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Cooling India

August 2014

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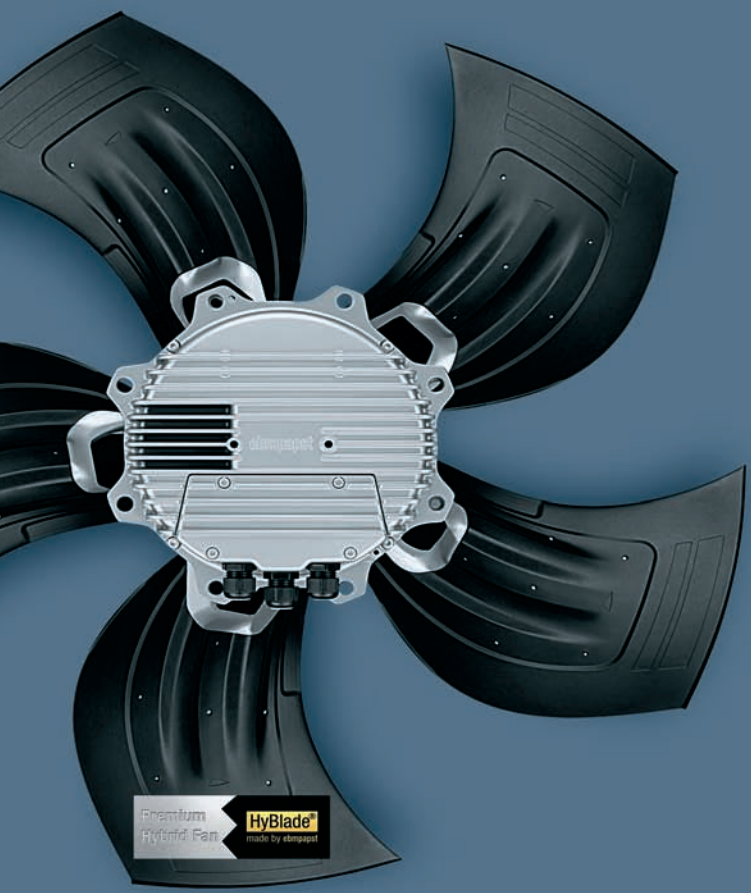
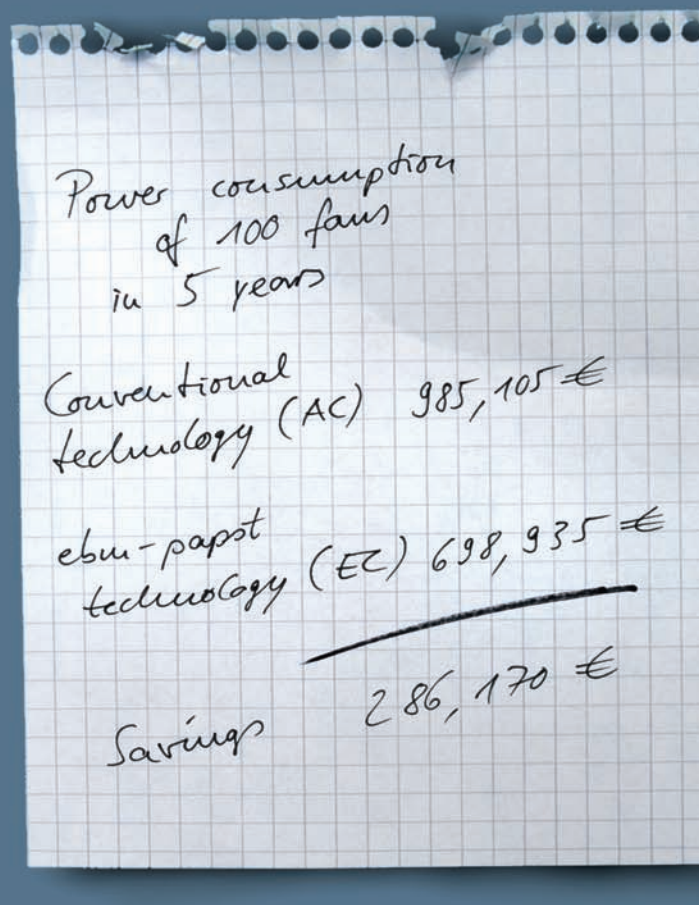
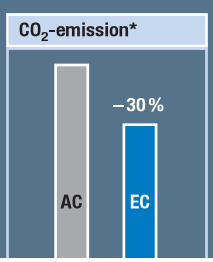
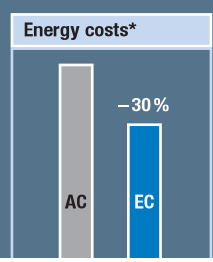






* Detailed calculations on our website
conventional technology
ebm-papst EC technology



A calculation so simple it only takes one slip of paper: Have your finance staff present you with your energy costs for all your ventilation, refrigeration and air-conditioning units. From this amount, now deduct 30 %. And there you are – this is how much you save from day one if you decide to use the latest generation of our EC fans. For they not only need extremely little maintenance, they are also already a whole lot better than required by the tough and rigorous European IE3 directives. And this is all there is to it. Almost. For what is not shown in the calculation is the considerable benefit for our environment due to the huge reduction in CO_2 emission, a positive side effect at no additional cost. For more information, simply go to **www.eco.ebmpapst.com**, and see how we fit your bill.

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Publisher's Letter

Air filters play a vital role in maintaining IAQ

Technological progress has dramatically changed the world in a variety ways. It has, however, also led to development of environmental problems, which threaten man and nature. The adoption of green or sustainable approaches, the way in which society is run, is seen as an important strategy in finding a solution to the energy problem. The key factor - like controlling CO_2 which is major contributor to global warming. An article 'Energy Efficiency Improvement utilising High Technology' assesses the Energy use in industry, buildings development and environment.

Further, a case study 'Airconditioning utility assessment in platinum rated green factory' deals with energy audit of a platinum rated green factory. It details the immediate steps taken by the industry post-audit, to monitor and target the airconditioning consumption and conservation related condition monitoring procedures. Yet the issue has another case study on 'Innovative Fleet Management, Using Quick Response Codes' which is a two dimensional barcode and how to use it creatively.

Air filters play an important role in maintaining IAQ of a building. Traditionally, in India, HVAC design, operations and maintenance practices have mostly focused on the H and AC part of the acronym and the V has been often neglected, especially in commercial buildings. However, a write-up 'Keeping the Air Clean - Importance of Air Filters in Commercial Office Spaces' deliberates why the quality of air being circulated be fit, pollutants in air that impact occupant health, or is the flow rate enough to cater to number of staff etc. While flipping pages you will find such more interesting articles.

Further, from September 2014, Cooling India the only monthly magazine is scheduled for posting on 15th of every month and would appreciate your feedback.

Please send your comments at pravita@charypublications.in

Pravita Iyer
Publisher & Director

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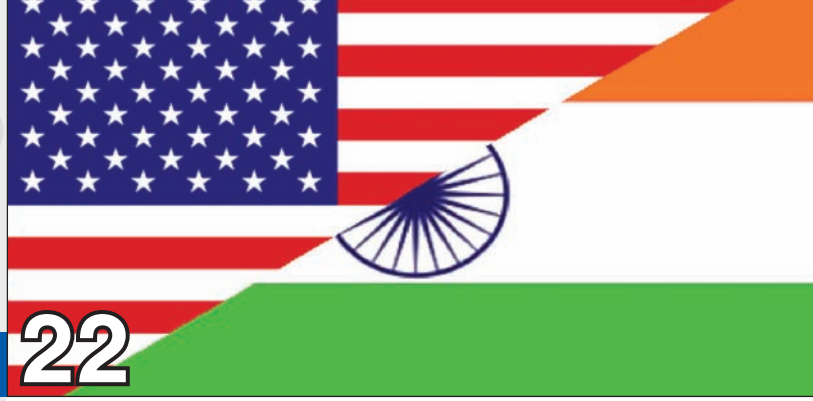

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1000m

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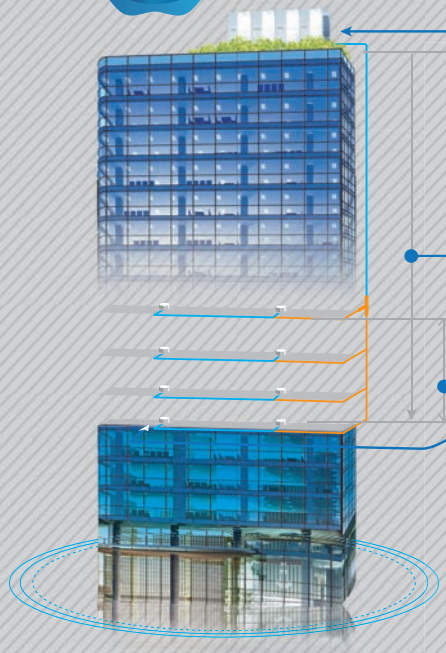

110m

Max.110m level difference between IDU~ODU (outdoor down)

175m

Max.175m actual piping length

30m

Max.30m level difference between IDU~ODU

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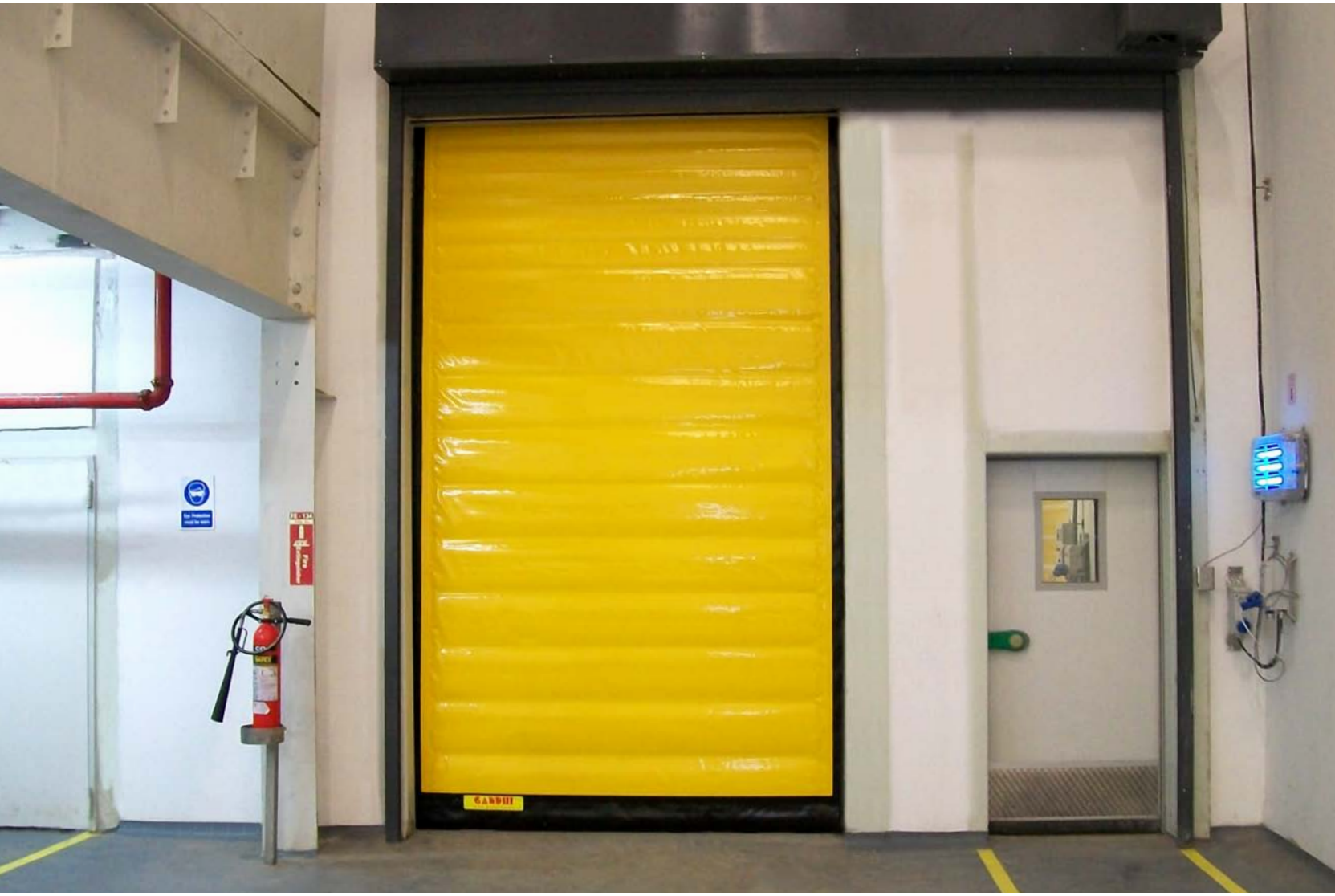
Automations Pvt Ltd



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Editorial

Phasing out Refrigerants and Natural Options

Emissions of certain chemicals like CFC, halon and HCFCs destroy ozone layer that shields the Earth from Sun's harmful ultraviolet radiation and have created an ozone hole over the South Pole. Phasing out HFC refrigerants is necessary to protect ozone layer in future. This requires servicing, retrofitting and/or replacing airconditioners. Choosing efficient system using environmental-friendly refrigerants has its benefits.

The cost effective option is to reduce HFC - being commercialised, and to replace CFC and HCFC refrigerants that deplete ozone layer; currently being phased out under Montreal Protocol. The release of Hydrochlorofluorocarbon chemicals used as refrigerants, deplete the Earth's protective ozone layer. R-22, an HCFC refrigerant is often used in airconditioning equipment. To protect the ozone layer, the United States is phasing out R-22, along with other chemicals. European countries such as Denmark, Austria, and Switzerland have already banned most usage of HFCs. Obviously, mitigation is needed to offset climate impacts.

Schedule to phase out HCFCs on January 1, 2015 includes doing away with servicing needs of equipment. While on January 1, 2020 the ban is on production and import of HCFC-22 and HCFC-142b; and R-22 after 2020. Phasing out methods include outright ban on HFCs, regulatory phase down like in some EU countries. Globally, voluntary phase down with incentives and carbon taxes are prominently counted. Yet, there is a way to develop alternative refrigerants with low GWP and ODP. Moreover, other technologies need to be encouraged.

There is need to be more concerted towards transforming innovative design of equipment for refrigerated transportation involving use of natural refrigerants instead of HFCs. This requires checking energy efficiency of refrigeration systems also. To utilize potential of natural refrigerants, synthetic refrigerants should be phased out, paving way to stimulate new developments in sync with regulatory norms. Water could possibly be refocused as a refrigerant and for that compressor technology needs to be revamped and such more to achieve cost convenient options.

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Daikin Group's CSR Report 2014

Daikin Industries, Ltd has issued its CSR Report 2014 summarizing CSR (Corporate Social Responsibility) activities in the Daikin Group from April 2013 to March 2014. This report serves to inform various stakeholders regarding CSR within the Daikin Group and deepen their understanding of activities undertaken by Daikin to achieve it. The report centers on the themes of Environment, Quality & Customer Satisfaction, Human Resources, and Social Contribution, which are all deemed essential to Daikin. In the 2014 edition, we provide feature articles on such topics as expansion of the next generation refrigerant R32 to each global region, promotion of activities for female employees, and support for reforestation around the world. Moreover, Daikin understands that climate change from increases in greenhouse gases is one of the most important social issues to which the company can contribute. For that reason, we are publishing actual results based on action item targets such as for curtailing CO_2 emissions by 23 million tons for fiscal year 2013 by promoting the widespread use of energy-efficient air conditioners, particularly in the developing countries where growth is remarkable. In order to further improve the credibility of environmental performance data, we have received third-party verification for the amount of greenhouse gas emissions since fiscal year 2013. In September, we plan to publish more detailed information for the CSR Report 2014 on the Daikin Industries company homepage Print editions in both Chinese and English are planned for publication during the same period. ■

Aga Marvel plans to address Industry-wide Energy Compliance Change

All refrigeration products will be required to meet higher energy standards wef September 15, 2014. Aga Marvel is the first manufacturer of undercounter refrigeration to declare plans to address the changing demands with a complete product line of ENERGY STAR compliant undercounter products, including beverage centers, all refrigerators, refrigerator/freezers, refrigerated drawers and keg dispensers. The company also used this innovation as a springboard to develop the industry's most efficient wine cellar line, despite its current exception in the DOE requirements. We have invested in the re-design of our entire household undercounter refrigeration product line to provide the consumer the most value in the industry, says Aga Marvel Engineering Director Jim Holland. All products are ENERGY STAR rated based on the new 2014 DOE energy standard, offering the consumer the lowest operating cost products available. Furthermore, we have addressed the features consumers want most, based on market research. The new models include a new state-of-the-art feature, content, configurations, and support for fully integrated built-in installations. ■

Ziehl-Abegg: Energy-saving EC motors in ventilation technology

Ziehl-Abegg laid foundations for the launch of energy-saving EC motors in ventilation technology. This came as the result of Germany's telephone exchanges changing to digital technology. The new technology required safe and reliable cooling of the operating rooms. The call for tender by Deutsche Telekom paved the way for the use of EC motors. Until then, fans in ventilation systems were driven using uncontrolled asynchronous motors. The first attempt to significantly reduce power consumption was the use of frequency converters as a control device. "Back then, the postal service wanted to have the energy requirement included in the offer," remembers Gerhard Leutwein. He was Head of Development at Ziehl-Abegg for control technology. The new call for tender took into account the power consumption for the next 10 years when calculating the retail price for the ventilation systems. Or to put it simply, fans could be fitted with a much more expensive motor, as long as this resulted in an energy-saving product when combined with the fan.Developers at Ziehl-Abegg had been working on mains-powered EC drives (EC: electronically commutated DC motor), since the mid 80's. But the much higher costs always prevented them from being used en masse. In 1989 came the first serious discussions with Hansa, a company that made air-conditioning units, about the use of the new motors as part of the postal service tender. Another two years passed however, before the motors went into full production. In order to meet Deutsche Post's requirements, both the fans (centrifugal impellers) and the motors were reconsidered and optimised again and again. By the end, the volume ran into many thousands of units. RD40K-4KW.4R.1L was the type designation of the first fan fitted with energy-saving EC motors. Back then, the flexible rotor was still made from steel, today they are made using aluminium. Due to the outstanding efficiency of the EC fans from Ziehl-Abegg, they were increasingly used by all leading manufacturers of digital exchanges. ■

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Carrier Transicold's NaturaLINE Trial wins Motor Transport's Innovation Award

Motor Transport honoured Carrier Transicold with its Innovation Award for a joint project with Sainsbury's to trial the world's first temperature-controlled trailer using the natural refrigerant CO_2. Carrier Transicold (UK) Ltd, helps improve global transport and shipping temperature control with a complete line of equipment for refrigerated trucks, trailers and containers, and is a part of UTC Building & Industrial Systems, a unit of United Technologies Corp. Labelled as "a potential game changer" by the Motor Transport judging panel, the two-year project launched in August 2013 uses a modified version of Carrier Transicold's NaturaLINE™ refrigeration system, which was initially developed for ocean container shipping. The 10.8-metre, insulated, urban distribution trailer delivers frozen produce to stores using NaturaLINE's non-ozone depleting CO_2 refrigerant, which has a Global Warming Potential (GWP) of one. In contrast, most temperature-controlled systems on commercial vehicles use conventional refrigerants such as R-404A (a fluorinated gas), with a GWP of 3,920. GWP is the measurement used to show the equivalent kilograms of CO_2. The GWP of CO_2 is lower than other natural refrigerants, such as propane, so even in the event of a leak, the use of CO_2 adds no new environmental risk."Congratulations to Sainsbury's for taking a bold step forward to reduce its carbon footprint by successfully demonstrating the application of the NaturaLINE CO_2 refrigeration system for road use," said David Appel, president, Carrier Transicold & Refrigeration Systems. "The trial's success is great news for Sainsbury's and the environment."The award was received by Victor Calvo, MD, Carrier Transicold EMEA; Justin Grace, managing director, Carrier Transicold northern Europe; and Nick Davies, head of transport operations, Sainsbury's. "We're delighted Carrier's natural leadership in environmental technologies has been recognised with this award," Grace said. ■

LG AC systems meet Energy efficiency demands of Architects and Design professionals

LG Electronics' award-winning commercial AC solutions, at the American Institute of Architects (AIA) Expo, offer exceptional versatility for architects, whether they are designing new "green buildings" or retrofit projects. LG's 2014 lineup of sustainable commercial and residential AC include Multi V Water IV, the Multi V IV, Multi V Ceiling Cassettes and more. The cutting-edge Variable Refrigerant Flow (VRF) technology at the heart of the LG commercial AC products on display at the AIA Expo have sustainable energy benefits, including minimizing efficiency losses over time, which can result in long-term cost & energy savings for the architect and building owner. LG's VRF systems also are designed to eliminate the added expense of duct work & distribution fans, resulting in a more efficient building infrastructure and, in turn, a more attractive aesthetic. VRF solutions are being sought after for architects due to their ability to be implemented in a variety of settings, such as offices, condos, hotels, retrofits and schools. The low sound levels of VRF systems also make them an attractive option. "LG offers best-in-class solutions that incorporate advanced technology & modern designs so architects can be heroes to their clients," said Kevin McNamara, VP of Commercial AC at LG. ■

Trane introduces myPLV tool to provide Application-specific Chiller Performance Metrics

Trane, developed a new tool to help building owners make better purchasing decisions. The Trane myPLV™ calculator is a free, manufacturer-agnostic tool that helps engineers, businesses and building owners quickly and accurately estimate chiller energy usage based on project specific operating conditions so they can select the right HVAC solutions for their building and application. Currently, the HVAC industry most often uses the Air-Conditioning, Heating and Refrigeration Institute (AHRI) Integrated Part Load Value (IPLV) to estimate future chiller performance. The IPLV is calculated using four operating points and weighting factors to estimate the percentage of time a single chiller, following an average load profile, will operate at various loads at a given set of entering-condenser water temperatures. In addition to the part-load assumptions, the IPLV calculation uses the weighted national averages of various factors - including weather data from 29 U.S. cities and building data based on a Department of Energy study. Because the IPLV calculations are based on weighted averages for various buildings and climate zones, they cannot be applied to specific building types or locations."The AHRI IPLV metric was not intended to predict the annualized energy consumption of a chiller in specific applications or operating conditions but for the lack of a simple and accurate tool, the industry has been using it to do just that," said Brian Fiegen, leader of Trane applications engineering group. "The problem is that a chiller in a hot and humid climate will operate differently than one in a cooler or drier climate, and the operation of a hospital is very different from an education or commercial facility." The myPLV approach recognizes that every building project is unique. This free tool can be downloaded at Trane.com/myplv. Users enter their location and building type, building peak load, number and size of the chillers in the plant and chiller condenser control strategy. The myPLV calculator provides customers an accurate estimate of their chiller future performance and helps engineers and building owners to make better informed purchasing decisions. ■

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LG Electronics Smart AC Control Solution enables mobile devices to control Home Temperature remotely

