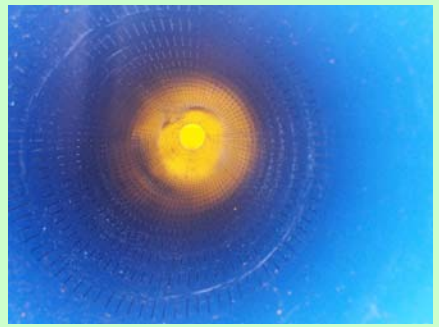
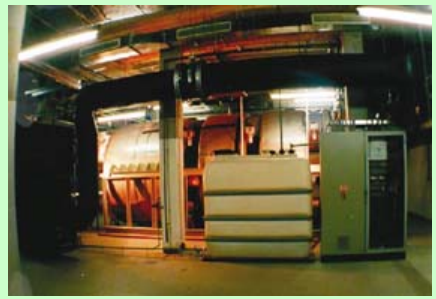
International Energy Agency

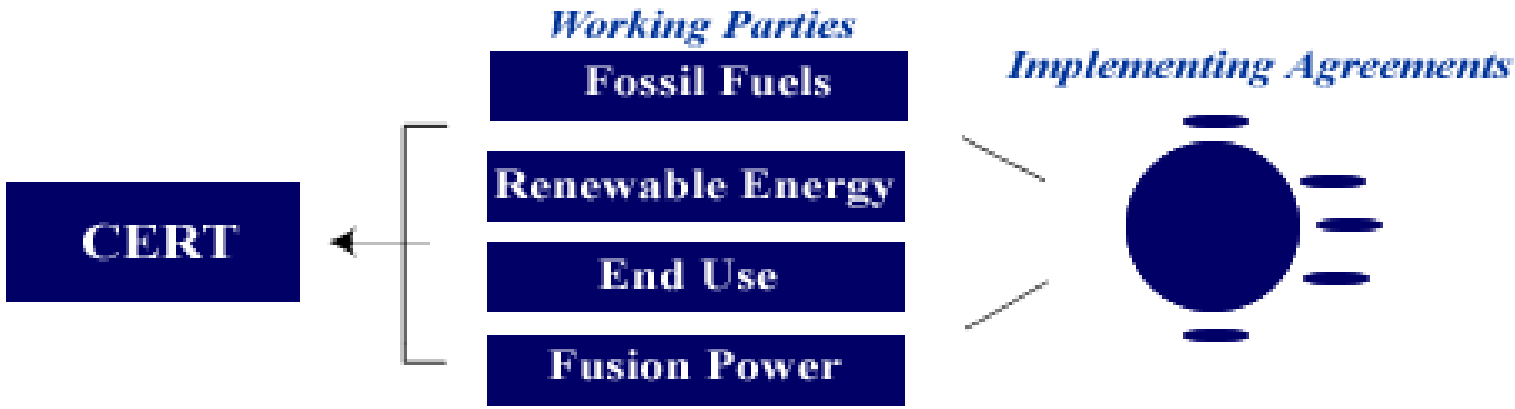
Energy Conservation through Energy Storage Programme





International Energy Agency IEA

IEA was formed by a group of OECD member states in 1974 after the first oil crisis. First aim was to set up a system to share available oil resources in times of supply crises. Later another focus was developed in the area of future of energy supplies and a number of research and information exchange programs have been established.

