

Underground Sun Conversion Underground Sun Storage

Experiences in the process
of approving seasonal
storage facilities for
renewable energy

UNDERGROUND
UN.CONVERSION

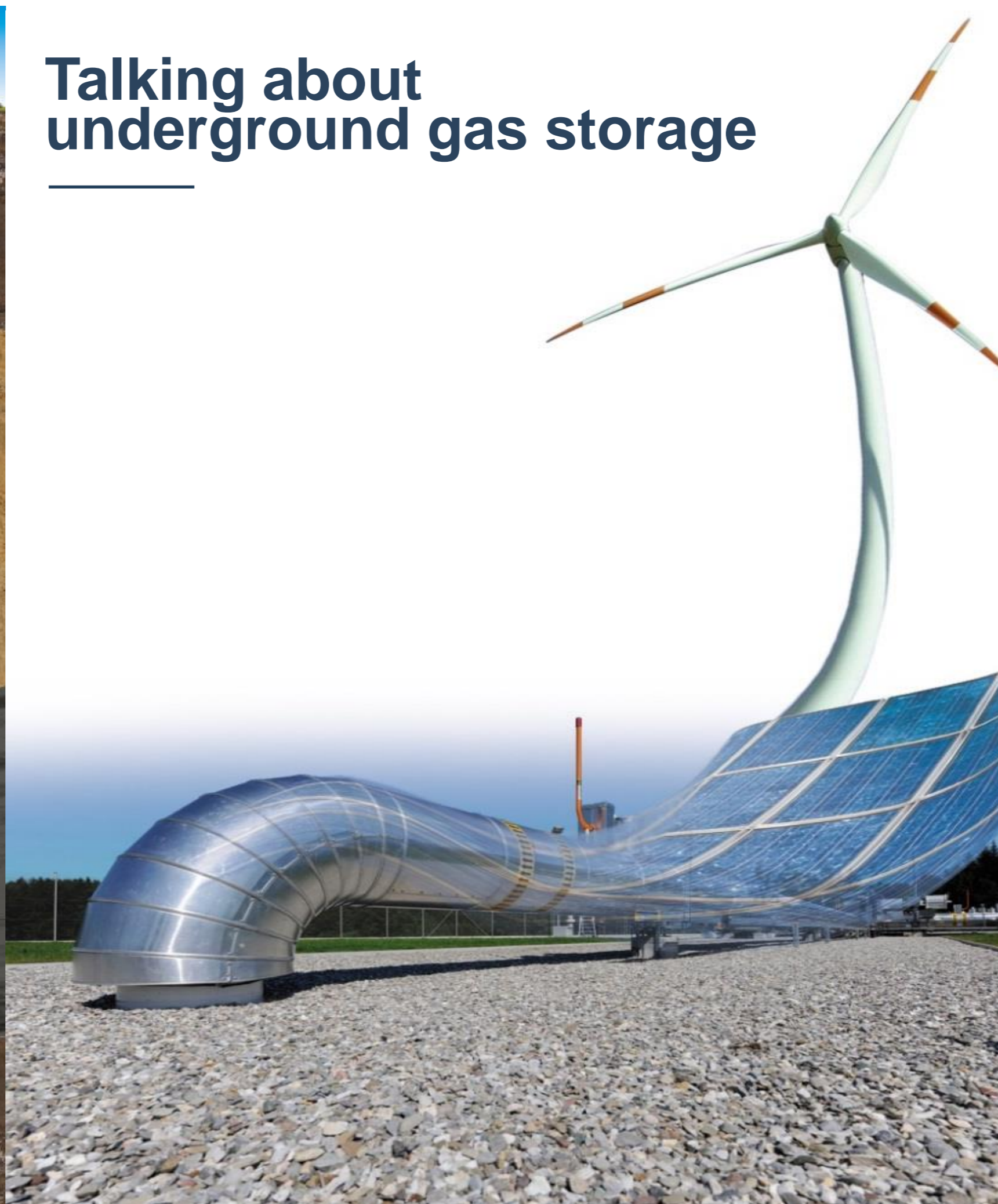
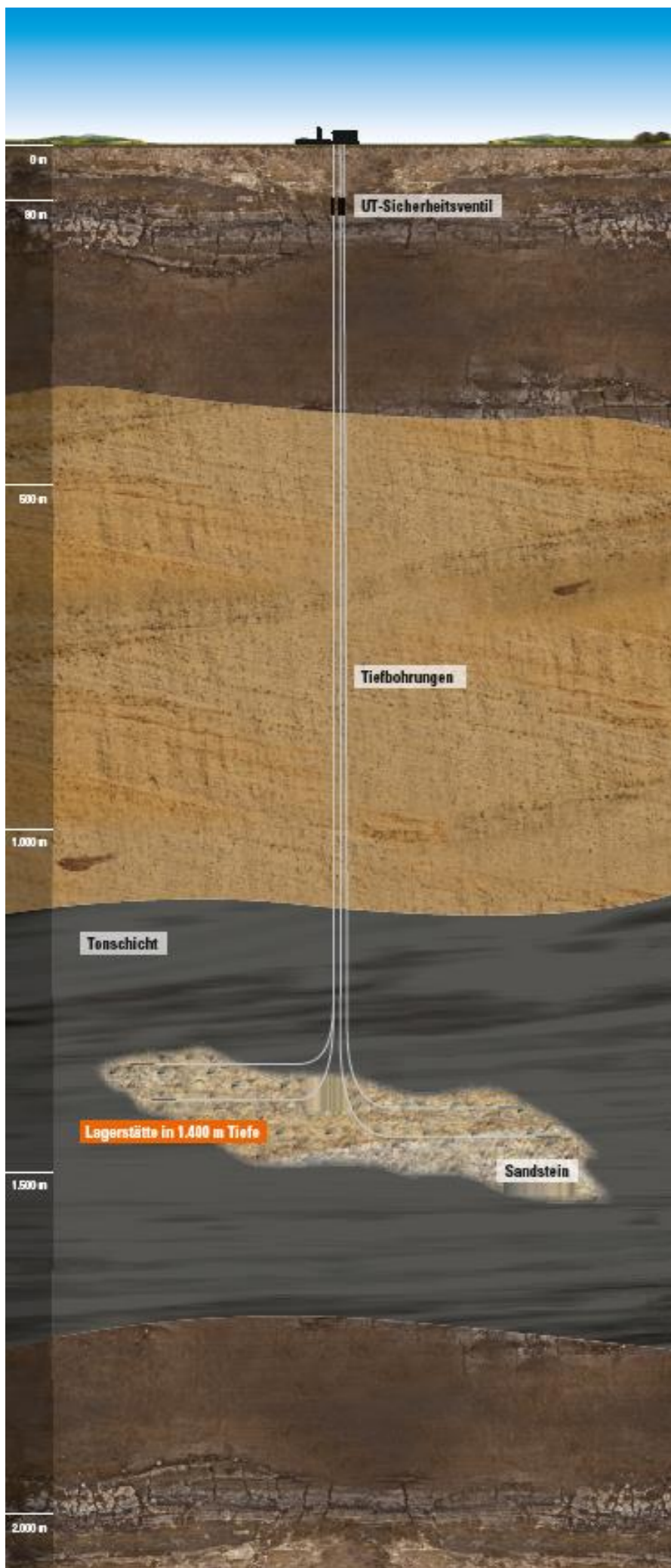
RAG Austria AG