LG Electronics USA has launched its new LG Smart AC Module that enables smartphone control of duct-free LG air conditioning systems. Introduced just in time for the hottest days of summer, the new smart control solution helps consumers enhance their personal comfort and conserve energy, even while on the go. When paired with the free Smart AC app, available for compatible Android and iOS smartphones, the LG Smart AC Module allows users to remotely control their air conditioner to ensure that, whether at home or away, their home stays at the ideal temperature. The seamless accessibility and flexible control of the Smart AC Module allows homeowners to turn on their air conditioning prior to coming home, creating the desired environment right when they walk in.The LG Smart AC module is the perfect complement to LG's standard and high-efficiency single-zone inverter systems that have earned the coveted "ENERGY STAR® Most Efficient" designation. It provides a solution for homeowners looking for additional energy savings and lower utility bills by offering the ability to adjust temperature settings remotely even while they're away from home. The user's wireless device communicates with the module on the indoor unit to control various functions and features, including temperature, fan speed and air flow directly through the smart phone app. Frequently used settings can be saved to a favorites list for easy replication of a preferred temperature scenario. Advanced settings include a sleep timer for programmed temperature control throughout the night and a purifying option for circulating filtered air." With LG, it's all possible. We're always looking for ways to offer consumers more convenience and flexibility and simplify their everyday tasks," said Kevin McNamara, vice president of Commercial Air Conditioning at LG. "The Smart AC Module gives homeowners a way to customize their home temperature, even if they are away, easily fitting into their busy lifestyles." ■

A new specification of skills for future

Join John Ellis, Past President of the IOR, for a discussion of future training requirements in the RACHP sector states, the Refrigeration, Air Conditioning and Heat Pump Sector is vibrant, challenging and developing quickly and in desperate need of an integrated and coherent training, education and qualification programme to address the issues confronting it in the 21st century. While it is recognised that the Refrigeration Industry itself has 3 different sectors which encompass Heat Pumping, Air Conditioning and Refrigeration, each sector shares the same technology with the vapour compression system at the heart of all these systems. Engineering technicians in the sector need to feel equally 'at home' in any of the three major areas which share a common scientific base. This paper will discuss what principles need to be incorporated in order to address skills shortages, how industry can assess whether engineers are competent and what actions and new roles industry bodies and employers have to take now if they want to make a real and lasting difference to skills in the future. The paper will be followed by a discussion panel to encourage debate. This is the first paper of the 2014-2015 IOR evening papers programme and will take place on October 9, 2014. ■

Emerson Climate Technologies plans for global HVACR Innovation Center

Emerson Climate Technologies, is intending to move forward with plans to develop a new $35 million innovation center on the University of Dayton campus in Ohio, to advance research and education for the global HVACR industry. The Emerson Innovation Center, the result of a partnership between ECT and University of Dayton, will be a unique research and training hub where Emerson experts, HVACR industry leaders, and university faculty and students can come together to focus on the technology, best practices to support trends that will drive and impact the future of HVACR. The Center will foster a collaborative approach to conducting innovation, research and training to create new technologies that address HVACR industry challenges, such as increasing energy efficiency, promoting sustainability and improving system connectivity. The Center's activities will focus on five HVACR industry end-markets: residential air conditioning, commercial air conditioning, food retail, food service and network/data centers. The facility will feature prototype installations of real-world applications, such as the heating and cooling system for a house and a refrigeration system for a supermarket, to give university researchers, Emerson product developers, industry partners, customers and students an opportunity to experiment with concepts, technologies and scenarios before trying them in actual customer installations. "This facility fills a real and critical need for the HVACR industry today," said Ed Purvis, executive vice president, Emerson Climate Technologies. "Nowhere else will you find a similar facility where academic researchers and industry participants can come together under one roof to dialogue, develop and test technology solutions through various real-world applications. The goal is to create the world's premier HVACR research and development facility where creativity and open-mindedness is encouraged. Here, new and game-changing concepts in technologies and services will be conceived and tested to create real and beneficial change in our industry and world." ■

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PassivSystems launches Research Project into UK Home energy efficiency

PassivSystems, a provider of intelligent connected energy services for residential homes, launches a research project, the Company is conducting into home energy efficiency and heat pumps in the UK, in collaboration with University College London. The research project: The Predictive Demand Control Pilot study into Heat Pumps, is part funded by the Department of Energy & Climate Change (DECC) Energy Entrepreneurs Fund (EEF) and will be conducted in social housing across UK for 2014/ 2015 heating season. The project will be trialling effectiveness of smart home energy efficiency technology with residential heat pumps, with a view to reducing home energy usage, and making use of lowest cost energy & thus lowering consumer energy bills. Participating tenants will receive intelligent heat pump controls including a tablet providing clear and simple control over their heat pumps. These controls will give them remote control over their home heating and hot water through the internet, as well as insight into the operation & efficiency of their heat pumps through a Smart Phone App & online portal. Through application of advanced weather-adjusted algorithms they should benefit from a reduction in their energy bills of between 10% and 38%. PassivSystems aims to publish this data in Spring 2015. ■

Symphony's PAT crosses 100 crore

World's largest air cooler company, Symphony Limited, reported a 76% rise in net profit at Rs 105.72 crore for financial year ended on June 30, 2014 as against Rs 60.11 crore in the corresponding previous fiscal year and Company declares 550% dividend. Commenting on the financial performance of the company, Nrupesh Shah, ED of Symphony Ltd said, the growth is on account of continuous innovation, strong branding, distribution network and undisputed market leadership. Symphony is commanding more than 50% market share in organized sector. Moreover, Asset light business model and negligible working capital are hallmarks of Symphony Business model. Domestic residential air coolers business grew 45% while exports too managed healthy growth of 60% on standalone basis during FY 2013-14. ■

Greenheck's mixed Flow Fan Model EQB features Octagonal Housing

Greenheck has expanded its line of mixed flow inline fans with the addition of Model EQB that combines the best properties of centrifugal and vane axial fans while providing higher efficiency and lower sound levels. Model EQB's unique octagonal housing is manufactured of formed galvanized steel panels coupled with a heavy-gauge steel drive frame that provides exceptional strength and durability. An aluminum mixed flow wheel ensures maximum efficiency and low sound levels. Standard universal mounting supports, field-rotatable housing, and removable duct collars allow for easy installation. Available in six sizes 12 through 30, Model EQB offers a performance range up to 23,000 cfm and static pressure up to 3 in. wg. Licensed to bear the AMCA seal for Sound and Air Performance, Model EQB is recommended for indoor, commercial clean air applications where quiet, economical operation is desired. Typical installations include office buildings, educational facilities, libraries, hospitals, concert halls and parking garages. Greenheck is the worldwide leader in manufacturing and distributing air movement and control equipment. ■

Thermo King voted 'Best Brand' by German Trade Magazines for Tenth Consecutive Year

More than 7,400 readers of the German trade magazines lastauto omnibus, trans aktuell and FERNFAHRER voted for their top brands in 22 different categories for the annual 'Best Brand' survey. Thermo King, a manufacturer of transport temperature control solutions for a variety of mobile applications and brand of Ingersoll Rand, earned the top rating in the 'Cooling Units' category. Thermo King first received this top rating in 2005 when the survey was extended from the truck and bus industry to include markets supplying commercial vehicles. "We are honored to be elected Best Brand for so many years. We take pride in delivering the industry's best transport refrigeration solutions and providing exceptional services to our customers," said Dwight Gibson, vice president of the Europe, Middle East and Africa region at Thermo King. "I am proud of our team's commitment to excellence. This recognition is a testament to our strong Thermo King dealer network in Germany." "The award represents our ability to deliver on our mission, which is to improve the quality of life around the world by helping to deliver perishable goods and pharmaceuticals safely, reliably and economical for our customers and provide comfort who those travel by bus and rail." More than 75 years ago, Thermo King shaped the transport refrigeration industry with development of the first successful mechanical transport refrigeration unit. Even though the industry has changed since, Thermo King continues to provide high-quality refrigerated transport solutions with low noise and exhaust emissions. Thermo King backs its customers with an unrivalled global network of certified dealer service technicians. The German market is supported by a nationwide sales and service network, comprised of five sales and service dealers and three service only dealers with a total of 73 locations, all committed to keep customers running and increase their uptime. ■

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Honeywell to reduce Climate Impact of Refrigerators and Freezers in China

Honeywell announced to help reduce the climate impact of refrigerators and freezers in China under a grant agreement signed between the U.S. Trade and Development Agency (USTDA) and Midea, a leading China-based manufacturer of home appliances. The project will focus on Honeywell Solstice® Liquid Blowing Agent (LBA), which allows appliance insulation to expand and provides the majority of the resulting foam's excellent insulating properties. Solstice LBA has a global warming potential of 1, which is 99.9 percent lower than the HFCs it often replaces. It also offers improved insulating performance when compared to those HFCs. Solstice LBA is nonflammable and not a volatile organic compound, unlike cyclopentane, an alternative blowing agent. Honeywell will partner will Midea to further develop the application technology of Solstice LBA for energy-efficient refrigerators in China. "We are honored to be part of this exciting program, which will help improve the environmental profile of refrigerators sold in China," said Ken Gayer, vice president and general manager of Honeywell's Fluorine Products business. "Honeywell is the leader in the development of low-global-warming-potential blowing agents, refrigerants, aerosols and solvents, and we are uniquely positioned to help manufacturers like Midea achieve their energy-efficiency goals.""Midea is a leader in the manufacture of energy-efficient appliances, and this grant will enable us to more quickly adopt technologies such as Solstice LBA," said Suk Sangjo, vice president of Midea's refrigeration division. "Solstice LBA can enable us to maintain the high energy-efficiency of our refrigerators while reducing their carbon footprint."Honeywell made the announcement at the sixth meeting of the U.S.-China Strategic and Economic Dialogue, which was established by U.S. President Barack Obama and former China President Hu Jintao. The meeting represents the highest-level bilateral forum to discuss a broad range of issues between the two nations."USTDA is committed to forming partnerships between the U.S. and China to mitigate the effects of global climate change," said USTDA Director Leocadia I. Zak. "This project will benefit the economies of both nations, while improving the environmental footprint of appliances in China." ■

ACRIB F Gas Implementation 2014 Conference November 11, 2014, London

The F Gas Regulation has led to significant changes in the UK refrigeration and air conditioning industry and is now subject to further change with new requirements coming in from 2015. The purpose of this ACRIB Conference is to provide clear and reliable information on the changes being introduced which will have a major impact on all sectors including manufacturers, suppliers, installers and end users. It is important for the future of the UK industry to prepare now to ensure that the new obligations are understood and implemented. This one day conference is designed for all those working throughout the UK supply chain in the stationary and transport refrigeration, air conditioning and heat pump sector through to end user. Delegates will gain valuable information to help their businesses and customers plan and adapt to changes with presentations from industry experts and guidance documents to take away. The panel question session at the end of the day will open the topic for delegates to raise additional issues and to explore the subject from the wider environmental, policy and international context. ■

ASHRAE announces special limited pricing offer; Changes to In Operation Methodology for bEQ Program

To allow greater uniformity for building types seeking an In Operation rating under its Building Energy Quotient (bEQ) program, ASHRAE is now using methodology from its standard for energy efficiency in existing buildings to calculate the rating. The bEQ program, a consistent, comprehensive and accurate method of rating and labeling buildings based on energy use, offers two rating labels: an As Designed label that rates the building's expected energy use under standardized conditions -independent of the building's occupancy and usage variables- and an In Operation label that rates the building's actual metered energy use as influenced by the building's occupancy, structure and usage. bEQ helps owners and managers zero-in on opportunities to lower building operating costs and make informed decisions on energy reduction strategies. Previous to this change, the In Operation rating relied on ENERGY STAR Portfolio Manager to provide a normalized median energy use index (EUI) for the rating calculation. Except for those buildings that were covered by Portfolio Manager, all other building types, such as convenience stores, libraries, fire stations and restaurants, had no methodology for this normalization. "The change to this new methodology provides several advantages for those who are submitting buildings for In Operation ratings," Ross Montgomery, bEQ Committee chair, said. "The new methodology allows greater uniformity for many more available building types, which should result in better rating comparisons since those buildings are now able to get a normalized energy use index. In addition, submission forms are now easier to use with more of the information/calculation automated and with expanded explanations, definitions and instructions to help better classify a candidate building." Montgomery explained that the updated bEQ Workbooks use methodology that allows generation of median EUIs by climate zone for all building types covered in the Commercial Building Energy Consumption Survey (CBECS), maintained by the U.S. Energy Information Administration. ■

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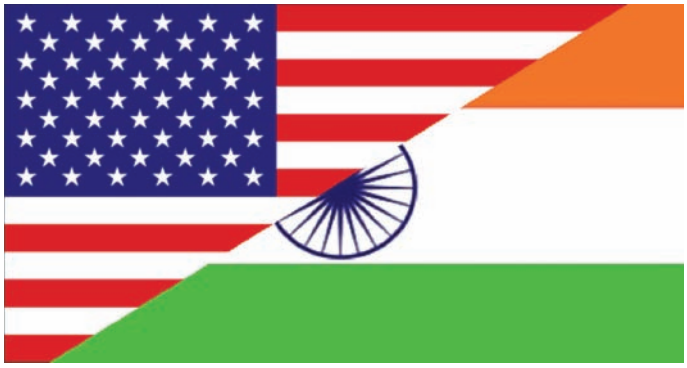
US-India Alliance to Enhance Building Performance and Energy Efficiency



The long-term alliance of the world's two biggest democracies has been setting the standard for carbon emission reduction for a number of years. This correlation on energy conservation between the United States and India has evolved over these years transitioning to formal guidelines, and directly impacts the heating, ventilation, and air conditioning (HVAC) industry, building performance from a construction perspective and energy efficiency regulations.

The relationship began with the construction of large-scale infrastructure projects dating back to the 1950s and continues with the research and deployment of energy efficient practices and testing programs today. The bond between the two nations took on a new life in 2005 when the U.S. and Indian Governments established the U.S.-India Energy Dialogue to boost mutual interests in energy security, facilitate the deployment of clean energy technologies, also to promote increased energy trade and investment.

The United States has committed its resources to the further development of a clean energy fellowship with India. The knowledge of energy playing a central role in a wide range of global issues including the impact of climate change on energy security, the availability of energy sources in remote areas, trade and investment as well as the economic growth of local government and national economies alike, the U.S. realizes the importance growing this alliance. President Barack Obama has been quoted to say, "The relationship between the United States and India will be one of the enduring partnerships of the 21st century."

The U.S.-India energy cooperation was set in motion when President Obama and Prime Minister Singh met in November 24, 2009. Since that day, the two Governments signed a Memorandum of Understanding to Enhance Cooperation on Energy Security, Energy Efficiency, Clean Energy and Climate Change, which established the U.S.-India Partnership to Advance Clean Energy (PACE).

PACE focuses on the implementation of strategic forward progress to move economies to a collective goal ofachieving higher-performance, lower emissions, & enhanced energy security. The programwas created for the nations to demonstrate the viability of existing clean energy technologies, also to identify new technologies that can increase energy access and security through a stronger collaborative process. PACE will put an emphasis on engaging the private sector, local governments, industries, and other stakeholders to apply best practices on sustainability in order to curb carbon growth. PACE has worked diligently with governments and the private sector to promote the guidelines set for India to go green.

Since its launch in 2009, PACE has reached several important goals. Theprogram's progress report, released in June 2013, showed positive results in the areas of strengthening institutional and human capacity; improving the enabling environment; mobilizing financing for clean energy; and increasing awareness and understanding of new clean energy technologies. The collaboration between the U.S and India made solid advances with the enhancement of energy security and an

Ryan Rex is an expert in the fields of HVAC, Plumbing and Green Building. He is the President of the Boaz Construction Company and Managing Producer for Boaz Entertainment and Productions, LLC.

accelerated adoption of clean energy. The program helps support the creation of, and to nurture, clean energy innovations via public-private cooperation, innovative financing mechanisms and cutting-edge technologies. The two nations are slated to use their combined strengths to acceleratethe research and deployment of clean energy, which is important not just for the U.S.-India partnership, but also for the world.

The U.S. Department of Energy (DOE) and the Ministry of New and Renewable Energy of India has worked together for the development of an online database to give consumers access to renewable energy and energy efficiency policies, regulations, and incentive programs for the benefit of project developers. This database was created having the interests of businesses, and consumers in mind.

Led by the U.S. Secretary of Energy and the Deputy Chairman of the Planning Commission of India, the dialog between the U.S. and India to promote clean energy initiatives sets long term goals and provides a high-level forum to engage a diverse range of governmental entities from both countries. All work under the Energy Dialogue has been organized into smaller groups for better management–Power and Energy Efficiency, New Technology and Renewable Energy, Coal, Oil and Gas, Civil Nuclear Energy, and Sustainable Growth. The entirety of the PACE program is essentially implemented and monitored through this Dialogue. We in the HVAC/R industry should pay close attention to the activities of the Power and Energy Efficiency group, as this portion of the program will have the most influence over our industry across India and abroad.

The launch of PACE eventually led to the establishment of the Joint Clean Energy Research and Development Center (JCERDC) one year later in November 2010. This organization was solely founded to promote clean energy innovation for the Power and Energy Working Group. Research within this group will focus on the fields of building performance and energy efficiency. This facility will have the greatest impact on the HVAC/R industry. The JCERDC will offer further support for the research and development of solar energy, and second-generation biofuels.

In addition to the promotion of clean energy innovation, the U.S. Agency for International Development (USAID) has supported the Government of India in monitoring and implementing a 150 million (USD) project to oversee the construction of fourteen smart grid pilot projects initiated by the Ministry of Power. At the same time, U.S. facilities in India areactively working with the private sector to support smart grid development for a number of Indian utility companies including: Calcutta Electric Supply Corporation Limited (CESC), Bangalore Electricity Supply Company Limited (BESCOM), Reliance Infrastructure Ltd. and TATA Power Delhi Distribution Limited (TPDDL). U.S. support of these utility providers focuses on smart grid studies and pilot projects.

The Power and Energy Efficiency Working Group is co-chaired by the DOE and USAID on the U.S. side, and by the Ministry of Power on the Indian side. The broad goals of the group are to continue the advancement of efficient and reliable electrical generation, transmission, and distribution. The group will work to promote the deployment of energy conservation practices to improve the efficiency of energy use, alsoto stimulate trade and investment in the power and energy efficiency sectors. The group is responsible for monitoring and implementing the power and energy efficiency elements of PACE.

Some notable accomplishments achieved through U.S.-India cooperation on Power and Energy have resulted in the creation of the Bureau of Energy Efficiency (BEE); and the establishment of India's first Energy Conservation Building Code (ECBC) with support under the USAID Energy Conservation and Commercialization (ECO) project. The group's current activities cover smart grids, grid integration of renewables, demand side management, micro-grid development, supply-side efficiency from existing fossil power generation, implementation of the ECBC, buildings-to-grid collaboration, waste heat utilization, and energy efficiency technology deployment, among other interests.

The PACE progress report of 2013 states that "Energy efficiency is the fastest, cheapest, and cleanest way to help India meet its increasing power demands. Investments in energy efficiency can help ensure that the booming growth in Indian cities, towns and villages can be made sustainable and also help meet its emission reduction targets. U.S. agencies are working with the Government of India and private sector to support smart grid development and promote energy efficiency in the buildings and industrial sector."

"Buildings account for 33% of the total electricity consumed in India. With an estimated 70% of the buildings stock projected for 2030 yet to be built, the Indian Government is working towards developing an energy-efficient building sector. It launched the Energy Conservation Building Code (ECBC) in May 2007, as a first step towards this objective. The U.S. Government has been supporting the Bureau of Energy Efficiency (BEE) in promoting its endeavor to the building efficiency sector via USAID's Energy Conservation and Commercialization (ECO) Project and the U.S. Department of Energy's various engagements at the national and state level."

The U.S.-India Joint Center for Building Energy Efficiency Research and Development (CBERD) consortium connects world-class researchers and

scientists from academia, industry, and government laboratories, and institutional partners from both India and the United States, under one virtual roof. "The CBERD will plan and execute milestone-driven research that emphasizes integration, flexibility, and operating efficiencies. An open model for bilateral institutional/industry collaboration embodies our overall commitment to accelerating the unbiased adoption of new energy-efficient technologies, to ensure the ultimate goal of providing the broadest technology development. Leadership from both nations will promote U.S.-India cooperation by jointly developing integrated work plans outlining project tasks and responsibilities, while coordinating scopes, knowledge transfer among the partners, and anticipated R&D deliverables and outcomes."

CBERD emphasizes the strength and expertise of both U.S. and Indian industrial participants, and the research that benefits both U.S. and Indian business interests. The results-based R&D will produce significant energy savings by driving the progress of effective savings tools and their installation via new construction projects in India and retrofits in buildings across the United States.

The strategy for the project is to address core issue of building energy efficiency by focusing research on two important areas of technological study: Building Information Technology (BIT) Systems & Building Physical Systems (BPS). The project has already completed the framework necessary for scientific collaboration, and has begun the academic partnership with its R&D and institutional partners.

USAID, via the PACE Deployment (PACE-D) Technical Assistance Program, supports the Bureau of Energy Efficiency (BEE) to promote energy efficiency in the building sector. These activities build upon BEE's past activities in the buildings sector, and will centeron the Energy Conservation Building Code (ECBC) implementation under India's Five Year Plan, which started back in 2012 and ends in 2017. The plan has a strategic vision of catapulting the booming Indian green building sector towards the promotion of Net Zero Energy Buildings (NZEBs), and low-energy HVAC systems by creating awareness. The ECBC's plan will work tocirculate knowledge and support the implementation of NZEB and HVAC retrofit pilot projects in different climatic zones of India to demonstrate feasibility of practical applications.

The PACE-D Technical Assistance Program has shown support for two major pilot projects in India: TheNalanda University in Bihar and Uttar Haryana BijliVitran Nigam Limited (UHBVNL) headquarters in Chandigarh.

Nalanda University was established in the fifth century, and operated for nearly 600 years. It's known as one of the world's oldest known centers for learning. The university is being revived in India with international support from sixteen countries from the East Asian Summit (EAS). PACE-D has signed on the help develop Nalanda University's campus in Rajghir, Bihar, into a NZEB. The newly developed university is located around theruins of the early university. These sacred ruins arecommonly referred to as "the ancient seat of learning."

The program will work in a continued effort to support the University in the evaluation of energy efficiency and renewable energy options for the campus, facilitate partnerships with stakeholders, and create awareness about Nalanda's NZEB success.

The DOE is working tirelessly to support the ECBC implementation in Rajasthan and Tamil Nadu. The governing bodies have developed a road-mapping tool to improve energy intensitylevels and arecurrently implementing it in Pune and Jaipur to help the cities meet their carbon targets. The tool allows local governments to prioritize areas of energy, water savings, and emissions reduction potential through appropriate efficiency interventions in selected locations.

The U.S.-India Centre for Building Energy Research and Development are field-testing the integrated communications and control technologies to manage building systems. These systems include advanced lighting, HVAC, and plug-load controls. The integration of these systems will minimize energy use, respond to occupancy and environmental changes, improve functionality, reliability, integrate sensor data across building systems, and most of all, enhance occupant comfort.

Working with third-party partners from the U.S. and India, the R&D team will conduct research in use of communication, network, and data management technologies to keep costs down and improve the capabilities of efficient HVAC, lighting, and related building systems. The Centre will research the integration of innovative cooling and natural ventilation systems that are responsive to small-zone, real-time occupancy patterns, shading requirements, and local weather conditions. It also provides data exchange between building systems and integrated controls through the development and use of scalable, low-power, wireless communication networks. The Centre will continue it's effortsto develop and prototype a network-based user control and feedback system where users can influence plug load, lighting, and HVAC controls, and see real-time energy data.

