FUTURE PERSPECTIVES FOR UNDERGROUND ENERGY STORAGE IN SLOVAKIA

EUROPEAN WORKSHOP ON UNDERGROUND ENERGY STORAGE

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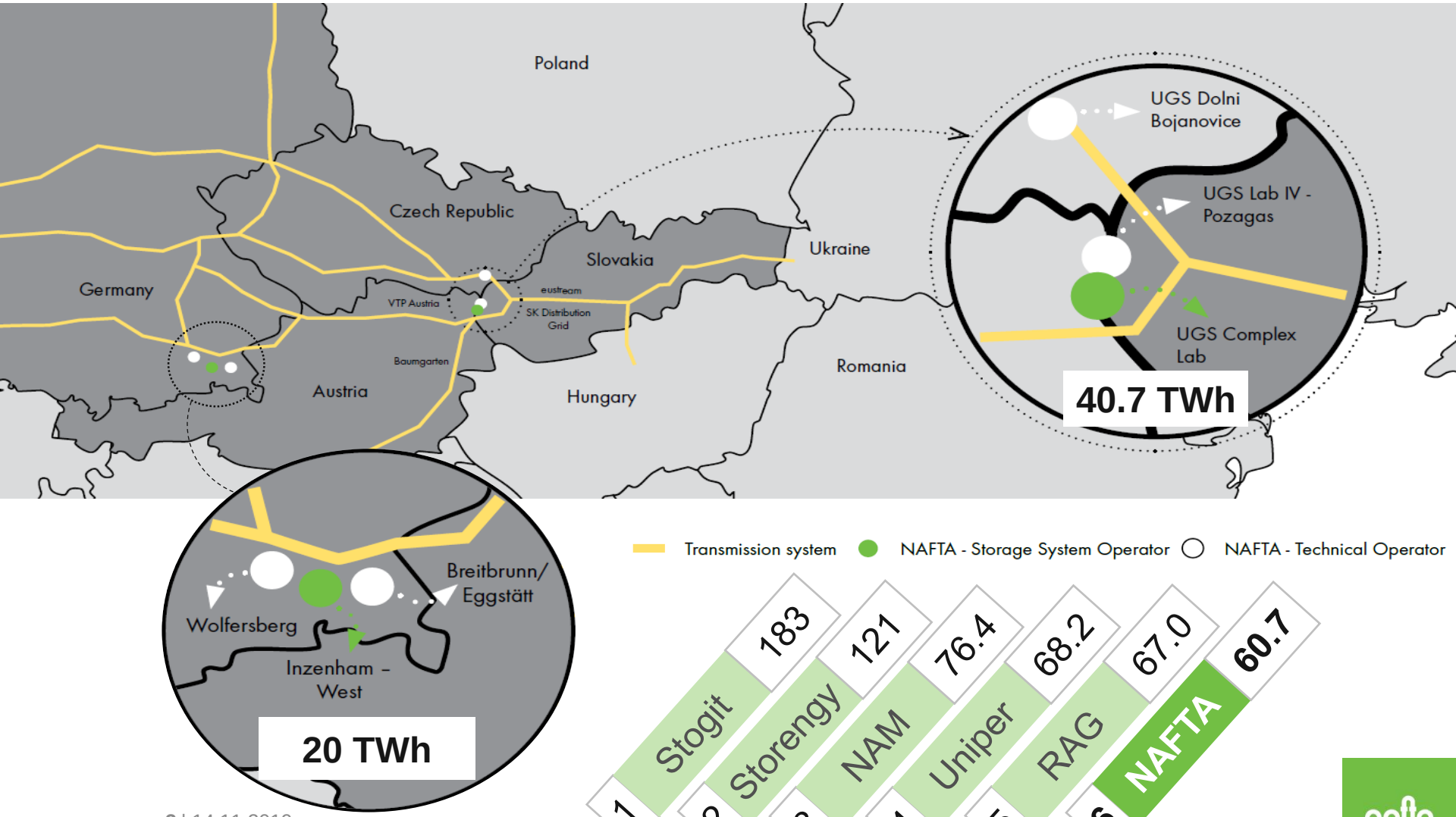
AGENDA

