natural gas has experienced a rapid upswing as an energy source. Starting from 0.76bn cu m of natural gas in 1955, output rose continuously to reach a peak of 2.5 bn cu m in 1978. Since then domestic production has hovered between 1 bn and 1.8 bn cu m annually. In 1970 domestic production still met 66 % of Austrian gas consumption. Due to the strong growth in take-up of this environmentally friendly energy source, the proportion stands at a sixth of the country's annual consumption today – with gas still a mainstay of security of supply.



Supply and trading

RAG has international gas trading operations, and supplies domestic and foreign energy companies, and industrial consumers. The company specialises in providing flexible and secure supplies of gas produced from domestic reserves.

In the past, RAG's equity gas output was sold almost exclusively to its owners. This was in the days before gas market liberalisation, when contract design and fulfilment were still a simple matter. The pace of change has been rapid since then. The EU's energy liberalisation efforts, initiated in 1998, have opened up the gas markets in large parts of Western and Central Europe, and traders and suppliers can now buy and sell gas on increasingly liquid exchanges and trading platforms. As a result of gas market liberalisation in 2002, RAG was able to market its gas production outside Austria and the focus switched away from sales at entry points to the national low pressure grid, towards exports via virtual trading points. RAG has since made a name for itself as a flexible, independent company. In 2002 its natural gas sales topped 1 bn cu m for the first time. The company has progressively built up a trading and supply business which operates on markets throughout Europe.

"Security of supply is the core issue for the energy sector. That's our mission, too, and we are totally committed to it. When everything is running normally people tend to forget how vital complete security of supply is in an emergency. We supply regional utilities and are the backbone of their services. Our storage facilities have to keep functioning, come what may, and be ready to spring into action at any time. That's our day-to-day business. There's a lot of high tech behind the scenes."

RAG is an active market participant of a number of European gas hubs and exchanges. EU-wide gas liberalisation and the creation of entry/exit systems have opened up new trading opportunities. The company's downstream division is responsible for gas trading and sales, and gaining the necessary access to markets. Many years of experience and close monitoring of markets enable RAG to provide its customers with tailor-made solutions.

With pricing increasingly decoupled from oil and driven by spot quotations, the influence of European trading points and exchanges is steadily growing. The resultant price volatility is bringing new challenges for supply portfolio design and risk management.

RAG also produces and supplies liquefied LNG (Liquefied Natural Gas) for use as a low-carbon transport fuel, or to make gas available to industrial and commercial consumers, that are not connected to the public gas grid.



Gas storage facilities

In Austria gas storage facilities are synonymous with security of supply. RAG is Europe's fourth-largest storage operator, with 6 bn cu m of storage capacity at its facilities.

RAG has been using depleted gas reservoirs to store gas for over 35 years. Expansion of gas storage in Upper Austria and Salzburg has made RAG not only the largest energy storage company in Austria over the last 20 years and one of Europe's leading operators of gas storage facilities, but also a cornerstone of security of supply in Austria and Central Europe. RAG has converted about half of the gas reservoirs discovered over its 80-year history into storage facilities and thus enabling a sustainable energetic use – a figure unmatched anywhere in the world. The company is well-equipped to meet one of the biggest challenges of the future – energy storability.

Thanks to the fact that Austria's geology is ideal for underground storage it is able to make a major contribution to security of supply in Europe as a whole.

Sustainable use of reservoirs

By progressively expanding its gas storage capacity, RAG has added a key additional link to its supply chain, and in so doing it has developed a sustainable use of gas reservoirs. The 6 bn cu m of storage capacity operated by RAG alone is roughly equivalent to 75 % of Austria's annual natural gas needs. Relative to consumption, the country already has the largest gas storage capacity in Europe. The company's storage facilities serve customers in Austria and abroad, and include joint ventures with multinationals such as Gazprom and Uniper. RAG's storage capacity is marketed by its RAG Energy Storage subsidiary.



Balancing out daily and seasonal demand swings

Natural gas is produced throughout the year, at roughly constant rates. Austria's imports are transported along long-distance pipelines from Norway and Siberia, and as LNG cargoes. The amount of gas consumed by industry, power stations and households varies according to the season and time of day. Demand is much higher in winter than in summer, and more gas is used during the day than at night. Gas must be stored to balance out these swings in demand, and to ensure that it is available when needed.

"Natural gas is by far the most environmentally friendly conventional energy source. It can be safely stored in very large quantities, and is ideal for transportation by existing underground pipeline infrastructure. Gas is crucial to energy security of supply, and plays a key economic role due to its use in industry, district heating and power generation."

50 of the gas reservoirs
% have been sustainably converted into natural gas storage.

Gas storage – the perfect partner for renewables

RAG's gas storage facilities are crucial to the progressive decarbonisation of the energy system, the attainment of climate targets and the growing use of renewable energy sources. Together, environmentally friendly natural gas and renewables are a dream team. Natural gas from storage is a dependable source of energy to balance out the swings in wind and solar power output. To achieve the planned expansion in the use of renewables, these energy sources need a partner in the energy mix to even out the supply fluctuations – and natural gas fits the bill perfectly. It is easy to store, and gas-fired power stations are not only environmentally friendly and efficient, they also offer outstanding operating flexibility. They are able to react immediately to ups and downs in wind and solar output. RAG's gas storage facilities can also be used for green gas. An important development is the injection of gas generated using wind and solar power (hydrogen or methane) into existing gas infrastructure. Biogas (biomethane) will also play an increasingly important role.



From gas fields into storage facilities

Storing gas in depleted reservoirs is certainly one of the most efficient, eco-friendly and safe ways of stockpiling energy – but it takes a lot of expertise to get it right. A modern storage facility is a masterpiece of engineering.

RAG's success is a product of the company's wealth of experience, innovative capacity, state-of-the-art technology and benchmark safety standards.

After a gas reservoir has ceased to be productive, it can be used as a storage facility instead.

When gas arrives at a storage facility via a pipeline network it first enters a metering station where it is filtered, and the quantity and quality are measured. Injection and withdrawal take place via a number of wells.

Where necessary, compressors bring the incoming gas up to the right injection pressure. Since compression raises the temperature, the gas must then be cooled before being conveyed to the wellhead and injected via the probes into the natural rock formations. The pressure that originally prevailed in the reservoir is not exceeded. The gas is withdrawn when it is

needed, and processed accordingly. It must be dried as it will have absorbed moisture in the reservoir. Once it is on-specification it enters the public grid and is transported to the consumer.

"In the course of its many years of storage experience, RAG has steadily developed the technical know-how required for natural gas storage. Thus, the most modern technology guarantees flexible use and maximum safety."

Conserving resources and the environment

Husbanding domestic resources and good environmental stewardship play a vital role in gas storage, and all the processes at storage facilities operated by RAG are designed for maximum eco-friendliness. Optimizing energy use and minimizing emissions, technologies for waste prevention and new methods for permanent monitoring and testing of plants and lines are particularly vital. This is where internal control and an energy management system certified according to the ÖNORM EN ISO 50001:2011

standard come in.