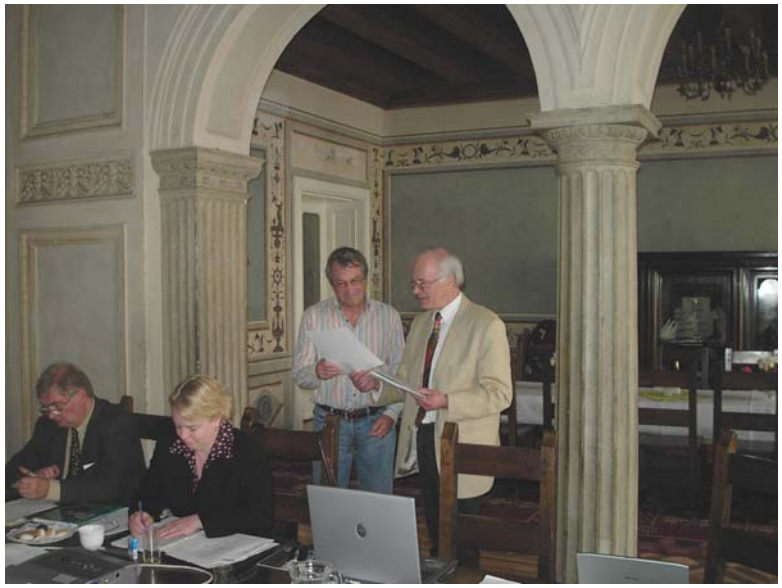


End Use Working Party

Implementing Agreements

Energy Storage (ECES)
Advance Fuel Cells
Alternative Motor Fuels
Buildings and Community Systems
Demand-Side Management
District Heating and Cooling
Electric Vehicles
Energy Conservation in Combustion
Heat Pumping Technologies
Heat Transfer and Heat Exchangers
High-Temperature Materials
High-Temperature Conductivity
Process Integration Technologies
Pulp and Paper

Energy Conservation through Energy Storage



The Energy Storage Programme is an R&D Agreement established in 1978 between a number of IEA countries with the aim of cooperative research, development, demonstrations and exchanges of information regarding energy conservation through energy storage.

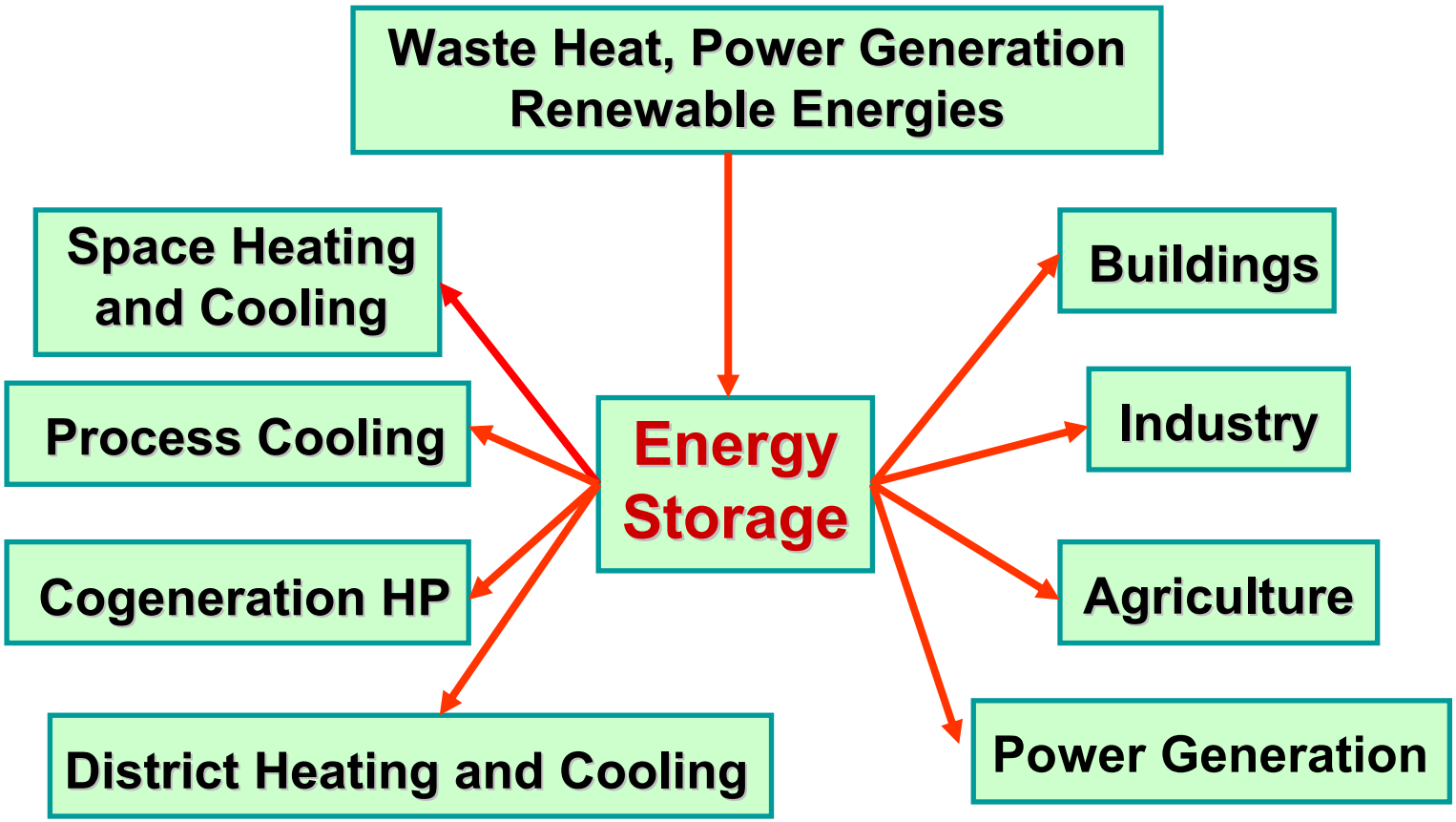
The full name reads: "**Implementing Agreement for a Programme of Research and Development on Energy Conservation through Energy Storage**". The separate activities put into execution within the framework of an Implementing Agreement, are called Tasks or Annexes

