International Energy Agency Energy Conservation through Energy Storage Programme

since 1978

Halime Paksoy

IEA ECES Chair

Cukurova University, Turkey

Workshop on Integration of Renewable Energies by Distributed Energy Storage Systems

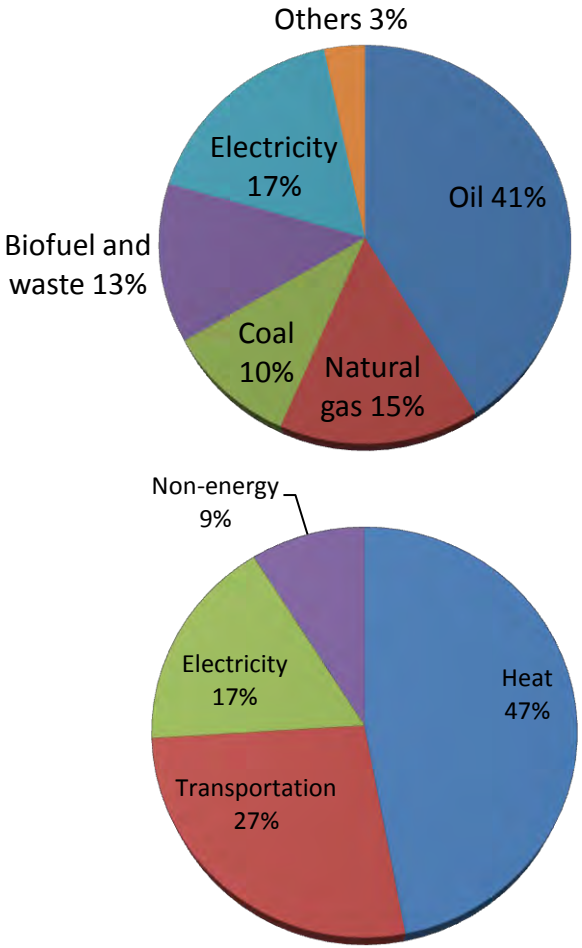
September 18-19, 2012, Paris

www.iea-eces.org

Energy SituationToday

- Fossil fuel dominant
- Heating and cooling has the largest share in final demand
- Dependence on imported fossil fuels increasing
- Oil and gas prices ever increasing

Total final consumption in the world in 2009*



* IEA, 2011

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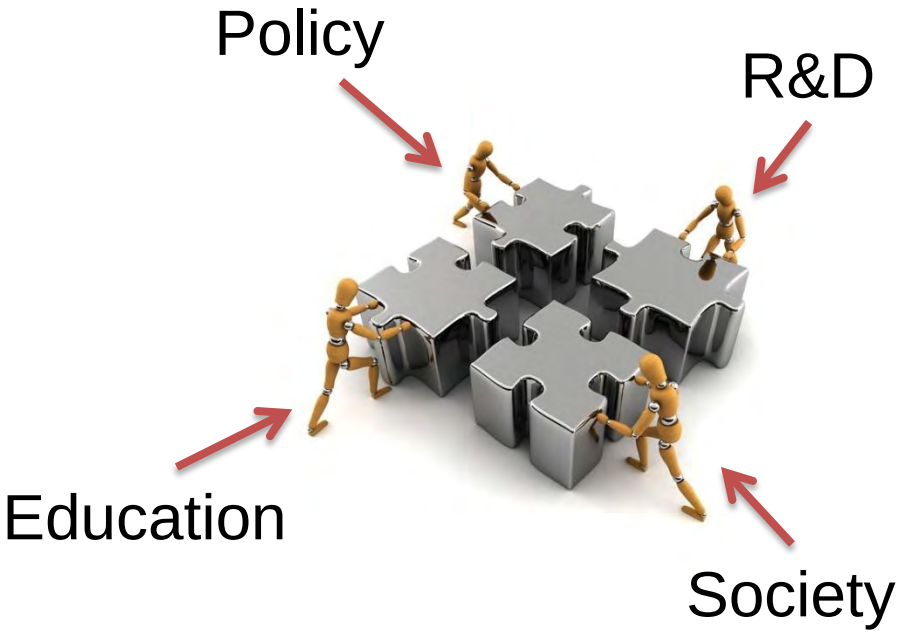
Future Challenge

How to dream of a
fossil fuel free society without
compromising our future?

