HSLU Lucerne University of Applied Sciences and Arts

The Industry Perspective

Pathway to Seasonal Thermal Energy Storage

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10th Swiss Symposium Thermal Energy Storage
January 20, 2023

Agenda

• Input presentation	10 min
• Discussion round 1	20 min
• Discussion round 2	10 min
• Synthesize	20 min

Back to the plenary to present the output 16.30 pm

Vision

Successful Deployment of Seasonal Thermal Energy Storage in 10 Years

10th Swiss Symposium Thermal Energy Storage

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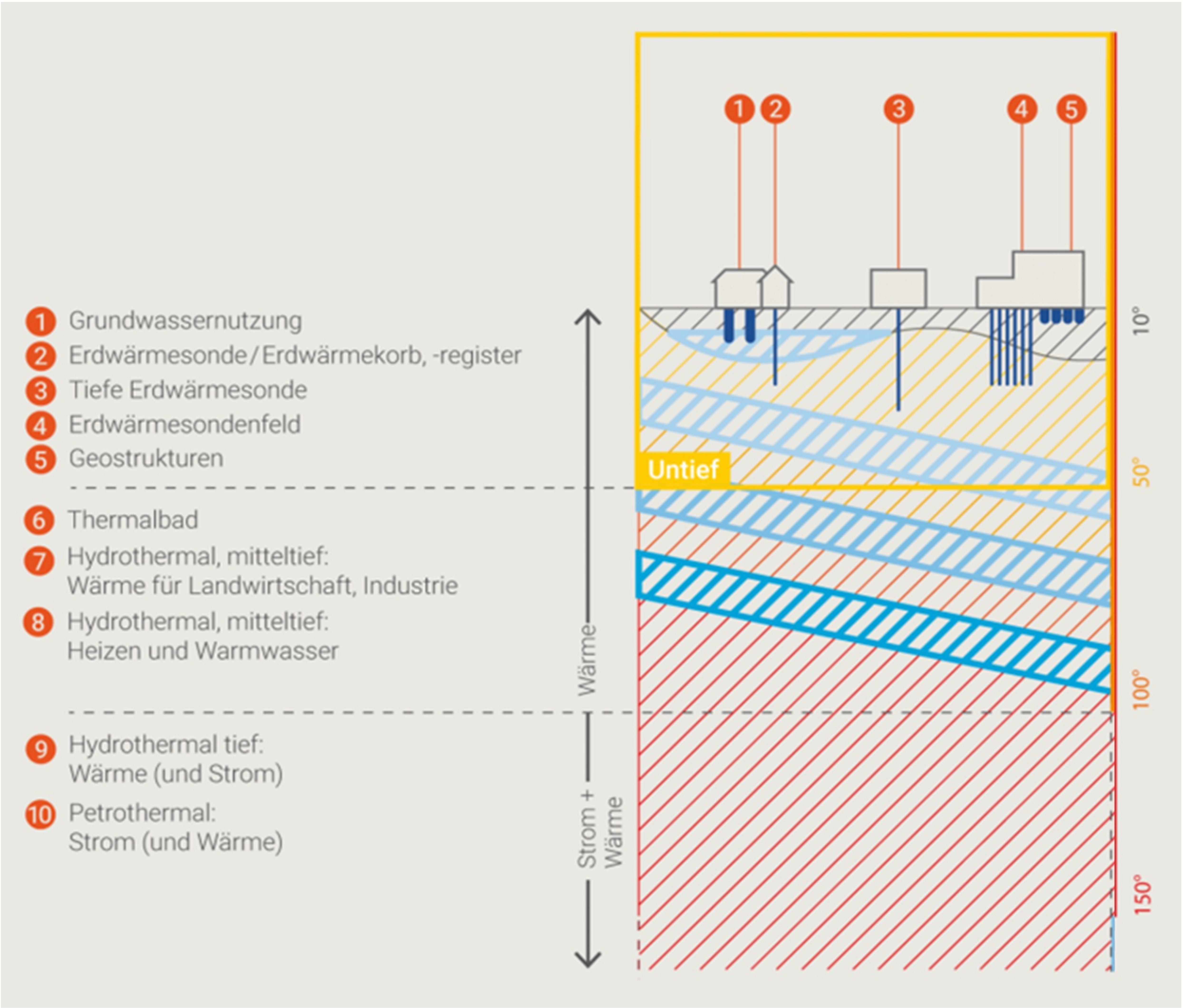
Challenges of Seasonal Thermal Energy Storage

"Seasonal heat storage enable the use of renewable energies without fossil peak loads"

Challenge 1)
Seasonal heat *storage takes up a lot of space*

Challenge 2)
Where did we place in the inner cities?

