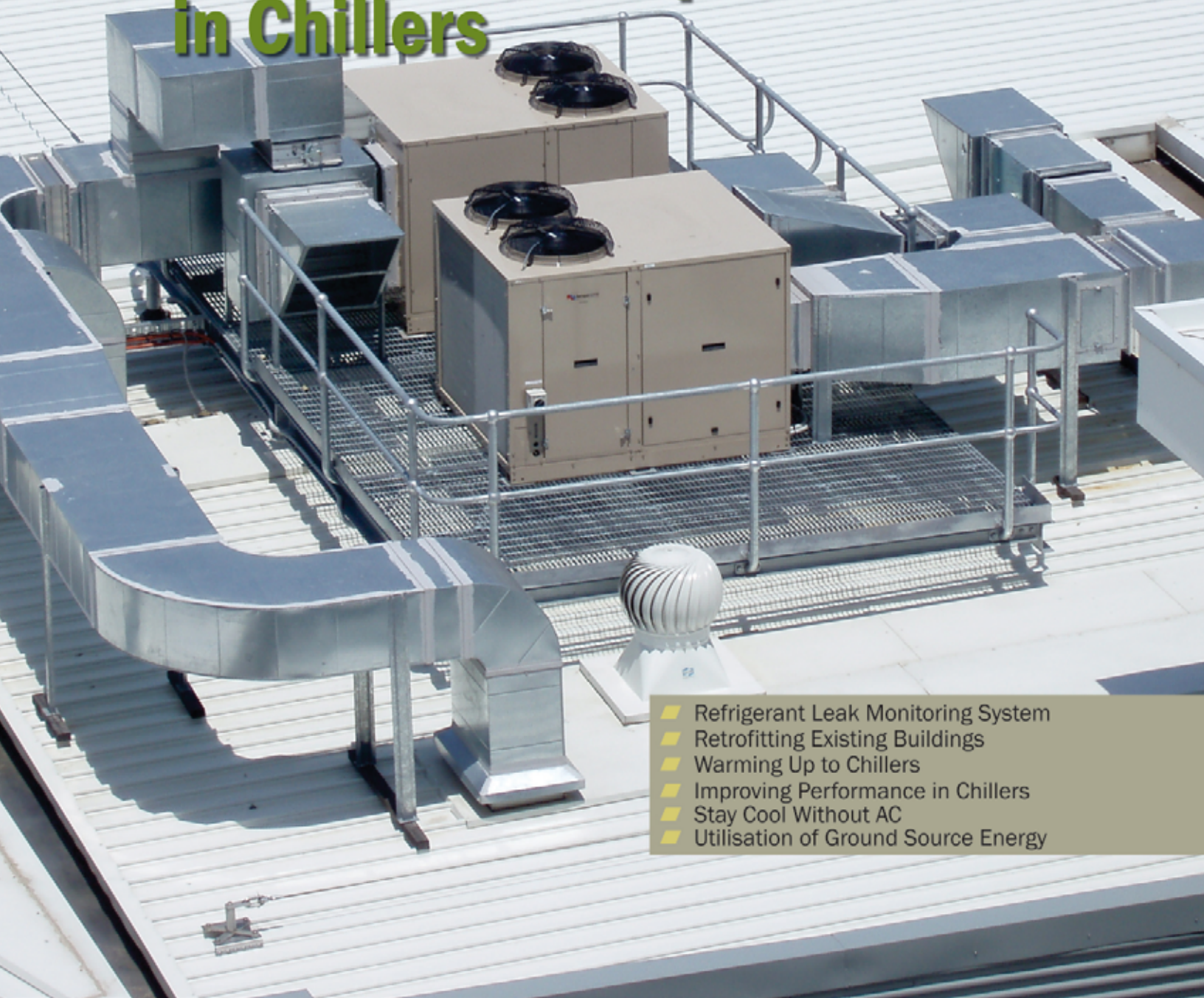


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- ▶ Refrigerant Leak Monitoring System
- ▶ Retrofitting Existing Buildings
- ▶ Warming Up to Chillers
- ▶ Improving Performance in Chillers
- ▶ Stay Cool Without AC
- ▶ Utilisation of Ground Source Energy





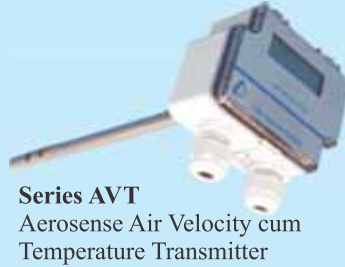
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**Series SAH**  
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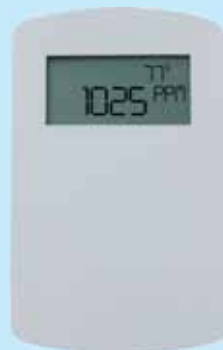
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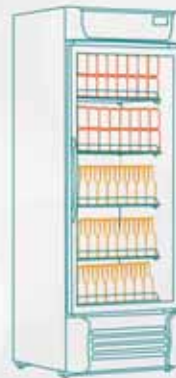
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# Publisher's Letter

## Happy days for the HVACR industry will be here again....But till then reduce your expenses

**H**ello and welcome to another edition of *Cooling India*. In Indian mythology it is said that Holi brings with it the summer. By the time you read this issue, Holi would be over and as they say in Greek, the dog days of summer has arrived. With the drastic change in climate worldwide, which was quite evident in many colder countries this year, the temperature has been rising steadily. I was in Canada for a month in the beginning of this year, which was supposed to be full of snow. But I can tell you people there were very worried because there was hardly any snow even in a place like Montreal.

Scientists are more concerned because human being over the past two centuries have artificially increased the greenhouse gases by burning fossil fuels and cutting down forests. To be precise, CO<sub>2</sub> and methane levels have gone up by about 36% and 140% respectively. Having said that, I can tell you there are certain things which are easy said than done. We live in a world where speed is of utmost important. Today, we are talking of setting up of Hyperloop travel between Indian cities that would be faster than the flight. I am though very skeptical about its launch in India.

India has been witnessing tremendous growth since a decade in all the sectors. Airconditioned Metro railway is now being set up all across the country. India is attracting FDIs and with the thumping majority with which the Modi government has won the just-concluded Uttar Pradesh election, the growth story of India is unstoppable. The boost to the economy has given the HVAC industry a fillip, as they have become one of the core building blocks for modern infrastructure. This will only propel the HVACR industry by almost 20%. Though I would say the refrigeration industry needs a little more push.

As mentioned earlier, victory in UP and other states has given the BJP more power in getting major bills passed -in the Parliament. I see an end to the recession mode. There was a dull period for the air conditioning industry in the 3<sup>rd</sup> and 4<sup>th</sup> quarter of the current fiscal. Some attribute this to demonitisation. However, I beg to differ because the currency ban was in any case during winter – a low sale period. The effect of GST on HVAC products will only be known when it is implemented later this year. But the prices are expected to go up. The industry hopes happy days will be here again for the infra industry. Finally, at tough times reduce your expenses. I would say keep your energy bills low by proper HVAC inspection, filter maintenance, etc. Running efficient HVAC doesn't need to be complicated.

Please send your comments at [pravita@charypublications.in](mailto:pravita@charypublications.in)

**Pravita Iyer**  
Publisher & Director

Member, Indoor Air Quality Association (IAQA)



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Printed by Pravita Iyer and Published by Pravita Iyer on behalf of Chary Publications Pvt Ltd., and Printed at Print Tech, C-18, Royal Ind. Est., Naigaum Cross Road, Wadala, Mumbai 400031 and Published at 906, The Corporate Park, Plot 14&15, Sector - 18, Vashi, Navi Mumbai - 400 703.

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Sr. No.	Parameter	Cooling Tower (Induced Draft)	LTMCS
1	Wet Bulb Temperature	29°C	29°C
2	Chilled Water Temp in °C (Assumed)	5°C	5°C
3	Supply Temp. from CT / LTMCS	33°C	30°C
4	Approach to WBT	4°C	1°C
5	<b>ΔT for Chiller</b>	<b>28°C</b>	<b>25°C</b>
6	Chilled Water Compressor Motor Kw for 1200 TR	720	643
7	Energy Saved in %	-	10.7%
8	<b>Energy Saved in Kw</b>	-	<b>77 Kw/Hr</b>
9	Total Running Hours per Annum	8640	8640
10	<b>TOTAL POWER SAVED PER ANNUM</b>	-	<b>6,65,280 Kw</b>



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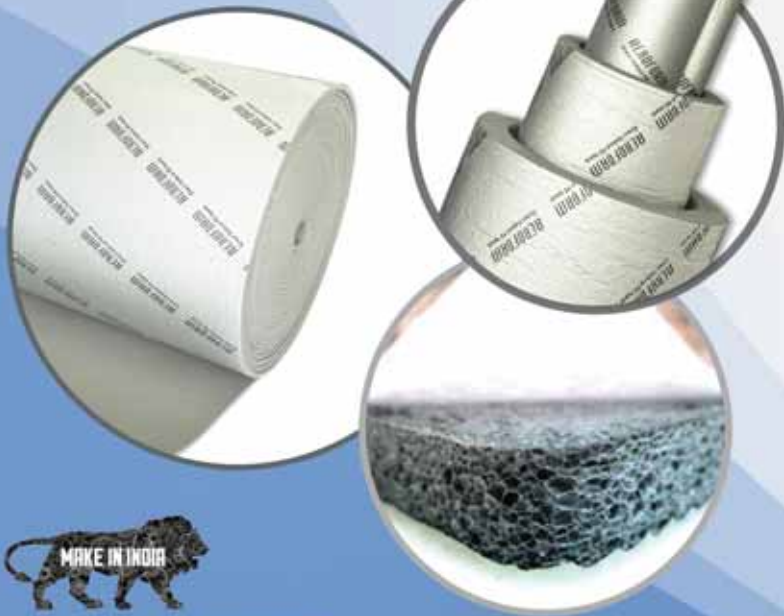
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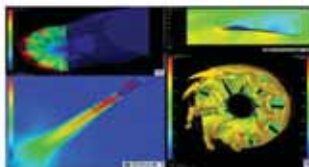


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## MHI Thermal Systems to Launch 17 Room Air-Conditioner Models

Starting in late March Mitsubishi Heavy Industries Thermal Systems, a Group company of Mitsubishi Heavy Industries, (MHI), will progressively launch three new series of air-conditioners for residential use, 17 models in all, into the Japanese market. The top-of-the-line SV Series will consist of 6 models featuring an outstanding annual performance factor (APF), which translates to superlative energy efficiency; the functionally advanced RV series will include 5 models all equipped with automatic filter cleaning; and the standard TV Series will incorporate 6 models.



SV Series Indoor Unit

All models in all three series equipped with MHI Thermal Systems' 'JET' and 'WARP' operating modes. JET delivers a powerful, especially large airflow, while WARP enables rapid cooling or heating. An 'Automatic Airflow' function is also provided that automatically controls airflow volume and direction to achieve a uniform temperature efficiently throughout a room.

The SV Series models are equipped with a motion sensor function that detects the level of ambient human movement and automatically controls the room temperature accordingly.

When the sensor detects that no one is present, the unit reduces output to prevent unnecessary cooling or heating. When the room remains empty for a long period, operation stops automatically; then when someone reenters the room, the unit resumes operation. In these various ways the SV Series models help to save energy. ■

## Carrier Collaborates with AT&T

AT&T and Carrier has announced the addition of AT&T wireless connectivity on commercial HVAC equipment with Carrier SMART Service, a remote connectivity and advanced analytics solution. This new offering uses the AT&T network to help collect and analyze chiller operating performance to deliver pre-emptive service solutions.

The data collected through AT&T IoT technology can reveal operating trends and provide a more complete understanding of the health of the chiller. Depending on the results, Carrier SMART Service can then provide recommendations for service, repairs or system modifications. This collaboration will provide facility managers the capability to make more informed maintenance decisions so that service and repairs are only performed when needed – often before an issue arises.

Carrier SMART Service will use AT&T IoT technology to help improve oversight of chiller energy and maintenance expenses. The AT&T Global SIM card and IoT Services, like Control Center, allow for near real-time access to data directly from the chiller. This persistent and reliable



service helps Carrier customers have the peace of mind to know whether their equipment is running at optimal levels. The benefits are :

- Early detection of an issue means faster resolution.
- Better energy management improves ownership costs.
- Proactive maintenance corrects minor problems before they lead to more complex and expensive repairs.

"IoT technology optimizes equipment management," said Chris Opie, Director of marketing North America, Carrier Commercial Systems. "The secure AT&T network gives our customers valuable information. It helps them better manage their equipment and facility – saving them time and money, while delivering

on our commitment to provide the most innovative and efficient service offerings." Carrier SMART Service is available in the United States with AquaEdge water-cooled chillers with product integrated controls. It is also portable, which means facility managers and building owners can use the technology on a temporary basis to troubleshoot, diagnose issues. ■

## Wolseley Merges with Swiss Walter Meier

Wolseley has signed an agreement to merge Tobler, its Swiss plumbing and heating business, with Walter Meier AG, a Swiss heating and HVAC distributor.

If completed, the merger would be consistent with the strategic objectives of

both Wolseley and Walter Meier to create a high quality, market-leading business across plumbing, heating and HVAC distribution in Switzerland.

The proposed merger is subject to approval by Walter Meier's shareholders, appropriate financing and Swiss competition clearance and therefore there can be no certainty that the transaction will be completed. If it is completed, Wolseley expects to receive cash consideration of CHF117.8 million and a 39.2% minority holding in the newly combined and enlarged business. ■





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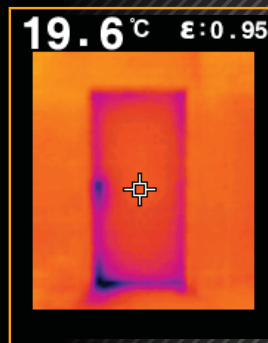
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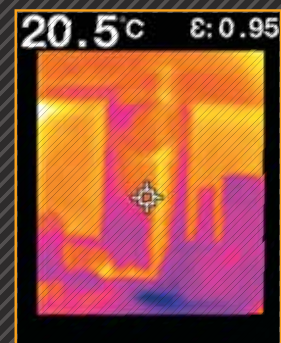
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## Istanbul's New Airport Chooses Systemair

Systemair AB company in Turkey has received an order for 531 Model FL NG series air handling units and 5630 fan coil units of a value of approximately EUR 9.5 million to the new airport in Istanbul.



The new airport is one of the largest ever infrastructure projects in the Turkish Republic, where flights to more than 350 destinations will take place. The project will be staged in four phases and the first new airport phase will be opened during 2018.

"We are proud to be selected to deliver to this largest ever infrastructure projects in the Turkish Republic. This new order confirms that our customers have confidence in our quality and reliability," says Ayça Eroglu, Managing Director Systemair Turkey. ■

## Haier AC Takes Lead in Accelerating Intelligent Manufacturing

With the recent publication of the Intelligent Manufacturing Development Plan (2016-2020), Haier Group's new strategic goal is accelerating industry progress. According to the 2016 Chinese Smart Air Conditioner Market Analysis Report, Haier's products, with sales volume of around 60%, have topped market share rankings for 35 straight months, continuing to lead the market with constant technological innovation and accelerated product iteration. Following the global transformation trend sparked by 'Industry 4.0', the Haier Interconnected Factory provides new ideas for the innovation of intelligent manufacturing in the domestic household appliance industry. ■

## United AIRAH Women to promote HVAC&R

AIRAH has established a new group, the Women of AIRAH to help promote diversity, representation and inclusion within the ranks of HVAC&R. Established in late 2016 and recently ratified by the board, the Women of AIRAH (WOA) group will work to develop AIRAH's strategy for supporting women and increasing their participation in both AIRAH and the HVAC&R industry at large.

"It is of great importance that the women within our industry are both acknowledged and supported," says AIRAH CEO Tony Gleeson, M AIRAH. "AIRAH understands that women are underrepresented in HVAC&R, and we believe that the creation of the Women of AIRAH group is an important step forward if this is to change. Women of AIRAH will not only provide women in the industry

with a forum to voice issues of concern, but will also work to make HVAC&R an attractive prospect for those looking to take the next step in their career."

The Women of AIRAH group will work with local AIRAH divisions to run events, networking sessions, mentoring, support and other initiatives. AIRAH has now finalised the group's state committee representatives, and is delighted to announce Ura Sarfejoo, M AIRAH, as the inaugural WOA

Chair. "The Women of AIRAH group is about improving diversity and the representation of women in the industry," says Sarfejoo. "It's important for women to feel included. For the sake of the profession, engineering needs more women to get involved, so this AIRAH initiative is incredibly exciting." ■



## USGBC's Greenbuild Conference in Mumbai in Nov

The US Green Building Council (USGBC) has announced that Greenbuild, the world's largest green building conference and expo, will be held in Mumbai, India from November 2-4, 2017. USGBC also announced that the Greenbuild International Conference and Expo will be held in partnership with the ABEC Exhibitions & Conferences Ltd (ABEC), and bring together Indian and global industry leaders, experts and frontline professionals dedicated to sustainable building, making Greenbuild the ideal space to learn about groundbreaking green building products, services and technologies in the region.

"Greenbuild is the place where the passion of the green building movement comes alive," said Mahesh Ramanujam, President & CEO, US Green Building Council and Green Business Certification Inc (GBCI). "India is the third largest market for LEED outside the US, and USGBC has committed to bringing its resources to advance more rapid adoption of green building practices in the country.

In fact, green building is projected to grow 20 percent in India by 2018, which makes my mother country the perfect location to hold the Greenbuild conference."

GBCI, the certification body for all LEED projects globally—which was incorporated in India last year—will also play a significant role in the conference along with its array of new rating systems designed to advance sustainability in the built environment. Emerging economies like China, India and Brazil are engines of green growth and development varies from two to six-fold over current green building levels.

Increased consumer demand has also pushed the world's green building market to a trillion-dollar industry, a surge that has led to a corresponding increase in the scope and size of the green building materials market, which is expected to reach \$234 billion by 2019.

Green building is about reducing energy waste and water use; it's about creating jobs and sparking economic growth; it's also about protecting the health of our children for the future. ■

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## Mitsubishi Electric Opens New Office in Dallas

The Dallas-Fort Worth region, in what seems like the heart of the US commercial real estate boom, now has another big player joining the mix. Mitsubishi Electric US, Inc. (Mitsubishi Electric) has announced the grand opening of its new office for the Cooling & Heating and Elevator & Escalator Divisions. According to the Dallas Morning News, a new Dodge Data & Analytics report found that North Texas construction hit record numbers in 2016, with almost \$21 billion in new building starts. This makes Dallas-Fort Worth second only to New York City in total construction starts.

"With Mitsubishi Electric's strong leadership position in both the cooling and heating and the elevator and escalator markets, this opening was strategic to taking a more active role in this region's commercial, multifamily and residential growth potential," says Mark Kuntz, senior vice president and deputy general manager, Mitsubishi Electric US, Inc. Cooling & Heating Division. "For the Cooling & Heating Division, this new office will be an important training center for HVAC engineers and contractors, as well as commercial and residential architects. This gives our customers a chance to experience firsthand the benefits of our innovative ductless and variable refrigerant flow cooling and heating systems."

For the Cooling & Heating Division, the new location will be a training center – the eighth for Mitsubishi Electric Cooling & Heating and one of more than 40 supplier training centers.

"The level of sophistication of this area's commercial architecture is noteworthy and we see a natural fit for the industry-leading quality and reliability of our elevators and escalators," says Michael Corbo, Executive Vice President and General Manager for Mitsubishi Electric US, Inc. Elevator & Escalator Division. ■

## Climaveneta's New Air Source Smart Heat Pump

Climaveneta expands its premium INTEGRA range and presents i-FX-Q2: a new air source smart heat pump that combines all the potentialities of the variable speed drive technology with the well-known advantages of the INTEGRA units. By matching the INTEGRA concept with the inverter technology in both the compressors and fans, the new unit further raises the efficiency bar making the production of hot and cold water absolutely cost-effective. i-FX-Q2 units are in fact able to perfectly and continuously match the real demands of the plant by dynamic adaptation of the rotational speed of compressors and fans, ensuring the maximum exploitation of the absorbed power, in any condition, and therefore minimum energy waste. Key benefits in terms of seasonal performance parameters (defined by EN14825 standards) are immediate: SCOP up to +20% higher and SEER up to +32% higher when compared to traditional high efficiency fixed speed units. Available with cooling capacities from 341 to 1125 kW, i-FX-Q2 can be further tailored to specific specifications or needs of any project. A flexible size selection enables customers to choose the best solution either in terms of efficiency or capacity.

Variable speed technology displays



top-level efficiencies especially at partial loads, which are the most common conditions throughout the entire year in a traditional comfort application. A multi-purpose unit is in fact sized in order to cover the maximum peak demand which, depending on the country where it is installed, may be in summer or in winter. However, in traditional comfort applications, the HVAC plant usually works at full load for very few hours every year: this implies that for the majority of the time the unit works at partial load. The presence of variable speed drive technology allows i-FX-Q2 units to effectively follow each combination of thermal loads required by the system, achieving TER values up to 19% higher compared to traditional fixed speed INTEGRA units.

The i-FX-Q2 INTEGRA heat pumps apply two VSD screw compressors placed in two completely independent circuits. A special configuration that ensures not only simplified maintenance of the compressors but also great redundancy of the cooling circuit. The inverter technology also results in no in-rush currents. This means that there isn't any electrical and mechanical stress as the units never exceed the nominal current without the need of additional devices such as soft-starters or star/delta commutators. ■

## Daikin Applied Makes 'Intelligent' Change

Daikin Applied has renamed its systems and controls businesses to reflect the move towards intelligent equipment. Intelligent Solutions is the new business name for Systems and Controls within the Daikin Applied portfolio. In addition, Daikin Applied's MicroTech Integrated Systems now becomes Intelligent Systems. Both offerings in the Intelligent Solutions portfolio address unique HVAC management needs.



Intelligent Equipment works at the HVAC unit level, giving customers with packaged rooftops and air cooled chillers unprecedented visibility into their HVAC unit performance. With Intelligent Systems working at the system level, customers who operate small-to-mid-sized buildings gain the power of intuitive and easy-to-use system controls without the cost of a full building automation system. ■



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## Cold Chain Market to be \$381bn by 2025

The global cold chain market is anticipated to reach USD 381.68 billion by 2025, according to a report by Grand View Research. The expansion of trade over the years has arisen the necessity of making improvements in the packaging of crops such as the materials used for packaging play a major role in enhancing the storage life. The development of cold chain is responsible for the reduction of wastage of perishable commodities and is vital for the growth of the food sector. Governments across globe provide key services, such as public infrastructure and legislation. Furthermore, service providers train employees to enhance technical expertise in the operation of specialized facilities.

Emerging countries such as India, Brazil, China, and Mexico are currently undergoing a rapid transition to a consumer-led economy. The retailers in these regions have ample opportunities to expand and grow, owing to the prevailing large number of middle-class income consumers. Advancements in the technology have enabled service providers to penetrate the emerging markets with innovative solutions to help solve issues relating to complex transportation. Investment in warehouse automation has been increasing over the past years to meet the customer requirements. High capital investment, running costs, and scalability of different picking methods are the key factors that restrain the market players to automate the warehouses. Furthermore, the growing application of telematics in logistics and transportation is likely to spur the refrigerated transportation market demand. The retailers and franchise customer have vertical integration with the cold chain service providers to ensure the safety and quality. The lack of cold chain facilities in less-developed economies made retailers to invest heavily in developing own cold chain logistics systems. ■

## First LEED Certification for Transit Worldwide Launched

Today the US Green Building Council (USGBC) and Green Business Certification Inc (GBCI) announced a new LEED green building rating system pilot designed to address the unique needs of transit systems around the world. Delhi Metro Rail Corporation (DMRC) will be the first metro in the world to pursue the pilot, LEED v4 O+M: Transit, for their metro stations in Delhi NCR and other states in India.

Performance of the metro stations will be monitored via the newly released Arc performance platform, which facilitates streamlined tracking of data across five performance categories; energy, water, waste, transportation and human experience. LEED v4 O+M: Transit will allow operational transit facilities to benchmark efficiencies and demonstrate continual improvement developed with invaluable input from DMRC. Transit owners can reduce their environmental

footprint, while also engaging riders on the importance of sustainability and the opportunity the public transportation sector has in minimizing greenhouse gas emissions. "Buildings and transportation are the two biggest drivers of climate change," said Mahesh Ramanujam,



President and CEO, USGBC and GBCI. LEED v4 O+M: Transit is targeted for operational transit. LEED-certified transit demonstrates lower resource use and carbon emissions, better quality of space for riders and saves money. ■

## Elanpro Unveils Refrigeration Solutions at Food World Expo

Elanpro, India's leading Commercial Refrigeration Company, showcased its entire range of commercial refrigeration products including hospitality refrigeration solutions, at Food and Hospitality World Expo. The expo was held at MMRDA Ground, BKC, Mumbai.

