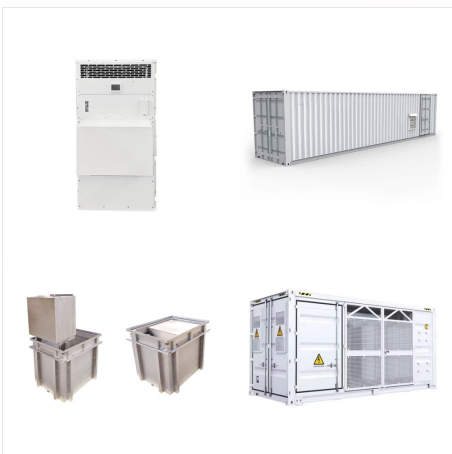




??? Smaller system, screw or scroll??? tanks  
downstream Chiller in downstream position: ???  
Decreases chiller efficiency ??? Decreases chiller  
capacity ??? Increases ice capacity (reduced  
number of tanks?) ??? Tank capacity benefit is  
substantial ??? Larger system, centrifugals??? tanks  
upstream S.I.C.



Thermal energy storage systems utilize chilled  
water produced during off-peak times ??? typically  
by making ice at night when energy costs are  
significantly lower which is then stored in tanks (Fig.  
2 below).



1. LCOS, the levelized cost of storage, compares  
the lifetime cost of batteries vs. the lifetime cost of  
thermal energy storage?u?. 2. At six to eight hours,  
thermal energy storage also has a duration that is  
three to four times longer than batteries. ???3. This  
finding has several key implications.

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



Thermal energy storage tanks take advantage of off-peak energy rates. Water is cooled during hours off-peak periods when there are lower energy rates. That helps owners avoid the cost of installing a new cooling tower, chiller, and ???

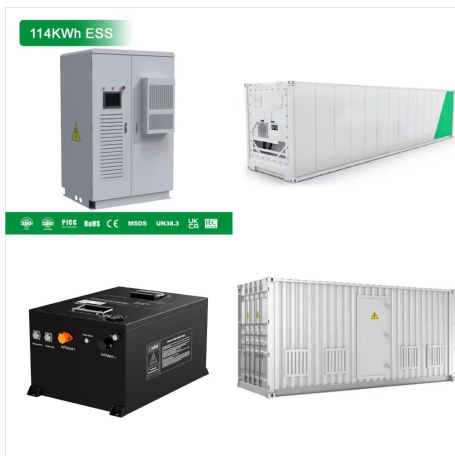


During discharging mode TES Tank will augment the chiller capacity to satisfy peak demand. Why Thermal Energy Storage CiNQ has been consistently delivering Thermal Energy Storage Tanks using chilled water storage for Data centers and District Cooling companies in UAE. More than 40 TES Tanks conceived and engineered by CiNQ are operational



Seasonal thermal energy storage. Ali Pourahmadiyan, Ahmad Arabkoohsar, in Future Grid-Scale Energy Storage Solutions, 2023. Tank thermal energy storage. Tank thermal energy storage (TTES) is a vertical thermal energy container using water as the storage medium. The container is generally made of reinforced concrete, plastic, or stainless steel (McKenna et al., ???)

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



glycol chiller's supply temperature set point can be reset to a temperature of say 45°F. For a system designed for an 18°F delta-T, the chiller would provide the cooling from 56°F to 45°F and the ice storage would provide the final cooling to 38°F. Locating the chiller upstream of the ice storage allows for a higher chiller leaving set



Thermal energy storage is particularly well adapted to air conditioning and industrial refrigeration systems. By smoothing the production of cooling energy, the STL optimises the use of electrical resources and protects the environment. Traditional air conditioning systems rarely operate at ???



This chilled or heated water is collected in a thermal energy storage tank, and is then withdrawn and distributed to the facility during the peak heating or cooling periods. In addition to savings from rate offsets, adding TES can also reduce initial costs by using chillers more efficiently. New chiller plant projects can benefit from TES

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



This makes thermal energy storage an optimal means for a chiller plant to collect, store, recover and discharge heating and cooling energy. That's just the start of what makes it such a powerful solution. One Trane thermal energy storage tank offers the same amount of energy as 40,000 AA batteries but with water as the storage material.



To achieve energy saving, cost saving and high security, novel cooling systems integrated with thermal energy storage (TES) technologies have been proposed. TES could be located at the upstream, downstream or other nearby locations of the heat source. which was also integrated with thermal storage tank to store energy at night. The



Discover Pittsburg Tank & Tower Group's thermal energy storage tank solutions. Learn how our custom-built tanks support efficient energy management and storage. Tanks. Overview. chiller, and pump. The tanks also increase the existing cooling system's efficiency and longevity by maximizing plant uptime and allowing for more regular



# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



A crucial component in this process is the buffer tank which is a giant thermal battery. These well-insulated tanks, filled with water or a material with high thermal capacity, store the captured energy with minimal heat loss. When peak demand hits, the stored thermal energy is released from the buffer tank to meet cooling or heating needs



Ice Thermal Storage Uses Less Energy ??? During daytime, chillers operate at higher supply temperatures and greater efficiency when piped upstream of the ice storage ??? At night, chillers operate when ambient temperatures are lower ??? Pump and fan energy can be less when colder system supply temperatures are used



TSU - F 5 Thermal Storage Products because temperature matters zReduced Air Handling Equipment: When the air distribution is designed with lower supply air temperatures, the size of the ductwork, fans and fan motors are reduced. zReduced Electrical Distribution: Smaller chillers, heat rejection equipment and pumps require less horsepower than a traditional system, which ???

