

INTERNATIONAL ENERGY AGENCY

ENERGY CONSERVATION THROUGH ENERGY STORAGE

A New Annex Proposal

Applying Energy Storage in Ultra-low Energy Buildings

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Introduction

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 buildings¹. 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. This will require that energy storage be intimately integrated into sustainable building design. Many past applications simply responded to conventional heating and cooling loads. Recent results from low energy demonstrations, distributed generation trials and results from other Annexes and IAs such as Annex 37 of the ECBCS IA, *Low Exergy Systems for Heating and Cooling* need to be evaluated. Although the ECES IA has treated energy storage in the earth, in groundwater, with and without heat pumps and storing waste and naturally occurring energy sources, it is still not clear how these can best be integrated into ultra-low energy buildings capable of being replicated generally in a variety of climates and technical capabilities.

Energy storage has often been applied in standard buildings that happened to be available. The objective was to demonstrate that the energy storage techniques could be successfully applied rather than to optimize the building performance. Indeed the design of the building and the design of the energy storage were often not coordinated and energy storage simply supplied the building demand whatever it might be.

Subtasks

This Task will consider the following four subtasks for study.

Subtask A: Coordinated national reviews of energy storage use in energy efficient buildings.

Subtask B: Collaborative evaluation of energy storage usage and proposed efficient systems based on Subtask A and other Annex results.

¹ An ultra-low energy building should have dramatically lower energy requirements than the minimum requirements of the building or energy code applying in the jurisdiction under consideration. For example, in Canada a 90% reduction in the energy use compared to the reference built to the Model National Energy Code for Buildings would be an ultra-low energy building.

Subtask C: Development of Sustainable Energy Storage Designs for a variety of ultra-low energy buildings using thermal, phase change materials and electrical storage options. Energy storage designs for the following building types would be examined:

1. A distributed electrical generation multi-unit residential building that stores cogenerated heat energy for multiple uses.
2. A renewable energy single family house
3. A small community that shares energy among various types of buildings and occupancies including residential, commercial and institutional.

Subtask D: Apply, monitor and evaluate demonstrations of these Designs in a number of countries and climates.

Schedule

Planning	July 2006	July 2007	
Subtask	Start	Finish	Result
A	July 2007	Dec 2007	National reviews
B	July 2007	Dec 2008	Proposed concepts
C	Jan 2008	July 2010	Sustainable designs
D	Jul 2008	July 2011	Monitored and evaluated applications

Objectives

The general objective of the Annex is to ensure that energy storage techniques are properly applied in ultra-low energy buildings and communities. Applications of these designs are foreseen in a post-Kyoto world where total CO₂ reduction is required. Proper application of energy storage is expected to increase the likelihood of sustainable building technologies.

Specific objectives include,

- assess the potential of harnessing natural energy sources to supply building heating and cooling through energy storage;
- assess the use of energy storage (electrical and thermal) to optimize the efficiency of distributed generation;

- develop and evaluate energy storage conceptual designs suitable for specific applications;

Results

Position energy storage techniques to respond to the needs of future buildings with very low energy and power requirements. This would include the use of natural energy from earth and water, waste energy from sources such as distributed generation and conventional storage technologies sized and modified to operate efficiently at customized temperatures and quantities.

Subtask A: Coordinated national reviews of energy storage use in energy efficient buildings.

- Standard reporting format
- National reviews of storage applications
- Design concepts used and practical results
- Database of National results

Subtask B: Collaborative evaluation of energy storage usage and proposed efficient systems based on Subtask A and other Annex results.

- Evaluation and inclusion of related findings from IAs on Buildings and Community Systems, Heat Pumps, District Heating and Cooling; Solar Heating and Cooling; and Energy Storage.
- Identification of obstacles to effective storage techniques.
- Recommendations for Subtask C designs.

Subtask C: Development of Sustainable Energy Storage Designs for a variety of ultra-low energy buildings using thermal, phase change materials and electrical storage options.

- Conceptual designs of ultra-low energy building types with energy storage recommendations.
- Case studies.

Subtask D: Apply, monitor and evaluate demonstrations of these Designs in a number of countries and climates.

- Design guidebook (electronic format)
- Collaborative designs and monitored results
- Web-site
- National Workshops

Scope

The Annex will cover:

- A variety of building types as selected by participants.
- New buildings.
- A variety of distributed electrical generation as selected by the participants from renewable technologies and fuel cells, Stirling engines, microturbines and engines.
- Small scale and distributed community energy systems.
- Various energy sources including natural energy sources and temperature ranges.
- A variety of climates as selected by participants
- Environmental impacts of systems

References

ASHRAE Strategic Plan March 2006

Annex 37 Low Exergy Systems for Heating and Cooling
Status: Completed (1999-2003); www.lowex.net