Elanpro showcased its technologically advanced launches for HORECA segment. The company exhibited its new launch Elanpro Cold wells – a GN 3V ventilated cooling well with high flexibility and perfect visibility. Ideal for display of buffet delicacies, the new offering by Elanpro blends high technology and aesthetic appeal leading a customer's eye directly to the exhibited products.

The company also showcased products like GT Touch and I Pro from recently launched SPM beverage dispenser range. Equipped with standard I-TANK technology to prevent ice accumulation on



the outer walls of the bowl, the range is inclusive of interactive touch screen. It is user friendly and versatile solution ideal for bars, cafeterias, cafes, catering and accommodation facilities, ice-cream shops and dessert bars.

Among the other exhibited products were Hospitality solutions like Elanpro Ice Machines, Bakeshop DC Series, Reach-in Chillers, vertical freezers and blast chillers. The company also showcased EWG bottle wine cooler series which provides quality storage and elegant presentation for red and white wine enthusiasts. ■

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### The Whalen Company Appoints Kel Finch to Board of Directors

The Whalen Company, a pioneering manufacturer of HVAC vertical stack riser heat-exchanger fan coil units and water-source heat pumps, has appointed Kelvin Finch to its Board of Directors.

In his new role, Finch will be bringing in the field experience to the table. His experience as a manufacturer's representative will add new perspective to the board that will help with expanding The Whalen Company. Finch comes to The Whalen Company with over 46 years in the HVAC industry. He started in 1970 at American Air Filter as an order coordinator and was later promoted to Sales Associate and then to Sales Branch Manager in 1981. American Air Filter was eventually sold to Allis Chalmers, then to Snyder General and later to McQuay. In



Kelvin Finch

1992, Finch went to work with HTS Engineering selling the same products as before with a focus on heat pump products. In 1998, Finch left HTS Engineering to start his own representative firm company, Air Mechanical Sales Ltd. Soon after, AMS became a representative for The Whalen Company and has maintained a relationship ever since. In 2015, Finch sold AMS to Emerson Swan Canada and has been assisting with the transition, which is

now complete.

"It is an honor and a privilege to be asked to join the Board of Directors," said Finch. "We have such a long and good history together. I can only hope that my extensive sales experience and background will contribute to the expansion of Whalen." ■

### François Deschênes Becomes President & CEO of Groupe Deschênes

Groupe Deschênes Inc (GDI), the largest Canadian company in its field announced the appointment of François Deschênes as President and Chief Executive Officer. He previously held the position of Vice President of Operations for the Quebec Region at GDI.

"After 17 years at the helm of the company, I am very proud to see that my brother François has been chosen to succeed me. François will be able to contribute to the growth and success of the company," said Martin Deschênes, President and CEO of GDI.

"As a family business for more than 75 years, GDI takes the succession process very seriously. The members of the Board unanimously selected François and will be happy to work with him to achieve the objectives of the company," said John



François Deschênes

LeBoutillier, Chairman of the Board of GDI. François said, "I am very pleased to have the opportunity to take the leadership of the organization. As President, Martin was able to undertake several initiatives that have moved the company forward to the enviable position it currently occupies in its market. We can count on a strong team and a solid foundation to continue our development."

François was appointed to the Canaplus Limited Partnership (now AD Canada P&H in 2016) as a representative of GDI in 2000. He also held the positions of Vice President of Supply and Vice President of Marketing. In 2010, he became Vice-President and General Manager of the subsidiary Deschênes & Fils ltée - Montréal. Last year, he was appointed Vice-President, Operations, GDI for the Quebec Region. ■

### Clive Parkman Takes Role of MD for Daikin Applied UK

Clive Parkman took on the role of Managing Director of Daikin Applied (UK) Ltd and with it the overall responsibility for the day to day running of the business.

Clive has significant experience of the UK Chiller and Air Handling Unit market, having led Airedale International and Barkell successfully over a period of growth for a number of years. His appointment will provide the company with additional insight and experience, focusing on delivering innovative project design through to delivery and further developing exceptional customer service and support. "I believe this is a great opportunity for me to continue the positive work undertaken over the past few years and I am pleased to have joined the business at this time," says Clive. "It is clear, there is a great team in place and



Clive Parkman

hopefully I will be able to guide and assist them in delivering improvements through product innovation and improved customer service. We will be looking at all aspects of the business and implementing positive changes that will continue Daikin Applied's growth and further establish its UK operations."

"Daikin continue to develop products focused on improving energy efficiency and exceeding environmental targets; our job here in the UK is to continue to provide our clients with market leading Chiller, AHU and Service & Maintenance solutions, designed specifically to meet their needs. With a strong portfolio of products and services and a wealth of knowledge within the organisation, I look forward to taking Daikin Applied UK in the next stage of its growth," he further adds. ■

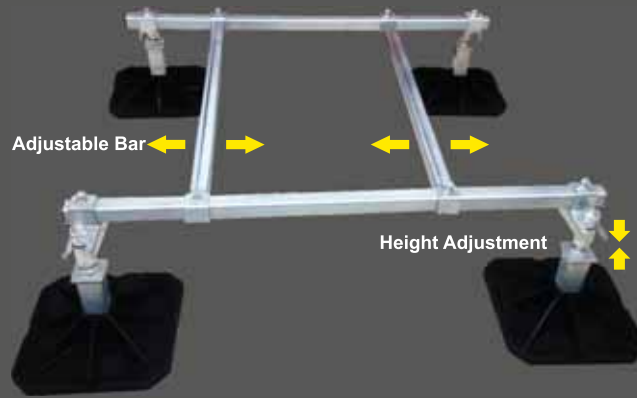


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## Infosys Inducted into ACREX Hall of Fame 2017

Infosys Limited received the honour of being inducted into the Hall of Fame at ACREX 2017, one of India's largest industry exhibitions. Instituted by ISHRAE in

partnership with Danfoss India, the coveted induction recognized Infosys for being at the forefront in driving energy efficiency and sustainability encouraging its peers and the industry in building a sustainable HVAC industry.

ACREX Hall of Fame is an industry benchmark instituted by Danfoss India in partnership with ISHRAE (Indian Society of Heating, Refrigerating and Air Conditioning Engineers) to recognize the excellence achieved in conserving energy by commercial buildings in the Indian subcontinent.

"While it is general practice to look outside India for best use case projects which have displayed energy saving capabilities, we have examples in India which can be benchmarked globally. It is vital to look at these success stories within India which can be emulated by others in the industry," said Ravichandran Purushothaman, President, Danfoss India. It is with this idea of identifying projects from which we can all learn and imbibe that Danfoss India associated with ISHRAE to bring you the prestigious ACREX Hall of Fame which is a



The coveted recognition has been awarded to Infosys for promoting energy conservation

journey we started in 2015 and are proud that the platform has been embraced by stakeholders in the Commercial Buildings space," he added.

This year, the coveted recognition has been awarded to Infosys for being a front runner in promoting energy conservation and sustainable work environment. With an integrated approach to developing energy efficient buildings that include sourcing natural lights, efficient LED Lighting, energy harvesting sensors & control and the implementation of the radiant panel based cooling, Infosys reaffirmed its commitment to develop and maintain a green infrastructure.

Acknowledging the award, Guruprakash Sastry, Regional Manager Infrastructure, Infosys said, "We are happy that Infosys is inducted to ACREX Hall of fame and serves as a testament to the increasing focus on energy efficiency and sustainability. With a performance based, data driven methodology, we are trying to approach energy efficiency and sustainability from a more holistic view and it is our belief that the scope for energy efficiency in buildings is immense and the key to energy efficiency is proper management." ■

## Daikin Receives Manufacturing Leadership Award

Daikin Applied Americas has been recognized as a Manufacturing Leadership Award winner by Frost & Sullivan for outstanding achievement with its Variable Volume Ratio (VVR) technology.

As HVAC technologies evolve to better deliver higher efficiencies in building performance, lower cost, and less energy yielding a smaller carbon footprint, one problem has continued to challenged engineers: HVAC systems are often pressed to meet a building's occupancy demands for varying conditions. Daikin addressed this challenge with the design and implementation of Variable Volume Ratio (VVR) technology in the new Pathfinder® air-cooled chiller.

With new VVR technology, the HVAC chiller's compressor senses the amount of lift needed in any given moment, and



Daikin gets Manufacturing Leadership Award winner by Frost & Sullivan for outstanding achievement with its Variable Volume Ratio (VVR) technology

adjusts the compression ratio automatically. The result is that the compressor works only as hard as it needs to; and facility operators don't pay for over-compression which is likely occurring 95% of the time. VVR technology delivers optimal efficiency at any operating condition.

"VVR technology allows Daikin to offer our customers more flexibility, higher efficiency and a better overall chiller product," says Rob Landes, chiller product manager, "Each individual customer's needs are different and equally important; with VVR we can address each need in a highly reliable way." The Manufacturing Leadership Awards organized by Frost & Sullivan is now in their 13th year honouring companies and individual leaders that are influencing the future of global manufacturing. ■

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2950 RPM

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# Refrigerant Leak Monitoring System

Leaking refrigeration systems generally pose a challenge to the refrigeration sector and require resolute action. Otherwise the industry may lose the initiative and be subjected to even tougher, mandatory laws and taxes to address, among other things, the associated negative environmental consequences...

An important operational target for all refrigeration systems can generally be said to be that they should be as tight and leak-proof as possible. There is no absolute leak-free

system and the use of gas detection products aims to minimise and control this leakage. Leaking refrigeration systems generally pose a challenge to the refrigeration sector and require resolute

action. Otherwise the industry may lose the initiative and be subjected to even tougher, mandatory laws and taxes to address, among other things, the associated negative environmental consequences.

This article is aimed at everyone who is involved in various ways with planning, installing and maintaining commercial and industrial refrigeration systems. It offers the user a comprehensive overview of what is required for different applications and how the existing standards are implemented. Ultimately, it is about personnel safety, profitability and the environment.



## Who need a Refrigerant Monitoring System?

Every refrigeration machine room and every refrigerated room needs a refrigerant monitor, especially, if the system to be monitored contains more than 23 kg of refrigerant. There are several good reasons to install a gas monitoring system.

The main reasons are personnel safety and environmental concerns in line with current legislation. It is also financially profitable to have reliable facilities with as leak-free systems as possible.

There are three main reasons to install refrigerant monitoring systems:

- For personnel health & safety
- For environmental care
- For financial reasons

### For personnel health & safety

Several of the gases in refrigeration plants are dangerous to humans. In lesser concentrations, ammonia can cause irritation to the respiratory tract and eyes, and in higher concentrations may lead to severe injuries and eventually death.

HFC (HCFC) refrigerants and carbon dioxide displace oxygen from the air and may ultimately bring about suffocation. HCs such as propane and isobutane are a hydrocarbon compound, containing only carbon and hydrogen. These compounds cause no damage to the environment, but are flammable. So, measures to minimise risk need to be taken. HCs may also cause suffocation.

### For environmental care

Most of the gases in refrigeration plants have adverse environmental effects. The so-called F gases, the fluorinated greenhouse gases, are discussed the most. Some older gases with chlorine compounds are now totally banned within the EC and may only be used in recycled form.

## HCFC

HCFCs like HCFC 123 and HCFC 22 are halogenated hydrocarbon compounds with chlorine that affect ozone depletion. These refrigerants are governed by Montreal Protocol and under phase out schedule in India.

## HFC

HFCs like HFC 134a and HFC 410A are halogenated compounds that do not contain chlorine and thus do not affect the ozone layer. However, HFCs have a significant impact on global warming so emissions must be minimised. The uses of HFCs are regulated by the Kyoto Protocol and recently being included in Montreal protocol as well. It thus is in our common interest to keep refrigerants in systems that are as free of leaks as possible.

### For financial Reasons

The refrigeration systems are, especially, prone to leaks: Vibration expansion and contraction in lines, breaks in capillary tubes, poorly connected flare connections all contribute to repeat service calls and early compressor failure. Statistically every refrigeration system loses its complete charge three times in ten years.

There is a direct relationship between refrigerant loss and compressor failure in a refrigeration system where failure can be traced back to inadequate refrigerant gas due to leaks.

Approximately 50% of supermarkets electric cost services the refrigeration system. And slow leak will gradually reduce a compressors capacity, and directly affect efficiency, causing the compressor to run more frequent and longer run times. This will directly reduce compressor life.

Refrigerant blends (400 Series) can leak the component with the highest saturation pressure first, leaving the blend in the system short of the chemical. When fresh refrigerant is added, blend is not the same. If a system is repeatedly charged, the resulting new blend will decrease equipment efficiency to the point that the entire charge.

### Choosing the Right System

A gas detection system consists of a chain – from discovery of the risk to the corrective action. It is important to think through the measures to be taken at each level of alert, and to plan for the appropriate staff to be informed, such as the plant

manager and maintenance contractor.

1. What is the purpose of the alarm?
2. Which gas(es) are to be detected?
3. What detection principles are the most appropriate? How many sensors are needed, where and how should they be placed?
4. What rules and regulations apply for the refrigerant in use?
5. What is the refrigerant's density relative to air?
6. How does the ventilation affect the detected area?
7. What steps are to be taken when an alarm occurs?

### The function of different alarm levels

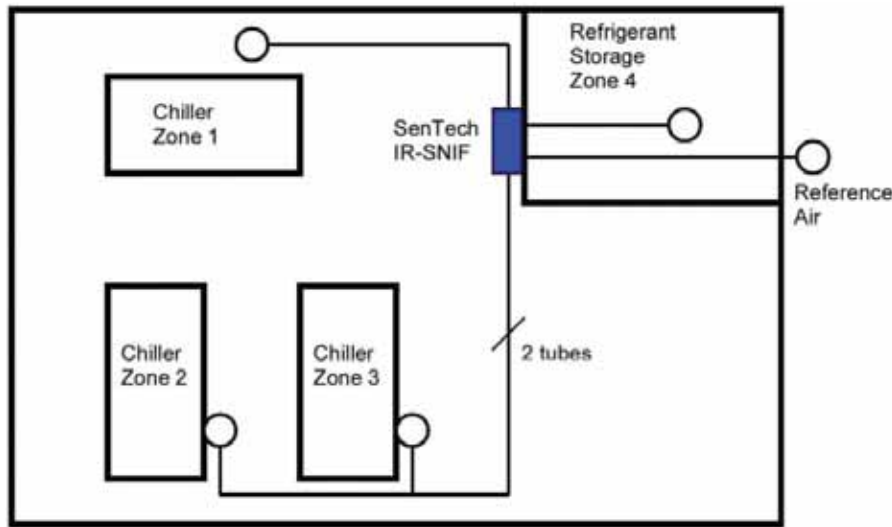
Alarms can typically be divided into Level 1, 2 and 3 alarms, also named low level alarm, main level alarm and high level alarm. Each different alarm level calls for different measures:

Normal (0 to 10 PPM): This PPM range is based on normal background readings of most refrigeration and comfort air applications. This level is considered safe for equipment and AEL recommendations

Low Level (25 PPM): Alarm for maintenance staff, this indicates possible leak. Repeated low alarms indicate a probable leak that should be identified and repaired for conservation purposes. The purpose of low level Alarm is to indicate that a possible leak exists and to provide early warning before the leak grows.

Main Level (50 PPM): Urgent alarm for maintenance staff, flashing light activated. This indicates a significant and growing leak. The probable leak should be identified and repaired as soon as practical, if not immediately. The purpose of main alarm is to indicate that a substantial or growing leak exists and minimize the refrigerant loss before it reaches a point which might affect personal and building operations. The building ventilations should not be started as this would hamper the ability to find leak.

High Level (150 PPM for R123 and 500 PPM for others): Emergency alarm as the main level alarm, with siren activated and alarm sent to the rescue services, refrigeration plant is shut down (power



Typical Sample Location

supply as well). This indicates that significant leak or possibly a catastrophic spill has occurred.

For R123, the level has exceeded the short term exposure level (STEL) of 150 PPM. The high speed exhaust ventilations should be turned on to reduce the level of below acceptable level exposure level of 50 PPM.

For other refrigerants, the level may have approached the AEL of 1000ppm. High speed exhaust ventilation should be turned on to reduce the level to below 50 ppm.

The purpose of high alarm is to indicate a major leak. In addition to ventilation, a remote area supervisor should be notified that a possible large leak has occurred and proper personal protective equipment might be needed in order to enter the space.

## Typical Sample Location

### Purpose of the alarm

To choose the right equipment and systems, a number of parameters first must be determined. This then controls the choice of products, their placement and the alert levels.

The main objectives of a gas alarm systems are:

- Leakage alarm, monitoring unoccupied space
- Emergency alarm
- Personnel health & security
- Warning of fire and explosion hazard
- Protect stored products.

## Leakage Alarm, Monitoring Unmanned Space

Monitoring of accidental leaks in order to avoid downtime, protect the environment and minimise the loss of refrigerant. There are no established alarm limits since the need has to be adapted to each refrigeration plant. Practical experience shows that the alert levels based on sanitary limits usually are too low for effective leakage alarms. The sanitary limits in turn are different depending on the type of gas.

## Emergency Alarm

Emergency alarm concerns in principle only ammonia plants and explosive gases. Emergency alarms will start the evacuation of buildings, neighbourhoods, etc and involve the monitoring of high concentrations directly dangerous to life and health. National legislation typically implies that a risk assessment or risk analysis must be made in all plants with ammonia. An action plan must be drawn up that, among other things, concerns how the staff should be alerted and act in order to be safe. In larger facilities, where there is a risk of external leakage to the surroundings, there must also be a plan for how the public should be warned.

## Room Volume Considerations

Normal industry practice has been to think about refrigerant leaks in terms of grams of refrigerant per unit time, such as lbs/hr or gr/yr. This is a natural and logical way of looking at it. The system monitors

the amount of refrigerant present in the air in parts per million (ppm) by volume or refrigerant molecules as compared to air molecules. In order to develop a correlation between the leak rate in weight per unit time and parts per million, there are a number of items that need to be considered. These are:

- 1 Room volume
- 2 The weight of refrigerant per unit volume at ambient temperature and pressure
- 3 The amount of time the refrigerant has been leaking
- 4 The rate at which fresh air enters the room and existing air is exhausted.
- 5 The location of the inlet, relative to the leak, air flow in the room and the rate at which the refrigerant expands to fill the room.

For a specific application, items 1 through 4 can be calculated, or estimated. Item 5 is virtually unpredictable, therefore in all calculations, it is assumed that the leaking refrigerant will expand to fill the room with an even distribution of refrigerant. This assumption will yield safer, conservative calculations. If the monitor sample and reference locations have been appropriately chosen, the monitor will see a higher concentration than calculated from the ideal formulas.

### Formula Definitions:

- ppm – refrigerant concentration  
 LR – Leak rate in cubic meter/hour  
 FA – Fresh air into the room in cubicmeter/hour  
 VOL – Room volume in cubic meter  
 t – Time in hours  
 R – Volume of refrigerant in cubicmeter  
 LRmin – Minimum leak rate that will result in a given ppm  
 RD – Refrigerant density in kg/cubicmeter

To be able to convert between ppm and leak rate in cubic meter/hour, the refrigerant density must be known, the refrigerant density of common refrigerants is

- R-22 RD22 = 3.59 kg/cubic meter  
 R-123 RD123 = 6.56 kg/cubic meter  
 R-134a RD134 = 4.34 kg/cubic meter

Lets try with two examples to



Emergency Alarm

demonstrate the conversion. Case I is for a sealed room, with no air turnover. Case II is for a room with a known air turnover.  
**Case I: Sealed room 15 m x 10 m x 3 m high**

1. How much R-22 (in kg) is necessary to cause a measurement of 25 ppm?  
 Given 25 ppm R-22 in the sealed room:  
 Volume of R-22 = parts per million/million x room volume  
 $R(\text{cubic meter}) = [25(\text{ppm})/1,000,000] \times [15 \times 10 \times 3](\text{cubic meter})$   
 $R(\text{cum}) = .01125 \text{ cubic meter of R-22 in the sealed room}$   
 Given .01125 cubic meter R-22, calculate weight in kg:

Weight = volume (cubic meter) x density (kg/cubic meter)  
 Weight =  $R(\text{cubic meter}) \times RD22(\text{kg/cubic meter})$   
 Weight =  $.01125(\text{cubic meter}) \times 3.59(\text{kg/cubic meter})$

**Weight = .040 kg**  
 2. If the leak rate is 150 kg/yr, how long will it take to reach 25 ppm?

Given the same refrigerant in the same room, 25 ppm weighs .040 kg:

Time (hr) = weight of R-22(kg) / [weight(kg)/time(yr)] x [time(hr)/time(yr)]

Time(hr) =  $.040(\text{kg}) / [150(\text{kg})/1(\text{yr})] \times [8760(\text{hr})/1(\text{yr})]$

Time(hr) = 2.34 hrs

**Case II: 10 m x 15 m x 3 m high room with fresh air makeup of 225 cubic meter/hr**

1. How much R-22 (in kg/yr) is necessary to cause a measurement of 25 ppm?  
 Given air turnover of 225 cubic meter/hr, calculate the leak rate that is required to maintain a measurement of 25 ppm:

Leak rate min (cubic meter/hr) = parts per million/million x fresh volume (cubic meter/hr)

Leak rate min (cubic meter/hr) =  $[25(\text{ppm})/1,000,000] \times 225(\text{cubic meter/hr})$

Leak rate min (cubic meter/hr) = .005625 cubic meter/hr

Given .005625 cubic meter/hr, calculate the leak rate in kg/yr needed to reach 25 ppm:

Leak rate (kg/yr) = leak rate (cubic meter/hr) x density (kg/cubic meter) x

$[8760(\text{hr}) / 1(\text{yr})]$   
 Leak rate (kg/yr) =  $.005625(\text{cubic meter/hr}) \times 3.59(\text{kg/cubic meter}) \times 8760(\text{hr/yr})$

Leak rate (kg/yr) = 176.9 kg/yr, therefore the leak rate must be greater than 177 kg/yr.

2. If the leak rate is 300 kg/yr, how long will it take to reach 25 ppm?

Calculate LR in cubic meter/hr:

LR (cubic meter/hr) =  $[\text{leak rate}(\text{kg/yr}) / \text{density}(\text{kg/cubic meter})] / 8760(\text{hr/yr})$

LR (cubic meter/yr) =  $300(\text{kg/yr}) / 3.59(\text{kg/cubic meter}) / 8760(\text{hr/yr})$

LR (cubic meter/yr) = .009539 cubic meter/hr

Calculate time in hr:

Time (hr) =  $[\text{Room volume}(\text{cubic meter}) / \text{Air flow}(\text{cubic meter/hr})] \times \ln[\text{LR}(\text{cubic meter/hr}) / \{\text{LR}(\text{cubic meter/hr}) - \text{Leak rate min}(\text{cubic meter/hr})\}]$

Time(hr) =  $[450(\text{cubic meter}) / 225(\text{cubic meter/hr})] \times \ln[.009539(\text{cubic meter/hr}) / \{.009539(\text{cubic meter/hr}) - 0.005625(\text{cubic meter/hr})\}]$

Time(hr) = 2(hr) x ln[2.437] Time(hr) = **1.78 hr**

### Conclusion

Refrigerant monitors system offers two important benefits: refrigerant conservation and safety. With the decreasing availability of refrigerants, coupled with rising cost, it is important to have a refrigerant monitor in the equipment room to provide early warning of refrigerant loss. As a leak-sensing device, a refrigerant monitor constantly measures the amount of specific refrigerants in the surrounding air. It's capable of initiating alarms, activating building ventilating systems, and integrating with building automation systems. Refrigerant monitors are also strongly recommended for all existing chiller rooms or refrigerant storage facilities. ■



**Kapil Singhal**  
 Founder  
 B P Refcool



# Retrofitting Existing Buildings

Green building is about reducing operational cost and at the same time increasing human comfort, hence it is a certain fact that even old existing buildings can get benefitted considerably by this concept. Today's building owners are retrofitting buildings, converting existing buildings into models of sustainability with the aim of reducing the energy bills and increasing the asset value...

grown in less than one decade in India and currently focuses on new building construction sector due to the increasing rates of construction in the country, existing building stock far exceeds that added annually; hence it is critical that policy interventions are made to improve energy efficiency in both new construction as well as existing buildings.

Furthermore, Green building is about reducing operational cost and at the same time increasing human comfort, hence it is a certain fact that even old existing buildings can get benefitted considerably by this concept. Today's building owners are retrofitting buildings, converting

One of the critical challenges being faced by the humankind today is climate change. As the common man grapples with the widespread environmental damage and its consequences, there is a need to start reforming the wasteful lifestyle. Green Building movement has exponentially





existing buildings into models of sustainability with the aim of reducing the energy bills and increasing the asset value.

