TES4SET
Thermal Energy Storage

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Tes4seT
Thermal Energy Storage for Sustainable Energy Technologies

Study into the possibilities of an Austrian virtual knowledge centre on thermal energy storage

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Summary

Thermal energy storage has a key enabling role in the transition to a fully renewable energy supply in Austria and internationally.
Austria plays a relatively important role in the international research and development activities on thermal energy storage. This role can be strengthened and ensured for the future by joining the R&D capacities of the knowledge institutes that work on thermal storage R&D. The new to form virtual institute for thermal energy storage would work on targeted collaboration projects with industry and other stakeholders to increase the knowledge position and the industrial competitiveness of Austria in the field of thermal energy storage technologies.

1. Introduction

About half of the primary energy is used for heating and cooling. Switching the energy production for this sector to renewable energy sources is a vast task, that only can be fulfilled by using all the possible renewable sources. As many of the sources are intermittent of nature and also heating and cooling demand patterns are not constant thermal energy storage technologies play a very important role.
Thermal energy storage (TES) technologies need to be optimised for each combination of energy source, energy conversion technology and application. This calls for a broad knowledge on thermal energy storage materials, components, systems and integration into an application. There have been serious advancements in thermal energy storage research and development in the past 15 years and some new materials and technologies are now entering the market. But this research and development needs a further strengthening and acceleration in order to provide the necessary technologies in time for the global energy transition.

Austria plays a strong role in the field of thermal energy storage. Five research and development organisations are active nationally and internationally in the field of storage materials, components and systems. In order to retain this strong position in the growing R&D field, Austria has to cluster its activities, that up to now are spread over these and other research and development organisations.

One of the goals in the Tes4seT project is to investigate the possibilities of having a broad collaboration between the Austrian knowledge institutes in the field of thermal energy storage research and development.
From the beginning, the idea was to start with a collaboration in the form of a virtual knowledge institute, a collaboration between research and development organisations working on common projects.
In the next chapters the different aspects of creating a virtual knowledge institute on thermal energy storage are described. In chapter 2, the main reasons for having a virtual institute are explained. Then, in chapter 3, the roles and activities of the institute are described and in chapter 4 a first view is given on the possible structure and form of collaboration. The roadmap to a mature virtual knowledge institute on thermal energy storage is described in chapter 5.

2. Why a virtual knowledge institute on Thermal Energy Storage?

TES is important in the energy transition
The energy transition is about the full replacement of fossil fuels with renewable energy sources. Thermal energy storage technologies are key enabling technologies that are necessary to have an optimal coupling between the variable supply of energy by the renewable sources and the changing needs for heating and cooling in all sectors. Without

thermal energy storage the needed capacity of renewable sources would be much higher and the efficiency of conversion processes would be much less.
Thus, the effective and fast development of thermal energy storage technologies is very important for the energy transition.

An institute creates an earlier critical mass
Having an institute means that separate organisations combine their knowledge and facilities. Consequently, the areas of expertise expand and the possibilities for collaboration and cross-fertilisation increase. The combination will lead to a better visibility and a higher ranking internationally than the ranking of the individual organisations. This increases the chances for international collaboration and for industry orders.

TES creates opportunities for industry in Austria
The need for thermal energy storage technologies is very high. There are a broad number of applications for TES, ranging from small TES systems for load-shifting storage of electricity in households to very large TES for district heating systems. The research and development activities in the virtual knowledge institute lead to new materials, components and systems that can be further developed with industry to new products and services of the industry. As the area of TES should follow a rapid development path, the growth opportunities for industry are accordingly strong.
The broad expertise in the institute furthermore offers the opportunity for industry to have a one-stop shop for development, demonstration and implementation.
If the institute has a proper industrial basis through participation of industry in the board or in supporting bodies, industries will have additional opportunities for co-development and for new coalitions and collaborations across industry sector borders.

A virtual institute has easier growing opportunities
As a virtual institute has no own infrastructure nor personnel, the growth in the initial stage is not connected to separate investments in these. Projects will be carried out by the R&D partners, with their personnel and on their equipment. As projects will be carried out in collaboration, use can be made of the project partner's infrastructure in case own equipment is not available. Additional equipment will be stationed at one of the project partner's facilities and becomes available for mutual use within the virtual institute.

3. What would be the roles and activities of the institute?

The virtual TES knowledge institute will be a central place for industries, system suppliers, policy makers and science partners that have questions about thermal energy storage technologies, applications and markets.

The roles of the institute are, amongst others:

- Perform R&D projects on TES materials, components, systems and applications. Developments on all for levels are necessary, as the number of technologies and the areas of applications are manifold.

- Increase the awareness on thermal energy storage possibilities with the above groups.
  In a world in which energy is synonymous for electricity it takes more effort to highlight the importance of thermal energy in general and of thermal energy storage in particular.

- Promote the collaborative research and development for the industry.
  Only with collaborative research it will be possible to effectively bring the technologies to a higher level of technology readiness and ultimately to the market. With collaborative research, industries can have an early opportunity at looking into possible future markets.

- Disseminate the knowledge on thermal energy storage.
  With good stories about thermal energy storage developments and applications, the awareness and acceptance of these technologies will grow and thus the chances for successful market adoption increase.