1. Demand for energy storage
2. Underground energy storage activities in Slovakia
3. Future challenges

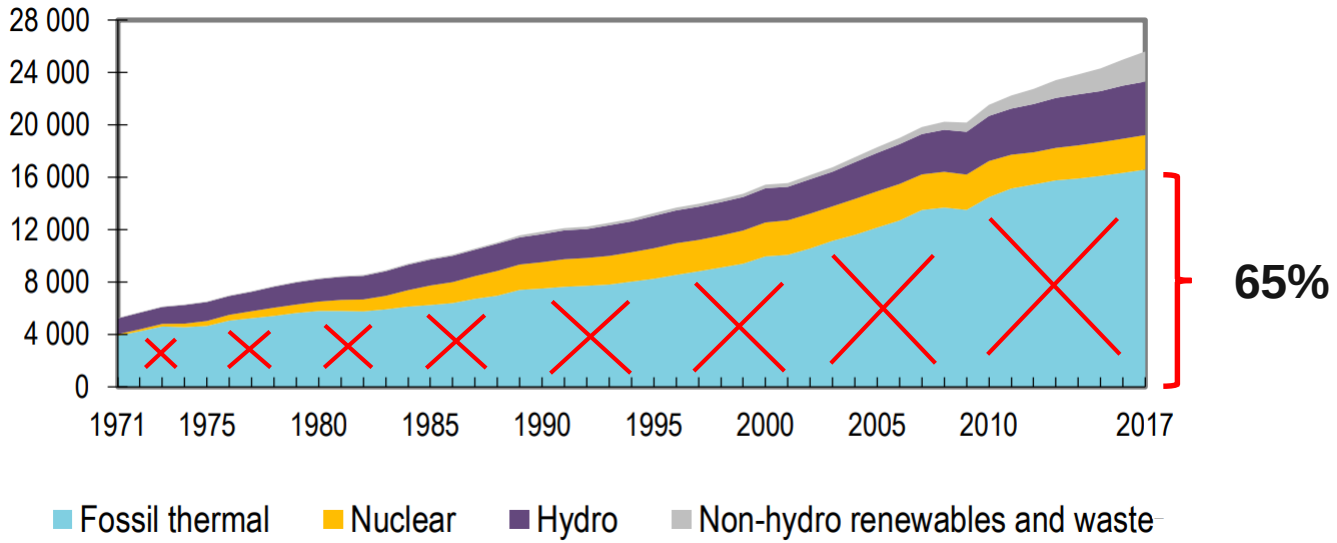
NAFTA STORAGE OPERATIONS ACROSS EUROPE



Demand for Energy Storage

WHY WE NEED MORE ENERGY STORAGE?

World electricity generation from 1971 to 2017 by fuel (TWh)



