

PROJECT HENRI

28.9.2023



[RECOVERY
AND RESILIENCE]
PLAN



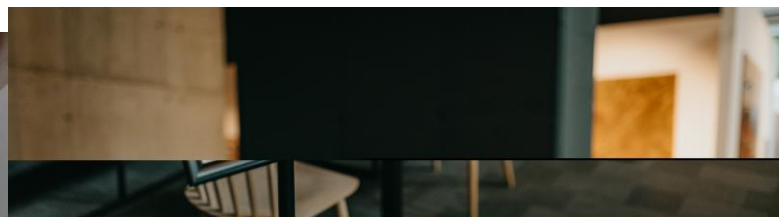
HENRI
HYDROGEN ENERGY RESERVOIR



www.projecthenri.eu

Jesenná konferencia SPNZ 2023

HENRIS 1ST CONFERENCE



3 02.10.2023

Jesenná konference SPNZ 2023



PROJECT INTRODUCTION

- HENRI – HYDROGEN ENERGY RESERVOIR
- HENRY CAVENDISH

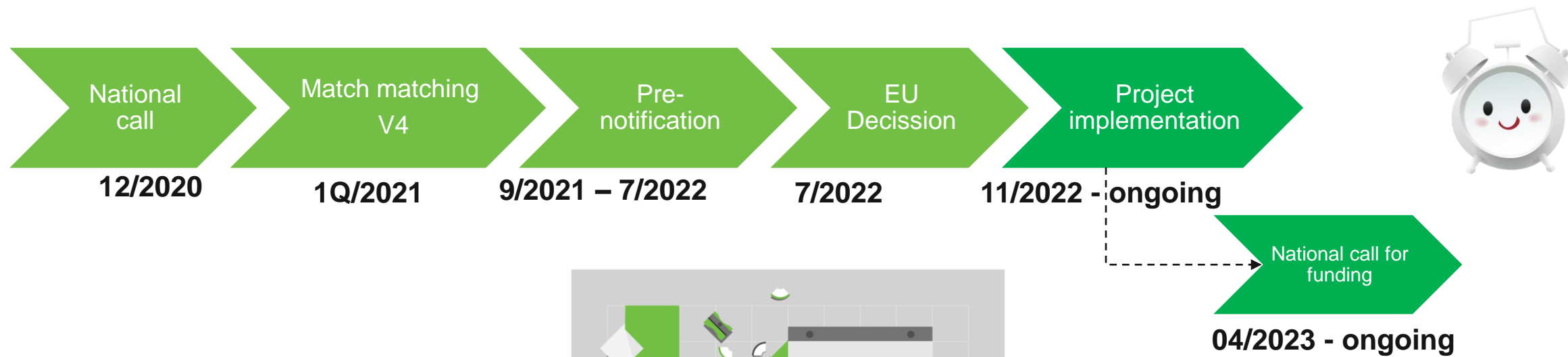


H. Cavendish

- An English natural philosopher, chemists and scientists
- Noted for discovery of Hydrogen
- (1731-1810)



