Annual Report 2014

International Energy Agency

Energy Conservation Through

Energy Storage Programme

Content

Front page image: Solar thermal plant at Lunderbjerg, west for Dronninglund, Dronninglund Fjernvarme (Dronninglund District Heating), Danmark.

About the IEA and the Technology Network

The International Energy Agency (IEA) is an autonomous agency established in 1974. The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The aims of the IEA are to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

To attain these goals, increased co-operation between industries, businesses and government energy technology research is indispensable. The public and private sectors must work together, share burdens and resources, while at the same time multiplying results and outcomes.

The multilateral technology initiatives (Implementing Agreements) supported by the IEA are a flexible and effective framework for IEA member and non-member countries, businesses, industries, international and non-government organisations to research breakthrough technologies, to fill existing research gaps,, to build pilot plants, to carry out deployment or demonstration programmes – in short to encourage technology-related activities that support energy security, economic growth and environmental protection.

More than 6,000 specialists carry out a vast body of research through these various initiatives. To date, more than 1,300 projects have been completed. There are currently 41 Implementing Agreements (IA) working in the areas of:

- Cross-Cutting Activities (information exchange, modelling, technology transfer)
- End-Use (buildings, electricity, industry, transport)
- Fossil Fuels (greenhouse-gas mitigation, supply, transformation)
- Fusion Power (international experiments)
- Renewable Energies and Hydrogen (technologies and deployment)

The Implementing Agreement for a Programme of Research and Development on Energy Conservation through Energy Storage belongs to the End-Use category above.

The IAs are at the core of a network of senior experts consisting of the Committee on Energy Research and Technology (CERT), four working parties and two expert groups. A key role of the CERT is to provide leadership by guiding the IAs to shape work programmes that address current energy issues productively, by regularly reviewing their accomplishments, and suggesting reinforced efforts where needed. For further information on the IEA, the CERT and the IAs, please consult www.iea.org/techinitiatives.

The Implementing Agreement

The scope of the Implementing Agreement for a Programme of Research and Development on Energy Conservation through Energy Storage (ECES) is:

- Research and dissemination activities on both thermal as well as electrical storage technologies
- Storage technologies as a main driver for the transformation of the energy system toward a low-carbon renewable based supply
- The international collaboration is to be carried out within a framework of typical IEA countries in combination with developing and transition countries

The Implementing Agreement (IA) started in 1978. Its present term ends by February 2016. At present Contracting Parties from the following countries have signed the IA: Belgium, Canada, China, Denmark, Finland, France, Germany, Italy, Japan, Korea, The Netherlands , Norway, Slovenia, Sweden, Turkey, the USA and the Institute of Heat Engineering (ITC) of the University of Technology, Warsaw, Poland and University of Lleida from Spain as sponsors. The Executive Committee (ExCo) is working intensively to attract more countries to not only join the activities but also sign the Implementing Agreement. Ireland, New Zealand, Australia, India and Chile are interested. Experts from several countries do already participate in the Annex work as observers.

According to the Strategy Plan (2011 – 2015) 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 ExCo 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.

Background

The power sector will be subject to basic changes in future. The percentage of renewable energies is going to increase, mainly the use of wind power and solar energy. This variable production will be a challenge for the grid. The amount of fluctuating energy both on the supply as well as on the demand side leads to a requirement to balance these energy flows and capacities. Grid expansion is not the most efficient solution from an energetic and economic point of view. Besides, it may not be possible for all parts of the world.

At the moment, many electric storage systems are considered to fulfil the balancing demand. Pumped-hydro plants, CAES and even different electrochemical storages are developed. Further research and developing activities will increase the efficiency of e.g. redox flow cells and NaS-batteries and decrease the specific costs. Even thermal energy storages may be suitable for balancing the electricity grid.

The use of waste heat in the industrial sector illustrates the possible contribution of energy storages to increase the overall energy efficiency. This can also be deduced from the fact, that there is a large percentage of the industrial heat demand within the total final energy consumption.

There is a big variety of energy efficiency measures in the building stock. Passive measures should reduce the heating and cooling demand at all. Cold storages for decreasing the cooling demand in buildings in summer are suitable to avoid black-outs. Seasonal storages may complete an efficient energy supply, especially in combination with district heating and cooling systems. Within the building sector energy storages bridges the gap between efficiency measures on the one hand and increasing use of the renewables. Solar assisted heating and cooling systems in combination with storages are a very promising solution for the future. Transforming surplus solar or wind energy to store it e.g. in decentralized latent heat storages can be a very energetically and economically efficient solution.

Energy storage technologies can overcome the temporal mismatch between electricity, thermal energy supply and demand and are the only and therefore most important instruments to reduce peak loads and enables load management. Whether energy storage is used for electricity or heat and cold, for centralized or decentralized options, or deployed for autonomous use or grid connection. In all aspects energy storage is becoming a crucial parameter to prepare our energy systems for the future.

