



Underground Sun Conversion

Renewable gas produced from solar power
and water – 1,000 metres underground

Geological history in fast motion: natural production of “renewable natural gas”

Over 1,000 metres below the ground – where natural gas was formed millions of years ago – renewable natural gas production will be investigated for the first time using a microbiological, environmentally friendly process.

As the shift to erratic renewable generation gathers pace, the need for storable forms of energy is greater than ever. There is a particularly strong need for energy sources with high energy density, such as methane (natural gas), for industrial processes, heat generation and transportation. Research performed as part of the newly launched Underground Sun Conversion project is aimed at identifying a process that offers a way to produce high-density energy forms as well as finding a solution to the question of storage. Another objective is to make full use of the natural gas infrastructure in place in many parts of the world.

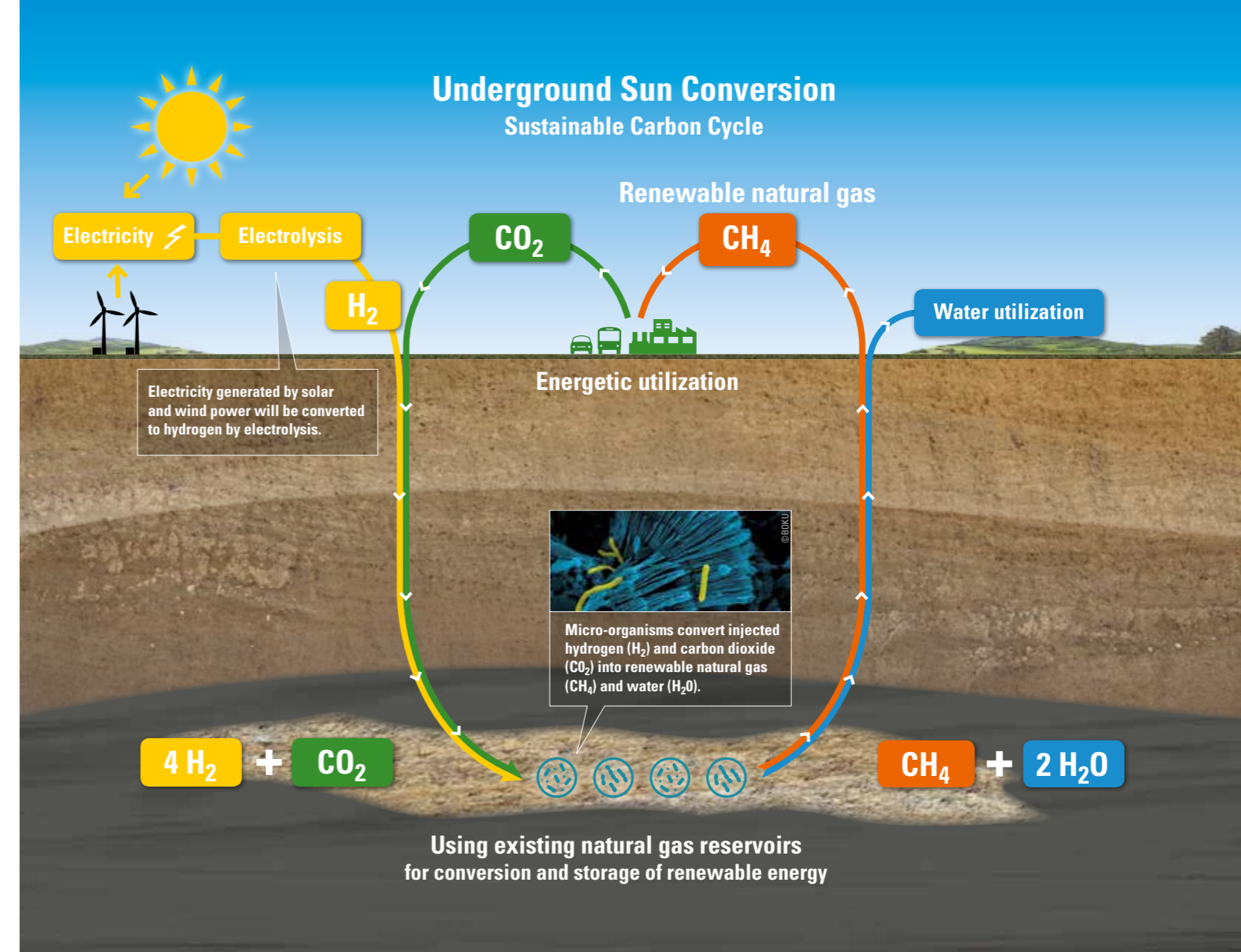
This innovative method is unique worldwide, and re-creates the natural process by which gas originates, but shortens it by millions of years – geological history in fast motion.

The aim of the RAG-initiated project, implemented in collaboration with partners, is to carry out research on principles for producing large quantities of renewable gas in the future, using a carbon neutral process, and storing it in environmentally friendly, naturally formed gas reservoirs, which will in turn provide urgently needed flexibility for renewable energy sources.



This environmentally friendly process has three major advantages:

- ✓ **Carbon neutral thanks to carbon cycle**
Renewable natural gas is carbon-neutral, if carbon dioxide that originates, for example from burning biomass, is utilised for the production process. This creates a 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.
- ✓ **Existing infrastructure is used**
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.



Project description

First, hydrogen is produced from solar or wind energy and water, in an above-ground facility, and then injected with carbon dioxide into an existing (porous) natural gas reservoir. At a depth of over 1,000 metres, in a relatively short time naturally occurring microorganisms convert these substances into renewable 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 reactors. The methanisation process and storage take place naturally in underground gas reservoirs – shortened by millions of years, representing a huge source of potential, and providing the urgently needed flexibility which renewable energy sources currently lack.

Initial laboratory tests conducted as part of the forerunner project, Underground Sun Storage – which is also supported by the Austrian Climate and Energy Fund – show that hydrogen and carbon dioxide injected into the reservoir are converted into methane by microbiological processes. This enables the creation of a sustainable carbon cycle.

Laboratory tests, simulations and scientific field tests at an existing RAG reservoir will be carried out in collaboration with a group of project partners. A further objective is to test whether the outcomes can also be achieved at many other reservoirs all over the world. Consequently, the results that the project aims to achieve are highly significant to further enhancing Austria's leading position in energy storage and research, and for the widespread export of both the technology and know-how underlying the process.

Project partners:



The Austrian consortium is led by RAG. The project partners are the University of Leoben; the University of Natural Resources and Applied Life Sciences, Vienna (Department of Agrobiotechnology, IFA Tulln); acib GmbH (Austrian Centre of Industrial Biotechnology); the Energy Institute at Johannes Kepler University Linz; and Axiom Angewandte Prozesstechnik GmbH.

The project will receive funding from the **Austrian Climate and Energy Fund** established by the Ministry for Transport, Innovation and Technology, as part of its energy research programme.



Company RAG

RAG developed and operates own gas storage facilities and Joint Ventures in Upper Austria and Salzburg. With a capacity of around 6 bn cubic metres RAG makes a major contribution to security of supply in Austria and in Central Europe.

RAG is lead manager of the consortium and lead investor of the lighthouse project Underground Sun Conversion.

For more information:

www.underground-sun-conversion.at



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