

CREATING POWERFUL INNOVATIONS

With *Climate Technology*



PLUS[®] | TECHNOLOGY FOR A BETTER WORLD

Founded in 1994, Pluss Advanced Technologies started with R&D and manufacturing of specialized polymers. In 2007 Pluss commenced development in the field of Phase Change Materials (PCMs) technology. In 2012, the company raised equity funds from Tata Capital Innovations Funds and expanded R&D, developed and commercialized first of its kind temperature control solutions using proprietary materials, addressed unmet need of temperature control across refrigeration, cold storage, cold-chain logistics, HVAC, and healthcare sectors. The company today has a global presence with its own subsidiary in Netherlands. Pluss has received several awards and recognitions, including the CII Innovation award twice, in 2014 and 2017. It has also received the Massachusetts Institute of Technology's Innovators under 35 awards, in 2016 and 2017. Since 2021, Pluss is a subsidiary of Carborundum Universal Limited (CUMI), which is a Murugappa Group company.



PLUSSTAINABLE
/plʌsˈsteɪnəb(ə)/

able to maintain the optimal rate or level to meet the needs of the present without compromising the needs of future generations, the **PLUS way**.

Sustainability drives all that we do. From the business that we are in, the ideas we generate, the products we develop to the processes we undertake. Our unwavering commitment to a sustainable way of living and working, drives us towards PLUSstainability at all times.

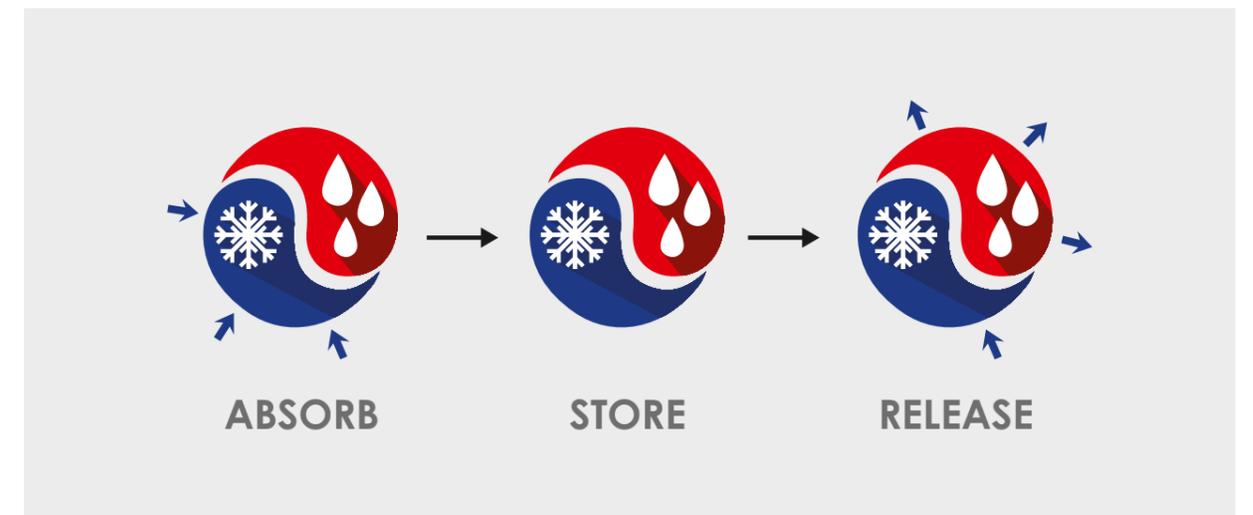


Our technology

Using save[®] PCMs for Thermal Energy Storage

Thermal Energy Storage (TES) technology eliminates the dependency on instantaneous electricity for heating or cooling applications. TES is one of the clean technologies which supports and extends the use of other clean technologies such as solar, wind, Distributed Renewable Energy (DRE), electric vehicles, etc. This means more control over the end-use without relying on electric power for the purpose of heating and cooling from the grid or electric batteries or diesel generators.

Phase Change Material (PCM) is a substance that stores large amounts of energy in form of latent heat at a constant temperature. This process is repeatable over a substantial number of cycles. In essence, a PCM can be called a thermal battery. PCMs are one of the most effective mediums of thermal energy storage as they are highly cost-effective, stable and environment friendly. PCMs have very wide scope of applications whether it is building construction, cold chain transportation/storage, solar energy storage, temperature-controlled packaging for food, pharmaceuticals, etc.