The big variety of energy storage potential requires many different technical storage based solutions. Apart from the technical development on component and sub-system level, very efficient solutions with regard to storage are found within the overall energy system. All kind of storages have to be taken into account to find the optimum in a given supply and demand situation.

Chairman's Report

The race for renewable energy is on the verge of a turning point. Many countries realize that this race can only be completed using energy storage technologies. ECES continues to carry out R-D&D activities showing the right way to pass this turning point.

We are close to finishing the 8th term of ECES, which will be in February 2016. Preparing the documents of request for extension for the next term, I can easily say that we have had one of the most active terms of ECES.

Of the 8 annexes completed in the last term, 3 were concluded this last year: Annex 21 "Thermal Response Test", Annex 23 "Applying Energy Storage in Buildings of the Future" and Annex 25 "Surplus Heat Management using Advanced TES for CO2 mitigation". Furthermore, a new annex on energy storage in buildings and districts - Annex 31 "Energy storage with Net Zero Energy Buildings and Districts: Optimization and Automation" has started. In the pipeline we still have two more: Annex 27 "Quality Management in Design Construction and Operation of Borehole System" and Annex 30 "TES for cost-effective energy management and CO_2 mitigation".

We continue to have very good co-operation with other IEA bodies. My keynote presentation at IEA SHC Conference on "Status, Research Activities and Future Applications for Thermal Energy Storage" in Bejing, took place on 13-15 October 2014. Our vice-chair Hendrik Wust and Operating Agent of Annex 26 Christian Doetsch represented ECES at IEA Experts' Group on R&D Priority Setting and Evaluation – EGRD Workshop on Energy Storage on 22-24 October 2014.

Again in 2014, we reached out to new members and re-activated some existing (yet inactive) members. The Dublin Institute of Technology has completed formal procedures and has signed the Implementing Agreement as a sponsor. The United Kingdom is interested in re-activating their membership.

The preparations for our next tri-annual conference are under way. Greenstock - 13th International Conference on Energy Storage will be organized by China in Beijing on May 19-21, 2015. The next Stock Conference is decided to be held in Turkey in 2018.

I need to thank our delegate Elena Palomo del Barrio from France, alternate delegates for Sweden, Conny Ryytty and for Finland, Raili Alanen, who will be leaving our group. I hereby give a very warm welcome to our new delegates who have joined us in 2014: Paul Kaaijk, delegate from France, and Steffen Linsmayer alternate delegate from Germany.

Last but not least, I wish to thank all the members of our Executive Committee, our Operating Agents, the experts of Annexes, our secretary team Hunay Evliya and Yeliz Konuklu, and the IEA desk officer John Dulac each, for their invaluable contributions to the success of ECES.

Halime Paksoy, Chairman ECES

Ongoing Activities

In 2014 five Annexes were performed by ECES.

Table 1. Ongoing Annexes

Annex-No.	Title	Time Schedule	Operating Agent
21	Thermal Response Test	2007-2014	ZAE Bayern/ Germany
26	Electric Energy Storage: Future Storage Demand	2010-2015	Fraunhofer Umsicht/ Germany
28	Distributed Energy Storages for the Integration of Renewable Energies	2013-2016	ZAE Bayern, Fraunhofer Umsicht/Germany
29	Material Research and Development for Improved TES Systems	2013- 2015	ZAE Bayern/ Germany
30	TES for Cost Effective Energy Management and CO2 Mitigation	2015-2018	DLR/ Germany
31	Energy Storage with Energy Efficient Buildings and Districts: Optimization and Automation	2014-2017	Concordia University/ Canada

Annex 28: Distributed Energy Storage for the Integration of Renewable Energies – DESIRE

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Overview of scope

A rapidly growing contribution by renewable energies to the overall energy production can be expected worldwide. Most renewables, like wind, PV or solar-thermal, are fluctuating resources. With increasing integration of renewable energies energy storage /energy balancing capacities are needed. So far the focus is on large, central and most cost effective energy storage technologies like pumped hydro or the conversion of surplus electricity into hydrogen. The potential and contribution of small and medium sized, distributed energy storage technologies to balance fluctuation caused by renewable energies is mostly unexplored. This Annex aims to answer the question of what can be the contribution of distributed energy storage on the integration of renewable energies in future energy systems.

Definition of »Distributed Energy Storage«

- Distributed energy storages (DES) can be defined by their location within an energy system. In this perspective DES can either be located
- at the consumer side (household up to small industrial application), or
- decentralized in the distribution grid, or
- at decentralized power generation sites (e.g. small biogas plant or single wind mill).

Figure 1 visualizes the relation of DES on the consumer side including local renewable energy sources, including the possibility of DES being located directly at the renewable energy source. The distribution grid is placed on top of this tetrahedron to represent the connection to the higher grid levels with centralized power plants.

