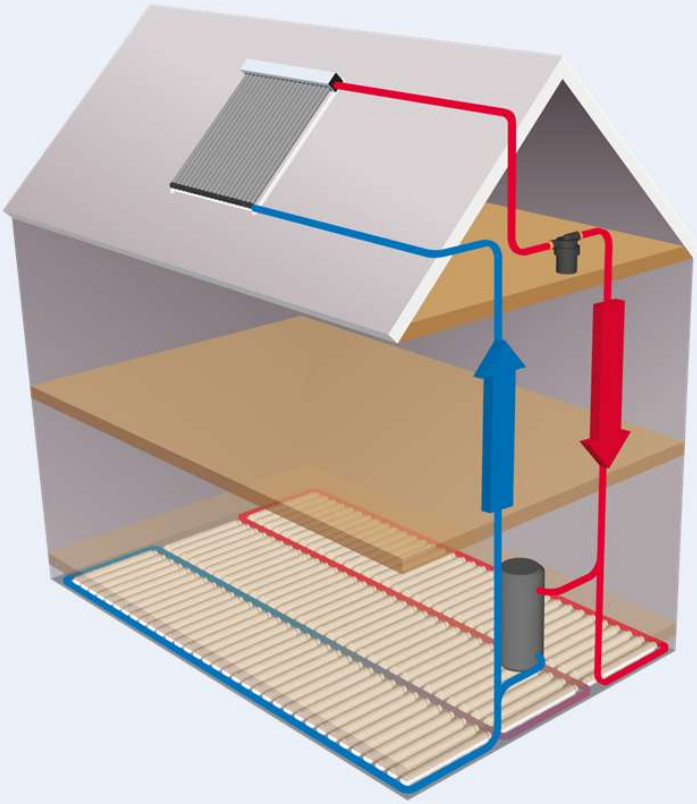
SOLAR & HEATING APPLICATIONS



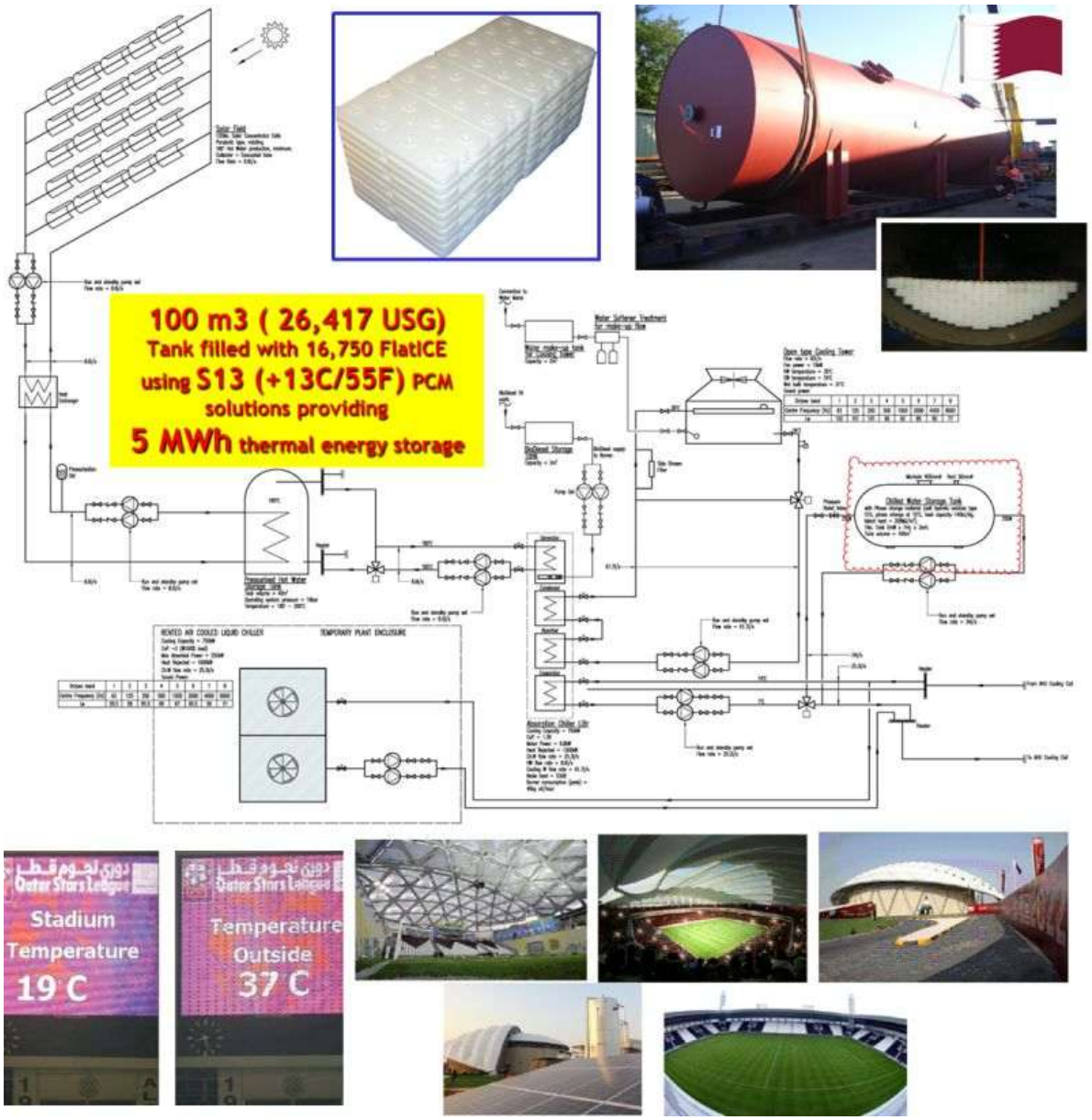
PCM

Solar Off-Grid Cooling PCM-TES application, FIFA 2022 World Cup Stadium, Doha, QATAR

As to overcome the hot weather which was the main objection for summer games for Qatar's 2022 World Cup bid, their bid committed to come up with off-grid green stadium green cooling design to cool the stadiums for both players and spectators during games. Design team came up an idea to use the solar energy to run heat driven machines all day and store the cool energy in TES tanks and later burst this stored energy into the stadium during evening games.

Solar energy generated by parabolic collectors drives the absorption chillers during day-time and the cool energy generated by the solar system placed in 100 m3 (26,417 USG) TES tank filled with 16,750 FlatICE using +13C (55F) PCM solutions providing 5 MWh thermal energy storage while the energy is available. Later when the games played during evening periods this stored energy discharged into the covered stadium and keep the spectators and players comfortable 2~3 hours.

In order to demonstrate the concept A small scale stadium is built to demonstrate and prove the proposed off-grid green stadium is technically possible and during summer trial this demonstration stadium clearly proved that the proposed concept is viable and works well.



UNDER FLOOR HEATING - TES

Encapsulated PCM containers filled with 27~32C (81~90F) Phase Change Material is ideal to store any excess energy and overcome overheating.
This Thermal Energy Storage capability provides a useful tool to store any free energy such as solar as well as shifting the loads from peak to off-peak periods for any domestic or commercial under floor heating applications.