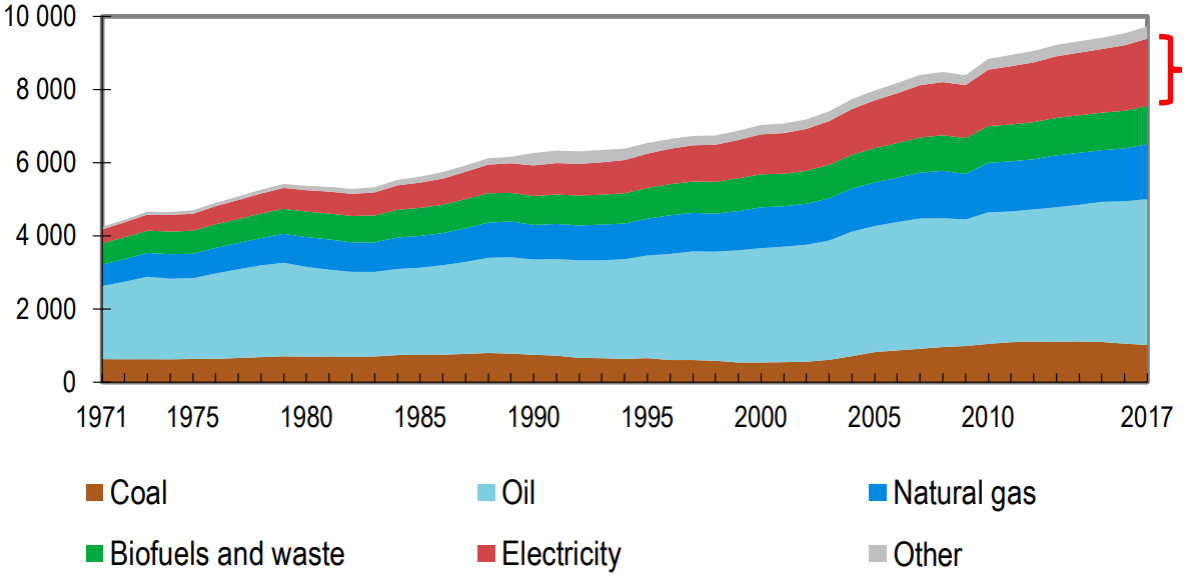
Source: IEA Statistics, www.iea.org

First intuitive answer – we need more energy storage in the future to cover flexibility of supply when replacing dispatchable fossil sources of electricity by intermittent renewable electricity sources

...but this is not a whole picture...

FUTURE ENERGY STORAGE NEED – FULL PERSPECTIVE

World total final energy consumption by source from 1971 to 2017 by fuel (Mtoe)



Electricity currently accounts for less than 20% of worlds final consumption of energy.

Source: IEA Statistics, www.iea.org

If the share of electricity in energy mix is increased then covering the intermittency of renewable electricity sources is even more acute. Moreover, fossil fuels currently cover majority of **seasonal energy demand**. This seasonality needs to be addressed as well.

EUROPEAN SEASONAL NATURAL GAS DEMAND

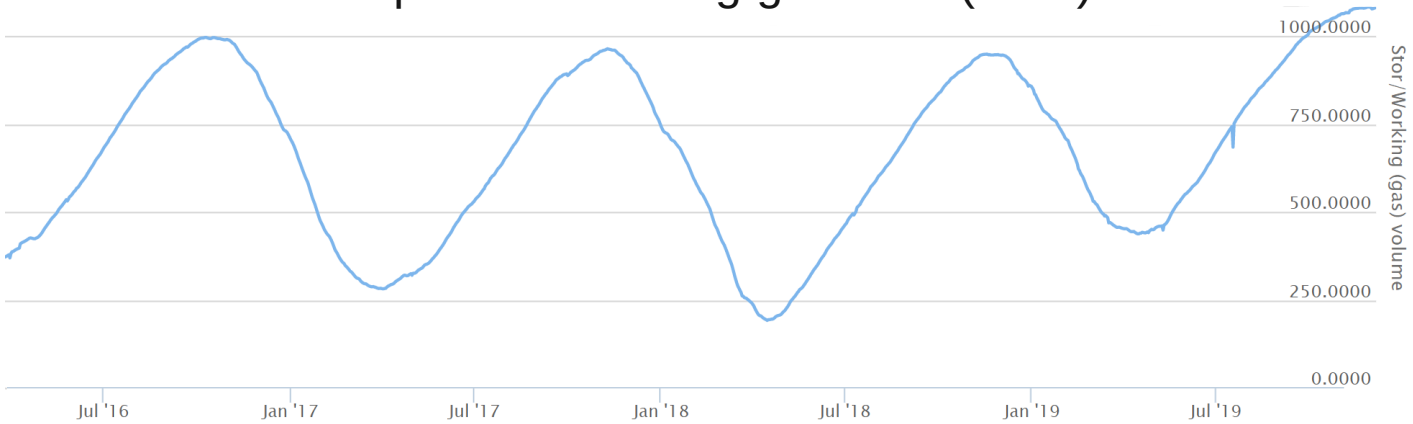
Total Final Energy Consumption OECD Europe 2017	14,631	TWh
Electricity supplied OECD Europe 2017	3,522	TWh
Underground Gas Storage capacity in Europe 2017	1,101	TWh

31%

8%

Source: IEA Statistics, www.iea.org

Europe UGS working gas level (TWh)



Source: GIE AGSI Storage Data, https://agsi.gie.eu/#/

Underground natural gas storages store significant part of energy consumed in EU and are actively used to balance seasonality of energy demand