Expertise and safety

RAG has demonstrated that it is equal to the technical challenges posed by gas storage, and has the requisite expertise. Its state-of-the-art storage facilities are permanently monitored and maintained. Highly skilled staff run the installations from a dispatching centre, working around the clock to maximise efficiency, and to optimise environmental and technical performance. RAG is also an industry leader in terms of safety, and the entire safety management system at RAG's installations is based on audited processes. In 2009 RAG became the first European company to obtain Technical Safety Management (Technisches Sicherheitsmanagement, TSM) certification from the German Technical and Scientific Association for Gas and Water (Deutscher Verein des Gas- und Wasserfaches e.V., DVGW). Systematic quality and environmental management, and strict health and safety standards are central to RAG's philosophy.

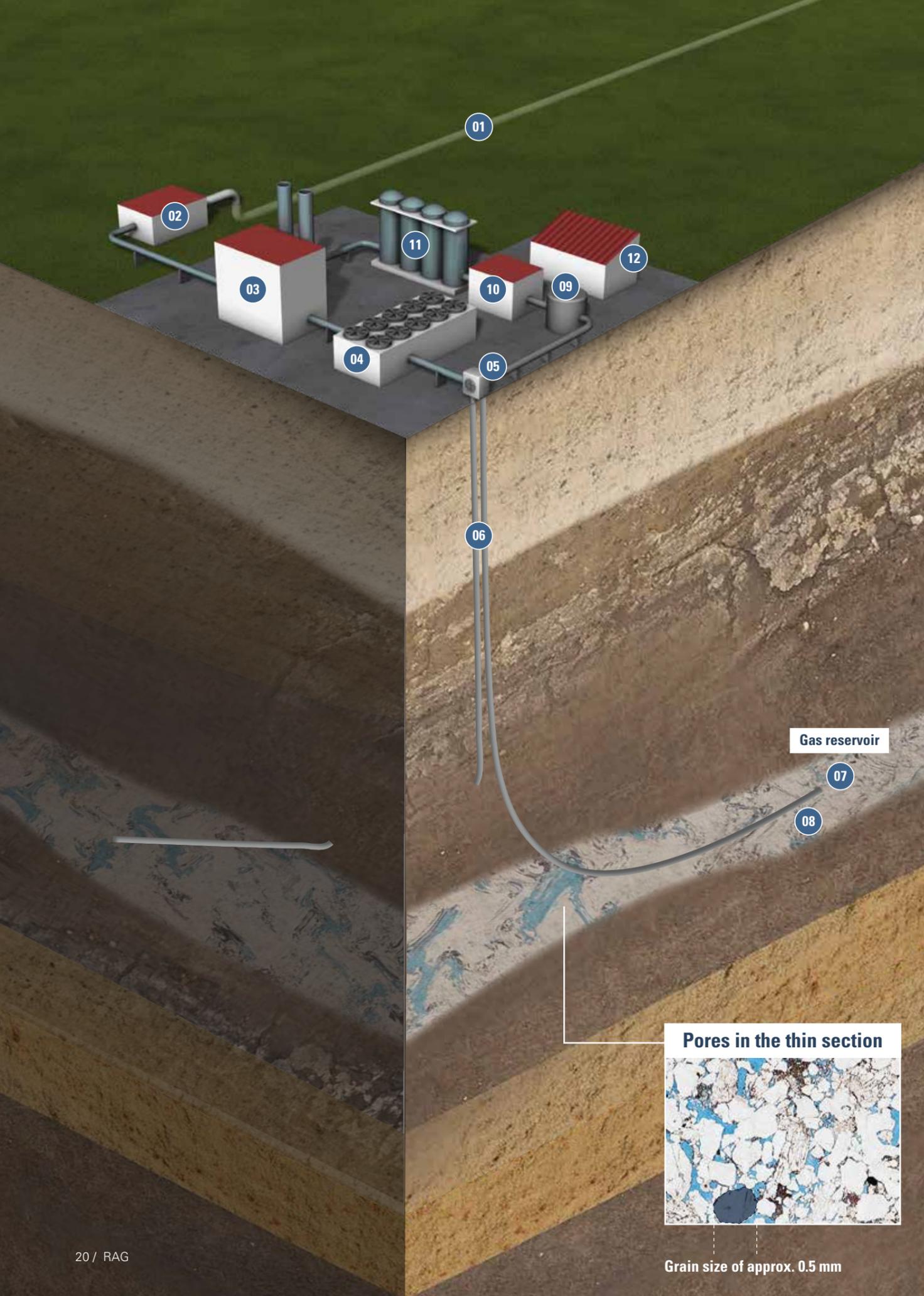
6 billion cubic metres

After starting out over 35 years ago with 50 million (mn) cu m of storage capacity in Puchkirchen, today RAG is one of Europe's biggest storage operators, with total storage capacity of about 6 bn cu m. This corresponds to a more than hundred-fold increase in capacity.

Efficient, sustainable and safe

Use of depleted gas reservoirs is the safest, most efficient and most environmentally friendly way of stockpiling energy. Austria has geological structures that are unique in Europe and ideal for gas storage. New supplies can be stored in these formations, where gas accumulated naturally over millions of years, at depths of over 1,000 metres. These former gas fields originated over 20 million years ago, when organic matter in the primeval ocean that occupied today's Prealps was trapped by sandstone sediments. Over time, the gas migrated into the pores of the sandstone, forming gas reservoirs that can have an area of several square kilometres. Clay strata several hundred metres thick overlie the gas reservoirs, and this natural insulating layer makes them an extremely safe means of underground storage. The proof of this comes from nature itself, since the original gas reserves were held there for millions of years.

How do gas storage facilities work?



01 Public grid

When gas arrives at a storage facility via a pipeline network, it first enters a metering station where it is filtered, and the quantity and quality are measured. Injection and withdrawal take place via a number of wells. Where necessary, compressors bring the incoming gas up to the right injection pressure. Since compression raises the temperature, the gas must then be cooled before being conveyed to the wellhead and injected via the probes into the natural rock formations. The pressure that originally prevailed in the reservoir is not exceeded.

02 Metering station

03 Compressor station

04 Cooling units

A certain amount of natural gas is left as cushion gas in the reservoir to minimize the number of wells. The cushion gas assists the pressure released after the natural gas has been exhausted and optimizes the storage facility for operation. The so-called „working“ gas is injected and withdrawn as needed. In this way, the natural gas storage can be operated economically and ecologically at the highest level.

05 Wellhead

06 Well

The gas is withdrawn when it is needed, and processed accordingly. It must be dried as it will have absorbed moisture in the reservoir. Once it is on-specification it enters the public grid and is transported to the consumer.

07 Reservoir

08 Working or cushion gas

09 Preheater

10 Pressure reduction station

11 Drying unit

12 Control room and stores

RAG's gas storage facilities

As the operator of storage facilities that have a total capacity of about 6 bn cu m of natural gas, RAG is Austria's largest gas storage provider and one of Europe's leading storage operators, making a significant contribution to security of supply in Austria and across Central Europe.

