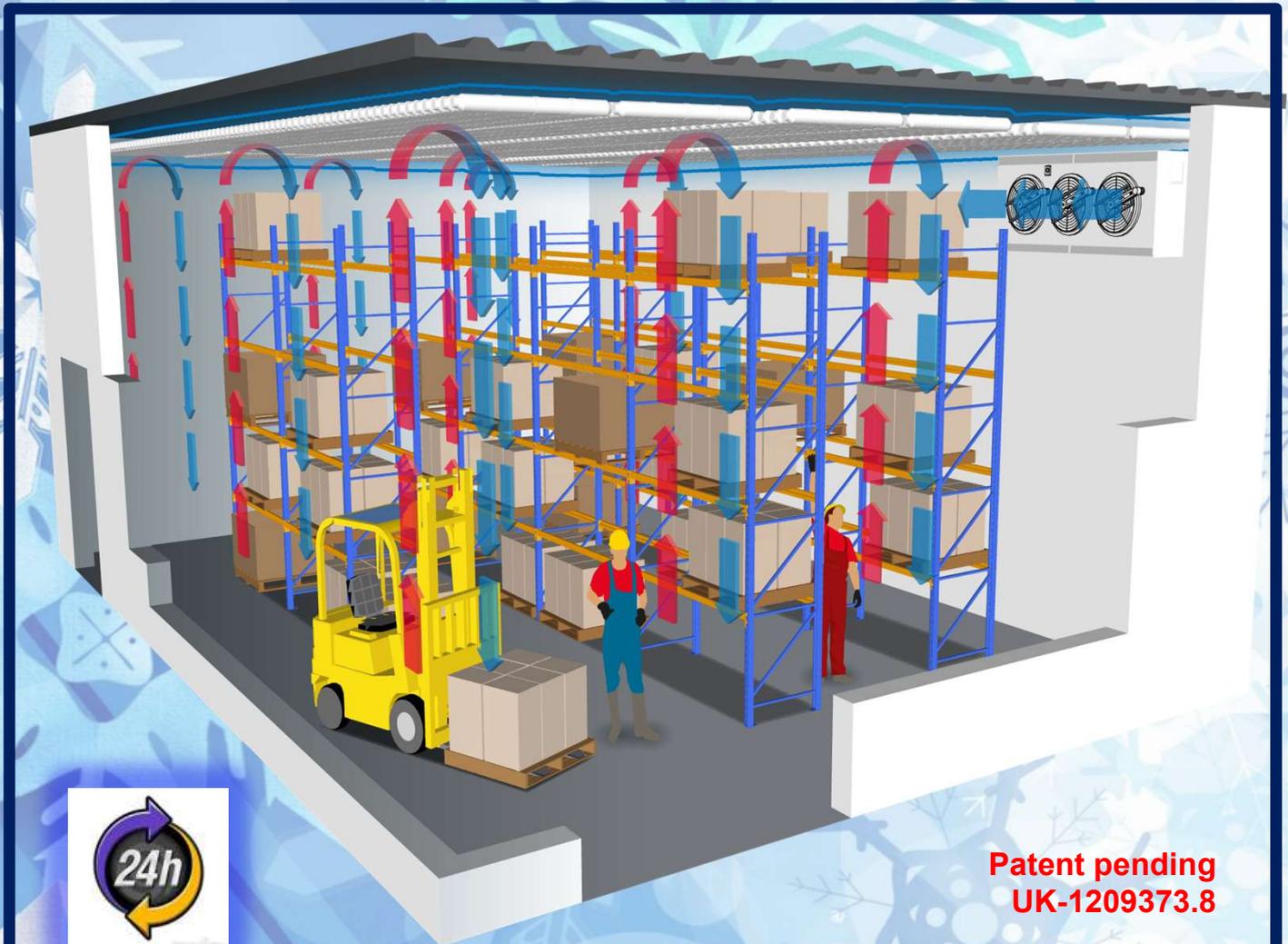


PlusICETM

COLD STORAGE



Patent pending
UK-1209373.8

LOAD SHIFTING & BACK-UP SYSTEMS



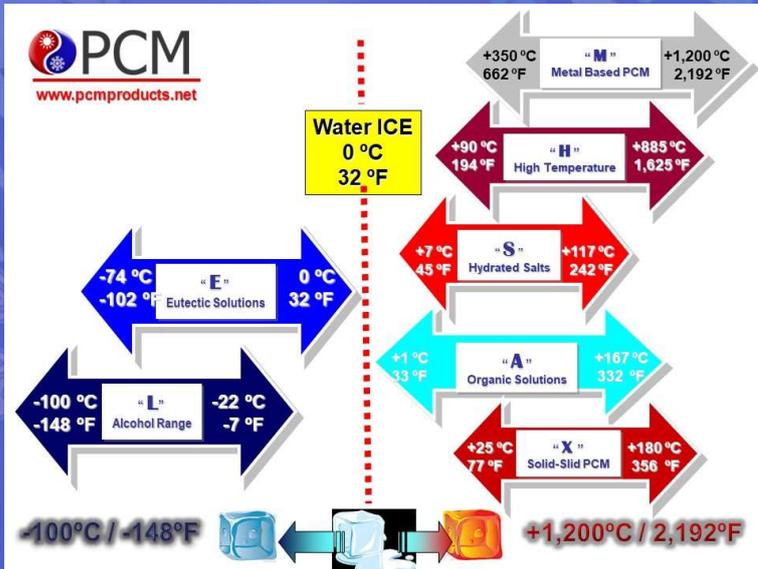
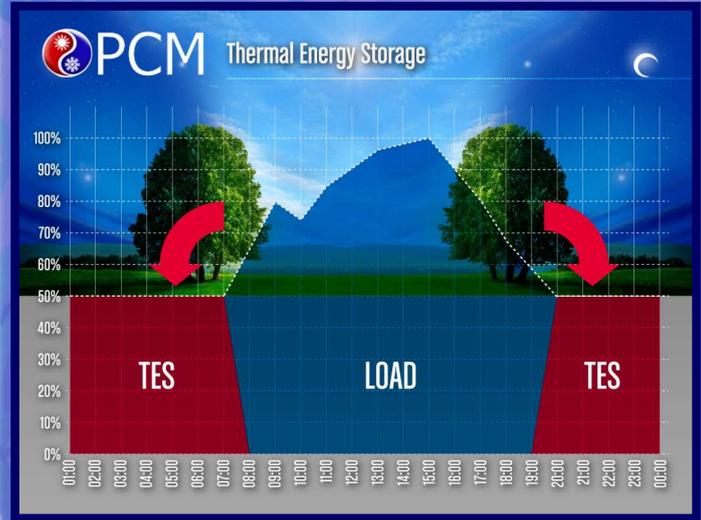
PCM

PHASE CHANGE MATERIAL PRODUCTS LIMITED



INTRODUCTION;

Thermal Energy Storage (TES) is the temporary storage of cold energy for later use. It bridges the gap between energy availability and energy use. A thermal storage application may involve a 24 hour or alternatively a weekly or seasonal storage cycle depending on the system design requirements. Whilst the output is always thermal, the input energy may be either thermal or electrical.



EUTECTIC SOLUTIONS;

Eutectic solutions also called Phase Change Materials (PCM) are products that store and release thermal energy during the process of melting & freezing (changing from one phase to another). When such a material freezes, it releases large amounts of energy in the form of latent heat of fusion, or energy of crystallisation. Conversely, when the material is melted, an equal amount of energy is absorbed from the immediate environment as it changes from solid to liquid.

PRODUCT RANGE;

For the majority of applications, PCM solutions have to be encapsulated in sealed containers. To this end, PCM Products Ltd. have developed many different standard as well as custom-made containers for special applications.

These containers within the cold store create an artificial load to store cold energy effectively shifting the cooling loads from peak to off-peak periods. TES can be applied to any new or existing cold store applications whether secondary refrigeration like Glycol or direct refrigeration like pumped or direct expansion conventional refrigeration systems. PlusICE containers filled with PCM solutions which have operating temperatures between -40°C (-40°F) and 27°C ($+81^{\circ}\text{F}$) cover all the way from deep freeze to ambient storage & handling applications.