Contrary to popular perception, industry interviews and research confirm that many energy-saving initiatives for existing buildings can be achieved with little or no cost. For example, Festival Walk in Hong Kong, a mixed-use commercial complex building built and managed by Swire Properties, one of the biggest real estate companies in Hong Kong and a member of the Swire Pacific Group, changed the control strategy of its air conditioning system in 2004 from a flow-demand oriented logic to a multi-criterion logic to minimize the mismatch of cooling load demand and chilled water flow demand. The investment for such a change was minimal since it only required modification of the program logic, but the energy savings reached approximately 4,00,000 kWh and reduced the release of CO<sub>2</sub> by 240,000 kg annually. To identify such saving opportunities like the Festival Walk case in existing buildings, the starting point is to make energy management a business priority for building operators and occupiers. In that way, a building doesn't have to be new to be green or energy efficient.

In addition to the developed countries where scope for new construction has been shrunk, the green building movement for existing buildings has begun even in developing countries like India due to the fact that building efficiency is key to cutting energy consumption. Buildings account for 16% of world energy consumption with a higher share in developed economies (nearly 40% of total energy use in the United States). In 2007, 878 million metric tonnes of greenhouse gases were attributed to commercial buildings worldwide. In US, while approximately 2% of commercial floor space is newly constructed each year, and a comparable amount renovated, the majority of opportunities to improve efficiency over the next several decades will be in existing building stock, most of which are constrained by old equipment, aging infrastructure, and inadequate operations resources.

As per Architects Journal, "The huge task of retrofitting UK buildings could offer three decades of work for architects, and overshadow new-builds by 2050".

Paul Finch, Chair - Commission for Architecture & the Built Environment (CABE) says, "There are more than 25 million homes in Britain, most of which do not conform to current environmental standards. If we retrofit 4,000 homes per week, it would give us 30 years worth of work. If you choose to seize it, this is one of the biggest opportunities for architects that we've seen in this country for a very long time."

It is also worthy to note here that 80% of the total lifecycle cost of a building goes in operation and maintenance (O&M) cost while the initial investment is only 20%. Hence, it is important to ensure that the building is operated and maintained in a more sustainable manner.

## Ratings for Existing Buildings

There are different ratings available to certify the sustainable and efficient operations in existing buildings and to streamline efforts to promote energy efficiency in the buildings sector viz.

1. **Energy Star** rating by Environmental Protection Agency (EPA)
2. **BEE Star Rating** for Buildings by Bureau of Energy Efficiency (BEE)
3. **LEED** (Leadership in Energy & Environmental Design) certification by United States Green Building Council (USGBC).
4. **IGBC Green Existing Building Operations and Maintenance Rating** by Indian Green Building Council

**Energy Star** Rating is focused on energy performance of the building and hence rating is awarded based on the energy consumption and savings of the respective building. An energy star certified facility meets strict energy performance standards set by Environmental Protection Agency (EPA). In order to qualify for the Energy Star, a building or manufacturing plant must earn a 75 or higher on EPA's 1-100 energy performance scale, indicating that the facility performs better than at least 75% of similar buildings

nationwide. The Energy Star energy performance scale accounts for differences in operating conditions, regional weather data, and other important considerations.

**Bureau of Energy Efficiency (BEE)** has developed a Star Rating programme for buildings which is based on the actual performance of a building in terms of its specific energy usage in kWh/sq m/year. This programme rates office buildings on a 1-5 Star scale, with 5 Star labelled buildings being the most efficient. The scheme is propagated on a voluntary basis and the label provided under it is applicable for a period of 5 years from the date of issue. Commercial buildings or establishments have been included in the list of industries and other establishments under the Energy Conservation Act (2001) and have been notified as designated consumers.

**LEED Existing Buildings Operations & Maintenance (EBOM) Rating System, developed by (USGBC)** helps building owners and operators measure operations, improvements and maintenance on a consistent scale, with the goal of maximizing operational efficiency while minimizing environmental impacts. LEED EBOM addresses whole-building cleaning and maintenance issues (including chemical use), recycling programs, exterior maintenance programs, and systems upgrades. It can be applied both to existing buildings seeking LEED certification for the first time and to projects previously certified under LEED for new construction, schools, or core & shell.

**LEED EBOM** is a third-party rating system and tool that provides performance options in:

1. Sustainable Sites
2. Water Efficiency
3. Energy & Atmosphere
4. Materials & Resources
5. Indoor Environmental Quality
6. Innovation & Regional Priorities

Up to 100 points are tallied and buildings can achieve one of four different performance ratings - Platinum, Gold, Silver or Certified.



**IGBC Existing Building Operation & Maintenance (EBOM) Rating System** is the first rating programme developed in India by IGBC, exclusively for existing building stock. It is based on accepted environmental principles and strikes a balance between known established practices and emerging concepts. IGBC Green Existing Buildings O&M Rating System is fundamentally designed to address national priorities of resource conservation while providing quality of life for occupants. The rating programme uses well-accepted national standards and wherever local or national standards are not available, appropriate international benchmarks have been considered.

IGBC Green Existing Buildings O&M rating system addresses green features under the following categories:

1. Site & Facility Management
2. Water Efficiency
3. Energy Efficiency

4. Health & Comfort
5. Innovation

### Energy Saving Tips

Taking simple steps can considerably reduce the amount of energy used in a building, which in turn can help save money in the long run. Such simple measures may include the following:

#### Lighting

- a. Replace old incandescent bulbs with energy-efficient compact fluorescent lights or LEDs.
- a. 40-watt fluorescent lamps can be replaced with 34-watt compact fluorescent lamps that produce almost the same amount of light.
- c. Install occupancy sensors or turn off lights when not needed. Occupancy sensors have been shown to save up to 30 percent on lighting costs during normal working hours. Lights in storage areas, conference rooms,

restrooms, or near windows can be left off when space is unoccupied.

- e. Install the timers or time clocks to ensure that interior and exterior lights are turned off at the appropriate time. These are generally simple to install and are inexpensive as well.

#### Air-Conditioners

- e. Set up thermostat temperature inside the space as per comfort requirements only i.e. not too cool and not too hot.
- f. Use an interior fan in conjunction with the window air conditioner

#### Refrigerators

- e. Regularly defrost manual defrost refrigerators and freezers
- f. Leave enough space between your refrigerator and the walls or cabinets

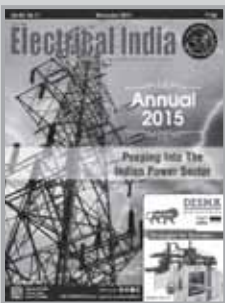
**Electronic Appliances:** Buy and use BEE star rated appliances

Improved efficiency of existing buildings through building retrofitting and other measures represents a high-volume, low-cost approach to reducing energy use and greenhouse gas emissions. As India pursues ambitious plans for sustainable development and equitable growth, energy efficiency is an important, low-cost resource. With an emphasis on “whole building” rather than piecemeal approaches, existing buildings can significantly reduce energy consumption and greenhouse gas emissions while producing financial rewards for owners. ■



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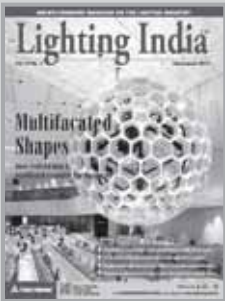
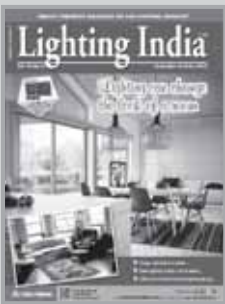
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Several Others...

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  - Machine
  - LED
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  - Electric Measuring Instrument
- Suppliers
  - Chemical
  - Starter
  - Lighting Products
  - Brass Component
  - Plastic Component
  - Gas
  - Cable Wire
  - Lamp Component
  - Electric Component
  - Steel Component
- Research & Testing Laboratories
- Electronics in Lighting
- Furnace Refractories

... and related accessories.

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- Consultants, Contractors & Traders, Project Managers
- Plant Engineers of Large Companies
- Builders & Developers
- Mechanical & Electrical Engineers
- Lighting Products Manufacturers, Suppliers & Distributors
- Entertainment Industry
- Construction Industry
- Hotels & Restaurants
- Fitness Centers
- Hospitals
- Airports Authority of India
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- Government Utilities:
  - Ministry of Power
  - Central Public Works Department
  - Electricity Utilities
- Non-conventional energy providers
- Manufacturers from other allied industries
- Universities, Technical & Research Institutions

Several Others...

## Emerson Launches Gurgaon Cold Chain Center

Emerson received overwhelming response from the key Industry stakeholders for its First Cold Chain Center located at Chakan, Pune. Encouraged by this success Emerson opened its new Cold Chain Center at Gurgaon to be close to its customers in North India.



Hakan Erdamar, President Asia and Middle East & Africa, for Emerson's Commercial & Residential Solutions

India is one of the fastest growing economies in the world and offers immense potential for the cold chain industry. The government has enabled growth by taking many steps in this direction - promoting cold chain infrastructure by encouraging adoption of environmentally responsible and energy efficient technologies, while also enabling skill development to support the industry.

Emerson received overwhelming response from the key Industry stakeholders for its First Cold Chain Center located at Chakan, Pune. Encouraged by this success Emerson opened its new Cold Chain Center at Gurgaon to be close to its customers in North India.

This center provides expert project design services to end users, contractors and

consultants. From heat load calculations to customized refrigeration solutions, Emerson's team works to ensure that the cold storage project is optimally designed. These services cater to the wide range of cold storage facilities such as fresh produce collection centers, pack-houses, fruit processing, dairy, logistics warehouses and retail. The Gurgaon center also offers practical hands on training covering a wide range of topics along with live equipment, simulation and solutions in action.

Speaking on this special occasion, Hakan Erdamar, President Asia and Middle

East & Africa, for Emerson's Commercial & Residential Solutions platform said, "Emerson has an unmatched array of products and solutions to support the Cold Chain Industry. Our value proposition of offering the best-in-class global technologies, customized locally for the India Cold Chain market, places us in a unique position to serve the industry in an optimal manner. We are delighted to meaningfully contribute to the development of the Cold Chain segment in India."

It is recognized that strong cold chain infrastructure leveraging highly energy efficient technologies and intelligent solutions will be vital to preserve food quality and minimize food wastage in India. Raising awareness levels through training and ensuring strong lifecycle support will act as catalysts for scaling up the cold chain infrastructure in the country.

Speaking at the launch, Sridar Narayanswami, Vice President and Managing Director of India, Emerson's Commercial & Residential Solutions platform, said, "North India is the largest region for Cold Chain with presence of key industry players across farm to fork. Several nodal agencies are based in this region. We are pleased to open this fully equipped facility to provide training, design services and technical support to our customers and partners." ■



Sridar Narayanswami, Vice President and Managing Director of India, Emerson's Commercial & Residential Solutions platform

# Warming Up to Chillers

A chiller is a compressor based cooling system that is similar to an air conditioner except it cools and controls the temperature of a liquid instead of air. The chiller will provide a stable temperature, flow and pressure once it has been programmed by a user for their individual needs...



Chilled water cooling systems, also known simply as “chillers”, are a popular choice for commercial air conditioning repair and institutions such as schools and hospitals. A chiller is a compressor based cooling system that is similar to an air conditioner except it cools and controls the temperature of a liquid instead of air. Large commercial buildings that require a substantial amount of cooling often use water chillers because they are cost effective and there is a reduced hazard by not having refrigerant piped all over the building. The chiller will provide a stable temperature, flow and pressure once it has been programmed by a user for their individual needs. Harmful particles are kept

out of the system by an internal strainer. Air-cooled chillers, meanwhile, can be located in open spaces like car parks, roofs or ground level areas and have the advantages of a relatively low installation cost and low maintenance. They can also do without a plant room, cooling tower or condenser pumps. The advantages are no heat buildup in a room and no need for ventilation. Noise level is greatly reduced since there is no fan operation.

Both a chiller and a cooling tower are used to remove heat from a liquid, which is used as a coolant in large devices like power stations. A cooling tower removes heat from the water that is discharged from a condenser. The discharged water is then

recycled back into the plant to be used to cool the system again, or discharged into the environment. Chillers absorb heat from a coolant, which is fully contained in a cooling system. The chiller then transfers heat to the air around the chiller unit. Though chillers and cooling towers perform similar functions, they vary according to their types and components used, and the nature of the equipment they cool and power. A chiller is a machine that removes heat from a liquid via a vapor-compression or absorption refrigeration cycle. This liquid can then be circulated through a heat exchanger to cool equipment, or another process stream (such as air or process water). As a necessary by product, refrigeration creates waste heat that must be exhausted to ambient or, for greater efficiency, recovered for heating purposes. The industrial chiller is a cooling system that removes heat from one element (water) and transfers it into another (ambient air or water). The other main components to a chiller are a temperature controller, a recirculating pump and a reservoir. Operation and setup is simple. Fill the reservoir with fluid to be recirculated, typically water or an ethylene glycol/water mix. Install plumbing between the chiller and the application and provide power to the chiller. The controller regulates the chiller’s functions. A portable chiller is a liquid cooling system on casters that can be relocated from one application to another with relative ease. It can be used to cool one or more heat generating devices. Chilled water is used to cool and dehumidify air in mid- to large-size commercial, industrial, and institutional facilities.

## Need for Chillers

### Equipment Protection

The most compelling reason for a chiller is the protection it provides to our valuable processing equipment such as spot welders, injection molding equipment and other applications. A chiller commonly

represents a small fraction of the cost of the processing equipment, yet it provides solid protection of our investment, 24-hours-a-day, seven-days-a-week for years and years to come.

**Increase Production**

The speed and accuracy of production will increase as we maintain a constant and proper cooling temperature in the equipment. A chiller will reduce the number of rejected parts while increasing the number of parts produced per hour.

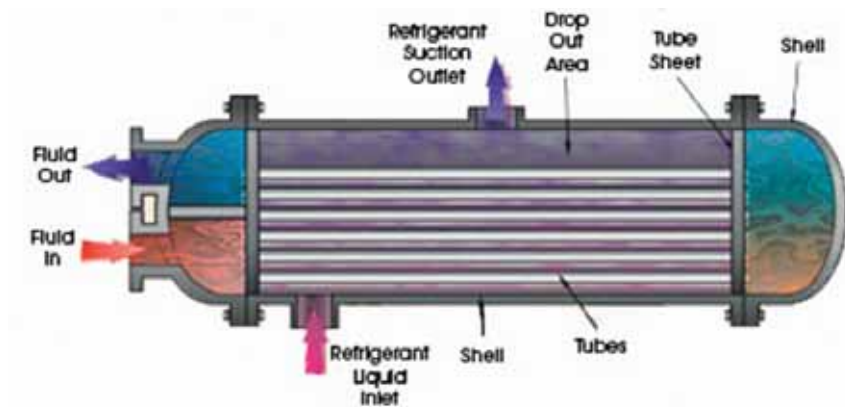
**Chiller Types**

**Air-cooled Chiller**

These chillers absorb heat from process water and can be transferred to the surrounding air. Air-cooled chillers are generally used in applications where the additional heat they discharge is not a factor. They require less maintenance than water-cooled units and eliminate the need for a cooling tower and condense water pump. They generally consume approximately 10% more power than a water-cooled unit as a wet surface transfer's heat better than a dry surface.

**Water-cooled Chiller**

These chillers absorb heat from process water and transfer it to a separate water source such as a cooling tower, river, pond, etc. They are generally used for large capacity applications, where the heat generated by an air-cooled chiller creates a problem. They are also considered when a cooling tower is already in place, or where the customer requires optimum efficiency of power consumption. Water-cooled chillers require condenser water treatment to eliminate mineral buildup. Mineral deposits create poor heat transfer situations that reduce the efficiency of the unit. Water chillers can be water-cooled,



air-cooled, or evaporative cooled. Water-cooled systems can provide efficiency and environmental impact advantages over air-cooled systems.

**Selection Process**

Water	Air
Need an adequate water supply available from tower or well source	If adequate water supply is not available
Heat recovery is not practical or unimportant.	Heat recovery is practical and important.
Plant ambient temperatures consistently exceed 95° F.	Plant ambient temperatures will not consistently exceed 95° F.
Ambient air is polluted with large dust and dirt particles.	Ambient air is not polluted with large dust and dirt particles.

**Chiller Designs**

One chiller cannot control every heat load. Some chillers are designed to cool to very low temperatures while others are designed for only mid-range applications. Some designs can support very high flow rates of fluid while other may be designed for just a trickle of fluid. The same issues

apply with ambient temperatures. Some chillers use refrigerant suited for a high ambient temperature environment while other refrigerants are formulated for cooler conditions. The customer must also consider the fluid being cooled. Distilled water or di-ionized water requires different conditions than tap water. Di-ionized and distilled water can cause the breakdown of metal they come in contact with. In cases like this the chiller is designed with no brass, copper or mild steel components that would come in contact with the water, instead, plastic or stainless steel are used. This eliminates the corrosive effects of the fluid.

- Refrigeration Compressors - are essentially a pump for refrigerant gas. The capacity of the compressor, and hence the chiller cooling capacity is measured in kilowatts input (kW), Horse Power input (HP), or volumetric flow (m3/h, ft3/h). The mechanism for compressing refrigerant gas differs between compressors, and each has its own application. Common refrigeration compressors include Reciprocating, Scroll, Screw, or Centrifugal. These can be powered by electric motors, steam turbines or gas turbines. Compressors can have an integrated motor from a specific

manufacturer, or be open drive - allowing the connection to another type of mechanical connection. Compressors can also be either Hermetic (welded closed) or semi-hermetic (bolted together).

- The condenser is a heat exchanger which allows heat to migrate from the refrigerant gas to either water or air. Condensers can be air-cooled, water-cooled, or evaporative. Air cooled condensers are manufactured from copper tubes (for the refrigerant flow) and aluminum fins (for the air flow). Each condenser has a different material cost and they vary in terms of efficiency. With evaporative cooling condensers, their coefficients-of-performance (COPs) are very high; typically 4.0 or more.
- Evaporators can be plate type or shell and tube type. The evaporator is a heat exchanger which allows the heat energy to migrate from the water stream into the refrigerant gas. During the state change of the remaining liquid to gas, the refrigerant can absorb large amounts of heat without changing temperature.

### Latest Developments

- In recent years, application of Variable Speed Drive (VSD) technology has increased efficiencies of vapor compression chillers. The first VSD was applied to centrifugal compressor chillers in the late 1970s and has become the norm as the cost of energy has increased. Now, VSDs are being applied to rotary screw and scroll technology compressors.
- The expansion device or refrigerant metering device (RMD) restricts the flow of the liquid refrigerant causing a pressure drop that vaporizes some of the refrigerant; this vaporization absorbs heat from nearby liquid refrigerant. The RMD is located immediately prior to the evaporator so that the cold gas in the evaporator can absorb heat from the water in the evaporator. There is a sensor for the RMD on the evaporator outlet side which allows the RMD to regulate the refrigerant flow based on the chiller design requirement.

## Chiller Applications

### Use in air conditioning

In air conditioning systems, chilled water is typically distributed to heat exchangers, or coils, in air handling units or other types of terminal devices which cool the air in their respective space(s). The water is then re-circulated back to the chiller to be cooled again. These cooling coils transfer sensible heat and latent heat from the air to the chilled water, thus cooling and usually dehumidifying the air stream. A typical chiller for air conditioning applications is rated between 15 and 2000 tons, and at least one manufacturer can produce chillers capable of up to 5,200 tons of cooling. Chilled water temperatures can range from 35 to 45 F (2 to 7 C), depending upon application requirements. When the chillers for air conditioning systems are not operable or they are in need of repair or replacement, emergency chillers may be used to supply chilled water. Rental chillers are mounted on a trailer so that they can be quickly deployed to the site. Large chilled water hoses are used to connect between rental chillers and air conditioning systems.

### Use in industry

In industrial application, chilled water or other liquid from the chiller is pumped through process or laboratory equipment. Industrial chillers are used for controlled cooling of products, mechanisms and factory machinery in a wide range of industries. They are often used in the plastic industries, injection and blow molding, metal working cutting oils, welding equipment, die-casting and machine tooling, chemical processing, pharmaceutical formulation, food and beverage processing, paper and cement processing, vacuum systems, X-ray diffraction, power supplies and power generation stations, analytical equipment, semiconductors, compressed air and gas cooling. They are also used to cool high-heat specialized items such as MRI machines and lasers, and in hospitals, hotels and campuses. Chillers for industrial applications can be centralized, where a single chiller serves multiple cooling needs, or decentralized where each

application or machine has its own chiller. Each approach has its advantages. It is also possible to have a combination of both centralized and decentralized chillers, especially if the cooling requirements are the same for some applications or points of use, but not all. Water-cooled chillers are typically intended for indoor installation and operation, and are cooled by a separate condenser water loop and connected to outdoor cooling towers to expel heat to the atmosphere. Air-cooled and evaporative cooled chillers are intended for outdoor installation and operation. Air-cooled machines are directly cooled by ambient air being mechanically circulated directly through the machine's condenser coil to expel heat to the atmosphere. Evaporative cooled machines are similar, except they implement a mist of water over the condenser coil to aid in condenser cooling, making the machine more efficient than a traditional air-cooled machine. No remote cooling tower is typically required with either of these types of packaged air-cooled or evaporative cooled chillers.

### Advantages

Chillers are a popular choice for commercial air conditioning repair and institutions such as schools and hospitals. If you are in the process of making decisions about your future cooling needs, then chilled water cooling should be one of the systems on your list. Below are a few advantages that chillers offer over other cooling systems and a few disadvantages that you should also keep in mind. The advantages offered by chilled water cooling systems:

**Safer for humans:** Safety should always be a primary concern when making decisions about the environment in which people live, work and play. Chilled water systems are fundamentally safe due to the use of non-toxic, chemically-stable water as the refrigerant; chillers don't require that potentially-hazardous refrigerants be circulated throughout a building in close proximity to occupants.

**Cost effective:** A chilled water cooling system can cut energy costs by up to one-half if it utilizes the latest in high-efficiency



equipment. Water is better at absorbing heat than air, and this fundamental fact of physics means that it will always have an advantage in this regard. Not only that, water is plentiful and cheap; eliminating the need to use costly refrigerants can contribute greatly to the overall cost savings.

**Sheltered from elements:** The operational machinery for chilled water cooling systems, except for cooling towers, is typically installed in a mechanical room, basement or other interior space. This means these complex components, such as evaporators and condensers, are less exposed to the elements than systems that are mounted on rooftops or in exterior locations. Less exposure to rain, ice and heat can extend the lives of these components by several years.

**Quiet Operation:** Another advantage offered by chillers is they operate at much quieter levels than air cooling systems. The flow of water through the system is less susceptible to the expansion and contraction that causes air to affect mechanical components such as ducts and vents. This degree of quietness is important for building

occupants, particularly in sensitive environments such as hospitals and schools where noise would otherwise be unhealthy or distracting.

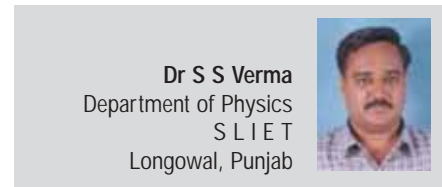
**Disadvantages**

**Cooling Towers:** Chillers utilize external cooling towers to transfer heat to the atmosphere, and these structures can be costly to build. They don't need to be located immediately adjacent to the building that holds the operational machinery, but they do utilize valuable real estate which adds to the cost. Cooling towers are also unsightly, and the water vapor generated during operation can be uncomfortable for those who pass by these structures.

**Enhanced Maintenance Needs:** Since chilled water cooled systems use water for transferring heat, this exposes the water to a variety of conditions that can create scaling. Scaling is an accumulation of deposits on metal, and this can cause corrosion as well as decrease system efficiency. To control the problems associated with scale, the water used in

chillers must be treated to remove impurities that can lead to scaling. In addition, periodic inspection and cleaning of the chiller's internal machinery and components will be necessary. This necessitates downtime for scheduled maintenance and added maintenance costs.

**Less Effective in Humid Environments:** Chilled water cooling systems don't work as well in climates with high prevailing humidity. Higher levels of humidity raise the wet-bulb temperature, which is an indicator of how efficiently water absorbs heat. An increase in wet-bulb temperature corresponds with increased operating costs as well as lower comfort levels due to the higher ambient humidity. Chillers can create a cold, clammy feeling for occupants if the humidity is too high. In this scenario, air cooled systems are much better at extracting moisture from the air. ■



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# Newly-Engineered 'Cooled' Material

Metamaterial — an engineered material with extraordinary properties not found in nature developed by a team of University of Colorado Boulder engineers can provide an eco-friendly means of supplementary cooling for thermoelectric power plants, which currently require large amounts of water and electricity to maintain the operating temperatures of their machinery...