Challenge 3)
How *can the additional costs of ~20 Rp/kWh be financed?*



Jörg Hofmann, Energie Wasser Luzern

Challenges of Seasonal Thermal Energy Storage

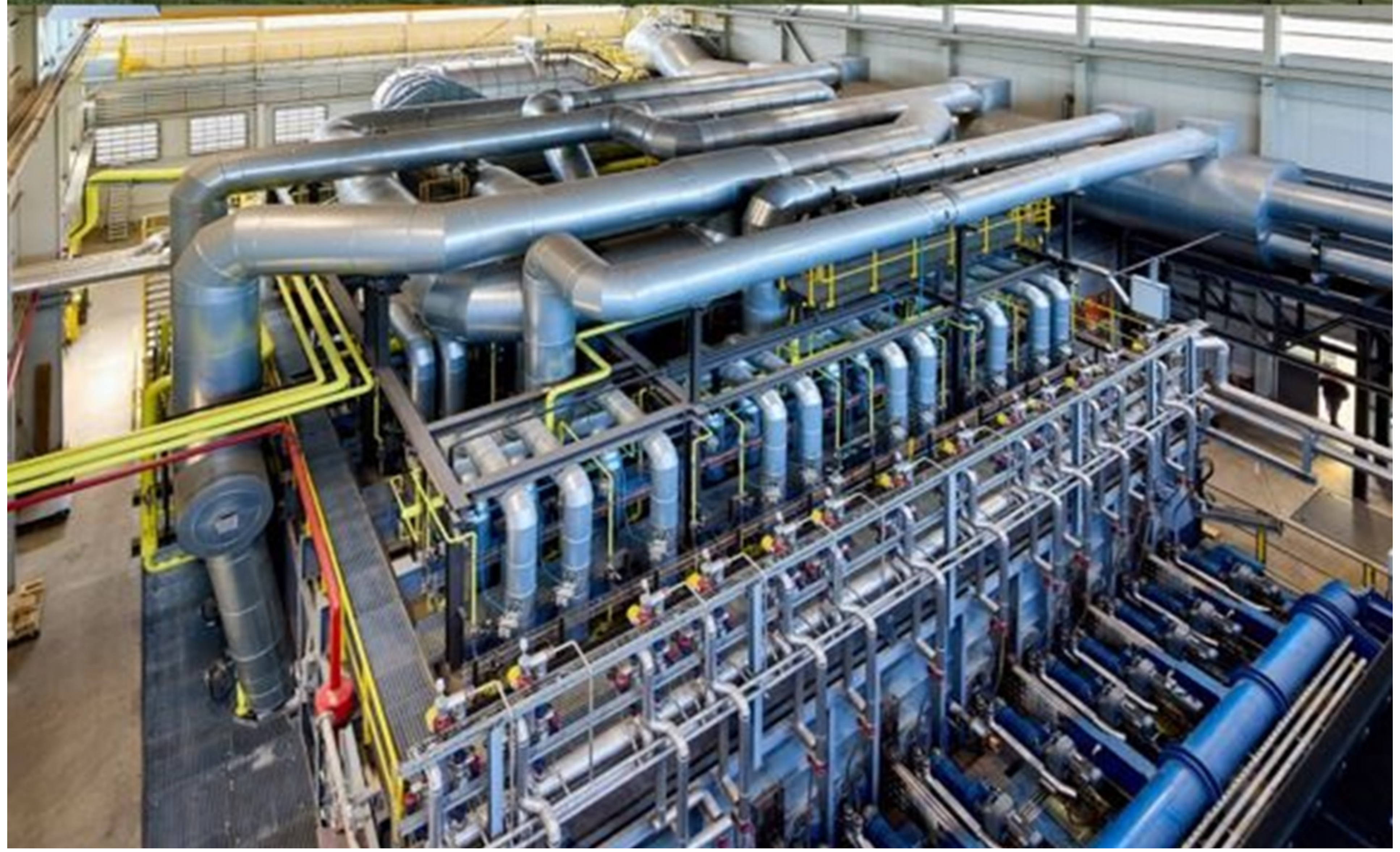
ewl täglich spürbar

We recovered 100 GWh of waste heat in the 2022 heating seasons. There is a similar potential for summer storage.

Challenge 1) high population density with limited room for substantial storage above ground

Challenge 2) rising demand in existing grids

Challenge 3) location of storage in relation to production and grid



Matthias A. Mast, Amestein & Waltert

Challenges of Seasonal Thermal Energy Storage

"Conventional STES (BHE) are being regularly deployed in new constructions / newly- developed sites; lacking are solutions for refurbishment / inner-city applications."

Challenge 1)
Current technology: limited applicability: demand side insufficient / availability of sufficent space in inner-citys

Challenge 2)
Current technology: intelligent automated control systems

Challenge 3)
Next generation STES: pilots /demonstration of large scale setups

Nadège Vetterli, Anex Ingenieure AG

Challenges of Seasonal Thermal Energy Storage

"The storage is an additional, cost-intensive component that enables to squeeze more out of the lemon"

Challenge 1)
The storage facility must bring added value – CO_2 reduction alone is not enough – for example network stability or being able to operate without redundancy are good arguments

Challenge 2)
Looking beyond the system boundaries, especially for waste heat recovery – optimize the entire system and not just the plant

Challenge 3)
Questioning energy concepts with fossil peak coverage - planning the storage from the beginning but investing later on (when the risk is reduced)

Challenges of Seasonal Thermal Energy Storage

"There is still too little awareness of the importance of STES to accept the economic risks"

Challenge 1)
Economic risk: High investment costs, long amortization period, high uncertainty regarding tariff forecasts