1) FlatICE Containers:

These containers are constructed of blow moulded HDPE and can be filled with any of our PlusICE PCM solutions. When stacked there is a small gap between each container, allowing either air or water to flow over the containers while providing a large PCM surface area for heat transfer.



FlatICE

2) TubeICE:

50mm (2") diameter x 1m (3.28ft) long PCM-filled HDPE tubular design enables them to be stacked effectively in both rectangular and cylindrical tanks for either air or water to flow as well as hanging from the ceiling/walls using standard pipe brackets.



TubeICE

3) IcePACKS:

Various size of standard / custom-made ice packs can be filled with any of our PlusICE Phase Change Material (PCM) with operational temperature ranges between -100°C (-80°F) and $+89^{\circ}\text{C}$ (192°F) for any cold storage & handling applications.



IcePACKS

4) Pouches:

PlusICE pouches are manufactured using two layers of film and by forcing these two separate layers into linear welding rollers, it is initially formed in strips of 50mm (2") side by side along the width of the film to form a blanket of flexible sheet.



Pouches



APPLICATION;

By placing the Eutectic products within the cold store one can create a TES facility whereby the excess refrigeration capacity during off-peak periods and lower ambient conditions over-night can be utilised to shift the peak load.

Eutectic TES can either be installed as part of the cold store fabric for example hanging TubelCE on ceiling/walls or alternatively containers like FlatICE can be placed on pallets and stored with the shelves or alternatively using ice packs / pouches Eutectic TES can be incorporated as part of the packaging / Palleting.

Although one may over-cool the stored products to create a small load shifting capability but using the Latent Heat Capacity of the Eutectic TES one can increase the thermal energy storage capacity by as much as 10~15 times for a given volume.

As the cooling load significantly varies over daily or weekly periods, Eutectic TES enables the operator to spread the load over a 24 hour period which in return offers the facility of running the refrigeration machinery during lower night-time ambient conditions to charge the Eutectic TES. Later during day-time / peak cooling periods this over-night stored energy can be utilised to top up the refrigeration load without the need for full load mechanical cooling.

Finally, a Eutectic TES is a static system i.e. no moving parts offering a full stand-by capability in case of any mechanical failures and offers a maintenance free back-up facility.



Before

Rack Installation



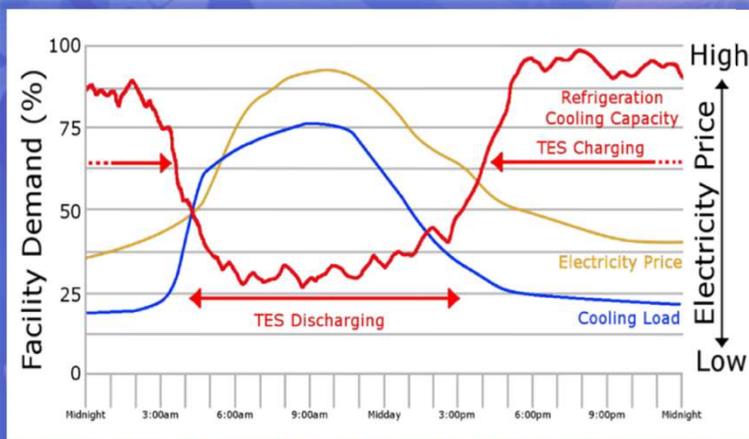
Ceiling Installation



After



Pallet Installation



ENERGY SAVING;

By simply running the refrigeration machinery over night-time cooler ambient periods, one can save as much as **15~25%** electricity consumption due to higher efficiencies of the refrigeration machinery at lower ambient condition as illustrated in this graph.

Reduced actual kWh electricity consumption coupled with the possible cheap off-peak electricity costs may reduce the overall cold store annual running cost by as much as **30~50%** depending on the region.