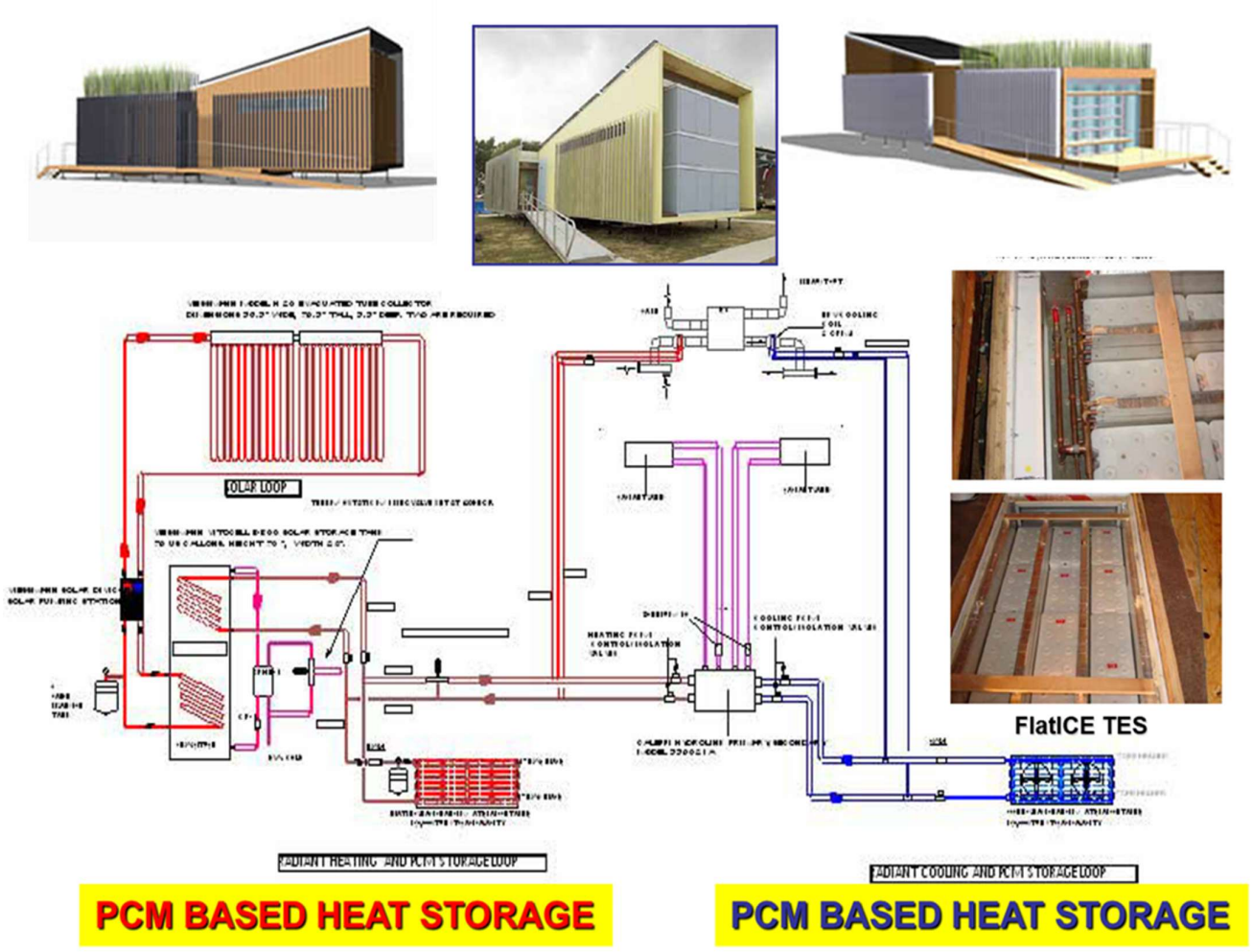




SOLAR HOUSE- USA APPLICATION

Rhode Island School of Design developed an off-grid self-sufficient house design for the 2005 Solar Decathlon Competition took place in Washington, USA.

