Unlocking the underground for seasonal thermal energy storage in Switzerland

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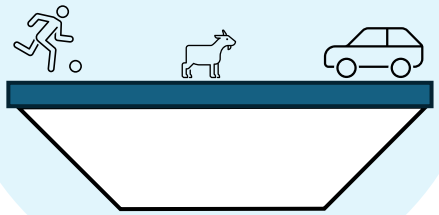
HSLU Lucerne University of Applied Sciences and Arts

THERMAL ENERGY STORAGE

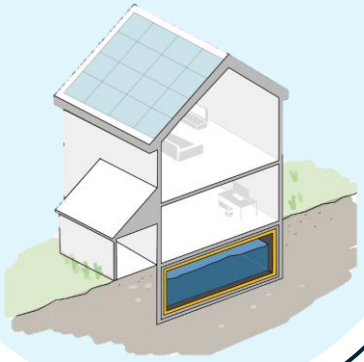
Underground Thermal Energy Storage Systems

Projects

Adapting PTES* LID for Multipurpose use



Basement as TES*



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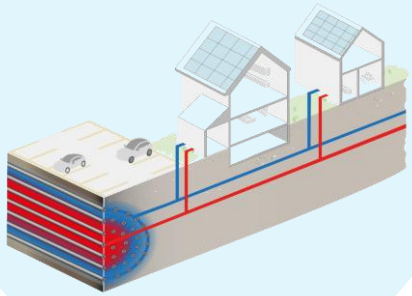
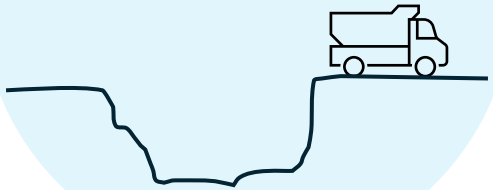
Tunnel

Horizontal borehole



Reusing gravel PIT as TES*



*TES = thermal energy storage
*PTES = Pit Thermal Energy storage

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THERMAL ENERGY STORAGE

Underground Thermal Energy Storage Systems

- Not Visible
- No impact on surface
- Possibility to use existing underground structures such as
  - Basement
  - Tunnel
  - Cavern

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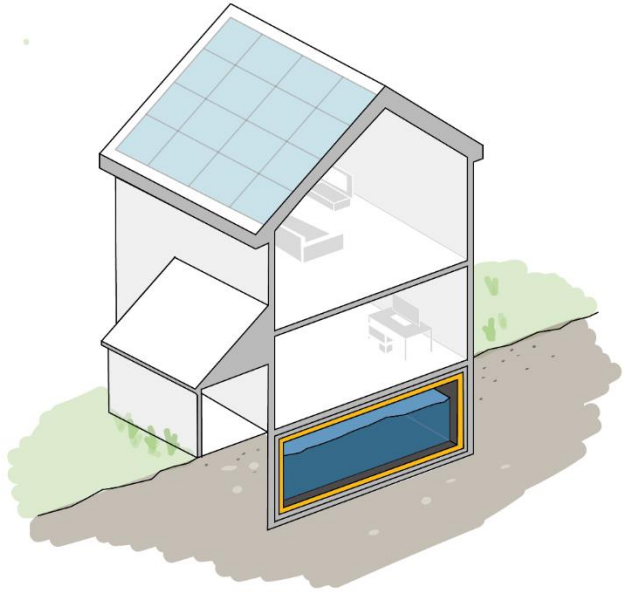
THERMAL ENERGY STORAGE

Project: Repurposing Basement

- **Goal:** Prototype development to validate the repurpose of a basement as a thermal energy storage.



- Thermal insulation to reduce heat losses withstanding the temperature and load
- Vapor diffusion tight barrier
- Construction and installation

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THERMAL ENERGY STORAGE

Thermal insulation

- Building an experimental setup to determine the long-term creep behavior of insulation material
  - Temperature range, flexible adjustable: 25-95°C
  - Pressure range on samples flexible adjustable: 0-260kPa
  - Humidity controlled
  - Place for 8 examinees (100x100x100mm)
- Accelerated process: Result of creep behavior for 50 years in 5 weeks.