The U.S.-India alliance to curb carbon emissions and promote clean energy technologies has had a profound impact on both nations. Their hard work and dedication to energy efficiency have been a shining example for all nations of the world to follow. We as citizens of the world take for granted the importance of efficient construction practices and building energy management. Commercial buildings account for over 70% of the energy usage in the U.S. alone. The fact that our governments are taking this concern seriously shows that we are evolving as a people. It shows that although demand is up, comparative consumption can go down. Benjamin Franklin once said, "Well done is better than well said". Meaning that we can talk the talk for as long as our lungs permit, but if we don't act accordingly, all will be for nothing. The implementation of PACE by the U.S. and India are proving to the world that backing scientific theory with excellent building practices is a great place to focus our collective energies to benefit all mankind. ■

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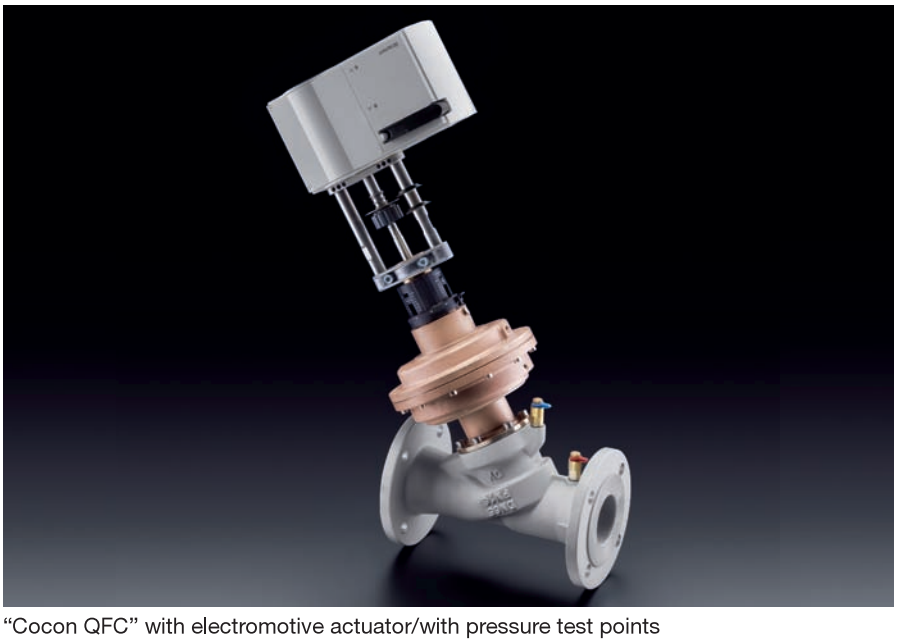
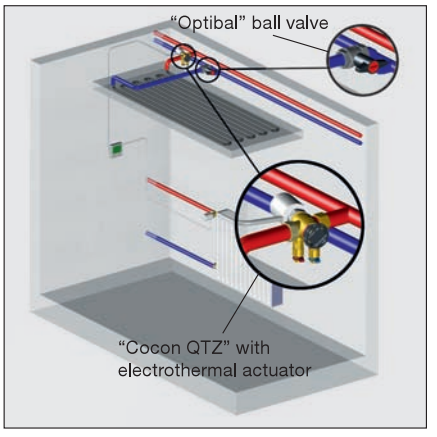


“Cocon QFC” with electromotive actuator/with pressure test points



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The Oventrop pressure independent dynamic balancing valve “Cocon Q” combines two hydronic functions in one valve.

Firstly, in connection with standard actuators or thermostats (M 30 x 1,5), the valve controls the flow rate depending upon the room temperature requirements.

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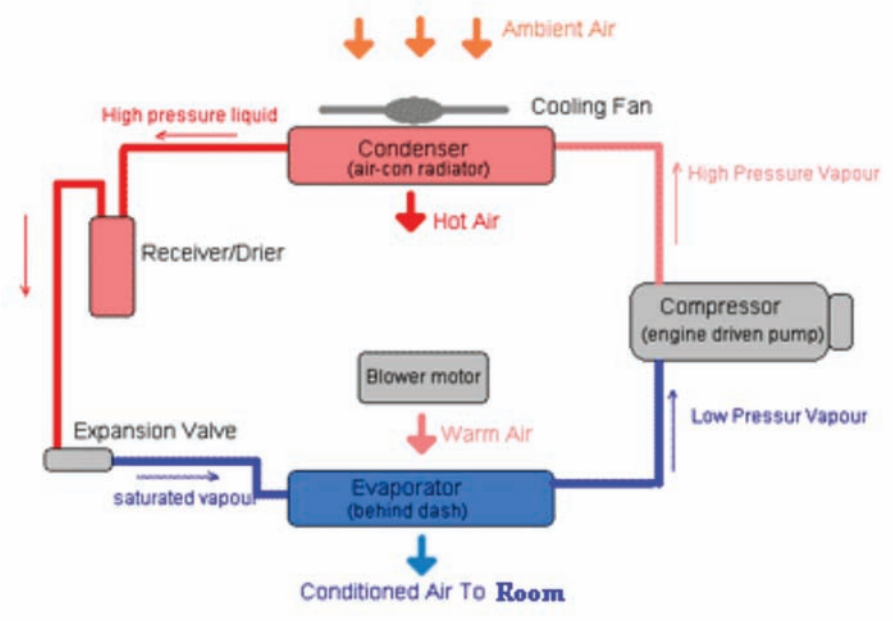
Air Conditioners and Air coolers

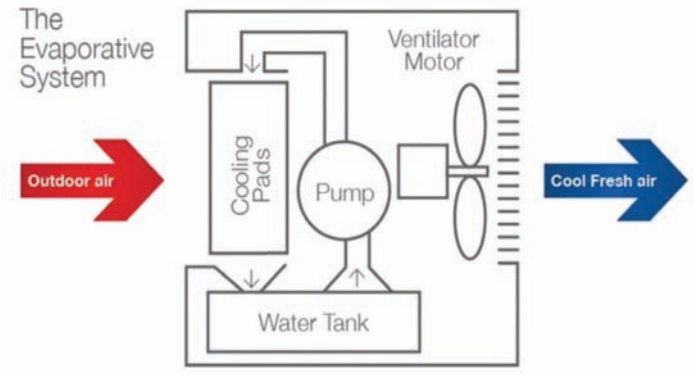
Air Conditioners and Air cooler, these two machines are completely different from each other, though they can produce cool air.

Air Conditioners is device which cools air with the help of vapor-compression or absorption refrigeration cycles. In this type of system, temperature of air drops by removing heat content of air. Whereas, air Coolers works on evaporative cooling theory in which temperature of dry air can be dropped through evaporation of liquid water to water vapor. This evaporation process brings down air temperature by keeping same heat content of air.

Major component of both system is shown in the following schematic diagram.



Air Conditioners



Air Coolers

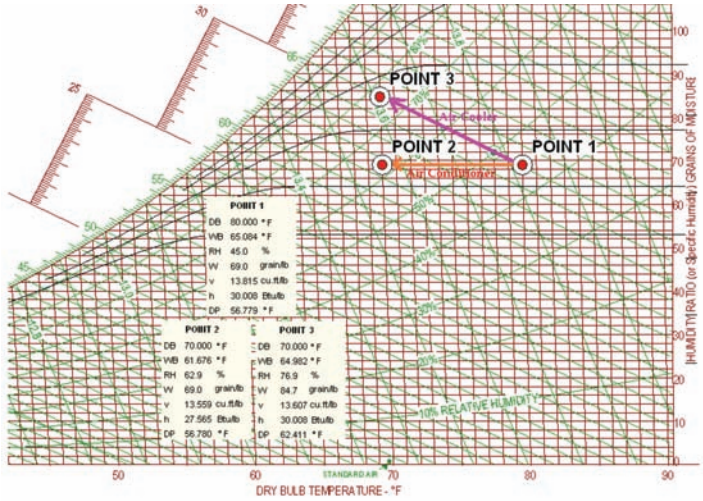


Figure 1

Cooling process of air by both machines from 80°F with 45% RH to 70°F is expressed in the psychrometric Chart. (Figure 1)

Process of air cooling is done in air conditioner (point 1 to point 2 in figure 2) where only sensible heat of air is getting removed due to which change in the enthalpy takes place and air is cooled down. The moisture contain of air is remain unchanged. To cool air from 80°F to 70°F (only sensible cooling) in air conditioner require around 0.5 kWh electrical energy per 1000 kg of air.

Rajesh Deshpande,
Managing Director of
Energetic Consulting Pvt Ltd (ECPL),
is BTech Chemical Engineering.

Parameter		UoM	Point 1	Point 2
Dry Bulb Temperature	DB	°F	80.00	70.00
Wet Bulb Temperature	WB	°F	65.08	61.68
Relative Humidity	RH	%	45.00	62.90
Humidity Ratio	W	grain/lb	69.00	69.00
Specific Volume	V	cu. Ft/lb	13.82	13.56
Enthalpy	H	Btu/lb	30.01	27.57
Dew Point Temperature	DP	°F	56.78	56.78

Parameter		UoM	Point 1	Point 3
Dry Bulb Temperature	DB	°F	80.00	70.00
Wet Bulb Temperature	WB	°F	65.08	65.08
Relative Humidity	RH	%	45.00	76.90
Humidity Ratio	W	grain/lb	69.00	84.70
Specific Volume	V	cu. Ft/lb	13.82	13.61
Enthalpy	H	Btu/lb	30.01	30.01
Dew Point Temperature	DP	°F	56.78	62.41

	Air Cooler	Air Conditioner
Advantages	Less Energy Required compared to AC Fresh, clean air Environmental friendly Allows for open windows and doors Less expensive to purchase Inexpensive installation Minimal maintenance required	Effective in any climate Removes moisture from the air Cooling can be controlled Works in all seasons Reduces humidity
Disadvantages	Best used in hot, dry climates Air supplied by cooler is humid Requires a constant supply of water Needs constant cleaning Cooling capability Depends on ambient Humidity	Energy consumption is 4.5 times than cooler Supply of re-circulated air Less environmental friendly Effective in enclosed space More expensive to purchase Expensive installation cost Regular cleaning needed

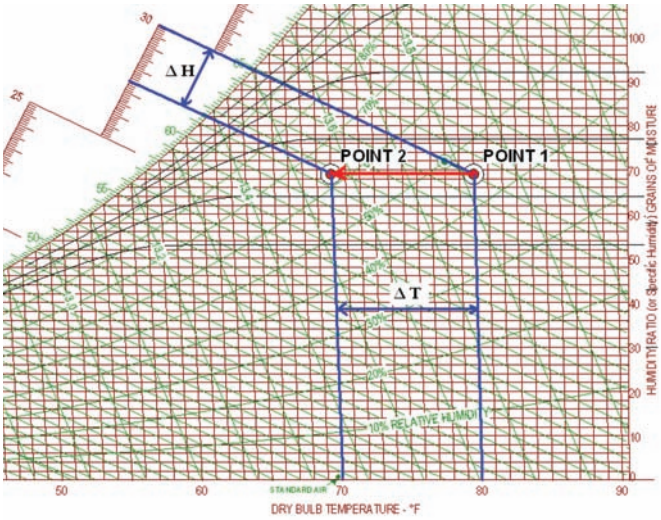


Figure 2

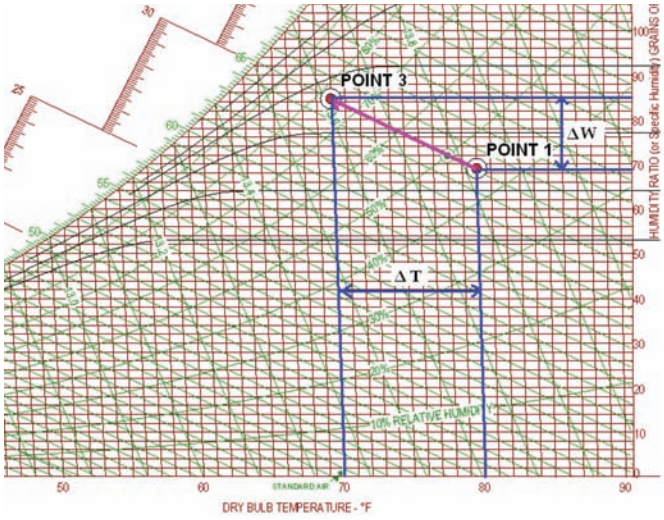


Figure 3

In Air cooler evaporation of water is increases moisture level of air and due to which air is cooled down (point 1 to point 3 in figure 3). In this process enthalpy of air is remain unchanged. To cool air from 80°F to 70°F in air cooler is require around 0.11 kWh electrical energy per 1000 kg of air. This process also require 2.2 liter of water per 1000 kg of air flow. ■

Cristopia Energy Systems (I) Pvt. Ltd., achieves AHRI Certi□cation with BITZER Compressors

Cristopia Energy Systems (I) Pvt. Ltd., an industry leader in Industrial and Commercial Air Conditioning products, has received AHRI certification for its entire range of Water cooled Screw chillers using BITZER Germany make CSW Semi-hermetic Compact Screw Compressors.

Air-Conditioning, Heating, and Refrigeration Institute (AHRI), world's leading product certification organization has also approved Cristopia Energy Systems' test bench for testing the machines as per AHRI standards. The test bench facility has satisfactorily met the test facility requirements and is approved for the purpose of conducting AHRI certification.

"Cristopia's Water cooled chillers has earned the trusted AHRI Certified□ mark, an assurance of the product's performance."

The certification was earned based on the technology standards and performance of the facility and chillers produced. Cristopia Energy Systems (I) Pvt. Ltd. is the first manufacturer to get water cooled screw chillers ranging from 65TR to 550 TR certified by AHRI.

"The certification from Air-Conditioning, Heating, and Refrigeration Institute for our water cooled chillers validates our efforts to continually manufacture high quality and efficient products that fulfill our customer's needs." said Rajesh Gandhi, Executive Director of Cristopia Energy Systems (I) Pvt. Ltd.

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Air-Conditioning

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To condition the air according to need is a great achievement. Air Conditioning is a prime need for human comfort to achieve maximum performance base output, to boost the production process to manufacture food, drugs, cold drinks, ice creams, confectionery products, etc.

Air conditioning may be defined as the simultaneous control of temperature, humidity (moisture content), motion of air, (movement and circulation), and purity (filtering and purification) of air within an enclosed space for the purpose of:

- Producing comfortable and healthy conditions for the occupants (persons) in residences, theatres, office building, hospitals, railway coaches, etc.
- Increasing efficiency of the employees working in factories, offices and stores. Conditioned air has a comfort effect, a health effect, and a psychological or emotional effect on human beings, and
- Making possible more complete environmental condition for manufacturing process in industries. Such industries include printing, textile manufacturing, chemical, pharmaceutical etc.

Factors in Air Conditioning

Complete air conditioning provides automatic control of the following

Dilip M Patel, MTech (Mech.), Principal, Shree V & K Patel Institute of Engineering,Mehsana, Gujarat

factors for all outdoor (outside) weather conditions for both summer and winter :

- Remove the dust, dirt, soot and germs from the outside air entering the air conditioning plant.
- Cool the air in summer and heat the air in winter.
- Decrease the humidify (moisture content in the air) in summer and increase the humidity in winter.
- Circulate and distribute the conditioned air evenly and pleasantly throughout the building at all times.
- Ozonate or ionize the air for the elimination (removal) of odours (unpleasant smell) after it has been conditioned.

Clean Air: Clean air is desirable for breathing, for the reason that the dust in the air covers the air passages of the nose, throat and lungs, which seriously affects their healthy functioning. Dirt is objectionable also because it serves as a carrier of germs. In the manufacture of food products, drugs and other chemicals, the dirt may be dangerous to health. In the finishing of automobiles and furniture and in many other manufacturing processes, the elimination (removal), of dirt is quite necessary. In the air cooling of electric generators in power plants, dirt must be removed as it may choke the narrow air passages in winding and thus, cause serious overheating.

Temperature Control: Control of temperature, which means the maintenance of any desired temperature (temperature of 25^0C is recommended for maximum comfort) within an enclosed space even when the outside temperature is either above or below the desired room temperature. This means, either addition or removal of heat from and within the enclosed space as the occasion might demand (i.e. to increase the temperature in winter and to decrease the temperature in summer).

Humidity Control: Control of humidity, which means adding humidity or moisture from air during summer, in order to produce comfortable and healthy conditions within an enclosed space. The water vapour in air, usually called "moisture", is an important but quite variable constituent of the atmosphere; its amount in outside air depends on the weather conditions. When air contains the maximum amount of water vapour that it can hold, it is said to be saturated. At a particular temperature, only a fixed amount of water vapour can be held by one kg of dry air. If the temperature of saturated water vapour drops down sufficiently, i.e. below its saturation temperature, some of the vapour will get condensed and if it is raised, the capacity of the air to hold water vapour will be increased. Humidity in air is necessary for comfort. During cold weather a person in a room often feels uncomfortable temperature. This condition is caused by air currents and insufficient water vapour in the air. Moisture is therefore, an important factor in any of the applications of air conditioning. Proper conditioning of air during hot weather increases not only the business but also the efficiency of employees. In some manufacturing processes, removal of dirt from air is of secondary importance, so that air conditioning is then mainly for the control of the humidity of the air used for ventilation or manufacturing purposes. Air conditioning has been found to improve the quality and to reduce the cost of manufacture of automobiles, drugs and pharmaceuticals, electric goods, textiles etc.

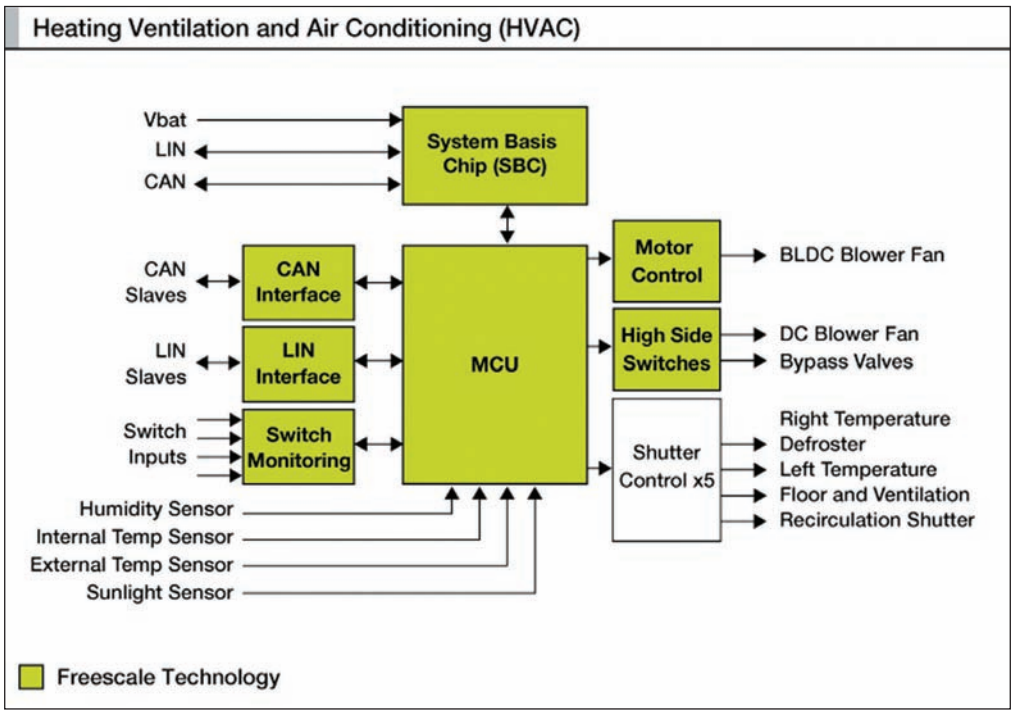
Air Motion Control: Control of air motion which includes the distribution of air in an air conditioned space. This is necessary to keep even temperature throughout the conditioned space. This factor also concerns the question of draught (air current) which affects the circulation of the air.

Removal of Odour: In air conditioning definite amount of Ozone should be introduced in the air conditioned room for deodourizing and refreshing the air. For this reason, air is passed through Ozonator after it has been conditioned. Ozonator is a small electric apparatus which is scientifically designed to produce and control the exact amount of Ozone required in the system. Ozone is used in air conditioning as an odour eliminator.

Terms used in Air Conditioning

In the study of air conditioning, the following terms should be well understood.

Dry air is a mixture of the constituent gases which comprise atmospheric air excluding water vapor. On an average, composition of dry air by volume is 20.95% oxygen, 78.09% nitrogen, 0.93% argon, 0.03% carbon dioxide and traces of other gases. Normally, argon is



grouped with nitrogen and carbon dioxide is ignored and is generally stated that volumetric composition of air is 21% oxygen and 79% nitrogen. Molecular weight of dry air is taken as 29.966 or 29.

Moist air is a mixture of dry air and water vapour. The amount of water vapour in moist air depends on degree of saturation. The weight of water vapour in moist air is expressed in grammes or kg per kg of dry air.

Water vapour in air is usually called "moisture" and is an important factor in any of the applications of air conditioning. Its amount in the outside air depends on the weather conditions. When a mixture of air and water vapour contains the maximum amount of water vapour that it can hold, it is said to be saturated. If the temperature of the mixture of air and water vapour is higher than the saturation temperature, the vapour is superheated. If the temperature of air drops below its saturation temperature, some of the water vapour will be condensed.

According to Dalton's law there is, in 'mechanical' mixture of gases, a pressure for each gas, which is called its partial pressure. The sum of all these partial pressures is the total pressure of the mixture. The partial pressure of the individual constituent (water vapour and air) is the pressure that it displays, and it has the same temperature as that of the mixture. The water vapour that is contained in or mixed with atmospheric air, is the humidity.

The weight of water vapour that the air in a given place can hold, depends on its temperature and is independent of the pressure of the air. It varies with the partial pressure of water vapour. Specific humidity or humidity ratio is the weight of water vapour in moist air per kg of dry air.

The actual weight of water vapour contained in a unit volume of air is called the absolute humidity. Weight of water vapour is expressed in grains or grammes per cubic metre. It may be noted that one kg is equal to 15,430 grains.

Relative humidity (R.H.) is the ratio of weight of the water vapour in the air in a given space at a given temperature, to the weight of water vapour of the air in the same space and, at the same temperature would contain when fully saturated. To illustrate if 50% is the relative humidity (R.H.) of air at a given temperature, it will then contain half as much moisture as it would contain when fully saturated. One kg of dry air at 25°C would contain 20.2 gm of water vapour (from tables of properties of air) when fully saturated (100 % R.H.). Hence, air at 25°C and R.H. 50% would contain 10.1 gm of water vapour.

Relative humidity of air varies with the temperature. With the increase of temperature, R.H. will decrease and vice versa. To illustrate, air at 25°C and R.H. 50% is heated to 30°C. Now, one kg of dry air at 30°C would contain 27 gm of water vapour (from tables) when fully saturated. Hence, R.H. of air at 30°C when heated from 25°C and 50% R.H. would be 10.1/27= 0.375, i.e. 37.50%. Again, suppose that air at would contain 10.8 gm of water vapour (from tables) when fully saturated. Hence, R.H. of air at 25°C and R.H. 50% when cooled to 15°C would be 10.1/10.8 = 0.935, i.e. 93.5%.

Relative humidity of 50% and dry-bulb temperature of 25°C is recommended for comfort. Dry-bulb (D.B.) temperature is the temperature indicated by an ordinary mercury thermometer. It is the measure of sensible enthalpy of air. It has no relation to the condition of the air so far as the humidity or the water vapour content is concerned.

