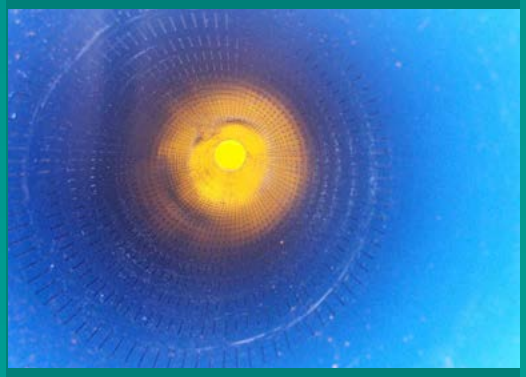
International Energy Agency

Energy Conservation through Energy Storage Programme

ANNUAL REPORT
2011



ECES

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Preface

ENERGY CONSERVATION THROUGH **ENERGY STORAGE** IMPLEMENTING AGREEMENT

The Implementing Agreement (IA) started in 1978. Its present term ends by the end of 2016. At present Contracting Parties from the following countries have signed the Implementing Agreement: Belgium, Canada, China, Finland, France, Germany, Italy, Japan, Korea, Norway, Sweden, Turkey, USA and IF Technologies from The Netherlands, the Institute of Heat Engineering (ITC) of the University of Technology, Warsaw, Poland and University of Lleida from Spain as sponsors. The Executive Committee is working intensively to attract more countries to not only join the activities but also sign the Implementing Agreement. New Zealand, Slovenia, Australia, Brazil, Bulgaria, India, Israel, Malaysia, South Africa and Switzerland are interested. Experts from several countries do already participate in the Annex work as observers. According to the new Strategy Plan (2011 - 2015) approved in 2010 the strategic objectives for the IA remain as follows:

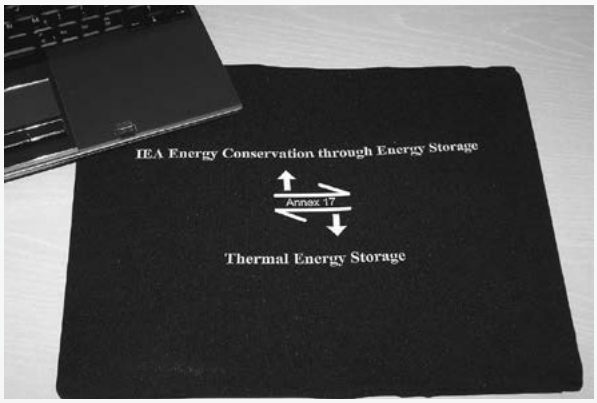
Technology: Maintain and develop international technical R&D collaborations that further the environmental and market objectives.
Environment: Quantify and publicise the environmental and energy efficiency benefits of integrated energy storage systems.
Market and Deployment: Develop and deliver information to support appropriate market deployment and provide effective collaboration and information to stakeholders.

The Executive Committee coordinates and leads the collaborative work in the Annexes and the Committee also takes an active part in various information activities such as workshops, seminars and conferences.

Introduction

We need energy - electrical or thermal - but in most cases not where or when it is available. Enjoying the sound of music while you are jogging, you can not stand beside the socket: electrical energy storages - batteries - make you mobile. The energy you need is stored for a short while and over the distance you like to run. Having a cold beer on a summers evening was possible even before cooling machines were invented. At that time people were cutting ice from the lakes in winter, transported the ice to the brewery and stored it in deep cellars. The cold was stored form the winter to the summer: An example for long term thermal energy storage and the utilization of renewable energies. In cold climates surplus solar heat from summer can be used in winter for heating of buildings by seasonal storage. Waste heat from industrial processes, steam from solar thermal power plants or electricity from photovoltaic panels are examples for energy sources, which can not be used more extensively without energy storages. A huge potential of energy sources substituting fossil fuels can only be exploited by energy storage systems, utilizing renewables like solar thermal, PV and wind energy. Thermal and electrical energy storage systems enable greater and more efficient use of these fluctuating energy sources by matching the energy supply with the demand. This can finally lead to a substantial energy conservation and reduction of CO2 emissions. The growing peak demand of today's energy consumption, essentially caused by electrical air conditioning, leads more often to blackouts all over the world. Such a problem - the shifting of a peak demand for only a few hours or minutes - can be solved by cold storage technologies. In this context energy storages can be the best solution not only from the technical point of view, but also for economical reasons.

Introduction



The energy to be stored can be either electrical or thermal. Both energies require completely different storage technologies. However, in the actual application both technologies can meet: The peak demand of electricity for example is in most cases caused by air conditioning, which is a thermal task. The cooling demand can be covered by a cold store (ice or chilled water) which is charged at off-peak hours by electric chillers. Energy storages can be described by their storage capacity (stored energy per mass or volume), power (energy output per time), storage period (how long the energy should be stored) and size. All these parameters can vary over a huge scale: From latent heat storage to prevent laptops from getting too hot (stored energy in the range of a few Wh) to the heat and cold thermal underground storage system underneath the German Reichstag in Berlin (stored energy in the range of some 2 GWh).

Many governments have committed themselves to reduce CO2 emissions into the atmosphere. They have decided to strengthen their national efforts and the international cooperation for research and development (R&D) in the International Energy Agency (IEA) and to increase the deployment of energy conservation technologies and utilization of renewable energy sources. So far in most industrialized countries, renewable en ergy sources contribute only marginally to satisfy energy demand. Energy storage technologies can help to solve problems caused by the intermittent energy supply of these sources. There is a huge potential for the application of energy storage systems. The fact that energy storage systems are not as widely used as they could is due to several reasons. In particular because most new storage systems are not yet economically competitive with fossil fuels and their long term reliability and performance is not yet proven. There are still some regulatory and market barriers which have to be overcome. Therefore further attempts are being made to resolve these issues.

The IEA Implementing Agreement on Energy Conservation through Energy Storage provides the platform for international cooperation (www.iea.org) in R&D. After almost three decades of R&D the emphasis of the cooperative R&D efforts has shifted towards the implementation and optimal integration of new storage technologies for an efficient use of energy and renewable energy sources. In the future more application oriented topics like thermal energy storage for cooling and industrial processes or mobile thermal storage systems for the utilization of waste heat will be investigated. The issue of implementation and deployment of new energy storage technologies has become a higher priority as the R&D phase is concluding.

Chairman's Report

This year it is my honor to present you our 2011 Annual Report as the chair of Energy Conservation Through Energy Storage(ECES) Executive Committee.

2011 has been an exciting year around the world. The past 12 months have brought new challenges and opportunities to the energy market. The earthquake and tsunami disaster in Japan put nuclear power option on hold in many countries. Tornadoes as well as climate extremes have continued to being observed around the world. This emphasizes once again the URGENT need to find a solution to climate change. Unrest in several Arab countries - the so-called „Arab spring" continues in the Middle East , which sits on vast petroleum reserves. This has caused high petroleum prices to increase even further. Countries under the threat of global economic crisis are desparately seeking cheaper energy sources to alleviate this financial burden.

The question most of us are trying to answer is : Without compromising our future, how can one dream of a fossil fuel free future? Answers are rarely simple - yet one thing is certain: Cheapest energy is energy saved! Energy storage technologies are central components of any system that can make this dream come true. Storage must be incorporated to utilize renewable energy.

2011 has been another very active and productive year for ECES. Effective international collaboration has become more important than ever. Increasing the number of participant countries enhances ECES's strength and motivation. Italy has reactivated their membership by assigning new delegates. University of Lleida has become our new sponsor member from Spain. Slovenia has started the process of signing the Implementing Agreement. We have contacts to Singapore, Greece and New Zealand as potential new members.

From IEA perspective, we contributed to the preparation of energy storage chapters in IEA Technology Roadmap - Energy-efficient Buildings: Heating and Cooling Equipment and Technology briefs prepared by Energy Technology Systems Analysis Programme (ETSAP).

On Annex level, we have completed Annex 20" Cooling with Thermal Energy Storage". Annexes under development and planned to start in 2012 include Annex 27 - aiming to address quality assurance of borehole thermal energy storage systems and integration of renewable energies by distributed energy storage systems. Both topics have critical importance in increasing awareness and success of energy storage projects.

Chairman's Report

A particular highlight of 2011 was a very productive Joint Executive Committee meeting and workshop with on "Key Technologies for Future Energy Systems - Solar Heating and Cooling and Energy Storage" with IEA Solar Heating and Cooling Programme.

We are all excited with the preparation of our next tri-annual international thermal energy storage conference that is going to held in Lleida, Spain on May 16-18, 2012. This will be the 12th conference that has been organized by ECES since 1985.

I would like to thank first Dr. Astrid Wille, from whom I took over the chairmanship. Astrid has been an excellent leader. I cannot thank Andreas Hauer enough - for his extraordinarily successful 7 year long secretarial support. My mission shall be to build upon where they have brought us up to. Also many thanks to our dedicated delegates who will be leaving us. We will miss having with us Frank Cruickshanks from Environment Canada, Edward Morofsky from Public Works Canada, Kirsti Midtomme from Norway, In-Hwan Oh from Korea, and Astrid Wille from Germany. I must give a very warm welcome to our new delegates who have joined us in 2011: Mario Conte from Italy, Hendrik Wust from Germany, Yong Jin Kim from Korea, Jorgen Sjodin from Sweden, and Rajinder Kumar Bhasin from Norway.

