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Swiss Federal Office of Energy SFOE
Solar Heat and Heat Storage research programme

Call for projects in the Solar Heat and Heat Storage research programme
07.04.2025 / Stephan A. Mathez and Andreas Eckmanns

Note: This call for projects was written in German and translated into French and English. In the event of any ambiguities, the German version applies.

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

Initial situation

Energy research provides impulses for systemic change towards renewable energy sources, supports the constitutionally mandated economical and efficient use of energy, and promotes an independent, sustainable energy supply that takes responsibility for future generations. With approximately 1.8 million buildings, the construction sector represents nearly half of Switzerland's primary energy consumption.

The Solar Heat and Heat Storage research programme aligns with the Energy Strategy 2050[1] and the objectives outlined in the SFOE Energy Research Concept 2025–2028[2]. The programme focuses on application-oriented research and the development of innovative technologies for heating and cooling solutions in buildings, neighborhoods, and urban areas.

Motivation

To decarbonize Switzerland's energy system and enhance its self-sufficiency and resilience against winter energy shortages, large-scale energy storage systems are essential. Storing energy in the form of heat remains by far the most cost-effective method. Seasonal and partially seasonal heat storage systems alleviate pressure on the electricity grid during the colder months through sector coupling. So-called 'giga-storage facilities,' with capacities exceeding ½ GWh, include pit or cavern storage systems (> 10,000 m³, ΔT=40 K), debris storage systems (> 25,000 m³, ΔT=40 K), borehole thermal storage systems (> 50,000 m³, ΔT=20 K), and aquifer storage systems (> 100,000 m³, ΔT=10 K). Additionally, 'mega-storage facilities' with capacities greater than ½ MWh are crucial for providing heat to buildings or neighborhoods, ensuring the continuous availability of renewable energy resources for reliable energy supply *at all times*.

Large-scale heat storage technologies demand heightened reliability and cost efficiency. Their planning requires comprehensive structural and geological analyses, while the operational phase must consider the impact of heat storage on long-term chemical and biological behavior. Additionally, the materials and processes employed must be evaluated for CO_2 emissions, availability, and environmental sustainability.

[1] Incl. the current adjustment to the Federal Council's target of net zero greenhouse gas emissions in 2050 in the Energy Perspectives 2050+. Link to the short report: Energy Perspectives 2050+ (admin.ch)
[2] https://www.bfe.admin.ch/bfe/en/home/forschung-und-cleantech/eidgenoessische-energieforschungskommission-core.html

Objective

Through this call for project submissions, the Solar Heat and Heat Storage research programme aims to address technical challenges related to heat storage and large collector arrays at TRL 4–6, as well as non-technical aspects. A broad spectrum of specialists is invited to submit their proposals in the form of project applications. The programme plans to support approximately 5 to 8 research projects with a total federal contribution of around CHF 1.0 million. The proposed projects should have a duration of 1 to 3 years.

The following priorities serve as the foundation for project submissions. They have been carefully chosen to align with and complement the SFOE's current Energy Research Concept 2025–2028, incorporate emerging trends in energy research, and build on the ongoing projects within the research programme.

The research projects should focus on specific locations that serve as exemplary cases for addressing the issues under investigation, enabling the most realistic and comprehensive project preparation. Interdisciplinary consortia comprising members from research, industry, and/or energy suppliers are required to collaborate on the projects. For key topics #01 to #03, the involvement of a partner from a real implementation project is mandatory. This partner should either be part of the team or engaged through a support group, with proof provided via a Letter of Intent (LOI).

Please note that topics not covered in this call for proposals can be submitted at any time as bottom-up applications within the framework of the 'Solar Heat and Heat Storage' programme.

Documents to be submitted and notes on the submissions

The following documents are required for a project submission:

- The projects should be formulated in detail in the form of applications (Attachment 2).
- Both a complete application and the finance sheet (Attachment 3) must be submitted.
- For project submissions, the current tariffs in accordance with the "Remuneration of personnel expenses in research and P+D projects" must be observed (see Annex VI of the Directive on the submission and evaluation of applications for financial support of energy research, pilot and demonstration projects - Attachment 4).