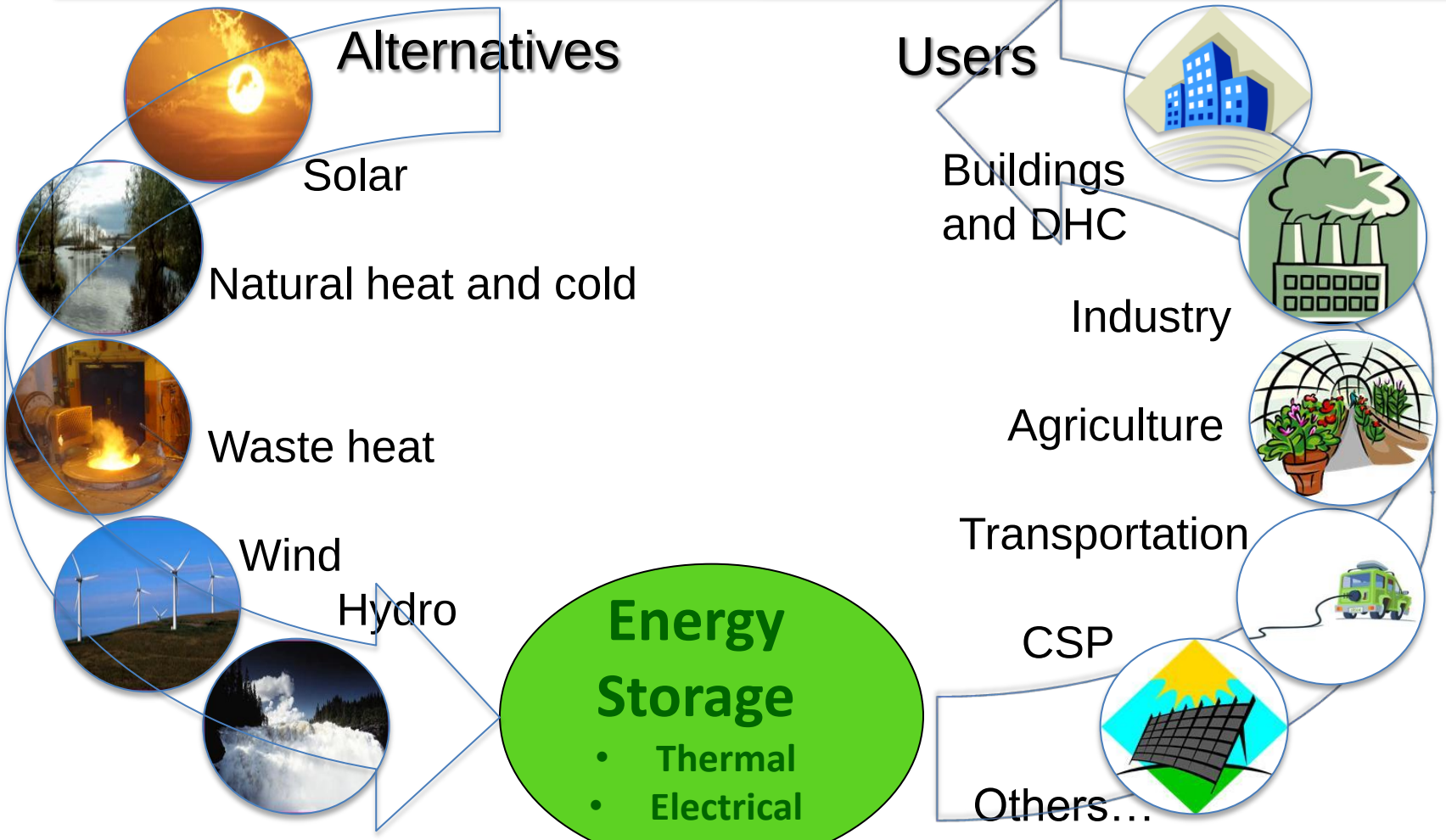


Alternatives to Fossil Fuels

- Renewables
  - solar, wind, biomass, hydro, geothermal
- Natural heat and cold
  - air, ground, surface water and oceans
- Waste heat from industrial processes

Most of these sources have an intermittent nature.

