energy storage

IEA Technology Collaboration Programme

COUNTRY REPORT
Switzerland

Stephan Mathez

with contributions from Michael Moser, Stefan Oberholzer, and Florence Bégué

99 XC Meeting, Sevilla, Spain, 20-22 May 2025

Country Specific Information (Status: End of 2023)

- Population: 8,96 mio.
- Total Energy Consumption: 213.2 TWh or 767 Petajoule (PJ)
- Building Heating and Development 2000 -> 2023:

- heating oil:	59.9 %	->	25.6 %
- natural gas:	18.0 %	->	26.7 %
- electric:	6.9 %	->	5.4 %
- heat pumps:	3.6 %	->	26.8 %
- district heating:	2.9 %	->	6.1 %
- wood:	8.4 %	->	9.3 %

- Domestic Hotwater: 25.3 % electric, 23.6 % natural gas, 21.1 % heating oil
- Electricity: Hydro: 56.6 %, Nuclear: 32.4 %, PV: 6.4 %, Wind: 0.2 %, Fossil: 1.6 %
- Public RD&D: CHF 406 Mio (2021: -26 Mio), thereof CHF 42 Mio (+ 10 Mio) for storage

RD&D Information Heat Storage
(Research, Development and Demonstration)

Dedicated Programmes: Solar Thermal and Heat Storage (S. Mathez/A. Eckmanns)

Programme Budget: CHF 1.0 Mio, Storage Related: ~75%

Call for Projects 2025:

"Challenges in the realisation of large-scale thermal storage and large collector fields"

- **Technical challenges for the realisation of large-scale thermal storage**
- **Connection of renewables and waste heat sources to large-scale thermal storage**
- **Improving framework conditions for large heat storage projects**
- **Challenges in the planning of large collector fields**

RD&D Information Electicity Storage
(Research, Development and Demonstration)

Dedicated Programmes: Batteries (S. Oberholzer), Electricity (M. Moser), Hydropower (M. Moser)

National Budget: > CHF 20 Mio (~ 5% of Total Energy RD&D)

R+D Issues:

- **Battery technologies: LIB (SSB), SIB, ZEBRA, RFB, 2nd-use, Recycling/Circular Economy**
- **Hydro/Pumped-hydro: operational impact on components and reservoirs; medium/ small pumped storage at distribution grid level; options to delay power production from autumn to winter**
- **Innovative processes to achieve grid and system stability incl. use of storage**
- **Efficient/reliable power electronic converters for various storage technologies**

RD&D Information Underground Thermal Storage
(Research, Development and Demonstration)

Dedicated Programme: Geo-Energy (F. Bégué),
Programme Budget: CHF ~1.0 Mio, Storage Related: ~75%

R+D Issues:

- **ATES - Geological risk: need a better characterization of the underground and permeability of the reservoirs; alternative technologies for transmissivity enhancement**
- **ATES, BTES, FTES: Bio-, hydro-, Geochemical monitoring and coupled thermo-hydro-bio-geochemical numerical modeling**
- **UTES integration into smart energy systems, grids, and heating and cooling networks**
- **Underground storage of hydrogen (UHS) and other Power-to-X derivates: exploratory methods and potential studies**

RD&D Information Hydrogen Storage
(Research, Development and Demonstration)

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Dedicated Programmes: Hydrogen and Fuel Cells (S. Oberholzer)

- **Materials research for new hydrogen tanks (-> mobility)**
- **Metal-hydride hydrogen storage (company GRZ)**
- **Research on hydrogen compression technology**
- **Power-to-Gas demo projects**

Hydrogen and Fuel Cell Technology: ~75 ongoing projects (not all storage related), h2fc.ch

Energy Storage Landscape

Thermal Storage:

- University of Geneva, SIG (Services Industriels de Genève): ATES
- University of Berne: ATES, fluid-rock interaction
- EMPA (Swiss Federal Laboratories for Materials Science and Technology) and Eawag (aquatic research): BTES and environmental monitoring
- HSLU (University of Applied Sciences Lucerne): CTES (NaOH), HyTES
- ZHAW (University of Applied Sciences Zurich, Winterthur): CTES (MgCl)
- OST (University of Applied Sciences of Eastern Switzerland): Aluminum storage, ice slurry storage, big water stores, seasonal storage
- ETHZ (Swiss Federal Institute of Technology, Zurich): Ice slurry storage, FTES
- EPFL (Swiss Federal Institute of Technology, Lausanne): FTES
- Industry: Zurich Airport (demo projects ATES); ewg (HT-ATES)