Wet-bulb (W.B.) temperature is the measure of enthalpy of air. It is the temperature indicated by a thermometer whose bulb is covered by a piece of wet (water moistened) wick.

The wet-bulb thermometer, has its bulb covered with a piece of clean soft cloth or wick, which is dipped in a small basin (cup) of water; this keeps the bulb moistened (wet). If there is much water vapour present in the air outside (i.e. atmospheric air has a high R.H.), there will be little evaporation from the moisture (contained in the wick) near the bulb of the thermometer, and therefore, only a small cooling effect will be produced. If the air outside is dry (less water vapour in air), more rapid evaporation will take place and lower will be the wet –bulb temperature (i.e. there will be more difference between the dry-bulb temperature and wet-bulb temperature). Thus, the difference in

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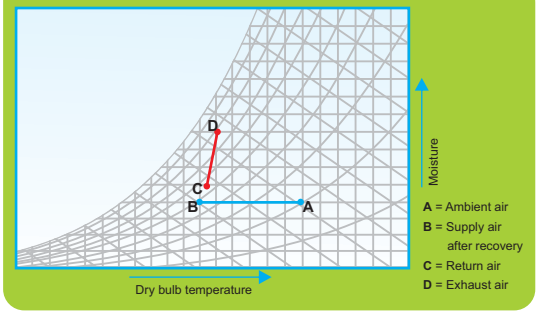
Psychrometric representation



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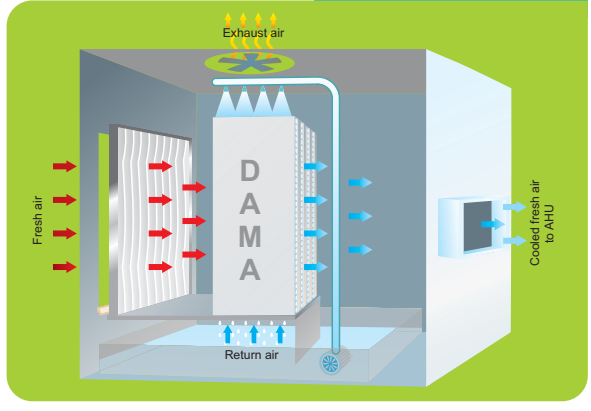
Principle of operation



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reading between the dry-bulb temperature and wet-bulb temperature is the measure of the amount of water vapour in air. Both the thermometers are read when steady conditions have been attained and the relative humidity is found by using Table or Psychrometric chart.

The difference between wet-bulb temperature and dry-bulb temperature is known as wet-bulb depression.

For example, the relative humidity of air having 30°C dry-bulb temperature and 22°C wet-bulb temperature, is 50% from Table 3-1. The wet-bulb depression is 30-22 = 8°C.

As the air is cooled the relative humidity increases. If the temperature is lowered sufficiently thereafter a point will be reached at which the relative humidity would be 100% or the air would be full saturated. This is termed the dew point (D.P.) or saturation temperature. A further vapour to be condensed in form of particles of water.

The difference between the dry bulb temperature and dew point temperature is known as dew point depression.

Effective temperature is an index of sensation of warmth produced by the combined effect of air temperature, humidity, and air motion. Sensation of warmth depends not only on the temperature of the surrounding air, as shown by ordinary thermometer, but also upon the wet bulb temperature (humidity), air movement and radiation effects. Effective temperature cannot be measured directly, but can be determined from dry-bulb and wet-bulb temperature charts or air motion observations, by referring to effective temperature charts or tables. These charts or tables are prepared as a result of a series of studies at research laboratories. Effective temperature can also be determined empirically. Effective temperature is an index of degree of warmth experienced by a person on exposure to different combinations of air temperature, humidity (moisture content of air), and air movement. To illustrate, the effective temperature of an air conditioned plant is 15°C, when the conditioned air produces a sensation of warmth like that experienced in slow moving air (at 6 m per min.) at 15°C.

Psychrometric is an instrument to measure the psychrometric properties of air. The most commonly used type employs two thermometers, one dry-bulb and other wet-bulb. The wet-bulb temperature reading in still air is erroneous. This reading is 10 to 20 of the bulb depression round the temperature of adiabatic saturation. The sling psychrometer is a common type most generally used for checking conditions on job. The instrument is rotated by hand to get air movement across the bulb of the thermometer. In the aspiration psychrometer, air across the stationery like those used in portable hair driers. Psychrometry deals with relation of air and water vapour or humidity. This relationship is shown by a series of curves that makes up the psychrometric chart.

Psychrometric Chart (Fig. 3-1) shows the relationship between the following fundamental properties of air, namely, (a) dry-bulb temperature, (d) dew point temperature, (c) wet-bulb temperature, and (d) relative humidity. When any two of these four properties are known, the other two can be determined directly from the psychrometric chart without any mathematical calculation.

Lines of dry-bulb temperature are vertical. The values of dry-bulb temperature are given on the base of the chart.

Lines of dew point temperature are horizontal. The saturation line (curve) is drawn by plotting the dry-bulb temperature (abscissa) versus moisture content in kg per kg of dry air necessary to saturate (ordinate). Under saturation conditions, the dry-bulb temperature becomes dew point temperature. The weight of moisture in kg to saturate 1 kg of dry air at a given temperature is determined by following the horizontal line from the given (desired) dew point to the right. The values of dew point temperature (saturation temperature) are given along the saturation curve of the chart.

The diagonal lines running downward from the saturation curve across the chart are lines of wet-bulb temperature. The values of wet-bulb temperature are given along the saturation curve of the chart.

The curved lines that follow the same direction as the saturation curve are the lines of relative humidity. The values of relative humidity are given along the lines of relative humidity.

Lines of constant volume are obliquely running downward to the right of the saturation curve. The values of specific volume (m^3/kg) are given on the base of the chart.

To determine the relative humidity of air for a given dry-bulb temperature and wet-bulb temperature, draw a vertical line from the given dry-bulb temperature to intersect the given wet-

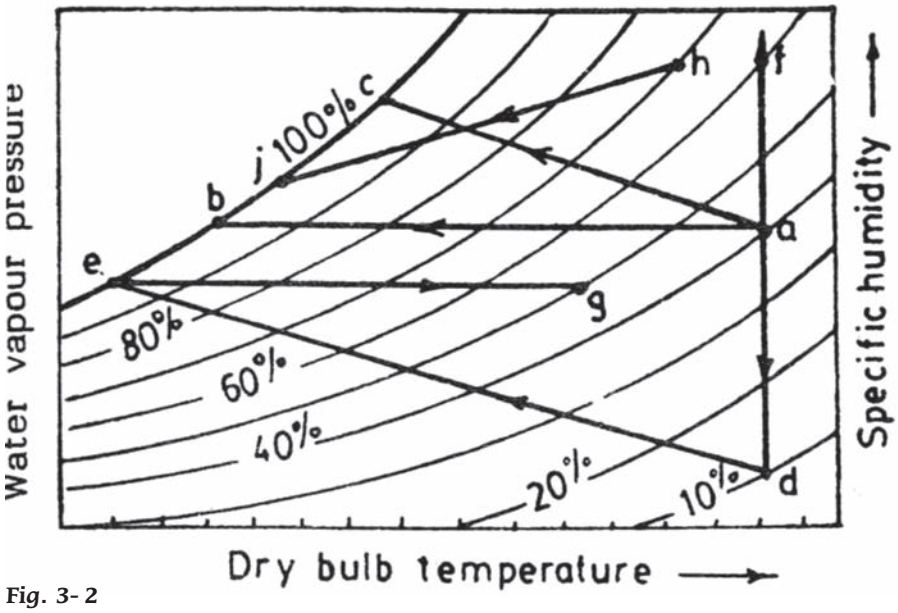
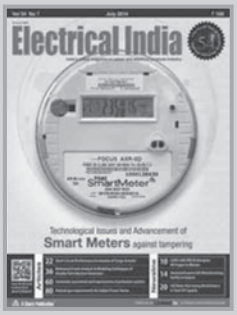
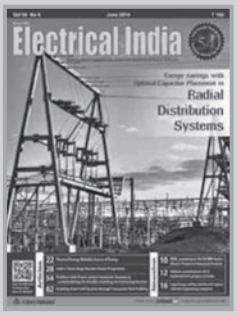


Fig. 3- 2





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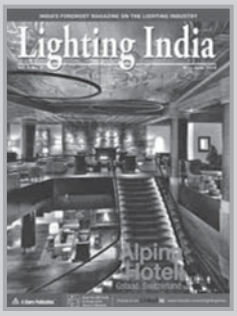

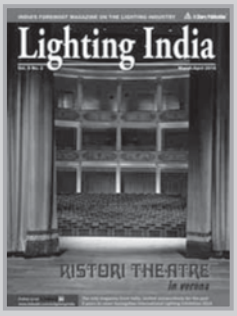

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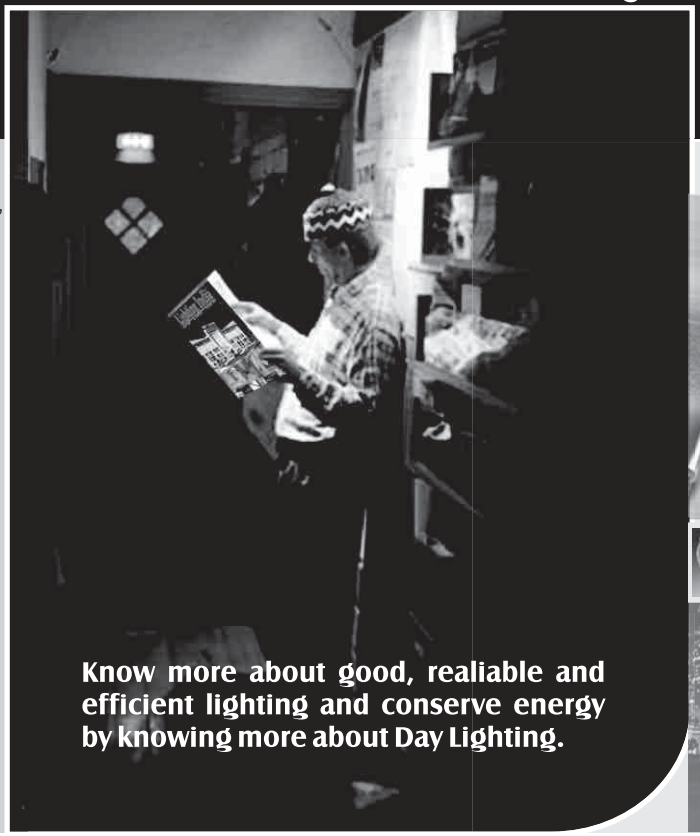

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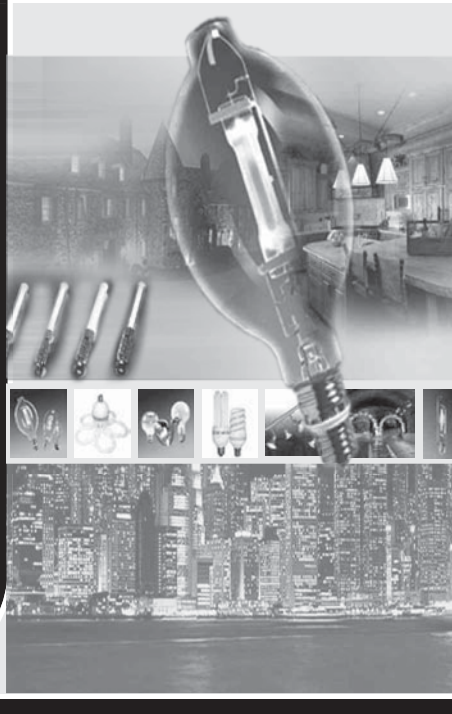

bulb temperature diagonal line. The point of intersection gives the R.H.

To determine the wet-bulb temperature for a given dry-bulb temperature and dew point temperature, from the point of intersection of vertical dry-bulb temperature line and horizontal dew point temperature line, follow the diagonal wet-bulb temperature line to saturation curve and read the wet-bulb temperature.

To determine the dew point temperature of air for giver dry-bulb temperature and relative humidity, follow the vertical line from the given dry-bulb temperature to intersect the given relative humidity curve. From the point of intersection, follow the horizontal dew point temperature line to the saturation curve and read the temperature.

To determine the enthalpy content or enthalpy of air for given dry-bulb temperature and relative humidity, from the point of intersection of vertical dry-bulb temperature line and relative humidity curve, draw a line parallel to diagonal wet-bulb temperature line upto the enthalpy scale and determine the enthalpy of air.

The determine the volume of air for a given dry-bulb temperature and relative humidity, from the point of intersection of dry-bulb temperature and relative humidity curves, draw a line parallel to constant volume line and determine the specific volume scale given on the base of the chart.

Figure 3-2 shows the psychrometric chart (on reduced scale) on which the different psychrometric processes are shown. Line ab represents sensible cooling at constant moisture content or at constant humidity ratio of air. Thus, in this process, dew point temperature remains constant, while relative humidity increases. The final temperature cannot be below the initial dew point temperature but the relative humidity will be raised. If we consider line b-a or e-g which represents heating without changing the moisture content. (i.e. humidity ratio) of air wherein the relative humidity is lowered.

Line a-c or d-e which is parallel to the wet bulb lines from the entering-air condition to the saturation curve is the adiabatic saturation process line. "Adiabatic" means no heat added or removed externally and 'saturation' implies adding of moisture. This process is carried out in practice by spraying water in air stream. Evaporative cooling closely approaches adiabatic saturation process. Evaporative cooling is more effective in hot dry climate when the cooler humid condition is more desirable than the hot dry condition. Generally, the leaving wet-bulb temperature cannot be lower than the spray water temperature. Thus, relatives humidity is raised during this process.

Line a-f and a-d respectively represents humidification process. During these processes, dry-bulb temperature remains constant and humidity increases in humidification and decrease in dehumidification process. Line h-j represents the dehumidification process accomplished by cooling and dehumidification, or summer air conditioning process wherein temperature of air leaving is reduced and consequently relative humidity is increased. ■

Keeping the Air Clean

Importance of Air Filters in Commercial Office Spaces

Traditionally in India, HVAC design, operations and maintenance practices have mostly focused on the "H" and "AC" part of the acronym and the "V" has been often neglected, especially in commercial buildings.

If the system is able to maintain 20 – 22 degrees in the summer, its working perfectly fine is what the maintenance team will usually say. However, is the quality of air that is being circulated fit for humans, are there any pollutants in the air that can impact occupant health, is the flow rate enough to cater for the number of staff etc. – these are questions that most O&M teams either do not know about or choose to ignore.

Office buildings constructed 15 – 20 years back were typically used only for work – people came, worked and went back. The modern commercial work spaces have evolved considerably, and they are part of a larger eco system that has not only the work space, but also space for recreation, entertainment, cafeterias, open air auditoriums etc. Thus, the quality of air that was suitable for a work space now needs to be re assessed and made suitable for the different spaces in a commercial building so that the occupants remain healthy and productive.

Higher levels of pollutants, both inside and outside further complicate the process of providing clean air for the occupants. Air filtration is thus an

Aneesh Kadyan, Director - Operations, for a leading real estate services firm, heads the operations of a large team of professionals in the building and facility management arena. He is a post graduate in Mechanical Engineering with vast experience in management. Aneesh is a Professional Engineer (PE), a certified Energy Auditor and an IGBC Accredited Professional (AP).

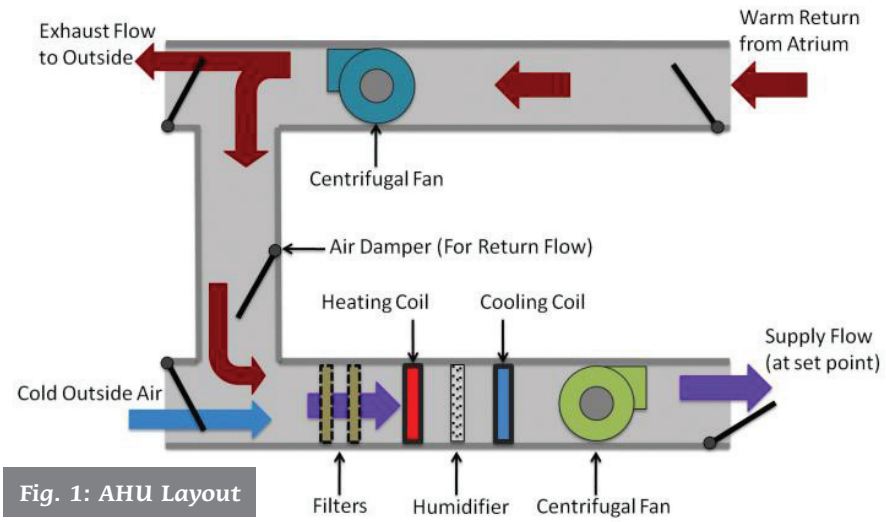

Fig. 1: AHU Layout

essential part of modern built spaces, and effectively managing the air filtration systems in a building will be a key skill set for the building maintenance teams of the future. Understanding the various aspects of air filtration is essential to effectively manage the air quality of these modern spaces.

Air filtration Systems overview

The majority of grade a commercial buildings have central air conditioning systems, where chilled water is supplied to Air Handling Units (AHU) which in turn circulate conditioned air within the work space. Specialized spaces within the office such as the server rooms and data centers have dedicated precision air conditioning units provide higher quality of air required for the equipment's in these spaces. Many earlier buildings rely on individual air conditioning units where external, air cooled air conditioner are used for cooling smaller work spaces. There is limited control on air quality and only minimal filtration is such external split unit installations. The AHU based systems however have a more advanced filtration system varying in complexity from basic dust filters of high efficiency filters used in "clean rooms". Typically, air is supplied to the work space at a positive pressure by a centrifugal fan (supply fan) and contaminated air from the room is channelled into the intake of this fan through "return air" ducting. A certain amount of fresh air is introduced into the return line and the cycle begins again. Figure 1 shows a layout of a typical AHU.

AHU filters consist of the filter media (Usually paper), the filter stack that holds the media and the channels that guide the air across the media surface. Figure 2 shows a typical AHU filter.

Fig. 2: AHU Filter

Air filtration Standards

The most commonly used air filtration approach is by using filters in an AHU. The two main standards used in the industry for qualifying the filters are the ANSI/ASHRAE standard 52. 22012 - "Standard Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size"and the Eurovent standard. The ASHRAE standard is the most commonly used, and the filers are identified by the Minimum Efficiency Rating Value (MERV). The standard list three main parameters that define filters – the pressure drop across the filter, the arrestance (% of dust that is captured by the filter) and the dust holding capacity. The filtration capacity is listed as an MERV value from 1 to 16, with the MERV 16 filters having the highest filtration capabilities. The type of filter to be used depends upon the type of application or space to be conditioned. Typically, commercial office spaces use MERV 12 and above filters. The MERV is essentially a measure of the amount of dust that the filter can retain. A MERV 8 filter has an efficiency of 30% - it will capture 30% of particles more than 1 micron. An MERV 13 filter will have an efficiency of 85% and MERV 15 an efficiency of 95%.

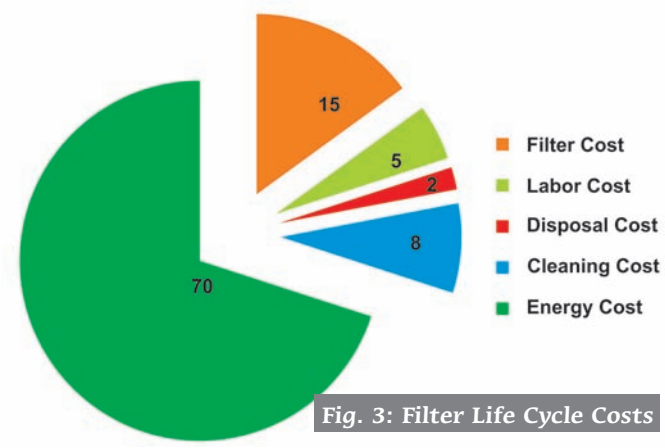

Fig. 3: Filter Life Cycle Costs

Another type of filter used in office spaces, especially where in server rooms and data centers is the High Efficiency Particulate Air (HEPA) filter which has an efficiency of 99.7% in capturing particles up to 0.3 micron.

A trade off is usually made between filtration quality and cost. With increasing quality of filtration, the energy needs to pass air across the filter increases, which in turn increases the cost. However, the primary consideration is usually the type of space the filter is being used in and the level of filtration needed.

Importance of using correct Filters

The two key factors to keep in mind when selecting air filters are the air quality of the space that is conditioned and the cost of operations.

Indoor Air Quality – Poor IAQ negatively impacts employee's health and also has a direct correlation on productivity of the work force. Filters, along with the optimum amount of air flow and injection of external fresh air play a key role in maintaining the best IAQ possible for a given cost and space.

Cost of Operations – The cost of filters goes up as the MERV value increases. In addition, the higher the MERV value, the cost of operations also increases as the energy required pumping air across the filter increases. The key therefore is to use filters with the required MERRV but with a lower pressure drop across the filter, which usually is available in higher quality filters that cost more. However, the initial cost is only a small fraction of the overall life cycle cost of the filter. The major component of the filter life cycle cost is the energy cost for passing air across the filter, which is approx. 60 – 80% of the cost 2. Thus, by correctly selecting the filter at the design stage, a large reduction in operating costs can be accrued.

Figure 3 shows the breakup of the life cycle cost of filter 2. A reduction in static pressure by 0.1" WG can save up to Rs 3000 per filter annually. Considering a typical AHU has 10 filters and there are 6- 8 AHU's in the buildings, substantial savings can be made by using the right filters.

Filter Maintenance Challenges

With a growing awareness of the need for better IAQ, there is a greater emphasis on using the best available filters for the space that is being air conditioned. Fitting the best filters money can buy is one thing, maintaining them to ensure that the filter perform as per the original design intent is another thing altogether. Filter maintenance is relatively simple – regular cleaning and monitoring of the pressure drop across the filters. Some of the factors that prevent filters from performing to their design efficiency in buildings are as follows.

- **Poor access to filters for maintenance:** This is the most common problem observed by boiling maintenance teams in buildings. With work space coming at premium, the space for the AHU's is reduced in many buildings. This results in limited or sometimes no access to the filters for maintenance. The maintenance team use this as an excuse for not doing the basic maintenance activities and the filter performance degrades.
- **Lack of maintenance facilities:** Filters are required to be cleaned mechanically, usually once a fortnight. Again, due to space constraints, space for washing the filters is not created in the AHU room and the maintenance team has to take the filters to the wash rooms of outside the buildings. This not only increases the chances of physical damage to the filters, it also leads to dust entering the air cavity as the filters are out of the casing for a long time.
- **Lack of knowledge of the maintenance team:** Since the filters are not seen as an important part of the HVAC eco system, the staff deputed to clean the filters is not given adequate training and supervision is often lacking. This results in improper cleaning of the filters and even damage to the media which in turn impacts performance.
- **Delay in replacement of filters:** For many building owners, as long as the grill temperature in the tenant space is within the desired range of 220^{O}C, there is no incentive to change the filters when they become choked or their efficiency falls
- **Lack of AHU pressure drop monitoring:** Very few maintenance teams actually record the AHU pressure drop and monitor any changes that can indicate the choking of the filters.

The two key factors to keep in mind when selecting air filters are the air quality of the space that is conditioned and the cost of operation.