Puchkirchen/Haag

RAG's gas storage operations originated in Puchkirchen, Upper Austria. This was the site of its first Austrian natural gas discovery, made in 1956. In 1982, after more than 25 years' production, RAG began using the gas reservoir as a storage facility. The last of a number of expansions was completed in 2009, and in the summer of that year Puchkirchen was linked with the Haag facility by a 20-kilometre pipeline. The facility currently has a maximum working gas volume of about 1.1 bn cu m (equivalent to 12.2 terawatt hours, TWh), and injection and withdrawal capacity of 520,000 cu m/hour (5.9 gigawatts, GW).

Haidach 5

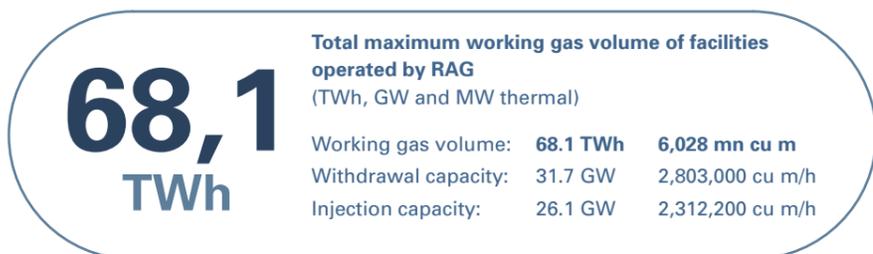
The repurposing of the depleted gas formation as a storage reservoir was carried out in 2005. Haidach 5 has a maximum working gas volume of around 16 mn cu m (equivalent to 181 gigawatt hours, GWh), and injection and withdrawal capacity of some 20,000 cu m/hour (226 megawatts, MW).

Nussdorf/Zagling

RAG built this facility between 2011 and 2014, as part of the 7Fields project, and it was commissioned in April 2014. It has a working gas volume of 289 mn cu m (equivalent to 3.3 TWh), with an injection capacity of 120,200 cu m/hour (1.4 GW) and withdrawal capacity of 150,000 cu m/h (1.7 GW).

Aigelsbrunn

Gas production at this field started in 2001. Development of the gas storage facility began in 2008, and it was commissioned on 1 April 2011. Aigelsbrunn has a maximum working gas volume of approximately 130 mn cu m, and injection and withdrawal capacity of 50,000 cu m/hour (equivalent to 565 MW).

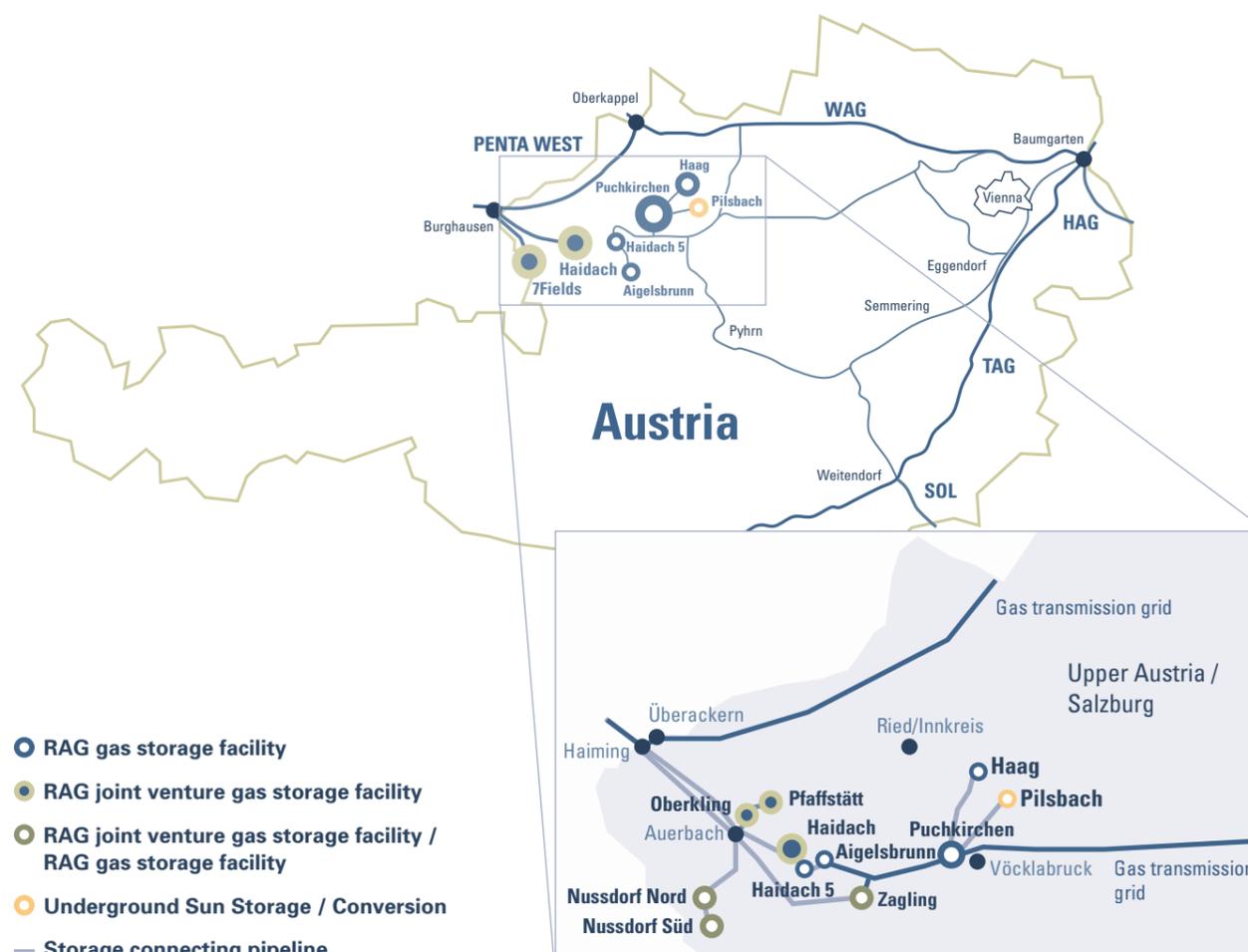


Haidach

The Haidach gas storage facility is a joint venture between RAG, Russia's Gazprom Export and Germany's Wingas. RAG designed and built the facility, and operates it. Gazprom markets the capacity. The first development phase came onstream in 2007, and the second in April 2011. The total storage capacity of 2.78 bn cu m of natural gas is equivalent to a quarter of annual gas consumption in Austria. Haidach is the second-largest storage facility in Central Europe.

7Fields

The 7Fields facility is a joint venture project between RAG and Germany's Uniper. As with Haidach, RAG was responsible for design and construction, and operates the facility. Uniper markets the capacity. The first development phase was completed in April 2011, after just two years' construction time, and the second phase was finished in April 2014. Storage capacity now totals some 1.7 bn cu m. The site is unique in Europe, with four storage stations connected via pipelines to three metering stations, and to the Austrian and international gas grids.