Last but not the least, I would like to thank all the members of the Executive Committee, our Operating Agents and the experts of Annexes, and our secretary Hunay Evliya and webmanager Yeliz Konuklu and IEA desk officer Carrie Pottinger for their excellent contributions to the collaborative work and success of ECES.

Halime Paksoy, Chairman ECES

Ongoing Activities

In 2011 five Annexes were performed by the “Energy Conservation through Energy Storage” Implementing Agreement.

Annexes No	Title	Time Sche-dule	Operating Agent
21	Thermal Response Test	2007-2010	ZAE Bayern/Germany
22	Applying Energy Storage in Buildings of the Future	2009-2012	Concordia University/Canada
23	Compact Thermal Energy Storage: Material Development for System Integration	2009-2012	ZAE Bayern/Germany
24	Surplus Heat Management using Advanced Thermal Energy Storage Technology	2010-2013	University of Leida/Spain
25	Electric Energy Storage: Future Energy Storage Demand	2010-2013	Fraunhofer Umsicht /Germany

Annex 21: Thermal Response Test

Thermal Response Test (TRT) is a measurement method to determine in situ ground thermal properties i.e. effective thermal conductivity of ground thermal resistance in boreholes. This is important for the design of Underground Thermal Energy Storages (UTES). The TRT equipment is usually set up on a trailer for easy transportation between test sites. This method has been very important in the rapid spreading of BTES systems. It has been a door opener for introducing this technology in “new” countries.

The overall objectives of Annex 21 are to compile TRT experiences worldwide in order to identify problems, carry out further development, disseminate gained knowledge and promote the technology. Based on the overview a TRT state-of-the-art, new developments and further work are studied.

Annex 21 was approved by the Executive Committee in April 2007, scheduled to run until April 2011 and at the Executive Committee Meeting in November 2010 extended until October 2011. Operating Agent is the Bavarian Center for Applied Energy Research, ZAE Bayern, Germany. Participating Countries: Germany, Sweden, Canada, Finland, Japan, Korea, Norway, Spain, Italy, Turkey and The Netherlands. Several other countries like Austria, Bulgaria, UK and USA have shown interest and attended some of the meetings as observers. Most of the interested institutions were not able to join due to lack of funding.

Activities 2011

Annex 21 ‘Thermal Response Test’ will end in 2011and therefore the main activity was the preparation of the final report.

One major point in the last year of cooperation focused on the standardization of the TRT procedure for national authorities. The members agreed to a minimum precision of the involved measurement devices and estimated the resulting overall precision of the TRT measurement. As a major influence on the precision of the final result the impact of the ambiance could be detected. These influences, together with uncertainties of the model assumptions cannot be quantified within a systematic error analyses. A statistical approach to determine the precision of the TRT method was conducted by applying several Thermal Response Tests to the same geology at four boreholes at the same location. They are arranged in a square with a distance of 8 m. The standard deviation of 8 tests together with the systematic error of the measurement device resulted in an overall error for ideal test conditions of:

$$\Delta\lambda_{eff,ges} = 0{,}05 \frac{W}{m \cdot K} + 0{,}02 \frac{W}{m \cdot K} = \pm 0{,}07 \frac{W}{m \cdot K}$$

Annex 21: Thermal Response Test

Table 1: Results of several TRTs on the same geology in South Germany.

Drilling	Tester	eff in W/(m.K)
ZAE-B1	ZAE	2,226
ZAE-B2	ZAE	2,304
ZAE-B2	ZAE	2,354
ZAE-B2	HBC	2,290
ZAE-B3	ZAE	2,217
ZAE-B3	HBC	2,270
ZAE-B4	ZAE	2,242
ZAE-B4	HBC	2,320

In order to quantify ambiance coupling effects in the future a method of linear regression was developed. It is based on the relation between the ambient temperature and the deviation of the theoretical solution and the experimental temperature response. **Figure 1** first shows both values over the time axis for an ideal and a bad example of ambiance coupling. Illustrating the deviation between model and experiment versus ambient temperature one can see a linear trend for the bad example and no effect at all for the ideal test.

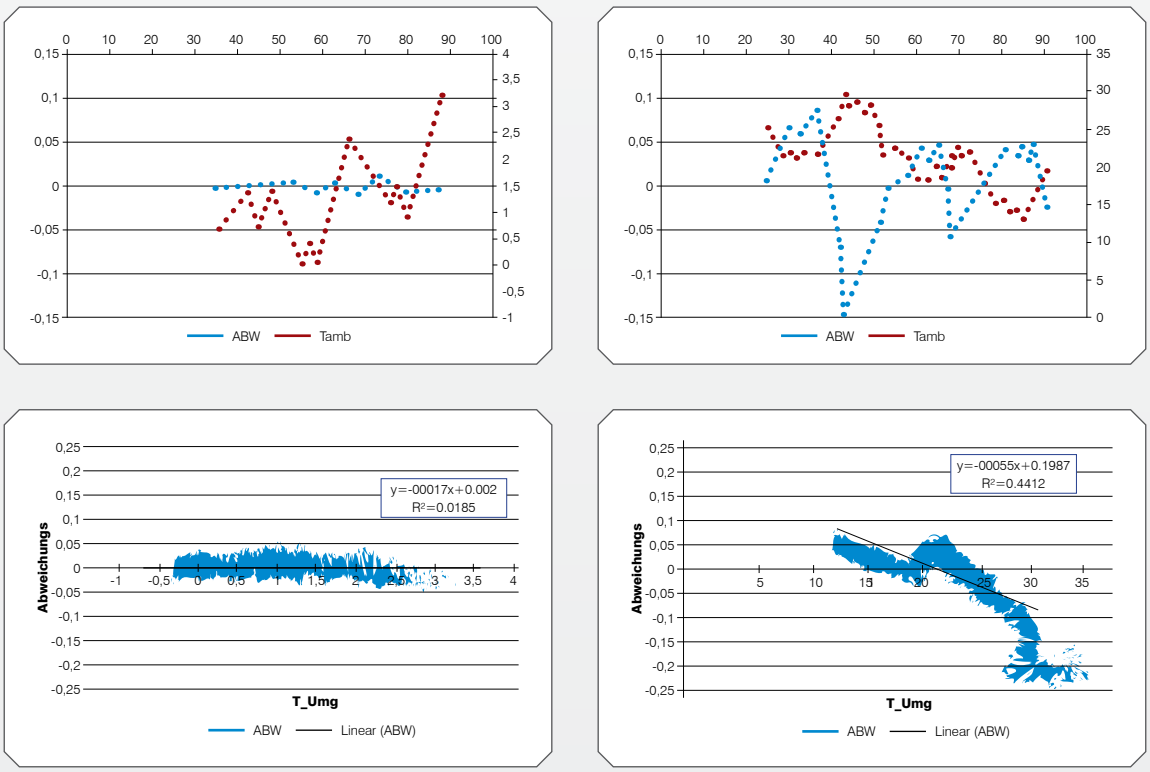


Figure 1: Above: Model deviation and ambient temperature over the measurement time.
Below: Model deviation versus ambient temperature. Both diagram types are shown for an ideal and a test with ambiance coupling.

Annex 21: Thermal Response Test

Together with a method of determining the convergence of the result, which promises to determine the appropriate measurement time for a successful evaluation within the aspired limits of precision, the final report of the Annex21 will include a recommendation for a standard test method.

Future Activities

It is planned to finish the final report which is based on the final reports of the five subtasks till the end of 2011.

Contact

Manfred REUSS – ZAE Bayern, Germany - reuss@muc.zae-bayern.de

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Koenigsdorff R.: Bohrlochwiderstand - Ist der TRT-Messwert auch der Planungswert in proceedings of OTTI - 11. Internationales Anwenderforum Oberflächennahe Geothermie in Regensburg, Germany 27./28. September 2011, p. 83-90

Konrad M.: Betrachtungen des Wärmetransports in Erdwärmesonden in proceedings of OTTI - 11. Internationales Anwenderforum Oberflächennahe Geothermie in Regensburg, Germany 27./28. September 2011, p. 91-97

Proell M.: Thermal Response Test, in proceedings of 1. VDI-Konferenz Waermepumpen (08./09. June 2010) in Stuttgart, Germany, VDI Wissensforum Duesseldorf 2010, p. 39-46

Proell M., M. Reuss: Tiefenaufgeloeste Bestimmung der Waermeleitfaehigkeit, in proceedings of Geothermiekongress 2010 in Karlsruhe, Germany

Proell M.: Vergleich verschiedener Methoden zur Bestimmung thermischer Untergrundeigenschaften in proceedings of OTTI - 10. Internationales Anwenderforum Oberflächennahe Geothermie in Linz, Austria 20./21. April 2010, p. 43-48

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Proell M.: Thermal Response Tests für die Qualitätssicherung an Erdwärmesonden in proceedings of OTTI - 11. Internationales Anwenderforum Oberflächennahe Geothermie in Regensburg, Germany 27./28. September 2011, p. 62-70

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Reuss M.: Techniken der Oberflaechennahen Geothermie in proceedings of OTTI - 10. Internationales Anwenderforum Oberflächennahe Geothermie in Linz, Austria 20./21. April 2010, p.13-22

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Annex 21: Thermal Response Test

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H.-J.G. Diersch and D. Bauer and W. Heidemann and W. Rühaak and P. Schätzl, (in press). Finite element modeling of borehole heat exchanger systems. Part 2.