- Increase the expertise on thermal energy storage.
  By bundled and targeted R&D activities the expertise on thermal energy storage materials, components and systems will grow effectively. This expertise contributes to an acceleration in the development of new thermal energy storage technologies.

- Increase R&D opportunities.
  By properly informing decision and policy makers about the potential of thermal energy storage and on the R&D needs for the technology developments, it will be possible to increase the number of R&D funding opportunities through new funding programmes or funding budget increase.

- Promote the professional development of thermal energy storage experts.
  The thermal energy storage market will rapidly grow in the coming decades. Only with a sufficient number of qualified researchers it will be possible to provide the growing market with new technologies.

The activities of the institute can be broken down in the following areas:

Research
Perform scientific research into materials, components, concepts and systems for thermal energy storage. Work on Proof of Principle for novel developments.
The developments can be used for thermal energy storage only, but specifically also for a combination of functions like drying, dehumidification, increase of comfort et cetera.

Development
The development activities are aimed at bringing concepts of technologies to a higher Technology Readiness Level (TRL). Prototypes are being developed and proof of concepts determined for novel technologies.

Product development
The aim of product development is to bring prototype to the level of market ready product, in very close cooperation with industry. This will in most cases also include the development of novel production technologies for thermal energy storage materials or products.

System integration
Together with market actors, studies are being performed into the aspects that are important for the integration of the storage technology into a larger (energy) system. These are system performance and costs, operational aspects and costs and non-technical integration aspects as consumer acceptance, financing, legal and standardisation aspects.

Market studies
These help to understand the potential of TES technologies in certain markets and besides can be used to increase the R&D opportunities and activities.

Dissemination
The active spreading of information to targeted groups is very important for awareness of TES and of the institute and for showing industries and other actors the potential of TES and future TES markets.

4. How would the structure and the collaboration look like?

As the knowledge institute is a virtual TES institute, the activities will be based on the execution of collaborative projects between the R&D organisations and on collaborative projects between R&D organisations and industries or other market partners.

The type of projects will depend on the research/development topic and on the application area. Projects can be fully financed by public bodies, partially by industry or other stakeholders or completely by industry or other stakeholders. Projects will be structured as collaborative actions, of which one partner is the coordinator responsible for the project execution and with a collaboration structure determined by a consortium agreement. Partners will enter a project with defined background knowledge.
The results of a project are shared by the project partners and the industry partners will have first commercial exploitation rights for project results.

The institute will be managed by a management board. Here, structure, organisation, scope of the institute and the composition of the User Board are determined.
Basis of the institute is the User Board. This consists of the research and development organisations and of industries and other stakeholders that have interest in the knowledge and skill incorporated in the institute. Examples of possible stakeholders are: heating appliance manufacturers, solar thermal companies, chemical and raw materials companies, metal parts production companies, control equipment manufacturers, energy service companies, district heating companies, electricity utilities et cetera.
In the User Board, topics of interest for future projects, participation in projects, utilisation of results and follow-ups of projects are discussed and decided upon.

There will be three levels of knowledge generated in projects. Deepest level is the knowledge generated in a project that is only available for the project partners. The intermediate level knowledge is available for all User Board partners and the shallow level is public knowledge. When planning a project, User Board partners can determine which level of knowledge will be available to them by deciding whether to participate in a project or not.

The fee for User Board participation has to be determined in a later stage. It can be a mix of a basic fee and an additional fee for project participation. The latter will reflect the use of background information in a project that already had been generated in earlier projects.

Especially in the start-up phase of the virtual institute additional funding has to be sought from general funding programs, to finance the costs connected to the administrative, legal, commercial and organisational work connected to the starting up. Generating the proper information for the different stakeholders is of great importance in order to arrive at a critical mass of User Board participants.

5. A roadmap to the Austrian Virtual Knowledge Institute on Thermal Energy Storage

With the aim to arrive at a full-grown virtual knowledge institute within a few years, the following main steps and activities can be executed.

PREPARATION

Formation of a core group of research and development partners; formulation of the goals for the next ten years; first sketch of the structure, scope and activities. Draft the work programme for the first year. Writing information material for acquisition. Collecting the first interested industries. Searching and acquiring initial funding. Determine operational structure for the initial phase.

INITIAL PHASE

A limited scope of the first R&D activities is taken. With selected industries, start the first collaborative projects. Define the working structure and install the User Board and Management Board. Secure funding for the first period. Determine the financial structure and further define the work programme for the first year. Start information work and dissemination activities. Expand the User Board participation, make the financial basis solid. Put administrative procedures into place.

GROWTH PHASE

Broaden the scope of the R&D work. Continuous initialisation of R&D projects. Broad industrial participation. Professionalising the management. Planning growth towards an international institute.

MATURITY

Further growth with wide scope of R&D work. International basis is established. First licensing income generation.

6. Conclusion

In order to accelerate the development and market uptake of thermal energy storage technologies, the presently distributed knowledge on these technologies can best be concentrated in a thermal energy storage virtual knowledge centre. In this centre, R&D organisations work together with industry and other stakeholders on the development of materials, components and systems and on the integration of thermal energy storage technologies in the different sectors. The projects are funded in a number of ways, either with public funds, with industry funding or with a mix of these. Generated knowledge will in first place be available to the industries directly involved and secondly to the partners that form the User Board of the institute. A number of steps and activities are described that are necessary to arrive at a virtual knowledge institute for thermal energy storage in its full maturity.