Company Profile and Vision

- Among leading technical Underground Gas Storage Operators
- State of the art facilities
- Innovation in energy storage
- Storage volume 66 TWh (6bcm)
- Unload capacity 30 GW

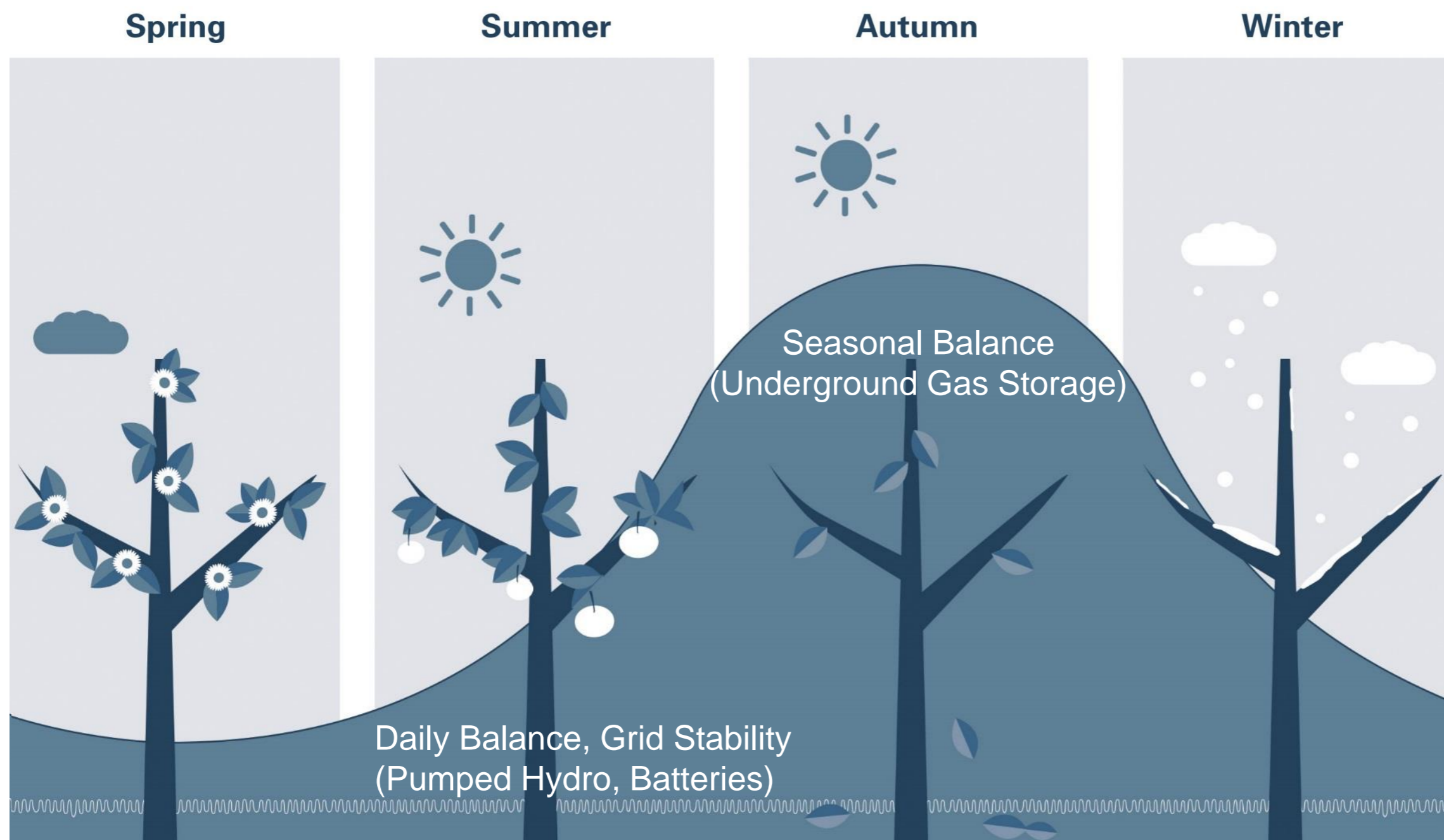
- Follow the vision to serve the renewables with our existing assets