Fig.: Picture of part of the creep setup (HSLU)

Accelerated and long-time creep testing of extruded polystyrene using isothermal and stepped isothermal method

David Schiffmann [a], Willy Villasmil [a,*], Sebastian Ammann [a], Hans Simmler [b], Jörg Worlitschek [a], Ludger Fischer [a]

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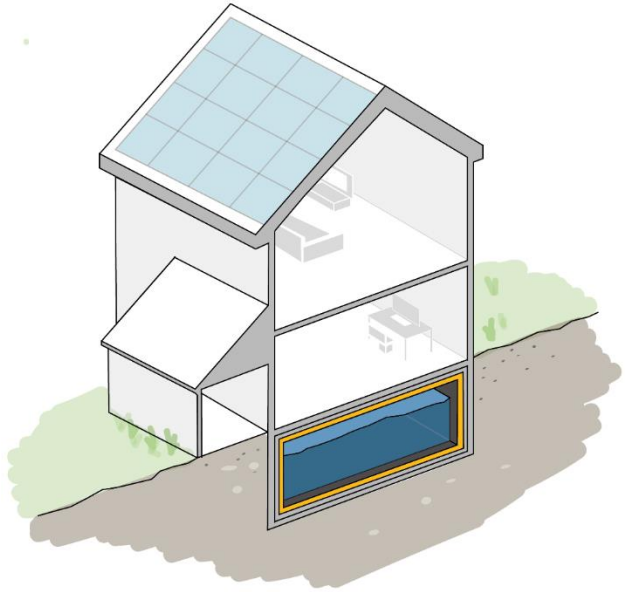
Pilot Plant – Basement

- **Goal:** Prototype development to validate the repurpose of a basement as a thermal energy storage.



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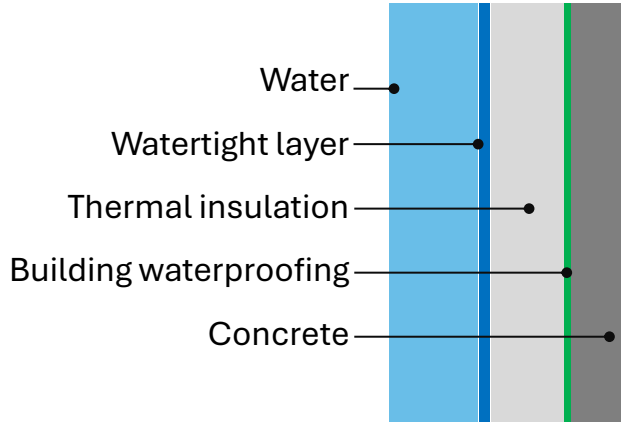
[1] «Analyse des schweizerischen Energieverbrauchs 2000-2016 nach Verwendungszwecken», BFE (2017)

Vapor diffusion tight barrier

- Building of an experimental setup to determine water-vapor transport trough membranes
  - Temperature range, flexible adjustable: 25-95°C
  - Probe size 0.022m^2 (circle with diameter 168mm)
  - Minimal measurable diffusion 13 mg/(m^2 day)