Challenge 2)
Lack of realized projects and experience

Challenge 3)
Space requirements, environmental regulations

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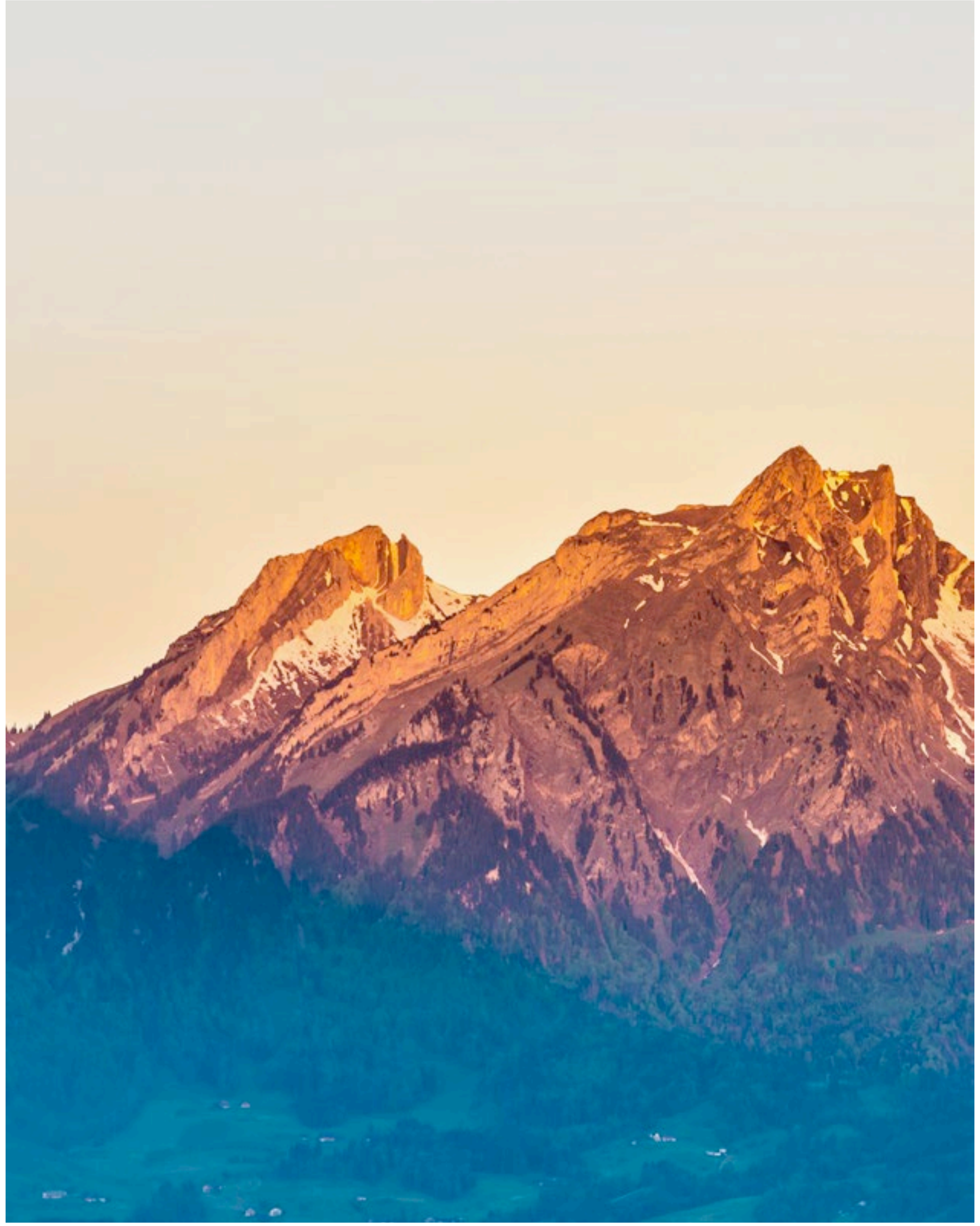
Challenges of Seasonal Thermal Energy Storage
The science perspective



How far have we come?
What is still to be done?

Luca Baldini[1], Fleury de Oliveira[2],
Ludger J. Fischer[3], Gianfranco Guidati[4]