02
Underground energy storage activities in Slovakia

SUN STORAGE – FIRST LESSON

Pilot project

- Storing of energy in form of H_2 in the mixture with natural gas – 10% vol. H_2

Laboratory research

1

- Laboratory research confirmed that 10% of H_2 should not cause issues in the reservoir
- Some chemical / microbial reaction was expected

Pilot plant

2

- NAFTA specified and delivered compressor unit
- Pilot operation confirmed technical feasibility of the concept

Results

3

- No H_2S production
- Microbial reaction occurred
- H_2 mixed with cushion gas

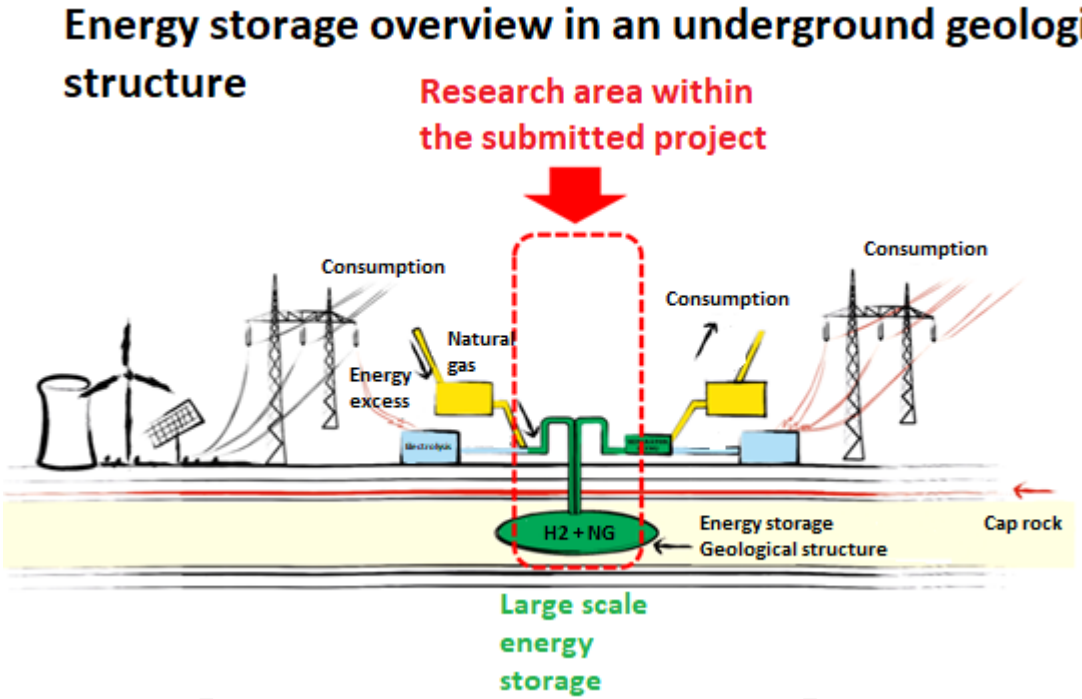
© RAG (photography: RAG-Archiv)

Source of picture: RAG

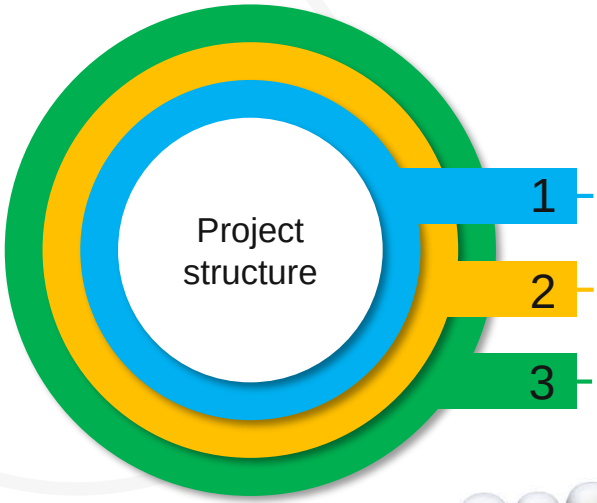
RESEARCH OF THE LARGE-SCALE ENERGY STORAGE IN THE FORM OF HYDROGEN IN THE GEOLOGICAL STRUCTURES