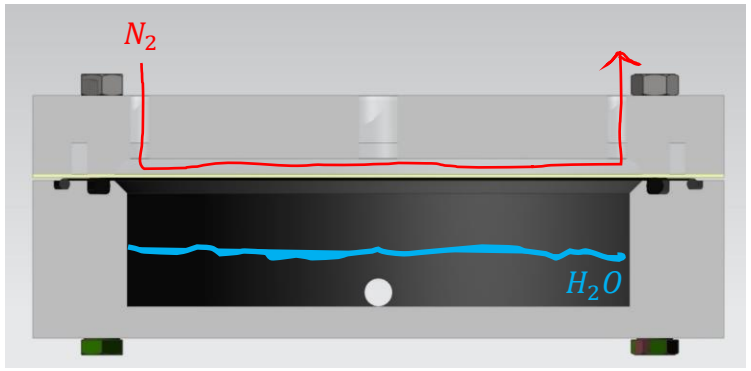
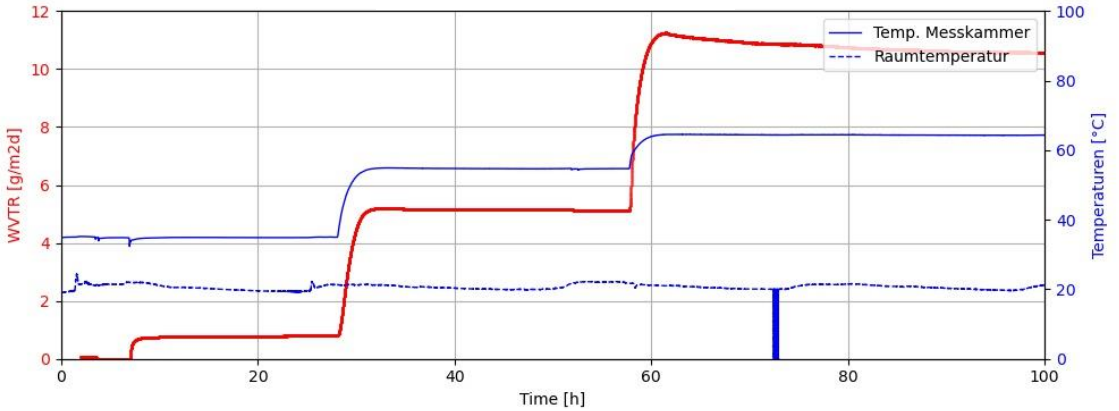


Fig.: 3D-Rendering of diffusion chamber(HSLU)

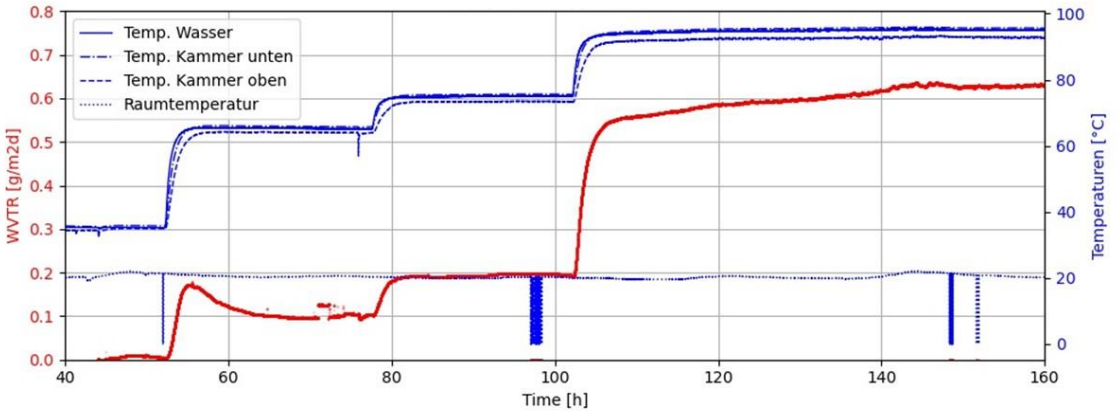
Vapor diffusion

- Testing different materials
  - For temperature > 95 °C strong increase of WVTR
  - WVTR: Water Vapor transmission rate

