













Underground Sun Storage

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Agenda

- RAG short company profile
- Underground Sun Storage project presentation
- Open tasks for the future







RAG – Rohöl-Aufsuchungs AG

Rohöl-Aufsuchungs Aktiengesellschaft (RAG) is the oldest oil and gas company in Austria. The core areas of business are oil and natural gas exploration and production, and development and operation of gas storage facilities.

- ~ 400 RAG Employees
- Total storage capacity: ~ 5,7 billion m³
- among top underground gas storage operators in Europe
- among leading energy storage operators in Europe







RAG group and fully-owned subsidiaries

RAG group







RAG – Ownership and management

Ownership



Management

Markus Mitteregger (Chief Executive Officer) Kurt Sonnleitner (Chief Technical Officer) Michael Längle (Chief Financial Officer)



Michael Längle, Markus Mitteregger and Kurt Sonnleitner

More information on <u>www.rag-austria.at</u>



RAG Core Competences







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What is the research campaign about?

 Chemical storage of renewable energy in porous subsurface reservoirs with exemplary test bed

Goals of this research campaign

- Research on effects of hydrogen exposure to porous storage reservoirs
 - Develop market opportunities in a future energy system
 - In the medium term synthetic gases are likely to enter underground gas storage facilities
- Demonstration of capability to store renewable energy via synthetic gases
- Show sustainable ways to use given natural reservoirs





Facts and Figures

- Flagship project of the Austrian "Klima und Energiefonds"
 - Duration: 3,5 years



- RAG is Consortium manager
- RAG is leading investor
- Public funding volume of up to 2,8 Mio Euro
- Scientific focus on porous rock exposed to methane/hydrogen mixtures with a share of up to 10% hydrogen
- Phase I: Fundamental research at universities
- Phase II: construction and operation of an in-situ test bed facility





Need for Research & Development



Source: DVGW, 2012









WP 2: Geochemistry and Reactive Transport modelling

- Hydrogen induced geochemical alteration of reservoir rock, fluids; changes in transport mechanisms?
- Design laboratory experiments
- Selection of core samples
- Laboratory experiments at DBI Leipzig
- Geochemical simulations
- Reactive Transport modelling



Source: DBI Leipzig 2014





WP 3: Microbial Processes in Hydrogen Exposed Reservoirs

- Hydrogen induced microbiological metabolic activities in porous reservoirs?
 - $4H_2 + SO_4^{2-} + 2H^+ \rightarrow H_2S + 4H_2O$ sulphate reducing bacteria
 - $2CO_2 + 4H_2 \rightarrow CH_3COOH + 2H_2O$ acetogenic bacteria
 - $4H_2 + CO_2 \rightarrow CH_4 + 2H_2O$ Methanogenesis
- Selection of core samples
- Extraction of reservoir fluids
- Design and operation of laboratory experiments by BOKU IFA Tulln



Source: BOKU IFA Tulln 2014





WP 5: Materials and Corrosion

- Hydrogen induced corrosion in wet gas environment?
- Hydrogen induced alteration of cement?
- Design laboratory experiments
- Selection of steel grades to be tested
- Operation of experiments by University of Leoben



Autoklav Source: University Leoben 2014





Time Schedule

- Fundamental research campaign at universities is in progress
- (Interim-) Results expected within the next two months
- Decision about realization of an in-situ experiment at an actual reservoir in summer 2014
- Design and approval by public authorities by end of 2014
- Construction and operation of in-situ facility in 2015 and 2016





WP 7 & 8: Construction and Operation In-situ Exp.

- Screening of possible locations/reservoirs is done
- Complete storage cycle with 10% Hydrogen
- 2 Mio. m³ @ app. 70bar
- Electrolysis compressor measurement and control instrumentation
- Inspection program in elaboration







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Open Tasks for the Future

- Transferability of findings to different reservoirs
- Influence on ignition temperature
- Explosion group according to ATEX directive
 - Natural gas: Ila
 - Hydrogen: IIc
 - Mixture: ?, depends on min. ignition energy
- Need of additional gas detection?
- Need of special training for operating personnel?





Underground Sun Storage – Contact

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Thank You!