PROJECT INTRODUCTION



[RECOVERY AND RESILIENCE] PLAN



PROJECT INTRODUCTION



Definition of methodology for reservoir assessment



Identification of suitable structure for storing of H₂ in Slovakia



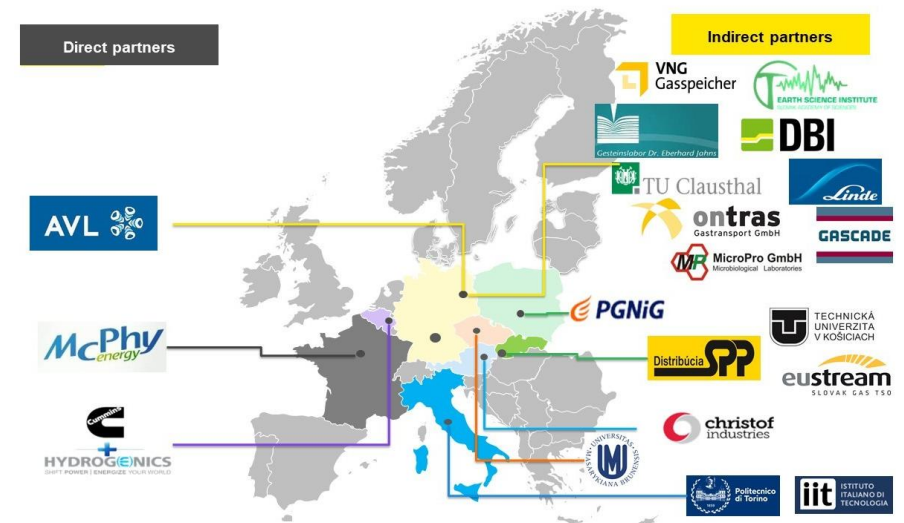
Based on R&D phase definition the max suitable H₂ storing concentration



Pilot technology for confirmation the research at real condition

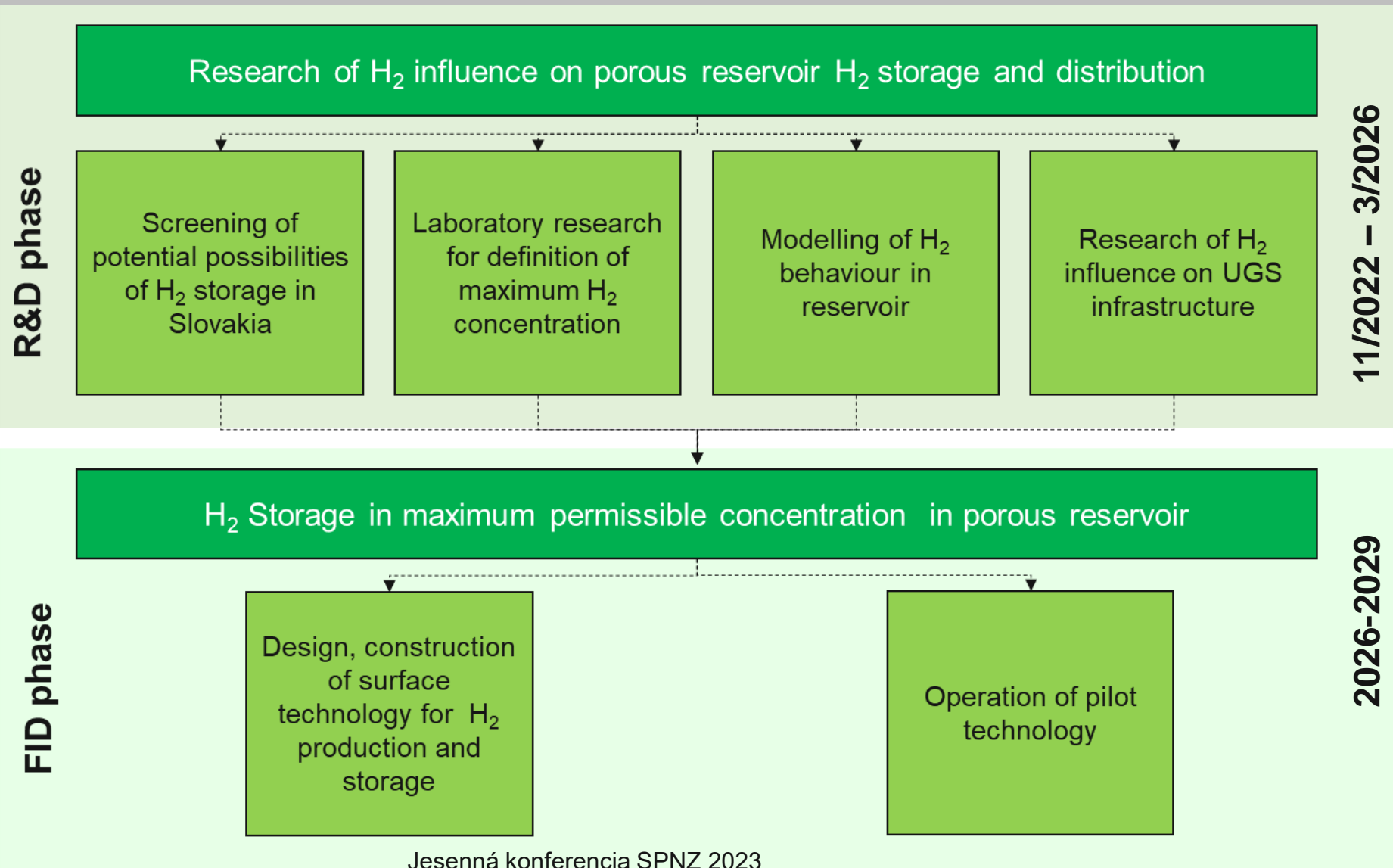
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PROJECT INTRODUCTION