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Annex 23: Applying Energy Storage in Buildings of the Future

Sustainable buildings will need to be energy efficient well beyond current levels of energy use. They will need to take advantage of renewable and waste energy to approach ultra-low energy buildings. Such buildings will need to apply thermal and electrical energy storage techniques customized for smaller loads, more distributed electrical sources and community based thermal sources. Lower exergy heating and cooling sources will be more common.

Building envelope and central thermal storage have been used as thermal energy storage (TES). Recently, TES has attracted increasing attention due to the potential benefits it can offer in energy efficiency, in shifting load from peak to off-peak, in emergency heating/cooling load, in economics and in environmental impact. Advanced design tools and technical improvements are required in TES technologies and systems. Indeed the design of the building and TES are often not coordinated. A building integrated with distributed thermal storage materials could shift most of peak load to off-peak time period. It is important to plan for the requirements of the buildings of the future. Hence, research is needed to ensure that the actual performance of buildings with TES in use matches expectation and predictions more closely.The use of TES requires smart energy management in buildings to achieve the overall goal of nearly-net-zero energy buildings. It is desirable to develop technical solutions and tools that incorporate advanced TES material to provide alternative option to conventional solutions and to meet the energy demands of buildings of the future.

Two expert meetings were held in 2011: The Spring meeting was organized in conjunction in conjunction with the International Symposium on Sustainable Systems and the Environment "ISSE'11" which was held In Abu Dubai on March 23rd and 24th. The Fall meeting was held in conjunction with the ISES Solar World Congress 2011 which took place in Germany on August 28th to September 1st, 2011. Three special sessions, on the topics of this Annex, consisting of two orals and one poster presentation, were organized. At both meetings, Annex members presented the outcomes of their work: The sessions were well attended.

Specific objectives of Annex 23 include:

- Assess the potential of harnessing natural energy sources to supply building heating and cooling through energy storage;
- Assess the use of energy storage to optimize the efficiency of distributed generation;
- Develop and evaluate energy storage conceptual designs suitable for specific applications; and
- Develop guidelines and procedures to estimate the environmental performance of energy storages when applied in ultra-low energy buildings and communities.

To reach these objectives, the annex is structured in five subtasks:

The Subtask A coordinated review of energy storage use in each participating country. The review included the performance assessment, the advantages, requirements and limitations. A report was prepared in 2011 and the results were presented at the experts meeting committee in Kassel (Germany) in September 2011. Overall, information on 22 projects was gathered: 6 from Canada, 6 from France, 3 from China, 3 from Sweden and 4 from Spain. These projects cover a wide spectrum of applications and

Annex 23: Applying Energy Storage in Buildings of the Future

are based on various storage materials. Overall, 10 projects use sensible heat storage technologies, while 12 use latent heat storage. The projects were mostly dedicated to space cooling (12), despite 5 being developed for space heating and 2 systems could be used both for heating and cooling. In addition, three systems were designed mainly for domestic hot water management.

From the presented results we can discern a trend that would need to be confirmed that is several projects tend to be intended to manage the demand (diminish peak power consumption). This brings the importance of the energy storage in the context of smart buildings and smart grid, where the control of the power demand is as important as the energy efficiency. Also, the necessity to improve the knowledge of the storage material has been identified 7 times as the most important information to improve the technology. In almost all cases, latent heat storage systems face this problem (lack of knowledge). This observation provides an important insight about why this technology is not yet mastered. In addition, for 13 systems, it has been noted that optimization is necessary for the control, sizing, system integration and modification. Finally, in one case, new application niches need to be found. All these comments indicate that more fundamental and applied researches are needed to remove many hurdles in the large scale applications of these technologies.

Subtask B carried out an extensive literature review and studied the existing techniques in order to develop a common evaluation technique for comparison of different energy storages. The preliminary draft was submitted at the last meeting.

Subtask C deals with the development of new sustainable TES or improvement of promising existing systems that have potentials to be successfully integrated with a variety of ultra-low energy buildings. A comprehensive literature review was carried out and it was concluded that the existing modeling approach of PCM is not computationally efficient for annual building energy load calculation and for application in the design of energy storage in buildings of the future, and it was agreed that some effort should be made in this area.

To achieve this goal it was necessary first to analyze the TES available on the market. It was however very difficult to extract general design rules or even simple practical results from the scientific literature. This problem arises from the fact that there is almost no inter-comparison between various designs. In most studies, the optimization of a single particular configuration is studied. Even for models, each group tends to use its own in-house solution without systematic comparisons with others. In addition, performances of energy storage systems are strongly related to local climatic conditions, which add to the difficulty of the reutilization of previously published results in subsequent research as a comparison basis.

In the period since the last report several simulations have been carried for different case studies. Professor Virgone´s group reported the development of a new numerical model for a PCM integrated wall, type 260. The model was then integrated with TRNSYS type 56 to simulate two cubicles; one with PCM and one without, where field measurements data were available. The result shows there is a good agreement between the model prediction and the experimental data. Further work is underway to investigate the application of PCM for low energy buildings.

Twin test units and houses that will be used in this research work for model validation Laboratoire des technologies de l'énergie (LTE) of Hydro-Quebec (Canada).

The focus of Task D is to collect reliable data from a number of demonstration projects. The collected data are used to study the performance of the system and are used by other participants for model verification. During the last year, several prototypes have been identified as potential targets. The systems that are already built and running or even experimentally evaluated are:

- PCM passive cooling with conventional brick, alveolar brick and concrete walls
- PCM wallboards
- Ventilated facade with PCM
- Ventilated façade with concrete
- Heat pump with PCM tanks
- Water+PCM tanks for domestic hot water
- PCM packed bed for cold storage

At this moment, contributors to this Subtask are:
- University of Lleida (Spain)
- INSA–Lyon (France)
- University of Auckland (New Zealand)
- Chalmers University of Technology (Sweden)
- University of Savoie (France)
- BuroHappold (United Kingdom)

The goal of subtask E is to evaluate and analyze the information obtain from previous subtasks to identify technologies to achieve the objective of this Annex.

The Subtask Leader discussed the application of these technologies for a wide range of future market. They are: renovation of existing buildings, new building which will be constructed based on existing building code, and future buildings with new technical devises and solutions. The discussions outlined tools and information needed for the assessing the performance of these technologies. The required information included: detailed information about thermal properties of these materials, validated calculation tools, tools for assessment of economic and ecological benefits for decision makers, LCA analysis, off-gassing, recycle-ability, fire behavior and health issues, etc. It was agreed that these information are needed to identify the most appropriate technologies and applications, and the development of design guidelines.

Operating Agent
Canada

Participating Countries
Australia, Brazil (Associate Member), Canada, China, France, Denmark (Associate Member), Greece (Associate Member), New Zealand, Norway, Spain, Sweden, Turkey and UK.

Contact
Fariborz HAGHIGHAT - Concordia University - Montreal, Quebec Canada - haghi@bcee.concordia.ca

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Annex 24: Compact Thermal Energy Storage: Material Development for System Integration

The objective of this joint Task with the IEA Energy Conservation through Energy Storage Programme is to develop advanced materials for compact storage systems, suitable not only for solar thermal systems, but also for other renewable heating and cooling applications such as solar cooling, micro-cogeneration, biomass, or heat pumps. The Task covers phase change materials (PCMs), thermochemical and sorption materials (TCMs), and composite materials and nanostructures. It includes activities on material development, analysis, and engineering, numerical modelling of materials and systems, development of storage components and systems, and development of standards and test methods.

The main added value of this Task is to combine the knowledge of experts from materials science with that of experts in solar/renewable heating and energy conservation.

In 2011 two expert meetings were held. The meeting in Spring 2011 was organized in conjunction with the International Conference for Sustainable Energy Storage 2011 in Belfast, UK, where there were two sessions on thermal energy storage materials and solar applications. The second meeting took place at the University of Minnesota, Minneapolis, USA. Both meeting were well attended. The picture shows the technical tour in Minneapolis at the solar decathlon building.

In the different Working Groups quite remarkable progress was achieved:
Materials engineering and processing: the decision was made to extend the materials database to economic data and environmental issues. The material data of sensible TES materials will also be included. As the performance data of the material are very much dependent on the application, much attention will be paid to the inclusion of the boundary conditions for the determination of the performance data, in order to enable a fair comparison between storage materials. New national activities were started on solid-solid PCMs, molecular alloys based on sugar alcohols, Cellulosis-PCM, Zeolite/MgSO4 and others.

Materials testing and characterisation: Further results from the round-robin test of different PCM samples were assembled and compared with the previous outcomes. In a dedicated DSC measuring workshop, organised in May 2011, a group of 12 experts used DSC machines from a number of suppliers both to train themselves in performing DSC analysis and to compare the measurements on a number of samples.

Striking differences were found between the measurements. The causes for these differences were investigated and methods for improvement were set up. These encompass both a unified measurement procedure and a unified calibration procedure. This will be tested in the coming period. Meanwhile, the round-robin tests will be continued with additional sample materials.

Numerical modelling: Progress was made in the development of dedicated numerical models, using the reaction force approach, to simulate the dehydration of magnesium sulphate. The deliverable on the state of the art in numerical modelling software will be completed with descriptions of numerical simulation methods for sorption materials. The first experimental data were collected that will be used for benchmarking the numerical codes. In total, 9 institutes will provide experimental data.