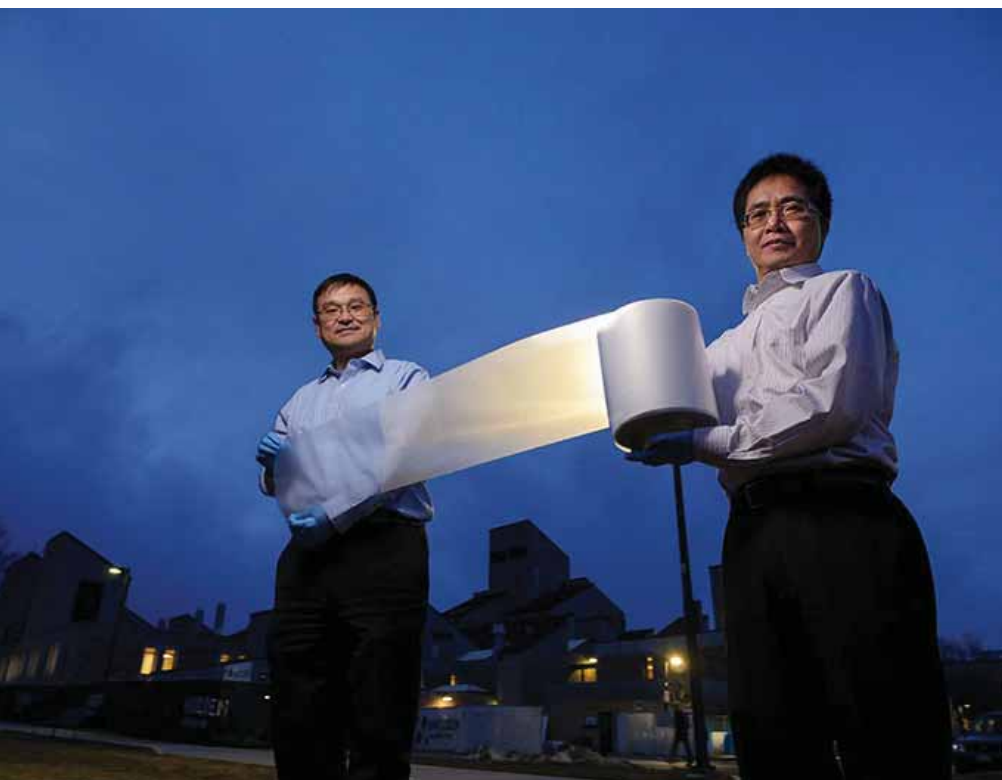
The new material, which is described in the journal *Science*, could provide an eco-friendly means of supplementary cooling for thermoelectric power plants, which currently require large amounts of water and electricity to maintain the operating temperatures of their machinery.

The researchers' glass-polymer hybrid material measures just 50 micrometers thick — slightly thicker than the aluminum foil found in a kitchen — and can be manufactured economically on rolls, making it a potentially viable large-scale technology for both residential and commercial applications.

"We feel that this low-cost manufacturing process will be transformative for real-world applications of this radiative cooling technology," said Xiaobo Yin, Co-Director of the research and an assistant professor who holds dual appointments in CU Boulder's Department of Mechanical Engineering and the Materials Science and Engineering Program. Yin received DARPA's Young Faculty Award in 2015.

The material takes advantage of passive radiative cooling, the process by which objects naturally shed heat in the form of infrared radiation without consuming energy. Thermal radiation provides some natural nighttime cooling and is used for residential cooling in some areas but daytime cooling has historically been more of a challenge. For a structure exposed to sunlight, even a small amount of directly-absorbed solar energy is enough to negate passive radiation.

The challenge for the CU Boulder researchers, then, was to create a material that could provide a one-two punch: reflect any incoming solar rays back into the atmosphere while still providing a means



A team of University of Colorado Boulder engineers has developed a scalable manufactured metamaterial — an engineered material with extraordinary properties not found in nature — to act as a kind of air conditioning system for structures. It has the ability to cool objects even under direct sunlight

with zero energy and water consumption.

When applied to a surface, the metamaterial film cools the object underneath by efficiently reflecting incoming solar energy back into space while simultaneously allowing the surface to shed its own heat in the form of infrared thermal radiation.

of escape for infrared radiation. To solve this, the researchers embedded visibly-scattering but infrared-radiant glass microspheres into a polymer film. They then added a thin silver coating underneath in order to achieve maximum spectral reflectance.

"Both the glass-polymer metamaterial formation and the silver coating are manufactured at scale on roll-to-roll processes," added Ronggui Yang, also a professor of mechanical engineering and a Fellow of the American Society of Mechanical Engineers.

"Just 10 to 20 square meters of this material on the rooftop could nicely cool down a single-family house in summer," said Gang Tan, an associate professor in the University of Wyoming's Department of Civil and Architectural Engineering and a co-author of the paper.

In addition to being useful for cooling of buildings and power plants, the material could also help improve the efficiency and lifetime of solar panels. In direct sunlight, panels can overheat to temperatures that hamper their ability to convert solar rays into electricity.

"Just by applying this material to the surface of a solar panel, we can cool the panel and recover an additional one to two percent of solar efficiency," said Yin. "That makes a big difference at scale."

The engineers have applied for a patent for the technology and are working with CU Boulder's Technology Transfer Office to explore potential commercial applications. They plan to create a 200-square-meter "cooling farm" prototype in Boulder in 2017.

The invention is the result of a \$3 million grant awarded in 2015 to Yang, Yin

and Tang by the Energy Department's Advanced Research Projects Agency-Energy (ARPA-E).

"The key advantage of this technology is that it works 24/7 with no electricity or water usage," said Yang "We're excited about the opportunity to explore potential uses in the power industry, aerospace, agriculture and more."

Co-authors of the new research include Yao Zhai, Yaoguang Ma and Dongliang Zhao of CU Boulder's Department of Mechanical Engineering; Sabrina David of CU's Materials Science and Engineering Program; and Runnan Lou of the Ann and H.J. Smead Department of Aerospace Engineering Sciences. ■

Source

University of Colorado Boulder

## APM Terminals opens new Reefer Services facility in Mumbai

**A**PM Terminals Inland Services, South Asia has opened a new reefer services facility in Dighode, Nhava Sheva. Strategically located 17 kilometers from the JNPT Port in Mumbai, it will deliver a one-stop solution for reefer customers dealing in commodities requiring controlled atmosphere and temperature. The opening ceremony was attended by key shipping lines and reefer customers.

The facility adheres to Institute of International Container Lessors (IICL) standards (the globally accepted standards for reefers) and has Original Equipment Manufacturer (OEM) certified technicians. The facility can handle 3000 refrigerated containers with world-class diagnostic equipment, an onsite 24/7 team of technicians and delivers one of the highest pre-trip inspection success rates – to ensure high quality performance of the reefer machinery in use. Other features include modern repair workshops, container survey stations, pre-trip inspection points, washing bays, and container handling equipment.

The strategic location, next to India's largest port is designed to help customers with better turn-around-time and



cost & operational efficiencies in their supply chains. Shipping lines, importers and exporters need to have perfectly functioning reefers to successfully grow their business.

The positive outlook and growth in the cold chain segment has fuelled the demand for reefers in India. "A real gap existed for dedicated reefer solutions in India. This exclusive facility aligns with our vision to create the industry's benchmark for world-class reefer services in South Asia," added Ajit Venkataraman, Managing Director, APM Terminals India Pvt. Ltd. ■



## “RATA focuses on highlighting commercial issues”

Established in 1949, Refrigeration & Air-Conditioning Trades Association Ltd (RATA) is one of the oldest association working for the development of air conditioning and refrigeration industry in India. **Ajit Panicker, Secretary, Refrigeration and Air Conditioning Trade Association (RATA)** gives a glimpse of different aspects of RATA, trends, growth drivers, opportunities in the HVAC&R industry in an exclusive interaction with **Supriya Oundhakar...**

### What is the role of Refrigeration and Air conditioning Trade Association (RATA) while giving support to the Indian refrigeration and air conditioning Sector?

Our primary focus is to bring all the members associated within the trade under one banner. We continue to engage with various MSMEs in this trade who are involved in manufacturing, trading, imports, service providers, sales and service dealers, retailers in the field of air conditioning and refrigeration. RATA focuses on highlighting the various commercial related issues that affect our trade with respective trade bodies. It also aims at bringing together various regional associations and societies together to help

the trade grow. RATA also aims at ensuring that the technical capabilities or other success stories of our associated societies reach out to all the trade members.

### Please brief us about RATA's activities for promotion of the sector.

**RATA** focuses on mitigating challenges that the trade foresees for its members. The activities for the promotion of the industry conducted by RATA are as below: **VRF Mela:** Most sales and service dealers have seen their sales dwindling with the advent of the organised large format retail markets and the online sales. These are two market developments which could make it difficult for the dealers to grow and sustain their business. RATA focuses on

encouraging most of such affected members in moving up the value chain by offering more technical products like the VRF system for their customers. This would be a new area of opportunity for the sales and service dealers to be part of the growing product segment. VRF Mela is an activity being held in every town in order to introduce opportunities the VRF segment offers to its dealers. It explains the way to build and transform their business and how to prepare for this transition. The Mela also introduces them to potential companies and suppliers for the VRF business. Over the last few years a number of brands have launched their VRF products and we believe quite a few more will be available in the Indian market as

this product segment gathers popularity. RATA can help bridge the need of the OEM for new dealers offering these VRF solutions. VRF Melas in Mumbai, Bangalore and Surat have received responses like never before and over the years at RATA we hope to connect OEMs with potential new VRF dealers.

**RATA - ICICI Skills Academy:** Manpower is a challenge faced by our trade members. RATA has associated with ICICI Skills Academy to help them manage air conditioning technician course and ensuring youngsters are skilled to make a beginning in the trade and ensuring they are offered jobs by our trade members. Last year RATA has helped over 200 such placements and we hope to increase these numbers exponentially in the coming years.

### What are the growth drivers of Indian Refrigeration and Air conditioning sector?

Growing economy will continue to be the growth drivers with the new policies driven by the government. The HVAC industry should see remarkable growth as the new infrastructure projects has gained momentum.

### What are the current trends in the sector?

We have witnessed a generic slowdown last year. It is mainly attributed to the tough economic conditions and could only be a stepping stone for the growth. The VRF segment has seen exponential growth and now it seems to be the most promising product segment in the HVAC trade.

### What kind of opportunities do you look forward for the sector with the government's roll out of 100 smart cities project and the government's emphasis on smart urban transportation (particularly metro projects)?

Smart Cities and Metro projects will help to increase growth in the requirement of air conditioning projects. MSMEs stand to benefit by providing installation and services for these requirements. RATA is proposing to the government that registered MSMEs to be protected under

their schemes and ensured their payments from these large corporate, thereby, maintaining their business cash flows.

### According to you, what are measures to be taken for improving energy efficiency and indoor air quality?

Bureau of Energy Efficiency (BEE) Check testing should be actively pursued to ensure the current labeling systems' adherence by OEMs. The invertors system should move towards mandatory labeling scheme. This would help customers in choosing the current product. Indoor Air Quality norms should be clearly defined and a conscious method needs to be introduced in implementing the system. Especially, in large applications guidelines



Most trades have come together for ensuring their fair share in India's growth thus benefitting their business. Unfortunately, our HVAC trade has been lagging behind in uniting for a common benefit. The achievements of our various societies have been remarkable in the field of training and imparting knowledge to the trade.

for the same and testing for IAQ should be gradually enforced. The need of the hour is also to sensitise solution providers and the customers on the aspects of IAQ.

### What are the solutions and services offered by the association keeping in mind rising global warming?

RATA is concerned about the issue of global warming and the role the Indian HVAC industry for reducing the same. RATA actively engages with the OZONE cell of the Government and helps in implementation of their programs especially helping the trade in adopting green refrigerants. RATA has conducted various training programs on green gases with the sole focus on encouraging trade members for moving towards equipment with green gases.

### What are major areas where you are contributing to?

Our focus is on helping trade members in scaling up their business and adopting

various changes. Digitization is a huge change affecting all businesses. At RATA, we are planning various programs in helping our trade members in digitization of their business. The IT revolution is leading to various changes in managing services for MSMEs. We believe faster adoption of such technology ensuring better profits and faster scalability for MSMEs in our trade.

### Did your expectations fulfill for the sector from Union Budget 2017-18?

There wasn't anything specific for the industry except the introduction of GST which would help smaller trade members to do business easily in other states and scale up their business.

### What are your expectations from the government for the growth of the sector?

The government needs to recognize large presence of MSMEs in the HVAC trade and help in terms of low cost finance. We expects the government to ensure that large corporate do not harass MSMEs especially in terms of due payments.

### What are your suggestions to the Indian HVAC&R trade members?

Most trades have come together for ensuring their fair share in India's growth, thus benefitting their business. Unfortunately, our HVAC trade has been lagging behind in uniting for a common benefit. The achievements of our various societies have been remarkable in the field of training and imparting knowledge to the trade. It is necessary to build a platform where commercial issues and other challenges faced by MSMEs of the HVAC trade are addressed so that our trade is not deprived of a fair share in India's growth. ■

# Improving Performance in Chillers

Inefficient chillers can waste significant amount of electricity, and even modest improvements in efficiency may yield substantial energy savings and attractive paybacks. To maximize cost-effectiveness, we recommend analyzing the entire chilled water system as well as exercising care in specifying the efficiency of the chiller itself...

remember that chillers are actually part of a chilled water system, and the efficiency and control of pumps and cooling towers can have a significant impact on overall efficiency.

Maximizing the efficiency of the chiller alone does not ensure that the system will operate efficiently. To maximize cost-effectiveness, we recommend analyzing the entire chilled water system as well as exercising care in specifying the efficiency of the chiller itself.

## Understanding of Specification Before Purchasing a Chiller

**Tons:** One ton of cooling is the amount of heat absorbed by one ton of ice melting in one day, which is equivalent to 12,000 Btu/h or 3.516 thermal kW.

**kW/ton Rating:** Commonly referred to as efficiency, but actually power input to compressor motor divided by tons of cooling produced, or kilowatts per ton (kW/ton). Lower kW/ton indicates higher efficiency.

**Coefficient of Performance (COP):** Chiller efficiency measured in Btu output (cooling) divided by Btu input (electric power). Multiplying the COP by 3.412 yields the energy-efficiency ratio.

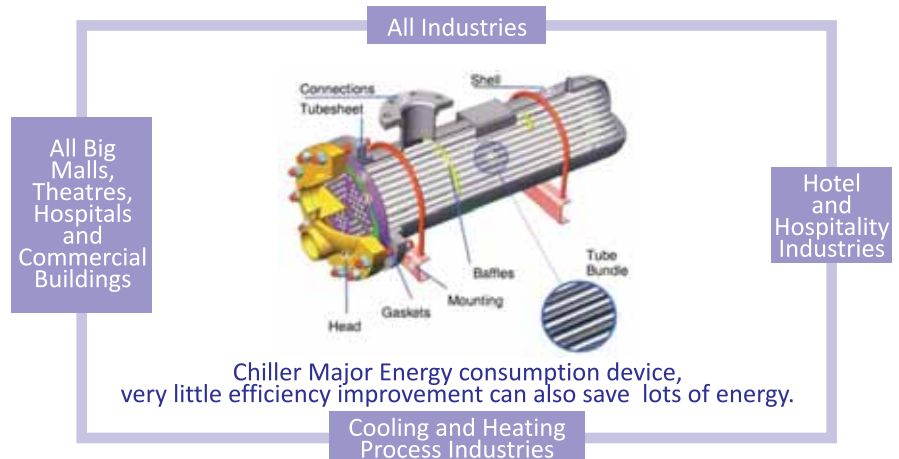


**D**ue to global warming, chillers have now-a-days become a necessity of any industry. For instance, if air conditioning system of an organization or industry fails or goes haywire, people become helpless due to hot temperatures if immediately an alternative arrangement is not provided. During summer, particularly, a poor or non-working cooling system could potentially spoil people's holidays leading to maligning organization's or hotel's reputation.

Inefficient chillers can waste significant amount of electricity, and even modest improvements in efficiency may yield substantial energy savings and attractive paybacks.

However, it's important to select a

chiller (and its associated efficiency) carefully by buying a chiller that is highly efficient. However, it may not be cost-effective in all cases. It is also important to



**Energy Efficiency Ratio (EER):**

Performance of smaller chillers and rooftop units is frequently measured in EER rather than kW/ton. EER is calculated by dividing a chiller's cooling capacity (in Btu/h) by its power input (in watts) at full-load conditions. The higher is the EER, the more efficient is the unit.

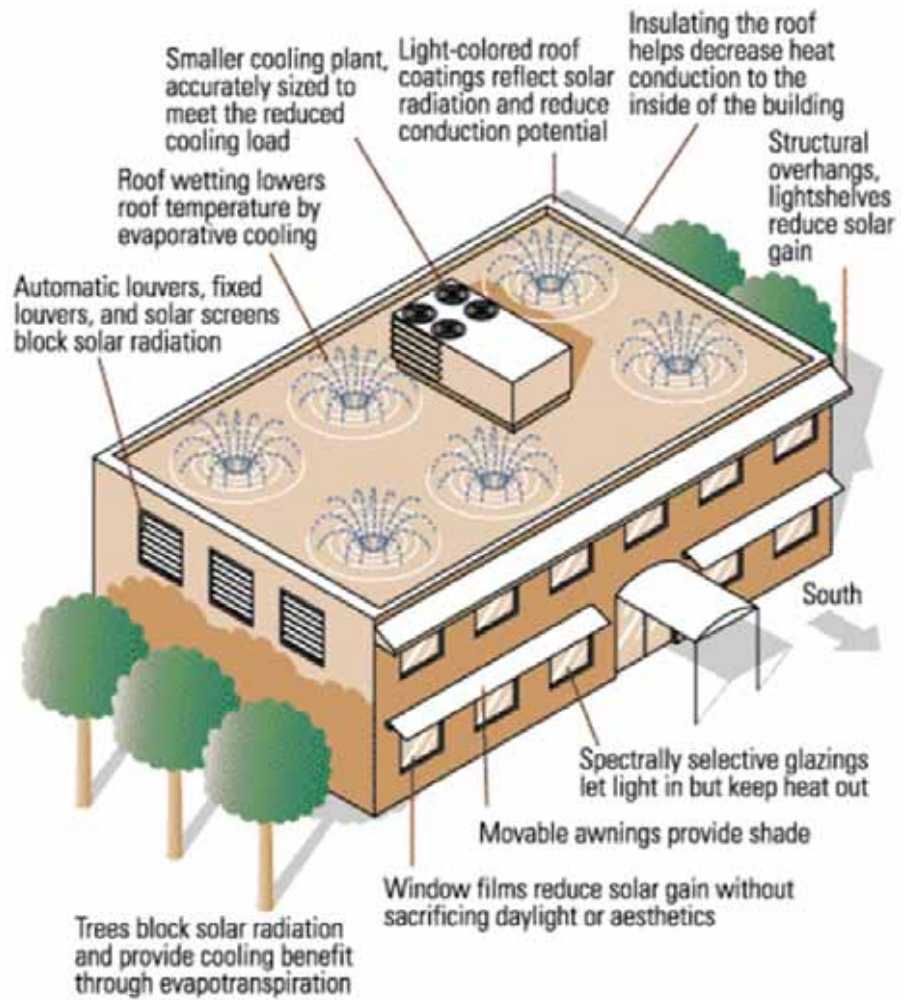
**ARI Conditions:** Standard reference conditions at which chiller performance is measured, as defined by the Air-Conditioning and Refrigeration Institute (ARI): 44°F for water leaving the chiller and, for water entering the condenser, 85°F at 100 percent load and 60°F at zero percent load.

**Integrated part-load value (IPLV):**

This metric attempts to capture a more representative 'average' chiller efficiency over a representative operating range. It is the efficiency of the chiller, measured in kW/ton, averaged over four operating points, according to a standard formula.

In most manufacturing and workplace buildings, chillers are the solitary widespread energy-using component. In many facilities, more than 70 percent of annual electricity use can be attributed to the building chillers. So, proper operation and maintenance of the building chillers should be a high priority in any facility energy management program. It is surprising, however, to see just how often chillers are operated or maintained inefficiently or ineffectively, resulting in higher energy costs, lower system performance and reliability, and decreased equipment life.

While many factors contribute to decreased chiller efficiency, the five most common ones include poor operating practices, ignored or deferred maintenance,



Source :platts

ignored cooling tower maintenance, oversizing, and ignoring alternate-fuel chillers. While each of these factors poses a real and significant threat to chiller efficiency, all can be easily controlled or eliminated by maintenance managers.

**Under Loading or Overloading**

Without knowledge of proper operating practices not only can decrease the chiller efficiency, but also chiller life.

Means such practices are the result of

two situations: trying to get a chiller to do something that

1. High/low flow rate: Providing more cooling water to a facility is to increase the rate of chilled water flow through the chiller. The belief is that with a higher flow rate, more cooling water will be available. But practically, increasing the flow rate through a chiller beyond the manufacturers stated limit actually reduces the operating efficiency of the chiller.

**Applications**

Air conditioning	Plastic industries	Metal Working cutting oils	Vacuum Systems	Analytical Equipment
Controlled cooling of products	Injection and blow molding	welding equipment	X-ray diffraction	Semiconductors
Die-casting	Machine Tooling	Chemical Processing	Power supplies and Power Generation Stations	Compressed Air and Gas Cooling
Pharmaceutical Formulation	Food and Beverage Processing	Paper and Cement Processing	Used to cool high-heat specialized items such as MRI Machines and Lasers	Hospitals
Hotels	Campuses	Hospitality Industry	Reliable Climate Control	Shops
All Theater	Shopping Malls	Conference Halls	Resorts	Swimming Pools

- Flow rate: Equally important, flow rates higher than those recommended increase the rate of erosion in the chiller's tubes, leading to early tube failure.

## Prevention is better than cure (Ignorance leads to big loss rather than small saving)


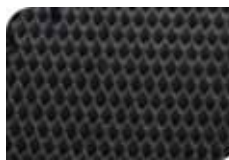


It is always advisable to think and take corrective action on future problems. Good practices are important to the efficient operation of all building equipment; there are few areas where this is more evident than in the maintenance of building chillers.

Most new, high efficiency centrifugal chillers carry a full-load efficiency rating of approximately rated kW per ton. If that chiller is well maintained, in five years it can be expected to have a full-load efficiency of 55-60 %. On an annual basis, poorly maintained chiller will use 20-25% more energy annually to produce the same cooling.

## Corrosion and Solutions



Most chiller tubes are copper, and experience galvanic corrosion due to two metals being dissimilar. The corrosion and loss of carbon steel can affect the performance of the chiller due to hard water or poor water quality resulting in

Before	After	Benefits
		Cooling Tower Fins remains rust and scale free . Faster cooling and maintain Delta T and Heat transfer efficiency
		Boiler tubes also remains scale free and saves life of boiler tubes Increase efficiency

flow issues and sediment buildup. This will finally lead to damage of the tube and refrigerant loss. To fight this problem as mentioned in many research paper, eco-friendly, chemical-free treatment with the help of 'Advance E-water Descaler' device can solve hard water problem 70-85 % without adding any chemical or extra components of the chiller.

With 'Advance E-water Descaler', we carry a large variety of products to get the machinery working to prevent downtime and dissatisfaction. It is one of the cheapest solutions in the world offering the best results in the market. It is composed of hydrogen and oxygen. As water gets contaminated by the substances with which it comes into contact, it is not available for use in its pure state. To some degree, water can dissolve with every naturally occurring substance on the earth. Because of this property, water has been termed a 'universal solvent.' Although beneficial to mankind, the solvency power of water can pose a major threat to industrial chillers, laboratory chillers, process chillers and other cooling systems. Corrosion reactions cause the slow dissolution of


metals by water. Deposition reactions, which produce scale on heat transfer surfaces, represent a change in the solvency power of water as its temperature is varied. The control of corrosion is a major focus of water treatment technology for all chiller systems. Facilities managers, lab personnel, and maintenance engineers often ignore scaling and corrosion issues.

## Conclusion

Overall, the water used in a chiller system should be of the best quality available. As a general rule, water treated through 'Advance E-water Descaler' is better than soft water particularly for industrial applications, which is far better than hard water. Some users resist the use of demineralised water because of the high cost and common belief is more aggressive or corrosive than raw or softened water. So, intermediate solution is water treated not with the help of costly DM Plant or RO Plant but economically viable technology 'E-water Descaler' is the next generation solution. Although it is true that untreated, oxygenated demineralized water is very corrosive, corrosion inhibitors passivate metal surfaces and remove dissolved oxygen resulting in final system water that is non-corrosive. ■



**Prof Gaurang Sharma**  
Professor,  
BVM Engineering College,  
V V Nagar, Anand, Gujarat





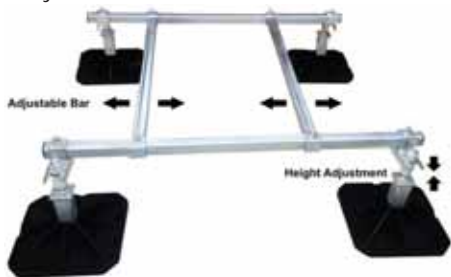
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- Available in various sizes as well as for customized designs; modular design allows units to be added later also.
- Hot dip galvanized metalwork.
- The legs can be removed individually for re-roofing /other works without dismantling the machine.
- Includes adjustable condenser clamps to keep the unit tightly in place.
- The height of the bars & horizontal distance between bars can be adjusted according to individual unit size. No welding needed.