PROJECT HENRI



WP1.1 Screening of potential sites for storage of H₂ in Slovakia



A methodology for assessing geological structures in terms of their suitability for conversion to UHS will be developed

(will include evaluation criteria on the basis of which the structures will be scored, and finally, on the basis of the achieved score, they will be recommended or excluded as potentially suitable/unsuitable for UHS)

Comprehensive geological screening of suitable reservoirs in porous rocks:

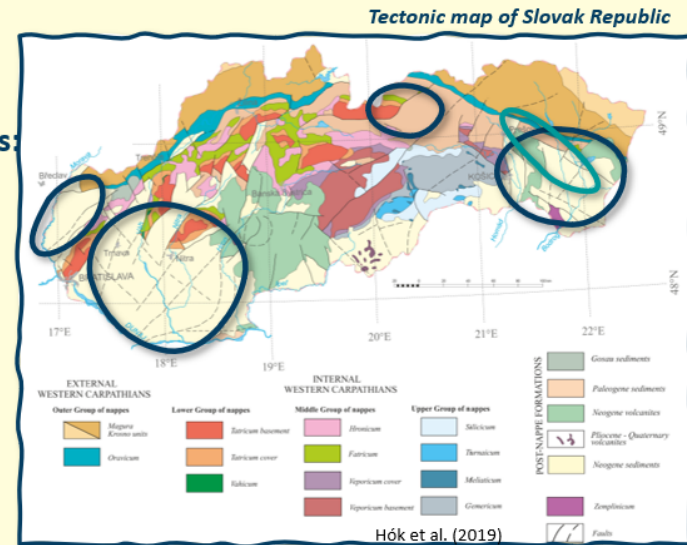
- depleted gas/oil deposits
- aquifers

Evaluating potential salt formations

Data gathering:

- ...depth, temperature, pressure, porosity, permeability, cap rock presence/ thickness/ integrity, mineralization of formation water, salinity, CO₂ and carbonate content, etc.;
- assessment of environmental and societal impacts

Data source: Geofond – National Archive of original geological reports, NAFTA Archive, maps, articles



WP1.1 Goal: Assessment of the possibilities of H₂ storage in underground geological structures (UHS) in Slovakia on the basis of the latest knowledge about this technology, our original methodology, and the order of evaluated sites



PROJECT HENRI / RESERVOIR ROCK TESTING

WP 1.2 Geochemical Investigation



- **Scope:**

- Laboratory Investigations: Alteration of reservoir rock

Reservoir	Pressure [bar]	Temperature [°C]	Salinity [mg/l]
Nr. 1	80	40	19 000
Nr. 2	160	90	16 000
Nr. 3	200	60	24 000



- different H_2 concentration (50% of H_2 , 100% H_2 , 25% of H_2 , 10% H_2)

- **Investigations:**

- Permeability measurements (water and gas)
- Petrographical characterization (Thin section analysis)
- Storage experiments in specific pressure vessel
 - » Total for 12 months (Sampling after 6 and 12 months)



PROJECT HENRI / CONCRETE TESTING

WP 1.4 Concrete Investigations



- **Scope:**

- Demonstration of stability of the concrete to hydrogen
- Long-term storage tests of concrete cores
 - » same conditions and hydrogen shares as WP 1.2 - Geochemical Investigation
- Evaluation of concrete stability before and after storage.

