THERMAL ENERGY STORAGE

A PERSONAL VIEW and
A FEDERAL PERSPECTIVE

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EcoStock 5-31-06
International Conference on Thermal Energy Storage:

STES/CAES Conf., Seattle, 1981

Internat. Conf. on Subsurface Heat Storage in Theory and Practice, Stockholm, 1983,

# 10 – Ecostock, Stockton, 2006
Beauty fades
Empires crumble
But Science persists

Ulugh Beg, Astronomer
and Prince of Samarkand,
ca. 1440
Energy Storage is essential for the Development of Living Cells, Animals, and Human Civilization.
Energy Storage in the Neolithic Revolution:

Domestic Animals

Pottery for Grain Storage

Permanent Houses
Sensible Heat Storage at Çatal Höyük, ca. 6500BC
The same Design on a Different Continent
Thermal Storage Indoors:

The Tiled Stove

Kachelofen

Kakelugn
Salzburg 1570

Sweden, 18th century
Thermal Storage in a Featherbed
Latent Heat
For Cooling

Ice Storage in Maybod, Iran

and in Boxborough, Massachusetts
Melt down
Norwegian ice exports to:

Britain

Germany

1860 65 70 75 80 85 90 95 1900 05 10 15

0 50 100 150 200 250 300 350
'thousand tons
Thermal Storage Program at U.S. Dept. of Energy

Established at ERDA

1977 – funding peak

1990 – phased out
DOE Research:

Pioneering Experiments in Aquifer Thermal Storage

- Auburn, 1976
- Minnesota, 1982
- Tuscaloosa, AL, 1982
Latent Heat Storage for Cold

- Ice Storage
- Frozen Earth
- Sublimation
- Clathrates
Thermal Storage for Buildings and Industry

- Bricks for batch processes
- Crosslinked Polymers
- Latent Heat Panels
The Federal Perspective:
Global Concerns
and A Gridside View
Growing U.S. Electricity Consumption
U.S. Energy-Related Carbon Dioxide Emissions, 1980-2030 (million metric tons)

History
- AEO2005
- AEO2006

Projections

metric tons per million dollars of GDP

Annual Energy Outlook 2005 and 2006
Buildings account for:

36 percent of Total Energy use,

65 percent of Electricity Consumption,

30 percent of Greenhouse Gas Emissions
A Mandate for Passive Thermal Storage

Technologies to reduce Consumption of Energy particularly from Fossil Fuels are urgently needed
CAISO May 24, 06: Load – Available Generation
When Load exceeds Supply,
Rolling Blackouts must be imposed
Peak Loads also cause
Transmission Congestion
CAISO Daily Peak Loads 2000 / 2001
Load Duration Curve

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**Peak Demand without Energy Storage**

**Peak Demand with Energy Storage**
A small Amount of Storage or DG will have a disproportionate Effect on electricity prices, pollution and grid stability.
To encourage more widespread Use of Thermal Storage (and DG) Utilities should introduce a number of Measures. State and Federal Agencies should support these:
- Time of Use Pricing
- Interruptible Rates
- Aggregation for Customers <1MW
- Buyback Programs
- Direct Subvention, Tax Reduction
Thermal Storage has an important Role in the Emergence of a new Architecture, the Stability of the Grid, and a cleaner World.