Apparatus and components: The deliverable on storage design aspects and design flow charts is planned to be ready early 2012. The individual design process descriptions will be worked out further, as will the storage design aspects description. The table of contents of the deliverable on Performance Measurement Test Protocol was deepened one step and the second draft will be reviewed in the coming period.

Cooling applications: A setup was made for the evaluation criteria of storage materials for cooling applications. The table of contents for the report on boundary conditions for cooling applications was drafted and two sets of boundary conditions for two cooling applications were discussed.

Heating and domestic hot water applications: As the different national projects that work on prototypes for this application slowly took off, the focus was laid on the definition of relevant boundary conditions for the operation of storage systems. Especially the hot and cold water storage systems are hard to beat in this temperature range. Additional advantages of PCM or TCM have to be clearly defined.

High Temperature Applications: Two State-of-the-art-reports were started: One on high temperature applications based on the final report of Annex 19 (ECES) and the other on numerical modelling in high temperature applications. The report on labscale activities on process heat applications at 200°C and field test on CSP (Concentrated Solar Power) applications will follow.

Theoretical limits: a study into the physical limits of thermal storage was drafted and discussed. Storage design variants were discussed and improved. These categories will be included in the report on theoretical limits. The suggestion to utilize analytical models to assess critical parameters in idealized TES (PCM, sorption and chemical reactions) was accepted.

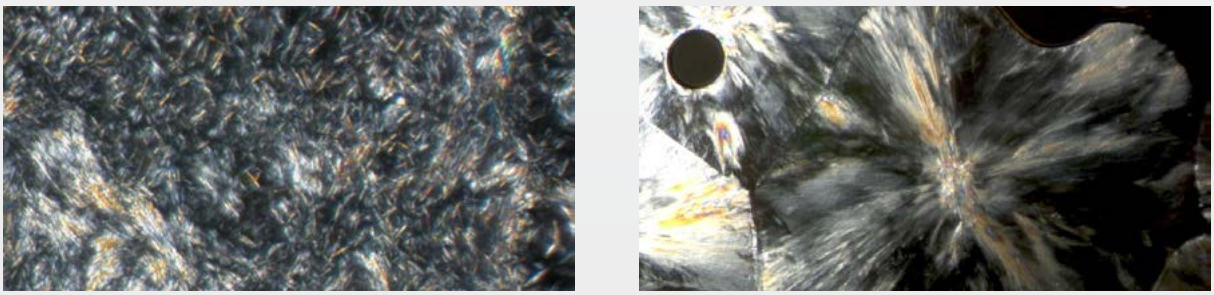


Figure 1: Extended chain (left) and folded chain (right) morphologies of poly (ethylene glycols) (PEGs) 10'000 as achieved by different crystallization temperatures and observed by Polarized Optical Microscopy (POM) (ZAE Bayern)

Operating Agent

Germany

Participating Countries

Austria, Australia, Belgium, Canada, Denmark, Japan, New Zealand, Switzerland, Germany, Spain, France, The Netherlands, Sweden, Turkey, UK, USA.

Contact

Andreas HAUER – ZAE Bayern – hauer@muc.zae-bayern.de

Future Activities

• First version of materials data base.

• Round-robin and comparison of characterization of compact storage materials completed and drafts defined for calibration and measurement procedures.

• Report on the state-of-the-art modelling techniques of PCM/TCM materials.

• Report on storage design aspects and design flow charts.

• Description and performance analysis of selected cooling applications

• Listing of boundary conditions and requirements for the room heating and domestic hot water application area

• Report on state of the art of high temperature storage applications

• Proposal for the finalization of this 4 years of the Task and proposal for the work in an extension of the Task for the 3 years 2013-2015.

Selected Publications

RISTIC, Alenka, FISCHER, Fabian, HAUER, Andreas, KAUCIC, Venceslav. Water sorption in gismodine type zeolite for heat storage applications. V: IX COPS 2011 : 9th international symposium on characterisation of porous solids, 5-9 June 2011, Dresden, Germany : [book of abstracts]. Frankfurt am Main: Deschema, 2011, pp. 71.

E. Iype, S.V.Nedea, C.C.M. Rindt, “ReaxFF force field optimization of MgSO4.xH2O to model hydration-dehydration processes in compact heat storage systems”, extended abstract+oral presentation, Eurotherm, 2011

P. Dolado, A. Lazaro, J.M. Marin & B. Zalba, Characterization of melting and solidification in a real scale PCM-air heat exchanger: Experimental results and empirical model, Renewable Energy, 36, 11, November 2011, pp. 2906-2917. DOI: 10.1016/j.renene.2011.04.008

Gil A, Medrano M, Martorell I, Lázaro A, Dolado P, Zalba B, Cabeza LF, State of the art on high temperature thermal energy storage for power generation. Part 1- Concepts, materials and modellization, Renewable & Sustainable Energy Reviews, 2010, 14, 31-55

S.K. Henninger, A. Freni, L. Schnabel, P. Schossig, G. Restuccia, Unified water adsorption measurement procedure for sorption materials, International Sorption Heat Pump Conference, Padova, Italy, 2011

Annex 25: Surplus Heat Management using Advanced Thermal Energy Storage Technology

The general objective of this Annex is to identify and demonstrate cost-effective strategies for waste heat management using advanced TES. New knowledge will be generated with regards to:

• The potential for advanced TES to minimize process waste heat through better process integration, enabling the use of waste heat for internal heating demands or cooling demands (via heat driven cooling).
• The potential for advanced TES to cost-effectively increase waste heat driven power generation in industrial applications.
• The potential for advanced TES to enable external use of heat from industrial scale processes through effective thermal energy distribution.
• The potential for advanced TES to increase the utilization of waste heat in vehicles like on-board cooling and minimization of cold-start.
• The potential for advanced TES to increase the use of waste cooling (e.g., the large cooling potential associated with LNG regasification) and free cooling for comfort cooling applications.

Thus, a sub-goal of this proposed annex is to really dig into the waste heat utilization issue from a very broad perspective and show the great potential for using advanced TES towards reaching a resource efficient energy system where waste heat (and cold) is minimized. This has a good potential for attracting a large number of participants from a variety of disciplines and levels of R&D (basic research to commercial systems).

List of Subtasks

1. Advanced TES in process integration and district distribution Subtask leader: Michael Himpel (ZAE Bayern, Germany)
2. Advanced TES in surplus heat driven power Subtask leader: Xavier Py (PROMES-UPVD, France)
3. Advanced TES in vehicles Subtask leader: Yukitaka Kato (Tokio IT, Japan)
4. Advanced TES for cooling (LNG, solar cooling, etc) Subtask leader: Luisa F. Cabeza (UdL, Spain)
5. Environomical performance assessment Subtask leader: Viktoria Martin (KTH, Sweden)

2011 activities

3rd meeting – 13-14 Oct 2011 – Osaka (Japan)

Participants

- Luisa F Cabeza (GREA - University of Lleida, Spain)
- Eduard Oró (GREA - University of Lleida, Spain)
- Antoni Gil (GREA - University of Lleida, Spain)
- Inés Fernández (University of Barcelona, Spain)
- Dong Zhang (Tongji University, China)
- Changying Zhao (Shanghai Jiaotong University, China)
- Weilong Wang (Sun Yat-Sen University, China)
- Yi Lin (Chinese Academy of Science, China)
- Thomas Bauer (German Aerospace Center, Germany)
- Michael Himpfel (ZAE Bayern, Germany)
- Ali Bourig (EDF, France)
- Antoine Meffre (PROMES UPVD, France)
- Halime Paksoy (Cukurova University, Turkey)
- Mathieu Lesfargues (University of Leeds, UK)
- Tadahiko Ibamoto (Tokyo Denki University, Japan)
- Kazunobu Sagara (Osaka University, Japan)
- Yukitaka Kato (Tokio Institute of Technology, Japan)
- Katsunori Nagano (Hokkaido University, Japan)
- Hideki Takana (Chubu University, Japan)
- Hironao Ogura (Chiba University, Japan)
- Hiroyuki Kakiuchi (Mitsubishi Plastics Inc., Japan)
- Keiko Fujioka (Functional Fluids Ltd., Japan)
- Masaaki Masuda (NGK Insulators, Ltd., Japan)
- Nuriyuki Kobayashi (Nagoya University, Japan)
- Yasuhisa Nakaso (The Kansai Electric Power CO., Inc., Japan)
- Takahiro Ogawa (Shinryo Corporation, Japan)
- Tsuyoshi Kito (Nogoya University, Japan)
- Seon Tae Kim (Tokyo Institute of Technology, Japan)
- Yuichi Ishida (SONY Corporation, Japan)
- Hideki Kawarai (The Kansai Electric Power CO., Inc., Japan)

• Xiaomei Li (Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ), Japan)
• Yoshiteru Tanaka (Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ), Japan)
• Remi Nakazato (Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ), Japan)
• Madoka Chiba (Heat Pump & Thermal Storage Technology Center of Japan (HPTCJ), Japan)
Observers
• Mohammed Farid (The University of Auckland, New Zealand)