- **Investigations:**

- Permeability measurements (Gas)
- Storage experiments in pressure vessel
- Microscopic investigations, X-ray diffraction, Energy-dispersive X-ray spectroscopy (EDX)



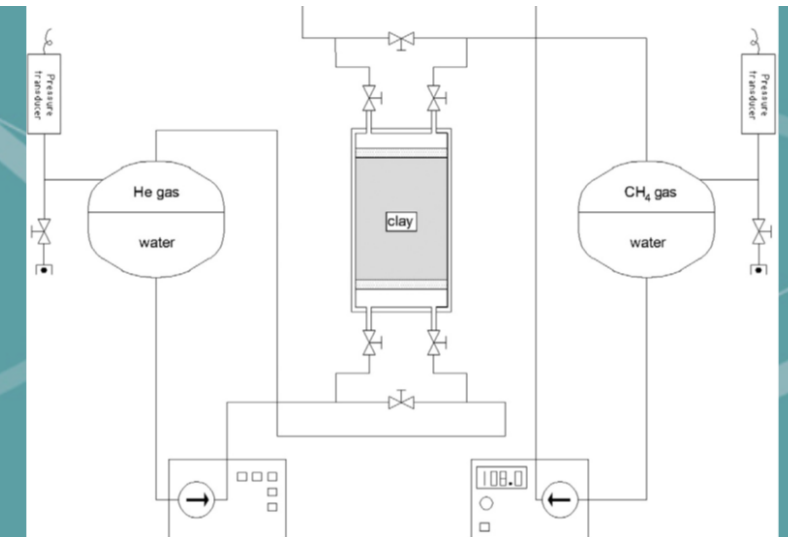
PROJECT HENRI / CAP ROCK TESTING

Our scheduled work in HENRI:

- Sample preparation from preserved core pieces
- Documentation of the work including white light photography
- CT-scanning for the documentation of the specimen's integrity
- Saturation under simulated in situ stresses
- Determination of the effective diffusion coefficient
- Determination of the brine permeability
- Determination of the threshold pressure using hydrogen, methane and mixtures hereof



- Estimation of losses through H₂-diffusion
- Very good sealing is extremely important
- Measurement of the gas diffusion in brine
- Measurement of the gas diffusion in the rock sample
- Numerical modelling with the help of COMSOL®
-



Scheme from Jacops et al. 2013, Elsevier

PROJECT HENRI / MICROBIAL REACTION

► Acquisition of representative formation water samples for laboratory analyses

► A laboratory program has been set up to:

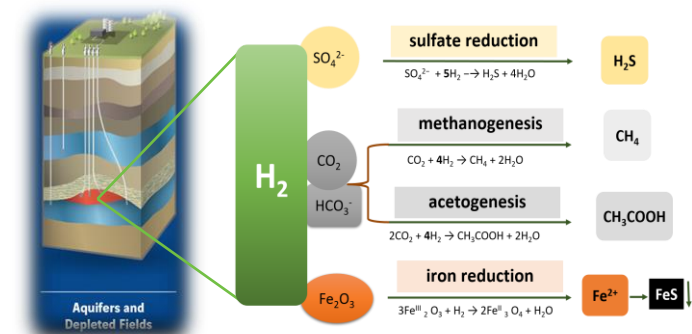
1a) Identify bacteria present in the reservoir water (salinity: 15 – 25 g/l)

1b) Qualitative and quantitative molecular-biological analyses of microbial population (Metagenome and qPCR-analyses)