Summary

Filters play an important part in maintaining the IAQ of a building. In addition, there is cost of operating the filters which is substantive, when considering the number of AHU's that are in use in a building. There is thus a strong business case to firstly select the best possible filter system and then allocate adequate resources for maintenance of the filters to ensure that the filtration is occurring at the designed efficiency levels. A properly maintained filter not only consumes less energy and helps with employee productivity by better IAQ, it also aids in making the air conditioning process more "green" and sustainable. ■

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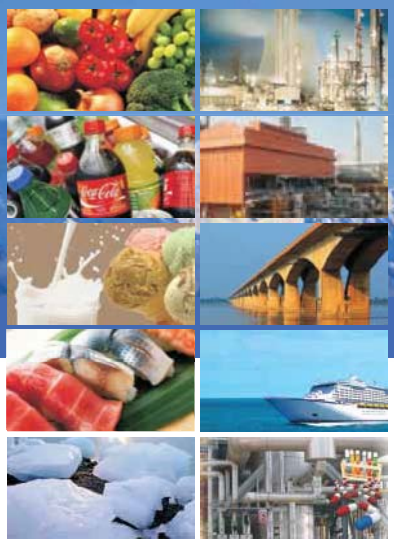

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Energy Efficiency in Buildings

There are some features for energy efficient buildings like bioclimatic architecture (i.e. shape and orientation of the building, solar protections, passive solar systems), high performing building envelope (i.e. thorough insulation, high performing glazing and windows, air-sealed construction, avoidance of thermal bridges) and high performance controlled ventilation: mechanical insulation, heat recovery. This can be achieved only when the building has been designed to minimise the energy loss and by installing energy efficient /star rated equipments in the building.

Energy Consumption by HVAC

Energy consumption in buildings has been growing in aggregate over time. Nowadays, energy demand of building includes lighting, warmth in the winter, cooling in the summer, water heating, electronic entertainment, computing, refrigeration, and cooking.

As per news published in The Economic Times dated Jun 8, 2014, the building sector's share of overall electricity consumption has more than doubled in the last four decades. It has grown from 15% in 1970-71 to 34% in 2010-11 and, therefore, offers cost effective opportunities for savings. It will be mandatory for all state governments to implement by 2017 the minimum requirements for energy efficient design and construction set by the central government to meet the challenges of depleting resources, increased urbanization and rapid construction.

Energy consumption by heating, ventilation, and air conditioning (HVAC) systems accounts for roughly 40% of total building energy consumption, and in turn, buildings account for 35% to 40% of total worldwide energy consumption. Thus, HVAC energy consumption in commercial buildings is a key contributor to total global energy consumption. Hence, improving

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its efficiency can reduce peak demand electricity charges. Capital and maintenance costs of HVAC equipment also comprise a significant proportion of building costs. In addition, high performing buildings are now getting better returns as tenants and purchases are demanding to occupy sustainable buildings.

Factors affecting Energy use by HVAC

There are five important factors that determine the energy use of an HVAC system:

- The design, layout and operation of the building: This affects how the external environment impacts on internal temperatures and humidity;
- The required indoor temperature and air quality: More extreme temperatures, greater precision and more refined air quality consume more energy;
- The heat generated internally by lighting, equipment and people : All of these have an impact on how warm your building is;
- The design and efficiency of the HVAC plant: It provides heat, cooling and moisture control exactly where it is needed in the building;
- The operating times of the HVAC equipment and ability of the controls: These limit operation to exactly when it is needed.

How to save energy while using HVAC

Driven by tightening energy efficiency regulations and by demand for higher-efficiency buildings, the technology for efficient HVAC systems is advancing. While significant energy and capital savings can be made through investing in energy efficient HVAC systems when constructing new buildings, good strategies exist to optimize energy use in existing HVAC systems. These strategies include reducing demand for HVAC services and ensuring good maintenance practices. For the improvement of energy efficiency of heating, ventilation and air conditioning (HVAC), hot water and boilers following energy-saving measures can be utilized.

Heating

Heaters are used to generate heat (i.e. warmth) for the building. This can be done via central heating. Such a system contains a boiler, furnace, or heat pump to heat water, steam, or air in a central location such as a furnace room in a home, or a mechanical room in a large building. The heat can be transferred by convection, conduction, or radiation.

Heating and hot water can account for 60% of your total energy use. By ensuring that efficient heating systems are specified, operated and maintained the potential savings can be substantial. There are three key ways of cutting your heating costs:

- Reduce temperature on Thermostat: Lowering set points by just 1^{O}C can

potentially reduce your annual heating bill by up to 8%, so reduce the temperature on the thermostat down to the minimum comfortable level.

- Replacement of inefficient boilers: Replacing an old gas boiler with no controls, with a high-efficiency condensing boiler and full set of heating controls will significantly cut carbon dioxide emissions and could save money.
- Install de-stratification fans: In commercial or industrial buildings with warm air heaters and high ceilings, de-stratification fans can reduce energy use by 20% by blowing warm air down to ground level where it's needed.

Ventilation

Ventilation is the process of changing or replacing air in any space to control temperature or remove any combination of moisture, odors, smoke, heat, dust, airborne bacteria, or carbon dioxide, and to replenish oxygen. Ventilation includes both the exchange of air with the outside as well as circulation of air within the building. It is one of the most important factors for maintaining acceptable indoor air quality in buildings.

Good ventilation provides fresh air and also helps protect a building against damp and condensation. But on the other hand, unnecessary ventilation can waste energy and cost a lot of money. For example, ventilation accounts for around 30% of heat loss in most commercial buildings (an estimated 25% in industrial buildings). Some points to be consider are:

- When buying new motors, always specify higher efficiency motors as it will save up to 5% on energy costs, for little or no extra capital cost.
- Variable speed fans can slow down when ventilation demands decrease. This will save money on electricity as well as reducing heating/cooling costs.
- Fans should be switched off when they're not in use. This not only wastes energy, but also removes heat from the building.
- A controlled ventilation strategy will satisfy the fresh air requirements of an airtight building. Air infiltration or opening of the window cannot be considered an acceptable alternative to designed ventilation.
- As the saying goes: 'build tight, ventilate right.'

Air conditioning

An air conditioning system, provides cooling and humidity control for all or part of a building. Air conditioned buildings often have sealed windows, because open windows would work against the system intended to maintain constant indoor air conditions. Outside, fresh air is generally drawn into the system by a vent into the indoor heat exchanger section, creating positive air pressure. The percentage of return air made up of fresh air can usually be manipulated by adjusting the opening of this vent. Typical fresh air intake is about 10%.

Air conditioning can use a huge amount of energy. In fact, air conditioning can increase a building's energy consumption and associated carbon emissions by up to 100%. However, there are some simple, low-cost ways to save energy and make air conditioning system more efficient.

- Air conditioning should not be operated below 24^{O}C. The heating and cooling systems should not be competing with each other - it's a waste of money. A temperature gap, known as a 'deadband', should be kept between heating and air conditioning control temperatures.
- Cooling should not be more than need - this wastes money and energy.
- Free cooling coils use the outside air as a source of cooling for air conditioning systems (when it's cool enough).

Thermal insulation

Insulation is as relevant in cold regions as in hot ones. In cold/cool regions, insulation keeps a building warm and limits the need for energy for heating whereas in hot/warm regions the same insulation systems keep the heat out and reduce the need for air conditioning.

Well installed insulation ensures energy efficiency in every part of the building envelope including ground decks, roofs lofts, walls and facades. It is also well suited for pipes and boilers to reduce the energy loss of a building's technical installations.

An exterior wall is well insulated when its thermal resistance (R value) is high, meaning the heat losses through it are small (reduced U value). Insulation is a key component of the wall to achieve a high R value (or a low U value) for the complete wall. The thermal resistance R of the installed insulation products has to be as high as possible.

Air tightness reduces air leakage

Air leakages need to be reduced as much as possible in order to create efficient, controllable, comfortable, healthy and durable buildings. With more stringent building regulations requiring better energy efficiency, air tightness is an increasingly important issue.

- Details that are vital to achieving good air tightness need to be identified at early design stage.
- Careful attention must be paid to sealing gaps and ensuring the continuity of the air barrier.

Conclusion

With the consolidation of the demand for thermal comfort, Heating, ventilation and air conditioning (HVAC) systems have become an unavoidable asset, accounts for almost half the energy consumed in building and 10-20% of total energy consumption in developed country. It also contributes to manufacturing facility energy use and costs. Energy and money can be saved by improving the efficiency of HVAC system while making the workplace more comfortable for employees and customers. Energy efficiency of HVAc can be increased by changing design of building and by installing and energy efficient equipment in the building. Installing energy efficient motor, pumps, air filters and installing occupancy sensors and star rated equipment, can result in even bigger savings. ■

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An Innovative Fleet Management, Using QR Codes

What is a QR code? The textbook definition of a QR Code is a two-dimensional bar code created by Japanese corporation Denso-Wave in 1994.

The "QR" is derived from "Quick Response." A type of Matrix or Two Dimensional bar-code. Rather than use a linear or laser type reader you use an imager – like the camera of an iPhone or a bar-code scanner that will scan linear and also has an imager.

My definition! Another existing technology that will solve many business problems. There are several QR code versions all of which allow varying amounts of information. Unlike UPC codes, the physical size of the QR code has little impact. In fact, if you have a QR code displayed on a screen during a presentation, it's likely that someone in the audience could use their iPhone or Android to take a photo of the code, and if they have the app on their phone action could be taken concerning the contents of the code.

It's very common to embed a URL in the QR code which directs you to a website. Now I really don't care who developed the code or the specifics of how it's constructed, but I do care about what it can do for us in both our personal and business lives. Being able to look past the technology, and imagine the use, is the key to using it to the fullest. In fact, there are many creative ways to use QR codes, all of which solve business challenges – I know as I have used it in thirty different applications.

Hey linear bar-codes! You'd better look out! QR codes could ultimately replace you!

QR Codes: A Case in Point

The Case: A company servicing the Oil and Gas industry has a substantial vehicle fleet worth tens of thousands of dollars. When vehicles are not in the field they are not generating new business or income.

The fleet being mobile, they struggle to keep timely and accurate maintenance schedules and physical locations of each asset. They also find it difficult to gain a mobile -in the field view of any given asset.

They use a robust web hosted software solution to manage the maintenance and other information regarding each of the fleet assets. But it's not really the software, it's the way we use the QR code that is the true innovation.

The Solution: QR codes were placed on each vehicle. Fleet managers capture the code on an iPhone, iPad, or other imaging device and they are taken directly to that asset in their software solution.

This can be done not only at their facility but anywhere they have phone coverage – like in a corn field. Information can then be viewed or updated regarding that asset. In fact we also placed the QR code on a key chain so if you have the keys to any vehicle you can also access that assets information.

The Bene□ts: Vehicles no longer sit unused. Timely updates of where the vehicles are, the maintenance history, and what the vehicles are doing is now updated visible in the system. Asset number entry is now accurate resulting in credible historical data. Management and staff are now able to focus on income generating and customer care events.

The result? You guessed it. Accuracy, Efficiency, Customer Care, all resulting in PROFIT. ■

Dan Belanger, is President of BELTECH - the Belanger Technology and Consulting Group. His background includes thirty years of solution based action in multiple business models including Distribution, Manufacturing, Warehousing, Facilities Management, Service, Retail, and Information Systems.

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Air-Conditioning Utility Assessment in a Platinum Rated Green Factory

The industry and the utility vendor do work together as a team in selecting the energy efficient equipments. Also, the industry sees now, the practical running cost of equipments, and practically works towards zero breakdowns during the sustained running of utility with the timely preventive and predictive maintenance schedules.

Energy saving in any process or here in the Air-conditioning utility can be first achieved by COARSE step control of AC compressors switching ON & OFF automatically suiting to process / utility load demands. And then, the FINE control of each AC compressor operation is done thru' VFD throttling to achieve pin-point regulation of the SET indoor temperature.

The first step towards energy efficiency air conditioning is that when the TR head load is demanding only, the AC needs to come on line. Otherwise, it can be shut off automatically and the AC need not be idling thru' inverter all the time waiting for the load demand. The load also does not call for stringent availability and a lapse of few minutes in between during switching ON delay is OK here. The AC Inverter working is efficient but more efficient is to switch OFF that part of the AC system when not required.

Recently, we conducted energy audit in a Platinum rated IGBC green factory. We are sharing with you, a part of energy study related air-conditioning utility of the industry during the energy audit and the steps taken by the industry

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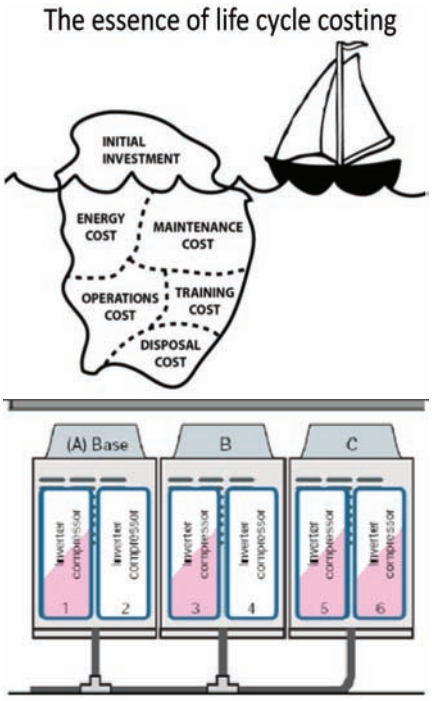
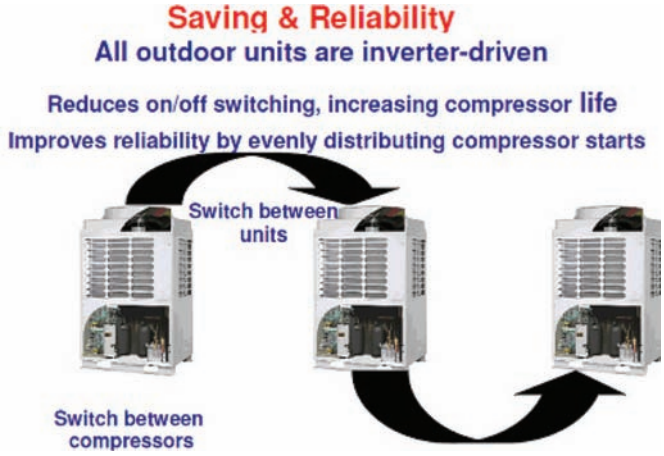
immediately after the audit to monitor & target the air conditioning consumption and conservation related condition monitoring procedures.

Industry Load Deta ils

- The industry is a HT consumer with a 500 KVA transformer. The Air conditioning utility rating is 30 TR AC package feeding to the CNC machine area of the factory. The 30 TR AC package system of 3 OD packs of VRF systems each with 2 AC compressors of 5 TR in the pack (2 x 5 TR per pack x 3 no = 30 TR) and the same located in the open terrace area of the factory.
- The Air conditioning system given by the vendor is a comprehensive intelligent system. Being 100% inverter compressors, at part load condition, the system intelligence decides the speed of each compressors and number of compressors it should operate to have minimum power consumption to achieve required capacity. All the compressors try to operate 30% to 80% as much as possible to optimize the efficiency.



- Initial Investment cost towards energy is only visible to the Industry now. But it has to visualize the life cycle costing considering the energy cost, wear & tear cost due to 24 x 7 mode run hours of the AC utility.



Energy Audit Site Observations

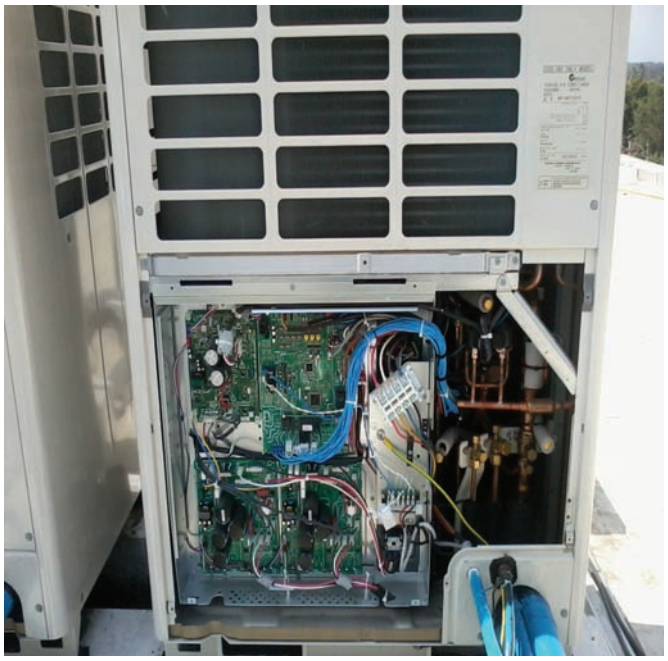
- When the energy audit was conducted, it was a lean period of production and hence not many machines were ON and working. But we found that the 30 TR AC package system was fully LIVE and ON throughout the day.
- The plants' heat load requirements for the AC was only 15 TR but actually 30 TR was fully ON to maintain the 15 TR load. For this load requirement, 2 packages of total 20 TR will be adequate and sufficient to cater to the 15 TR load. These were observed for three hours in the morning and during the starting of the shift time & only few machines were only ON.
- Here we measured the KW to find all the 3 packages; with each package running with only compressor out of 2 compressors per block totaling 15 TR. We could vary the load conditions since it was start of the morning shift and found for 8 TR requirements, this 30 TR AC package system, runs on minimum loading thro VFD to meet the lean heat load demand.
- Why should we run 3 OD packs of 30 TR when the AC demand can be met by only one OD Pack of 10 TR? So to provide automatic ON /OFF switching to each pack with suitable time delay taking care to avoid frequent switching. The EPROM controller in the vendor console to have few more steps like -
  - Automatic switching off individual packs in case of under loading with due time delay between switching on & off states.
  - Three OD can be rotated to run in turns automatically, so as to achieve equal run hours of all the compressors.

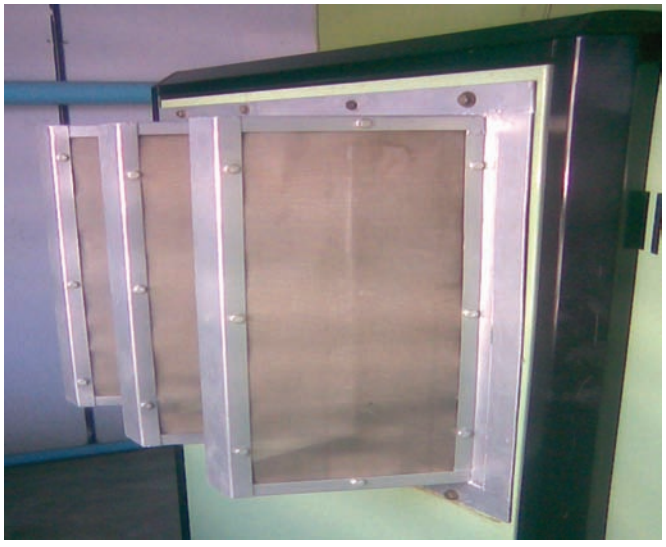
Energy Audit Observations and Recommendations

- We observed the factory had done networking of energy parameters of all the equipments and hooked them to the computers. We suggested them to buy Hour meter Rs.400/- to fit in each of the AC compressor to know how much each 5 TR AC compressor worked per day in all the 6 AC compressors to know the run hours of the AC compressors along with kwh meter costing Rs 3000 to each AC compressor of each package. Or if the same input is available from the vendor console, that needs to be hooked to the plant computers.
- We have clarified to the user; say for 50% load is there now, say 15 TR out of 30 TR why should we run all the three packages of 10 TR totalling 30 TR at 50% loading each say 5 TR on each package now? Instead we suggested running only 2 packages of 10 TR at 75% loading; hence equal to 15TR say at 7.5 TR per each package and automatically shutting off the third package.
- The sole reason is ONLY for the sake of power saving in not running idling third pack in loop here. Now we are running unnecessarily 3 AC compressor packages of higher KW even for part loading of 30%. We understand that the AC compressor efficiency for sustained IPLE is better at 50 to 70% load band & over a broader band of 30 to 80% loading.
- Precisely to say here, the functioning of 30 TR to be like this, that during rise and fall in demand as-
  - one package only (10 TR) to be ON automatically up to 8 TR max demand
  - Two packages to be ON in Auto for (20 TR = 2 x 2 x 5 TR) from 8 to 16 TR demand
  - Three packages 30 TR to run in Auto from 16 to 30 TR demand.

1 & 2 images – Umbrella shade on top needed for protection against direct Sun and heat and against hot spot failures.

- To provide umbrella type shade like in the Telecoms buildings, wherein outdoor of AC package Air cooled condensers located under umbrella shed on open terrace. If the space is not constraint, then spread the outdoors with sufficient spacing in between. Also provide V type pre filter to each of the condenser fins for daily cleanability on line.
  - The industry utilities say like DG sets, Air compressors, coil cooler etc are having Daily cleanable Vee type Pre – filter now. We can also provide to each of AC block and clean the same daily in the morning to avoid dust particles.
- To put slide in slide out window AC air filter in the entire fresh air duct opening to avoid outside dust entering inside. To daily clean the same first thing in the morning before starting the AC utility.
- Why the AC package installation crew don't provide suction and discharge pressure gages as in-situ type inside the hood and viewable from outside? These gages will help us to know that the Refrigerant gas is optimumly pressurized midway between the high and low limits and not leaked out during routine monthly checks.
- This brings down the AC run hours as shown by the AC hour meter running up to 10% less hours per day when not under the Sun. To provide shade on top of the entire outdoors to comfort the heat transfer and this will not directly heat up all the inverter PCB inside the machine panel but under the direct Sun heat ingress. The micro processors are in the panel kept directly under the Sun. To plan for sustainable





long working, to provide weather proof sunshade on top of the systems.

- To provide Velocity Recovery Ring for all the above open-to-top exhaust fans for better air efficiency exchange. Shade can be provided with more head room to accommodate throw distance of condenser exhaust fans.
- To increase the temperature settings to 25^{O}C inside premises especially and this yields 5% savings and fit in BLDC type SUPER fans inside premises for positive cross ventilation with no hot pockets inside. This fan consumes only 11 watts at the mid speed position knob and gives mild breeze.
- The harmonics generated from the AC packages is more & around 30% THD and H 5 Amps predominant. The vendor OEM to insert Line Reactor Choke or Harmonic Reduction LC filter to reduce harmonics distortion towards the EB incoming grid. Because of the utility VFDs working, this industry was forced to go in Active Harmonic Filter at the transformer secondary. Let us collectively try to arrest the harmonics at source within the respective utility and production machine panels.

Pointers to Industry Segment

- The industry needs to work towards sustained energy savings in the utility by lean running of minimum utility during the lean running of their production equipments. The vendor also becomes a part of industry energy management in educating & supporting the industry generically, that the utility equipment needs comfort for its running first now and prolong the MTBF so as to allow the industry to efficiently utilize the same for decades.
- The factory has gone for an efficient & intelligent system of operating the HVAC facility and we have suggested to fine tune the same further to reduce & sustain the AC running cost further.
- "A green building is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building." This industry decided to monitor and target the Air conditioning utility consumption immediately after the audit. ■

GWS will have its own warehouse in India

Surit Mohapatra, *Country Manager, India, Global Water Solutions Ltd, in an exclusive interview with* ***Cooling India*** *says, we have our master distributor, sales channel in every city to promote our sale.*

With 18 years of extensive experience what scope and changes do you see for water tanks and treatments in HVAC industry?