Key benefits of PCMs



Cooling/Heating without the need for an external source of energy at the time of operation.



Shift peak power loads to off-peak power hours.



Provide a clean backup medium during contingency.



Effective heat/cool dissipation and thermal management medium.



Extend the use of renewable energy by storage.

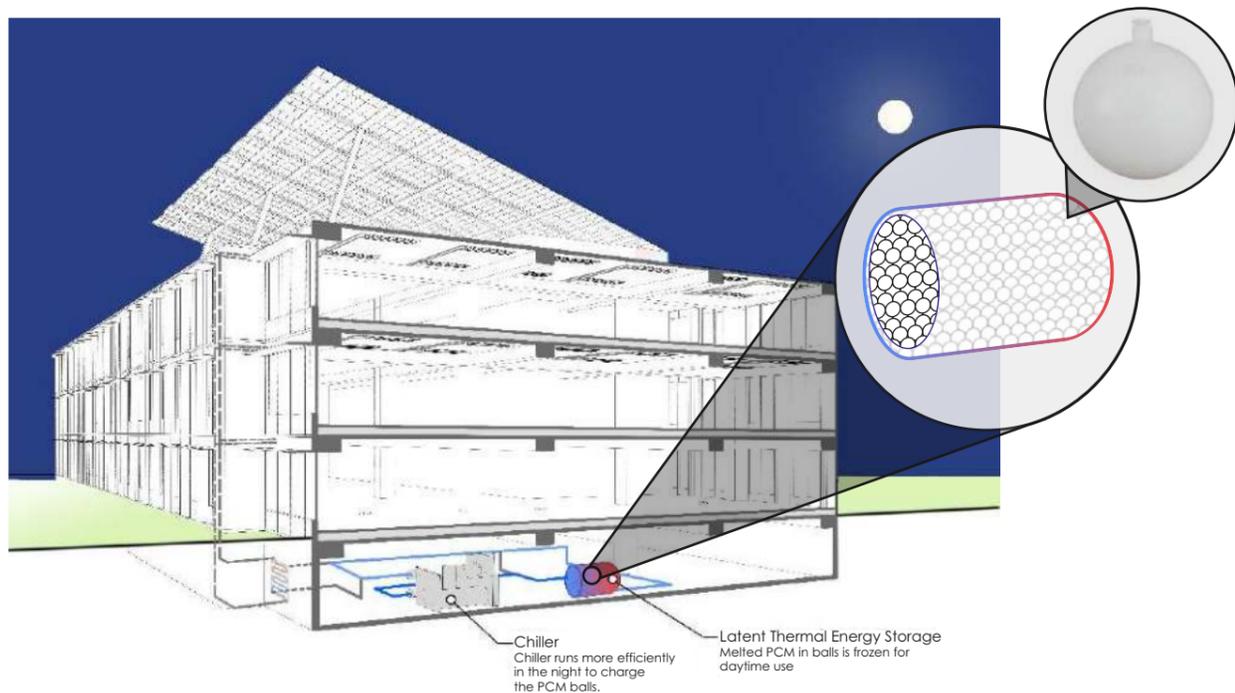


Reusability - Reduction of emissions and use of fossil fuels.

HVAC

Commercial Buildings (Active System)

Thermal Energy Storage (TES) can actively take part in managing the refrigeration cycle of the building. It helps in demand-side management by reducing the load on the chiller during peak hours. TES integrated with Phase Change Materials is an efficient way of maintaining temperature in a building.



Advantages:

- Chiller, condenser pumps, cooling the tower can be downsized
- Avoids the electricity consumption during peak tariff hours
- Reduces the overall AC load by 42%
- Electrical load of the building reduces by 28%

Product Range				
Product Description:	75mm HDPE ball with HS08 PCM	75mm HDPE ball with HS01 PCM	80mm SS ball with HS48 PCM	100mm SS ball with HS48 PCM
Application:	Cooling	Cooling	Heating	Heating
Energy Storage: (kWh/Encapsulation)	0.01	0.01	0.02	0.04

HVAC

Commercial Buildings (Passive System)

Thermal Energy Storage System (TESS) can also be applied passively in a building. **MassEffekt®** is a registered solution by us that can be retrofitted in the existing space without increasing the refrigeration capacity. This solution maintains the room temperature by restricting temperature variations due to door openings.