1. ZHAW, 2. UNIGE, 3. HSLU, 4. ETHZ

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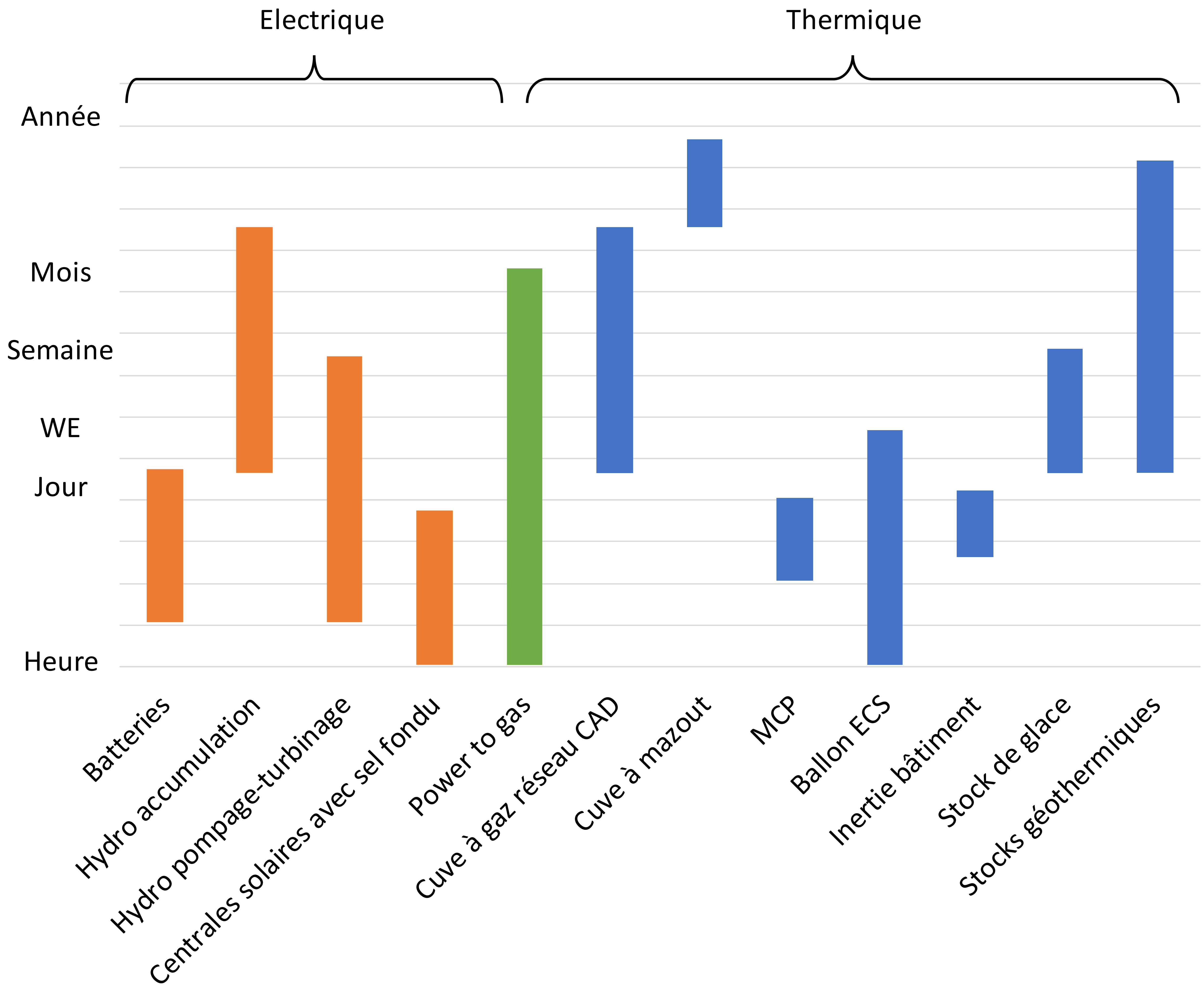
Challenges of Seasonal Thermal Energy Storage

Actual situation

Thermal Energy Storages are used in everyday life

- Domestic hot water tanks
- Greenhouse water tanks
- Cold water and ice tanks
- Buffers to ensure heat-pump and wood boilers production
- High-temperature buffers connected to district heating

- Dense boreholes systems with seasonal storage
- Anergie networks with low-temperature seasonal storage