Participants at the 3rd meeting of Annex 25

Presentations

a) Materials and heat transfer in TES

i. Composite materials for high temperature thermal energy storage applications. Mathieu Lesfargues (University of Leeds, UK)

ii. Phase change heat transfer in thermal energy storage - Changying Zhao (Shanghai Jiaotong University, China)

iii. Thermal performance of direct-contact thermal energy storage container - Jing Ding and Weilong Wang (Sun Yat-Sen University, China)

iv. Low cost materials for STES – Inés Fernández (University of Barcelona, Spain)

b) Other applications

i. Development of new OQSOA material and installation example of Adsorption Heat Pump - Hiroyuki Kakiuchi (Mitsubishi Plastic Inc, Japan)

ii. Trend of Thermal Energy Storage Technology for vehicles - Yukitaka Kato (Tokyo Institute of Technology, Japan)

iii. The use of phase change materials to improve thermal comfort in cars - Mohammed M. Farid and Nur Hakima Awalludin (The University of Auckland, New Zealand)

iv. PCM storage for solar cooling applications: effectiveness improvement in a thermal storage tank using fins - Antoni Gil et al. (University of Lleida, Spain)

v. Efficient utilization of surplus heat and solar thermal using multi-stage energy storage system - Yi Jin (Chinese Academy of Sciences, China)

c) Industrial applications

i. High temperature BTES plant at ITT Water and Waste Water plant in Emmaboda, Sweden - Halime Paksoy (Çukurova University) on behalf of Olof Andersen (SWECO, Sweden)

ii. Overview of Annex 19 activities - Optimised Industrial Process Heat and Power Generation with Thermal Energy Storage - Thomas Bauer (DLR, Germany)

iii. Waste heat recovery and thermal energy storage in industrial processes. State of the art and perspectives of EDF activities - Ali Bourig (EDF, France)

d) Heat pumps

i. Duration performance of a chemical heat pump with CaBr2/H2O system - Tsuyoshi Kito and Noriyuki Kobayashi (Nagoya University, Japan)

ii. Reactivity enhancement of magnesium oxide/water chemical heat pump by using carbon based material - Seon Tae Kim and Dr. Yukitaka Kato (Tokyo Institute of Technology, Japan)

iii. Composite materials and reactor beds for chemical heat pump and thermal storage - Keiko Fujioka (Functional Fluids, Japan)

iv. Recycling Heat Utilization Systems Using Chemical Heat Pumps - Hironao Ogura (Chiba University, Japan)

e) Cold storage

i. Thermal energy storage for low temperature applications. Ongoing Project – Eduard Oró et al. (University of Lleida, Spain)

ii. Comparative study of different numerical models of a packed bed thermal energy storage system – Eduard Oró et al. (University of Lleida, Spain and KTH, Sweden)

iii. A dynamic type ice storage system with a closed ice-making device using supercooled water - Takahiro Ogawa (Shinryo Corporation, Japan)

f) High temperature applications

i. Experimental study on high temperature phase change materials, heat storage module and system above 400 ºC - Dong Zhang (Tongji University, China)

ii. Theoretical study on scale up of thermal energy storage systems in solar power plants - Antoni Gil et al. (University of Lleida, Spain and CNRS-PROMES, France)

iii. Fundamental properties of dimethyl terephthalate (DMT) as an organic phase change material for high temperature thermal energy storage – Halime Paksoy (Çukurova University, Turkey)

iv. High temperature thermal energy storage material from vitrified fly-ashes - Antoine Meffre et al. (CNRS-PROMES, France) Subtask 5 1st working meeting - 13-14 Oct 2011 - Osaka (Japan)

Participants

- Luisa F Cabeza (GREA - University of Lleida, Spain)
- Inés Fernández (University of Barcelona, Spain)
- Viktoria Martin (KTH, Sweden)
- Amir Vadiei (KTH, Sweden)
- Eduard Oró (GREA - University of Lleida, Spain)
- Antoni Gil (GREA - University of Lleida, Spain)
- Cristian Solé (GREA - University of Lleida, Spain)
- Laia Miró (GREA - University of Lleida, Spain)

Conclusions

The objective of this meeting, leaded by Dr. Viktoria Martin, sub-task leader, was to describe the work to be developed within Sub-task 5 of Annex 25.
First the outline of the final report was studied, and it was concluded that chapters 2, 3 and 10 are of interest here
It was unanimously concluded that the following tasks have to be performed to be able to achieve common results:
- Common definition of “surplus heat”
- There would be a pre-requisite of a PINCH analysis and thermoeconomic optimization to judge if it is really surplus heat. Too much to demand for partners in Annex 25 to target each industry for such a request.
- Definition of a methodology for CO2 accounting

Researchers exchange

Title: High temperature energy storage in thermal applications
Researcher: Antoni Gil
Origin organisation: University of Lleida (Spain)
Host organisation: CNRS-PROMES (France)
Date: Feb-May 2011
Title: Thermal energy storage for low temperature applications
Researcher: Eduard Oro
Origin organisation: University of Lleida (Spain)
Host organisation: KTH (Sweden)
Date: June-Sept 2011

Contact Information of Operating Agent

Luisa F. Cabeza
University of Lleida
lcabeza@diei.udl.cat
webpage - www.annex25-eces.org

Participating countries

CHINA
Tongji University
Prof. Dong Zhang (zhangdng@tongji.edu.cn)
FRANCE
PROMES UPVD
Prof. Dr. Xavier Py (py@univ-perp.fr)
EDF R&D
Dr. Ali Bourig (ali.bourig@edf.fr)
GERMANY
ZAE Bayern
Michael Himpel (himpel@muc.zae-bayern.de)
JAPAN
Osaka University
Prof. Kazunobu Sagara (sagara@arch.eng.osaka-u.ac.jp)
Tokyo Institute of Technology
Dr. Yukitaka Kato (yukitaka@nr.titech.ac.jp)
SPAIN
University of Lleida
Prof. Dr. Luisa F. Cabeza (lcabeza@diei.udl.cat)
Antoni Gil (tgil@diei.udl.cat)
Eduard Oró (eduoro@diei.udl.cat)
University of Barcelona
Dr. Inés Fernández (ana_inesfernandez@ub.edu)
University of Zaragoza
Dr. Pablo Dolado (dolado@unizar.es)
SWEDEN
KTH
Dr. Viktoria Martin (Viktoria.Martin@energy.kth.se)
TURKEY
Dr. Halime Paksoy (hopaksoy@cu.edu.tr)
Observers
NEW ZEALAND
The University of Auckland
Prof. Dr. Mohammed M. Farid (m.farid@auckland.ac.nz)

Selected Publications in 2011

Publications in Journals with Impact Factor

Arce P, Medrano M, Gil A, Oro E, Cabeza LF, Overview of thermal energy storage (TES) potential energy savings and climate change mitigation in Spain and Europe, Applied Energy, 88, 2764-2774, 2011

Castell A, Belusko M, Bruno F, Cabeza LF, Maximization of heat transfer in a coil in tank PCM cold storage system, Applied Energy, 88(11), 4120-4127, 2011

Fukushima Y, Kikuchi Y, Kajikawa Y, Kubota M, Nakagaki T, Matsukata M, Kato Y, Koyama M, Tackling Power Outages in Japan: The Earthquake Compels a Swift Transformation of the Power Supply, J Chem. Eng. Japan, 44(6), 365-369, 2011

Haillot D, Goetz V, Py, X, Benabdelkarim M, High performance storage composite for the enhancement of solar domestic hot water systems: part 1: storage material investigation, Solar Energy, 85, 1021-1027, 2011

Kato Y, Obara T, Ryu J, Yamanaka I, Mori S, Suzuki M, Ujisawa Y, Performance analysis of active carbon recycling energy system, Progress in Nuclear Energy, 53, 1017-1021, 2011

Kim ST, Ryu J, Kato Y, Reactivity Enhancement of Chemical Materials Used in Packed Bed Reactor of Chemical Heat Pump, Progress in Nuclear Energy, 53, 1027-1033, 2011

Py X, Calvet N, Olives R, Meffre A, Echegut P, Bessada C, Veron E, Ory S, Recycled Material for Sensible Heat based Thermal Energy Storage to be used in Concentrated Solar Thermal Power Plants, Journal of Solar Energy Engineering, 133, 1-8, 2011

Sato H, Yan XL, Tachibana Y, Kato Y, Control Strategies for Transients of Hydrogen Production Plant in VHTR Cogeneration Systems, Progress in Nuclear Energy, 53, 1009-1016, 2011

Tagawa Y, Mori S, Suzuki M, Yamanaka I, Obara T, Ryu J, Kato Y, Synergistic Decomposition of CO2 by Hybridization of a Dielectric Barrier Discharge Reactor and a Solid Oxide Electrolyser Cell, Kagaku Kogaku Ronbunshu, 37(2), 114-119, 2011

Contributions in conferences

Olives R, Py X, Gil A, Cabeza LF, Theoretical study on scale change of thermal energy storage systems in solar power plants, ISES Solar World Congress, Kassel (Germany) 2011

Navarro ME, Martínez M, Gil A, Fernández AI, Cabeza LF, Py X, Selection and characterization of recycled materials for sensible thermal energy storage, ISES Solar World Congress, Kassel (Germany) 2011

Gil A, Oró E, Solé C, Ruiz A, Salmerón JM, Cabeza LF, Experimental study of thermal energy storage rates in high temperature phase change systems for solar refrigeration, ISES Solar World Congress, Kassel (Germany) 2011

Arce P, Medrano M, Cabeza LF, Assessment of the benefits of employing thermal energy storage in Spain, Germany and Europe, ISES Solar World Congress, Kassel (Germany) 2011