The following points must be observed for project proposals:

- The aspects described under the focal points do not have to be fully reflected in the project proposals, but are to be understood as indicative guidelines.
- The projects are assessed on the basis of the criteria set out in the implementation directive on the submission and evaluation of applications for financial assistance for energy research pilot and demonstration projects.
- Subsidiarity: The SFOE research programmes are intended to complement projects by the private sector and public research institutes. Accordingly, projects supported by other project partners generally have a greater potential for realisation. In principle, the higher the technological maturity, the greater the expected share of own and third-party funds.
- In the time available for submission, it is not always possible to secure any project partners, research objects or third-party funding sources for a project. On the other hand, these points are very relevant for the award of the contract. The submission must clearly indicate which partners and research facilities have already been secured or are available (letters of intent). If only partial assurances are available, the award is provisional and a contract can only be issued once all relevant assurances have been received.
- It is necessary to argue for a consistent presentation of the initial situation and objectives of project submissions with TRS (where applicable).[3]

[3] The description of the TRS can be found in Annex I of the "Implementation instructions for the submission and evaluation of applications for financial assistance for energy research, pilot and demonstration projects" (Annex 4).

- It is recommended that opportunities for cross-institutional and cross-organisational cooperation be examined in joint project proposals in order to bundle complementary expertise in one project.

Procedure

The following deadlines are planned:

07.04.2025	Publication on the SFOE homepage
21.04.2025	Any questions by e-mail to energieforschung@bfe.admin.ch
24.04.2025	Answers to questions (anonymised on the SFOE website)
23.05.2025	**Submission of applications** by e-mail to energieforschung@bfe.admin.ch (followed by confirmation of receipt)
July 2025	Feedback to the applicants: • Approved without conditions • Approved with conditions (application must be revised) • Reject with reasons • A list of all subsidised projects (with project title, abstract and names of the award recipients) is published on the SFOE website.

Assessment criteria

The SFOE assesses project applications on the basis of the implementation directive on the submission and evaluation of applications for financial assistance for energy research pilot and demonstration projects (Annex III). In addition to the formal and substantive admission criteria, the following qualitative criteria are assessed:

- Q1 Organisation: competencies, project organisation, responsibilities, approach, methodology and data, work plan and milestones
- Q2 Excellence: preparatory work, suitability, expertise, track record, recognition, potential for success of the project team
- Q3 Project content: relevance, cooperation, added value, innovative content, costs/benefits, subsidiarity
- Q4 Impact potential: energy potential, acceptance, public and expert discussion, sustainability
- Q5 Diffusion: Implementation potential, multiplication potential, public interest

The criteria are assessed in relation to the main topics #01 to #04.

Supplements

Attachment 1: Descriptions of key topics #01, #02, #03 and #04 (following)

Attachment 2: Application for financial support of energy research projects

Attachment 3: Finance sheet for applications and financial reports: Project costs and financing

Attachment 4: Directive on the submission and evaluation of applications for financial support of energy research, pilot and demonstration projects

Attachments 2, 3 and 4 can be downloaded from the SFOE website at Research programmes

Attachment 1: Key topics and description of the research questions

Call for project submissions - thematic focus #01

Title: "Technical challenges for the realisation of large-scale thermal storage"

Description:

Unlike steel tanks designed for water volumes of up to 100 m³, which are typically housed within buildings, large storage tanks with capacities of 250 m³ or more are situated outdoors or below ground level. Outdoor storage tanks must withstand diverse weather conditions, while underground components face significant pressures, shear forces, and hydrogeological, chemical, or biological stresses, depending on the type of tank. Due to the highly site-specific nature of geological conditions, each storage facility operates as a prototype. It must be designed and constructed on site to maintain quality standards, even under adverse weather conditions.

Here is a non-exhaustive list of possible research topics:

a) Which storage media are suitable and how can their properties be improved?
   - Chemically long-term stable storage media under real operating conditions (no or easily removable toxic by-products)
   - Biologically long-term stable water quality (no or limited growth of microorganisms, bacteria, algae, biofilm, siltation, ...), concepts for maintenance or disinfection, no corrosion, scaling and clogging due to biological (and mineralogical) by-products, control of oxygen migration and distribution in the storage tank (aerobic/anaerobic processes)
   - Possible impact on groundwater resources and ground-level fauna and flora
   - Cycle stability with thermochemical and phase change storage media (even with any impurities)

b) Innovative choice of materials and design:
   - Durability, temperature and pressure resistance of the materials and joints between the elements of the storage tank shell
   - Corrosion resistance of metals and metal contact points for various storage media and environmental influences

c) Minimisation of heat loss:
   - Long-term storage: Low storage losses due to reduced thermal conduction, reduction of convective currents (inside and/or outside), thermal radiation / evaporation depending on atmospheric counter-radiation, wind speed, etc.
   - Thermal stability of the materials

d) Possible additional benefits of the storage surfaces

Around 40% of the total budget of the call for proposals (maximum 2 - 4 projects) is earmarked for these topics.