Pressure tanks are now very essential for each & every housing society, hotel, hospitals, metro stations, airport, shopping complexes & individual houses. We also manufacture tanks for water treatment & Expansion tanks for HVAC industries. Pressure tanks also use as energy saving devices as it save energy & reduces nos. of start & stop of pump.

Could you share with us the expanded water treatment product line that GWS displayed at the Aquatech Shanghai 2014?

During the Shanghai Aquatech 2014 expo GWS exhibited a full range of pressure tanks for pressure boosting, water well, water storage and water treatment applications. These included our traditional branded product such as PressureWave, Challenger and C2Lite, as well as some of our newer product lines including our new All-Weather pressure tanks suitable for mining, marine, and other harsh environment applications. We also had our new range of SpringTech water filtration products on display. These included our state-of-the-art FRP media tanks with patented Vortech distribution technology as well as our One Cartridge Tanks and Filters. The One Cartridge Tanks and Filters were a big hit with both local Chinese customers and foreign customers alike. They were lining up to learn more about the unique Cartridge tank designs as well as our latest Cartridge filter technologies.

Would you share some of the features and advantages of PumpWave electronic controller?

PumpWave controller is an electronic controller. It works on pressure sensing & flow sensing principle. Pump Wave replaces the pressure switch, pressure gauge, float switch & five way connector. PumpWave further reduces no of start & stop of pump & hence it is more power consuming device. PumpWave gives a constant pressure supply.

Can you tell us about GWS new expansion in Africa, why did GWS selected Africa from the geographical point of view?

GWS Africa has recently opened an office and warehouse facility near Johannesburg, South Africa. We decided to open GWS Africa as we see the African continent as a key to our emerging market strategy. By setting up a subsidiary company with product inventory and customer support in South Africa, we are better poised to service the greater African continent and supply our products quickly and efficiently to our African customers and OEM partners.

How far have you been successful in establishing the market presence and increasing revenues of GWS for India, Srilanka, Bangladesh and Maldives?

In past five year we have increase our market share in each countries. In India we have grown @ 38-40 % every year.

In past 5 year we have grown 4 times than the sale of year 2009. We have our master distributor, sales channel in every city to promote our sale.

What policies/ technologies you adhere to developing new products?

GWS' core company value is "Excellence through Quality". We apply this value in everything that we do. It starts in the R&D phase and carries through to manufacturing all the way to the after sales service support that we stand committed to providing to our customers. All new products are designed with the latest technologies and industry trends in mind. Just look at our newest tool, the GWS Pressure Tank Sizing Calculator, which is currently available on iPhone, iPad, and iPod Touch. We developed this app to give our customers a quick and easy tool to use for quickly selecting pressure tank sizes as well as calculating tank draw down and water storage volumes. Android and Windows compatible versions will be coming out soon!

Please comment on the five years successful supply agreement with Grundfoss? What further changes are the two companies trying to bring in near future?

We have global agreement with Grundfos. We supply our tanks to Grundfos in gray color. We have jointly open the market globally. We also supply OEM brand tank to Grundfos & DAB. Grundfos has acquire DAB Italy. We are happy the way Grundfos has increased market share. We also supply all pump companies our tanks either as direct supply, or, through our distributor. In fact since we are supplying to all pump companies we are pump neutral.

Can you detail us about the hydronic heating and thermal applications?

We sale thermal expansion tanks in China, Europe, Australia, News land USA & in all oversea market. In India we don't have much application for heating & thermal expansion tanks.

Tell us in short about overall changes that you would like to see in GWS in the next two year?

In next two year time GWS will have its own warehouse in India. We are looking for channel partner for our water treatment tanks & we are looking to have a direct distributor for Water Treatment products & valves. We are planning to have 100% market share for pressure tank & water treatment tanks. With Water treatment products & existing pressure tank business we will have 100% marketing share. ■

Global Water Solutions Ltd, offers a full line of pre-pressurized diaphragm tanks for water well, pressure booster, pressure management, reverse osmosis, hydronic heating and thermal applications. GWS is positioned to serve global markets with strategically located production in Randolph, Massachusetts, USA and Taichung, Taiwan with additional distribution warehouses and regional headquarters spread around the world. GWS continues to be in the forefront of innovation and new technologies for pressure tanks and is the most comprehensive supplier of Pressure Tanks, globally.

Chillventa Congressing – high-calibre technical programme

CHILLVENTA 2014

Preparations are in full swing as Chillventa enters its fourth round. From October 14-16, 2014, the exhibition halls in Nuremberg will once again play host to the international gathering of the refrigeration, air conditioning, ventilation and heat pump sector. The technical programme Chillventa Congressing will take place on Monday October 13, 2014, and will deliver expert know-how of the highest calibre. "There are yet more exciting challenges and opportunities in store for the refrigeration, air conditioning, ventilation and heat pump technology sector," says Dr Rainer Jakobs, coordinator of Chillventa Congressing. "The latest F-gas regulation is having a significant impact on the market. Whereas in Germany the sector is focusing on the shift to renewable energies, internationally the key issues continue to be the environment and climate protection," says Dr Jakobs. At Chillventa Congressing, renowned international speakers will share expertise from R&D and practice and provide information about the current political frameworks in Europe and worldwide.

A selection of the presentations on offer

"The latest development in thermal storage systems" is the title of the presentation by Dr.-Ing. Karin Rühling from the Department for Building Energy Systems and Heat Supply at the Dresden University of Technology. In the refrigeration area, presentations include "Research findings on the use of air as refrigerant". The ASERCOM/EPEE Symposium will report on the EU's energy efficiency targets for 2030 and their significance for the industry. An overview of current activities and the status achieved in eco-design and associated market surveillance will be presented and discussed. There will also be reports on the initial impact of the recently adopted F-gas regulation on international provisions, industry and users.

Heat pumps

The heat pump segment will provide a global overview of current issues. As well as market trends in Europe, the USA, China and Japan, research activities in various countries and specific research findings, for example on cold climate, thermally driven and domestic hot water heat pumps will be presented.

Innovation Day: Energy of the future

The theme of the Innovation Day, which is part of Chillventa Congressing, is "Energy of the future – risks and opportunities for refrigeration, air conditioning and heat pumps". ■

Thermal Radiant Barrier

Human use and consumption of energy has long been an issue, especially in the context of sustainable design and construction. Today, it is an issue that our country and the world is becoming increasingly aware due to its current non-renewable nature and harmful environmental impacts. Energy consumption becomes more of a problem when temperatures rise.

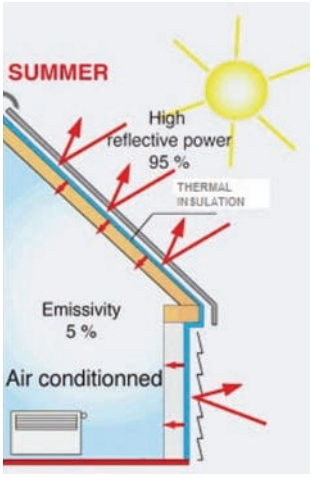
Radiation from the sun beats down upon and is absorbed by the metal roofs and facades of warehouses, increasing the cooling load of HVAC systems to maintain indoor temperatures. HVAC energy use has major impacts on the environment. It not only contributes to greenhouse gas emissions, but also to the depletion of natural resources. This issue is perpetuated by energy inefficiency. HVAC non-efficiency means higher rates of power consumption, which translate to higher energy bills and operating costs.

Thermal Comfort for Hu mans

In order to make sense out of these contradictory statements, let us examine when we human beings are thermally comfortable. Most humans at rest or doing light work produce about 150 watts of heat as a result of the biological processes in our body. We are comfortable, if we can get rid of this heat effortlessly. There are three ways by which our body loses this heat. They are Radiation; Convection and Perspiration. Radiation is the same process by which the sun heats us from millions of kilometers away. The average temperature at which the room surfaces give out or absorb heat by radiation is called the Mean Radiant Temperature or MRT in short. If the MRT is less than the human skin temperature, then the surfaces absorb heat radiated by our body. If it is higher, then the structure actually heats up the body, so that we have to get rid of that heat also, in addition to the 150 watts of metabolic heat. Convection happens when air that is cooler than the body temperature, flows over our skin and cools it. If the room surfaces are cool, then they cool the circulating air by contact and it then flows over our body. So both radiation and convection processes work together. Consequently, if the MRT is high, then both radiation and convection processes add heat to the body instead of removing it. Then our body has only one alternative left i.e. Perspiration. We start perspiring

with the hope that the air moving over our body will absorb it and cool us by evaporation. So, it follows that both the room MRT and the circulating air have to be cooler than our skin in order to make us feel comfortable. Cooler the better. The air must also be relatively dry for absorbing the perspiration.

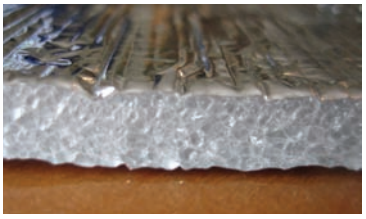
Emissivity



All materials give off or emit energy by thermal radiation as a result of their temperature. The amount of energy radiated depends on the surface temperature and a property called the emissivity also called as emittance. The higher the emissivity, the greater the emitted radiation at that wavelength. Radiant barrier materials must have low emissivity usually 0.1 or less at the wavelengths at which they are expected to function.

Radiant Barrier Mater ial: Aluminum Foil

Radiant barriers and reflective insulation employ a reflective material, generally aluminum, that reflects radiant heat rather than absorbing it. There are many types of radiant barrier materials like single sided foil, foil faced roof sheathing materials, double sided foil with reinforcement between the foil layers, multilayer foil system. Radiant barrier chips type are also available.



Aluminum foil is a commonly used radiant barrier, we can apply it below the metal roof in the warehouse. Radiant barrier sheet make for a much more efficient application and deliver high performance.

Balaji Kungiri, Mechanical Engineer from Rajiv Gandhi Institute of Technology, Mumbai University, working at Panasia Engineers Pvt Ltd, Mumbai.

Roof Sheathing

Factors Affecting on Thermal Radiant Barrier

Factors affecting the type and amount of insulation to use in a warehouse include, climate, ease of installation, durability, moisture, decomposition, replacement at end of life, cost effectiveness, flammability & environmental impact and sustainability.

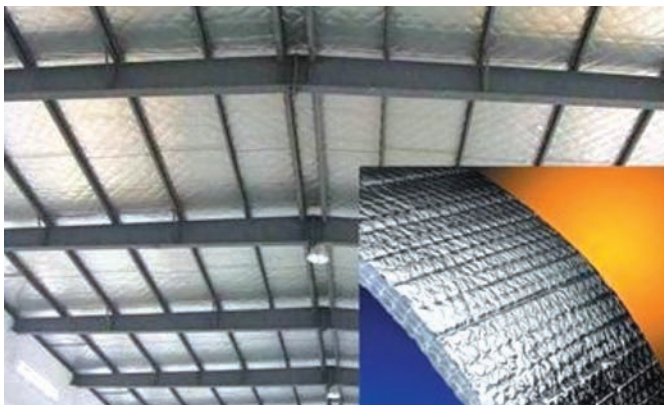
Mater ial Cost

Cost for thermal radiant barrier depend on several factors, including the following, whether purchase includes installation, amount purchased, manufacturing method and type of reinforcement, presence of other insulation materials.

How to Install

The insulation material is light weight in nature. The best way to install a radiant barrier in an existing metal roof is simply lay the foil material to the underside of the metal roof top. The process of insulation is quite simple, hence we can install insulation sheet in both conditions.

- During warehouse in under construction
- Complete ready warehouse.



How it Works

The low emissivity of a radiant barrier reduces the thermal heat flow from the heat source. A low emissive radiant barrier takes advantage of the low thermal conductivity of the air space, thus reducing the amount of radiant heat energy that gets absorbed by metal roof insulation. The insulation surface temperature is lower, and the heat flow through the insulation is reduced. However, not all heat energy that gets into your metal roof is from radiation. Some of the heat energy is from convection, which occurs when surrounding air comes into contact with the underside of the hot roof. Aluminum foil, the operative material in metal roof radiant barriers, has two physical properties. First, it reflects thermal radiation very well. Second, it emits very little heat. In other words, aluminum is a good heat reflector and a bad heat radiator. If you paint the light bulb black, when it is turned on, there is no light emission. A radiant barrier has a similar effect on infrared heat. Aluminum foil across the metal roof airspace reflects heat radiated by the roof. Even if the radiant barrier material has only one aluminum foil side and that side faces down, it still stops downward heat transfer because the foil's low emissivity will not allow it to radiate the roof's heat to the insulation below it.

Radiant Barrier Saving

Actual savings from radiant barrier depends on the amount of heat from roof contribute to the warehouse. In general we can say that the more energy efficient warehouse is, the larger the percentage of energy can be saved from the radiant barrier. In hot climates, benefits of metal roof radiant barriers include both cost savings and increased comfort level.

How Radiant Barrier is Us eful for Metal Roof Insulation!

Without a radiant barrier, your roof radiates solar generated heat to the insulation below it. The insulation absorbs the heat and gradually transfers it to the material it touches, principally the ceiling. A roof radiant barrier stops almost all of this downward heat transfer so that we can stay comfortable without air conditioning during mild weather. We can expand these radiant barriers material for insulation use of more in our metal roof warehouses for comfort.

Aluminium Foil Insulation better than Other s

Aluminum foil is a new environmentally-friendly heat insulation material, which is soft, light weight and easy to install. This material not only has good insulation, heat reflection & anti radiation functions but also has good moisture barrier.

Case Studies

ATE Enterprises Pvt Ltd, Ahmedabad

In ATE factory roof, they used aluminum sheet as the basic raw material. We can compare roof bottom temperature by following calculation.

Analysis

Radiant heat transfer per unit area with Aluminum sheet (Emissivity = 0.55)

Q rad 1 = Emissivity (alum sheet) x Stefan boltzmann constant x (T14 – T24)

$= 0.55 \times (5.67 \times 10^{-8}) \times ((60+273)^4 - (23+273)^4)$

= 144 Watts/ Sq mtr

Radiant heat transfer per unit area with Aluminum sheet, under deck insulation with aluminum foil (Emissivity = 0.04)

Q rad 2 = Emissivity (alum foil) x Stefan boltzmann constant x (T14 – T24)

$= 0.04 \times (5.67 \times 10^{-8}) \times ((43+273)^4 - (23+273)^4)$

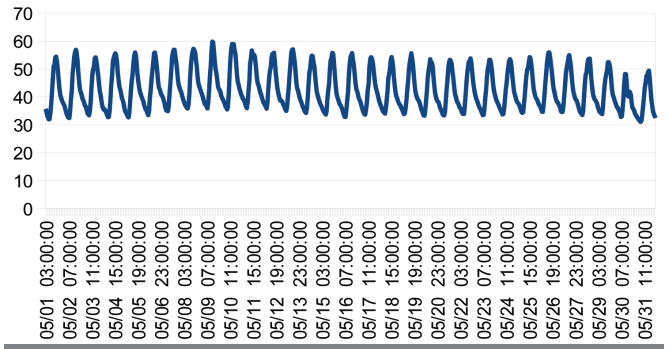
= 5.2 Watts/ Sq mtr

Effective mean radiant temperature when heat transfer is 5.2 Watts/ Sq mtr (Case no.2)

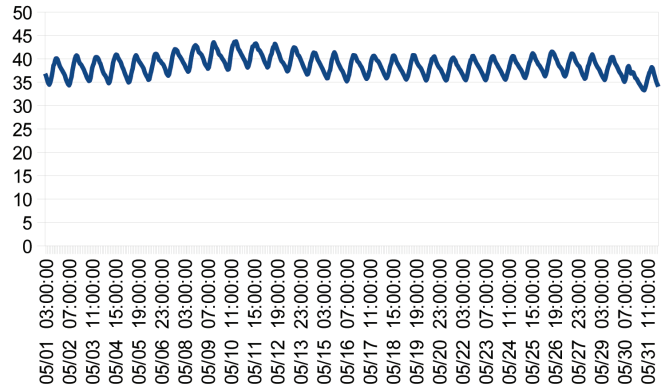
Q rad 2 = Emissivity (alum foil) x Stefan boltzmann constant x (T1 new 4 – T24)

$5.2 = 0.55 \times (5.67 \times 10^{-8}) \times ((T1\ new)^4 - (23+273)^4)$

T1 new = $24^{O}C$.



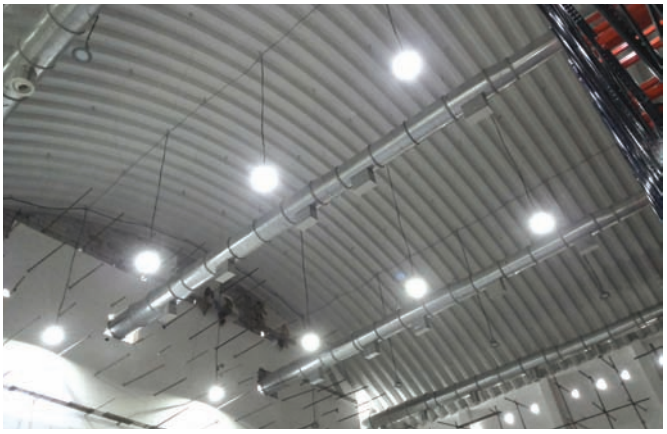
Customer Name: ATE Enterprises Pvt Ltd, Ahmedabad Zone Mean Radiant Temperature Without Insulation



Customer Name: ATE Enterprises Pvt Ltd, Ahmedabad Zone Mean Radiant Temperature With Insulation

IPCA Laboratories Pvt Ltd, Athal

In Ipca Athal warehouse roof, they have used high quality, high grade, pre-coated Galvalume material as the basic raw material. The thermal radiant barrier aluminum foil insulation laid inside the metal roof. We can compare metal roof bottom temperature by following calculation.



Analysis

Radiant heat transfer per unit area with Galvalume Sheet (Emissivity = 0.28)

Q rad 1 = Emissivity (galvalume sheet) x Stefan boltzmann constant x (T14 – T24)

= 0.28 x (5.67 x10^{-8}) x ((60+273)^4 – (23+273)^4)

= 73 Watts/ Sq.mtrs

Radiant heat transfer per unit area with Galvalume sheet, under deck insulation with aluminum foil (Emissivity =0.04)

Q rad 2 = Emissivity (alum foil) x Stefan boltzmann constant x (T14 – T24)

= 0.04 x (5.67 x10^{-8}) x ((43+273)^4– (23+273)^4)

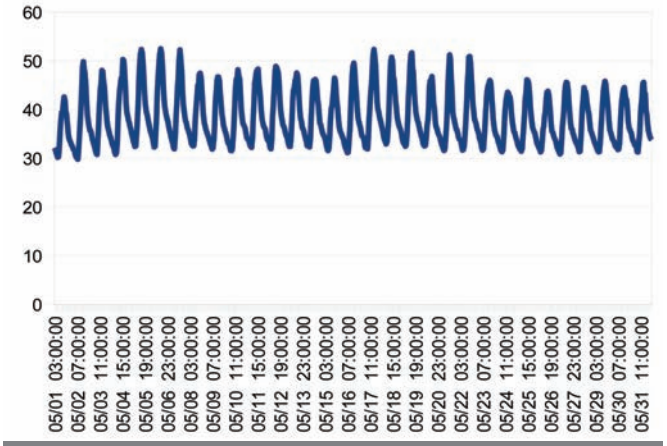
= 5.2 Watts/ Sq.mtrs

Effective mean radiant temperature when heat transfer is 5.2 Watts/ Sq.mters (Case no.2)

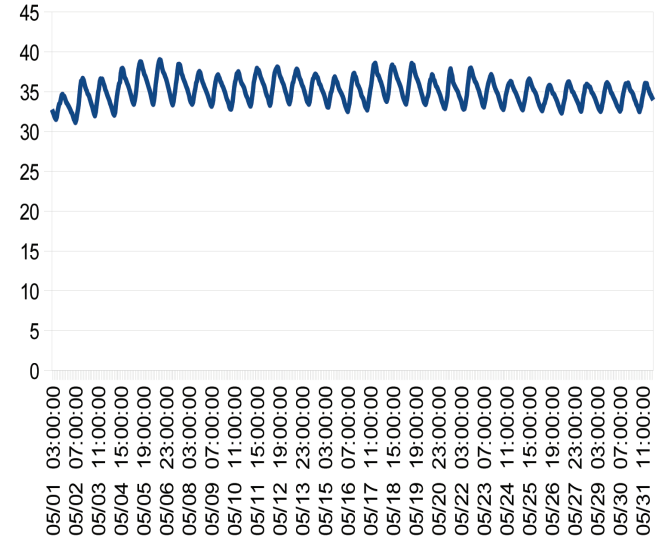
Q rad 2 = Emissivity (alum foil) x Stefan boltzmann constant x (T1 new 4 – T24)

5.2 = 0.28 x (5.67 x10^{-8}) x ((T1 new)^4 – (23+273)^4)

T1 new = 26^{O}C.



Customer Name: IPCA Laboratories Pvt Ltd, Athal Zone Mean Radiant Temperature Wt hout Insulation



Customer Name: IPCA Laboratories Pvt Ltd, Athal Zone Mean Radiant Temperature W th Insulation

As shown above aluminum foil inside the roof reduces radiant heat gain and maintains the effective mean radiant temperature below body temperature so there will be no heat gain from roof.

In IPCA Laboratories Ltd, Athal Air conditioning: Roof Load reducing in terms of Btu/hr

Btu/hr in Warehouse metal roof without insulation (for area 11500 Sq. ft)

= 11500 (Area in Sq. ft) X 52 (Temp. Diff. In ^{O}F) x 0.67 (U value of metal roof)

= 400660 Btu/hr 33.0TR

Btu/hr in Warehouse metal roof with insulation (11500 Sq ft)

= 11500 (Area in Sq ft) X 52 (Temp. Diff. In ^{O}F) x 0.10 (U value of metal roof with aluminum foil insulation)

= 59800 Btu/hr 5TR

Actual saving = 28 x 1.3 x 0.6 x 0.7 x 365 x 24

= 133923

= 133923/11500 (11,500 Sq. ft.)

= 11.64 Kwhr/Sq.ft./year.

Capacity of Dx System in Ipca athal warehouse without insulation:

= 90 TR with 40,000CFM

(To maintain Dry Bulb Temperature Not More Than 25^{O}C in warehouse)

Capacity of Dx System in Ipca athal warehouse with aluminum foil insulation:

= 60 TR with 22,000CFM

(To maintain Dry Bulb Temperature Not More Than 25^{O}C in warehouse)

As per aluminum foil insulation, it also reduce the CFM required in warehouse according to reduction in sensible load.

Conclusion

The purpose of specifying and applying radiant barriers or reflective insulation is energy conservation, which plays a crucial role in sustainable design. ■

Eco-friendly Oxyhydrogen Gas Generators for BRAZING

Mixed oxyhydrogen gas generators are major step-change in brazing. This technology, manufactured by Oxyweld, is helping small and big companies in refrigeration and air conditioning sectors since 34 years, to increases quality of their products and safety inside the working place.

Ga s generator function

These technologies work only with water and electricity. Gas is generated through a particular electrolytic cell, able to get oxyhydrogen gas from the water.

Safety in working place and quality of the joints

The system eliminates the usage of traditional gas cylinders and the possibility of explosion. Gas pressure is very low, below 0,5 BAR. Consider that conventional gases work between 5-10 BAR. There is no gas storage inside the gas generator because machine produces it only on demand. Conventional cylinders keep 200 BAR of gas stored.

Moreover, all Oweld gas generators don't produce optical radiations, dangerous for eyes and skin of the operators. Conventional gases give off UV, Visible and Infrared radiations.