Cabeza LF, ES2011 Plenary Presentation “Thermal Energy Storage and its impacts on CSP Applications”, 5th International Conference on Energy Sustainability, Washington DC (USA) 2011

Cabeza LF, Thermochemical energy storage: a new challenge for all researchers, New Perspectives for Thermal Energy Storage - Workshop - CIC energigune, Vitoria (Spain) 2011

Ishitobi H, Uruma K, Ryu J, Kato Y, The reactivity of metal salt-modified materials for chemical heat pump in a repetitive reaction, Proc. of International Sorption Heat Pump Conference (ISHPC11), Padua, Italy, April 6-8, 2011

Kato Y, Dipu AL, Ujisawa Y, Feasibility study on carbon recycling iron-making system, Proc. of 1st International Conference on Energy Efficiency and CO2 Reduction in the Steel Industry (EECR) in METEC InSteelCon 2011, Düsseldorf, Germany, 27 June- 1 July, 2011

Kim ST, Ryu J, Kato Y, Expanded graphite mixture reactant for packed bed reactor of chemical heat pump, Proc. of International Sorption Heat Pump Conference (ISHPC11), Padua, Italy, April 6-8, 2011

Meffre A, Olives R, Py X, Recent Advances in Thermal Diffusivity Measurements. Workshop AIE Annex 25, Perpignan (France), 11-12 April 2011

Meffre A, Py X, Olives R, Calvet N, Guillot E, Fourcher B, Chocs thermiques surfaciques et mesures de diffusivité par voie solaire. Conférence SFT 2011, Perpignan (France), 24-27 Mai 2011

Meffre A, Py X, Olives R, Guillot S, Faik A, Bessada C, Echegut P, Michon U, High temperature thermal energy storage material from vitrified fly ashes, International SolarPaces Conference, Granada (Spain), 2011

Meffre A, Olives R, Py X, Bessada C, Echegut P, Michon U, Design and industrial elaboration of thermal energy storage units made of recycled vitrified industrial wastes. International ASME Conference 2011, Denver, Colorado (USA), November 2011

Olives R, Py X, Gil A, Cabeza LF, Theoretical study on scale change of termal energy storage systems in solar power plants, Workshop AIE Annex 25, Perpignan (France), 11-12 April 2011

Oró E, Solé C, Farid MM, Cabeza LF, Improving the thermal performance of freezers using phase change materials, IC-SES 2011, International Conference for Sustainable Energy Storage 2011, Belfast (UK) 2011

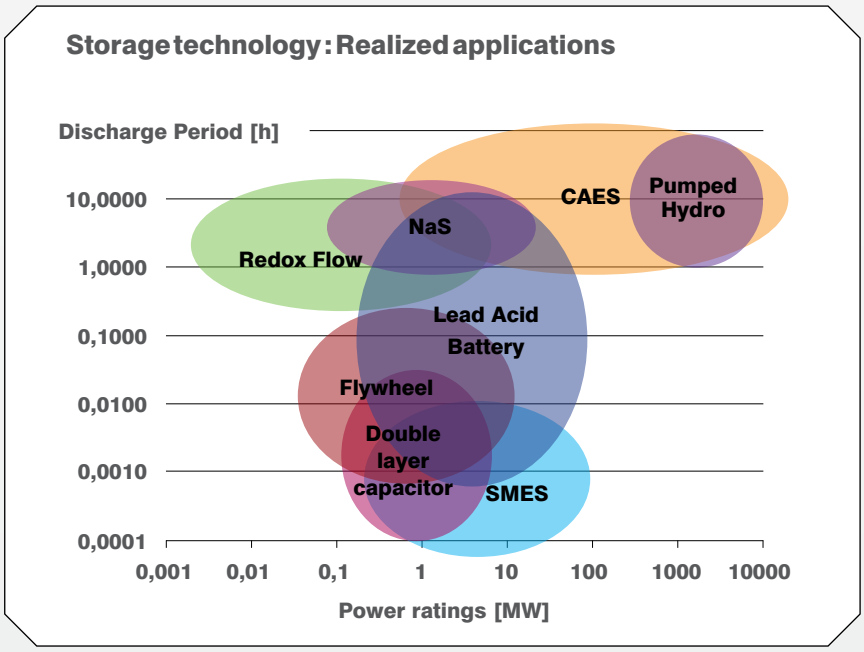
Py X, Meffre A, Olives R, Echegut R, Bessada C., Michon U, Sustainable Energy Storage for Concentrated Solar Power using Recycled Industrial Waste, International Conference for Sustainable Energy Storage IC-SES, Belfast (UK), 20- 24 February 2011

Py X, Meffre A, Olives R, Echegut P, Bessada C, Michon U, High temperature materials for sensible heat thermal energy storage : applications, limitations, new approaches, MFHT4, Orléans (France), 30 March - 1 April 2011

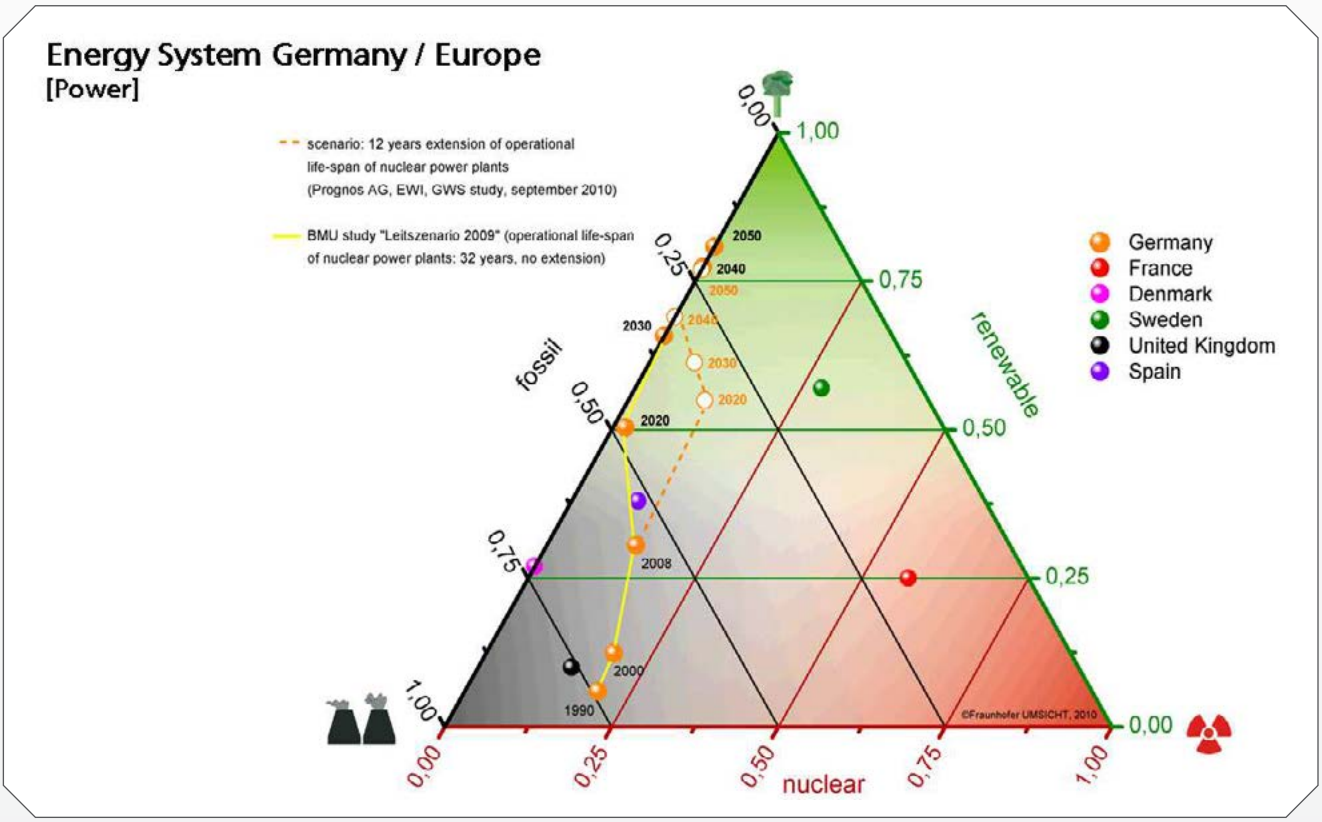
Py X, Réutilisation de déchets pour le stockage haute température. Conférence Internationale du Pôle de compétitivité DERBI, Perpignan (France), 16-18 May 2011

Annex 26: Electric Energy Storage: Future Energy Storage Demand

The future of electricity network involves a massive penetration of unpredictable renewable energies. For insuring network stability as well as for maximizing the energy efficiency of such networks, storage is a key issue. Up to now, the integration of renewable energies did not take into account the demand side and was performed in a “fit and forget” way. The optimum evolution in an economic perspective is in the future to have an integration that is respecting the needs. One solution - beneath demand side management and grid extension – is the use of energy storages. The main purpose of adding energy storage systems in the electricity grid is to collect and store overproduced, unused energy and be able to reuse it during times when it is actually needed. Essentially the system will balance the disparity between energy supply and energy demand. Worldwide between 2% and 7% of the installed power plants are backed up by energy storage systems (99% pumped hydro systems). The future demand of energy storage devices is actually unknown. Only the main influence factors on this demand are known.