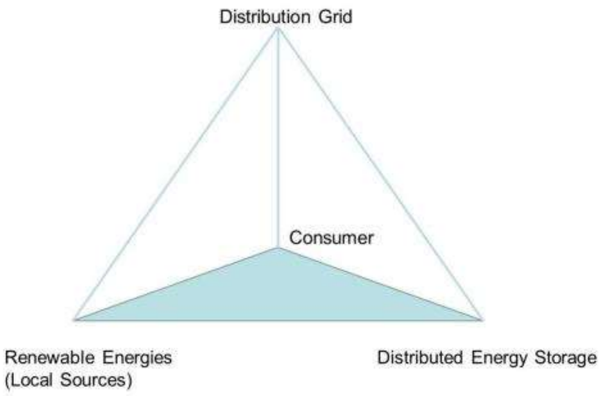


Figure 1: Configuration of distributed energy storage systems

This Annex focuses on the overall storage properties/characteristics and its impact for the integration and utilization of renewable energies, but not on R&D of storage technologies and its specific technological challenges. Several Annexes of the Implementing Agreement ECES dealt with both thermal and electrical energy storage technologies and their implementation in various applications. Recently Annex 26: “Electrical Energy Storage: Future Energy Storage Demand” investigated the demand of energy storage for different long term energy scenarios. Annex 28 will also lead to better coordinated international R&D activities. It will visualize and demonstrate possible synergies among the different system approaches.

The overall goal of Annex 28 is to foster the role of DES and to better evaluate the potential storage capacities for the integration of renewables at an economical competitive level. To reach this goal, distributed energy storage technologies and their properties will be examined, storage properties requirements depending on the different renewable energy sources will be reviewed and possible control and operation strategies for DES and technologies by smart grids will be studied. Finally the potential of DES systems for the integration of renewable energies based on the actual final energy demand shall be quantified and guidelines for choosing the most suitable DES technology for the actual application will be developed. Best practice and success stories examples will be given.

The scope of this Annex includes all energy storage technologies suitable on the consumer side. Three main fields of application – households, trade and commerce and industry – will be investigated. The Figure 2 shows these fields and the typical electric power range.

Contracting Parties or Sponsors participating and representing institutes

Country	Institutes
Germany	ZAE Bayern (OA), Fraunhofer UMSICHT (OA), Fraunhofer ISE, Inkubator Leuphana, Forschungsstelle für Energiewirtschaft e.V., E.on Innovation Center Energy Storage, Bosch & Siemens Hausgeräte GmbH, GP Joule GmbH
Denmark	PlanEnergi
Spain	University of Lleida
Sweden	KTH Stockholm
The Netherlands	TNO - Business Line Manager
Turkey	Cukurova University, Arcelik A.S. R&D Center

Activities / Achievements

Due to the interdisciplinary nature of this Annex an extensive task-definition process was necessary. A number of new participants was attracted and initial discussions about the work plan and the internal structure of the activity were held.

As a result the activities in this Annex are structured in Sub-Tasks. This Annex does not focus on energy storage technologies, but on current typical energy storage applications/systems. These energy storage applications/systems were defined as “energy storage solutions” in the following.

The four Sub-Tasks are shown in figure 2.

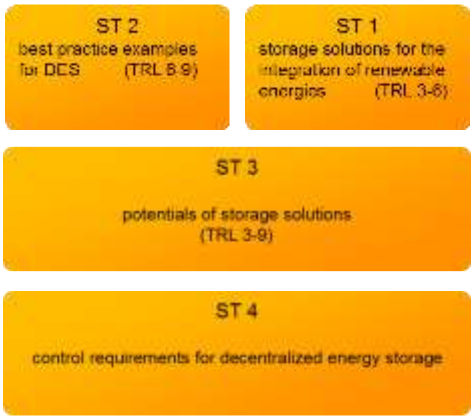
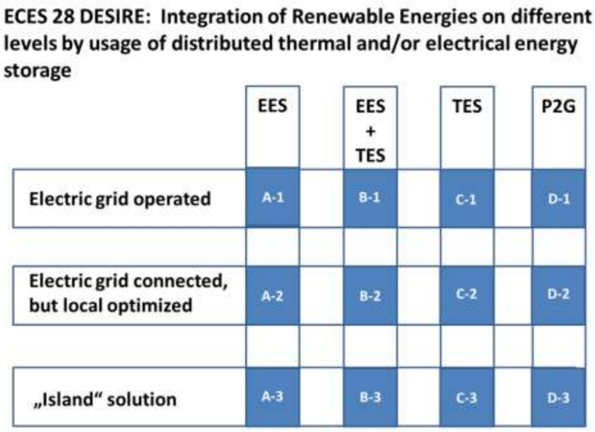


Figure 2: The 4 Sub-Tasks of the Annex

In Subtask 1 storage solution in ongoing R&D projects (TRL 3-6) are presented and discussed, while in Subtask 2 best practice examples of DES (TRL 6-9) are listed and described. Based on this inventory from both subtasks, Subtask 3 has to identify the general potential of DES solutions (TRL 3-9) in different countries. In this Subtask also realized or potential business cases are reported. Subtask 4 is focused on the necessary control requirements for the operation of DES solutions, especially when operated in order to provide flexibility measures for the grid. This Subtask will have a strong connection to smart grid activities e.g. the ISGAN Implementing Agreement.