Talking about underground gas storage

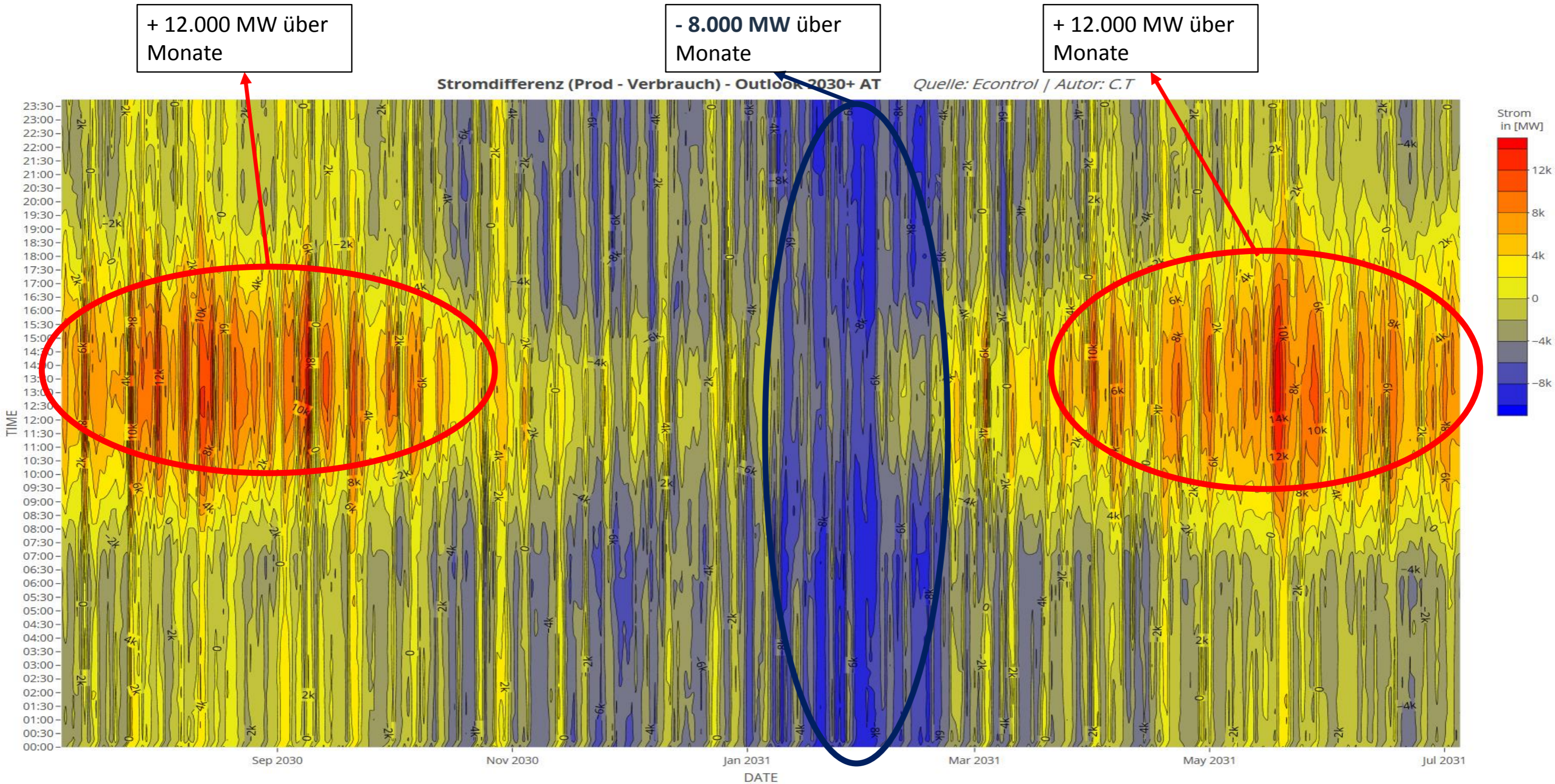


Different services

Energy storage during the year



2030+ residual scenario for electricity in AT



INPUT data: 2030+ vs. 2017 @15 minute intervals:

- Demand: +30% (~63 to 81 TWh/a)
- RES generation : Wind x3, Solar x20, Hydro x1 (~ 41 auf 80 TWh/a)