Energy Storage
Matching Supply and Demand



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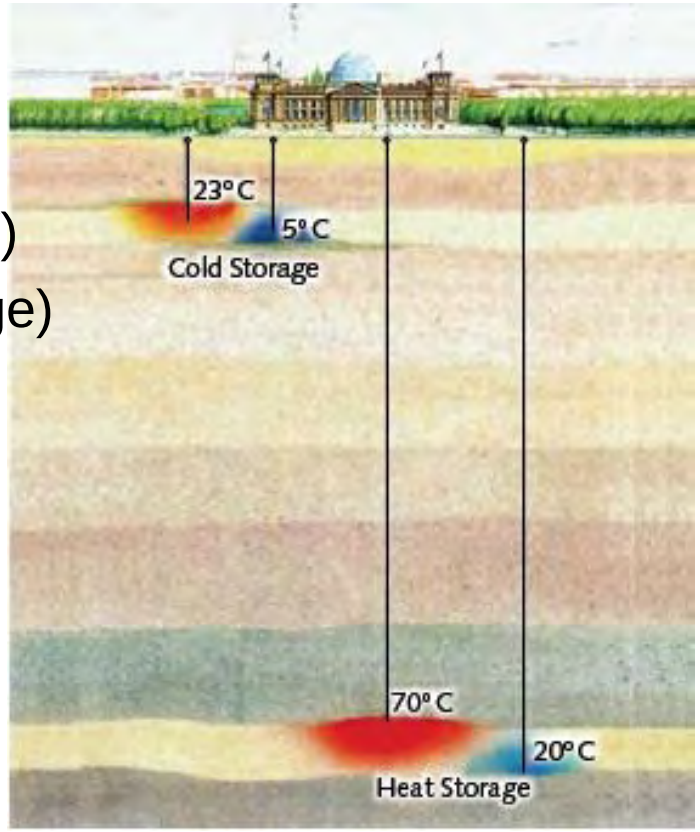
Energy StorageTechnologies

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)

Dishwasher



Parliament Building

Thermal Energy Storage (TES)

- Sensible TES (Heating/cooling Storage medium)

  Storage Capacity ≈ 100 MJ/m³
  Storage Volume for 1 GJ ≈ 10 m³

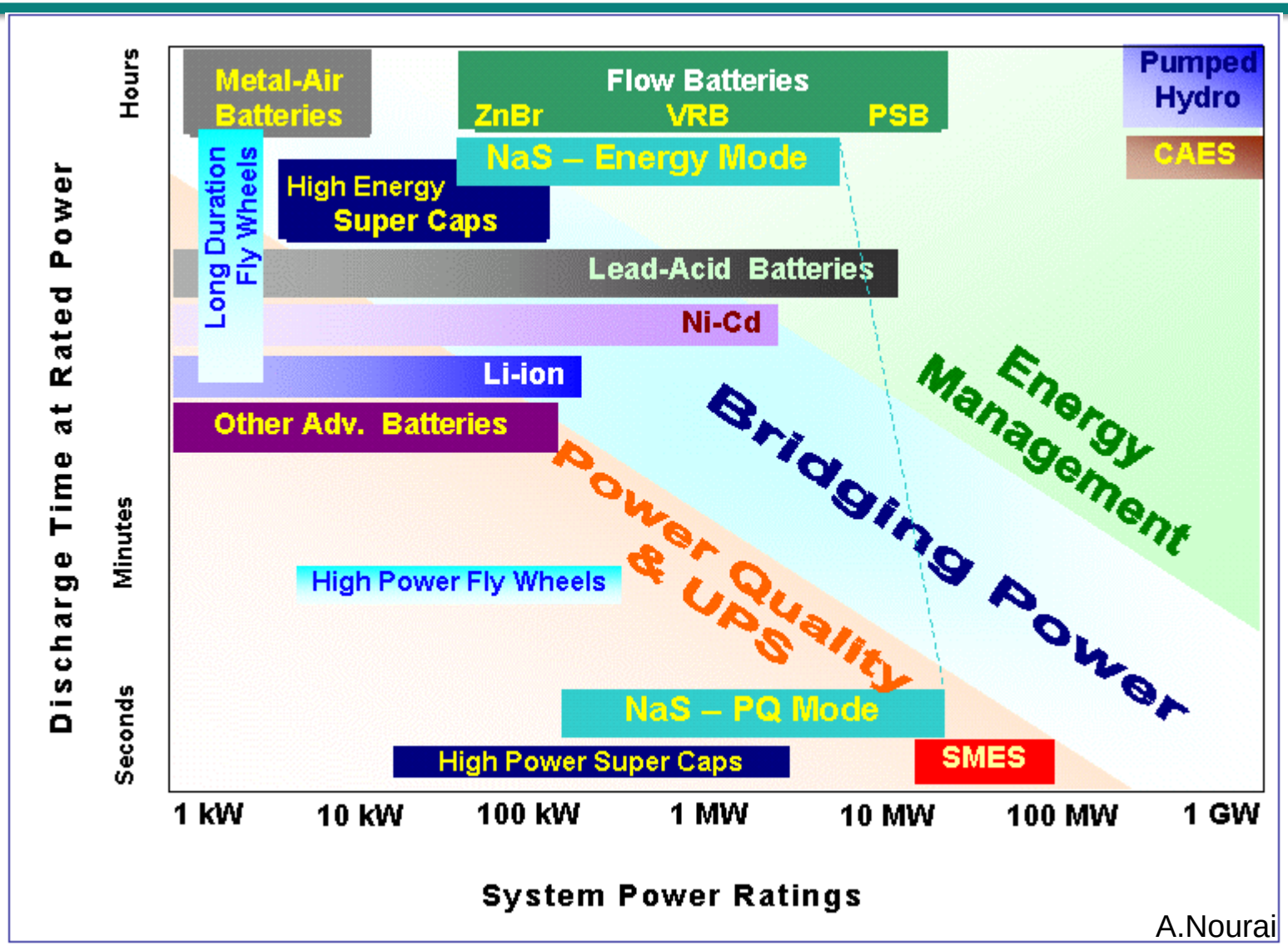
- Latent TES (Phase Change Materials PCM)