Challenges of Seasonal Thermal Energy Storage

Actual situation

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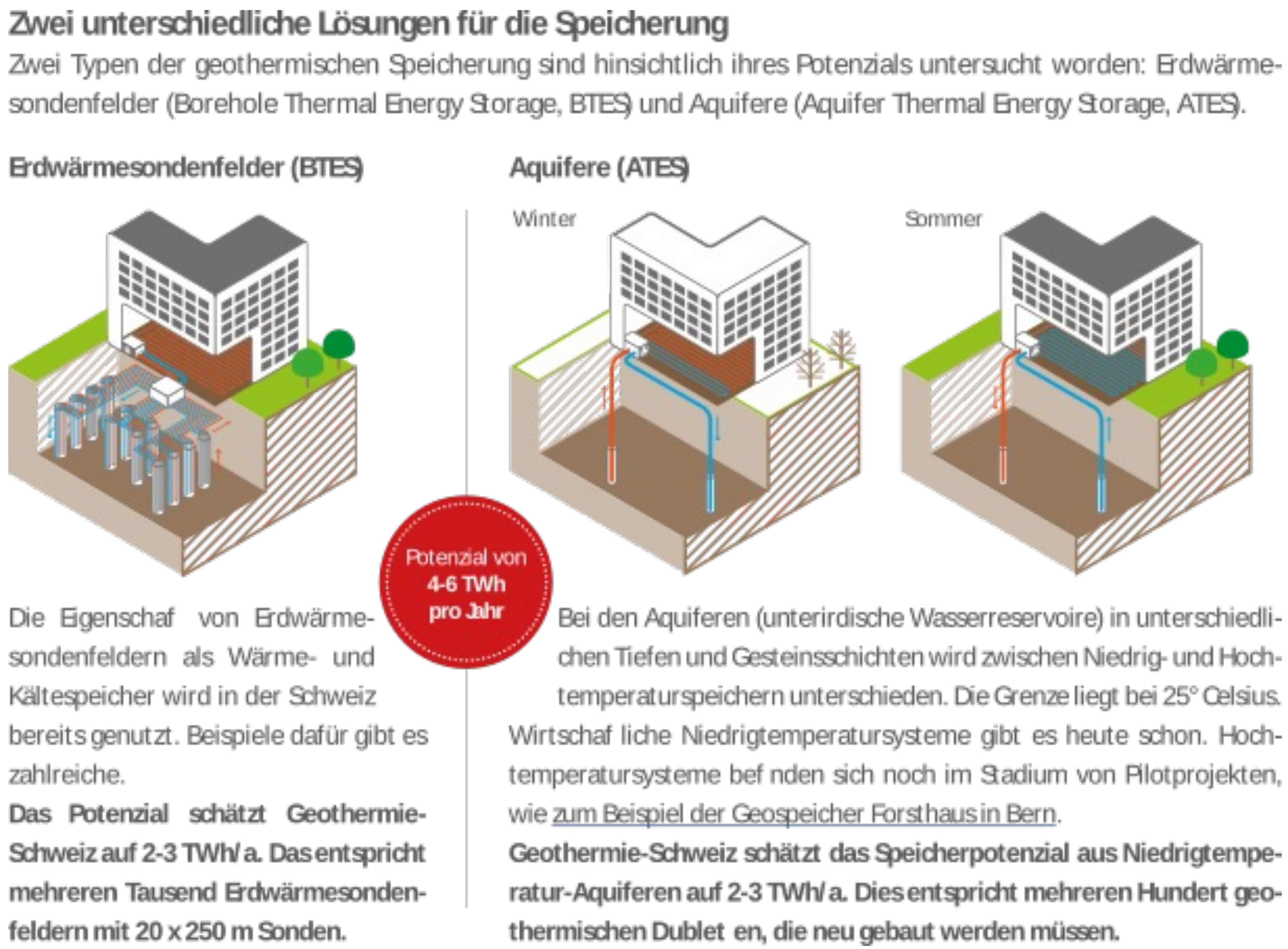
Why Seasonal Thermal Energy Storages are not used at large scale ?



Zwei unterschiedliche Lösungen für die Speicherung

Zwei Typen der geothermischen Speicherung sind hinsichtlich ihres Potenzials untersucht worden: Erdwärmesondenfelder (Borehole Thermal Energy Storage, BTES) und Aquifere (Aquifer Thermal Energy Storage, ATES).

Die Eigenschaf von Erdwärmesondenfeldern als Wärme- und Kältespeicher wird in der Schweiz bereits genutzt. Beispiele dafür gibt es zahlreiche.

Das Potenzial schätzt Geothermie-Schweiz auf 2-3 TWh/a. Das entspricht mehreren Tausend Erdwärmesondenfeldern mit 20 x 250 m Sonden.

Bei den Aquiferen (unterirdische Wasserreservoire) in unterschiedlichen Tiefen und Gesteinsschichten wird zwischen Niedrig- und Hochtemperaturspeichern unterschieden. Die Grenze liegt bei 25° Celsius. Wirtschaf liche Niedrigtemperatursysteme gibt es heute schon. Hochtemperatursysteme bef nden sich noch im Stadium von Pilotprojekten, wie zum Beispiel der Geospeicher Forsthaus in Bern.

Geothermie-Schweiz schätzt das Speicherpotenzial aus Niedrigtemperatur-Aquiferen auf 2-3 TWh/a. Dies entspricht mehreren Hundert geothermischen Dublet en, die neu gebaut werden müssen.

GEOTHERMIE SCHWEIZ

Challenges of Seasonal Thermal Energy Storage
The science perspective

Leading question 1: What can we do, what is our contribution, and what are our most important steps?

Leading question 2: What is missing and what are our expectations from others?

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Challenges of Seasonal Thermal Energy Storage
The science perspective

Need of a long-term view of system development combined with real measurements and standard exploitation strategies

Challenge 1) Lack of planning tools and master-plans

Challenge 2) Lack of standard strategies to guarantee optimal exploitation (energy, CO_2, $) and STES integration in coupled systems (elec, heat, cooling, gas)

Challenge 3) Lack of an extensive knowledge of real running temperatures (DH return temperature, for example)

Challenge 4) Lack of an extensive and homogeneous underground database (geology, chemistry, physical properties) for underground projects

Challenges of Seasonal Thermal Energy Storage
The science perspective

Planning tool development

- Where to place STES ?
- How to create a STES master-plan that take account of territorial characteristics ?
- What system to be planned and what efficiency to be used ?

Standard strategies in the new coupled energy system

- How to better exploit STES ?
- What kind of KPI do we need ?
- When to charge/discharge (what kind of external signal do we need) ?
- How to ensure a good integration between Source-STES-Sink (energy, power, temperature)?