=> **Big scale seasonal storage needed**

Underground Sun Storage

UNDERGROUND SUN.STORAGE

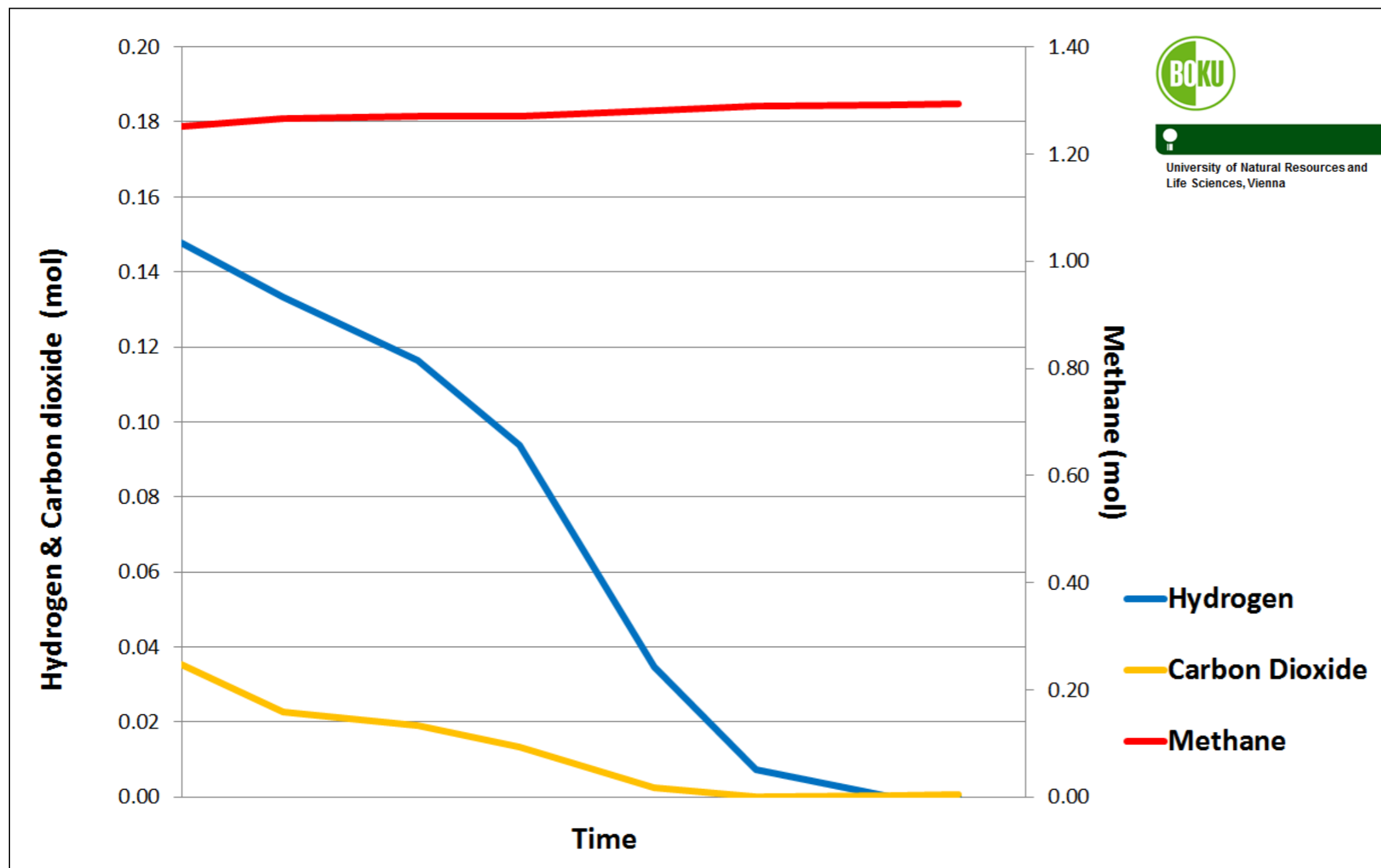


- Project finished
- Renewable Energy can be stored as Hydrogen in underground gas reservoirs.
- 10 % share of H2 tested
- Project confirmed scale up potential to RAGs commercial facilities
- Open: Assignability to other geological reservoir settings
- 100 % Hydrogen in natural gas reservoirs is the next development objective
- <https://www.underground-sun-storage.at/>