  Storage Capacity ≈ 300 - 500 MJ/m³
  Storage Volume for 1 GJ ≈ 2,5 m³

- Thermochemical Reactions (e.g. Sorption storages)

  Storage Capacity ≈ 1000 MJ/m³
  Storage Volume for 1 GJ ≈ 1 m³

Electric Energy Storage (EES)



A.Nourai

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Mission of ECES

"To facilitate an integral research, development, implementation and integration of ***energy storage technologies*** *to* ***optimize energy efficiency*** *in any kind of energy system and to enable the* ***increasing use of renewable energy*** *instead of fossil fuels."*

ECES Strategy Plan 2011-2015

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Participating Countries

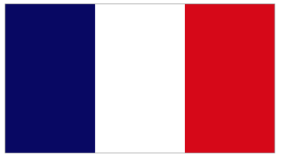
15 countries, 3 Sponsors


Belgium


Canada


China


Finland


France


Germany


Italy


Japan


Korea


Norway


Sweden


Turkey


USA


IF Technologies,NL


Institute of Heat Eng.
Univ of Tech Warsaw, PL


Univ of Lleida, ES


Slovenia


Denmark

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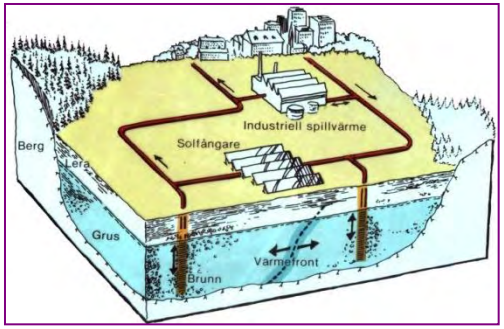
Thermal Energy Storage - *Sensible*

Sensible Thermal Energy Storage

- Water Tanks
- Underground Thermal Energy Storage (UTES)
  - Aquifer Thermal Energy Storage (ATES)
  - Borehole Thermal Energy Storage (BTES)
  - Cavern storage and pit storage (CTES)

Annexes: 1,2,3,4,6,7,8,12,13,20 and 21



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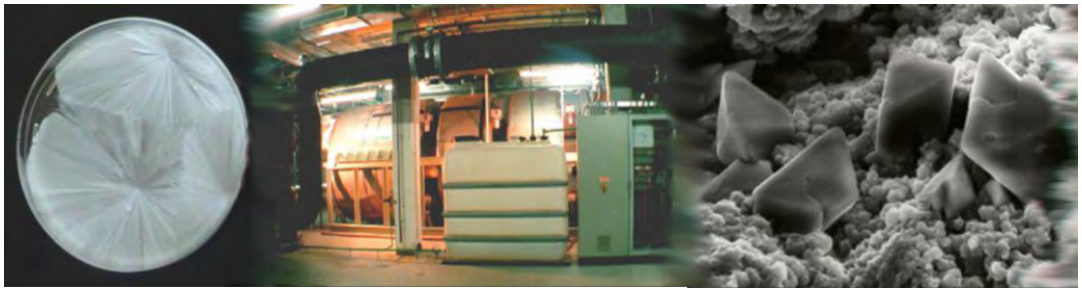
Thermal Energy Storage – *Latent and Thermochemical*

Phase change materials and chemical reactions

- Phase Change Materials
  - Paraffins, salthydrates, water/ ice
  - Micro/ macrocapsules, slurries
- Chemical Reactions(Sorption Storages)
  - Solid / liquid sorbent materials
  - Open / closed systems

Annexes: 5, 10, 14, 17, 20 and 24/42



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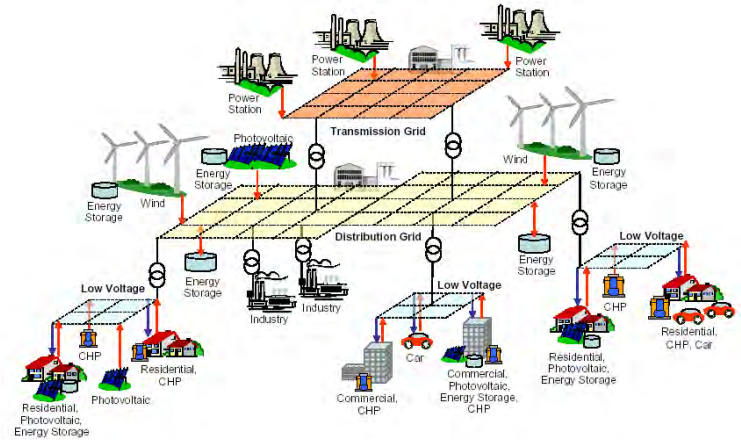
System Integration