The Sociopolitical Perspective

Pathway to Seasonal Thermal Energy Storage

Pascal Leumann, Wärme Zürich, CH
Gianni Operto, aeesuisse, CH
Isabelle Stadelmann, University of Berne, CH
Ulrike Sturm, Hochschule Luzern – Soziale Arbeit, CH

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Stadt Zürich

Challenges of Seasonal Thermal Energy Storage

Challenge 1)
(Seasonal) thermal energy storage is a **well-known and technically feasible** solution to decarbonize the heat supply.
This is **not known** in the **population an politics**.

Challenge 2)
When using water as a storage medium, the **huge space requirement** is **extremely challenging**, especially in urban areas.

Challenge 3)
Solutions with **smaller space requirements** or solutions with **use of the underground** would be very interesting.

Challenges of Seasonal Thermal Energy Storage

Dachorganisation der Wirtschaft für erneuerbare Energien und Energieeffizienz

"In spite of scientific evidence and economic advantage, the technology is insufficiently deployed"

Challenge 1)
Insufficient awareness, experience, confidence

Challenge 2)
Excessive regulatory restrictions

Challenge 3)
Lack of appropriate incentives

Challenges of Seasonal Thermal Energy Storage

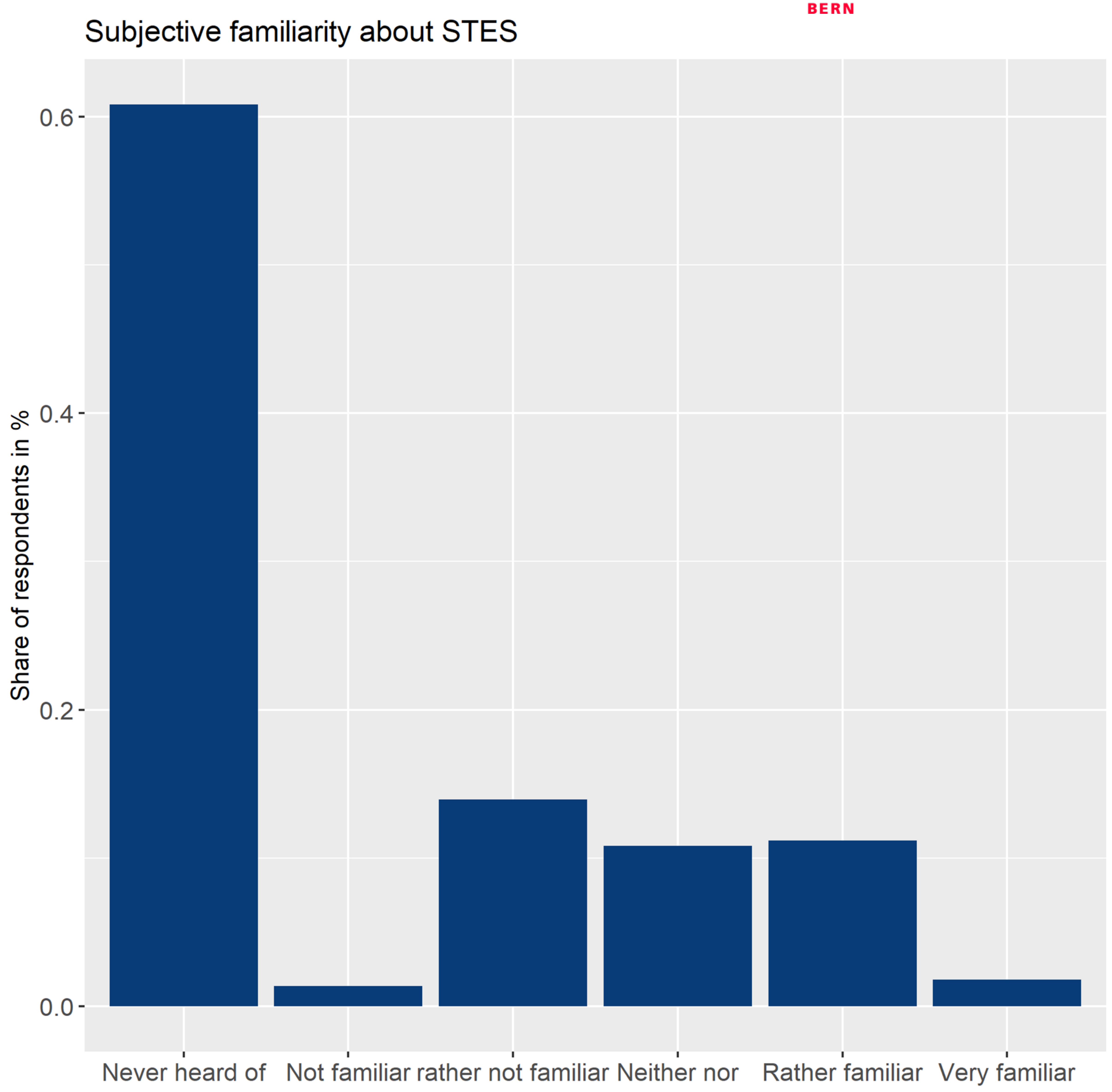
UNIVERSITÄT BERN

„While scientists consider STES to be important for the energy transition, most people barely know what STES is and means."