In a cold-room

In an office building

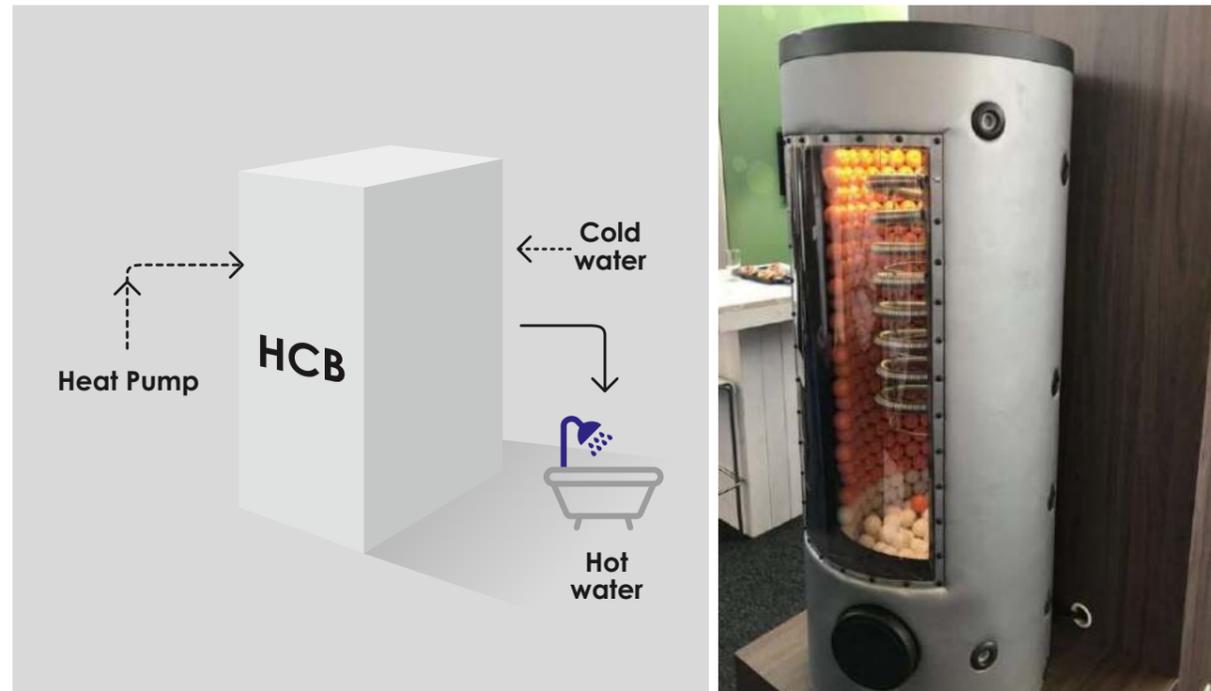
Advantages:

- Reduces dependency on the power source
- Shifts peak power loads to off-peak hours
- 50% more stable temperatures
- Peak period consumption reduced by 43%
- Lowers operating cost by 25%

Product Range				
Product Description:	MassEffekt® with HS18N PCM	MassEffekt® with OMO5 PCM	MassEffekt® Ceiling Matt with HS22 PCM	MassEffekt® Ceiling Matt with HS20 PCM
Application:	Cold Warehouse	Cold Warehouse	Comfort Cooling	Comfort Cooling
Energy Storage: (TRH/sq. meter)	0.31	0.17	0.14	0.13

Residential Buildings

Compact Heat Battery is an innovative and energy-efficient solution for storing the energy of a heat pump. It helps in delivering instant hot water. The thermal battery contains phase change materials to efficiently store heat for domestic hot water systems and space heating.