Concept development and best practise

- Storage based concept for energy optimised buildings
- Storage demand for energy systems (general approach)

Annexes: 23, 26



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Completed Annexes in 2006 - 2010

Annex 18: Transportation of Thermal Energy Utilizing Thermal Energy Storage Technology

- Assessment of multifunctional fluids as pumpable TES
- Feasibility studies for transporting heat/cold via
  - train, truck or boat

Operating Agent: Sweden

Completed Annexes in 2006 - 2010

Annex 19: Optimised Industrial Process Heat and Power Generation with Thermal Energy Storage

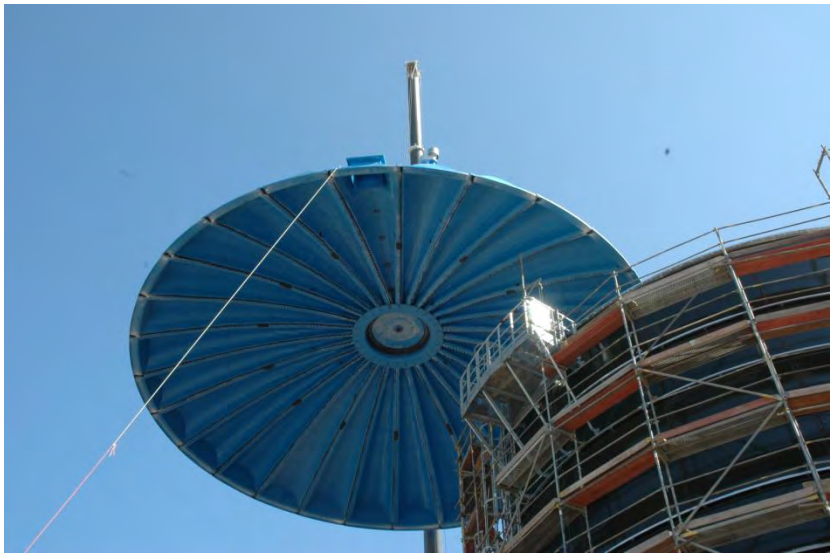
- Identification of possible near term economic applications of TES in the industrial sector
- Development of suitable technical solutions
- Estimation of market potential for industrial application and concentrated solar power

Operating Agent: Germany

Completed Annexes in 2006 - 2010

Annex 20: Sustainable Cooling with Thermal Energy Storage

- optimized integration TES in cooling systems
- evaluating sustainability of 20 demonstration projects from 8 countries
- performance evaluation with two or more design tools



Operating Agent: Japan

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Ongoing Annexes

Annex 21: Thermal Response Test for Underground Thermal Energy Storage

- Development of time and cost efficient methods
- Evaluation of experimental results and standardisation of test procedures

Operating Agent: Germany

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Ongoing Annexes

Annex 23: Applying Energy Storage in Ultra-low Energy Buildings

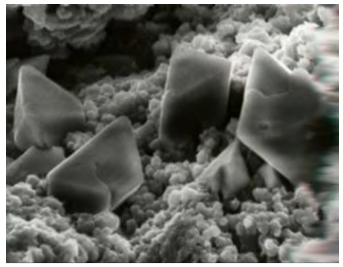
- Evaluation of energy storage use in energy efficient buildings
- Concept development and demonstration projects

Operating Agent: Canada

Ongoing Annexes

Annex 24: Compact Thermal Energy Storages – Material Development and System Integration (Joint Annex with SHC-IA)

- Defining criterias for evaluation of thermal energy systems and their potential
- Material development
- System integration



Operating Agent: Germany, The Netherlands

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Ongoing Annexes

Annex 25: Surplus Heat Management using Advanced TES for CO2 mitigation

- Identify and demonstrate cost-effective strategies for surplus heat management using advanced TES
- Increase awareness on potential of surplus heat utilization for CO2 mitigation