Classification Scheme for »Distributed Energy Storage Technologies«



ECES 28 DESIRE: Integration of Renewable Energies on different levels by usage of distributed thermal and/or electrical energy storage

	EES	EES + TES	TES	P2G
Electric grid operated	A-1	B-1	C-1	D-1
Electric grid connected, but local optimized	A-2	B-2	C-2	D-2
„Island“ solution	A-3	B-3	C-3	D-3

Figure 3: Classification of DES solutions

In order to classify the ongoing R&D projects as well as best practice examples the following structure will be applied (see figure 3). Three levels of grid integration of the DES were put in place. Four different energy storage technologies configuration were defined.

In the vertical categories electrical energy storage (A), thermal energy storage (C) and a combination of both (B), as well as chemical energy storage/power 2 gas (D) are considered.

For the classification of the different ongoing projects, different levels of integration in the grid were defined. Solutions with no connection to the distribution grids are referred to as "'Island' solutions" (level 3). The category "Electric grid operated" (level 1) refers to system configurations delivering grid services like grid balancing etc.. The last category "electric grid connected, but locally optimized" (level 2) represents storage solutions that are connected to distribution grids, which instead of providing grid system services are optimized for the local application.

At the first two experts meetings the main question was formulated:

"What can be the contribution of distributed energy storages to the integration of renewable energies in future energy systems?"

A classification scheme for storage technologies as well as a subtask structure and its contents were discussed and approved. The workplan was updated and subtask leaders (for ST 1-3) were appointed.

At the workshops 8 presentations were given on new developments of DES (from phase-change-materials in fridges to quick-charging devices for electric vehicles). Also 8 presentations came from best practice examples, dealing with huge hot water storages in Denmark to the model region on the island of Pellworm (Germany). The latter example includes distributed Li-Ion batteries as well as re-dox-flow-systems and thermal energy storage for wind and PV integration.

Figure 4: Distributed electrical storages at Pellworm

Annex 29: Material Research and Development for Improved TES Systems

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Overview of scope

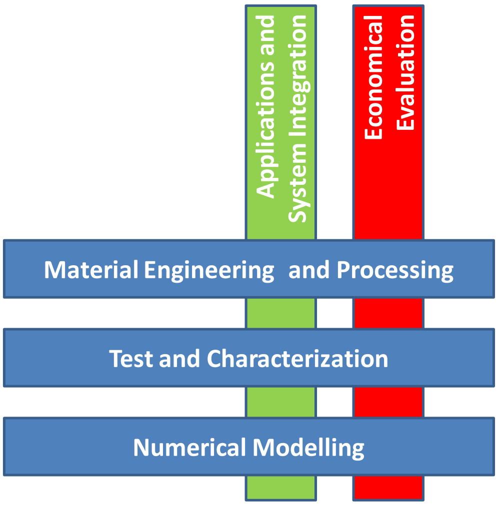
The overall goal of this task is to develop advanced materials and systems for an improved performance storing thermal energy. Therefor new materials and composites for compact thermal energy storage should be identified, designed and developed. For these materials measuring and testing procedures have to be put in place in order to characterize their potential performance within actual storage applications. The material requirements for relevant applications should be proofed, by means of numerical simulation on the material micro-scale as well as on the system level. Finally the impact of new materials on the performance of thermal energy storage in the different applications should be assessed.

A secondary objective of this task is to further expand and intensify the collaboration between material researchers, system developers and industry working in the field of thermal energy storage.

This task deals with advanced materials for latent and chemical thermal energy storage. The activities include the material scale as well as the system level. This task will include multiple application areas from cooling to heating and domestic hot water or to high temperature applications in industry and power generation.

The Task is organised in a matrix-like structure. Such a structure

- maximises the interaction between materials researchers and application experts
- maximises knowledge exchange between groups working on adjacent topics
- gives the task an organisational structure that reflects the different emphasis in this Annex



The horizontal axis represents materials-related categories. It is divided into groups of similar activities:

- Materials engineering and processing,
- Test and characterisation,
- Numerical modelling

The vertical axis represents application and system related categories. This Annex will focus on system integration for actual applications and the predicted performance under application conditions. Finally the economical evaluation of new developed materials shall be evaluated

Each category corresponds to a Working Group. Each Working Group is coordinated by a Working Group Leader.