Advantages:

- 4 times smaller than the equivalent hot water cylinder
- Usable with a wide range of energy sources
- Supplies energy on demand
- Shifts the electricity load from peak to non-peak hours
- Downsizes the heat pump
- It can be used for both heating and cooling solutions
- Commonly used PCM are SaveE® 20°C, 48°C, 58°C

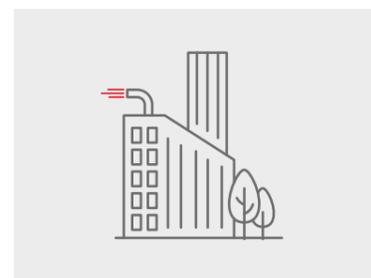
Possible Applications:



Industrial waste heat



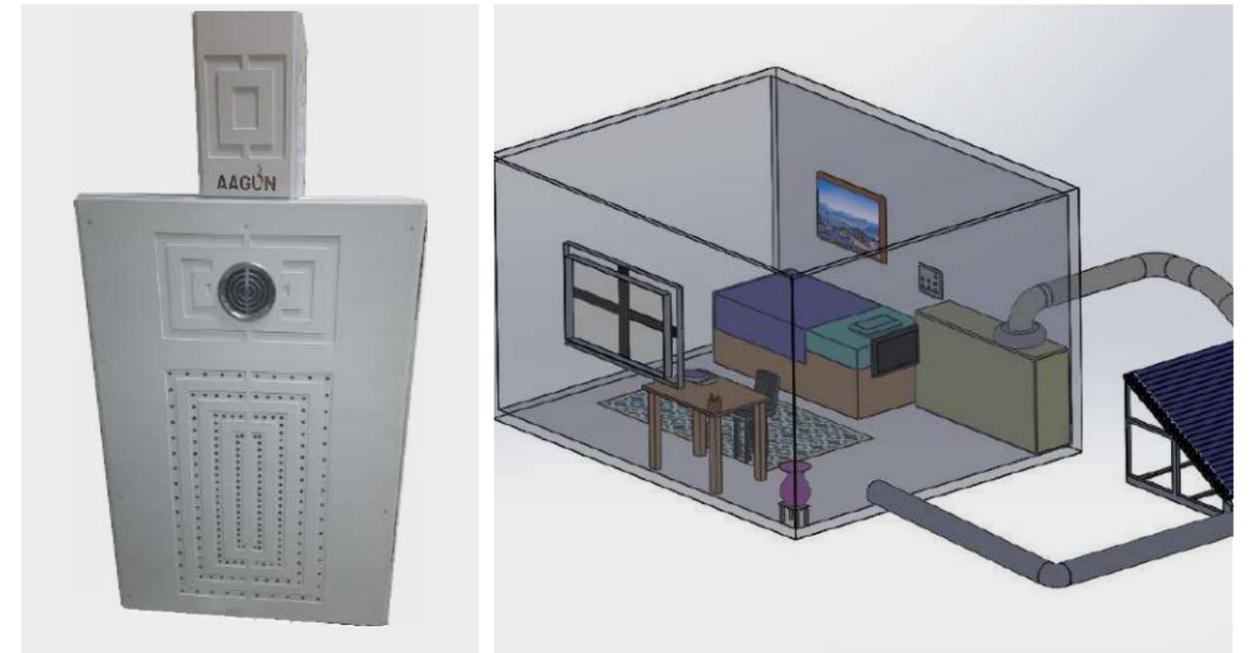
Residential heating system



Steam generation plant in a hotel

Off-Grid Heating Solution

Aagun Spatial is a Phase Change Materials (PCM) integrated room heating system that can provide thermal comfort in high-altitude areas where the temperature during night falls to as low as -20°C. The system is designed to work independently of grid energy for 24 hours. The PCM technology enables storage of heat generated during the day using solar thermal which is used to continue the heating process throughout. The system can maintain room temperature in the range of 15-25°C.



Product Description:	Aagun Spatial
Application:	Off grid Space Heating
Energy Storage: (kWh/1000 cubic ft.)	5.5

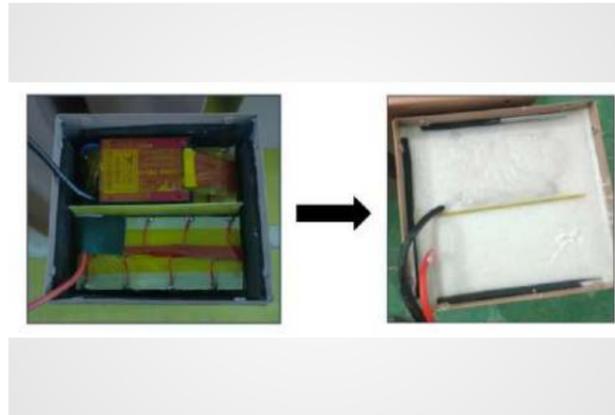
Advantages:

- Operational during non-sun hours
- Low operational or running cost
- Environment-friendly
- Payback period is < 2 years
- Modular and aesthetically appealing
- Can be multiplied as per the area

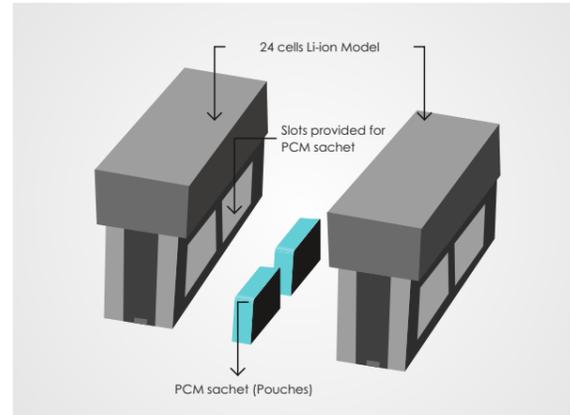
BATTERY THERMAL MANAGEMENT

Electric Vehicles

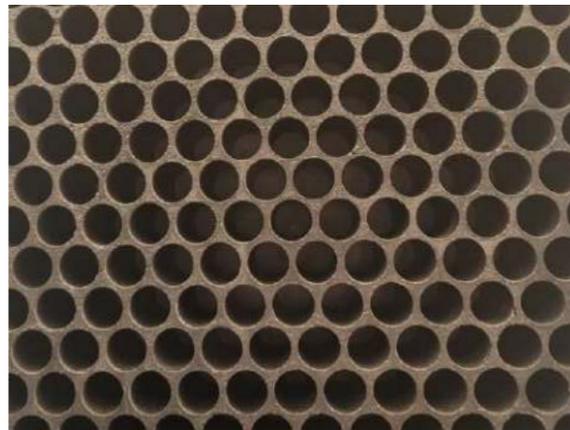
Phase Change Materials are used as passive cooling solutions for battery thermal management. They help in enhancing the overall performance of the battery. Battery with phase change materials is a safer option in conditions like Thermal Runaway which can lead to an explosion. There are various methods of incorporating PCMs in battery packs:-



Flood and Fill



PCM pouches in available space



EG PCM block (Form Stable)

Advantages:

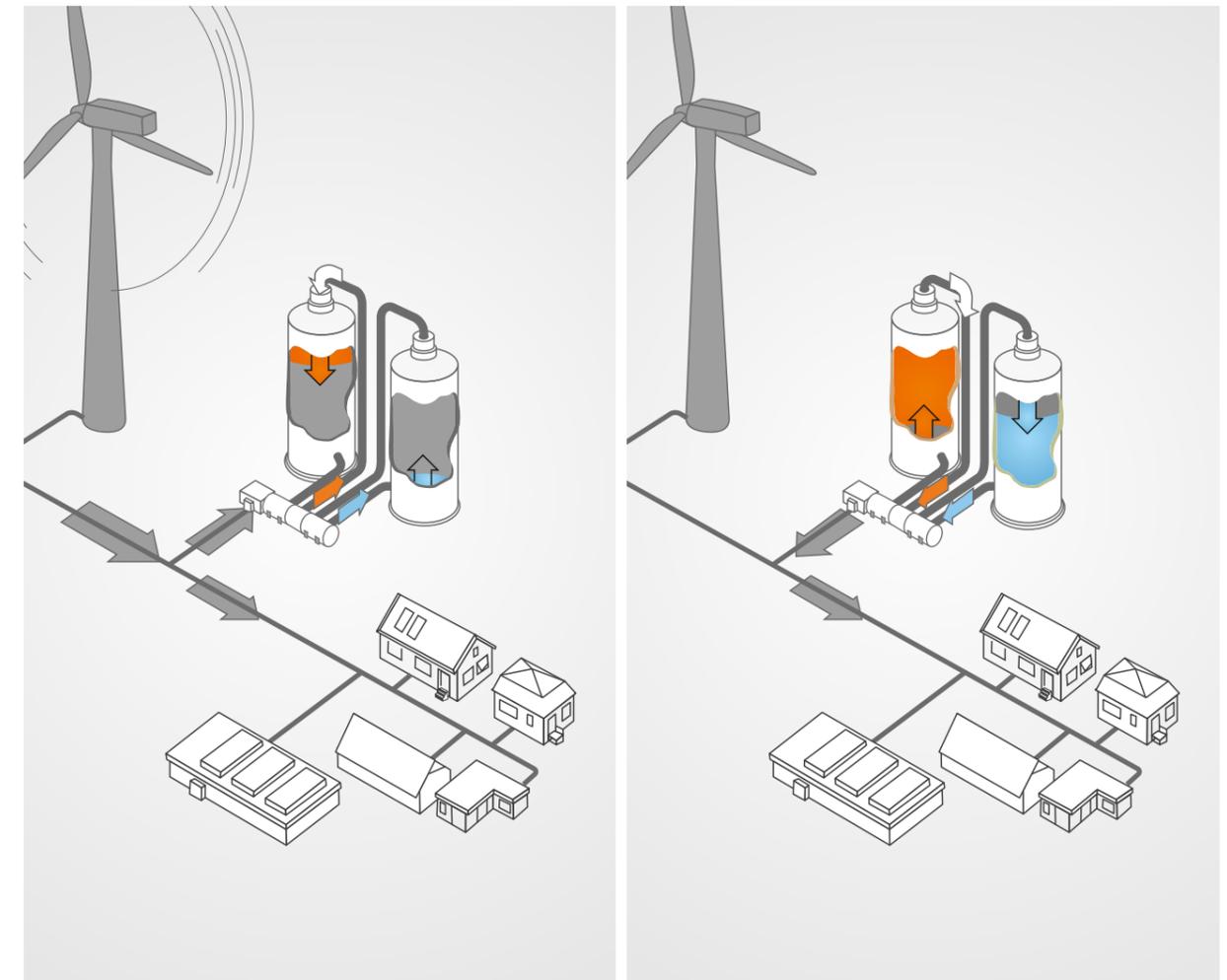
- Three methods to choose from
- The thermal conductivity of the block is 8 W/mk
- Non-flammable
- Compatible with all types of cells

Product Description	Type	Thermal Conductivity (W/m-K)	Heat Sink Capacity (kWh/cubic meter)
EG46	Form Stable Exfoliated Graphite	8	20.65
EG50	Form Stable Exfoliated Graphite	8	22.05
OM46	Flood & Fill	0.2	47.70
OM42	Flood & Fill	0.19	43.27
OM48P	Flood & Fill	0.19	46.08

BATTERY THERMAL MANAGEMENT

Large Li-ion Battery Servers

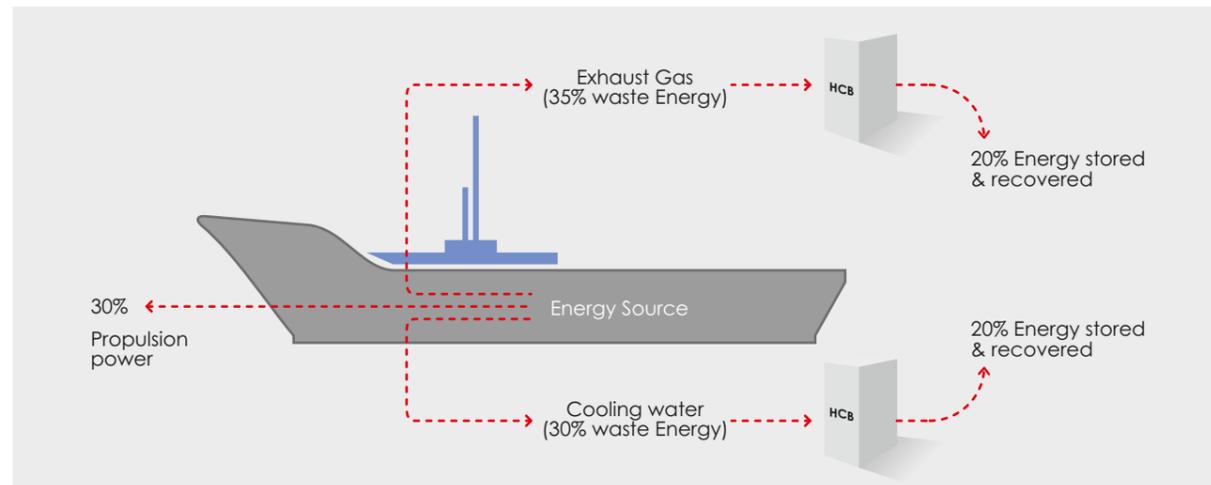
Renewable energy-based power generation systems such as wind, solar or tidal often generate surplus energy which is fed into the grid as well as stored in Li-ion batteries. For high-capacity battery management systems, active cooling is an effective method of rejecting heat. PCM-based thermal storage systems provide an additional capacity to the existing refrigeration system during unprecedented heat surges from the batteries. PCM-based thermal storage systems also allow the overall cooling capacity to be downsized.