Operating Agent: Spain

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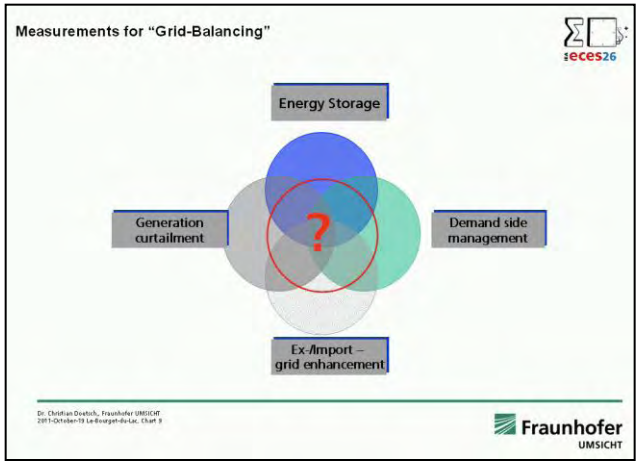
Ongoing Annexes

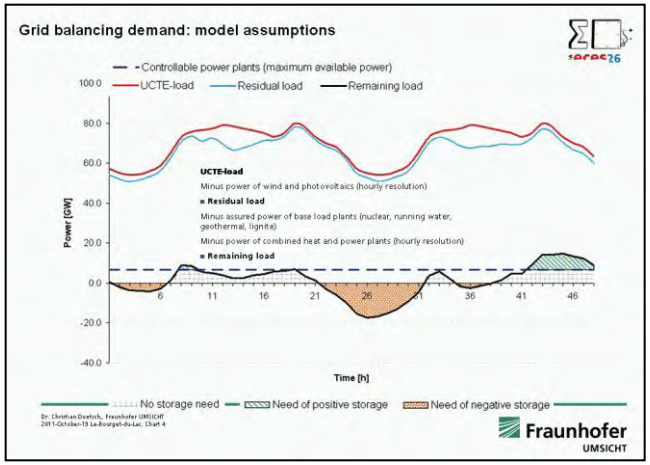
Annex 26: Electric Energy Storage: Future Energy Storage Demand

- Identification of typical (fluctuating) energy demand and production in a given area for different grid situations

- Calculation of energy storage demand as part of the total balancing demand to reach economic maximum
- Analysis and characterisation of different energy storage technologies

Operating Agent: Germany





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Achievements of IEA ECES
Introduction of UTES to Market

- Underground Thermal Energy Storage (UTES) become a standard design option in many countries:
  - Buildings,
  - Airports,
  - Greenhouses,
  - Hospitals,
  - ……

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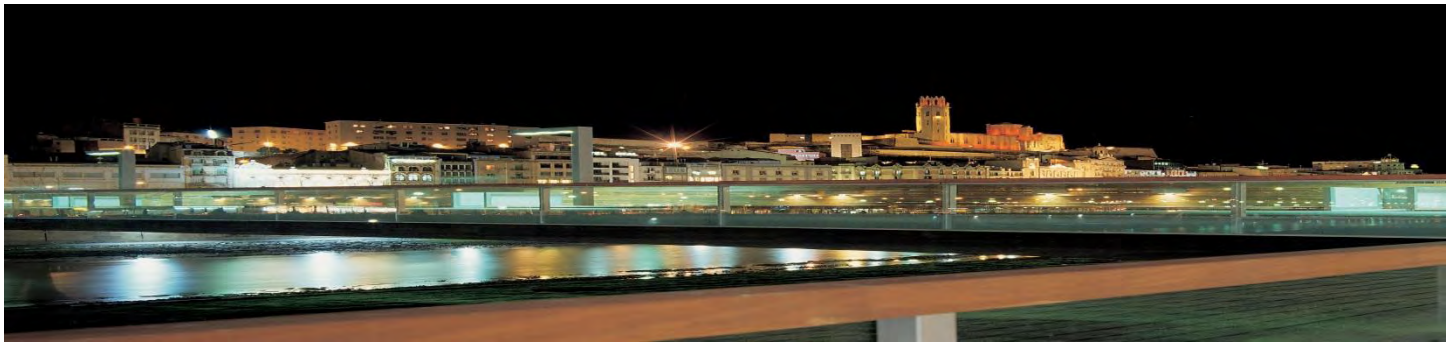
Achievements of IEA ECES

- Thermal Response Test –TRT: “Door opener for BTES”