Watch the video to see how simple it is to install:  
<https://youtu.be/ZhzMeNr5VNE>

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- Max Head : 8 Mtr.



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- Designed for High Delivery Head and Flow Rate.
- Oil-Resistant Water Tank and Impeller.
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- Include solenoid valve.
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# Stay Cool Without AC

Phase change materials (PCMs) are known for storing thermal energy by virtue of their inherent latent enthalpy. PCM tiles integrated with building envelope promises to offer the ease of construction without encroaching on valuable floor space occupied by building structure. PCM tiles are installed and analyzed in naturally ventilated rooms located in various geographic locations around India. Appropriate indoor and outdoor environmental conditions are logged to provide insights into PCM effectiveness...

India is the world's third largest greenhouse gas emitter. India pledges to reduce carbon emission per unit of GDP (emission intensity) to 35% by 2030 from 2005 [1]. India's building sector experiencing unprecedented growth in the

past decade. It is expected to grow about five times from 2.1 million square metre in 2010 to about 10.4 million square metre in 2030 [2]. India's residential sector will fuel energy consumption unless focused policy and market effort is not initiated to provide

30 to 60% savings by 2050 [2]. As per predictions, a significant increase in energy consumption and rapid expansion in the use of space cooling appliances is expected. Figure 1 demonstrates the increasing pattern of energy consumption by service within buildings [2]. This increase will largely be due to outdoor climate change, building construction and materials, operational modes, thermal discomfort levels and increase in resident's ability to own and use cooling systems. In India, along with a challenge to reduce energy consumption, reduction in peak demand is also necessary for India to focus on. Today, India's energy consumption per unit area of the exterior wall, the roof and the window are two to

Floating Balls of Rotterdam cooled (Air Conditioned) by PCM



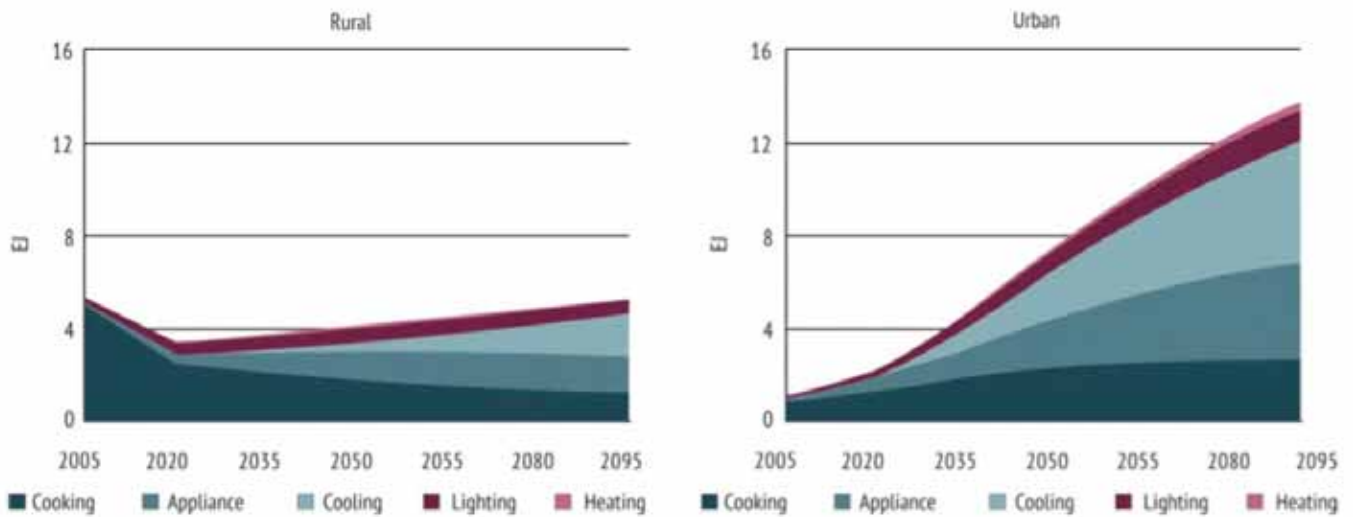


Figure 1: Energy consumption by service in rural & urban area (1 Exajoules, EJ = 1018 Joules, J) [1]

five times higher than that in developed countries [3]. One of the best ways to reduce energy consumption is to achieve energy efficiency in buildings.

Solar radiation is the most important direct reason for the air conditioning energy consumption, which accounts for almost 40% electrical peak load in large cities [3]. In summer, for single story buildings the cooling load through the roof has the ratio of 36.7% in the whole building envelop cooling load, while the multi-story building can reach to 8-10% [3]. Back in time, older buildings, churches, castles, etc. had an adequate thermal storage mass for retaining heat energy which ensured cool interiors despite the summer heat outside. But in the current age of lightweight constructions, due to lack of thermal mass in buildings, room temperatures quickly rise to a level that is equal to or even higher than the temperature outside. Conventionally, this problem is solved by installing air-conditioning systems which however, are expensive to buy and operate; their energy consumption is huge and offers the highest electrical peak load today in every residential and commercial space in India. Additionally, the user's comfort is decreased by draft, noise and dryness of the air. A research showed that air conditioning energy consumption can drop about 10% when inner temperature is decreased by 1°C [3]. Thus, thermal conditioning of the building (roof or wall) cannot only improve the indoor thermal comfort, but can also reduce air conditioning cooling load. One of the

approaches has been to use PCMs in buildings that can absorb or release a large amount of heat at a constant or near constant temperature (Fig. 2), which makes it widely potential and has attracted several researchers, companies & technologists over the years in businesses involving precise temperature maintenance.

Ice is the most popular example of a phase change material at 0°C. To give you an example, melting of one kilogram of ice at 0°C to produce one kilogram of water at 0°C requires 333 kilojoules of energy. However, the same amount of energy would also be able to heat a kilogram of water from 0°C to approx. 80°C. Hence, these materials can store a large amount of energy at a constant temperature without letting the heat ingress through them. In building applications, PCMs of high heat storage capacity per unit volume (i.e. high energy storage density) is required to increase the thermal mass of the buildings equivalent to 240 mm of concrete with just 10 mm of PCM (refer Fig. 3) in an effort to reduce the amount of energy required to cool or heat the building in summer or winter, respectively. These advanced PCMs can intelligently maintain pleasant temperatures in summers without installing an air conditioning system by increasing the thermal mass of the building structure in least amount of space.

To understand the potential of PCM for temperature control (refer Fig. 4), it is necessary to look at the case without PCM as a reference. During the day, the PCM begin to store the heat at the point at which the interior temperature begins to become

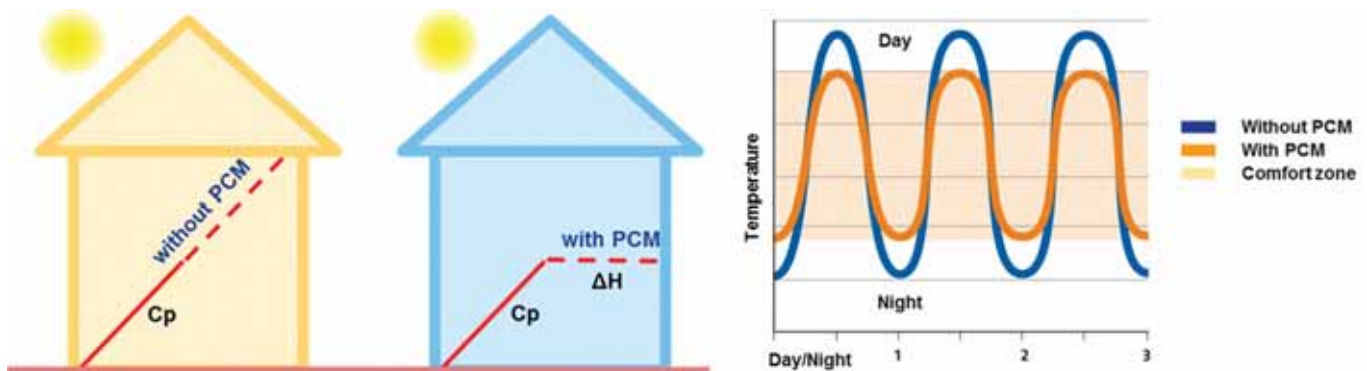
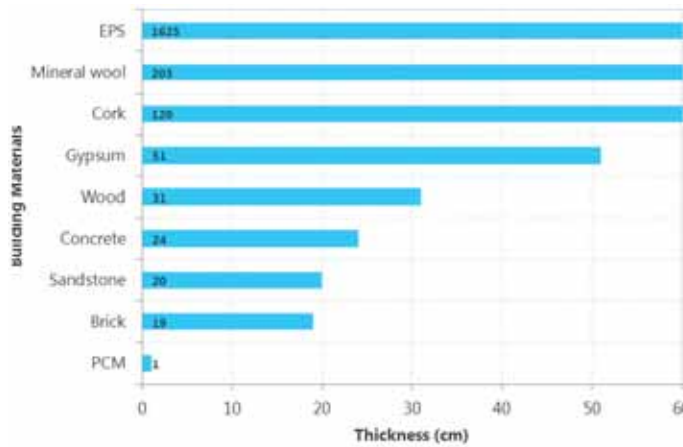


Figure 2: Effect of using PCMs in buildings: PCM normalizes the temperature to a desired temperature without the use of an active cooling system



Material	Thickness (cm)	$C_p$ per mass (kJ/kg.K)	Density (kg/m <sup>3</sup> )	$C_p$ per volume (MJ/m <sup>3</sup> K)	Q/V for $\Delta T = 4^\circ\text{C}$ (MJ/m <sup>3</sup> )
PCM	1	75	800	60	130
Brick	19	1	1800	1.8	7.2
Sandstone	20	0.7	2300	1.61	6.44
Concrete	24	0.84	1600	1.34	5.38
Wood	31	1.5	700	1.05	4.2
Gypsum	51	0.8	800	0.64	2.56
Cork	120	1.8	150	0.27	1.08
Mineral wool	203	0.8	200	0.16	0.64
EPS	1625	1.2	16	0.02	0.08

Figure 3: Heat capacities in 4°C interval for different building materials compared to PCM[4]. Necessary layer thickness of different building materials to store as much heat as 10 mm layer of PCM

excessive. The PCM which has a melting point of 24°C begins to absorb heat from the ambient air at this temperature, preventing the interior from heating up any further. This ensures pleasant working conditions and an agreeable temperature to live and work, and there are no large increases in temperature. Apart from enhancing the comfort, a large reduction in costs can also be achieved by dissipating the accumulated heat during the night by allowing cold night air to circulate through them. In developed countries, such a configuration shifts the heat load from expensive daytime to cheaper night time. Additionally, these materials allow more usable space i.e. higher net floor area in the buildings.

Unfortunately, water with its phase transition temperature at 0°C and 100°C is not suitable for use in buildings. Hence, special grades of PCMs is developed which are ideally leak-proof, mechanically-stable and more conductive than ordinary PCMs. One of them is form-stable (FS) PCMs. FS-PCMs are encapsulated in metal coffins of good thermal conductivity to allow accelerated heat exchange with the cold night air from outside. These building

tiles can be designed to the usual grid dimensions of the building. The only pre-requisite for the PCM tiles to function is to ensure natural or mechanical ventilation in the night to allow the PCM to release the heat absorbed during the day. This is referred to as the charging of the PCM. Some of the key advantages of PCM building tiles for smart temperature management are:

- Allows huge savings on electricity demand by offering
- Comfortable interior climate without noise and dryness
- Large energy storage density at phase transition temperature
- Occupies limited space and can be retro-fitted in any existing building
- Easy to install and remove in the event of relocation
- Non-combustible, non-toxic and flame-retardant
- No servicing and operating expenses
- Life longer than that of conventional air conditioner

Currently, a range of PCMs exclusively for building segment are in development, they are: form-stable (FS) PCMs, emulsified PCMs, macro-encapsulated (ME) PCMs. Traditionally, PCMs are

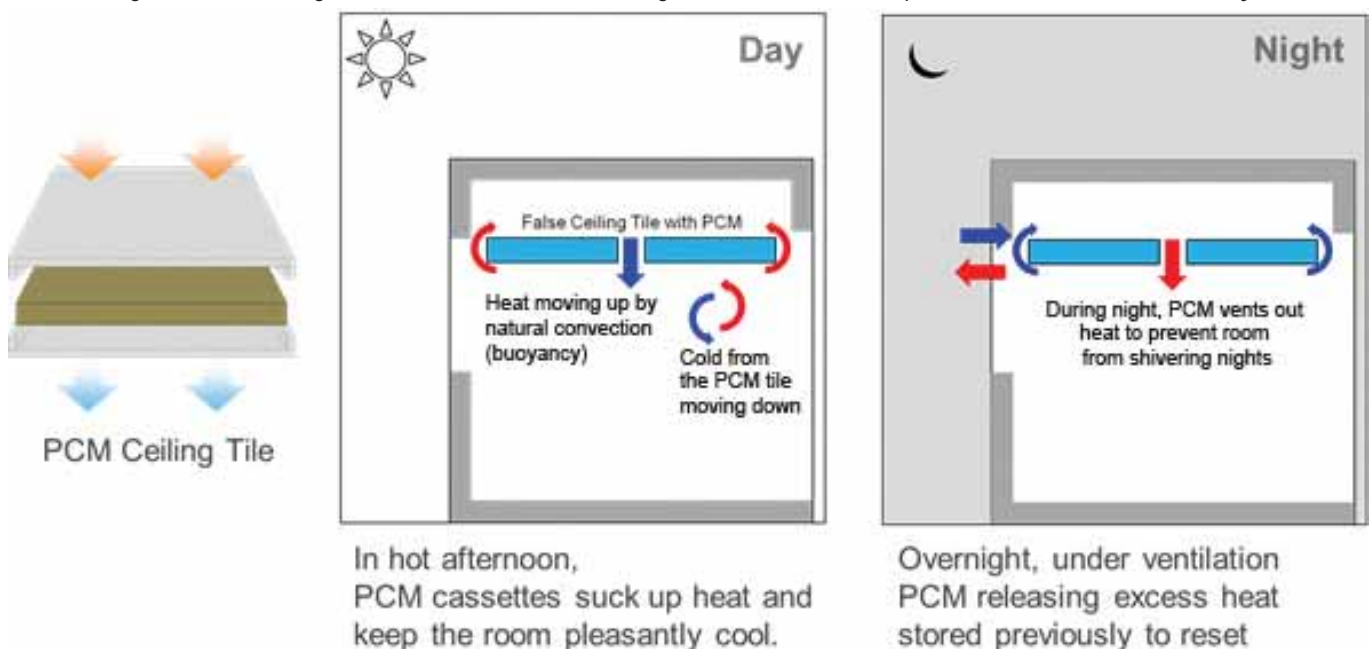


Figure 4: The general concept for cooling with PCM integrated in building materials



Figure 5 (a) New commercialized PCMs for building applications; (b) Encapsulation technology available: a. HDPE Polymer Thermotabs; b. Stainless Steel balls; c. High barrier Aluminum foil; d. HDPE extrusion profiles; e. HDPE pipes; f. PET film; g. HDPE 70mm balls; h. HDPE 25mm balls; i. Aluminum bottles

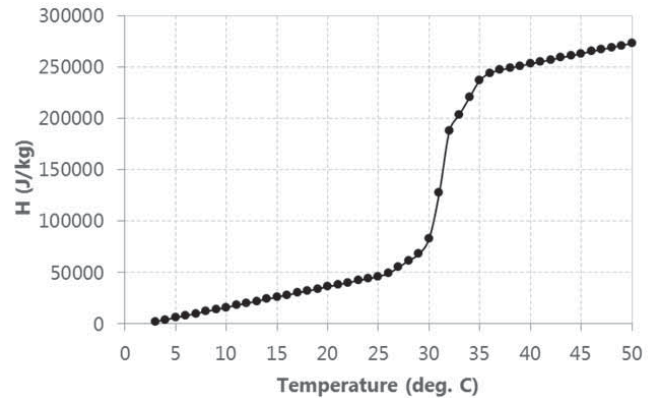
of three types: inorganic, organic and eutectic type PCMs. Organic PCMs can be modified to composite PCMs to form FS-PCMs and ME-PCMs, while inorganic PCMs are modified to form emulsified PCMs, refer Fig. 5(a). To prevent leakage and to improve heat transfer characteristics PCMs are encapsulated. Several aspects which govern the selection of an encapsulation are: (a) chemical compatibility of the container wall with the PCM; (b) thickness of the container wall to assure the necessary diffusion tightness; (c) suitability of the thermal characteristics of the container (encapsulating) material with the PCM while in application; and (d) the encapsulation must be designed in a way that it is able to cope up with the mechanical stress acting on the walls caused by the volume change of the PCM. Fig. 5 (b) depicts some of the common industrial scale encapsulation followed for inorganic and organic PCMs for its application in a chosen field ranging from healthcare, pharmaceutical, solar, cold-chain logistics, etc.

To understand the potential benefits of using PCMs as a building envelop in the form of a wall or a ceiling in any commercial or residential building, a dynamic building simulation using EnergyPlusTM is performed to generate meaningful building performance histograms. The answers about comfort are derived as well as clear economical figures about pay-back time and reduction of cooling capacity is deduced. Here, a 3m x 3m x 3m radio-communication room is chosen in the month of summer in Delhi. The constraints applied are:

- PCM of 30°C in the ceiling. The thermo-physical properties of the chosen PCM:

PCM Melting Temperature	28-35 °C
Melting Energy	180 kJ kg <sup>-1</sup> = 50 Wh kg <sup>-1</sup>

- A door facing South and a window facing East
- Standard glazing windows
- Windows and Ventilation System open during the night for natural cooling
- The inside place is lightened with a 10W/m<sup>2</sup> and equipment load is 50W/m<sup>2</sup>



- People scheduled to be in the office during the day from 9 am to 6 pm
- Free exchange of air at a rate of 0.2 l/h
- Standard Packaged Terminal Air Conditioner with thermostat at 26°C
- Standard masonry construction with concrete, brick and plaster as shown in Table 1.

Fig. 6 indicates reduction in day temperature and cooling load over the summer months of New Delhi by the application of a 30°C PCM in the ceiling of a 100 sq. ft. room with and without ventilation. Fig. 6(a) plots the ambient temperature distribution of one whole year (January to December i.e. 0 to 8760 hours) for New Delhi. The highlighted "yellow" band indicates the operating temperature range for 30°C PCM. Fig. 6(b) indicates the buildings dimensions 2.6 x 2.6 x 2.6 m. They are constructed as per the details given above. It is elevated 0.4 m from the ground and fitted with a door and a window. The result, Fig. 6(c) indicates that the interior climate remains balanced even in mid-summer periods of heat and the peaks mitigate. The room with PCM experiences less temperature swing which decreases the peak cooling load and the overall space cooling load. In Fig. 6(d) with 30°C PCM, the decrease in cooling load range from 25-40% in the month of March & April (max. 36°C, min 20°C) to 10-20% during May-July (max. 46°C, min 27°C). Fig. 6 (e) clearly depicts the decrease in

Table 1: Standard masonry construction with concrete, brick and plaster

Roof	Wall	Floor
100 mm Lightweight Concrete $k = 0.53 \text{ W/m-K}$ ; $\rho = 1280 \text{ kg/m}^3$ ; $C_p = 840 \text{ J/kg-K}$	100 mm Brick $k = 0.89 \text{ W/m-K}$ ; $\rho = 1920 \text{ kg/m}^3$ ; $C_p = 790 \text{ J/kg-K}$	50 mm Insulation Board $k = 0.03 \text{ W/m-K}$ ; $\rho = 43 \text{ kg/m}^3$ ; $C_p = 1210 \text{ J/kg-K}$
50 mm Insulation Board $k = 0.03 \text{ W/m-K}$ ; $\rho = 43 \text{ kg/m}^3$ ; $C_p = 1210 \text{ J/kg-K}$	200 mm Heavyweight Concrete $k = 1.95 \text{ W/m-K}$ ; $\rho = 2240 \text{ kg/m}^3$ ; $C_p = 900 \text{ J/kg-K}$	200 mm Heavyweight Concrete $k = 1.95 \text{ W/m-K}$ ; $\rho = 2240 \text{ kg/m}^3$ ; $C_p = 900 \text{ J/kg-K}$
Ceiling Air Space Resistance Thermal resistance = $0.18 \text{ m}^2\text{-K/W}$	50 mm Insulation Board $k = 0.03 \text{ W/m-K}$ ; $\rho = 43 \text{ kg/m}^3$ ; $C_p = 1210 \text{ J/kg-K}$	100 mm Lightweight Concrete $k = 0.53 \text{ W/m-K}$ ; $\rho = 1280 \text{ kg/m}^3$ ; $C_p = 840 \text{ J/kg-K}$
↑	Wall Air Space Resistance Thermal resistance = $0.15 \text{ m}^2\text{-K/W}$	Cooling Air Space Resistance Thermal resistance = $0.10 \text{ m}^2\text{-K/W}$
19 mm Acoustic Tile $k = 0.06 \text{ W/m-K}$ ; $\rho = 368 \text{ kg/m}^3$ ; $C_p = 590 \text{ J/kg-K}$	19 mm Gypsum board $k = 0.16 \text{ W/m-K}$ ; $\rho = 800 \text{ kg/m}^3$ ; $C_p = 1090 \text{ J/kg-K}$	19 mm Acoustic Tile $k = 0.08 \text{ W/m-K}$ ; $\rho = 368 \text{ kg/m}^3$ ; $C_p = 590 \text{ J/kg-K}$
5 mm PCM FS30 $k = 0.395 \text{ W/m-K}$ ; $\rho = 950 \text{ kg/m}^3$ ; $C_p = 2000 \text{ J/kg-K}$		

the number of hours in a year the building interior will be experiencing temperatures above 34, 36 and 38°C for the cases: without PCM, PCM+night ventilation and PCM+night HVAC. It can be realized that with efficient cooling or charging of the PCM

in the night to a temperature below the PCM melting temperature, the day temperatures can very well be moderated to PCM temperature. All in all, there will be annual saving in your electricity consumption compared to other passive cooling systems.