WASTE HEAT RECOVERY

Ships

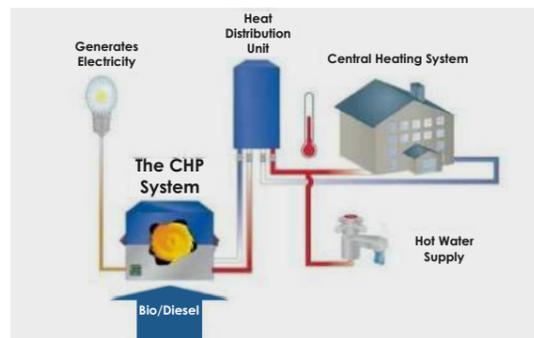
The surplus heat generated in ship operations is at 70°C to 80°C. This heat can be extracted and stored using high temperature PCMs. The stored heat can be used for various applications such as for heating water used for shower or to heat the cabins in cold region. The heat can be used for anti-icing on decks, railings, stairs, and more. For tropical regions, the waste heat can be used to even generate cooling using a vapour absorption chiller. Almost 50% of the energy that would have been lost to the atmosphere can be circulated back into the system, reducing the fuel consumption and emissions.



Industrial Waste Heat

The waste energy emitted by industries at medium temperature levels of 50°C to 70°C in various processes can be harnessed in Thermal Energy Storage. This stored energy can be used in preheating water, space heating, and producing cooling by the use of vapor absorption chillers. This can increase the overall efficiency of the plant and reduce carbon emissions.

Combined Heat & Power (CHP) Systems generate residual heat at 150°C and above at very high capacities. This temperature if stored effectively can fulfill the demand for heating an entire township.



Commonly used save[®] PCM

PLUSS[®] has PCMs from -75°C to +89°C, but the commonly used PCMs in Climate technologies are as follows:

save [®] PCM	Phase Transition Temp (°C)	Latent Heat (kJ/kg)
OM18	19	167
OM08	7	175
OM48	48	165
OM50	53	170
HS01	1	350
HS18N	-18	242
HS48	50	211
HS58	58	267
HS78	78	240

Encapsulations



HDPE Tabs



HDPE Balls



Multilayer Pouches



Stainless Steel Balls

Members



National Centre of Cold Chain

Development NCCD is an autonomous body established by the Government of India with an agenda to positively impact and promote the development of the cold-chain sector in the country.



India Energy Storage Alliance,

IESA was launched in 2012 to help technology and system integration companies involved in energy storage and microgrids to understand and capture the opportunities in the growing markets.



Clean Energy Access Network,

is an all India representative organization launched in 2014 with a clear mandate to support, unify and grow the decentralized clean energy sector in India.



Reichs-Ausschuss für Lieferbedingungen (RAL),

Several active PCM enterprises formed the Quality Association PCM in 2004 to develop proper quality assurance procedures.

Awards



GITA- Global Innovation & Technology Alliance - 2022



FICCI- DST Lockheed Martin Award - 2015



WWF- Climate & Energy – 2021



TCL- Supply Chain Innovation Award for Pharmaceuticals - 2018



DST, GI- Department of Science & Technology, Government of India - 2020 & 2017



BIRAC- Sparsh Grant - 2022



UNIDO- FLCTD Innovation Challenge - 2018 & 2022



MIT- Innovators under 35 India Award - 2016 & 2017



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