Project goals:

- Identifying, laboratory testing and modelling of the suitable geological objects in Slovakia for hydrogen storage, depending on specific geological conditions as well as the amount of hydrogen mixed with the natural gas
- Developing of the methodology to guide candidates interested in field of the energy storage in the form of hydrogen. The methodology should answer which tests needs to be done to allow real physical storage



RESEARCH OF THE LARGE-SCALE ENERGY STORAGE IN THE FORM OF HYDROGEN IN THE GEOLOGICAL STRUCTURES



Main activities
- Research of H_2 impact to the geochemical, mineralogical and geological properties of the reservoir
- Monitoring of microbial impacts
- Modelling of the selected structure

Project partners
- Consortium of three academic institutes of SAV
- Main universities in Slovakia: **STU** Bratislava, **UK** Bratislava, **UPJŠ** Kosice
- Industrial partner - **NAFTA**

- The project applied for financial support from the call of long-term strategic research of the Ministry of Education of the Slovak Republic

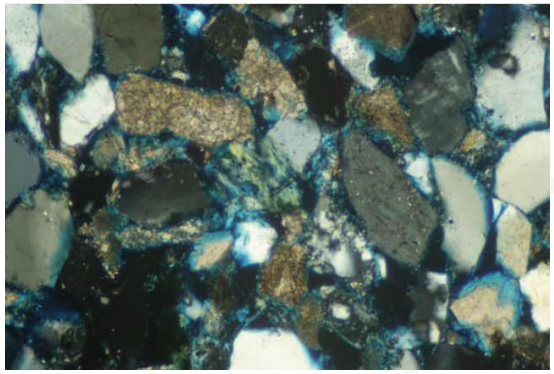
RESEARCH OF THE LARGE-SCALE ENERGY STORAGE IN THE FORM OF HYDROGEN IN THE GEOLOGICAL STRUCTURES

Hydrogen impact to the geological integrity as well as to the cap rock

- Research of possible H_2 reactions with the abiotic parts of the reservoir
- Complex analysis of macro components of the reservoir, their properties (porosity, permeability, structure, etc.) and micro components of the reservoir (minerals, gases, sedimentary organic matter, etc.)

Characterization of chemical processes of the reservoirs

- Monitoring of potential changes in rocks, structures due to the influence of H_2
- Individual experiments will be carried out in the reactor, simulating real reservoirs conditions (temperature, pressure ...)



Source of pictures: DBI Leipzig 2014; BOKU IFA Tulln 2014

RESEARCH OF THE LARGE-SCALE ENERGY STORAGE IN THE FORM OF HYDROGEN IN THE GEOLOGICAL STRUCTURES

Research of microbial activity in pressure reactor simulating real reservoirs conditions

- Analysis of microbial activities that can potentially take place under real conditions
- Monitoring the impact of hydrogen for a change in microbial activities, with an impact on the resulting products

Analysis of the microbiome composition of the underground hydrogen reservoir

- Each deposit (except salt caverns) contains a microbial community
- Understanding it may help to eliminate inappropriate microbial reactions, or to eliminate microbial reactions or may indicate that the reservoir is not suitable for storing the mixture under given conditions

Source of pictures: DBI Leipzig 2014; BOKU IFA Tulln 2014

RESEARCH OF THE LARGE-SCALE ENERGY STORAGE IN THE FORM OF HYDROGEN IN THE GEOLOGICAL STRUCTURES

Analysis and modeling of thermo-hydro mechanical behavior of rocks and construction materials

- Investigation of thermo-hydromechanical properties of reservoir layer and cap rock
- Testing the impact of H_2 on materials used in selected natural gas storages – focus on sealing materials, rubbers and cement

03

Future challenges

FUTURE CHALLENGES

- Establish sound regulation on hydrogen content in the gas grid
- Develop sustainable technology of hydrogen storage in porous rock storages
- Align time frame of research with application of the climate policy
- Research cooperation within Europe
- Climate policy coordination within whole world

„The secret of change is to focus all of your energy, not on fighting the old, but on building the new“

Socrates