Natural gas on the move

Mobility plays an essential role in a functioning economy. But in the age of climate change, one thing is clear: transport fuel must be clean, affordable and safe. Gas fits the bill on all counts.

Natural gas is the cheapest and safest way to slash road traffic pollution.

Global, European and national climate targets aim for a reduction in vehicle emissions, since all medium and long-term forecasts predict growth in traffic – especially heavy goods traffic. In recent years the effects of improvements in the efficiency of drive systems and fuels have been cancelled out by sharp growth in goods traffic. This has led to annual increases in road traffic related greenhouse gas emissions. Road traffic is responsible for about 45 % of emissions. In urban areas in particular, air quality suffers from vehicle emissions. A raft of EU initiatives are therefore promoting increased use of natural gas or rather LNG as transport fuels.

The advantages are obvious:

- ✓ Reduced nitrogen oxide emissions
- ✓ Reduced fine particulate emissions
- ✓ Reduced noise

Infrastructure

Major investments are being made in infrastructure (filling stations) across Europe. RAG operates LNG and CNG filling stations in Upper Austria, opening up driver access to

environmentally friendly, affordable natural gas. As a producer of natural gas and operator of gas storage facilities, RAG can warrant a crisis-proof supply of fuel at stable prices far into the future.

The fuel of the future

The use of environmentally friendly gas as a fuel can make a major contribution to hitting ambitious climate targets. In the future, green gas produced from renewable sources could also be used in the form of LNG, in addition to conventional natural gas. RAG's ongoing research and development activities are opening up new possibilities. Power-to-gas technology is being used to produce synthetic gas from surplus electricity generated by solar and wind power installations. Hydrogen is derived from water by means of electrolysis. This gas can then be converted into methane, binding CO₂ in the process. The synthetic methane is of the same quality as natural gas, and can simply be injected into the existing gas grid and held in natural gas storage facilities. This means that renewable gas for transportation can be provided at any time, around the clock, and need never run out.

Mobile gas supplies

Natural gas is frequently required for testing purposes or as an emergency supply in a variety of situations that occur in the operation of gas plant and pipelines. Since gas cannot always be withdrawn from pipelines, RAG has acquired extensive experience in compressing natural gas (methane) to produce CNG, and in transporting CNG. This expertise is also available to our customers, forming part of the portfolio of products and services we offer.



Liquid natural gas (LNG)

LNG is a tried and tested technology, and refuelling is quick and easy. Since it is ideal for long-haul routes it is perfect for heavy goods vehicles.

LNG is a competitive, clean and affordable alternative to conventional fuels for road haulage.

The strict environmental requirements of the Euro 6 emissions standard can easily be met by LNG. In comparison with diesel, emissions of sulphur oxide and fine particulates from vehicles running on LNG are 95 % lower, while nitrogen oxide emissions are over 70 % lower and CO₂ emissions up to 15 % lower. Noise emissions from LNG vehicles can be up to 50 % lower than those of diesel vehicles. In other words, LNG already offers an environmentally benign alternative for mobility, and the cost arguments are also on its side. Operating costs are an important factor for road hauliers, and with LNG vehicles fuel costs undercut conventional fuels such as diesel.

Infrastructure

RAG opened Austria's first LNG filling station at Ennshafen port, near Linz, in 2017. The site in Enns has a capacity of 12 tonnes of LNG, enough to refuel between 60 and 90 trucks. RAG delivers natural gas using its own LNG tankers. Some of the gas comes from RAG's gas fields in Austria, and is processed at the company's LNG plant in Gampern, Upper Austria. This currently produces about two tonnes of LNG a day for use at the Ennshafen LNG filling station. This is enough to refuel 10-15 LNG-powered trucks a day.

In establishing LNG as an environmentally friendly fuel for goods vehicles, RAG is making a vital contribution to achieving Austria's climate targets.

Advantages of LNG-powered trucks

- ✓ CO₂ emissions up to 20,000 kg/year lower in comparison with a Euro 6 diesel truck
- ✓ 95 % reduction in fine particulates
- ✓ Over 70 % reduction in nitrogen oxides (NO_x, NO₂)
- ✓ No AdBlue/catalytic convertor needed
- ✓ Mature technology for use in heavy goods vehicles, and assured long-term availability
- ✓ Reduction in vehicle noise of about 50 %
- ✓ Infrastructure being rolled out along the LNG Blue Corridors – principle routes for LNG heavy goods vehicles in Europe
- ✓ EU initiatives such as Horizon 2020

What is LNG?

Liquefied natural gas (LNG) is natural gas that has been converted to a fluid state by cooling it to a temperature of around -160 °C. The expansion ratio of natural gas from liquid to gaseous form is 1:600, meaning that large volumes of energy can be transported and stored as LNG. It can be produced in Austria or transported to customers in specially designed road, barge and sea-going tankers. As well as being easy to transport and store, LNG offers another significant benefit: it is highly economical and efficient. As extremely pure natural gas that consists almost entirely of methane, it has an average gross calorific value of approx. 11.3 kWh per cubic meter of gas.

Compressed natural gas (CNG)

Environmentally friendly natural gas is an outstandingly economical, safe and clean vehicle fuel, and has been in use in Austria and around the world for decades. In principle, gas-powered cars work the same way as cars that run on petrol – the petrol engine was actually originally developed for gas. This has many advantages: the technology is mature, and the same engine can run efficiently on either CNG or petrol. The gas is condensed by compressors at the filling station, and stored in pressurised containers.

Clean – safe – quiet – cheap

Natural gas is an affordable and environmentally friendly alternative to conventional fuels. It takes the form of methane – produced from natural sources, biofuel production or the conversion of renewable solar and wind energy. This means the fuel tank contains either natural gas or compressed natural gas made from natural materials – protecting the environment. Since natural gas has a high hydrogen and low carbon content, up to 20 % less CO₂ arises than with normal petrol. In comparison with diesel, nitrogen oxide emissions are 90 % lower, and in comparison with petrol, 80 % less carbon monoxide is emitted. The main emission produced when burning gas is steam – and vehicles emit virtually no fine particulates. Using CNG vehicles can significantly improve air quality, especially in urban areas. CNG is also quieter. Natural gas burns more slowly, and therefore more softly, making it only about half as noisy as diesel. With an octane rating of 130, it is also extremely

knock-resistant. All in all, vehicles running on natural gas are quieter than those that use petrol or diesel.

Filling up

It could hardly be easier or safer: filling up is as simple as it is for vehicles running on conventional fuels. However, CNG will not flow if the connection to the car is not correctly made and leak-proof. The process takes roughly the same amount of time as filling up a car with regular fuel. CNG filling stations can now be found throughout Austria, and the network is continually expanding. The country has about 160 stations at the moment – relative to the size of the country, this is the most extensive network in Europe.

RAG has operated public, self-service natural gas filling stations at its sites in Gampern and Kremsmünster, open around the clock, since 2014. This business model will be steadily rolled out across RAG's exploration and production areas, to give consumers access to environmentally friendly, affordable, locally-produced natural gas as a transport fuel.