2) Enrichment of hydrogen-consuming microorganisms

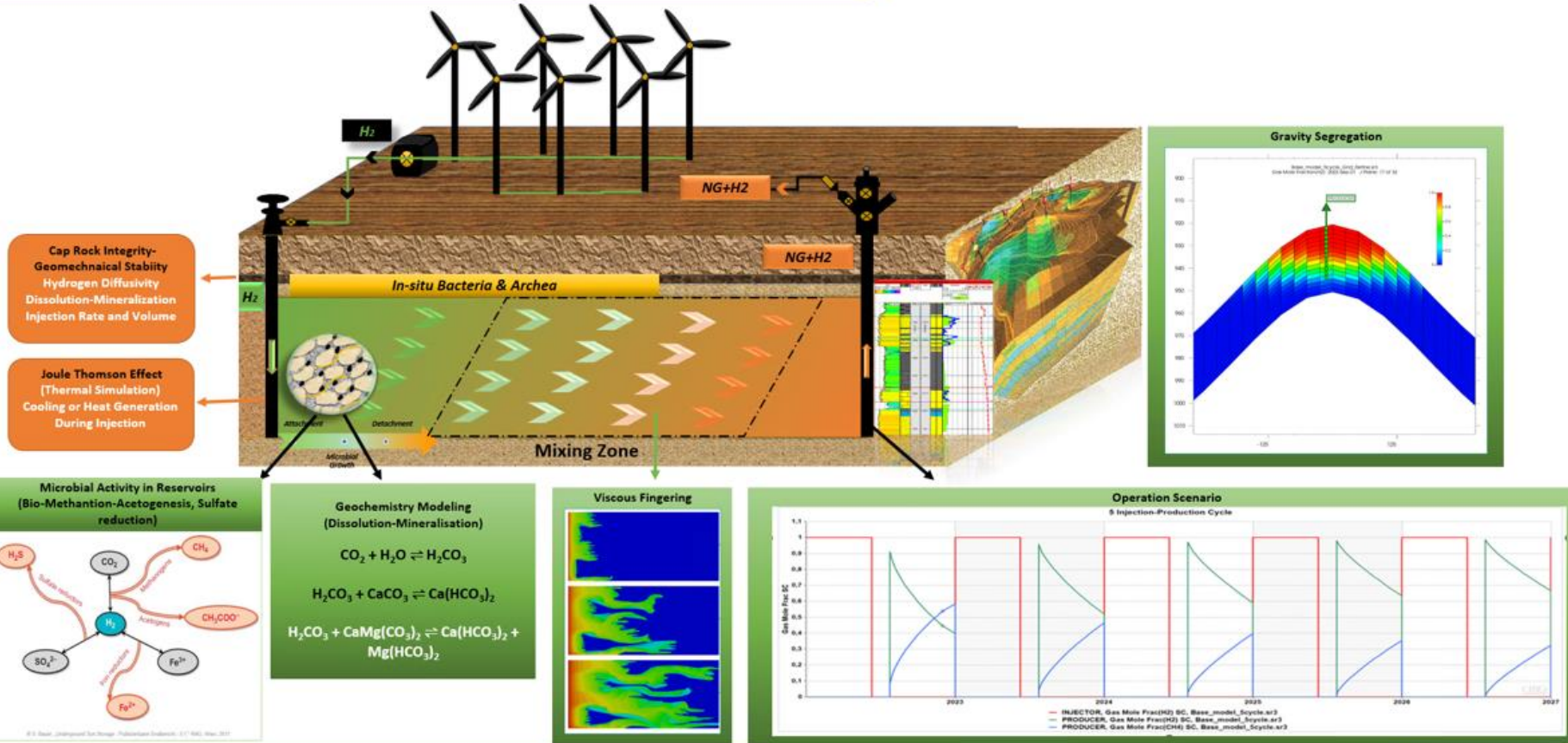
3) Characterization of bacterial activity simulated by H₂ (ambient pressure tests)

Analyses program: Microscopy, microbial community analysis, H₂ consumption, chemical composition of the gaseous and liquid phases (anions, organic acids), etc.