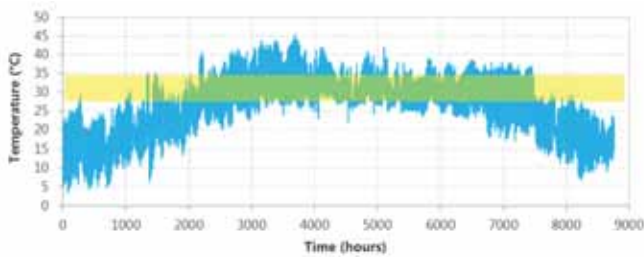


Figure 6a

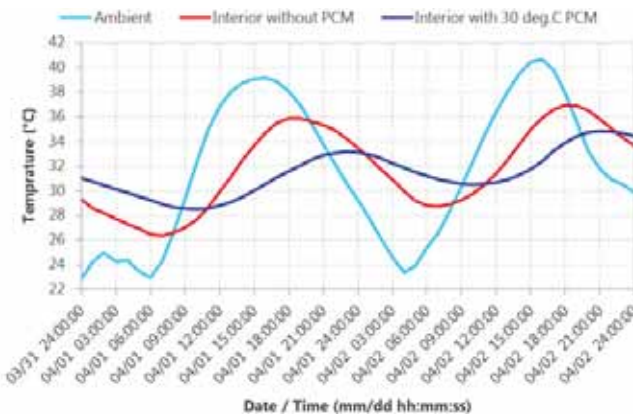


Figure 6c

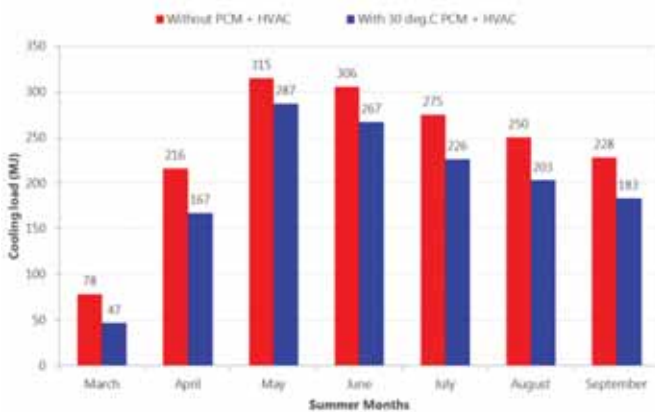


Figure 6d

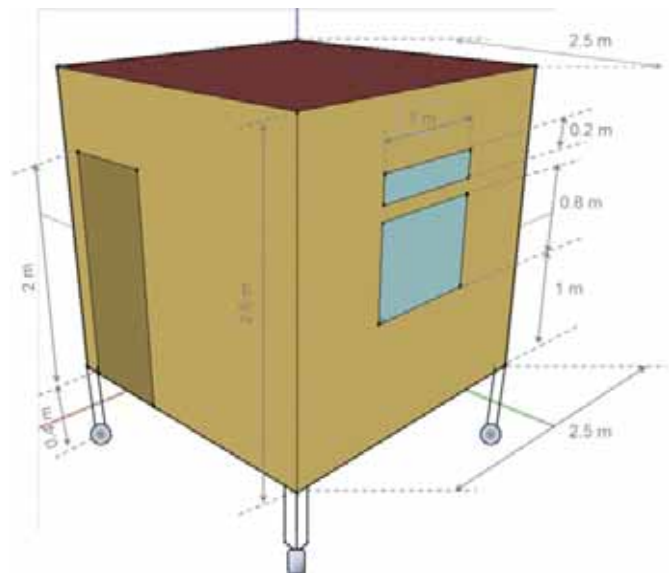


Figure 6b

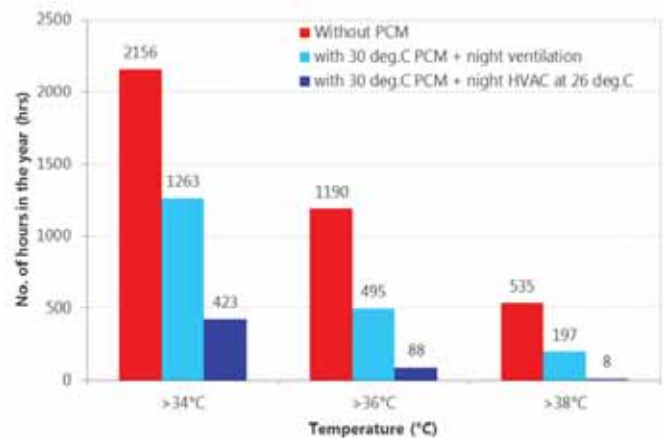



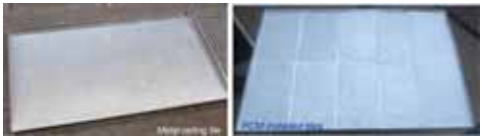
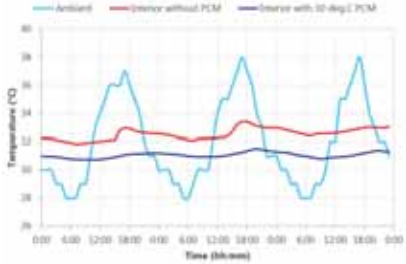
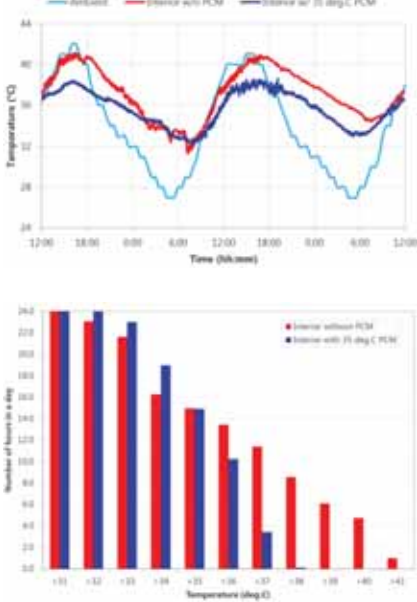




Figure 6e

Case Studies

<p>Name</p>	<p>I. CEPT University, Ahmedabad</p>  	<p>II. DTDC Courier Services, Gurgaon</p>  
<p>Description</p>	<p>PCM in the ceiling of a building without any cooling technology was first implemented at CEPT University, Ahmedabad under Indo-US Joint Center for Building Energy Research &amp; Development (CBERD) which is a Partnership for Advancement of Clean Energy – Research (PACE-R) with Oakridge National Laboratory &amp; Lawrence Berkeley Laboratory as partnering organizations. Two rooms were chosen next to each other with one room being an ordinary insulated room while the other room installed with a 30°C PCM.</p>	<p>The room was a typical masonry construction with wall and roof assembly without any special insulation. The room was experiencing higher heat ingressions much like the current buildings in India. The experiments were conducted in mid-April where the room interior without PCM was experiencing peak temperatures of 41°C. The weather conditions were studied to identify the most suitable PCM temperature for the months of summer. The max and min temperatures were predicted to be 44°C and 27°C, respectively. Hence, 35°C PCM was chosen as it will experience enough lower temperature during the night for the PCM to recharge comfortably.</p>
<p>PCM type</p>	<p>FS-30</p>	<p>FS-35</p>
<p>PCM volume</p>	<p>0.5 cm thick tile in 3m x 3m ceiling i.e. 0.2% volume of the total room volume: 3m x 3m x 3m</p>	<p>0.5 cm thick tile in a 4m x 3m ceiling i.e. i.e. 0.2% volume of the total room volume: 4m x 3m x 2.5m</p>
<p>Saving</p>	<p>Peak temperature during the afternoon reduced from 33°C to 31°C</p> 	<p>Peak temperature during the afternoon reduced from 41°C to 37°C</p> 

	<b>III. Greenhouse, Asheville, North Carolina, USA</b> 	<b>IV. Bharti Airtel Telecom Shelter, Delhi</b> 
<b>Name &amp; description</b>	<p>PCM was implemented in the walls of the greenhouse as a PCM curtain. The greenhouse was experiencing very high wall temperatures, much higher than the ambient. To regulate the wall temperature to below ambient temperatures, a 22°C PCM was installed in all the walls as a curtain.</p>	<p>A very effective utilization of PCM as a heat battery to store cold energy during the night for its use during the day was executed on telecom shelters to save on the energy consumption, peak demand and electricity cost. The telecom shelter can be categorized as a lightweight structure with wood and metal sheets constituting the wall and roof structure. To regulate the temperature of the shelter below 25°C, HVAC systems are operational throughout the day and for most part of the night. Additionally, a generator is installed to provide the power backup for operating the HVAC system to maintain the temperature inside. To save on the operation and maintenance cost, PCM was used to provide the backup during power failures by maintaining a constant temperature without additional power source. A 22°C PCM was installed along the walls to give a 6-8 hour backup throughout the day by maintaining the interior temperature around 25°C.</p>
<b>PCM type</b>	HS-22	HS-22
<b>PCM volume</b>	<p>1 cm thick curtain in with PCM encapsulated in PVC tubes to form a curtain along the walls. PCM occupied 1% of the total greenhouse space volume</p>	<p>PCM occupied 2% of the total telecom shelter space volume. The PCM tiles were 1 cm thick.</p>
<b>Saving</b>	<p>The temperature at the wall with PCM was almost 12°C cooler than the recorded temperature without PCM. The afternoon peak temperature reduced from 47°C to 35.5°C.</p>	<p>(a) Saving on diesel cost for the generator&amp;HVAC running cost;                      (b) 8 hour of cold backup without any additional power source or maintenance;                      (c) PCM battery as a passive system is automatic – no man power required;                      (d) PCM replaced a 7.5 kVA generator by allowing 80% reduction in total cost per year</p>



Phase Change Material Air Condition



## Conclusion

Latent heat storage in buildings is important in the reduction of cooling loads and reduction of temperature increases. The placement of the PCM is dependent on the wall/roof/floor surface through which the heat ingress is the highest; they are commonly ceiling and south wall. The amount of PCM is dependent on the specific thickness of PCM to be used for its effective charging and discharging on a daily basis. The natural ventilation during the night in summer and during the day in winter has a great significance in reducing the energy consumption of the space. The application of PCM in buildings has the ability to reduce the peak load of electricity demand throughout the year by reducing the cooling peak load during the day in summer and heating peak load during the night in winter. PCM utilises solar energy continuously, storing it during the day and releasing it at night, particularly for space heating in winter, thus improving the degree of thermal comfort. Additionally, they have the ability to store natural cooling by ventilation at night in summer and to release it to decrease the room temperature at night, thus reducing the cooling load of air conditioning. A most suitable PCM for a given climatic condition can offer decrease in energy consumption ranging from 30 to 40%, however, that is dependent

on: set-point temperatures of the space, and variance between the peak temperatures and the PCM operating temperature.

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Gurgaon



## SCM Frigo behind Chile's first CO<sub>2</sub> plant

Chile's first transcritical CO<sub>2</sub> system has been installed at a Jumbo supermarket in the southern city of Valdivia. The project was implemented by the Ministry of Environment's Ozone Unit and was funded by the Climate and Clean Air Coalition (CCAC). The 5,300 m<sup>2</sup> store, which opened on January 12, was built to the highest standards in sustainability. It includes 100% LED lighting and an

integrated building energy management system, alongside the CO<sub>2</sub>-only refrigeration system. CCAC, which funded the installation, was launched in 2012 by the United Nations Environment Programme (UNEP) and brings together governments, civil society and the private sector to help reduce short-lived climate pollutants (SLCPs) such as black carbon, methane and HFCs. Claudia Paratori, a coordinator in the Chilean ministry's Ozone Unit, said that this was the first instance of transcritical CO<sub>2</sub> refrigeration in Chile and was an opportunity to promote the technology, eliminate HCFCs and minimise the use of HFC-based systems in the country. "This



project will connect the different actors in the cold chain supermarket sector, promote the adoption of this technology, and help minimise the introduction of HFC-based systems in Chile," Paratori said. "The implementation of this project will generate multiple benefits for the environment and society. The Ministry of Environment also hopes it will contribute to the local environmental management of the city of Valdivia," she

added. The supermarket industry was identified as the largest user of HFCs in Chile in a CCAC and United Nations Development Programme national inventory of HFCs consumption and emissions. The project leaders claim that the Valdivia system delivers energy savings of about 20%. This effort to showcase alternatives to hydrofluorocarbons (HFCs) marks a national commitment to promote more climate-friendly refrigeration technologies. CCAC, meanwhile, also implements technology demonstration projects elsewhere, for example in Jordan in the commercial refrigeration sector, and in India in the mobile air-conditioning sector. ■

# Thermal Imaging for Best Cold Storage Conditions

Gubba Cold Storage offers its customers high-quality cold storage services for a wide range of products. In order to guarantee the best conditions for the stored goods, Gubba Cold Storage makes sure that its infrastructure is in an impeccable state. That is why the company recently invested in thermal imaging technology from FLIR. Thanks to FLIR, no insulation leakage or bad electrical wiring goes unnoticed...

Since 1987, Gubba Group Ltd has been offering cold storage services out of Hyderabad, Telangana, India. Gubba Cold Storage's eleven cold storage units are operational on a 24/7 basis and offer infrastructure for stocking seeds, pharmaceuticals products as well as agricultural products. Every stored product in the cold storage facilities has its own set of prescribed temperature settings. Understandably, with the continuous operation of Gubba Cold Storage's facilities

lead to high energy consumption.

"At Gubba, we provide a host of value added services to our customers that helps build their trust," says Gubba Prashant, Director, Gubba Group Ltd. "As customer satisfaction is our main priority, we will do everything in our capacity to ensure that our customers' stocks are preserved perfectly."

## Insulation Leaks & Humidity

To preserve the temperature in the cold

storage units, the quality of insulation is of course of utmost importance. Leaks in the insulation material covering the cold storage unit can be a threat to the temperature uniformity inside the unit. However, insulation leaks used to be discovered in a rather random fashion and repaired on the fly. What's more, insulation leaks can also allow moisture to enter the unit, which can also disturb the required relative humidity.

The moisture that enters the building will condense and freeze. Eventually, the build-up of ice can also affect the insulation properties of the cold store wall and weaken the structure of the wall or building. "I did not know about the power of thermal imaging, until I saw one of these cameras at work at a FLIR exhibition booth in India," says Gubba Prashant.

"There, I discovered that you can quickly scan large areas to look for insulation problems, find moisture beneath the insulation surface and much more. We decided to invest in one of FLIR's handheld thermal imaging cameras and we haven't regretted it ever since."

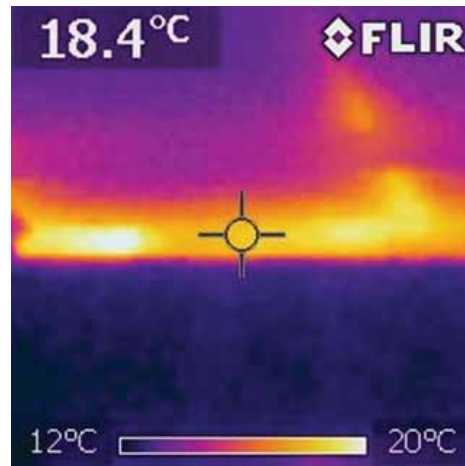
## Easy & Timely Detection

At Gubba Cold Storage, Gubba Prashant is now frequently using a FLIR i3 point and shoot camera to monitor the cold storage units and to detect possible leakages. One of the many advantages of this new approach is that inspections can now be scheduled in advance and on a regular basis. Small leakages can easily be detected before it

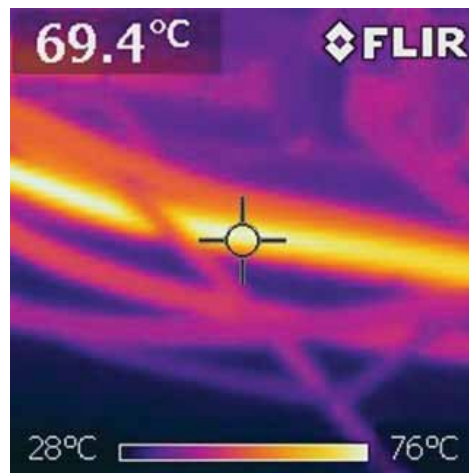




Leaks in the insulation material covering the cold storage unit can be a threat to the temperature uniformity inside the unit.



Gubba Group uses the FLIR i3 camera extensively for safety checks in electrical panels and chiller rooms across its various cold storage buildings.



escalates into something worse. And more importantly, by blocking these leakages in time, uniformity in temperature and relative humidity is maintained in the unit. This

helps Gubba Cold Storage to save its customers' stocks from perishing.

The FLIR i3 is the smallest, lightest and most affordable thermal imaging camera



Gubba Group employees performing a thermal audit with FLIR i3 camera.

on the market from FLIR. It is incredibly easy to use and requires no former experience. It really is a matter of "point shoot- detect" to obtain high-quality thermal images that will immediately give you the thermal information you need. It only weighs 365 g and is easy to store in a belt pouch.

### Soft & Hard Benefits

"Again, next to safeguarding our facilities, doing regular inspections with our FLIR thermal imaging camera and sharing these thermal images with our customers also allows us to build trust," says Gubba Prashant. "After performing a thermal audit with our FLIR i3 camera, we provide our customers with a report that certifies perfection in temperature and relative humidity maintenance."

"But next to these intangible benefits, there are also hard benefits, such as enormous power savings and reduced energy bills, as a result of repairs we were able to do based on information from our thermal imaging camera."

### Electrical Inspections

Aside from detecting heat and energy loss in cold unit storage structures, FLIR's thermal imaging camera has proved to be an accurate and effective tool in Gubba Cold Storage's facilities predictive maintenance programs. In electrical installations, hot spots in the thermal image usually point to emerging problems. With the FLIR i3 camera, Gubba Prashant's team can now scan electrical cabinets and components and survey multiple wires and connections to get an instant picture of potential trouble.

"We use the FLIR i3 camera extensively for safety checks in electrical panels and chiller rooms across our various cold storage buildings," says Gubba Prashant.

"When the thermal imaging camera clearly shows you an electrical cable that is much hotter than its environment, you know you have to intervene. This is how we can prevent bigger problems from happening." ■

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## Innovations in Building Energy Efficiency Trigger Growth Prospects in Gulf

With the penetration of information and communication technology, buildings are expected to become smarter, intelligent, environmentally friendly, and energy efficient, says Sasidhar Chidanamarri, Associate Director, Energy & Environment Practice – MENASA, Frost & Sullivan.

The Gulf Cooperation Council (GCC) is at an interesting juncture as the economic and social initiatives driving the transition towards energy efficiency have never been stronger. High economic growth and diversification from oil and gas have significantly increased demand for electricity and energy. Furthermore, the region's policies on fuel and electricity subsidies have led to wastefulness, and to inefficient buildings and industrial infrastructure, making these countries some of the most energy intensive globally. The current economic growth path is unsustainable; hence, there is a push to develop both renewable energy and energy efficient policies to meet the increasing energy demand and to diversify the electricity mix and to reduce dependence on fossil fuels.

"With the penetration of information and communication technology, buildings are expected to become smarter, intelligent, environmentally friendly, and energy efficient," said Sasidhar Chidanamarri, Associate Director, Energy & Environment Practice – MENASA, Frost & Sullivan.

In a recent White Paper titled 'Innovations and Disruptions in Building

Energy Efficiency in the GCC', Frost & Sullivan highlights a number of technologies and services that will become more relevant as a result of greater adoption of renewable energies and energy efficient policies in the GCC as compared to other regions.

Potential products that are likely to gain traction in the GCC energy efficiency industry are LED Lighting, Building Management Systems, District Cooling, Building Insulation, Variable Frequency Drives, Energy Recovery Devices, Trigeneration Plant Systems, Solar Thermal Air Conditioning, Non-Electric Chillers, Low-Emissivity Glass, and Building Integrated Photovoltaics. Besides the aforementioned products, the services market such as Energy Performance Contracting is also expected to gain significant opportunities in the GCC. Analysis by Frost & Sullivan shows that the market for Energy Performance Contracting in the UAE was estimated to be USD 80-100 million in 2015 and is expected to have a CAGR of 15-17 per cent in the next four to five years.

If adopted, the energy efficiency policies will provide a financial boost to governments as there is an opportunity

cost associated with reducing wasteful consumption of oil or electricity. They will also eliminate the need for massive investments in power generation. Reforms related to fuel and electricity tariffs by GCC governments are also improving prospects for energy and environment technologies, besides improving the financial situation in an era marked by falling revenues due to low oil prices. The market for energy efficiency products and solutions as well as energy service companies are bound to grow, driven by government initiatives and a shift in opinion and attitude towards viewing energy expenditure as a strategic cost centre.

"With buildings becoming fully integrated and networked using wireless, web-based automation systems, owners seek to maximise the real benefits," noted Sasidhar. "Hence, energy management will lead to improvements in operational efficiency, optimisation of energy, and demand management."

The large potential of this market can be gauged by the burgeoning real estate development activity and the need to cut energy consumption across commercial, residential, and government infrastructural segments. ■

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- Electromechanical linear actuator system for hospital, beds, O.T tables, O.T lights
- Dental chairs, Blood donor coach
- Power backup systems (UPS, Inverters & SMF batteries)
- Rehabilitation aids

... and related accessories.

## Professional Readers - MEA

### Industries:

- Medical and Surgical Equipment & Supplies
- Pharmaceutical & Bulk Drugs
- Disposable Supplies
- Diagnostics & Laboratory Instruments
- Hospital Furnishing & Related computer software
- Rehab. & Therapeutic aids
- Ophthalmic Instruments
- Oral & Dental Equipment
- Optical Equipment and supplies
- Institutions & Other allied industries

### Professionals:

- Medical Professional / Doctors
- Surgeons
- Paramedical Professionals
- Hospital Administrators
- Pathologists
- Radiologists
- Physiotherapists

Several Others...

## Honeywell's Refrigerant for Kirloskar Chillers in India

Kirloskar's new 'Make in India' chillers help the country deliver on its focus for next-generation cooling systems. Solstice ze is an environmentally preferable hydrofluoro-olefin (HFO) refrigerant developed by Honeywell that will support the Indian Government's transition away from high-global-warming-potential refrigerants...



**H**oneywell announced that Kirloskar Chillers, part of the Kirloskar Group, Pune-based engineering conglomerate, is using Honeywell's Solstice ze (R-1234ze(E)) refrigerant in its new line of chillers manufactured in India. The chillers, which are large central air conditioning units, are now available for installation in both industrial and commercial buildings in India, Middle East, South East Asia and Europe.

Kirloskar's new 'Make in India' chillers help the country deliver on its focus for next-generation cooling systems. India is one of the key signatories of the Kigali amendment to the Montreal Protocol, which is focused on phasing down the use of high-global-warming hydrofluorocarbons (HFCs). Solstice ze is an environmentally preferable hydrofluoro-olefin (HFO) refrigerant developed by Honeywell that is available immediately as an option to support the Indian Government's transition away from high-global-warming-potential refrigerants.

"We evaluated the range of options

available for our latest generation of chillers, and Honeywell's Solstice ze is the ideal solution, since it helps us meet environmental targets to reduce greenhouse gas emissions," said Prashant Joshi, Vice President for Kirloskar Chillers. "Honeywell's technical expertise helped us during development of the first HFO-chiller produced in India."

Solstice ze is non-ozone-depleting with an ultra-low global warming potential (GWP) of less than 1, complying with global environmental standards and regulations. It is classified as A2L and is non-flammable below 30°C. Solstice ze is safer to use than hydrocarbons or ammonia, which are either extremely flammable or highly toxic.

"Honeywell is committed to continuing to invest in the development of next-generation, lower-GWP solutions that make it easier for industries to adopt and use alternatives to higher-GWP refrigerants," said Julien Soulet, Managing Director for Honeywell Fluorine Products in Europe, Middle East, Africa and India. "We are happy to help the Indian Government by enabling an environment where innovative manufacturers like Kirloskar can introduce new energy efficient products that benefit from our expertise in developing sustainable alternative refrigerants with reduced environmental impact."

Kirloskar Chillers is an innovative provider of solutions for heating, ventilation, air conditioning and

refrigeration (HVAC&R) with a comprehensive range of centrifugal and screw chillers from 50 TR to 2400 TR. It is introducing the first chiller with Solstice ze in India, designed to be the industry's most economical and competitive when assessed by performance and overall cost-effectiveness. Designed for a wide range of operating conditions, Kirloskar Chillers offers a combination of operating efficiency, design flexibility, reliability and serviceability.

Honeywell is a world leader in the development, manufacture and supply of refrigerants that are sold worldwide under the Solstice and Genetron brand names for a range of applications, including refrigeration, building and automobile air conditioning. Honeywell and its suppliers are in the middle of a \$900 million investment program in technology development and new capacity based on Honeywell's hydrofluoro-olefin (HFO) technology, which helps customers lower their carbon footprint without sacrificing end-product performance.

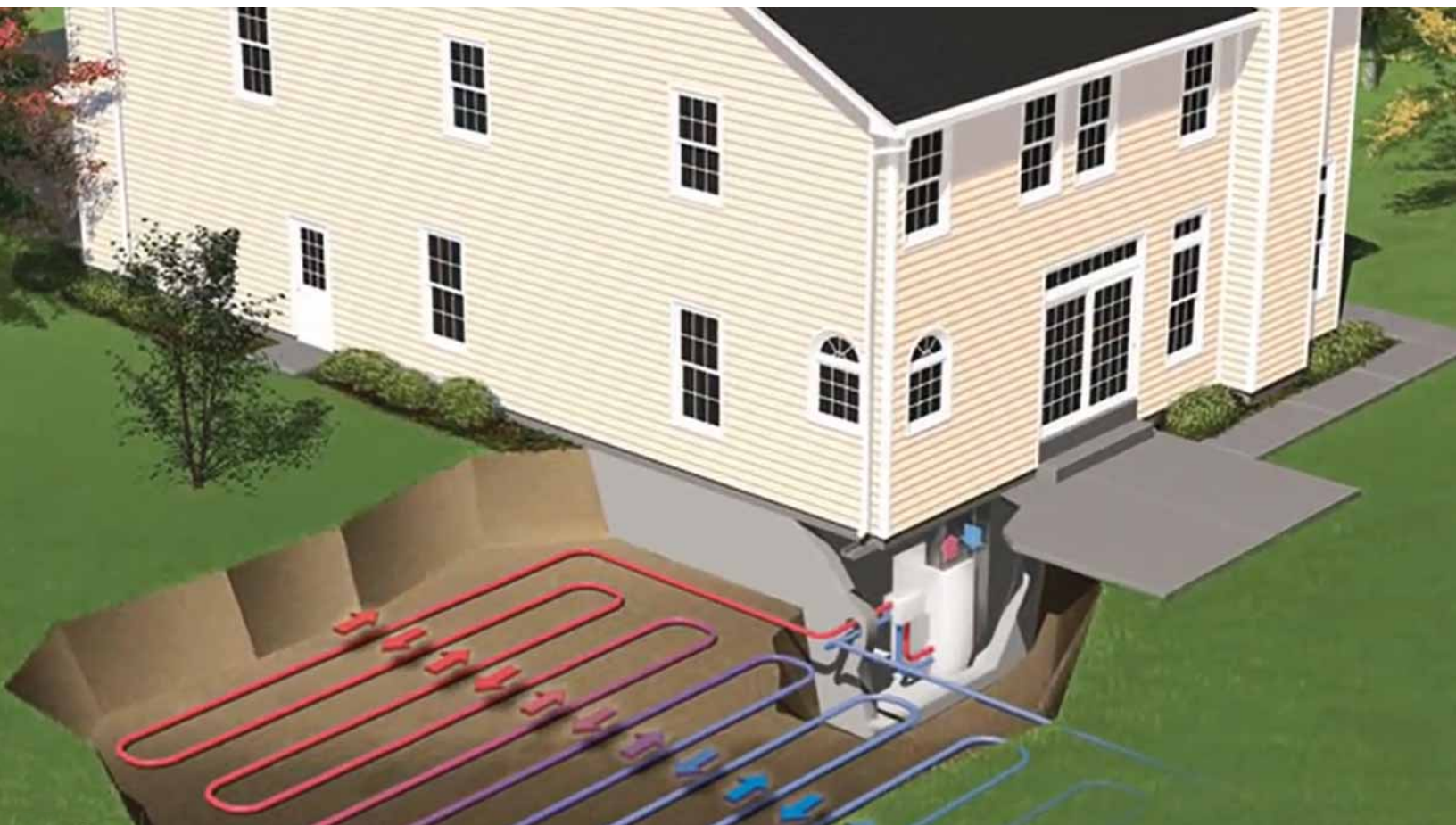
Honeywell's family of Solstice-branded products includes refrigerants for stationary, commercial refrigeration and mobile refrigerants, liquid and gaseous blowing agents, solvents and propellants—all based on Honeywell's hydrofluoro-olefin (HFO) technology that helps customers lower their carbon footprint without sacrificing end-product performance. Worldwide adoption of Solstice products has resulted in the reduction of more than 35 million metric tons of greenhouse gases to date, equal to permanently eliminating emissions from more than 7.5 million cars. ■

# Utilisation of Ground Source Energy

## Part 1

This paper highlights the potential energy saving that could be achieved through use of ground energy source. It is concluded that the direct expansion of GSHP are extendable to more comprehensive applications combined with the ground heat exchanger in foundation piles and the seasonal thermal energy storage from solar thermal collectors. This study highlights the energy problem and the possible saving that can be achieved through the use of the GSHP systems. This article discusses the principle of the ground source energy, varieties of GSHPs, and various developments...