1kg of natural gas contains the same amount of energy as 1.5l of petrol



New technology

The future belongs to green gas. For some time now, RAG has been working hard on new approaches to making large amounts of renewable energy conveniently accessible for consumers. Wind + sun = green gas – this is the equation behind power-to-gas. Together with natural gas, this could be the key to the success of the energy transformation. It can make the transportation and storage of large amounts of solar and wind power economically viable. It can mean that climate friendly energy is always available whenever it is needed.

Green gas not only has immense potential, it is sustainable, affordable and hence available round the clock. In other words, it is the enabler of the energy transformation.

Its flexibility means that gas – and increasingly renewable green gas, thanks to power-to-gas technology – offers a secure, sustainable and climate-friendly supply of energy.

Together, versatile natural gas and renewables are already a dream team. Sometimes the wind does not blow or the sun goes in, while at other times surplus power is produced. To meet ambitious climate goals, and for renewable energy sources to increase their share of the energy mix over the long term, renewables need a means of compensating for fluctuations in output.

Variable green power supplies are not the only problem. How can we draw on energy produced in summer during the winter? What is to be done with all the excess power generated by wind and solar farms at times of low consumption?

This surplus energy needs large amounts of storage so that it can be made available during peak periods. The pump storages used up to now do not have sufficient capacity. The solution is obvious. Gas infrastructure in the shape of pipelines and subterranean storage facilities – which can store more gas than is consumed in Austria in a year – already fulfil all the requirements for future use as a storage system for green gas.

A number of German studies indicate that using existing gas infrastructure and power-to-gas technology can slash the cost of the energy transformation. This approach would both remove the need to build new power transmission lines and spare consumers the expense of replacing efficient gas central heating systems and appliances.

Energy storehouses

Most of the renewable electricity produced in Austria is generated in spring and summer – outside the heating season. Run-of-river power stations produce twice as much energy in summer as they do in winter, and seven out of every ten kilowatt hours (kWh) of solar power are generated in the summer months. But this energy cannot be stored for extended periods because the electricity storage that would be needed is lacking. Existing gas storage facilities are the answer.

Power-to-gas

The principle behind power-to-gas could hardly be simpler: Surplus solar and wind power is used to split water into oxygen and hydrogen by means of electrolysis. The hydrogen can then be stored for later use, for example as primary energy in fuel cells. A further process stage is also possible: in methanation, the hydrogen reacts with carbon dioxide (CO₂) to form methane, the main component of natural gas (typically making up 98 %). The CO₂ can be drawn from the atmosphere or it can come from a biogas or industrial plant. The product of the process is renewable synthetic natural gas.

This means that electricity can be converted into gas, making it storable in large quantities for the first time. The process solves one of the biggest problems posed by electricity storage – shortage of space. It can simply fall back on existing natural gas infrastructure, in the shape of the pipeline grid and the gigantic storage facilities. Instead of developing and rolling out expensive, high-tech storage solutions, power can be transformed into synthetic natural gas and stored in depleted gas reservoirs.

The process gives rise to no emissions apart from the oxygen released when the water is split. Today the efficiency of the conversion process is already about 60 % – a lot when one thinks that today surplus electricity is often not used at all owing to the lack of storage capacity, and instead wind turbines are idled or whole wind farms taken off the grid.

Underground Sun Storage

Harvesting, storing and supplying solar energy: RAG tested this groundbreaking approach to energy production and storage in a unique research project, Underground Sun Storage.

RAG's constant ability to innovate and commitment to research and development are among its key success factors.

The storability of hydrogen produced using solar energy was demonstrated at a small depleted gas reservoir in Upper Austria. Energy from renewable sources that can be retained thanks to storage offers the only straight replacement for conventional energy – and Austria's gas storage facilities provide the necessary infrastructure. The project is being financed by Austria's Climate and Energy Fund.

The challenge

In most cases renewable energy sources are difficult to manage. Neither the wind nor the sun obey energy demand. But the electricity grid cannot store energy, so grid operators have to adjust generation precisely to demand. If it were possible to store large amounts of power and inject it back into the grid when needed, generation would no longer be tied to demand. That is why huge energy storage facilities are essential in a world that relies on renewables. In nature, carbon and hydrogen have evolved as primary sources of energy, and the main substances in which energy is stored.

“Power-to-gas technology enables conversion of surplus electricity into hydrogen or rather synthetic methane. The Underground Sun Storage project is investigating the storability of hydrogen as an additive to natural gas / synthetic methane in pore reservoirs.”