Energy Storage Landscape

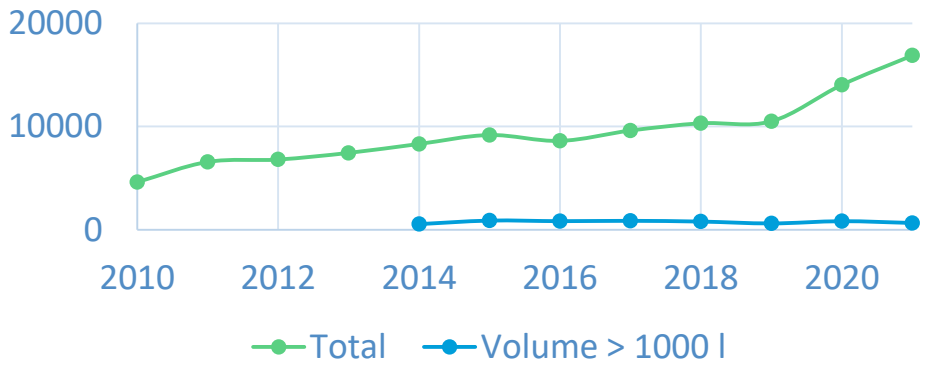
Electrical Storage:

- CSEM (Centre Suisse d'Electronique et de Microtechnique), Batteries: from materials to systems
- PSI (Electrochemistry Laboratory): Battery technologies
- EMPA (Materials for Energy Conversion): Battery technologies
- Many others in Battery technologies: https://ibat.swiss/swiss-battery-landscape/
- BFH (Berne University of Applied Sciences, Biel): Battery manufacturing, system integration (home, grid, mobility), reuse, recycling
- EPFL (Swiss Federal Institute of Technology, Lausanne): Grid integration, Hydro
- ETHZ (Swiss Federal Institute of Technology, Zurich): Hydro, power electronics
- MAN Energy Solutions: ETES

Policies & Market

- **Energy Storage Policies: No subsidies granted for thermal storages, Risk guarantee (since Jan. 2025) for public infrastructure supporting Net Zero target (Climate and Innovation act Art 7) applicable for UTES if:**
  - Storage efficiency < 15% of forecast
  - Double usage of surface falls away (for PTES)

  (50% of mitigation resp. sunk costs if no mitigation possible, max. 5 Mio for 15 years, Conditions: exploration risk excluded, sufficient simulation and exploration work must be presented)
- **A few P&D projects are supported by federal and local funds**
- **Subsidies for solar thermal require appropriate storage sizing (www.qm-solar.ch)**
- **Market trends:** **Thermal Storages Installed**



- **"Power Law" (Public Vote June 2024), for Players > 10 GWh/a: (1) Hydropower storage and demand side reserves to ensure power supply in winter; (2) Local Electricity Communities "LEC" on Grid Level 7 and 5**

Top 3 projects

- “BigStoreDH“ 2-Zone Water Storage
- Volume: 28’000 m^3
- Temperatures: 60 – 110 °C
- Storage Period: Days
- Demand: Local heat grid
- Autarky: –
- System: Local Resources like Wood, Heat pump, Waste Heat

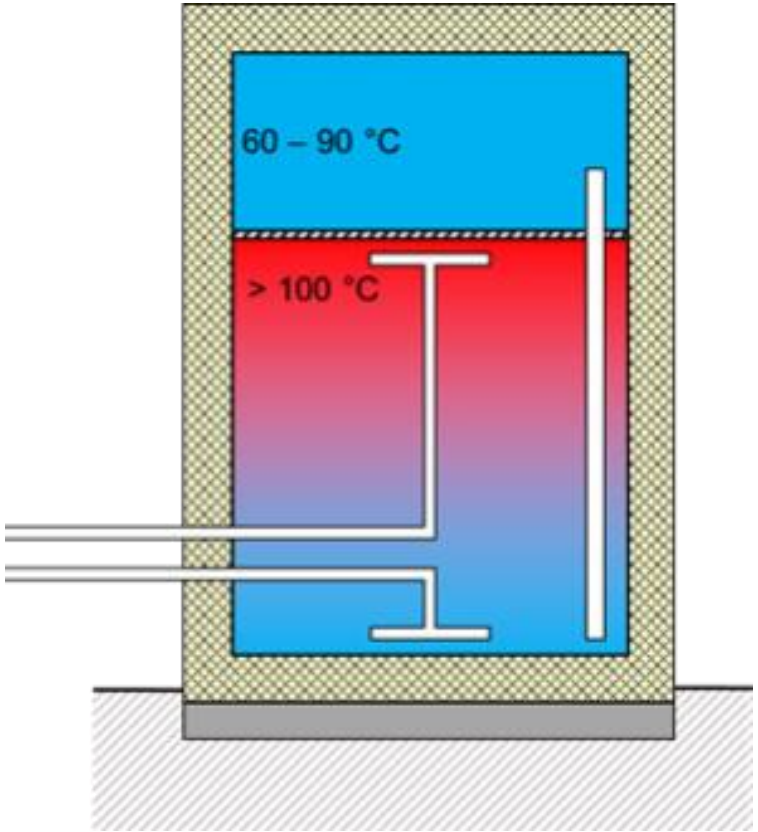
- “SorpStor-Frauenfeld” (NaOH)
- Volume: 12 m^3 (scalable)
- Temperatures: –
- Storage Period: Months
- Demand: Industrial
- Autarky: 80 – 100%
- System: PV + heat pump