Contracting Parties or Sponsors participating and representing institutes

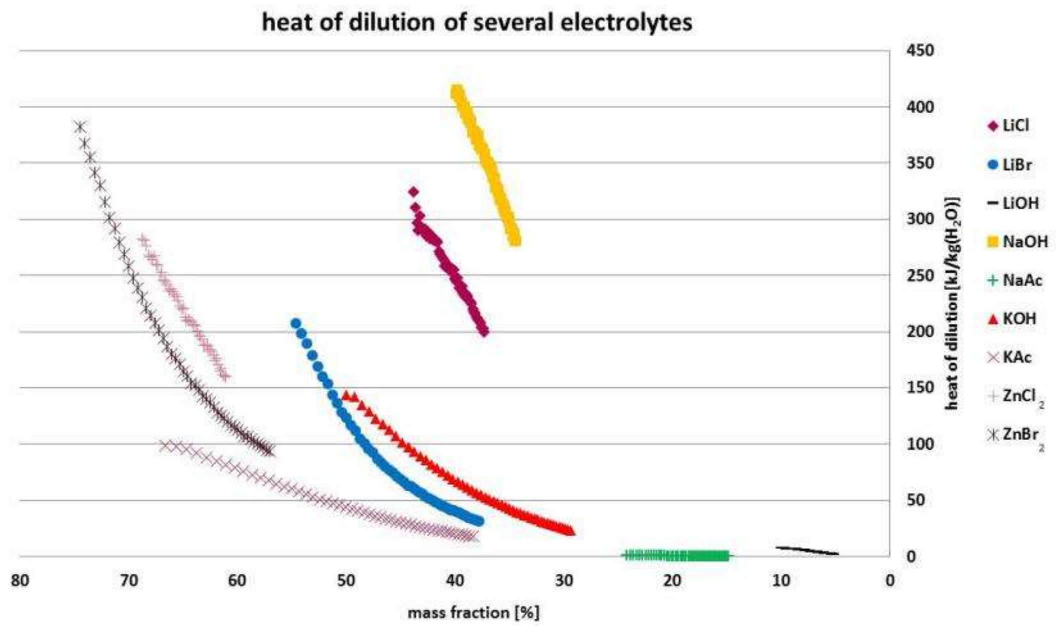
Country	Institutes
Germany	ZAE Bayern, Fraunhofer ISE
France	University of Bordeaux
Japan	Chubu University
Slovenia	National Institute of Chemistry
Spain	University of Lleida
Sweden	Royal Institute of Technology
Turkey	Çukurova University

Activities/Achievements

In 2014 two workshops and experts meeting were held in Lyon, France, and Nagoya, Japan. At these meetings over 70 participants gave over 30 presentations on their ongoing R&D activities.

Within the Working Group on material engineering and processing new candidates for high capacity storage were investigated. As an example figure 1 shows the heat of dilution of several electrolytes which can be utilized for thermal energy storage.

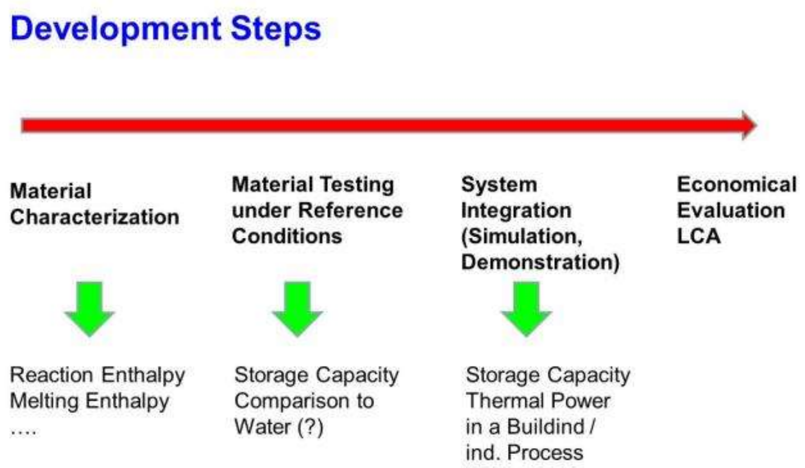
Figure 5: Heat of dilution of several electrolytes for thermal energy storage



In 2014 a materials database could be established. It has 3 different material categories Phase-Change-Materials (PCM), Thermo-Chemical-Materials (TCM) and Ad- and Absorption materials.

In order to provide standard test procedures for PCM and TCM, methods were developed to characterize new materials within this Annex. A first draft of a standard "Measurement procedure Phase Change Materials Task 4229" was delivered.

One of the goals of this Annex is to identify a method how to develop new material with respect to an actual application. Therefor a first testing under application conditions is planned (after the basic characterization of the material). Operation conditions of relevant applications will be defined as reference conditions for this testing stage. The figure below shows schematically the different development steps in this process.



After the material testing under reference conditions a first evaluation of the new materiel (and comparison to any other TES technology) is possible.