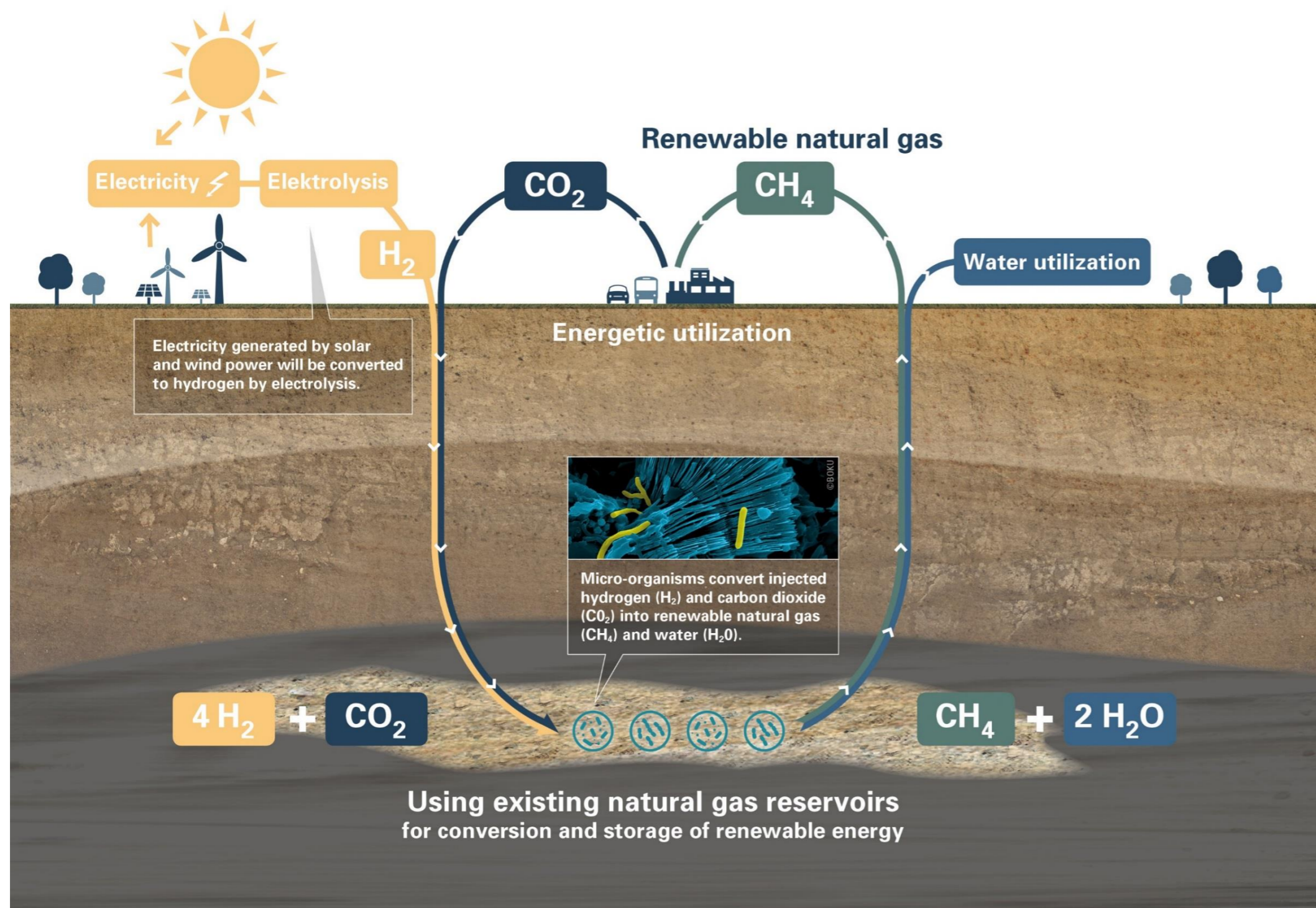
Conclusion – Sun Storage Field Experiment

- Laboratory tests and in-situ experiments suggest a natural **conversion of Hydrogen and CO2 to Methane** (=natural gas) in suitable underground gas reservoirs
- Due to these results a follow up project **Underground Sun Conversion** was initiated
 - Renewable natural gas made in the reservoir by a natural microbial process
 - Geological history in fast motion – recreation of natural genesis of gas