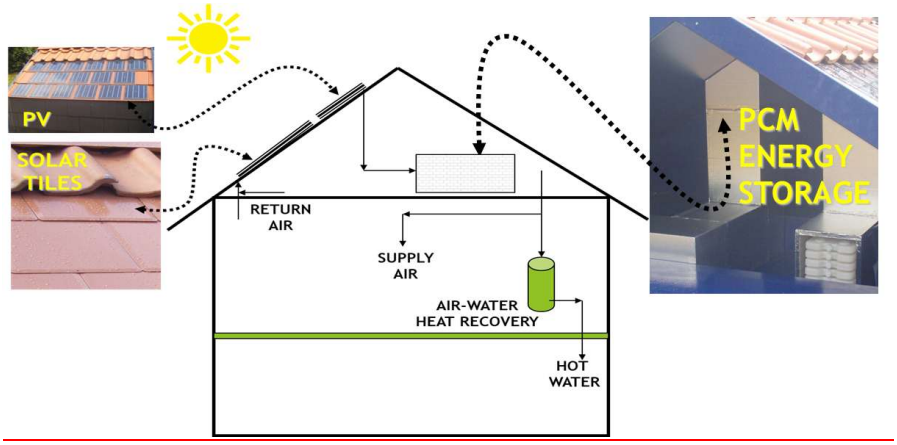
Design is based on utilising night cool energy storage in PCM based TES tanks filled with 22C (72F) for day-time cooling requirement as well as using solar collectors to produce hot water as well as store excess heat during day sun light period within the 46C (115F) warm PCM based TES tanks for night heating. Power requirements for these systems also provided via solar PV panels & battery combinations for an 80 m2 (800 ft2) typical house application.



PV HEAT RECOVERY HEATING SYSTEM

PV panels are a great option to provide free energy but by nature bulk of the solar radiation nearly 80% of it converted into heat via PV panels while only 20% power output. As there are many incentives around the World to encourage the use of PV panels in particular domestic applications but generally this free heat is not utilised.

The TRISLATE concept has been proved through technical trials in the Dublin Institute of Technology. There are two products in the range, the TRI- AIR slate which is a metal slate which collects hot air by fan during the day and cool air at night. The second product is the TRI-PV-AIR slate which collects Photovoltaic electrical energy, plus heat, plus cool energy at night. This triple function gives rise to the name TRISLATE.



GREENHOUSE THERMAL BALANCE APPLICATIONS

During day-time solar gains result in excessive indoor temperatures and this excess heat melts the PCM modules and thereby absorbs the excess heat and in return over-night indoor temperature drops and this cold energy again absorbed by the PCM modules and effectively becomes radiant heaters. This heat storage capacity provided by PCM modules stabilise and minimise the indoor temperature fluctuation.



DESERT ROSE SOLAR DECHATLON COMPEPITION 2018, DUBAI, UAE

As part of the solar decathlon competition in UAE University of Wollongong, Australian team develop an off-grid domestic dwelling whereby the essential services like electricity, cooling and heating all provided using free energy i.e. solar & cooler night conditions.

The Desert Rose HVAC system utilises an air-to-water heat pump as the primary source of cooling within the home. Unlike traditional residential HVAC systems, the Desert Rose decouples its sensible and latent cooling in the home by utilising an innovative Daikin product called Desica.

The system also employs an energy recovery ventilator which recovers waste energy and pre-cools fresh air as it enters the house. Phase Change Material (PCM) thermal storage tanks are used to cool the Desert Rose House to improve energy efficiency. PCM tanks act as a 35 kWh liquid thermal store that is cooled at night when the ambient temperature is cooler, increasing the coefficient of performance of the heat pump. The thermal store is then used during the middle of the day to drive the fan coil units instead of using the heat pump. This drastically reduces the amount of energy used by the HVAC system during peak load.



MELBOURNE / COMMONWEALTH GAMES OLYPIC VILLAGE SOLAR HOT WATER TES APPLICATION

As part of the financial planning a new housing development aimed to house athletes during games but once the games over these houses would be sold to public. However, during games the numbers of athletes occupied these building would be 4~5 higher than average family. As the organizer aimed to make this new village as environmentally friendly as possible and to this end hot water is aimed to be provided by solar.

However, as all athletes compete during day time as well as excessive hot water requirement is provided by PCM thermal energy storage tanks whereby for a give tank size PCM-TES provided 4 times higher energy density, Stainless steel balls filed with 89^{0}C (192^{0}F) hydrated salts placed inside a standard size hot water tank and this way full hot water requirement provided during games but once they are sold to public this extra energy density also utilized to cover any cloudy days for the standard family occupation.