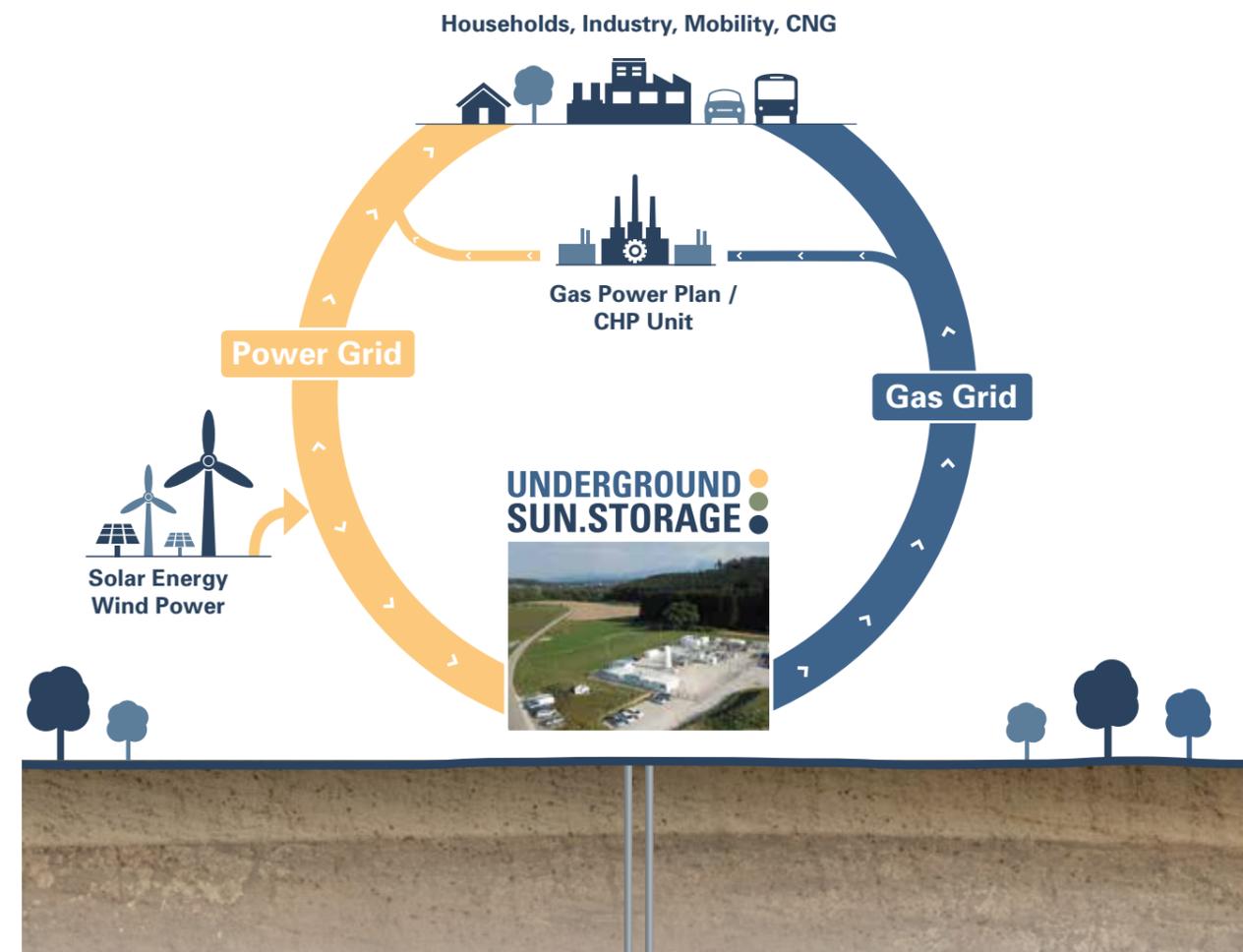
Storing hydrogen

We have taken these processes as a model and imitated them with power-to-gas technology. Using electrolysis, excess energy generated from renewables is transformed into hydrogen, which can be stored in the natural gas network. A range of tests are being conducted to investigate how far the natural gas infrastructure tolerates hydrogen. These have already demonstrated that the existing infrastructure copes well with hydrogen content of up to 10 %.

Finding a solution to the question of storing renewable energy is the key to maximising its contribution to the energy mix and thereby achieving a substantial reduction in CO₂ emissions. In terms of the strategic development of energy systems for the future, the research project led by RAG is hugely significant for companies, political decision-makers and public authorities.

Seasonal conversion and storage

UNDERGROUND SUN.STORAGE



The research project

The main purpose of this pioneering project was to investigate the hydrogen tolerance of underground gas storage reservoirs. The project demonstrated that gas storage facilities can tolerate hydrogen content of up to 10 %. This means that naturally formed gas storage reservoirs are not a limiting factor within the gas system as a whole, and with their vast storage capacity (more than 8 billion cubic metres in Austria, equivalent to 92 terawatt hours), their role in the energy system of the future could change significantly, since they can be used to store and balance supplies of renewable energy.

The project comprised laboratory experiments, simulations and a field trial conducted on an industrial scale at an existing reservoir with similar characteristics to Austria's large developed storage facilities. The tests were accompanied by a risk assessment, a life cycle assessment, and an analysis of the legal and economic environment. Simulation tools developed in the course of the project were calibrated by comparing the results of the laboratory tests, simulations and the field trial. They will make it possible to investigate many other structures around the world in the same way.



Underground Sun Conversion

Geological history fast forward: over 1,000 metres below ground, where natural gas formed millions of years ago, a microbiological process for producing renewable natural gas is being tested for the first time. It will permit the organic, renewable production of natural gas.

This unique method recreates the process by which natural gas originates, but shortens it by millions of years – like geological history in fast motion. A microbiological process can transform hydrogen and CO₂ into methane – renewable natural gas – in suitable gas reservoirs. Converting the energy, increasing the energy density and storing it take place out of sight, in porous rock formations at depths of over 1,000 m.

Manufacturing natural gas

First, hydrogen is produced from solar or wind energy and water (using power-to-gas technology) in an above-ground facility, and then injected into an existing gas (pore) reservoir. At a depth of over 1,000 metres, in a relatively short time naturally occurring microorganisms convert these substances into renewable natural gas – which can be stored in the same reservoir, withdrawn as needed at any time, and transported to consumers via the existing pipeline network. The aim of the research project is to use existing gas (pore) reservoirs as natural geological “reactors”. The methanation process and storage take place naturally in

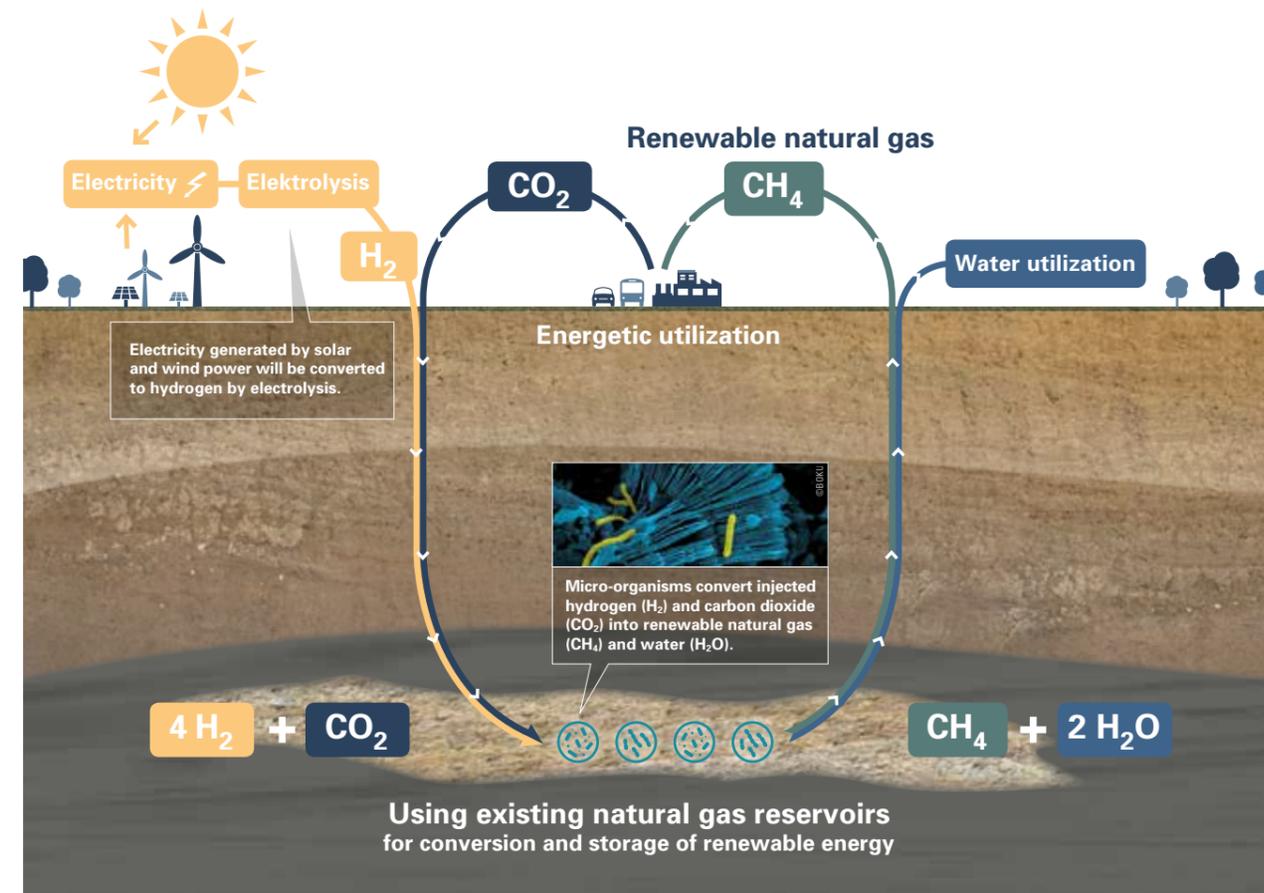
an underground pore reservoir. This is the key to the project’s huge potential as it promises to provide the urgently needed flexibility that renewable energy currently lacks. It holds out the promise of achieving the creation of a sustainable carbon cycle. Laboratory tests, simulations and scientific field tests are being carried out at an existing RAG reservoir in collaboration with a group of project partners. A further objective is to test whether the research results can be repeated in other formations around the world. The striven findings are of great importance as they could extend Austria’s lead position in energy storage, and associated research and development. The goal is to apply the methods developed by the project – both the technology and the expertise – on a global scale.