Regarding quality, these two gases (hydrogen and oxygen) are mixed automatically by the machine and eliminating the human intervention, the process is standardized, the flame's quality is always consistent therefore quality of brazing improves accordingly. The first immediate benefit in using this system is the leakages reduction (and cost reduction in after sales).

Thanks to the concentrated flame. The heat is localized and does not spread, eliminating the risk to overheat the brazing piece and nearby assembly components. Such a flame drastically reduces the oxidation inside the brazed pipes. For the refrigeration/air conditioning industry less oxidation inside the tubing results in extended life-time of the components.

Ox yweld location and the products availability in India

Oxyweld produces totally in Italy, supporting over 10,000 customers in over than 45 countries, covering several fields of application like HVACR.

Diego Andreetta, the Sales Manager, said, "We think that India has a huge potential; we are supplying to many Indian big players and actually our products are available through two local sales points, in two strategic areas that allow us to stay more close to the customers ensuring also a fast after sales service managing".

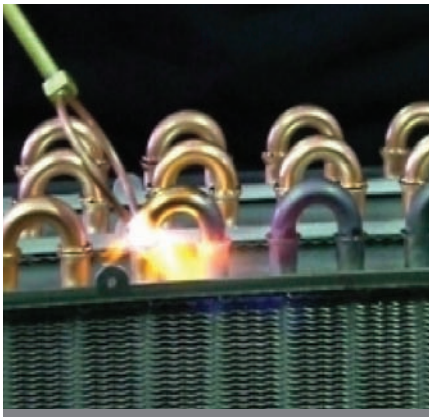
Ox yweld growth strategy

Andreetta continues, "The business has changed so much in these past years. We have to be the best in our own job and offer reliable solutions with a low environmental impact. This is also our group vision. Every year we invest 10% of our turnover in R&D and education to

Diego Andreetta, Global Sales Director of Oxyweld, with degree in Economy, Udine University (Italy).

Copper-Copper connections

Alloy penetration



Heat Exchanger brazing

get this goal and we will continue to do it. Celebrating 34 years brings a real sense of achievement, this label is now a by-word of quality but especially now, we have to keep going on without losing our objective and customer's needs. Our strength is our staff and customers loyalty built during these three decades".

Diego Andreetta concluded, "In the coming five years, OXYWELD will be focusing on achieving further competitive milestones with the completion of new models and significant investments in marketing activities in order to sensitize more the knowledge of this technology and his advantages". ■

Pictures of brazing: Courtesy Oxyweld

Energy Efficiency Improvement utilising High Technology

- An Assessment of Energy use in Industry, Buildings Development and Environment

Globally, buildings are responsible for approximately 40% of the total world annual energy consumption. Most of this energy is for the provision of lighting, heating, cooling, and air conditioning.

Increasing awareness of the environmental impact of CO_2, NO_x & CFCs emissions triggered a renewed interest in environmentally friendly cooling, and heating technologies. Under the 1997 Montreal Protocol, governments agreed to phase out chemicals used as refrigerants that have the potential to destroy stratospheric ozone. It was therefore considered desirable to reduce energy consumption and decrease the rate of depletion of world energy reserves and pollution of the environment. One way of reducing building energy consumption is to design buildings, which are more economical in their use of energy for heating, lighting, cooling, ventilation and hot water supply. This article discusses the potential for such integrated systems in the stationary and portable power market in response to the critical need for a cleaner energy technology. Anticipated patterns of future energy use and consequent environmental impacts (acid precipitation, ozone depletion and the greenhouse effect or global warming) are comprehensively discussed in this paper. Throughout the theme several issues relating to renewable energies, environment and sustainable development are examined from both current and future perspectives.

Passive measures, particularly natural or hybrid ventilation rather than air-

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conditioning, can dramatically reduce primary energy consumption. However, exploitation of renewable energy in buildings and agricultural greenhouses can, also, significantly contribute towards reducing dependency on fossil fuels. Therefore, promoting innovative renewable applications and reinforcing the renewable energy market will contribute to preservation of the ecosystem by reducing emissions at local and global levels. This will also contribute to the amelioration of environmental conditions by replacing conventional fuels with renewable energies that produce no air pollution or greenhouse gases. The provision of good indoor environmental quality while achieving energy and cost efficient operation of the heating, ventilating and air-conditioning (HVAC) plants in buildings represents a multi variant problem. The comfort of building occupants is dependent on many environmental parameters including air speed, temperature, relative humidity & quality in addition to lighting and noise. The overall objective is to provide a high level of building performance (BP), which can be defined as indoor environmental quality (IEQ), energy efficiency (EE) and cost efficiency (CE).

- Indoor environmental quality is the perceived condition of comfort that building occupants experience due to the physical and psychological conditions to which they are exposed by their surroundings. The main physical parameters affecting IEQ are air speed, temperature, relative humidity and quality.
- Energy efficiency is related to the provision of the desired environmental conditions while consuming the minimal quantity of energy.
- Cost efficiency is the financial expenditure on energy relative to the level of environmental comfort and productivity that the building occupants attained. The overall cost efficiency can be improved by improving the indoor environmental quality & the energy efficiency of a building.

Several definitions of sustainable development have been put forth, including the following common one: development that meets the needs of the present without compromising the ability of future generations to meet their own needs. A recent World Energy Council (WEC) study found that without any change in our current practice, the world energy demand in 2020 would be 50-80% higher than 1990 levels. According to a recent USA Department of Energy (DoE) report, annual energy demand will increase from a current capacity of 363 million kilowatts to 750 million kilowatts by 2020. The world's energy consumption today is estimated to 22 billion kWh per year, 53 billion kWh by 2020. Such ever-increasing demand could place significant strain on the current energy infrastructure and potentially damage world environmental health by CO, CO_2, SO_2, NO_x e uent gas emissions and global warming. Achieving solutions to environmental problems that we face today requires long-term potential actions for sustainable development. In this regards, renewable energy resources appear to be the one of the most efficient and effective solutions since the intimate relationship between renewable energy and sustainable development. More rational use of energy is an important bridge to help transition from today's fossil fuel dominated world to a world powered by non-polluting fuels and advanced technologies such as photovoltaic (PV) and fuel cells (FC).

An approach is needed to integrate renewable energies in a way to meet high building performance. However, because renewable energy sources are stochastic and geographically diffuse, their ability to match demand is determined by adoption of one of the following two approaches: the utilisation of a capture area greater than that occupied by the community to be supplied, or the reduction of the community's energy demands to a level commensurate with the locally available renewable resources.

For a northern European climate, which is characterised by an average annual solar irradiance of 150 Wm^{-2}, the mean power production from a photovoltaic component of 13% conversion efficiency is approximately 20 Wm^{-2}. For an average wind speed of 5 ms^{-1}, the power produced by a micro wind turbine will be of a similar order of magnitude, though with a different profile shape. In the UK, for example, a typical office building will have a demand in the order of 300 $kWhm^{-2}yr^{-2}$. This translates into approximately 50 Wm^{-2} of fa ade, which is twice as much as the available renewable energies. Thus, the aim is to utilise energy

efficiency measures in order to reduce the overall energy consumption and adjust the demand profiles to be met by renewable energies. For instance, this approach can be applied to greenhouses, which use solar energy to provide indoor environmental quality. The greenhouse effect is one result of the differing properties of heat radiation when it is generated at different temperatures. Objects inside the greenhouse, or any other building, such as plants, re-radiate the heat or absorb it. Because the objects inside the greenhouse are at a lower temperature than the sun, the re-radiated heat is of longer wavelengths, and cannot penetrate the glass. This re-radiated heat is trapped and causes the temperature inside the greenhouse to rise. Note that the atmosphere surrounding the earth, also, behaves as a large greenhouse around the world. Changes to the gases in the atmosphere, such as increased carbon dioxide content from the burning of fossil fuels, can act like a layer of glass and reduce the quantity of heat that the planet earth would otherwise radiate back into space. This particular greenhouse effect, therefore, contributes to global warming. The application of greenhouses for plants growth can be considered one of the measures in the success of solving this problem. Maximising the efficiency gained from a greenhouse can be achieved using various approaches, employing different techniques that could be applied at the design, construction and operational stages. The development of greenhouses could be a solution to farming industry and food security.

Energy security, economic growth and environment protection are the national energy policy drivers of any country of the world. As world populations grow, much faster than the average 2%, the need for more and more energy is exacerbated (Figure 1). Enhanced lifestyle and energy demand rise together and the wealthy industrialised economics, which contain 25% of the world's population, consume 75% of the world's energy supply. The world's energy consumption today is estimated to 22 billion kWh per year. About 6.6 billion metric tons carbon

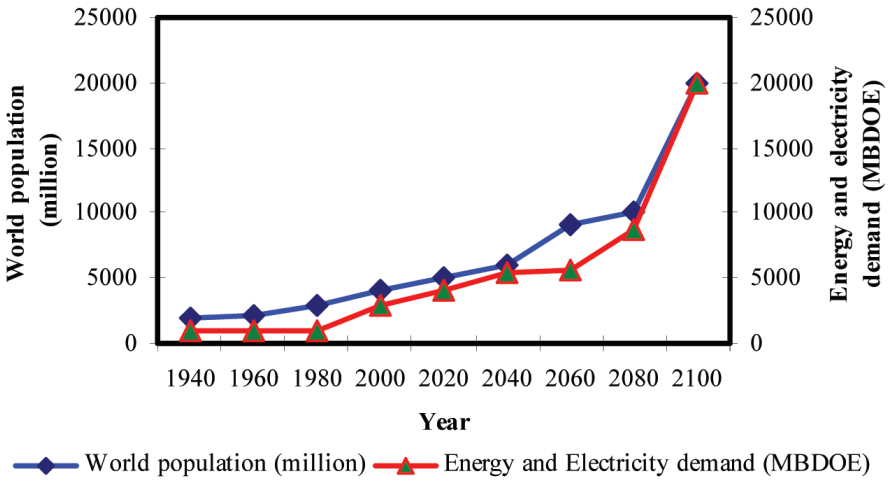

Fig. 1: Annual and estimated world population and energy demand
Million of barrels per day of oil equivalent (MBDOE)

equivalent of greenhouse gas (GHG) emission are released in the atmosphere to meet this energy demand. Approximately 80% is due to carbon emissions from the combustion of energy fuels. At the current rate of usage, taking into consideration population increases and higher consumption of energy by developing countries, oil resources, natural gas and uranium will be depleted within a few decades. As for coal, it may take two centuries or so.

Technological progress has dramatically changed the world in a variety of ways. It has, however, also led to developments e.g., environmental problems, which threaten man and nature. At the current rate of usage, taking into consideration population increases and higher consumption of energy by developing countries, oil resources, natural gas and uranium will be depleted within a few decades, as shown in Figures 2, and 3. As for coal, it may take two centuries or so. One must therefore endeavour to take precautions today for a viable world for coming generations.

Research into future alternatives has been and still being conducted aiming to solve the complex problems of this recent time e.g., rising energy requirements of a rapidly and constantly growing world population and global environmental pollution. Therefore, options for a long-term and environmentally friendly energy supply have to be developed leading to the use

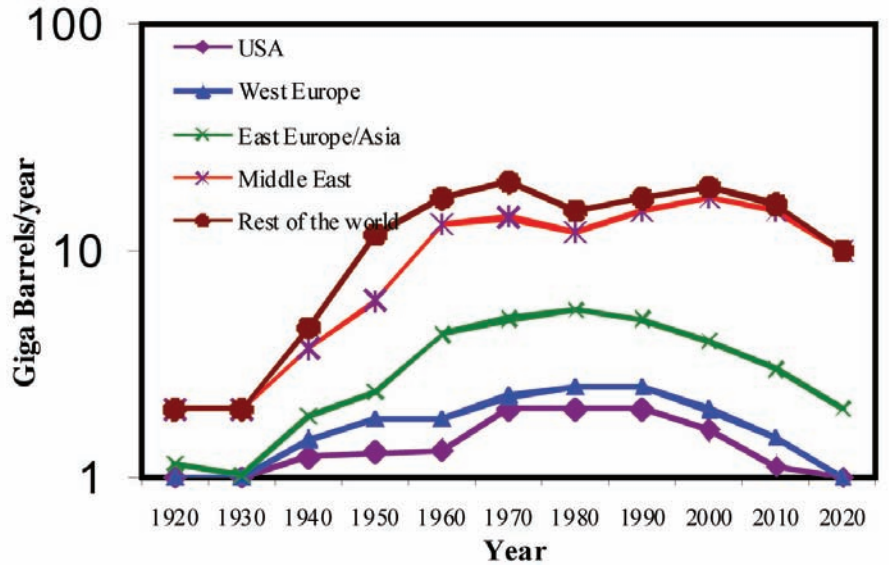

Fig. 2: World oil productions in the next 10- 20 years

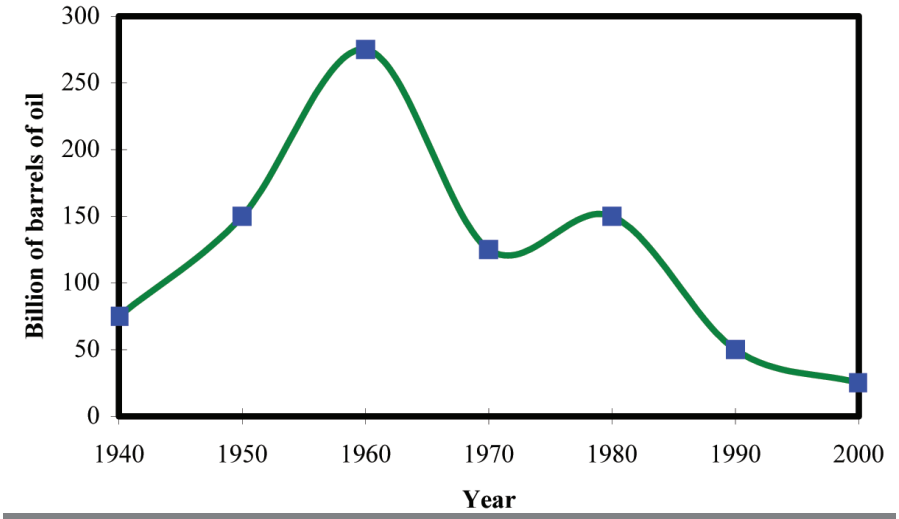

Fig. 3: Volume of oil discovered worldwide

of renewable sources (water, sun, wind, biomass, geothermal, hydrogen) and fuel cells. Renewables could shield a nation from the negative effect in the energy supply, price and related environment concerns. Hydrogen for fuel cells and the sun for PV have been considered for many years as a likely and eventual substitute for oil, gas, coal and uranium.

A one-kilowatt PV system producing 150 kWh each month prevents 75 kg of fossil fuel from being mined. 150 kg of CO_2 from entering the atmosphere and keeps 473 litres of water from being consumed. Electricity from fuel cells can be used in the same way as grid power: to run appliances and light bulbs and even to power cars since each gallon of gasoline produced and used in an internal combustion engine releases roughly 12 kg of CO_2, a GHG that contributes to global warming.

People, power and pollution

Over millions of years ago plants covered the earth, converting the energy of sunlight into living tissue, some of which was buried in the depths of the earth to produce deposits of coal, oil and natural gas. The past few decades, however, have experienced many valuable uses for these complex chemical substances, manufacturing from them plastics, textiles, fertiliser and the various end products of the petrochemical industry. Indeed, each decade sees increasing uses for these products. Renewable energy is the term used to describe a wide range of naturally occurring, replenishing energy sources. Coal, oil and gas, which will certainly be of great value to future generations, as they are to ours, are non-renewable natural resources. The rapid depletion of non-renewable fossil resources need not continue. This is particularly true now as it is, or soon will be, technically & economically feasible to supply all of man's needs from the most abundant energy source of all, the sun. The sunlight is not only inexhaustible, but, moreover, it is the only energy source, which is completely non-polluting.

Industry's use of fossil fuels has been blamed for warming the climate. When coal, gas and oil are burnt, they release harmful gases, which trap heat in the atmosphere and cause global warming. However, there has been an ongoing debate on this subject, as scientists have struggled to distinguish between changes, which are human induced, and those, which could be put down to natural climate variability. Nevertheless, industrialised countries have the highest emission levels, and must shoulder the greatest responsibility for global warming. However, action must also be taken by developing countries to avoid future increases in emission levels as their economies develop & populations grows, as clearly captured by the Kyoto Protocol. Notably, human activities that emit carbon dioxide (CO_2), the most significant contributor to potential climate change, occur primarily from fossil fuel production and consumption. Consequently, efforts to control CO_2 emissions could have serious, negative consequences for economic growth, employment, investment, trade and the standard of living of individuals everywhere.

Scientifically, it is difficult to predict the relationship between global temperature and GHG concentrations. The climate system contains many processes that will change if warming occurs. Critical processes include heat transfer by winds and tides, the hydrological cycle involving evaporation, precipitation, runoff and groundwater and the formation of clouds, snow, and ice, all of which display enormous natural variability.

The equipment and infrastructure for energy supply and use are designed with long lifetimes, and the premature turnover of capital stock involves significant costs. Economic benefits occur if capital stock is replaced with more efficient equipment in step with its normal replacement cycle. Likewise, if opportunities to reduce future emissions are taken in a timely manner, they should be less costly. Such a flexible approach would allow society to take account of evolving scientific and technological knowledge, while gaining experience in designing policies to address climate change.

The World Summit on Sustainable Development in Johannesburg in 2002 committed itself to "encourage and promote the development of renewable energy sources to accelerate the shift towards sustainable consumption and production". Accordingly, it aimed at breaking the link between resource use and productivity. This can be achieved by the following:

- Trying to ensure economic growth does not cause environmental pollution.
- Improving resource efficiency.
- Examining the whole life-cycle of a product.
- Enabling consumers to receive more information on products and services.
- Examining how taxes, voluntary agreements, subsidies, regulation and information campaigns, can best

stimulate innovation & investment to provide cleaner technology.

The energy conservation scenarios include rational use of energy policies in all economy sectors and the use of combined heat and power systems, which are able to add to energy savings from the autonomous power plants. Electricity from renewable energy sources is by definition the environmental green product. Hence, a renewable energy certificate system, as recommended by the World Summit, is an essential basis for all policy systems, independent of the renewable energy support scheme. It is, therefore, important that all parties involved support the renewable energy certificate system in place if it is to work as planned. Moreover, existing renewable energy technologies (RETs) could play a significant mitigating role, but the economic and political climate will have to change first. Climate change is real. It is happening now, and GHGs produced by human activities are significantly contributing to it. The predicted global temperature increase of between 1.5 and 4.5^{O}C could lead to potentially catastrophic environmental impacts. These include sea level rise, increased frequency of extreme weather events, floods, droughts, disease migration from various places and possible stalling of the Gulf Stream. This has led scientists to argue that climate change issues are not ones that politicians can afford to ignore, and policy makers tend to agree. However, reaching international agreements on climate change policies is no trivial task as the difficulty in ratifying the Kyoto Protocol has proved.

Therefore, the use of renewable energy sources and the rational use of energy, in general, are the fundamental inputs for any responsible energy policy. However, the energy sector is encountering difficulties because increased production and consumption levels entail higher levels of pollution and eventually climate change, with possibly disastrous consequences. At the same time, it is important to secure energy at an acceptable cost in order to avoid negative impacts on economic growth. To date, renewable energy contributes as much as 20% of the global energy supplies worldwide. Over two thirds of this comes from biomass use, mostly in developing countries, some of it unsustainable. Yet, the potential for energy from sustainable technologies is huge. On the technological side, renewables have an obvious role to play. In general, there is no problem in terms of the technical potential of renewables to deliver energy. Moreover, there are very good opportunities for RETs to play an important role in reducing emissions of GHGs into the atmosphere, certainly far more than have been exploited so far. However, there are still some technical issues to address in order to cope with the intermittency of some renewables, particularly wind and solar. Yet, the biggest problem with relying on renewables to deliver the necessary cuts in GHG emissions is more to do with politics and policy issues than with technical ones. For example, the single most important step governments could take to promote and increase the use of renewables is to improve access for renewables to the energy market. This access to the market needs to be under favourable conditions and, possibly, under favourable economic rates as well. One move that could help, or at least justify, better market access would be to acknowledge that there are environmental costs associated with other energy supply options and that these costs are not currently internalised within the market price of electricity or fuels. This could make a significant difference, particularly if appropriate subsidies were applied to renewable energy in recognition of the environmental benefits it offers. Similarly, cutting energy consumption through end-use efficiency is absolutely essential. This suggests that issues of end-use consumption of energy will have to come into the discussion in the foreseeable future.

However, RETs have the benefit of being environmentally benign when developed in a sensitive and appropriate way with the full involvement of local communities. In addition, they are diverse, secure, locally based and abundant. In spite of the enormous potential and the multiple benefits, the contribution from renewable energy still lags behind the ambitious claims for it due to the initially high development costs, concerns about local impacts, lack of research funding & poor institutional and economic arrangements.

Hence, an approach is needed to integrate renewable energies in a way that meets high building performance requirements. However, because renewable energy sources are stochastic and geographically diffuse, their ability to match demand is determined by adoption of one of the following two approaches: the utilisation of a capture area greater than that occupied by the community to be supplied, or the reduction of the community's energy demands to a level commensurate with the locally available renewable resources.

Energy and population growth

Urban areas throughout the world have increased in size during recent decades. About 50% of the world's population and approximately 7.6% in more developed countries are urban dwellers. Even though there is evidence to suggest that in many 'advanced' industrialised countries there has been a reversal in the rural-to-urban shift of populations, virtually all population growth expected between 2000 and 2030 will be concentrated in urban areas of the world. With an expected annual growth of 1.8%, the world's urban population will double in 38 years.

With increasing urbanisation in the world, cities are growing in number, population and complexity. At present, 2% of the world's land surface is covered by cities, yet the people living in them consume 75% of the resources consumed by mankind. Indeed, the ecological footprint of cities is many times larger than the areas they physically occupy. Economic and social imperatives often dictate that cities must become more concentrated, making it necessary to increase the density to accommodate the people, to reduce the cost of public services, and to achieve required social cohesiveness. The reality of modern urbanisation inevitably leads to higher densities than in traditional settlements and this trend is particularly notable in developing countries.

Generally, the world population is rising rapidly, notably in the developing

countries. Historical trends suggest that increased annual energy use per capita, which promotes a decrease in population growth rate, is a good surrogate for the standard of living factors. If these trends continue, the stabilisation of the world's population will require the increased use of all sources of energy, particularly as cheap oil and gas are depleted. The improved efficiency of energy use and renewable energy sources will, therefore, be essential in stabilising population, while providing a decent standard of living all over the world. Moreover, energy is the vital input for economic and social development of any country. With an increase in industrial and agricultural activities the demand for energy is also rising. It is, however, a well-accepted fact that commercial energy use has to be minimised. This is because of the environmental effects & the availability problems. Consequently, the focus has now shifted to non-commercial energy resources, which are renewable in nature. This is bound to have less environmental effects and also the availability is guaranteed. However, even though the ideal situation will be to enthuse people to use renewable energy resources, there are many practical difficulties, which need to be tackled. The people groups who are using the non-commercial energy resources, like urban communities, are now becoming more demanding and wish to have commercial energy resources made available for their use. This is attributed to the increased awareness, improved literacy level and changing culture. The quality of life practiced by people is usually represented as being proportional to the per capita energy use of that particular country. It is not surprising that people want to improve their quality of life. Consequently, it is expected that the demand for commercial energy resources will increase at a greater rate in the years to come. Because of this emerging situation, the policy makers are left with two options: either to concentrate on renewable energy resources and have them as substitutes for commercial energy resources or to have a dual approach in which renewable energy resources will contribute to meet a significant portion of the demand whereas the conventional commercial energy resources would be used with caution whenever necessary. Even though the first option is the ideal one, the second approach will be more appropriate for a smooth transition.