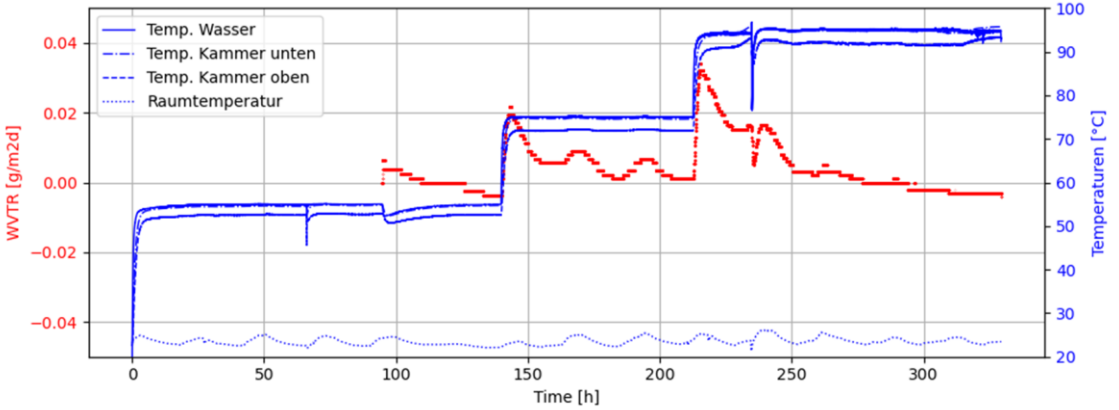
open sealing material



aluminum coated sealing film



aluminum composite film



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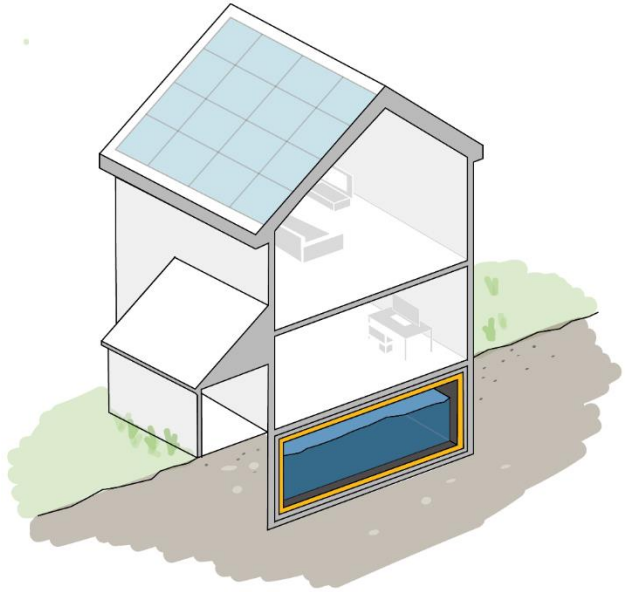

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THERMAL ENERGY STORAGE

Construction and installation

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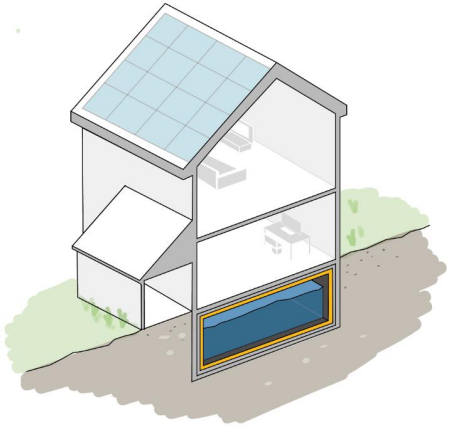
Underground Thermal Energy Storage Systems



Residential thermal energy storage System

Larger thermal energy storage systems combined with a district heating Network

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Tunnel

- Current Innosuisse project (SwissSTES)
- The following challenges are addressed:

- Develop algorithm to reduce material waste in thermal insulation production for challenging geometries
- Vapor diffusion tight barrier for higher temperature -> to increase storage capacity and thus reduce specific cost
- Optimal thermal storage for a new geometry (wider than tall)

Collaboration and opportunities

- Congratulations to SCAUT: to the award **“research institutions of national importance”**

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THANK YOU FOR LISTENING

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