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Annex 31: Energy Storage with Energy Efficient Buildings and Districts: Optimization and Automation

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Overview of scope

The large scale electrical grid is becoming increasingly powered by renewable sources and increasingly experiencing issues caused by their inherent intermittency, leading to curtailment of renewable generation and associated costs. Installation of smaller scale renewable generation at the district or building level is restricted by the capacity of the local electrical grid to accept excess generation. The ability of low energy buildings to act as energy storage (ES) nodes to buffer these fluctuations (and potentially gain a financial benefit) is the key to increasing renewable electricity generation at all scales. ES technologies are then a central element of designing and operating energy efficient building (EEBs) and districts and are needed for efficient use of energy resources and dealing with the intermittency of energy supply and demand.

To effectively meet the concept of EEBs, whether or not this is achieved using district energy resources, ES has a vital role to play due to the intermittency in energy demand against the transient cost or availability of energy resources. Further research is needed to develop efficient and reliable design approaches and operating strategies for storage in conjunction with thermal and electrical energy produced on-site in buildings and districts, and to support intermittency in the external grid.

The general objective of this Annex is to address the integration, control, and optimization of energy storage with buildings, districts, and/or local utilities. The focus will be on the development of design methods/tools, optimization, and advanced control strategies for effectively predicting, evaluating, and improving the performance of EEBs and districts when energy storage is available.

Contracting Parties or Sponsors participating and representing institutes

Country	Research Group
Canada	Concordia University, Public Works Government Services Canada, Laboratoire des Technologies de l'énergie d'Hydro-Québec
China	Hunan University, Southeast University
Czech	Brno University of Technology
Estonia	Tallinn University of Technology
France	ENTPE-University of Lyon, University of Savoie, University of Lyon – CETHIL, University of Strasbourg, University of Toulouse
Italy	Politecnico Di Milano, Università degli Studi di Torino
Japan	University of Tokyo
Slovenia	University of Ljubljana
Turkey	Çukurova University
UK	Cambridge University, University of Strathclyde

Activities/Achievements

Two expert meetings were held in 2014. An international Technical Forum was organized at each meeting with invited talks and open panel discussions on topics related to the integration thermal energy storage with energy efficient buildings.

The First Expert meeting and Technical Forum was held in Lyon-France on June 18-20, 2014 where 17 presentations were given and *over* 60 participants attended. The Second Expert meeting and Technical Forum was held in Milan-Italy on October 16-18, 2014 where 15 presentations were given by the Annex members and other researchers: 36 participants attended this meeting.

An extensive review of the literature work has been carried out over the period of the Annex. It was agreed that to publish the outcomes as a special issue of the Int. journal of Energy and Building.

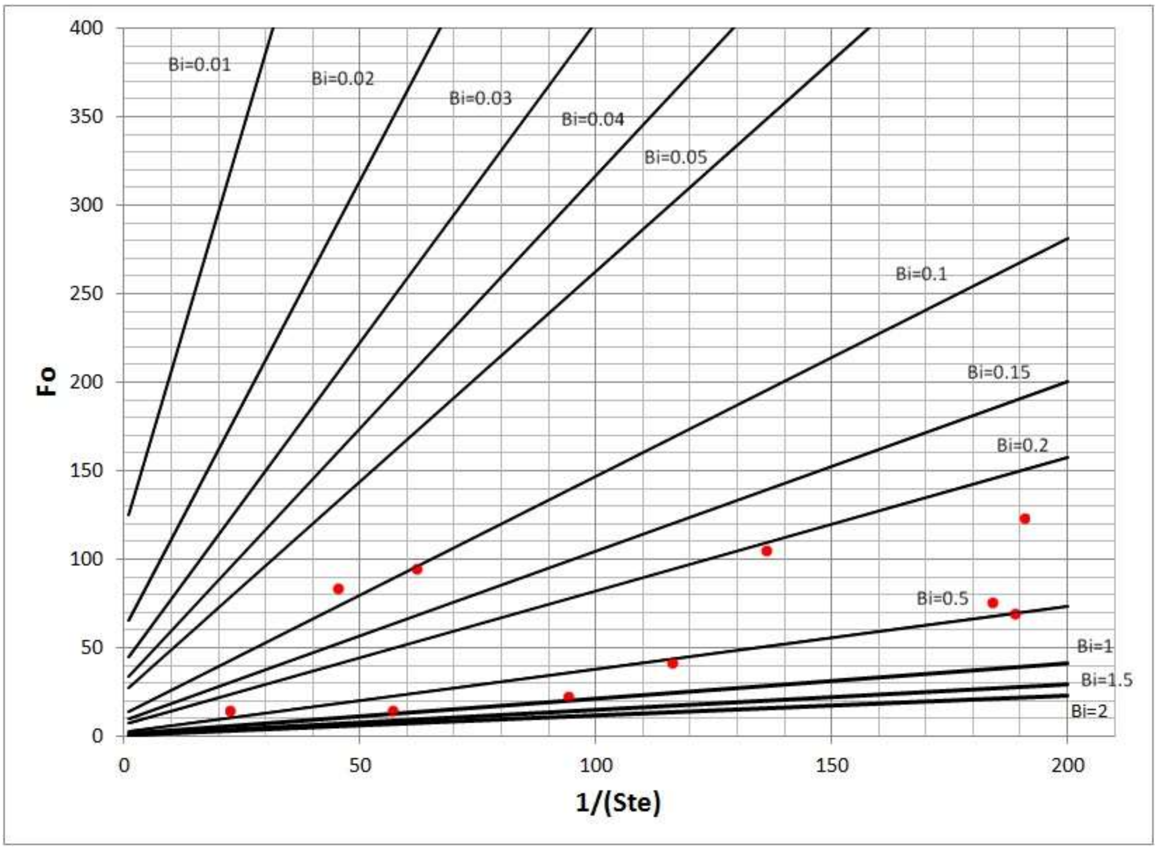
Application of Phase change material in building envelope: design tool