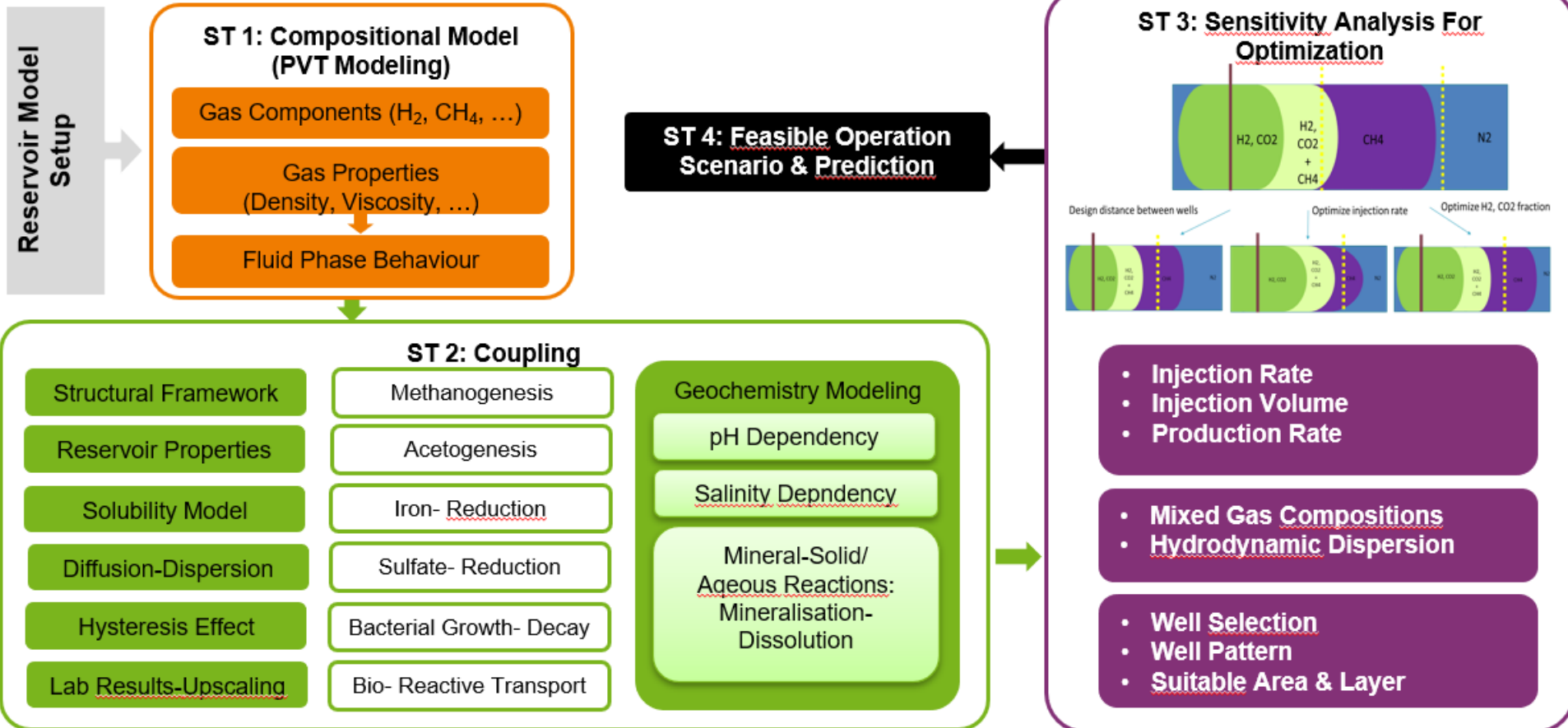
PROJECT HENRI / MODELING

Why We Need Reservoir Simulation?



PROJECT HENRI / MODELING

Reservoir Simulation Approach in Commercial Software



THANK YOU FOR YOUR ATTENTION

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