Achievements
Information Dissemination

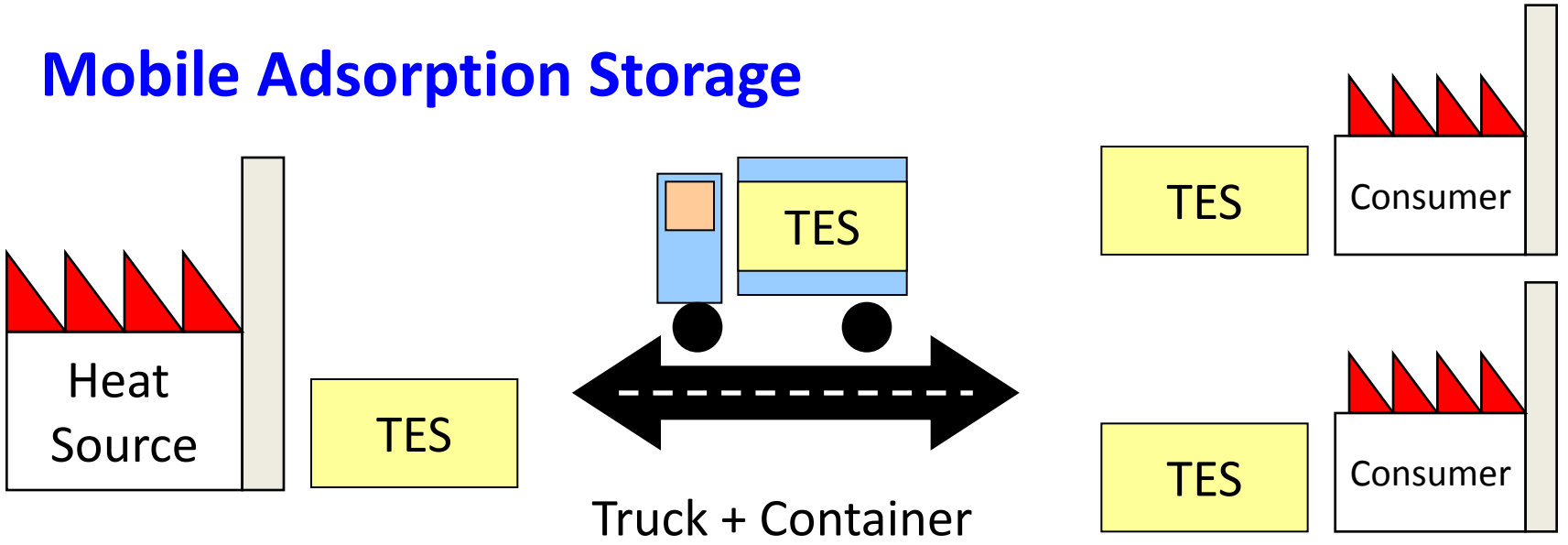
- Workshops in conjunction with Annex Experts Meetings
- Organization of International Tri-annual Conferences on Energy Storage for the past 30 years : Storage Olympics
  - TERRASTOCK 2000: Stuttgart, Germany
  - FUTURESTOCK 2003, Warsaw, Poland
  - ECOSTOCK 2006, Pomona, New Jersey, USA
  - EFFSTOCK 2009, Stockholm, Sweden
  - INNOSTOCK 2012, Leida, Spain



Achievements of IEA ECES

Waste heat on wheels

Mobile Adsorption Storage



- **Industrial Waste Heat**
- **Waste Incineration**
- **CHP Plants**

- **Process Heat**
- **Heating**
- **Drying**
- **…**

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Achievements of ECES

Waste heat on wheels

Mobile Adsorption Storage

Waste Incineration
(Charging Temp. 150 ° C)

Material Zeolite / 13 t
Capacity max. 3 MWh
Power max. 1 MW

Drying Process
(Dischar. Temp. 180 ° C)

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New Annexes

Annex 27

Quality Management in Design, Construction and Operation of Borehole Systems

Learn from experiences and don't make a mistake twice!

- Compile national standards and guidelines for BTES/BHE
- Identify and investigate problems of the design and construction phases
- Work out handbooks and guidelines for design and construction
- Investigate operational failures
- Work out preventative guidelines for monitoring, maintenance and rehabilitation measures

Operating Agent: Germany

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New Annexes

Integration of Renewable Energies by Distributed Energy Storage (DES) Systems

- Identifying possibilities to integrate fluctuating renewable energy sources into future energy systems
- Focusing on decentralized energy storage technologies including mechanical, electro-chemical, thermal and chemical approaches
- Defining storage properties requirements depending on the different renewable energy sources (wind, PV, solar thermal)

Operating Agent: Germany

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Motivation for the New Annex on DES

Requirements for the Modern Grid*

- Digitization of society:

  Increased power quality

- Environmental concern:

  Dispatchable renewables

- Growth in energy consumption:

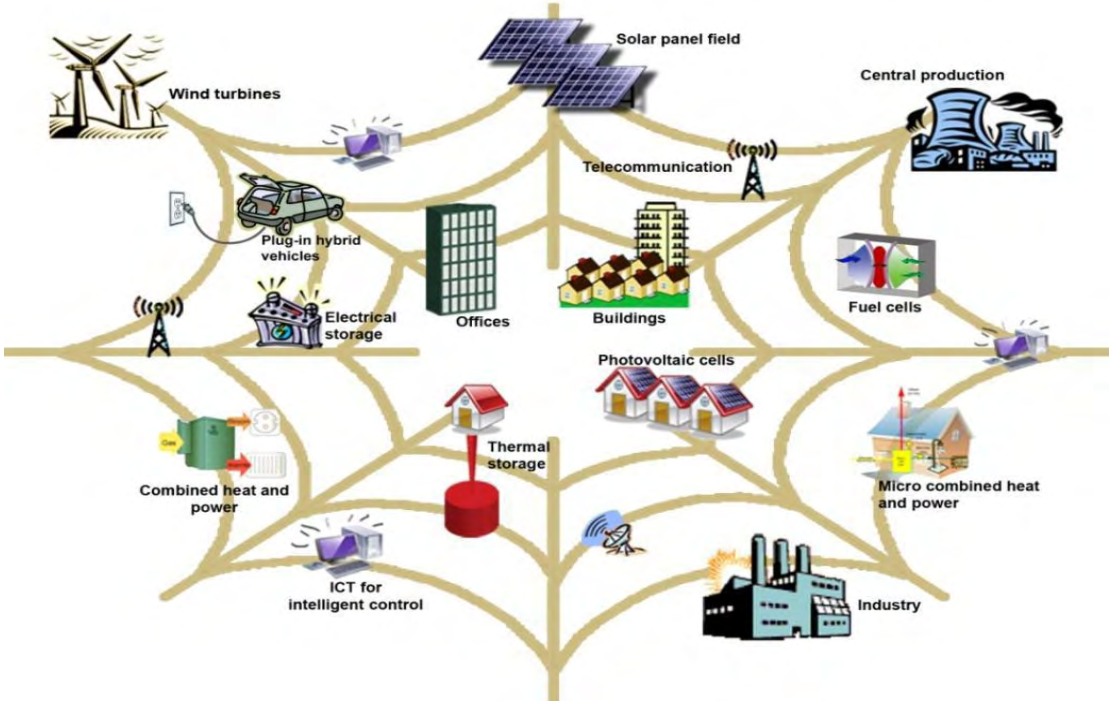
  Increased asset utilization

- Security :

  Uninterupted supply

* I. Gyuk

Distributed Energy Storage



TES and/or EES

- Which
- When
- Where

Maximizing the overall efficiency to meet final energy demand.

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ECES
Benefits and Impact

- Global collaboration for efficient energy use and energy conservation
- Numerous projects utilizing renewable energy sources
- Mitigation of CO_2 emissions
- Information dissemination and technology transfer

Energy Storage is one of the key technologies of Future Energy Systems.

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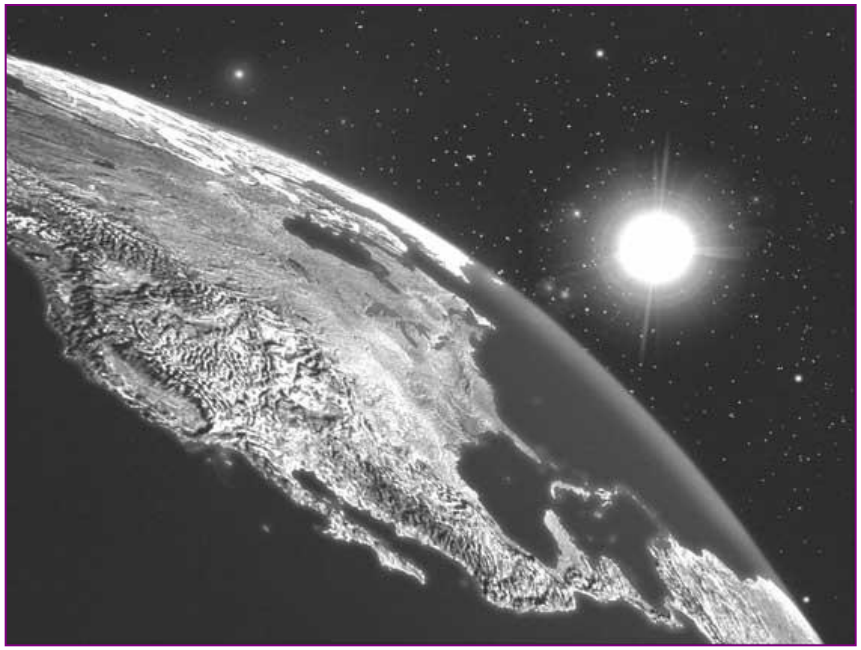
The world is to face ever tougher years – financially and environmentally. Rapid action must be taken now.

EARTH

CAN'T

WAIT !



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1973
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