Survey about different storage technologies (>100 kW) realized in the world



Survey about power plant fleet in some European countries and the development in Germany

The main objective of this task is to develop a method or approach to calculate the regional energy balancing demand and to derive regional storage demand rasterizing the area and taking into account that there are competitive technical solutions.

Additionally there are two important aspects. On the one hand an overview about the different technical and economical and legal framework requirements in the different countries.

Case Studies: Running projects, planned projects and future projects of stationary energy storage systems.

And on the other hand typical operation modes for energy storages and derived from this typical charge/discharge curves, needed for future standardizations.

To reach these objectives, the annex is structured in four main work packages

I. Technical and economic framework conditions for energy storage systems The aim is to give an assessment and a comparison about general technical and economical conditions in the different countries.

Leader work package 1 (interim): Dr. Bert Droste-Franke, European Academy, Germany

II. Calculation method to determine spatial demand for electric energy storage

In this core work package a new, spatial mathematical method has to be developed and applied to different “worlds” to derive the grid balancing demand and the energy storage demand as a part of it.
Leader work package 2: Dr. Yvonne Scholz, DLR Germany

III. Applications of electric energy storage systems

In this work package realized and future applications of electric energy storage will be examined to derive business cases and to compare them with real case studies.

Leader work package 3 (interim): Dr. Grietus Mulder, VITO, Belgium

IV. Requirements for test procedures

The aim of this work package is to develop guidelines - derived from applications - for testing energy storage systems.

Leader work package 4: Dr. Marion Perrin, INES-CEA - France

Current participants:

Country	Researcher	Companies
Germany	Fraunhofer (OA), DLR, Europäische Akademie	RWE, EON, Next Energy, Evonik, EWE
Belgium	VITO	
France	INES-CEA	
Finland	VTT	
Korea	KIST	Samsung

Interested countries: Japan, UK, US, ES, EU

Meetings

- Kick-off Meeting, Germany, Oberhausen, 2010-Apr-08
- 2nd Meeting, Spain, Barcelona, 2010-Oct-25
- 3rd Meeting, France, Le-Bourget-du-Lac, 2011-Oct-19/20
- 4th Meeting will take place in Spain, Lleida, 2012-May-14/15

Impressions of the 3rd Meeting in France, Le-Bourget-du-Lac.

Publications

Wrobel, P.; Beyer, D. 2011, „Local Energy Balancing Demand for Germany?“ Poster, 6th International Renewable Energy Storage Conference, IRES 2011. CD-ROM : 28.- 30. November 2011, Berlin, bcc Berlin Congress Center; EUROSOLAR, 2011

Contact

Christian DOETSCH - Fraunhofer UMSICHT, Germany –
christian.doetsch@umsicht.fraunhofer.de

Further Activities

New Annexes

Annex 27, Quality Management in Design Constrution and Operation of Borehole Systems

The quality assurance issues included in the strategic plan of ECES is going to be addressed for borehole thermal energy storage systems in this annex.
Manfred REUSS - ZAE Bayern, Germany - reuss@muc.zae-bayern.de

Integration of Renewable Energies by Distributed Energy Storage Systems

A workshop for task definition phase will be organized in 2011.
Operating agent : Andreas HAUER – ZAE Bayern – hauer@muc.zae-bayern.de

Conferences

The 12th International Conference on Energy Storage is going to be held in Leida, Spain, 16-18 May, 2012 (www.innostock2012.org). This is one of the series of triannual conferences organized by ECES. There will be a special session on IEA with inputs from different IAs. The conference includes all energy storage topics:

- Underground thermal energy storage
- Sensible, latent and thermochemical storage
- Electrical energy storage

Executive Committee Meetings

The Executive Committee had two regular meetings during the year 2011. The 71st Executive Committee Meeting in Istanbul, Turkey on May 11-12 and the 72nd XC Meeting in Bad Aibling, Germany on November 25-26.

The most important items and decisions of the XC Meetings in 2011 are outlined below.

The Istanbul, Turkey Meeting, May 11-12, 2011

- Approval of the minutes of the 70th XC Meeting.
- XC decided acting by unanimity and determined by written procedure, to request the CERT to extend the current term of the Implementing Agreement to 28 February 2016.
- Approval of the progress reports of the ongoing Annexes 21, 23, 24, 25 and 26.
- Discussion about the new Annex proposal: Annex 27 “Quality Management in Design, Construction and Operation of Borehole Systems”: This Annex aims to address the quality assurance of borehole thermal energy storage systems.
- Discussion about the results from the Experts Workshop “Energy Storage Issues and Opportunities”, on February 15, 2011, Paris organized together with IEA office and CERT. The workshop showed the need for moderated dialogue among policy makers, industry, academia and other energy technology bodies. 69 participants from 48 organizations (50% public, 40% private, 10% intergovernmental) were present at the workshop. The problem was there are different perceptions of storage that arise from lack of communication. The potential for coordination with Experts Group on Science in Energy Technologies – EGSE to continue this activity will be determined.

• Discussion about the Energy Saving Potential of Thermal Energy Storages: Spain has finished calculations for the EU states and Spain. The table will be distributed to ECES partner countries and collected data will be evaluated by Spain.
• Discussion on the results of the IEA Energy Technology Network questionnaire: ECES was among the first group of IAs that were evaluated. The first results show that the number of organizations in the annexes is about 4 times higher at the ExCo level participation and public sector is predominant. The most prominent barrier of all the IAs is lack of awareness.
• Discussion on joint SHC XC and Workshop preparation: Titles of presentations were determined taking into account an even distribution of ECES and SHC contributions.
• The progress of the organization of the planned "Innostock" conference 2012 in Lleida (Spain) was presented, the program and contribution of ECES was discussed in detail.

The Bad Aibling, Germany Meeting, November 9-10, 2011
• Minutes of the 71st XC Meeting were accepted.
• CERT approved the sponsor membership of Leida University from Spain .
• ExCo elected Halime Paksoy as chair, Hunay Evliya as secretary and German delegate Hendrik Wust as vice chair for the year 2012.
• Approval of final report of Annex 20.
• Approval of progress reports of the ongoing Annexes 23,24,25 and 26.
• Discussion about the new Annex proposal: Annex 27 "Quality Management in Design, Construction and Operation of Borehole Systems": The final annex text will be presented at the next XC.
• A workshop will be realized for task definition phase of Integration of Renewable Energies by Distributed Energy Storage Systems.
• XC discussed the need to have an energy storage roadmap and decided to contact IEA to get more information on required steps to prepare a roadmap.
• Discussion on to improve communication and impact: A Strategy Paper for Communication will be prepared.
• Discussion on the need to have an education activity: First concept for summer school will be prepared.
• The progress of the organization of the planned "Innostock" conference 2012 in Lleida (Spain) was presented. The awards that will be given at the conference are: Fredrik Setterwall award, Best PCM paper award in memory of Rolf Ulvrengen (Climator) and best paper and poster awards
• XC decided to have China to organize the next Stock Conference in 2015.
• Summary of the variety of conferences and workshop ECES attended in 2011, one highlight was the ISES Conference 28 August – 2 September 2011, Kassel, Germany.
• XC decided to support the SHC Conference for Buildings and Industry in San Francisco, USA, July 9-11, 2012.
• XC decided to start a dialogue to discuss possible collaboration with newly established European Association for Storage of Energy - EASE.

Storage Coordination Group

ECES is consolidating the responsibility for the coordination of all storage related activities within the IEA through activities to start Forum on Energy Storage After the first workshop about the role of energy storage in future energy systems in 2009, ECES organised a second workshop in Bad Tölz in 2010 with the title: "Energy Storage: Matching the Supply and Demand in the Future". Important results from this workshop have been the need for structuring the knowledge and the boundary conditions for the different energy storage systems to enable the optimal use in practice. Furthermore, the demand for best-practice examples has been pointed out. Both aspects require to proceed with the storage coordination activities. Third activity in this scope was organized together with IEA CERT. Workshop on "Energy Storage Issues and Opportunities" was held on 15 February 2011 in Paris. 69 participants from 48 organisations (50% public, 40% private, 10% intergovernmental) attended the workshop. The presentations at this workshop were:

- Motivation and Rationale, Peter Cunz, Chair, IEA Committee on Energy Research and Technology (Switzerland)
- Storage Technology Issues and Opportunities, Andreas Hauer, ZAE Bayern Center for Applied Energy Research (Germany)
- Progress with Energy Storage, Imre Guyk, Department of Energy (United States)
- Thermal Storage: Residential and Commercial Buildings, Luisa Cabeza Universidad de Lleida
- Options for Integrated Systems, Wolfgang Woyke E.On
- Stationary Batteries for Networks, Hitoshi Koyabu, Tepco (Japan)
- Balancing Grids with Storage, John Cheng, CLP Holdings (Hong Kong)
- Building Applications, Aart Snijders, IF Technology, Michael Taylor, IEA
- Industrial Applications, B.Müller, Bosch-Rexroth, Cecilia Tam, IEA
- Transport and Electricity, Lew Fulton, IEA, David Elzinga, IEA
- Storage in National Strategies, Henry Kenchington, Electricity Delivery and Energy Reliability, Department of Energy (United States)
- Modelling Energy Storage Demand, Karl-Peter Felberbauer, Joanneum Research, Forschungsgesellschaft (Austria)
- International Strategies Energy Storage, Rodica Loisel, JRC SETIS(Netherlands) and Bruno Prestat, EDF R&D (France)
- Defining a Pathway for Energy Storage, A. Wille, Julich Research Centre (Germany)
- Workshop Conclusion, Bo Diczfalusy, Director, Sustainable Policy and Technology (IEA):

Co-ordination and Co-operation with Other IAs and Institutions

ECES is taking part in Building Coordination Group (BCG) and Electrical Coordination Group (ECG) of IEA. ECES has contributed to EGSE- Workshop and supported the NEET-activities. ECES has participated in the following IEA workshops to report on energy storage activities:

- IEA Clean Energy Technologies Symposium in Singapore: Nov 2-3 2010
- IEA - RSA Bilateral Event, 4-6 July,2011, Johannesburg, South Africa

There is an active joint annex with SHC IA: Task42/24 on Compact Thermal Energy Storage: Material Development for Systems Integration. Fall 2011 XC and a workshop was organized jointly with SHC IA.