Introduction
"Energy Storage…another time and place"

- Energy is needed, but not always where it is available
- Storage of thermal energy (heat and cold)
- Storage of electrical energy (batteries)
- Seasonal storage (ice, renewable energies)

Introduction
"Energy Storage…another time and place"

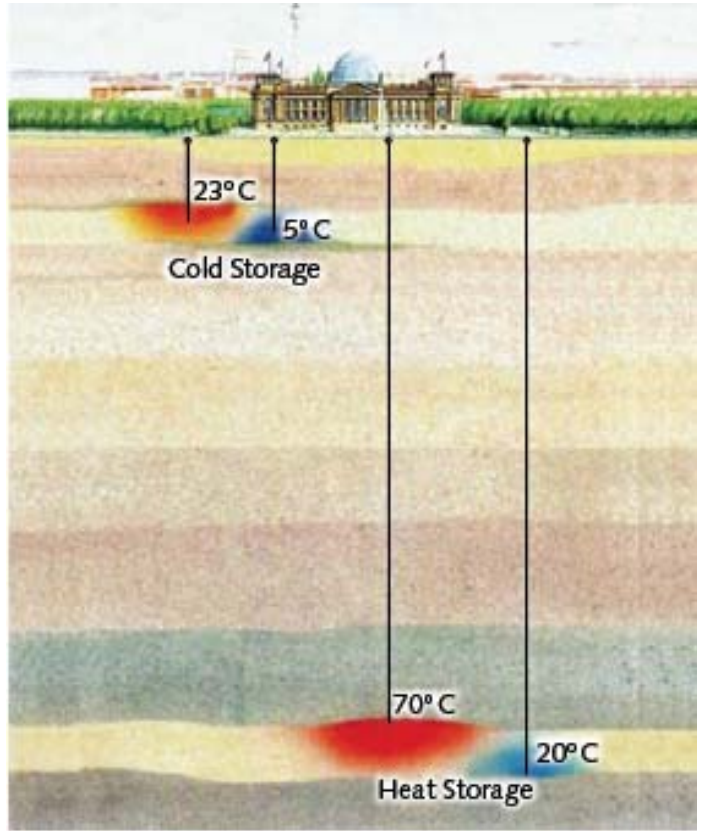
Energy Storage : central component in energy efficient systems



Introduction
"Energy storage technologies…a big variety "

Energy storage systems cover a wide range of different storage technologies for different applications

- Thermal or Electrical Energy Storage
- Storage Capacity (Wh-GWh)
- Charging / Discharging Power (W-MW)
- Storage Period (short-long term storage)



Motivation
"Energy conservation…the benefits of energy storage"

- Examples: Waste heat utilization, solar thermal, photovoltaics…
- Efficient use of fluctuating energy sources = energy conservation + reduction of CO_2 emissions
- Peak shifting (for hours or minutes) → no black-outs
- Energy storage: technical and economical interesting!



Mission

To research, develop, implement, and integrate energy storage technologies that optimize energy utilization by improving overall energy efficiency and economic growth, while benefiting the local and global environments.

Objectives

Technologies

- advance RD&D of energy storage technologies
- achieve significantly improved efficiency and cost-effectiveness

Environment

- evaluate and document the many environmental benefits of energy storage
- ensure that potential environmental problems are directly addressed
- avoid potential environmental problems by sound technical analysis and design techniques

Objectives

Market

- encourage the required steps be taken to achieve the proper application of proven energy storage technologies world-wide in various sectors:

  Commercial Industrial Agricultural

Information and Technology Transfer

- Assure that information developed in this Programme is availableto the target audiences in a useful and usable format
- Facilitate the greater storage technologies in developing countries

Thermal Energy Storage

Thermodynamics of the storage process:

- Sensible TES (Heating/cooling Storage medium)

  ≈ 100 MJ/m³ / 10 m³

- Latent TES (Phase Change Materials PCM)

  ≈ 300 - 500 MJ/m³ / 2,5 m³

- Thermochemical Reactions (e.g. Sorptions storages)