Austrian Climate and Energy Fund lead project

Initial laboratory tests conducted in the Underground Sun Storage project showed that hydrogen injected into the reservoir with CO₂ is converted into methane by microbiological processes. The Underground Sun Conversion project was initiated on the basis of these findings, and is being implemented by an Austrian consortium led by RAG. The project is being financed by Austria’s Climate and Energy Fund as part of its energy research programme.

A sustainable carbon cycle

UNDERGROUND
SUN.CONVERSION



Benefits

Carbon neutral

Renewable natural gas is carbon neutral if CO₂ that is already present – for example, from burning biomass – is utilised and absorbed by the production process. This creates a sustainable carbon cycle.

Renewable energy becomes storable

Solar and wind power output fluctuates due to changing weather conditions, meaning that production cannot be adjusted to demand.

The problem of storing renewable energy is solved by converting it into renewable natural gas.

Use of existing infrastructure

Infrastructure already in place can be used for the natural production process, as well as for underground storage in natural gas reservoirs, and environmentally friendly transportation to consumers.

A responsible corporate citizen

Responsible corporate behaviour is vital to security of energy supplies in tomorrow's world. Careful stewardship of valuable energy resources, protecting the environment and the climate, and good relations with our neighbours are more important to RAG than ever.

Our company has long fostered an open-door culture where communication thrives, and it is fundamental RAG's success.

Cutting-edge process engineering, highly efficient plants and some of the most stringent safety standards anywhere in Europe, as well as dedicated, experienced staff ensure that security of supply is engrained in our day-to-day operations.

Responsible management

At RAG, corporate social responsibility (CSR) means carefully considering the economical, ecological and social aspects of our activities when making decisions. In addressing these issues we take our lead from the international ISO 26000 social responsibility standard. Our responsibilities to our employees, customers, shareholders and suppliers, as well as to society and the environment are integral to our decision-making processes. Our activities are broken down into these different areas of accountability, and we follow the applicable guidelines on corporate governance, compliance and integrity. All of these considerations are embedded in our policies and underpin RAG's success.

Accepting our responsibilities to employees

Respectful employee relations

Equal opportunities, integration and diversity are central to RAG's corporate philosophy. Our workforce brings together many different nationalities, and all are treated absolutely equally in terms of pay and career opportunities, regardless of their gender, religion, cultural background or ethnicity.

An inspirational work environment

We are committed to providing our employees with excellent, flexible and safe working conditions, and an environment that supports them in making the best use of their abilities and promotes their development. RAG invests in staff development programmes and training including health education courses. An in-house health promotion scheme offers employees a selection of free courses, such as nutrition, exercise and relaxation programmes, as well as initiatives that reflect the latest health-related trends. The company also works closely with healthcare facilities and doctors. RAG has been awarded

the Austrian Health Ministry's quality seal for workplace health promotion; the seal for the 2016-2018 period was received in March 2016. The company offers individual working time and working practices models, in order to meet employees' needs for flexibility. Employees also have the option of taking various types of sabbaticals, and a range of part-time working arrangements are available for older employees. This gives staff the space they need to develop, as well as boosting motivation.

Safety

The safety of staff and local residents, and protecting the environment, are extremely important to RAG. Eliminating the potential risks and dangers facing all of the people working at RAG, and communities affected by our activities, as well as avoiding damage to the environment, is a top priority. When it comes to preventing accidents, the company goes beyond merely complying with the statutory requirements. Its aim is zero accidents in all of its activities, and in order to achieve this RAG has established a dedicated managerial unit which systematically monitors adherence to its targets on the basis of the internal health, safety and environment (HSE) management system, and supports their consistent application and improvement. In addition to implementing workplace safety measures for its own employees, RAG integrates the external companies into its safety-related initiatives. Through clear processes, efficient communication, defined policies and instructions, RAG can also provide these employees with the best possible protection of health and safety. All of RAG's processes are designed to maximise environmental soundness. Particularly close attention is paid to minimising energy use and emissions, use of waste avoidance technology, and new methods for continuous surveillance and testing of plant and pipelines.

Taking a responsible approach to the environment

Research into groundbreaking technology

Working for a future of secure, sustainable and affordable energy supplies, while also reducing greenhouse gas emissions and improving energy efficiency, is one of the biggest challenges facing the world today. For years, RAG, Austria's biggest energy storage company, began focusing on decarbonisation and the transformation of the energy system. In cooperation with several partners, RAG has initiated and conducts research into the production of renewable, carbon neutral natural gas, and storing it in natural gas reservoirs in an environmentally friendly manner. This means that in future it may be possible for large quantities of renewable energy, such as wind and solar power, to be converted into gas, and transported and stored using existing gas infrastructure.

Efficient use of energy and resources

We attempt to use and distribute the energy required for our operations as efficiently as possible. The commissioning of combined heat and power (CHP) plants in Strasswalchen and Kremsmünster has enabled us to make particularly efficient use of electricity and heat from our production and storage facilities, and to inject energy into the public grid. A project to reduce vehicle emissions has been in place for several years. This involves upgrading the vehicle fleet so that it is predominantly made up of gas powered vehicles, and establishing the necessary filling station infrastructure. This move will sharply reduce carbon dioxide emissions compared with conventional fuel types, and eradicate emissions of fine particulates. The aim is to make it simpler for RAG employees and customers, and the general public to switch to environmentally friendly and affordable technology.



Reusing natural reservoirs

Thanks to the use of depleted natural gas reservoirs as gas storage facilities, in the past few years RAG has made a key contribution to European security of supply. About half of the gas reservoirs discovered in the company's 80-year history have now been converted into storage facilities and thus enabling a sustainable energetic use – a track record unmatched anywhere in the world.



