



TES SYSTEMS AND CHP SYSTEMS
CEM REFRESHER TRAINING
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FOR ENERGY MANAGEMENT AND EFFICIENCY PROFESSIONALS







THERMAL ENERGY STORAGE TECHNOLOGY - 3
FOR ENERGY PROFESSIONALS
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ENERGY SPECIALIST CURRICULUM





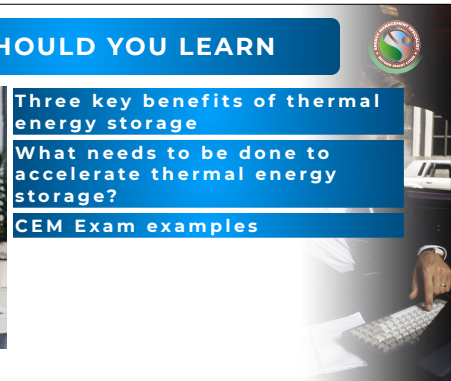
WHAT SHOULD YOU LEARN



Three key benefits of thermal energy storage

What needs to be done to accelerate thermal energy storage?

CEM Exam examples



THREE KEY BENEFITS OF THERMAL ENERGY STORAGE



- ✓ Reduce peak demand and level demand by storing energy when there is less demand and releasing when there is high demand.
- ✓ Reduce CO₂ emissions and costs by making sure energy is used when it is cheaper and there is more renewable energy in the mix.
- ✓ Increase the overall energy efficiency of energy systems.
- ✓ Thermal energy storage is also a key part of peak shaving systems, where off-peak power is used to drive heat pumps that can produce heat or cold produced by cheaper electric power and waste heat from industrial sources in order to balance energy system loads.

USING DISTRICT ENERGY SYSTEMS FOR THERMAL STORAGE



Modern district energy systems have a flexible thermal infrastructure where available energy sources can be “plugged in”. The energy, in the form of hot or chilled water, can then be distributed to buildings via a pipe network for immediate use or be stored in thermal storages for later use.

The thermal energy can be stored for a few hours or days, for example in heat storage tanks, or for several months in large pits or other storage facilities. In this way, district energy system can provide flexibility to the energy system in two ways: by providing storage and by enabling switching between different energy sources for example, large-scale heat pumps, waste heat, solar thermal storage and geothermal.

HOW CAN A SUPERMARKET BE USED FOR THERMAL STORAGE?



A supermarket has a high thermal capacity due to the amount of food which needs to be chilled or frozen. In effect, this means a supermarket has the potential to become a ‘virtual power plant’ simply by adjusting its electricity consumption.

Most supermarkets are energy managed by a central controller connected to multiple cooling cases to control temperature levels.

A supermarket can choose to lower the temperature of its freezers when energy is abundant in the grid. This energy is then stored in the frozen goods. When energy supply is lower or demand is higher, the supermarket can again slightly – and safely – raise the temperature while using less energy.

DIGITALIZATION IS IMPORTANT TO MAXIMIZE THE POTENTIAL OF THERMAL ENERGY STORAGE



Digitalization is one of the major keys to unlocking the potential of more energy efficient, resilient and sustainable energy systems.

In the heating and cooling sector, digital technologies will help manage the increasingly complex district energy systems that are being created by integrating a multitude of intermittent renewable and low carbon energy sources as well as connecting thermal and electricity infrastructures.

This is why digitalization is so important to efficient thermal energy storage: Using sensors, IoT and AI it is possible to smartly predict energy supply and demand, the share of renewables in the energy mix, plus energy prices - and the ability to adjust energy use and the use of thermal energy storage accordingly.

WHAT NEEDS TO BE DONE TO ACCELERATE THERMAL ENERGY STORAGE?



✓ A regulatory framework should support the creation of decentralized energy systems that encourage systems integration and the use of waste heat, heat pumps, smart heating and cooling systems, and energy storage.

✓ Mainstreaming of sector integration in other policies and frameworks should be encouraged, as most climate and energy policies are sector specific and do not support interaction between sectors.

✓ We need to ensure that electricity prices reflect the energy mix to encourage the uptake of renewables - for example, through CO2 pricing.

✓ We must ensure that power price incentivizes or rewards energy storage. For example, electricity should be cheaper when there is a lot of renewable energy and more expensive when there is not, and it should be attractive to store and sell back energy to the grid.

CEM REVIEW PROBLEMS



1. TES systems yield large energy savings. A) True B) False

2. Distinguish between full and partial storage systems. Which would likely be better in new system design?

3. Why are utilities encouraging TES?

CEM REVIEW PROBLEMS

6. With a load leveling TES strategy, a building manager will
(A) Not operate the chiller during peak hours
(B) Essentially base load the chiller (i.e., operate at high load most of the time)
(C) Operate only during the peak times
(D) Operate in the "off" season
7. A large commercial building will be retrofitted with a closed loop water to air heat pump system. Individual department meters will meter costs to each department. Demand billing is a small part of the total electrical cost. Would you recommend a TES?
(A) Yes (B) No

TES ADDITIONAL - ANOTHER STORAGE MEDIUM

- ☒ There is one more storage medium that is available, but it is almost never used. It is Eutectic Salt.
- ☒ Eutectic salt was used some in the 1970s and early 1980s for storage of heat, but its use for air conditioning is not common today. But, it could be used.

EUTECTIC SALT STORAGE

- ☒ Expensive, high tech solution
- ☒ Allows use of existing 6 degree C chillers
- ☒ Typical melt range is 5 to 8 degrees C
- ☒ Requires only 30 to 50% of the space needed for chilled water tanks
- ☒ Requires secondary heat exchanger
- ☒ May be considered hazardous The salt has a useful life of about five years, and must then be sent back and replaced

STORAGE CAPABILITY OF EUTECTIC SALTS



- ✓ Eutectic salts use latent heat associated with freezing and melting, but one kg of solid eutectic salt absorbs only about 115 kJ to become liquid.



SUMMARY OF STORAGE TANK SIZING THESE ARE REAL WORLD, PRACTICAL NUMBERS – NOT FOR USE ON CEM TEST



- ✓ Chilled water .12 to .15 cubic metres per kWh
- ✓ Eutectic salt .03 to .05 cubic metres per kWh
- ✓ Ice .025 to .035 cubic metres per kWh



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SMART CITIES



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