- “CIRCUBAT” (https://circubat.ch/)
- Interdisciplinary project to develop a circular economy model for automotive lithium batteries in Switzerland

Project “BigStoreDH”: Big Storages for District Heatings

© AgroEnergie Schwyz AG. 28'000 m3 unpressurized water tank.

Unpressurized steel tanks typically operate below 100 °C. However, flat-bottom two-zone storage tanks allow higher temperatures. A false ceiling divides the tank into two volumes: the upper section increases pressure in the lower section, enabling temperatures above 100 °C.



Project “SorpStor-Frauenfeld”: Sorption Heat Storage Demonstrator

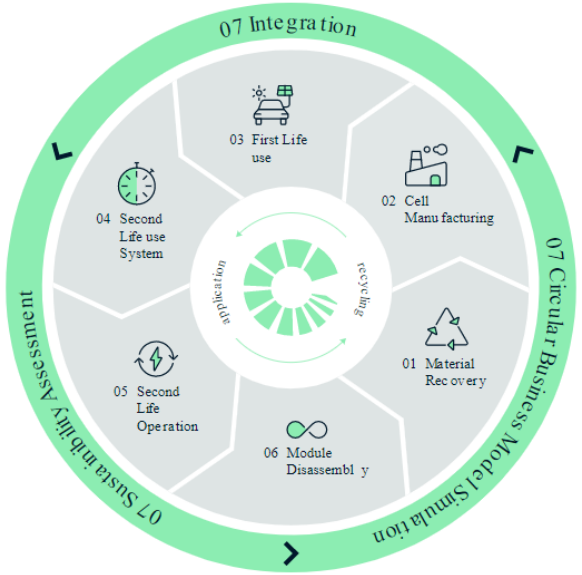
Sorption heat storage uses sodium hydroxide to absorb and release water, storing thermal energy. Solar or renewable heat concentrates the solution in summer, while winter evaporation and condensation release heat for space heating. The process continuously recycles materials, making it efficient and sustainable. Sodium hydroxide is ideal due to its strong water affinity, low cost, and long-term usability.

GEWINNER DES watt d’or 2025

© HSLU, 12 m^3 seasonal NaOH storage. Scalable Storage Concept.

Project “CIRCUBAT”: Swiss circular economy model for automotive lithium batteries

- **The CircuBAT research project aims to close the loop between production, application and recycling of lithium-ion batteries from mobility.**
- **Interdisciplinary project with 7 Swiss research institutions and 24 companies.**
- **The project is part of the newly launched flagship initiative of the funding agency Innosuisse.**
- **Topics:**
  - Material Recovery
  - Cell Manufacturing
  - First Life Use
  - Second Life Use & Operation
  - Disassembly and Components Recovery
  - Sustainable Business Model



Battery projects

AFREESSB – Anode-free all-solid-state batteries: From thin film to bulk
Article: Batteries reduced to the essentials

Solid-state battery production "Novel method for a resource efficient solid-state battery cell production" (Innosuisse)
https://www.aramis.admin.ch/Grunddaten/?ProjectID=47580

BIENE "Battery manager – cost and benefit-optimised control of batteries on rail vehicles" (SFOE)
https://www.aramis.admin.ch/Grunddaten/?ProjectID=52094

Battery projects on ARAMIS: https://energyresearch.ch/aramis.php?PR=batt

Other Relevant Information

- **Swiss Federal Scientific Report Database: https://www.aramis.admin.ch**
- **Project Codes:**

Storage Concept	Project Code
ATES	P2ATES, VESTA, ZH-Airport, HEATSTORE
BTES	LeSoPot, ARTS
CTES (NaOH)	NaOH-Speicher, NLA-Storm, SorpStor-Frauenfeld
CTES (MgCl)	TCology
HyTES (PCM/Water)	HyTES
Ice Slurry Storage	SlurryStore, ModIceCrys
Aluminum Storage	AlEnCycle
Big Water Stores	BigStoreDH, OptiCADSol, TES4DH
Seasonal Storage	100%solarLCA, USC-FlexStore
E-Tank	ExSolStore
CAES	AA-CAES
FTES	BEACH, Demo-FTES
Grid integration	BAT4SG, REEL Demo, GISOptiTES, RESULTES, DescentGrids
Optimize Local Storages	WinTES, BigStoreSwarm, StoWaDimWRG, B-MES

The Energy Storage TCP

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