BENEFITS

REDUCED RUNNING COST

Load shifting provides reliable operation and lower annual electricity / energy running costs. Eutectic TES Load shifting also enables to maximise the use lower night-time tariffs.

REDUCED MACHINERY

Shifting some of the peak load may enable designers to reduce the main machine size for new installations.

INCREASED CAPACITY

As a retrofit application, the additional TES load can increase the system output without any additional machinery.

GREEN SOLUTION

Reduced machinery size and energy consumption results in significantly reduced direct and indirect CO₂ emission.

QUICK RESPONSE

The large latent heat energy storage provides quicker response in large and sharp loads.

LOWER MAINTENANCE COST

Machinery runs for longer periods without any start / stop and therefore it offers a far more reliable operation.

FLEXIBLE SYSTEM

The overall machinery capacity and TES capacity can be exactly matched to system loads.

STAND-BY CAPACITY

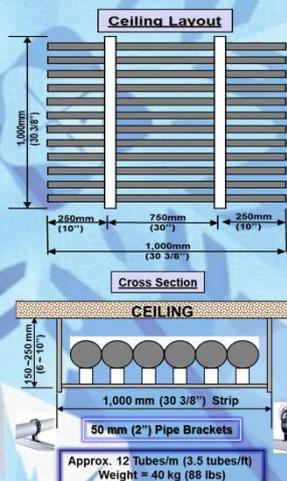
In case the main machinery fails, the stored energy can be utilised to handle the system loads, hence, providing a degree of back up facility.



PCM		TubelCE Capacity Table								2021-V2
PCM Type	Phase Change Temperature		Weight		Capacity per TubelCE		Capacity per module (12 Tubes / m)		HS Tariff code	
	(°C)	(°F)	(kg)	(lbs)	kWh	RT-h	kWh/m ³	RT-h / USG		
E0	0.0	32	1.75	3.86	0.163	0.046	64.49	0.069	39269021	
E-2	-2.0	28	1.87	4.13	0.169	0.048	66.94	0.072	28362000	
E-3	-3.7	25	1.86	4.09	0.170	0.048	67.34	0.072	28342100	
E-6	-6.0	21	1.94	4.28	0.162	0.046	64.10	0.069	28364000	
E-11	-11.6	11	1.91	4.21	0.164	0.047	65.05	0.070	31042000	
E-15	-15.0	5	1.86	4.09	0.165	0.047	65.30	0.070	28271000	
E-19	-18.7	-2	1.97	4.34	0.178	0.050	70.38	0.076	28271000	
E-21	-20.6	-5	2.17	4.78	0.142	0.040	56.09	0.060	28332980	
E-22	-22.0	-8	2.07	4.55	0.175	0.050	69.28	0.075	25010000	
E-26	-26.0	-15	2.19	4.82	0.161	0.046	63.77	0.069	25010000	
E-29	-29.0	-20	2.49	5.48	0.173	0.049	68.34	0.074	28275100	
E-32	-32.0	-26	2.26	4.98	0.141	0.040	55.87	0.060	28342980	
E-34	-33.6	-28	2.11	4.65	0.117	0.033	46.39	0.050	28273100	
E-37	-36.5	-34	2.63	5.79	0.164	0.047	64.97	0.070	28364000	
E-50	-49.8	-58	2.32	5.11	0.113	0.032	44.64	0.048	28272000	
E-65	-65.0	-85	2.07	4.55	0.138	0.039	54.52	0.059	28273985	

PCM Products has a policy of continues product and product data improvement and reserves the right to change design and specifications without notice

Ceiling Installations



Rack Installations



PlusICE Module

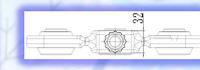
W x L x H
1,000mm x 900mm x 80mm
(39.4" x 35.4" x 3.15")

Weight
40 kg / 88 lbs

Pallet Installations



Standard Pallet
200 FlatICE / Pallet
~ 500 kg (1,125 lbs)



13mm (1/2")
Gap for
air flow



For additional information contact;

Distributor / Installer Stamp



PHASE CHANGE MATERIAL PRODUCTS LIMITED

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