The building envelope integrated with PCM can provide latent heat thermal energy storage (TES) distributed in its entire surface area and inhibit the enhanced thermal mass in lightweight buildings. Selecting the most appropriate PCM wallboard based on its thickness and thermo-physical properties is the main target and requires a practical design tool.

Considering the shift of space conditioning energy to off-peak hours, the design tool needs to calculate the installation thickness of PCM wallboard to satisfy the following objective: PCM wallboard be fully charged (complete its phase transition from one phase to another regarding the heating or cooling application) during a pre-set time period known as design off-peak period. Therefore, the tool requires to evaluate the effect of the thermos-physical properties of PCM, the charging time and the room temperature evolution on the heat transfer phenomena of the wallboard.

According to Bastani et al. (2014) the temperature evolution inside a PCM wallboard is a function of the following dimensionless numbers: $\theta_{PC} = f(Bi, Fo, X, Ste)$

Figure: Here, "Fo=(PCM conductivity*charging time)/(PCM density*PCM specific heat*PCM thickness2)", "Ste-1=(PCM latent heat/PCM specific heat* 1°C melting range)", and "Bi=(Room heat transfer coefficient* PCM thickness/ PCM conductivity)"



These dimensionless numbers consists of the effective parameters on the charging procedure of the PCM wallboard including its thickness. The correlation between those dimensionless numbers is the tool to calculate the best and most efficient installation thickness of a PCM wallboard. Considering Heisler chart as the base chart for non-PCM wallboard, the char was expanded to include PCM wall-boards as well. Consequently, a number of charts were developed to consider all the possible PCM wallboard with different thermos-physical properties. As a sample, for all materials with a similar melt-ing temperature and melting range the following chart can be utilized to calculate the best thickness of a PCM wallboard.

The chart can be modified through some extra correlations to be utilized for other PCM wallboards with other melting temperature and melting range.

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New Annexes

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

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Duration Annex 27

June 2015 – May 2018

Overview of Scope

In many countries in Europe, in North America and Asia the market for underground thermal energy storage (UTES) for heating and cooling and especially for ground source heat pumps (GSHP) was growing rapidly in the last years. The technologies applied are depending on the local geological situation either aquifer based systems (ATES or groundwater heat pumps) or based on borehole heat exchangers (BTES or heat pumps with BHE's). The field of application covers a wide range from family homes for heating or cooling to large commercial buildings for heating and/or cooling and very large BTES for seasonal storage of heat (e.g. in solar district heating systems, cogeneration …).

The overall objectives of the proposed annex are, based on the background described above, to avoid mistakes in design and construction failures related to the borehole system. Information and knowledge collected should serve as a basis for national and international standards. This will make BTES technically safer, more cost effective and will strengthen the future usage of this technology. Consequently the knowledge and confidence of the regulation bodies in this technology should be enforced to avoid ineffective restrictions resulting in increasing costs.

The specific objectives are:

- Collect and compile national standards and guidelines for BTES/BHE for heating and cooling
- Analyze national design procedures and construction methods

- Identify and investigate problems of the design and construction phases
- Work out handbooks and guidelines for design and construction in order to avoid future mistakes
- Investigate operational failures
- Work out preventative guidelines for monitoring, maintenance and rehabilitation measures
- Identify related problems in order to establish further R&D

Activities

A task definition workshop is planned in September 2015.

New Annexes

Thermal Energy Storage for Cost-Effective Energy Management and CO_2 Mitigation

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Duration of Annex:

July 2015 - June 2018

Overview of Scope

Thermal energy storage as a cross-cutting technology can contribute significantly to various sectors in order to shape a future energy system based largely on renewable energies and utilizing energy more efficiently. As diverse as the applications are the technologies and thermal energy storage systems that fulfill such requirements. Cost efficiency and quantifiable benefits within existing processes are pre-requisites to pave the way for market introduction of storage systems.