ECES is also contributing to Storage Group within EC European Renewable Heating and Cooling Technology Platform – RHCTP.

Executive Committee Members

Belgium

Delegate

Bert Gysen
Vlaamse Instelling voor Technologisch Onderzoek, VITO
Boeretang 200
B-2400 Mol
BELGIUM
Tel.: +32 14 335 914 (5511)
Fax: +32 14 321 185
bert.gysen@vito.be

Canada

Delegate

Edward Morofsky
Public Works and Government Services Canada
Place du Portage, Phase III, 8B1
Gatineau, Quebec K1A 0S5
CANADA
Tel.: +1 819 956 3419
Fax: +1 819 956 3875
Ed.Morofsky@pwgsc.gc.ca

Alt. Delegate

Frank Cruickshanks
Environmental Protection & Operations Directorate
Climate Change Section
45 Alderney Drive, Dartmouth
Nova Scotia B2Y 2N6
CANADA
Tel.: +1 902 426 6885
BB: +1 902 425 1731
Fax: +1 902 426 4457
Frank.Cruickshanks@ec.gc.ca

China

Delegate

Xu Wei,
China Academy of Building Research -CABR
30# Beisanhuandonglu ChaoYang District, Beijing
CHINA 100013
Tel: +86-10-8427-0105
Fax: +86-10-8428-3555
xuwei19@126.com

Alt. Delegate

Zhang ShiCong,
China Academy of Building Research -CABR
30# Beisanhuandonglu ChaoYang District, Beijing
CHINA 100013
Tel: +8610- 84270181
Fax: +8610-84283555
zsc2062198@yahoo.com.cn

Finland

Delegate

Jussi Mäkelä
Energy and Environment National Technology Agency of Finland (TEKES)
Kyllikinportti 2
P.O. Box 69
FIN-00101 Helsinki
FINLAND
Tel.: +358 50 3955166
Jussi.Makela@tekes.fi

Alt. Delegate

Raili Alanen
VTT Energy and P&P
Tekniikantie 2, Espoo
P.O.Box 1000
FIN-02044 VTT,
FINLAND
Tel.: +358 20 722 5808
Fax: +358 20 722 7026
Raili.Alanen@vtt.fi

France

Delegate

Elena Paloma del Barrio
Universités Laboratoire TREFLE/CNRS
UMR 8508
Esplanade des Arts et Métiers
F-33405 TALENCE cedex
FRANCE
Tel.: +33 5 56 84 54 04
elena.palomo@bordeaux.ensam.fr

Alt. Delegate

Eric Peirano
Département “Energie Renouvellable”
ADEME
500 route des Lucioles
F-06560 Sophia-Antipolis
FRANCE
Tel.: +33 4 93 95 79 34
eric.peirano@ademe.fr

Germany

Delegate

Hendrik Wust
Project Management Jülich
Division Energy Technologies
Forschungszentrum Jülich GmbH
D-52425 Jülich GERMANY
Tel.: +49 2461 61-3166
Fax.: +49 2461 61-3131
h.wust@fz-juelich.de

Alt. Delegate

Rolf Stricker
Project Management Jülich
Division Energy Technologies
Forschungszentrum Jülich GmbH
D-52425 Jülich
GERMANY
Tel.: +49 2461 61 1575
Fax. +49 2461 61 3131

Italy

Delegate

Mario Conte
ENEA - Italian National Agency for
New Technologies, Energy and
Sustainable Economic Development
Technical Unit “Advanced Technologies
for Energy and Industry”Coordination of
Energy Storage Systems
Casaccia Research Centre
Via Anguillarese, 301
00123 S. Maria di Galeria (Roma)
Tel. +39.06.3048.4829
Fax +39.06.3048.6306
e-mail: mario.conte@enea.it

Japan

Delegate

Tadahiko Ibamoto
Tokyo Denki University
2-2, Kanda-Nishiki-cho
Chiyodaku Tokyo 101-8457JAPAN
Tel.: +81 3 5280 3429
Fax: +81 3 3429 3264
ibamoto@cck.dendai.ac.jp

Alt. Delegate

Xiaomei Li
Heat Pump & Thermal Storage Techn. Center of Japan
28-5, Nihonbashi
Kakigara-cho, 1 chome Chuo-ku Tokyo JAPAN
Tel.: +03 5643 2404
Fax: +03 5641 4501
li@hptcj.or.jp

Korea

Delegate

Yong Jin Kim
Environment & Energy Systems Division,
KIMM Korea Institute of Machinery & Materials
104 Sinseongno, Yusung-Gu,
Daejeon 305-343,
Republic of Korea
Tel.: +82-42-868-7475
Fax.: +82-42-868-7284
yjkim@kimm.re.kr

Norway

Delegate

Rajinder Kumar Bhasin
Norwegian Geotechnical Institute (NGI)
Regional Manager Asia
Postal address: P.O. Box 3930 Ullevaal Stadion, NO-0806 Oslo, Norway
Street address: Sognsveien 72, NO-0855 Oslo, Norway
Tel.: +47 22 02 30 05
Fax: +47 22 23 04 48
Rajinder.Kumar.Bhasin@ngi.no

Sweden

Delegate

Jorgen Sjodin
Energy Technology Department
Swedish Energy Agency
Tel.: +46 (0)16 544 21 38
jorgen.sjodin@energimyndigheten.se

Alt. Delegate

Conny Ryytty
The Energy Technology Department
Swedish Energy Agency
P.O.Box 310,
S-69104 Eskilstuna SWEDEN
Tel.: +46 16 544 2096
Fax: +46 16 544 2261
conny.ryytty@energimyndigheten.se

Turkey

Delegate

Halime Paksoy
Çukurova University
Faculty of Arts and Sciences
Chemistry Department
TR-01330 Adana TURKEY
Tel.: +90 322 338 6418
Fax: +90 322 338 6070
hopaksoy@cu.edu.tr

Alt. Delegate

Hunay Evliya
Çukurova University
Centre for Environmental Research
Chemistry Department
TR-01330 Adana TURKEY
Tel.: +90 322 338 6361
Fax: +90 322 338 6361
hevliya@cu.edu.tr

USA

Delegate

Imre Gyuk
U.S Dept.of Energy
1000 Independence Ave
Washington DC 20585 USA
Tel.: +1 202 586 1482
Fax: +1 202 586 5860
Imre.Gyuk@ee.doe.gov

Alt. Delegate

Lynn Stiles
Richard Stockton College
NAMS PO Box 195, Pomona
NJ 08240-0195 USA
Tel.: +1 609 652 4299
Fax: +1 609 652 4972
lynn.stiles@stockton.edu

Sponsors:

IF Technology

Delegate

Aart Snijders
IF Technology b.v.
Frombergstraat 1
P.O. Box 605
NL-6800 EA Arnhem
The NETHERLANDS
Tel.: +31 26 3274965
Fax: +31 26 4460 153
a.snijders@ifinternational.com

University of Lleida

Delegate

Luisa F. Cabeza
University of Lleida
Edifici CREA
C/ Pere de Cabrera s/n
25001 Lleida
SPAIN
Tel.: +34-973-00 3576
Fax: +34-973-00 3575
lcabeza@diei.udl.cat

Alt. Delegate

Albert Castell Casol
University of Lleida
Edifici CREA
C/ Pere de Cabrera s/n
25001 Lleida
SPAIN
Tel.: +34-973-00 3570
Fax: +34-973-00 3575
acastell@diei.udl.cat

Institute of Heat Engineering

Delegate

Roman W. Domanski
Warsaw University of Technology
Thermodynamics Division
Polish State Committee for Scientific Research
Ul. Nowowiejska 25
PL-00-665 Warsaw
POLAND
Tel.: +48 22 825 52 70
Fax: +48 22 825 05 65 or
+48 22 825 52 76
rdoma@itc.pw.edu.pl

Alt. Delegate

Maciej Jaworski
Warsaw University of Technology
Ul. Nowowiejska 25
PL-00-665 Warsaw
POLAND
Tel.: + 48 22660 52 09
mjawo@itc.pw.edu.pl

Secretary:

Hunay Evliya
Cukurova University
Centre for Environmental Research
Chemistry Department
TR-01330 Adana
TURKEY
Tel.: +90 322 338 6361
Fax: +90 322 338 6361
hevliya@cu.edu.tr

ECES and SHC Joint Executive Committee Meeting
November 9-10, 2011, Bad Aibling, Germany

International Energy Agency Energy Conservation Through Energy Storage Programme
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