**R**enewable energy sources have one thing in common; they all existed before man appeared on this planet. Wind, wave, hydro, solar, geothermal and tidal power are all forces of nature and are mostly intermittent energy sources, geothermal is the only consistent phenomenon. Geothermal renewable energy sources were probably the first to be fully utilised by man. Early civilisations tapped this heat to cook, fire clay pottery, create baths and spas and even heat their homes. Roman villas had under floor heating from natural hot





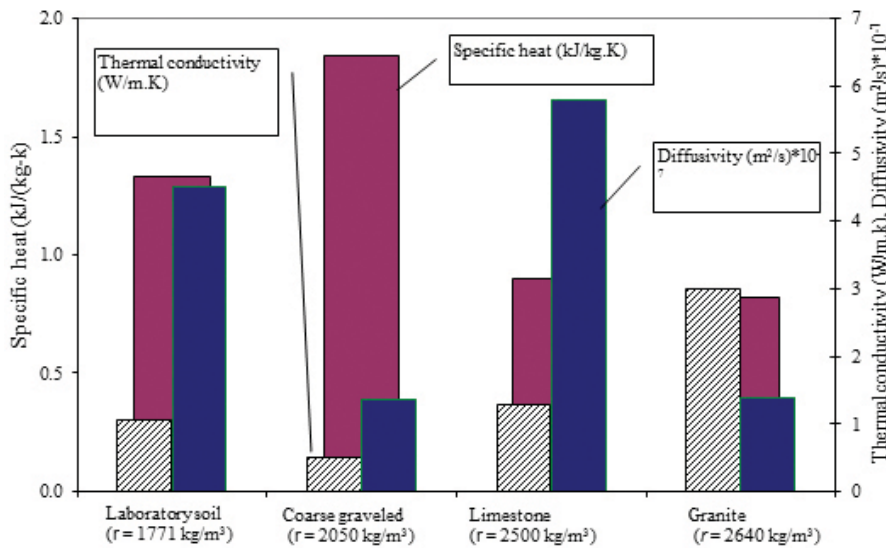


Figure 1: Measured thermal properties for different soils

springs over 2000 years ago.

Shallow geothermal resources (< 400 m depth by governmental definition in several countries) are omnipresent. Below 15-20 m depth, everything is geothermal. Figure 1 show a summary of the soil thermal properties. The temperature difference between the ground and the fluid in the ground heat exchanger drives the heat transfer so it is important to determine the ground temperature. The temperature field is governed by terrestrial heat flow and the local ground thermal conductivity structure (groundwater flow). In some countries, all energy stored in form of heat beneath the earth surface is per definition perceived as geothermal energy. The same approach is used in North America. The ubiquitous heat content of shallow resources can be made accessible either by extraction of groundwater or, more frequent, by artificial circulation like the borehole heat exchanger (BHE) system. This means, the heat extraction occurs—in most cases—by pure conduction; there is no formation fluids required. The most popular BHE heating system with one or more boreholes typically 50-200 m deep is a closed circuit, heat pump coupled system, ideally suited to supply heat to smaller, de-central objects like single family or multi-family dwellings (Figure 2). The heat exchangers (mostly double U-tube plastic pipes in grouted boreholes) work efficiently in

nearly all kinds of geologic media (except in material with low thermal conductivity like dry sand or dry gravel). This means to tap the ground as a shallow heat source comprise:

- Groundwater wells (“open” systems),
- Borehole heat exchangers (BHE),
- Horizontal heat exchanger pipes (including compact systems with trenches, spirals, etc.), and
- “Geo-structures” (foundation piles equipped with heat exchangers).

A common feature of these ground-coupled systems is a heat pump, attached

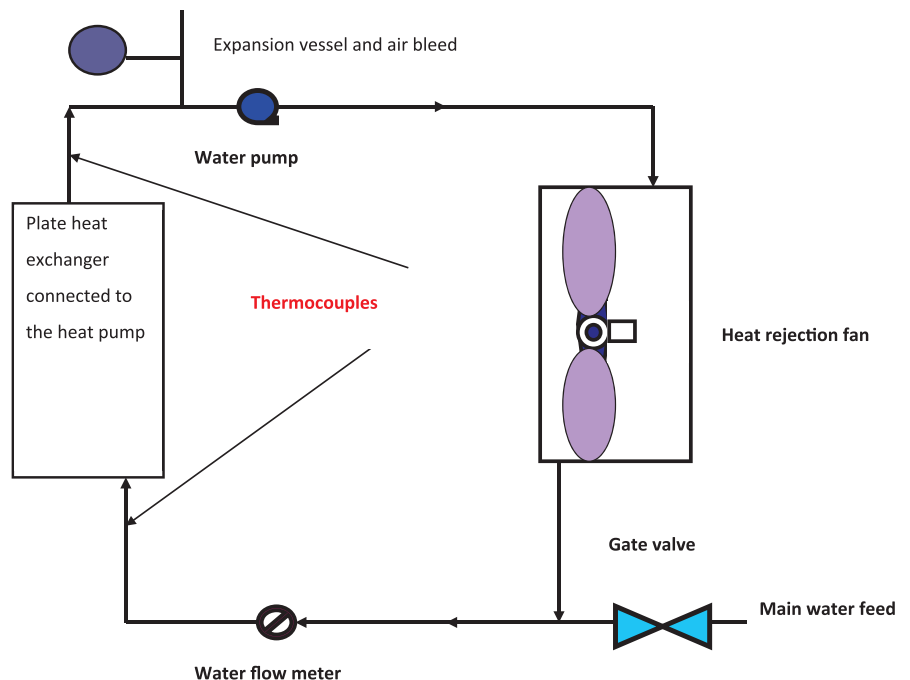


Figure 2. Typical application of a borehole heat exchanger (BHE) heat pump system in a central European home, typical BHE length = 100 m

to a low-temperature heating system like floor panels/slab heating. They are all termed “ground-source heat pumps” (GSHP) systems. In general, these systems can be tailored in a highly flexible way to meet locally varying demands. Experimental and theoretical investigations (field measurement campaigns and numerical model simulations) have been conducted over several years to elaborate a solid base for the design and for performance evaluation of BHE systems. While in the 80s, theoretical thermal analysis of BHE systems prevailed in Sweden monitoring and simulation was done in Switzerland, and measurements of heat transport in the ground were made on a test site in Germany.

In the German test system at Schöffengrund-Schwalbach near Frankfurt/Main, a 50-m BHE was surrounded by a total of 9 monitoring boreholes at 2.5, 5 and 10 m distance, also 50 m deep. Temperatures in each hole and at the BHE itself were measured with 24 sensors at 2 m vertical distance, resulting in a total of 240 observation locations in the underground. This layout allowed investigating the temperature distribution in the vicinity of the BHE. The influence from the surface is visible in the

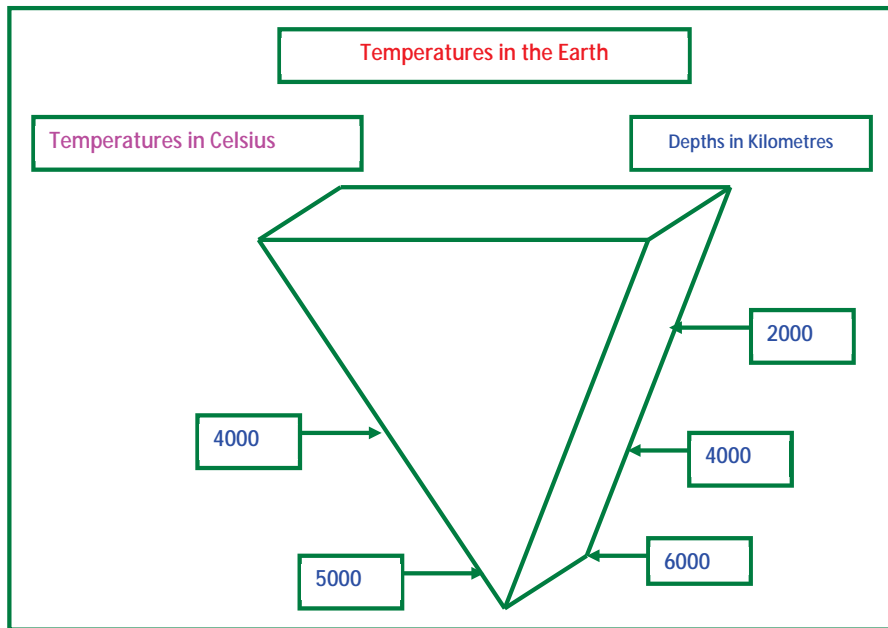


Figure 3: Earth energy budget

uppermost approximately 10 m (Figure 1), as well as the temperature decrease around the BHE at the end of the heating season. Measurements from this system were used to validate a numerical model for convective and conductive heat transport in the ground. Starting in 1986, an extensive measurement campaign has been performed at a commercially delivered BHE installation in Elgg near Zurich. The object of the campaigns is a single, coaxial, 10 m long BHE in use since its installation in a single-family house. The BHE supplies a peak thermal power of about 70 W per m of length.

The ground temperature results are highly informative with respect to the long-term performance. Atmospheric influences are clearly visible in the depth range 0-15 m, and below 15 m, the geothermal heat flux dominates. The results show that in the near field around the BHE, the ground cools down in the first 2-3 years of operation. However, the temperature deficit decreases from year to year until a new stable thermal equilibrium is established between BHE and ground, at temperatures that are some 1-2 K lower than originally. Thus, a "thermal collapse" (i.e., sudden drop of heat extraction efficiency) will not happen. After calibration of a numerical model with the data from the Elgg system, the extrapolation for an operation over a

30-year period as well as the thermal recovery for 25 years following the end of the operation period has been simulated. Temperature close to the BHE in winter drops quickly in the first years, only to stay more or less stable over the next years. In summer time, initial temperatures are not achieved again, but the temperature drop is decreasing from year to year. After termination of the operation, a rapid thermal recovery can be seen in the first spring, followed by a slowing down of the recovery process due to the decreasing temperature gradients. In the numerical simulation, a complete recovery will occur only after an indefinitely long time period; nevertheless, the remaining temperature deficit 25 years after the operation is stopped, is only in the order of 0.1 K. The long-term reliability of BHE-equipped heat pump systems, along with economic and ecological incentives, led to rapid market penetration. This was accomplished by the development of design standards (e.g., and easy-to-use design tools.

### Heat Pumps

Heat pumps work on a similar principle to domestic refrigerators, extracting heat from one source and transferring it to another. A key ingredient in the heat pump is the refrigerant in its coils, usually a substance called Freon, which vaporises

into a gas at a boiling point far lower than the 100°C that water requires to boil. When the refrigerant boils, it changes from a liquid to a gas, absorbing heat from its surroundings. As the refrigerant changes back into liquid form it gives up its heat to the surrounding atmosphere. An expansion valve and an electric compressor control this process of transformation from liquid to gas and back again.

Earth energy (EE) heat pump is one of the most efficient means available to provide space heating/cooling for homes and offices (Figure 3). It transfers the heat located immediately under the earth's surface (or in a body of water) into a building in winter, using the same principle as a refrigerator that extracts heat from food and rejects into a kitchen. A heat pump takes heat from its source at low temperature and discharges it at a higher temperature, allowing the unit to supply more heat than the equivalent energy supplied to the heat pump. An Earth Energy system relies on the 51% of solar energy that is absorbed by the land and water.

### Terminology

Due to the large demand for EE as cooling devices, the earth energy industry uses the term 'ton' to describe a unit that will provide approximately 12,000 Btu of cooling capacity. On average, a typical 2,000 square-foot new residence would require a 4-ton unit for sufficient heat. Within the full swing of heat pump applications in Europe, ground-coupled heat pumps play a significant role. The development started around 1980 when the first BHE coupled heat pump systems were built in Germany and Switzerland. Following a larger number of new units installed during the oil price crises and a subsequent low (except for Switzerland), the number of new installations is again increasing in the 90s.

### Airflow

EE units work efficiently because they provide a small temperature rise, but this means that the air coming through the register on the floor is not as hot as the air from a gas or oil furnace. A unit must heat

more air to supply the same amount of heat to the houses, and duct sizes must be larger than those used for combustion furnaces to accommodate the higher CFM (cubic feet per minute) air flow. The major advantage of an EE system is that the heat obtained from the ground (via the condenser) is much greater than the electrical energy that is required to drive the various components of the system. The efficiency of a unit is the ratio of heat energy provided versus the electrical energy consumed to obtain that heat, and it is called its Coefficient of Performance (COP). EE units must exceed 3.0 (i.e., for every kilowatt of electricity needed to operate the system, the heat pump provides three kilowatts of heat energy).

### Soil Type

Loose dry soil traps air and is less effective for the heat transfer required in EE technology than moist packed soil. Each manufacturer provides specifications on the relative merits of soil type; low-conductive soil may require as much as 50% more loop than a quality high-conductive soil.

### Auxiliary Heat

When the outdoor air temperature drops below the design balance point, the EE unit cannot meet the full heating demand inside the house (for units sized to 100% of heat loss, this is not an issue). The difference in heat demand is provided by the supplementary or auxiliary heat source, usually an electric resistance element positioned in the unit's plenum. Like a baseboard heater, the COP of this auxiliary heater is 1.0; so excessive use of backup heat decreases the overall efficiency of the system and increases operating costs for the homeowner.

### Balance Point

The outdoor temperature at which an EE system can fully satisfy the indoor heating requirement is referred to as the balance point, and is usually  $-10^{\circ}\text{C}$  in most regions of North Europe. At outdoor air temperatures above this balance point, the unit cycles on and off to satisfy the demand for heat indoors. At temperatures

below this point, the unit runs almost continuously, and also turns on the auxiliary heater (called second stage heat) to meet the demand.

### Heat Transfer Fluids

Closed-loop units can circulate any approved fluid inside the pipe, depending on the performance characteristics desired. Each manufacturer must specify which fluids are acceptable to any particular unit, with the most common being denatured ethanol or methanol (the latter is not approved for use).

### Loop Depth

EE technology relies on stable underground (or underwater) temperature to function efficiently. In most cases, the deeper the loop is buried, the more efficient it will be. A vertical borehole is the most efficient configuration, but this type of digging can be very expensive.

### Loop Length

The longer the amount of piping used in an outdoor loop, the more heat that can be extracted from the ground (or water) for transfer to the house. Installing fewer loops than specified by the manufacturer will result in lower indoor temperature, and more strain on the system as it operates longer to compensate for the demand. However, excessive piping can also create a different set of problems, as well as additional cost. Each manufacturer provides specifications for the amount of pipe required. As a broad rule of thumb, an EE system requires 400 feet of horizontal loop or 300 feet of vertical loop to provide heat for each ton of unit size.

### Loop Spacing

When the distances between buried loops are greater than, the efficiency is higher. Industry guidelines suggest that there should be 3 m (10 feet) between sections of buried loop, in order to allow the pipe to collect heat from the surrounding earth without interference from the neighbouring loop. This spacing can be reduced under certain conditions.

### Loop Configuration

Closed loops generally are installed

either in a vertical or in a horizontal configuration, depending on the land available and a number of other factors. Earth Energy ground pipe comes in two common diameters: 0.75" and 1.25". Two coiled loops (commonly called the Svec Spiral and the Slinky) require less trenching than conventional straight pipe. As a result, the lower trenching costs and the savings in property disruption offset the higher cost of the coiled pipe.

### Varieties of Heat Pumps

Air conditioning systems are an example of an air-to-air heat pump. They are becoming increasingly prevalent, particularly, because new cars are often fitted with air conditioning systems and people are beginning to ask for more controlled internal environments. However in the UK, the need for air conditioning is often a result of overheating because of unsatisfactory shading and poor natural ventilation. Every attempt should be made to design buildings, which do not require air conditioning, because of the additional energy load required.

In addition to air-to-air heat pumps there are air to water heat pumps and water to air systems. These can draw water from a well or pond and expel the used water to a discharge well. Because the source of heat is fairly constant (about  $10^{\circ}\text{C}$ ) the heat pumps are more efficient than air-to-air systems. Water to water heat pumps are even more efficient, taking the energy from geothermal supplies which are at a constant year round temperature and transferring heat to about  $53^{\circ}\text{C}$ .

Because heat pumps do not produce very high temperatures, they work best when heating well insulated houses, which are designed to be heated by low temperature systems. Traditional radiators, which are oversized, will give a larger area to dissipate heat and so work at lower surface temperatures. Underfloor water based heating systems are ideal as they work on the radiant heating principle which creates a comfortable environment at a lower temperature.

The heating loads for a house will vary

**Table 1: Surface area requirements GSHP (sq metres)**

Design	Horizontal	Vertical
2 pipes per trench	2000	3500
4 pipes per trench	1400	2400
6 pipes per trench	1400	2400

considerable over the year. At the coldest time of the year, the energy requirements will be greatest. If the design to these levels of maximum load, the heat pumps size can get very big, and as a result costly. It is thought best to design the heat pumps to only cover about 50 to 70% of the annual heating demand, and where demand peaks over a smaller period, to provide supplementary direct electrical heating (or alternatives) to meet this demand.

### Types of Geothermal Systems

There are a number of different methods to heat a building using geothermal energy:

- Groundwater GSHP, of which there are two variations, open loop and closed loop. An open loop groundwater GSHP supplies ground water directly to each heat pump and then returns the well water to the source. This system is normally not recommended because of fouling and corrosion concerns. The closed loop uses an isolation plate and frame heat exchanger between the ground water and the building water loop.
- Surface-water GSHP, which uses multiple heat exchangers made from spooled plastic pipe submerged in a body of surface water and connected to the building heat pumps.
- Ground heat exchanger GSHP, which relies on a ground-coupled heat exchanger installed either horizontally in trenches or as "U" tubes in vertical bores.

The heat exchangers are connected together in parallel, and run-outs are tied to the building's water loop. The selection of a particular design depends on the available land area. Table 1 provides the guidelines on the surface-area requirements for horizontal/vertical configurations. The decision to use any of

the above systems depends on the results of geotechnical / hydrogeological investigations.

### Water Discharge Quality

There are environmental regulations, which govern how the water used in an open-loop system can be returned to the ground. A return well is acceptable, as long as the water is returned to the same aquifer or level of water table. A discharge pit is also acceptable, as long as certain conditions are followed.

Open water systems depend on a source of water that is adequate in temperature, flow rate and mineral content. EE units are rated under the nation performance standard (CSA C446) based on their efficiency when the entering water temperature is 10°C (0°C for closed loop units), but this efficiency drops considerably if the temperature of water is lower when it comes from the lake or well. Each model has a specified flow rate of water that is required, and its efficiency drops if this rate is reduced. The CSA installation standard demands an official water well log to quantify a sustainable water yield. Water for open-loop systems must be free of many contaminants such as chlorides and metals, which can damage the heat exchanger of a unit.

### Selecting A GSHP

GSHPs are very similar to conventional heat pumps. Their specifications differ from conventional water-source heat pumps (WSHP) only in the following areas:

1. GSHPs operate over a very wide range of entering water temperatures from

source (ground), typically, 20°F to 110°F, whereas the conventional WSHP operates over a very narrow range (60 to 90°F). This requires the use of an extended-range heat pump to preserve the ability of the system to operate at low ground-water temperatures. Table 2 gives the typical temperature ranges for the water loop of GSHPs.

2. GSHPs with the ground as a heat exchanger must be rated under ARI 330 or CSA 446 closed-loop conditions. GSHPs are to be rated under ARI 325 or CSA 446 open-loop conditions. Conventional heat pumps are rated under ARI 325 or CSA 656 conditions.
3. GSHPs usually use a thermal-expansion valve as opposed to the capillary expansion device used in WSHPs.
4. GSHPs typically encounter low suction temperatures and, therefore, need to be specified with low-temperature/pressure controls for freeze protection.
5. GSHPs usually employ larger liquid side and airside heat exchangers and insulated internal components to prevent internal condensation.
6. In conventional WSHPs, the insulation on the loop piping is not required because the loop temperatures are always maintained above 45°F. GSHP system piping will require insulation, and, in some cases, antifreeze solutions will be required to prevent freeze up.
7. Specify copper heat exchangers for heat pumps on closed-loop ground source, groundwater, or surface-water applications. Use only cupronickel heat exchangers for open ground-water systems.
8. While calculating the loads for the

**Table 2: Entering liquid temperatures for different system types (°F)**

Horizontal design	Heating	Cooling
Ground heat exchanger	30-55	90-105
Surface water heat exchanger	30-45	80-95
Closed loop ground water	40-50	75-85
Open loop ground water	50-60	55-65

ground-source heat pumps, it is necessary to perform the calculations with an hour-by-hour and month-by-month simulation program because these calculations will be required to design the well field.

## Selection and Pre-Installation Considerations

The ground source heat pump (GSHP) system represents the natural evolution of a traditional water loop heat pump (WLHP) system. The GSHP system offers all the advantages of the WLHP system, combined with considerable reductions in building operating costs. The beauty of this system is that it can perform both heating and cooling without the use of separate boilers/furnaces and A/C systems.

A GSHP system does not create heat; it moves heat from one area to another. GSHP systems use the ground (earth, ground water, or surface water) as heat sink in the summer and a heat source in the winter. This system is considered the most energy-efficient, environmentally safe, and cost-effective system available. Among the many components of a GSHP system, the most important is the heat pump itself.

## Heat Pump Accessories & Controls

Considerations for heat pump:

- Heat pumps, whether water or ground source, should not be used to handle large outdoor air loads. These outdoor air loads should be handled through separate A/C units, preferably with heat-recovery capabilities and conditioned outdoor air ducted to each heat pump.
- Heat-pump sizing is very critical. It doesn't need to oversize heat pumps. In general, size at no less than 95 percent for adequate latent-heat capacity. Do not size greater than 125 percent of the zone peak sensible-cooling load unless the heat pump has multi-speed fan/compressor and automatic means of adjusting flow.
- Pay special attention to the

specifications for the on/off automatic valve in the source water-supply connection to the heat pump, which is interlocked with the compressor to permit compressor operation only after it is fully open. Though seemingly a small component in the overall system, this is prone to frequent failures if it is not of good quality. Its failure will lead to expensive compressor failures.

- Heat-pump schedules must include the minimum acceptable coefficient of performance for heating performance and energy efficiency ratio for the cooling performance to take advantage of the most efficient heat pumps available on the market.

## Geothermal Heating Systems

Geothermal energy is a natural resource, which can be used in conjunction with heat pumps to provide energy for heating and hot water. CO<sub>2</sub> emissions are much lower than gas fired boilers or electric heating systems. Geothermal heating is more expensive to install initially, than electrical or gas fired heating systems. However, it is cheaper to run, has lower maintenance costs, and is cleaner in use than other sources of heating.