The general objective of this Annex is to develop a methodology for characterization and evaluation of thermal energy storage systems for industrial and power plant applications, non-residential buildings and transport in terms of technical, economic and environmental aspects. This methodology will be applied to various case studies originating from demonstration projects, where thermal energy storage systems are realized in an industrial environment. Thus, the most promising possibilities for integration of thermal energy storage systems to achieve cost-efficient thermal management and CO2 mitigation will be identified.

Activities/Achievements

On August 25, 2014 the pre-definition meeting was held in Stuttgart, Germany with the participation of Spain, Sweden, Japan and Germany. Following presentations of potential contributions to Annex 30, the focus of the future work plan was discussed. It was decided to cluster the work in this Annex into three areas of activity: (1) definition of requirements, (2) methodology for characterization and evaluation and (3) application – case studies. Overall, five subtasks were defined. Four subtask leaders have been identified and are representing the countries of Germany, Japan and Spain for subtasks 1&5, 2 and 3, respectively. A schematic of the work plan is depicted in figure XX. This work plan was approved by the Executive Committee XC 78 in November of 2014.

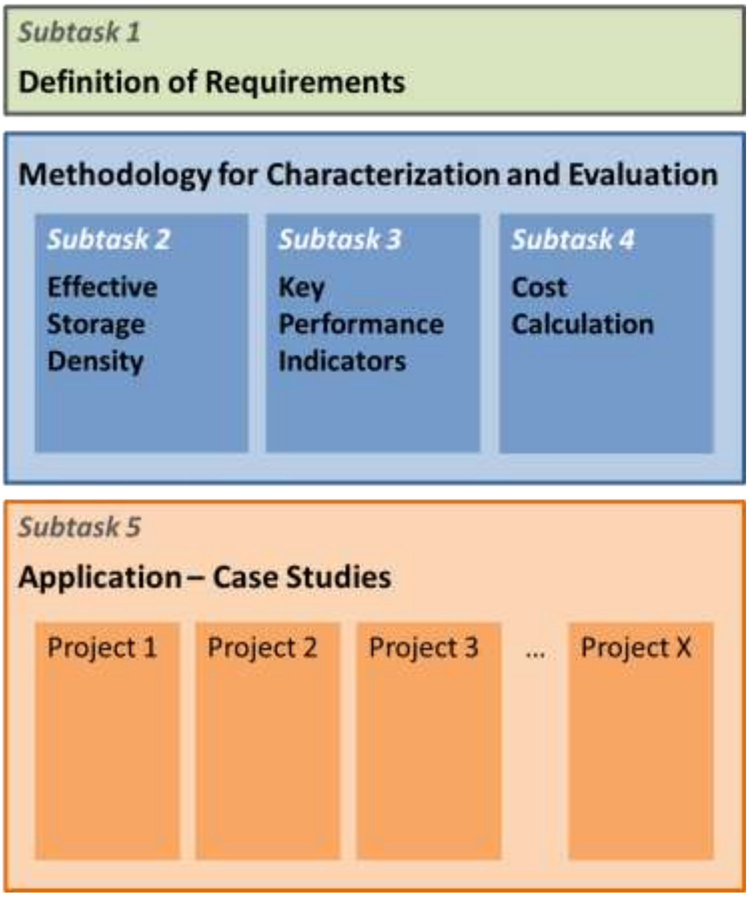

Figure XX: Schematic of the work plan of Annex 30

Further Activities

Conferences

GreenStock 2015

The next tri-annual conference, 13th International Conference on Energy Storage will be organized by China in Beijing on 19-21 May 2015. ECES delegates will participate in the International Scientific Committee.

Executive Committee Meetings

The Executive Committee had two regular meetings during the year 2014. The 77th XC was in Amersfoort, The Netherlands on May 7-9, 2014 and the 78th XC was in Dublin, Ireland on November 5-7, 2014. The 2015 XC meetings will be as follows:

- Spring 2015: XC79 May 22, 2015, Beijing, China
- Fall 2015: XC80 November 4-6, 2015 in Aalborg, Denmark

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

- Participation at Building Coordination Group (January 20-21, 2014), Industrial Strategy Group (October 23, 2014), CHP/DHC Strategic Workshop (May 27-28, 2014) and Transportation Contact Group (April 15-16, 2014)
- IEA Technology Roadmap on Energy Storage was launched on March 2019. Available at http://www.iea.org/publications/freepublications/publication/name,36573,en.html
- Presented at the IEA EGRD Workshop on Energy Storage on 22-24 October 2014 in Berlin
- Joint annex with SHC IA: Task 42/Annex 29 Material Research & Development for Improved TES Systems
- Feedback from Storage Group within EC European Renewable Heating and Cooling Technology Platform – RHCTP
- Links to European Energy Research Alliance (EERA) Joint Programme on Energy Storage (EERA) and European Association for Storage of Energy (EASE)

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ECES Executive Committee Meeting, November 2014, Dublin, Ireland

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Energy Conservation Through

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