Challenge 1)
Increasing people's sensitization for STES

Challenge 2)
Translating „technical discussion" into accessible information for citizens and stakeholders

Challenge 3)
Integrating relevant preferences of „users" into technology development



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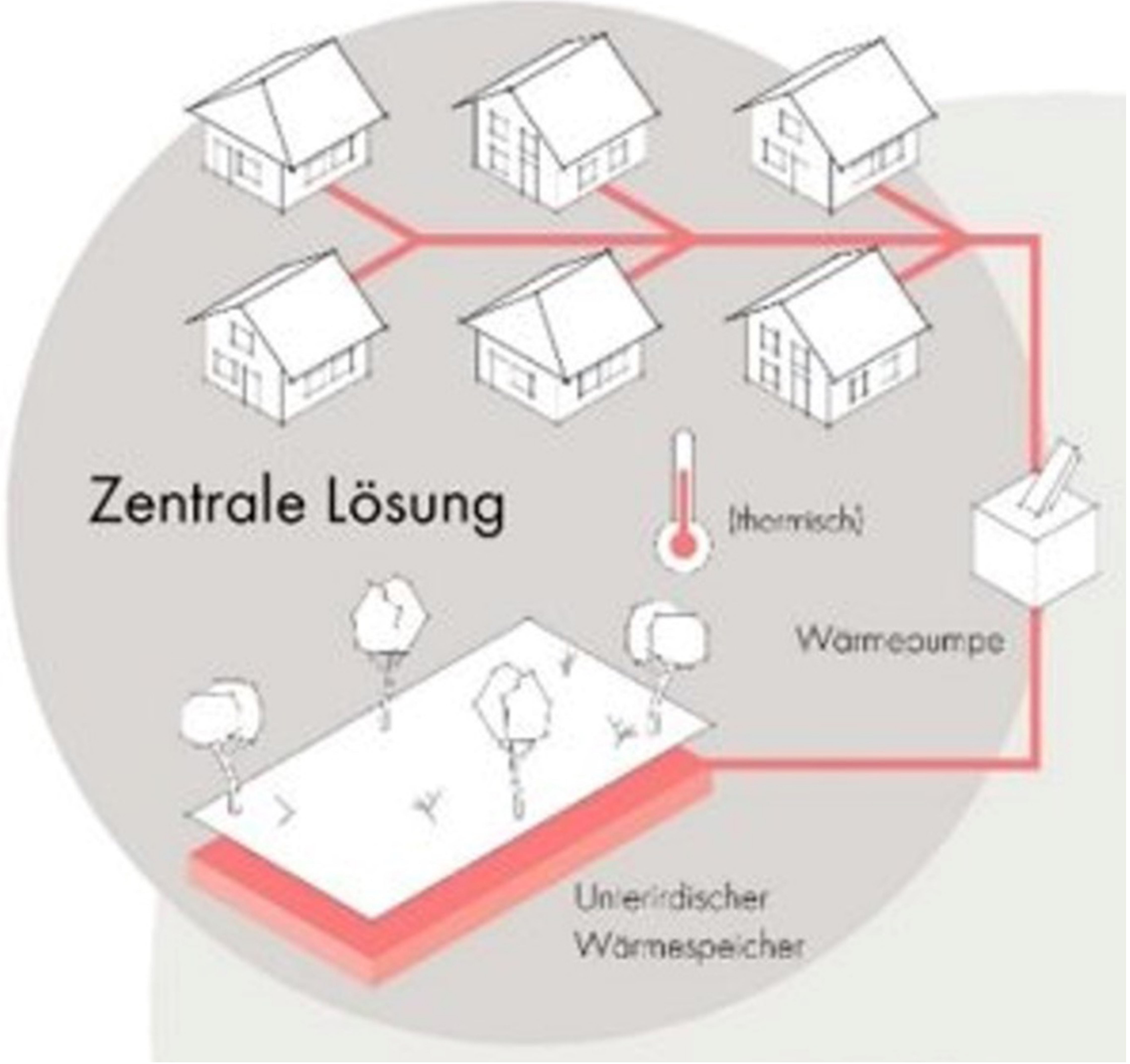
Challenges of Seasonal Thermal Energy Storage

"Land requirement for energy facilities, including STES, must become part of mandatory energy spatial planning. The importance of energy planning is so far underestimated in CH."

Challenge 1)
To implement spatial energy planning into the Swiss planning system and procedures.

Challenge 2)
To spread knowledge of systemic thinking combining renewable energies and storage (inlcuding STES) and sector coupling among (non-energy) experts and politicians.

Challenge 3)
To reach out to municipalities and end-users and to enhance their systemic knowledge of energy supply and storage.



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The New Generation Perspective

Pathway to Seasonal Thermal Energy Storage

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Rebeka Sträter, University of Bern
Héctor Ramírez, University of Basel / ZHAW
Arthur Rinaldi, University of Geneva
Richard Lüchinger, HSLU

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Introduction

- In the context of climate change, new generations will be disproportionally more affected.
- Access to high level discussion and political spaces are limited for younger people.
- In response, climate activists and ground political movements have entered the discussion in the last decade.