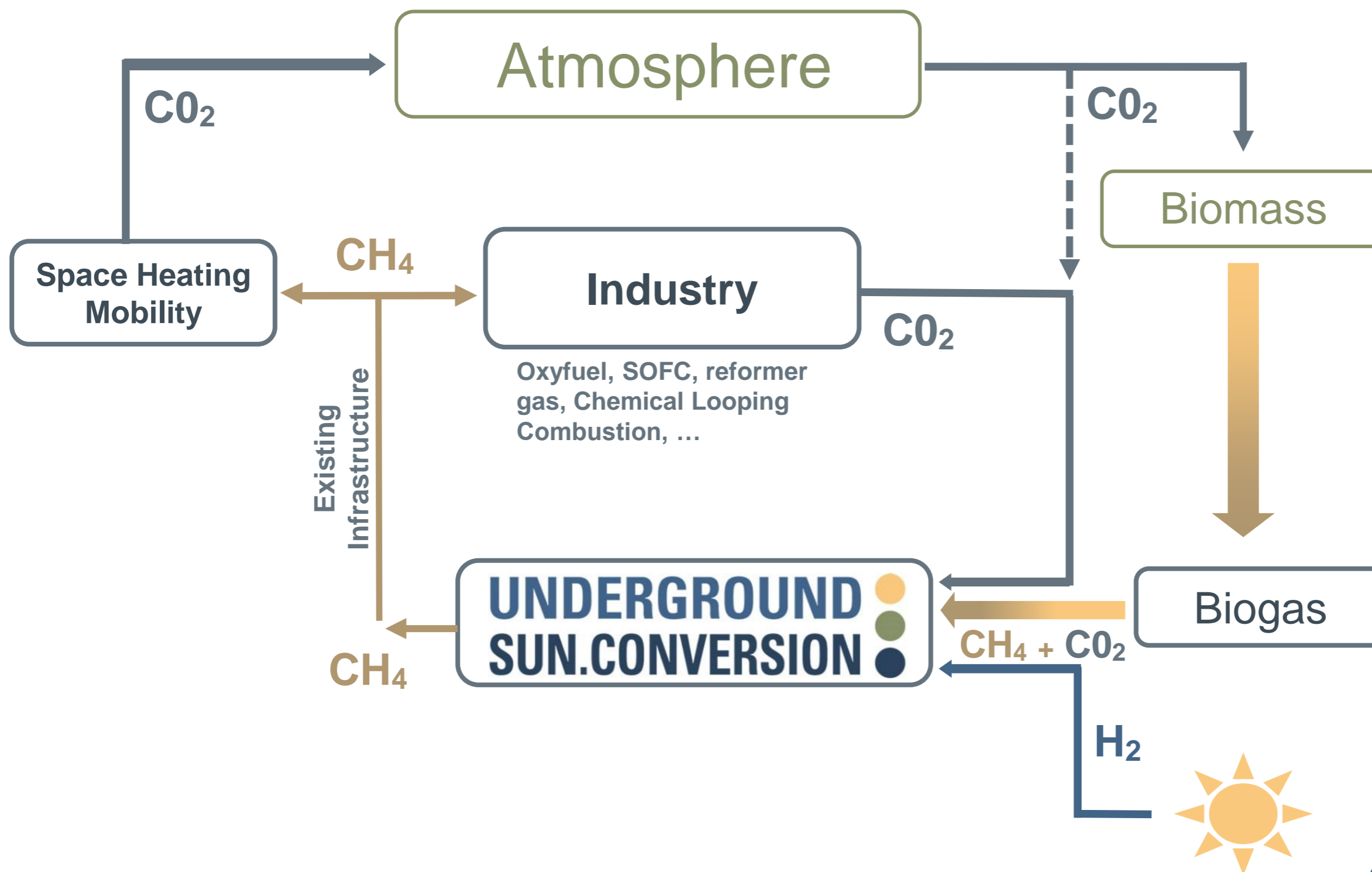
Changes in gas composition

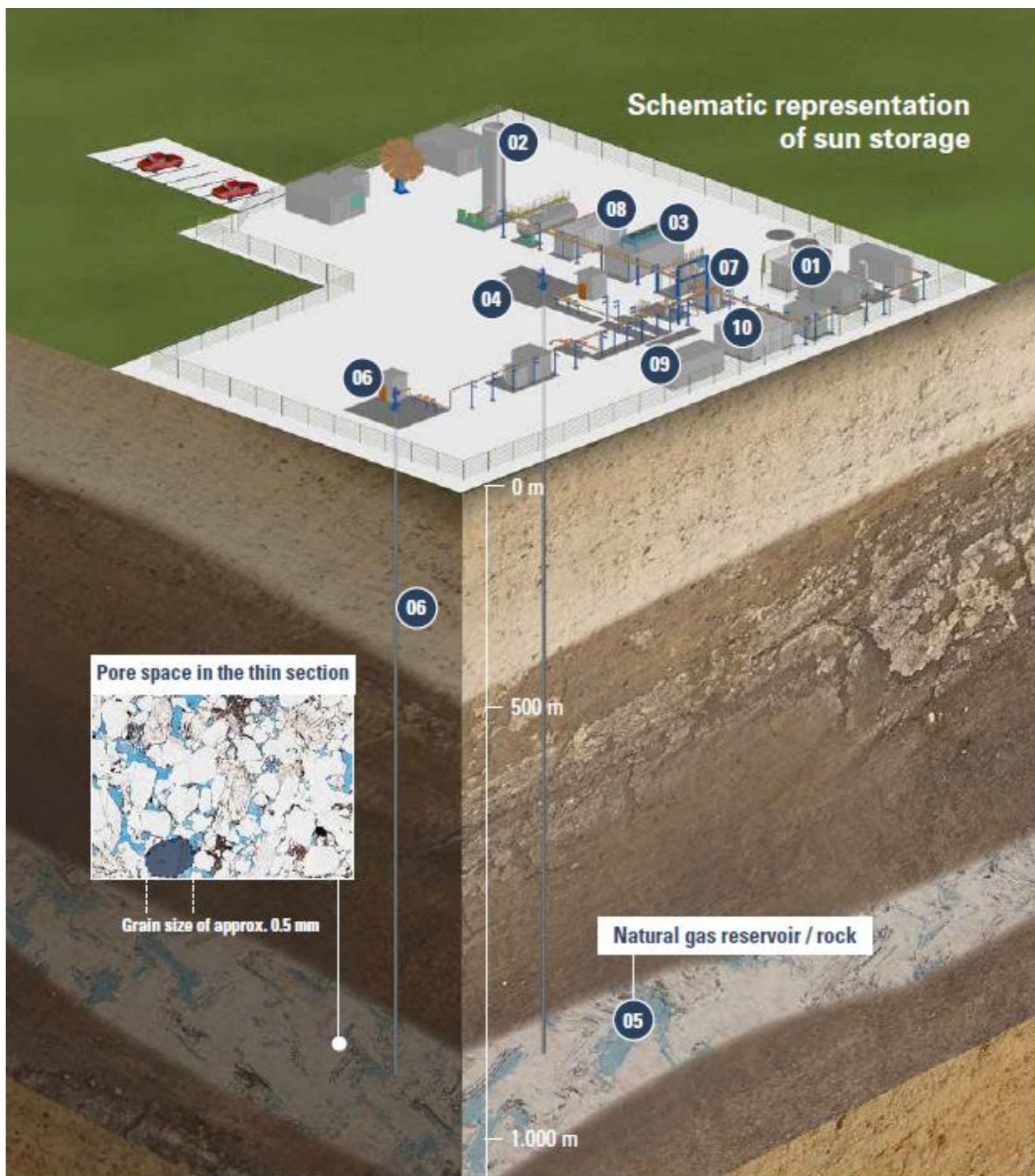


Natural gas in a sustainable Carbon cycle



Establishing a sustainable Carbon Cycle





In-situ Field Experiments

- Construction works finished
- Commissioning ongoing
- Batch experiments starting November 2018
- Second well – Q1/2019
- Cycle Experiments till end of 2020

01 Elektrolysis	05 Gas reservoir	09 Electricity grid connection
02 CO ₂ - tank	06 Withdrawal well	10 Control unit / EMSR
03 Compressor station	07 Drying unit	
04 Injection well	08 Gas conditioning	

Approval by Public Authorities - Initial Position

- Underground Sun Storage/Conversion is not routine business
- Hydrogen in subsurface: no references available
- First contact with mining authority prior to applying for R&D funding
- Complex project causes multi permission issues at different authorities
- Good cooperation and open-minded authorities

Overview of affected legal areas 1/2

- Mining Act (MinroG)
 - Construction and Operation of test facility
 - Storage operation plan
 - Changing of Dedication of the Well:
production -> storage
 - Minimum distance towards other
infrastructures
- Commercial Act (Betriebsanlagengenehmigung)
 - Construction and Operation of Hydrogen
Production Unit
- Water Right (Wasserrecht)
 - Water well

Overview of affected legal areas 2/2

- Nature Protection Law (Naturschutzgesetz)
 - Test facility situated on land dedicated for agriculture
- Electricity Act (Starkstromwegerecht)
 - Construction and Operation of electricity supply
- “AGS” license agreement
 - AGS: Aufsuchung – Gewinnung – Speicherung
 Exploration – Production - Storage

Framework conditions for operation

- Role in the system (consumer, producer, service)
- Electricity consumption – price/revenues/taxes
- Grid connection – electricity/gas
- Gas quality issues
- Role of CO₂
- What kind of service?
- Operator?

Conclusion

UNDERGROUND SUN.CONVERSION



- State of the art **underground gas storage** facilities are essential for Europe's **security of supply**
- Increase of erratic **renewable energy** generation and the integration of natural gas and electricity markets in turn will generate **additional demand in seasonal and high-capacity large scale storage options**
- Underground Sun Storage as well as Underground Sun Conversion technology can solve the problem of seasonal power storage
- Generation Renewable natural gas closes a **sustainable natural carbon cycle**
- Integration of renewable gas combines the benefits from classical **natural gas infrastructure** and the sociopolitical target of renewable energy supply
- Suitable **legal framework** has to be developed

Contact

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