The temperature of the earth under 2 metres of the surface is a fairly constant 10°C throughout the year. At a depth of about 100 metres, the temperature of any water or rock is at about 12°C throughout the year. The heat stored at this depth comes largely from the sun, the earth acting as a large solar collector. For very deep wells, in excess of about 170 metres, there is an added component of heat from the core of the earth. As an approximation, one can add 3°C of heat gain for every 100 metres of depth drilled into the earth.

A closed loop system takes the heat gained from the bedrock itself. In a vertical system a borehole of a diameter of about 150mm is drilled, depth varies between 32 and 180 metres but will depend on the energy requirements. Multiple boreholes can be drilled. A pair of pipes with a special U-bend assembly at the bottom is inserted into the borehole and the void

between pipe and hole backfilled with a special grout solution so that the pipe is in close contact with the rock strata or earth. Fluid (referred to as 'brine' is then circulated through this loop and is heated up by the bedrock. Different rock types will give different results. In some cases a number of boreholes will be made (for example, over a car park) to provide sufficient energy for the heat pump supply. If the ground is not suitable, horizontal loops can be laid or even trench filled 'slinky' loops, which are very simple to install. However, trench filled systems and horizontal systems require much more ground than vertical systems. If one has a pond or lake nearby, then can lay a closed loop at the base of the pond (it needs to be about 2 metres deep), or simply extract the water directly out of the lake at low level and re-distribute it elsewhere in the lake.

Heat pumps can be cheaper to operate than other heating systems because, by tapping into free heat in the outdoor air, ground or water supply, they give back more energy-in the form of heat-than the equivalent amount of electrical energy they consume. For example, in heating mode, a highly efficient heat pump could extract energy from the earth and transfer it into a building. For every 1 KWh of electrical energy used to drive the heat pump, around 3 to 4 kWh of thermal energy will be produced. In cooling mode, the heat pump works in reverse and heat can be extracted from a building and dissipated into the earth. Heat pumps which work in a heating mode are given a 'coefficient of performance' or 'COP' calculated by dividing the input kWh into the output kWh. This will give a COP figure, which varies with the input temperature and is the ratio of energy in to energy out. In cooling mode, the ratio is called the 'energy efficiency ratio' or 'EER'. When the EER and COP ratios higher, the more efficient the unit. Geothermal/GSHPs are self-contained systems. The heat pump unit is housed entirely within the building and connected to the outside-buried ground loop.

## Conclusion

The direct expansion (DX) ground source heat pump (GSHP) systems have been identified as one of the best sustainable energy technologies for space heating and cooling in residential and commercial buildings. The GSHPs for building heating and cooling are extendable to more comprehensive applications and can be combined with the ground heat exchanger in foundation piles as well as seasonal thermal energy storage from solar thermal collectors. Heat pump technology can be used for heating only, or for cooling only, or be 'reversible' and used for heating and cooling depending on the demand. Reversible heat pumps generally have lower COPs than heating only heat pumps. They will, therefore, result in higher running costs and emissions and are not recommended as an energy-efficient heating option. The GSHP system can provide 91.7% of the total heating requirement of the building and 55.3% of the domestic water-heating requirement, although only sized to meet half the design-heating load. The heat pump can operate reliably and its performance appears to be at least as good as its specification. The system has

a measured annual performance factor of 3.16. The heat pump system for domestic applications could be mounted in a cupboard under the stairs and does not reduce the useful space in the house, and there are no visible signs of the installation externally (no flue, vents, etc.).

The performance of the heat pump system could also be improved by eliminating unnecessary running of the integral distribution pump. It is estimated that reducing the running time of the pump, which currently runs virtually

continuously, would increase the overall performance factor to 3.43. This would improve both the economics and the environmental performance of the system. More generally, there is still potential for improvement in the performance of heat pumps, and seasonal efficiencies for ground source heat pumps of 4.0 are being achieved. It is also likely the unit costs will fall as production volumes increase. By comparison, there is little scope to further improve the efficiency of gas- or oil-fired boilers. ■

### Nomenclatures

ACH	Air changes per hour		and the Regions
GSHP	Ground source heat pump	DTI	Department of Trade and Industry
HRV	Heat recovery ventilator	AFUE	Annual fuel utilisation efficiency rating
DC	Direct current	ARI	The Air-conditioning and Refrigeration Institute
HSPF	Heating season performance factor	COP	Coefficient of performance (%)
SEER	Seasonal energy efficiency ratio	GHP	Geothermal heat pump
Btu	British thermal unit	GL	Ground loop
EER	Energy efficiency rating	HP	Heat pump
DX	Direct expansion	N	Air change per hour (ACH) (h <sup>-1</sup> )
GS	Ground source	P	Pressure (Pa) (kPa)
EPA	Environmental Protection Agency	Q	Heat (thermal energy) (J)
HVAC	Heating, ventilating and air conditioning	Q <sub>c</sub>	Capacity (thermal power) (W)
DETR	Department of the Environment Transport		

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## Vertiv Wins CIO Choice 2017 Honor & Recognition Awards

**V**ertiv, formerly known as Emerson Network Power, announced that it won two awards at the prestigious CIO Choice 2017 Honor & Recognition Awards ceremony held in Mumbai. The company was recognized amidst a gathering of over 400 CIOs and ICT business leaders for its excellent performance in two categories – Data Center Cooling and Data Center Power for large enterprises.

The CIO Choice Awards is a B2B platform that recognizes and honors products, services and solutions based on the preferences of CIOs and ICT decision makers. The awards recognize Vertiv for its excellent work amongst its peers in the industry and re-emphasizes Vertiv's commitment to its customers. The award-winning Liebert® range of products is designed by Vertiv to protect the power and IT infrastructure of an organizations' mission critical systems. This 5th annual CIO Choice event, focusing on companies based or operating in India, was by far the most competitive in its history, with the highest number of nominations and entry submissions to date. More than 200 entries were received this year, from a wide

array of public and private ICT vendor companies, both large as well as small and medium enterprises and from a variety of geographic regions in India. CIO Choice 2017 Honor & Recognitions were presented in 52 categories, recognizing 28 distinct brands. Winners of CIO Choice 2017 were determined by an independent CIO voting survey from across the country on product performance, customer satisfaction and continued customer service. It is a recognition and validation that CIOs can trust because it is 'By the CIO and for the CIO'. It offers the CIO community an authentic aid to finding and considering the most preferred and stable products, services and solutions. Having earned the honor to wear the CIO Choice logo, ICT vendors will be enjoying new media campaigns and amplified CIO exposure resulting in increased sales. KPMG was the knowledge partner for CIO Choice 2017.

Dr A S Prasad, head, product and marketing – India at Vertiv added, "This is our first award since we rebranded from Emerson Network Power to Vertiv and we hope many more continue here on." ■

# Powerful Participation in ACREX 2017

ACREX India 2017 was organised by the Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) and produced by NuernbergMesse India Pvt Ltd.



The 2017 chapter of ACREX India, the biggest, widest and a most dynamic global platform on this side of the continent on all that is cool held in Delhi in February. The focus was not limited only to HVAC&R the exhibition but also on diverse building engineering services that include electrical & plumbing services, building automation and the ever-growing cold chain industry.

ACREX India 2017 was organised by the Indian Society of Heating, Refrigerating and Air Conditioning Engineers (ISHRAE) and produced by NuernbergMesse India Pvt Ltd. It was held at the India Exposition Mart (IEM), Greater Noida. The venue is the largest in India occupying over 77,000 square meters of indoor exhibition space and 1,70,500 square meters of constructed area for conducting exhibitions.

ACREX India 2017 was meant not only

the launch-pad for potential business collaborations, but also a living resource pool and a seamless amalgamation of Integrated Building Solutions.

The event witnessed the powerful international participation from 25 countries including Belgium, China, Czech Republic, Egypt, France, Germany, Italy, Japan, Korea, Malaysia, Saudi Arabia, Singapore, Spain, Switzerland, Taiwan, the Netherlands, UAE, UK, Ukraine and USA.

ACREX Hall of Fame is an industry benchmark instituted by Danfoss India in partnership with ISHRAE to recognize the excellence achieved in conserving energy by commercial buildings in the Indian subcontinent. The coveted recognition aims to encourage energy efficiency among industry stakeholders and showcase success stories in the HVAC space in India.

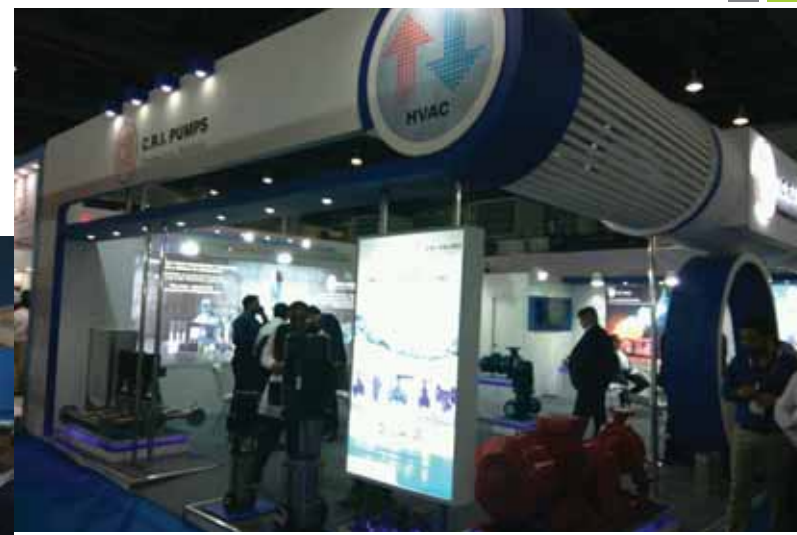
This year, the coveted recognition has been awarded to Infosys for being a front runner in promoting energy conservation and sustainable work environment. With an integrated approach to developing energy efficient buildings that include sourcing natural lights, efficient LED Lighting, Energy harvesting sensors & control and the implementation of the radiant panel based cooling, Infosys reaffirmed its commitment to develop and maintain a green infrastructure.

What makes the 2017 Hall of fame stand apart is that every stakeholder, HVAC consultant, HVAC contractor were recognized for their contribution to making the sustainable journey possible. Ten HVAC projects were nominated out of many entries across India.

"There is a need to build awareness about energy efficiency and HVAC for the development of infrastructure and sustainability in our country. Proper energy management will lead to improvements in energy efficiency, optimization of energy and demand management. In the future, buildings can become smarter, intelligent and environmental friendly. ISHRAE through ACREX aims at identifying a project which is ideal to be placed in the hall of fame and aligns with our visions for the country in terms of energy efficiency, innovation and technology," said Sachin Maheshwari, President, ISHRAE in a press release.

Experts & stalwarts of industry from international organizations like ASHRAE & AMCHAM USA, UNEP, CIBSE UK, REHVA & EBTC France, VDMA & IGCC Germany, CAR China, FTI Thailand, ABOK Russia, Turkish HVAC-R Exporters (ISIB) Turkey have been using this platform for 'Connect, Share, Create Knowledge Forums and strategic alliances'.

# Cooling India with few of its clients at Acrex '17





# Status of 34 Mega Food Park Projects as on November 2016

Sr No	Project Name	Project Cost (Rs in crore)	Date of In Principal Approval	Date of final Approval	Amount of Grant Approved (Rs in crore)	Amount of Grant Released (Rs in crore)	Expenditure (Rs in crore)
Andhra Pradesh							
1	Andhra Pradesh Industrial Infrastructure Corporation, Krishna	184.88	31.03.2015	31.12.2015	50	APIIC is in the process of meeting the conditions for release of first installment.	
2	Srini Food Park Pvt Ltd , Chittoor	121.10	16.12.2008	27.03.2009	50	49.92*	122.68
3	Godavari Mega Aqua Park Pvt Ltd, West Godavari	122.60	21.09.2012	16.12.2013	50	15	24.36
Assam							
4	North East Mega Food Park Pvt Ltd, Nalbari	80.85	16.12.2008	30.03.2009	50	45	69.58
Bihar							
5	Pristine Mega Food Park Pvt Ltd , Khagaria	127.64	21.09.2012	06.08.2014	50	14.12**	24.92
6	JVL Mega Food Park Pvt Ltd, Rohtas	117.21	19.12.2013	10.08.2015	50	SPV has been issued preliminary notice of cancellation. SPV needs to meet the conditions for the release of first tranche of first installment	
Chhattisgarh							
7	Indus Best Mega Food Park Pvt Ltd, Raipur	124.50	06.09.2012	04.06.2014	50	SPV has submitted an expenditure of Rs. 13.61 Cr. SPV needs to obtain term loan disbursement for release of first Tranche of first Installment	
Gujarat							
8	Gujarat Agro Infrastructure Mega Food Park Pvt Ltd, Surat	117.87	21.09.2012	22.05.2014	50	14.19 **	35.55
Haryana							
9	Haryana State Industrial & Infrastructure Development Corporation Limited, Sonipat	177.59	31.03.2015	06.11.2015	50	HSIDC is in the process of meeting the conditions for release of first installment.	
Himachal Pradesh							
10	Cremica Food Park Pvt. Ltd., Una	99.70	21.09.2012	06.08.2014	50	14.01**	21.64
Jammu and Kashmir							
11	RFK Greens Food Park Pvt. Ltd., Pulwama	79.43	21.09.2012	19.02.2014	50	5.00	13.02
Jharkhand							
12	Jharkhand Mega Food Park Pvt. Ltd., Ranchi	114.74	16.12.2008	27.03.2009	50	43.78**	108.32
Karnataka							
13	Integrated Food Park Pvt. Ltd, Tumkur	144.33	03.08.2010	27.03.2011	50	48.22**	159.82
Kerala							
14	Kerala State Industrial Development Corporation limited (KSIDC), Alappuzha	129.15	31.03.2015	27.11.2015	50	10.00	11.94

15	Kerala Industrial Infrastructure Development Corporation (KINFRA), Palakkad	119.02	31.03.2015	27.11.2015	50	15.00	18.18
Madhya Pradesh							
16	Avantee Mega Food Park Pvt. Ltd. (formerly Ruchi Acroni) Dewas	144.12	31.03.2015	31.12.2015	50	15.00	35.80
17	Indus Mega Food Park Pvt. Ltd., Khargoan	131.28	10.10.2011	27.08.2012	50	45.00	127.59
Maharashtra							
18	Wardha Mega Food Park Pvt. Ltd. (Formerly known as Jain Agro Trading Company Private Limited), Wardha	92.36	31.03.2015	13.01.2016	50	SPV is in the process of meeting the conditions for release of first installment.	
19	Paithan Mega Food Park Ltd., Aurangabad	124.56	01.04.2011	08.03.2013	50	23.77 **	54.71
20	Satara Mega Food Park Pvt. Ltd., Satara	139.33	21.09.2012	06.08.2014	50	29.50	82.98
Mizoram							
21	Zoram Mega Food Park Pvt. Ltd., Aizawl	75.20	19.12.2013	10.06.2015	50	15.00	17.47
Odisha							
22.	Odisha Industrial Infrastructure Development Corporation (IDCO), Khurda	134.13	31.03.2015	06.11.2015	50	15.00	31.29
23.	MITI Mega Food Park Ltd., Rayagada	80.17	29.04.2011	16.04.2012	50	30.00	31.22
Punjab							
24.	Punjab Agro Industries Corporation Ltd., Ludhiana	117.61	31.03.2015	27.11.2015	50	15.00	14.11
25	The Sukjhith Starch & Chemical Limited, Kapurthala	123.72	31.03.2015	06.11.2015	50	SPV is in the process of meeting the conditions for release of first installment.	
26	International Mega Food Park Pvt Ltd, Fazilka	130.38	03.08.2010	25.05.2011	50	45	137.33
Rajasthan							
27	Green Tech Mega Food Park Pvt Ltd, Ajmer	113.57	21.09.2012	19.02.2014	50	14.85**	39.22
Telangana							
28	Telangana State Industrial Infrastructure Corporation Pvt Ltd, Khammam	109.44	31.03.2015	05.02.2016	50	TSIC is in the process of meeting the conditions for the release of first installment	
29	Raaga Mayuri AgroVet Pvt Ltd, Mehboobnagar	124.15	31.03.2015	31.12.2015	50	10.00	15.69
30	Smart Agro Industries Corporation Pvt Ltd, Nizamabad	108.95	19.12.2013	10.06.2015	50	5.00	14.36
Tripura							
31	Sikaria Mega Food Park Pvt Ltd, West Tripura	87.45	29.04.2011	30.11.2011	50	28.50**	48.30
Uttarakhand							
32	Patanjali Food and Herbal Food Park Pvt Ltd, Haridwar	95.08	16.12.2008	27.03.2009	50	50	97.38
33	Himalayan Food Park Pvt Ltd, Udham Singh Nagar	99.96	21.09.2012	23.01. 2014	50	29.79**	51.18
West Bengal							
34	Jangipur Bengal Mega Food Park, Murshidabad	132.70	16.12.2008	16.03.2010	50	45	160.86

\*Sri M FP- Rs. 8.00 lak h ad justed due to interest earned on the grant

\*\* Penalty imposed due to delay in submission for the request of the release of Grant-in-aid

Source: Ministry of Food Processing Industries

## Airedale's Next Generation InRak

**A**iredale International is set to showcase its new InRak (300mm) at Data Centre World along with a number of other solutions, all of which are engineered to perform, in today's data centre environment.

The InRak 300mm is a precise and high performance in-row cooling solution which offers industry leading cooling efficiency for its capacity. With an EER of 73.6, the InRak provides up to 54% more energy efficient cooling for its capacity than its nearest competitor.

Designed to sit between the server racks in a hot aisle containment configuration, the InRak takes advantage of its position close to



the server heat source and the higher return air temperatures that are associated with it, providing targeted IT cooling via the shortest, direct route.

Easily scalable, the InRak allows for incremental increases in cooling requirements, with its compact, modular design. This makes it easy for multiple units of different size and capacity to be added as load increases or to eliminate hot spots.

With flexibility at its core, the InRak requires no floor or ceiling void and has a small footprint. Compatible with racks from any manufacturer, it includes easy and simple connection

points that allow for fast installation from either above or below.

Driven by smart controls logic, the

InRak delivers complete confidence with aisle differential pressure control; and dual power supply.

### SmartCool i-drive unit (5-83kW)

An inverter compressor precision air conditioning unit designed for use in high density applications using elevated return air temperatures. The SmartCool i-drive delivers exact setpoint control for superior efficiency and performance.

The OnRak is a resilient rear door heat exchanger designed to manage high discharge temperatures directly from the server into the aisle space. It provides up to 35kW cooling with an EER of 114.5 (n); 183.0 (n+1).

ACIS provides a highly graphical, simple-to-use BMS to manage and optimise cooling and other building services, from any manufacturer, in a single, integrated system across multiple sites and communication protocols. ■

## Carrier's New 30MP Chiller

**C**arrier is expanding its water-cooled AquaSnap 30MP modular chiller line to offer a multi-chiller accessory that allows control of upto eight 30MP chillers simultaneously. When combined with the line's new ease of mobility, customers can now maneuver 500 tons through tight spaces such as an elevator – making the line an ideal solution for replacement, retrofits and new construction applications. Carrier, a world leader in high-technology heating, air-conditioning (HVAC) and refrigeration solutions, is a part of UTC Climate, Controls & Security, a unit of United Technologies Corp. The line's

increased capacity, up to 500 tons, combined with its enhanced modular design provides customers greater choice in meeting their cooling needs. The system features enhanced mobility, including optional castors, as well as height adjustment capability that translates to improved ease of installation.

"We at Carrier are always working to help our customers maintain cost discipline with designs that



reduce installation costs. In the past, large, expensive equipment was needed to install this level of tonnage," says Chris Opie, Director, Marketing, Carrier Commercial Systems. "We are committed to continually innovating and always listening closely to our customers to design

and redesign our products to meet their needs." ■

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# Forthcoming Events At A Glance

## China Refrigeration 2017

**Venue:** Shanghai New International Expo Center, China  
**Date:** 12<sup>th</sup> to 14<sup>th</sup> April 2017  
**Website:** www.chinaexhibition.com

## Asia Cold Chain 2017

**Venue:** BITEC, Bangna, Bangkok, Thailand  
**Date:** 27<sup>th</sup> to 29<sup>th</sup> April 2017  
**Website:** www.asiacoldchainshow.com

## ASHRAE Annual Conference 2017

**Venue:** Hyatt Regency Long Beach, CA, USA  
**Date:** 24<sup>th</sup> to 28<sup>th</sup> June 2017  
**Website:** www.ashrae.org

## Cleanroom Guangzhou 2017

**Venue:** China Import and Export Fair Complex  
**Date:** 16<sup>th</sup> to 18<sup>th</sup> August 2017  
**Website:** www.clcte.com

## Mostra Convegno Expocomfort 2017

**Venue:** Marina Bay Sands, Singapore  
**Date:** 12<sup>th</sup> to 14<sup>th</sup> September 2017  
**Website:** www.mcxpocomfort-asia.com

## SIFA 2017

**Venue:** Les Dock De Paris, France  
**Date:** 3<sup>rd</sup> to 5<sup>th</sup> October 2017  
**Website:** www.expo-sifa.com

### Declaration FORM IV

Statement about ownership & other particulars of the newspaper entitled COOLING INDIA required to be published under Rule 8 of the Registration of Newspapers (Central Rules, 1956).

1. Place of Publication : 906, The Corporate Park, Plot 14 & 15, Sector 18, Vashi, Navi Mumbai 400703.
2. Periodicity of Publication : Monthly (15th of every month)
3. Publisher's Name : Pravita Iyer  
 Nationality : Indian  
 Address : As above
4. Printer's Name : Pravita Iyer  
 Nationality : Indian  
 Address : As above
5. Editor's Name : Mahadevan Iyer  
 Nationality : Indian  
 Address : As above
6. Name and addresses of individuals who own the newspaper and partners or shareholders holding more than one percent of the total paid up capital
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## Apple Park to be World's Largest Naturally Ventilated Building

Apple announced that Apple Park, the company's new 175-acre campus, will be ready for employees to begin occupying in April. The process of moving more than 12,000 people will take over six months, and construction of the buildings.

Envisioned by Steve Jobs as a center for creativity and collaboration, Apple Park is transforming miles of asphalt sprawl into a haven of green space in the heart of the Santa Clara Valley. The campus' ring-shaped, 2.8 million-square-foot main building is clad entirely



in the world's largest panels of curved glass. Designed in collaboration with Foster + Partners, Apple Park replaces 5 million square feet of asphalt and concrete with grassy fields and over 9,000 native and drought-resistant trees, and is powered by 100 percent renewable energy. With 17 megawatts of rooftop solar, Apple Park will run one of the largest on-site solar energy installations. It is also the site of the world's largest naturally ventilated building, projected to require no heating or air conditioning for nine months of the year. ■

## Largest Engineered Timber Office Building in Australia

Continuing the trend for innovative timber construction in office building design, 5 King is a high-performance commercial building that will become the tallest engineered timber building in Australia, according to developers. The 52-meter tower, located in the Brisbane Showgrounds development, has been designed by Bates Smart for Lend Lease. Developers for the project also

claim that it will also hold the title for the largest gross floor area (GFA) for an engineered timber office building worldwide. In blending tradition with innovation, architects have designed a building that addresses the fundamental need to connect to nature



and preserve the environment. The development utilizes cross-laminated timber (CLT) and glue-laminated timber (Glulam), together combining the structural strength of concrete and steel with a low carbon footprint.

At ground level, a substantial 54-meter-long timber colonnade will be lined with cafés and restaurants. The side-core design offers generous 1,588-square-meter net leasable area

(NLA) floor plates, with a total of 14,921 square meters of NLA over 10 floors. The glass façade on the main south elevation maximizes natural daylight, while sunshades on other façades reduce energy consumption to reduce carbon footprint. ■

## Energy-Efficient 'Smart Flower' in Dubai

A flower-shaped solar panel that can reorient itself to face sunlight has been announced by Dubai Municipality. The Smart Flower was developed by an Austrian company and contains sensors allowing it to automatically track rays of sunlight, the municipality said. This feature makes it 23 per cent more efficient than traditional roof-top solar systems. The device has a weather-adapting feature and a passive ventilation system to ensure it is efficient in high temperatures.

The Smart Flower has unique features of 2.31 kW production capacity. It automatically blooms in the morning and closes in the evening, and uses the Solar Tracking Technology to track the sun's rays through digital sensors. It ensures high efficiency in generating



clean energy and uses the self-cleaning technology to get rid of dust and dirt to increase efficiency up to 5%.

Hussain Nasser Lootah, Director General of the Municipality, said the Smart Flower is in line with the vision of Sheikh Mohammed bin Rashid, Vice President and Ruler of Dubai. "Dubai Municipality's commitment to innovation and implementation of creative ideas in line with Dubai Government's vision of becoming the world's most innovative and sustainable city," said Lootah. The Smart Flower is one of several initiatives started by the municipality's sustainability and renewable energy department, said Khalid Al Awadhi, Assistant Director General for the municipality's environment, health and safety control sector. ■

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