About the New Generation

- **The new generation:** 16 – 29 years old
- **Level of knowledge:** Low level of knowledge about basic scientific concepts of climate change and tendency to underestimate the consensus on climate change.
- **Governments:** Governments are seen as having the main responsibility for addressing climate change.
- **Frustration:** Helplessness in dealing with climate change, leading to low personal commitment.
- **Trusted messengers:** Social media are important sources of information on climate change.
- **Positive attitude:** Positive attitude toward low-carbon technology.

Source: Corner, Adam, et al. "How do young people engage with climate change? The role of knowledge, values, message framing, and trusted communicators." (2015)

How to Engage New Generation more Effectively?

- **Values:** Messages should appeal to young people's interests and values. Providing accurate information is not enough to achieve engagement.
- **Self-efficacy:** Building young people's sense of self-efficacy appears to be important. Topics and media that are stimulated by young people themselves, preferably through a peer-to-peer approach, have been shown to promote sustainable behavior.
- **Convenient solutions:** Energy-saving or -conserving behaviors that are considered convenient, and cool are more likely to appeal to young people.

Source: Corner, Adam, et al. "How do young people engage with climate change? The role of knowledge, values, message framing, and trusted communicators." (2015)

Pathways to Seasonal Thermal Energy Storage

What can the new generation do?

How can we get the new generation more involved in the development of seasonal heat storage?

How can we bring seasonal thermal energy storage to the new generation?

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Challenges of Seasonal Thermal Energy Storage

How far have we come?
What is still to be done?

Synthesize
The Science Perspective
The Industry Perspective
The Sociopolitical Perspective
The New Generation Perspective

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The Science Perspective

What can we do, what is our contribution, and what are the most important steps to follow?

- Define design tools, modular designs, design rules, best practices, reference cases/systems, benchmarks, KPIs, operation guidelines
- "Educate" decision makers (politics, general public), provide them with scenarios, decision support
- Coordinate **OPEN** data collection and provision at national scale (together with SFOE, swisstopo, etc)
- Reduce cost, raise TRL, demonstrate in the real world!
- International and interdisciplinary networking; we need to work together in a better way
- Set a clear target (1 TWh by 2030, 5 TWh by 2050)

What is missing and what are our expectations from others?

- From the practitioners: provide real cases, data, boundary conditions
- From politics, regulators: dynamic electricity prices; regulations (above/below ground); incentives
- SFOE: More funding to close knowledge gaps, fair distribution proportional to importance to reach the net-zero goal
- More technical experts
- Politics: Call for a moon shot project!

The Industry Perspective

What can we do, what is our contribution, and what are the most important steps to follow?

1) Good communication strategy – talking about
   - risks, fears openly,
   - pilots nationally and internationally
   - results of existing projects
2) We need to do first pilot projects (close by)
   – examples and success stories
3) We should use existing infrastructures
   - big existing tanks, bunkers, tunnels, lakes ..
4) We need to develop business models

What is missing and what are our expectations from others?

1) We need a national vision and mission statement
   - Boundary conditions
2) We need spatial planning to be closely related
3) We need to force knowledge transfer:
   - rough guidelines, information, etc. for less informed people, investors, …
4) We need acceptance from public
5) We need access to data

The Industry Perspective - Online

What can we do, what is our contribution, and what are the most important steps to follow?

- Strenghten research centers and industries collaboration to build pilot scale facilities
- Spread the idea of thermal storages
- Usage of non-seasonal facilities that already exist for showcasing
- Make clear: Avoid curtailment of PV power in summer by turn it to heat
- How to install demonstrators in projects and implement it in the real market
- Work together with industrial partners to test and modify materials, Examples: efficiency heat pump, batteries...
- How to implement knowledge from demonstrators and implement it in the market - user friendly
- We want to implement STS as a building-complex (9 buildings) - possibilities for pilot projects - want to store our waste heat

What is missing and what are our expectations from others?

- Federal plan for resources availability/import and export
- Adaptation of Swiss regulations to European market for renewable energies
- Federal help for financial investment by industry
- Tecno-economical analysis applied to scientific research
- Bring together technologies and knowledge from science
- Bring together implementation partners and knowledge partners

The Sociopolitical Perspective

What can we do, what is our contribution, and what are the most important steps to follow?

- Information and sensibilization of different stakeholders (e.g. awareness about different types of energy, including children)
- Simple consultation/planning tools available at the population level
- Visible successful stories (e.g. pilots)→ add to the norm change
- Regulatory aspects

What is missing and what are our expectations from others?

Political level

- STES needs to be put on the political agenda
- Carbon prices or State subsidies for STES
- Negotiation of priorities on legal requirements

Planning authorities

- Suitability criteria nation-wide
- Space planning → new zoning: energy zones

Scientists and professionals

- Scientific advisory boards for politics
- energy consultants for politicians and municipalities

The New Generation Perspective

What can we do, what is our contribution, and what are the most important steps to follow?

- Create platforms for exchange (from older to younger, from science to the public; make it accessible)
- Education: Provide the right knowledge and encourage / increase critical thinking

What is missing and what are our expectations from others?

- Technology sex appeal (make it cool, advertise it)
- Time (time is running out, speed up!)
- Information and awareness