Call for project submissions - Thematic focus #02

Title: "Connection of renewables and waste heat sources to large-scale thermal storage"

Description:

The charging and discharging of water-based thermal storage systems with volumes of up to 100 m³ and outputs of up to 100 kW have been extensively studied and optimized over recent decades. Stratified storage tanks effectively minimize exergy losses by maintaining low flow velocities during loading and unloading and utilizing efficient heat exchangers. However, in systems with larger storage volumes and transfer capacities, phenomena such as turbulence, jets, and convective effects on the storage surface become more pronounced. For aquifers and underground storage facilities, the geological properties of the reservoir significantly influence how loading temperatures evolve over time, leading to delays until the heat is extracted.

Storage tanks act as a vital buffer between renewable energy sources and heat consumers, connecting either directly or through a thermal network. Over the lifespan of a storage facility, energy demand may fluctuate. The renewable energy yield at a given site depends on the types of energy sources available and can often be enhanced through repowering and diversification. To ensure reliability, storage tanks and heat exchangers must sustain their functionality even with increased energy transfer demands. Additionally, the storage system should be adaptable to shifts in consumption patterns, such as a future decrease in heating needs or a rise in cooling requirements.

Here is a non-exhaustive list of possible research topics:

a) How can technical installations for charging and discharging storage tanks be realised in a low-maintenance, reliable and durable manner?
b) The requirements in accordance with topic #01 b) (innovative choice of materials and design) and c) (minimisation of heat losses) must also be observed for heat exchangers.
c) Harmonisation with the requirements of the energy system (system integration)
d) What special features apply to questions a) - c) for irregularly occurring renewable heat sources (e.g. solar thermal energy)?
e) How should continuous sources such as waste heat be considered when dimensioning?

Approximately 20% of the total budget of the call for proposals (maximum 1 - 2 projects) is earmarked for these topics.

Call for project submissions - Thematic focus #03

Title: "Improving framework conditions for large heat storage projects"

Description:

Large storage tanks involve substantial investment costs and are designed to operate for 50 years or more, typically requiring refinancing within 20 to 30 years. Their longevity, maintenance, and the replacement of critical components impose significantly greater demands on their planning and design compared to modern “compact storage tanks”.

The planning of large storage facilities is a time-intensive process, involving authorization procedures, environmental impact assessments (EIA), and the development of comprehensive business cases. Additionally, technical planning poses significant challenges, as each large storage facility is unique and requires consideration of numerous factors, including its size and unconventional temperature conditions. Furthermore, Switzerland has not yet developed practical expertise in the planning and implementation of such facilities.

In this thematic focus area, the diverse planning aspects and their financial implications will be thoroughly analyzed to identify key elements. From this analysis, recommendations will be developed to support business concepts tailored to various market scenarios.

The following questions regarding costs and economic efficiency will be discussed:

a) What are the cost drivers for the planning and construction of large storage facilities?
b) What influence do the flow/return temperatures and the charging and discharging capacities have?
c) How does storage dimensioning depend on the energy sources used, the energy consumers supplied or system integration in general?
d) What are the critical framework conditions to enable reliable economic operation?

Approximately 20% of the total budget of the call for proposals (maximum 1 - 2 projects) is earmarked for these topics.

Call for project submissions - thematic focus #04

Title: "Challenges in the planning of large collector fields"

Description:

Large thermal collector fields offer the potential to generate sustainable thermal energy at consistently low and stable long-term costs. One significant challenge lies in identifying suitable roof or open spaces near consumers or storage facilities for their installation. Additionally, the planning and implementation of these systems pose further difficulties, as there has been little experience or expertise in Switzerland in the design and development of these system scales so far.

The federal subsidy for systems > 70 kW capacity[4] for space heating and hot water, which has been in force since 2025, offers interesting incentives for solar thermal energy. The relevant planning expertise can still be deepened in various respects and prepared for practical application.

This involves the following questions, for example:

a) **Dimensioning and hydraulic arrangement of the collector area**: How should collector arrays (for different collector types, temperatures, overheating protection, pipework, etc.) be correctly dimensioned, even with collector rows of different lengths?
b) **Thermal system load**: Which materials and constructions are suitable for withstanding the thermal and mechanical loads of large thermal collector arrays?
c) **Vapour formation**: How can vapour formation in large thermal collector arrays be minimised or managed without problems?
d) **Statics and installation**: How can static requirements and safety aspects be considered when installing large thermal collector arrays?
e) **Maintenance and operating costs**: What strategies can be developed to minimise the maintenance costs of large thermal collector arrays and ensure their long-term cost-effectiveness?

Approximately 20% of the total budget of the call for proposals (maximum 1 - 2 projects) is earmarked for these topics.

[4] According to EnV Annex 6a (was included in EnG Art. 50a with the KIG)