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



upstream, series chiller downstream and parallel chiller with a storage tank (Yin et al. 2015). Seher et al. (2012) used a tool called the Demand Response Quick Assessment Tool (DRQAT) to model TES.



Thermal energy storage (TES) tanks are specialized containers designed to store thermal energy in the form of chilled water. As water possesses excellent thermal transfer properties, it is an ideal medium for energy storage. TES tanks are multi-faceted, making them useful for many different types of buildings and facilities, including hospitals, airports, military ???



??? Utilizes thermal energy storage Chiller  
Downstream of Ice ice pump chiller pump  
water-cooled chiller load pump ice storage tanks  
VFD VFD bypass pipe cooling coil with two-way  
chiller ice storage tanks Chillers Upstream of Ice  
SCREENCAST 7UDQH& " 6  
H/HDUQLQJ6HULHV,FH6WRUDJH6VWHPV

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



An Ice Bank(R) Cool Storage System, commonly called Thermal Energy Storage, is a technology which shifts electric load to off-peak hours which will not only significantly lower energy and ???



During the off-peak period, the glycol chiller is operational. The glycol chilling system generates low temperature glycol that circulates through the tubes of the thermal storage coils. The circulating glycol removes heat from the water in the tanks, causing the water to freeze onto the exterior surface of the thermal storage coils. Melt-Out



The second-generation Model C Thermal Energy Storage tank also feature a 100 percent welded polyethylene heat exchanger and improved reliability, virtually eliminating maintenance. The tank is available with pressure ratings up to 125 psi.

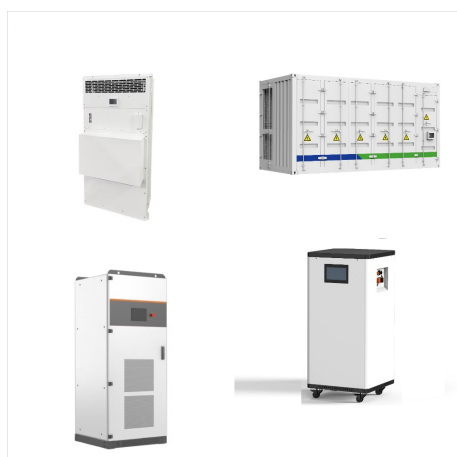
# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



What is thermal energy storage? Thermal energy storage means heating or cooling a medium to use the energy when needed later. In its simplest form, this could mean using a water tank for heat storage, where the water is heated at times when there is a lot of energy, and the energy is then stored in the water for use when energy is less plentiful.



Thermal energy storage (TES) for HVAC applications is a way of utilizing the cheap electrical energy during lean periods to produce thermal energy when it is not needed (or is less expensive to produce). Here's how TES Works The concept behind TES is simple. Water is cooled by chillers during off-peak \* hours and stored in an insulated tank.



The STL thermal energy storage system provides the shortfall of the energy when demand is higher than the chiller capacity. Thus chiller operation is continuous and its efficiency is at a maximum. The downstream or upstream series layout allows to operate with a high  $\Delta T$  and to give priority on both operations and investment costs savings



# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



In district cooling, thermal energy storage tanks are used to store cooling energy at night where the electricity is cheaper. During the day, the stored cooling energy is released. However, with additional TES tanks, the energy efficiency of the chiller plant does not increase but the operating cost can be greatly reduced by playing around



Cooling Production: During typical hours of operation, chillers (water or air cooled) produce cold water that is used to cool the data center. Additional chilled water is produced then stored in large, insulated TES tanks. Chilled water thermal energy storage tanks represent a smart, efficient solution for managing the temporary cooling



Even though each thermal energy source has its specific context, TES is a critical function that enables energy conservation across all main thermal energy sources [5] Europe, it has been predicted that over  $1.4 \times 10^{15}$  Wh/year can be stored, and  $4 \times 10^{11}$  kg of CO<sub>2</sub> releases are prevented in buildings and manufacturing areas by extensive usage of heat and ???

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS



Photo courtesy of CB&I Storage Tank Solutions LLC. Thermal Energy Storage Overview. Thermal energy storage (TES) technologies heat or cool During off-peak hours, the warm water exits the tank at the top and runs to the chiller. Chilled water systems typically store supply water at 39°F to 42°F, which is compatible with most



In its simplest configuration, the "empty tank" method employs just two tanks: one to hold the cool supply water and one to hold the warm return water; this keeps the two temperature zones ???



During that time, chilled water is collected and stored in a thermal energy storage tank. Then, during peak rate times, the cooler water is integrated into the cooling system to provide greater efficiency and reduce overall costs. Reduced Power Consumption ??? With thermal energy storage, chiller operation is shifted to evening hours when

# THERMAL ENERGY STORAGE CHILLERS UPSTREAM VS CHILLERS DOWNSTREAM OF TANKS

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Cool storage offers a reliable and cost-effective means of cooling facilities ??? while at the same time ??? managing electricity costs. Shown is a 1.0 million gallon chilled water storage tank used in a cool storage system at a medical center. (Image courtesy of DN Tanks Inc.) One challenge that plagues professionals managing large facilities, from K-12 schools, colleges and ???