Environmental protection

When constructing facilities, RAG takes preservation of the natural environment into account at the planning stage, as part of the environmental analysis. Locations are carefully selected, with the amount of land used as well as emissions and damage to the landscape kept to an absolute minimum. The land is restored to its previous state once the project has been completed. When it comes to constructing permanent facilities such as those for gas storage, RAG is committed to creating compensation areas. We also aim to continually expand cooperation with public authorities, nature conservation experts, planners, local authorities and landowners, and to take account of their requirements and interests from an early stage.

A fair partner and a good neighbour

RAG has a strong reputation for forging long-term relationships with its contractual partners and suppliers. Fair and proper business dealings, integrity and transparency are central to these partnerships. This includes a strong commitment to working with companies that respect and operate in line with RAG's corporate philosophy. Adherence to internal compliance rules designed to prevent corruption is underpinned by staff training, the four-eye principle and an internal control system. Responsible treatment of all stakeholders, especially residents and local authorities in the areas where we

operate, has always been an article of faith for RAG. The company engages in detailed discussions with stakeholders in order to minimise the environmental and social impact of its activities. Constant communication with local authorities, public agencies and key local institutions is essential to building solid partnerships. Ongoing efforts to improve this dialogue with stakeholders are aimed at strengthening trust in the company and its operations.

Dedicated to local communities

Throughout its history, RAG's activities have promoted regional economic growth, and as a major employer and orderer, the company makes an important contribution to the Austrian economy. Guided tours of facilities, open days and partnerships demonstrate the strength of RAG's commitment to the regions where it operates. The company carries out regular training and drills with local volunteer fire brigades, and offers paid internships and supervision of master's theses for students at the University of Leoben. RAG also supports various regional social projects.

History

1935

Rohöl-Aufsuchungs Aktiengesellschaft (RAG) is formed on 15 October as Rohöl-Gewinnungs AG by Socony Vacuum Oil Company, Inc. (now Exxon Mobil Corporation) and N.V. de Bataafsche Petroleum Maatschappij (now Royal Dutch Shell plc).

1936

RAG drills its first deep well, RAG 1, in Marchfeld, Lower Austria

1938–1945

Austria's annexation by Nazi Germany in 1938 drastically changes the legal and economic framework in which the company operates. In 1941 all of RAG's property is declared "enemy assets", leaving the company with nothing but a few fields.

1945–1955

The Soviet Mineral Oil Administration controls RAG's production in Lower Austria. In 1946, former German assets (banks and the iron, steel, chemical and oil industries) are nationalised, including large parts of RAG, which are transferred to the newly established OMV between 1955 and 1957, under the Austrian State Treaty. As compensation, RAG receives concessions in Upper Austria, Salzburg and Styria. RAG and the Austrian government conclude four exploration and production agreements.

1956

RAG's first discovery well, Puchkirchen 1, is drilled, marking the start of oil development in Upper Austria.

1958

RAG signs a supply agreement with Lower Austrian gas supplier Niogas (now EVN).

1963

Commercial natural gas production begins in Upper Austria. Numerous gas fields are subsequently discovered – today they are used as gas storage facilities.

1978

Opening of the Kremsmünster Krift tank farm, required to comply with the Oil Stockholding and Reporting Act.

1979

RAG concludes a master agreement with Oberösterreichische Ferngas GmbH.

1982

Construction of RAG's first gas storage facility, at Puchkirchen, with a working gas capacity of around 40 million (mn) cubic metres (cu m).

1989

The Berndorf field marks the first commercial gas discovery in Salzburg Province.

1992

Rohöl-Aufsuchungs Ges.m.b.H. is converted into an Aktiengesellschaft (stock corporation). EVN Energie Versorgung Niederösterreich acquires 50 % of the shares, with Mobil Oil Austria and Shell Austria AG each taking 25 % stakes.

1993

EVN transfers its interests to the newly formed RAG-Beteiligungs-Aktiengesellschaft (RBG), in which Bayernwerke AG acquires a 40 % holding, and SAFE and Steirische Ferngas Ges.m.b.H. each take 10 %.

1997

The largest ever gas discovery in the Austrian section of the Molasse basin – around 4 billion (bn) cu m – is made at Haidach in Upper Austria.

2001

RAG makes its first sales of gas to Germany and Italy.

2002

The Austrian gas market is liberalised, in accordance with the Natural Gas (Amendment) Act.

Capacity at the Puchkirchen storage facility is expanded to 700 mn cu m.

2005

An agreement is signed for construction of the Haidach storage facility, and work begins on the largest project in RAG's history. The facility is a joint venture with Gazprom Export and Wings.

2007

The Haidach I storage facility opens with storage capacity of 1.2 bn cu m. Capacity at the Puchkirchen storage facility is expanded to 850 mn cu m.

2008

Work starts on the final expansion phase at Puchkirchen, to bring storage capacity to 1.1 bn cu m and withdrawal capacity to 520,000 cu m/h.

Construction of the 7Fields storage facility begins – RAG's largest project to date.

2009

RAG Austria joins the new Austrian gas exchange.

2010

The final expansion phase of the Puchkirchen storage facility comes onstream, bringing capacity to 1.1 bn cu m.

2011

The Haidach II, 7Fields I and Aigelsbrunn gas storage facilities are completed. The total capacity of gas storage facilities operated by RAG reaches approximately 5 bn cu m.

2013

RAG establishes RAG Energy Storage GmbH, a wholly-owned subsidiary responsible for marketing capacity at storage facilities.

2014

Formation of wholly-owned subsidiary RAG Energy Drilling GmbH. Commissioning of phase two of the 7Fields facility.

Total capacity of gas storage facilities operated by RAG reaches 5.8 bn cu m.

RAG's first public natural gas filling station, between Puchkirchen and Gampern, is opened.

2015

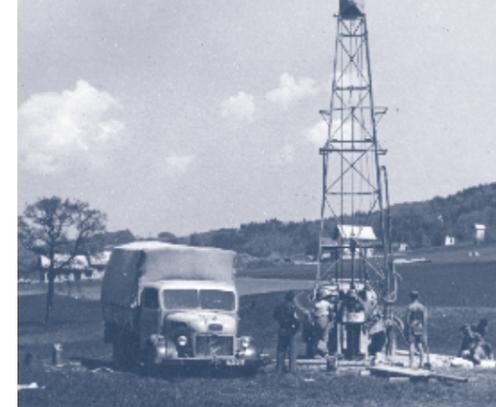
The test storage facility to be used in the Underground Sun Storage project opens in Pilsbach, Upper Austria.

2017

The country's first LNG filling station opens at the Ennshafen port in Upper Austria. RAG establishes RAG Exploration & Production GmbH, focusing on oil production.

2018

Change of company name from Rohöl-Aufsuchungs AG to RAG Austria AG. Commissioning of the pilot plant Underground Sun Conversion.



Executive Board

Markus Mitteregger, Chief Executive Officer
Michael Längle, Chief Financial Officer
Kurt Sonnleitner, Chief Technical Officer

Subsidiaries, associates and joint ventures

RAG Energy Storage GmbH
RAG Energy Drilling GmbH
RAG Exploration & Production GmbH
Silenos Energy GmbH

Joint Ventures

Haidach storage facility
7Fields storage facility

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