  ≈ 1000 MJ/m³ / 1 m³

Thermal Energy Storage

Sensible Thermal Energy Storage: Water Tanks and Underground TES

- Aquifer Thermal Energy Storage (ATES)
- Borehole Thermal Energy Storage (BTES)
- Cavern storage and pit storage (CTES)

Annexes: 1, 2, 3, 4, 6, 7, 8, 12 and 13

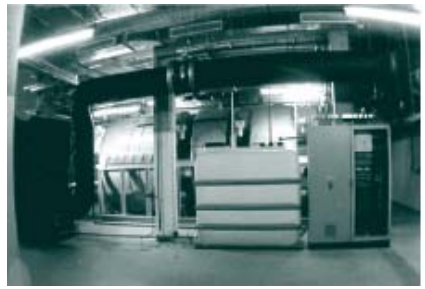
Thermal Energy Storage

Phase change materials and chemical reactions

- Advantages
  - Higher energy densities
  - Constant / adjustable discharging temperature
- Phase Change Materials
  - Praffins, salt hydrates, water / ice
  - Micro / macro capsules, slurries
- Chemical Reactions (Sorption Storages)
  - Solid / liquid sorbent materials
  - Open / closed systems

Annexes: 5, 10, 14, and 17






Participating countries and corresponding organizations

- **Belgium**, Ministry of Economical Affairs
- **Canada**, Public Works and Government Services Canada
- **Denmark**, Ministry of Energy
- **Finland**, Technology Development Centre TEKES
- **France**, TREFLE/CNRS
- **Germany**, Forschungszentrum Jülich GmbH
- **Italy**, Ente per le Nuove Tecnologie l' Energia e l'Ambiente (ENEA)
- **Japan**, Heat Pump & Thermal Storage Technology Center of Japan
- **Norway**, Geological Survey of Norway
- **Spain**, IBERDROLA, Madrid
- **Sweden**, FORMAS
- **Turkey**, Çukurova University
- **United Kingdom**, Department of Trade and Industry (dti)
- **United States of America**, Department of Energy
- **IF Technology** (The Netherlands), as a sponsor
- **Institute of Heat Engineering** of the University of Technology Warsaw (Poland), as a sponsor

Interested Countries (Non IEA Members)

- **Korea**: Observer at 63rd ECES Executive committee meeting in Beijing
- **India**: Expert meetings and workshops in Annex 10 and Annex 17
- **China**: Expert meetings and workshops in Annex 17 and Annex 20, ECES Executive committee meeting planned in April 2007

Ongoing Annexes

- Annex 18 **„Transportation of Thermal Energy Utilizing Thermal Energy Storage Technology“**, 2006 – 2009, member countries: **Sweden**, Germany, Japan

- Annex 19 **„Optimised Industrial Process Heat and Power Generation with Thermal Energy Storage“**, 2006 – 2009, member countries: **Germany**, France

Ongoing Annexes

- Annex 20 **„Sustainable Cooling with Thermal Energy Storage“**, 2005 – 2008, member countries: **Japan**, Canada, Germany, Sweden,Turkey

- Annex 21 **„Thermal Response Test for Underground Thermal Energy Storage“**, 2007 – 2010, member countries: Germany, Sweden, Japan and Turkey

Planned Annexes

- Energy Storage Applications in Closed Greenhouses

- Applying Energy Storage in Ultra-low Energy Buildings

Information Dissemination and Technology Transfer

- Workshops in conjunction with Annex Experts Meetings
- Int. Conferences on Thermal Energy Storage
  - TERRASTOCK 2000: Stuttgart, Germany
  - FUTURESTOCK 2003, Warsaw, Poland
  - ECOSTOCK 2006, Pomona, New Jersey, USA
  - EFFSTOCK 2009, Stockholm, Sweden (planned)

EFFSTOCK 2009

Thermal Energy Storage for Energy Efficiency and Sustainability

The 11th International Conference on Thermal Energy Storage

Please contact the ECES Implementing Agreement!

- Internet homepage www.iea-eces.org

Achievements

- Technological progress: UTES, PCM and thermochemical storage
- Technical and economical feasibility to implement energy storage technologies
- Data and information base on energy storage technologies (Annex 10, 14, 17)
- Environmental benefits of energy storage technologies
- Development of national and international guidelines and standards for storage systems
- Development of design tools and computer models
- Continued technology transfer to industry and NMC and information dissemination

Thank you very much for your attention!

Is that all you saved from last summer? Energy Storage helps to conserve Energy and to protect the environment!