Energy and environmental problems

Technological progress has dramatically changed the world in a variety of ways. It has, however, also led to developments of environmental problems, which threaten man and nature. During the past two decades the risk and reality of environmental degradation have become more apparent. Growing evidence of environmental problems is due to a combination of several factors since the environmental impact of human activities has grown dramatically because of the sheer increase of world population, consumption, industrial activity, etc. throughout the 1970s most environmental analysis and legal control instruments concentrated on conventional e uent gas pollutants such as SO_2, NO_x, CO_2, particulates, and CO (Table 1). Recently, environmental concerns has extended to the control of micro or hazardous air pollutants, which are usually toxic chemical substances and harmful in small doses, as well to that of globally significant pollutants such as CO_2. Aside from advances in environmental science, developments in industrial processes and structures have led to new environmental problems. For example, in the energy sector, major shifts to the road transport of industrial goods and to individual travel by cars has led to an increase in road traffic and hence a shift in attention paid to the effects and sources of NO_x and volatile organic compound (VOC) emissions. Environmental problems span a continuously growing range of pollutants, hazards and ecosystem degradation over wider areas. The main areas of environmental problems are: major environmental accidents, water pollution, maritime pollution, land use and sitting impact, radiation and radioactivity, solid waste disposal, hazardous air pollutants, ambient air quality, acid rain, stratospheric ozone depletion & global warming (greenhouse effect, global climatic change) (Table 2).

The four more important types of harm from man's activities are global warming gases, ozone destroying gases,

Pollutant	EU limit
CO	30 mg/m^2; 1h
NO_2	200 □g/m^2; 1h
O_3	235 □g/m^2; 1h
SO_2	250-350 □g/m^2; 24 h 80-120 □g/m^2; annual
PM_{10}	250 □g/m^2; 24 h 80 □g/m^2; annual
SO_2 + PM_{10}	100-150 □g/m^2; 24 h 40-60 □g/m^2; annual
Pb	2 □g/m^2; annual
Total suspended particulate (TSP)	260 □g/m^2; 24 h
HC	160 □g/m^2; 3 h

Table 1: EU criteria pollutant standards in the ambient air environment

Environment	Directive name
Water	Surface water for drinking Sampling surface water for drinking Drinking water quality Quality of freshwater supporting fish Shellfish waters Bathing waters Dangerous substances in water Groundwater Urban wastewater Nitrates from agricultural sources
Air	Smokes in air Sulphur dioxide in air Lead in air Large combustion plants Existing municipal incineration plants New municipal incineration plants Asbestos in air Sulphur content of gas oil Lead in petrol Emissions from petrol engines Air quality standards for NO_2 Emissions from diesel engines
Land	Protection of soil when sludge is applied

Table 2: Significant EU environmental directives in water, air and land environments

Damage	Manifestation	Design
NO_X, SO_X	Irritant	Low NO_X burners
	Acid rain land damage	Low sulphur fuel
	Acid rain fish damage	Sulphur removal
CO_2	Global warming	Thermal insulation
	Rising sea level	Heat recovery
	Drought, storms	Heat pumps
	Increased ultra violet	No CFC's or HCFC's
O_3 destruction	Skin cancer	Minimum air conditioning
	Crop damage	Refrigerant collection
	Pontiac fever	Careful maintenance
Legionnellosis	Legionnaires	Dry cooling towers

Table 3: The external environment

gaseous pollutants and microbiological hazards (Table 3). The earth is some 30^{O}C warmer due to the presence of gases but the global temperature is rising. This could lead to the sea level rising at the rate of 60 mm each decade with the growing risk of flooding in low-lying areas (Figure 4). At the United Nations Earth Summit at Rio in June 1992 some 153 countries agreed to pursue sustainable development. A main aim was to reduce emission of carbon dioxide and other GHGs. Reduction of energy use in buildings is a major role in achieving this. Carbon dioxide targets are proposed to encourage designers to look at low energy designs and energy sources. Problems with energy supply and use are related not only to global warming that is taking place, due to e uent gas emission mainly CO_2, but also to such environmental concerns as air pollution, acid precipitation, ozone depletion, forest destruction and emission of radioactive substances. These issues must be taken into consideration simultaneously if humanity is to achieve a bright energy future with minimal environmental impacts. Much evidence exists, which suggests that the future will be negatively impacted if humans keep degrading the environment (Table 4).

During the past century, global surface temperatures have increased at a rate near 0.6^{O}C/century and the average temperature of the Atlantic, Pacific and Indian oceans (covering 72% of the earth surface) have risen by 0.06^{O}C since 1995. Global temperatures in 2001 were 0.52^{O}C above the long-term 1880-2000 average (the 1880-2000 annually averaged combined land and ocean temperature is 13.9^{O}C). Also, according to the USA Department of Energy, world emissions of carbon are expected to increase by 54% above 1990 levels by 2015 making the earth likely to warm 1.7-4.9^{O}C over the period 1990-2100, as shown in Figure 5. Such observation and others demonstrate that interests will likely increase regarding energy related environment concerns and that energy is one of the main factors that must be considered in discussions of sustainable development.

Environmental transformations

In recent years a number of countries

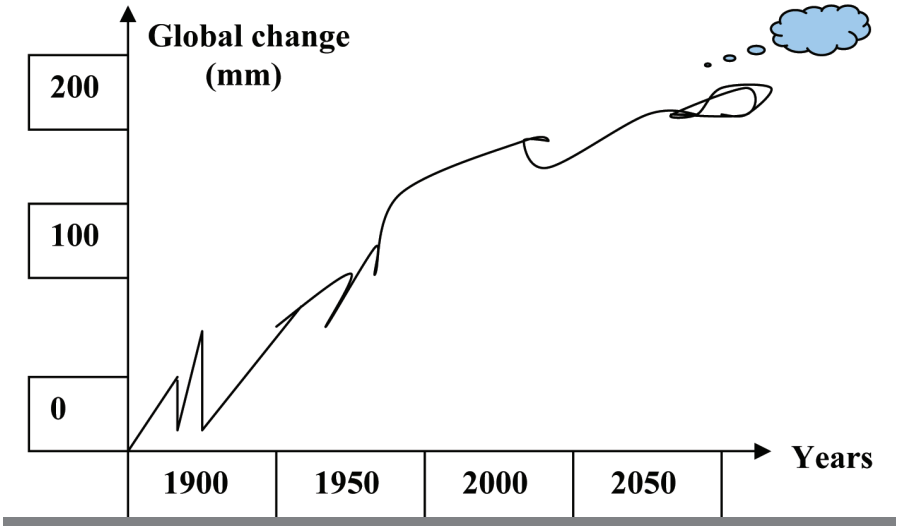

Fig. 4: Change in global sea level

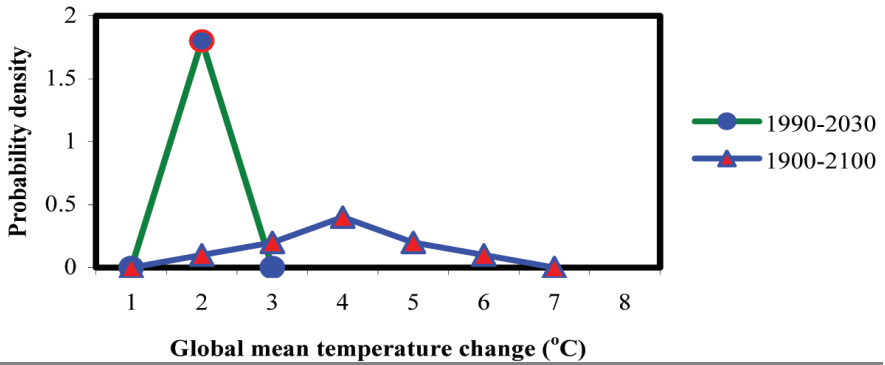

Fig. 5: Global mean temperature changes over the period of 1990- 2100 and 1990- 2030

Rank	Nation	CO_2	Rank	Nation	CO_2	Rank	Nation	CO_2
1	USA	1.36	6	India	0.19	11	Mexico	0.09
2	Russia	0.98	7	UK	0.16	12	Poland	0.08
3	China	0.69	8	Canada	0.11	13	S. Africa	0.08
4	Japan	0.30	9	Italy	0.11	14	S. Korea	0.07

Table 4: Global emissions of the top fourteen nations by total CO_2 volume (billion of tons)

have adopted policies aimed at giving a greater role to private ownership in the natural resource sector. For example, in the UK the regional water companies have been privatised and have been given a considerable degree of control over the exploitation of the nation's regional water resources. Similar policies

have been followed in France & other European countries. Typically, a whole range of new regulatory instruments such as technological standards accompanies such privatisation on water treatment plants, minimum standards on drinking water quality, price controls and maximum withdrawal quotas. While some of these instruments address problems of monopolistic behaviour & other forms of imperfect competition, the bulk of regulatory measures is concerned with establishing 'good practices' aimed at maintaining the quality of the newly privatised resources as a shorthand. Society has to meet the freshwater demands of its population & its industry by extracting water from the regional water resources that are provided by the natural environment (lakes, rivers, aquifers, etc.). These water resources are renewable but potentially destructible resources. While moderate amounts of human water extractions from a given regional water system can be sustained for indefinite periods. Excessive extractions will change the geographical and climatic conditions supporting the water cycle & will diminish the regenerative capacity of the regional water system, thereby reducing the potential for future withdrawals. Typically, recovery from any such resource degradation will be very slow & difficult, if not impossible; resource degradation is partially irreversible.

To make sustainable water extraction economically viable, the sustainable policy has to break even (all costs are covered by revenues) while unsustainable policy has to be unprofitable (costs exceed revenues):

$(1+r)\ vt_{-1} = 5y_t + v_t$ (1)

Where: r is the interest rate, t=year, y is the revenue.

$(1+r)\ vt_{-1} > 105y_t$ (2)

$(1+r)\ vt_{-1} < (105/(105-5))\ v_t$ (3)

The term (105/(105-5)) is to define the natural productivity factor of the water resource as (1+g) = (105/(105-5)); g is the natural productivity rate.

Rate g will be close to zero if the sustainable extraction level is much smaller than the unsustainable level. Using g, the equation can be as follows:

$v_t > (1+r)/(1+g)\ v_{t-1}$ (4)

Regulatory measures that prevent resource owners from adopting certain unsustainable extraction policies are a necessary pre-condition for the effective operation of a privatised natural resource sector. Unregulated water privatisation would result in an inflationary dynamics whose distributional effects would threaten the long-term viability of the economy. This inflationary dynamics is not due to any form of market imperfection but is a natural consequence of the competitive arbitrage behaviour of unregulated private resource owners.

Sustainability concept

Absolute sustainability of electricity supply is a simple concept: no depletion of world resources and no ongoing accumulation of residues. Relative sustainability is a useful concept in comparing the sustainability of two or more generation technologies. Therefore, only renewables are absolutely sustainable, and nuclear is more sustainable than fossil. However, any discussion about sustainability must not neglect the ability or otherwise of the new technologies to support the satisfactory operation of the electricity supply infrastructure. The electricity supply system has been developed to have a high degree of resilience against the loss of transmission circuits and major generators, as well as unusually large and rapid load changes. It is unlikely that consumers would tolerate any reduction in the quality of the service, even if this were the result of the adoption of otherwise benign generation technologies. Renewables are generally weather-dependent and as such their likely output can be predicted but not controlled. The only control possible is to reduce the output below that available from the resource at any given time. Therefore, to safeguard system stability and security, renewables must be used in conjunction with other, controllable, generation and with large-scale energy storage. There is a substantial cost associated with this provision.

It is useful to codify all aspects of sustainability, thus ensuring that all factors are taken into account for each and every development proposal. Therefore, with the intention of promoting debate, the following considerations are proposed:

- Long-term availability of the energy source or fuel.
- Price stability of energy source or fuel.
- Acceptability or otherwise of by-products of the generation process.
- Grid services, particularly controllability of real and reactive power output.
- Technological stability, likelihood of rapid technical obsolescence.
- Knowledge base of applying the technology.
- Life of the installation – a dam may last more than 100 years, but a gas turbine probably will not.
- Maintenance requirement of the plant.

Environmental aspects

Environmental pollution is a major problem facing all nations of the world. People have caused air pollution since they learned to how to use fire, but man-made air pollution (anthropogenic air pollution) has rapidly increased since industrialisation began. Many volatile organic compounds and trace metals are emitted into the atmosphere by human activities. The pollutants emitted into the atmosphere do not remain confined to the area near the source of emission or to the local environment, and can be transported over long distances, and create regional and global environmental problems. The privatisation and price liberalisation in energy fields has to some secured (but not fully). Availability and adequate energy supplies to the major productive sectors. The result is that, the present situation of energy supplies is for better than ten years ago (Table 5).

A great challenge facing the global community today is to make the industrial economy more like the biosphere, that is, to make it a more closed system. This would save energy, reduce waste and pollution, and reduce costs. In short, it would enhance sustainability. Often, it is technically feasible to recycle waste in one of several different ways. For some wastes there are powerful arguments for incineration

	Plant data	System data
Existing data	Size	Peak load
	Life	Load shape
	Cost (fixed and var. O&M)	Capital costs
	Forced outage	Fuel costs
	Maintenance	Depreciation
	Efficiency	Rate of return
	Fuel	Taxes
	Emissions	
Future data	All of above, plus	System lead growth
	Capital costs	Fuel price growth
	Construction trajectory	Fuel import limits
	Date in service	Inflation

Table 5: Classifications of data requirements

with energy recovery, rather than material recycling. Cleaner production approach and pollution control measures are needed in the recycling sector as much as in another. The industrial sector world widely is responsible for about one third of anthropogenic emissions of carbon dioxide, the most important greenhouse gas. Industry is also an important emitter of several other greenhouse gases. And many of industry's products emit greenhouse gases as well, either during use or after they become waste. Opportunities exist for substantial reducing industrial emissions through more efficient production and use of energy. Industry has an additional role to play through the design of products that use less energy & materials and produce lower greenhouse gas emissions.

Development in the environmental sense is a rather recent concern relating to the need to manage scarce natural resources in a prudent manner-because human welfare ultimately depends on ecological services. The environmental interpretation of sustainability focuses on the overall viability and health of ecological systems- defined in terms of a comprehensive, multiscale, dynamic, hierarchical measure of resilience, vigour and organisation. Natural resource degradation, pollution and loss of biodiversity are detrimental because they increase vulnerability, undermine system health, and reduce resilience. The environmental issues include:

- Global and transnational (climate change, ozone layer depletion).
- Natural habitats (forests and other ecosystems).
- Land (agricultural zones).
- Water resources (river basin, aquifer, water shed).
- Urban-industrial (metropolitan area, air-shed).

Environmental sustainability depends on several factors, including:

- Climate change (magnitude and frequency of shocks).
- Systems vulnerability (extent of impact damage).
- System resilience (ability to recover from impacts).

Economic importance of environmental issue is increasing, and new technologies are expected to reduce pollution derived both from productive processes and products, with costs that are still unknown. This is due to market uncertainty, weak appropriability regime, lack of a dominant design, and difficulties in reconfiguring organisational routines. The degradation of the global environment is one of the most serious energy issues. Various options are proposed and investigated to mitigate climate change, acid rain or other environmental problems. Additionally, the following aspects play a fundamental role in developing environmental technologies, pointing out how technological trajectories depend both on exogenous market conditions and endogenous firm competencies:

- Regulations concerning introduction of Zero Emission Vehicles (ZEV), create market demand and business development for new technologies.
- Each stage of technology development requires alternative forms of division and coordination of innovative labour, upstream and downstream industries are involved in new forms of inter-firm relationships, causing a reconfiguration of product architectures and reducing effects of path dependency.
- Product differentiation increases firm capabilities to plan at the same time technology reduction and customer selection, while meeting requirements concerning network externalities.
- It is necessary to find and/or create alternative funding sources for each research, development and design stage of the new technologies.

Action areas for producers

- Management and measurement tools- adopting environmental management systems appropriate for the business.
- Performance assessment tools- making use of benchmarking to identify scope for impact reduction and greater eco-efficiency in all aspects of the business.
- Best practice tools- making use of free help and advice from government best practice programmes (energy efficiency, environmental technology, and resource savings).
- Innovation and ecodesign- rethinking the delivery of 'value added' by the business, so that impact reduction and resource efficiency are firmly built in at the design stage.
- Cleaner, leaner production processes- pursuing improvements and savings in waste minimisation, energy and water consumption, transport and distribution, as well as reduced emissions. Tables (6-8) indicate energy conservation, sustainable development and environment.
- Supply chain management- specifying more demanding standards of sustainability from 'upstream' suppliers, while supporting smaller firms to meet those higher standards.
- Product stewardship- taking the broadest view of 'producer responsibility' and working to reduce all the 'downstream' effects of products after they have been sold on to customers.
- Openness and transparency- publicly reporting on environmental performance against meaningful targets; actively using clear labels and declarations so that customers

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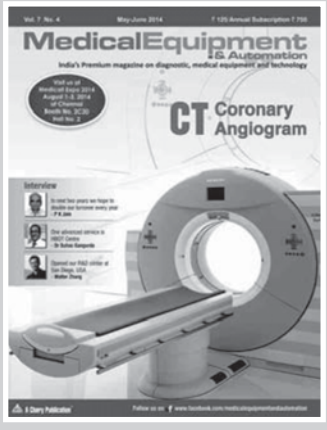

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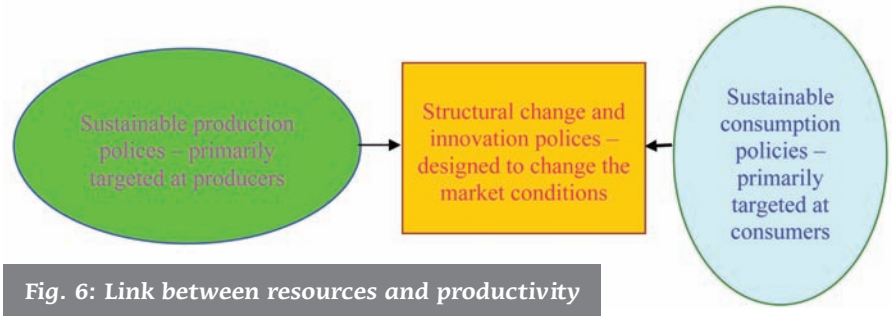


Fig. 6: Link between resources and productivity

are fully informed; building stakeholder confidence by communicating sustainability aims to the workforce, the shareholders and the local community (Figure 6).

With the debate on climate change, the preference for real measured data has been changed. The analyses of climate scenarios need an hourly weather data series that allows for realistic changes in various weather parameters. By adapting parameters in a proper way, data series can be generated for the site. Weather generators should be useful for:

- Calculation of energy consumption (no extreme conditions are required)
- Design purposes (extremes are essential), and
- Predicting the effect of climate change such as increasing annually average of temperature.

This results in the following requirements:

- Relevant climate variables should be generated (solar radiation: global, diffuse, direct solar direction, temperature, humidity, wind speed and direction) according to the statistics of the real climate.
- The average behaviour should be in accordance with the real climate.
- Extremes should occur in the generated series in the way it will happen in a real warm period. This means that the generated series should be long enough to assure these extremes, and series based on average values from nearby stations.

Growing concerns about social and environmental sustainability have led to increased interest in planning for the energy utility sector because of its large resource requirements and production of emissions. A number of conflicting trends combine to make the energy sector a major concern, even though a clear definition of how to measure progress toward sustainability is lacking. These trends include imminent competition in the electricity industry, global climate change, expected long-term growth in population and pressure to balance living standards (including per capital energy consumption). Designing & implementing a sustainable energy sector will be a key element of defining and creating a sustainable society. In the electricity industry, the question of strategic planning for sustainability seems to conflict with the shorter time horizons associated with market forces as deregulation replaces vertical integration. Sustainable low-carbon energy scenarios for the new century emphasise the untapped potential of renewable resources. Rural areas can benefit from this transition. The increased availability of reliable and efficient energy services stimulates new development alternatives. It is concluded that renewable environmentally friendly energy must be encouraged, promoted, implemented, and demonstrated by full-scale plant especially for use in remote rural areas.

This is the step in a long journey to encourage a progressive economy, which continues to provide us with high living standards, but at the same time helps reduce pollution, waste mountains, other environmental degradation, and environmental rationale for future policy-making and intervention to improve market mechanisms. This vision will be accomplished by:

- 'Decoupling' economic growth and environmental degradation. The basket of indicators illustrated shows the progress being made (Table 9). Decoupling air and water pollution from growth, making good headway with CO_2 emissions from energy, and transport. The environmental impact of our own individual behaviour is more closely linked to consumption expenditure than the economy as a whole.
- Focusing policy on the most important environmental impacts associated with the use of particular resources, rather than on the total level of all resource use.
- Increasing the productivity of material and energy use that are economically efficient by encouraging patterns of supply and demand, which are more efficient in the use of natural resources. The aim is to promote innovation and competitiveness. Investment in areas like energy efficiency, water efficiency and waste minimisation.
- Encouraging and enabling active & informed individual and corporate consumers.

Criteria	Intra-system impacts	Extra-system impacts
Stakeholder satisfaction	- Standard expectations met - Relative importance of standard expectations	- Covered by attending to extra-system resource base and ecosystem impacts
Resource base impacts	- Change in intra-system resource bases - Significance of change	- Resource flow into/out of facility system - Unit impact exerted by flow on source/sink system - Significance of unit impact
Ecosystem impacts	- Change in intra-system ecosystems - Significance of change	- Resource flows into/out of facility system - Unit impact exerted by how on source/sink system - Significance of unit impact

Table 6: Classification of key variables defining facility sustainability

On some climate change issues (such as global warming), there is no disagreement among the scientists. The greenhouse effect is unquestionably real; it is essential for life on earth. Water vapour is the most important GHG; next is carbon dioxide (CO_2). Without a natural

Technological criteria	Energy and environment criteria	Social and economic criteria
Primary energy saving in regional scale	Sustainability according to greenhouse gas pollutant emissions	Labour impact
Technical maturity, reliability	Sustainable according to other pollutant emissions	Market maturity
Consistence of installation and maintenance requirements with local technical known-how	Land requirement	Compatibility with political, legislative and administrative situation
Continuity and predictability of performance	Sustainability according to other environmental impacts	Cost of saved primary energy

Table 7: Energy and sustainable environment

Economic system	Social system	Environmental system
Durability	Preservation of cultural values	Preservation of resources
Meeting changing needs of economic development	Meeting changing needs of individuals and society	Reuse, recycling and preservation of resources
Energy conservation and saving	Savings directed to meet other social needs	Preservation of resources, reduction of pollution and global warming

Table 8: Positive impact of durability, adaptability and energy conservation on economic, social and environment systems

Economy-wide decoupling indicators
- Greenhouse gas emissions
- Air pollution
- Water pollution (river water quality)
- Commercial and industrial waste arisings and household waste not cycled
Resource use indicators
- Material use
- Water abstraction
- Homes built on land not previously developed, and number of households
Decoupling indicators for specific sectors
- Emissions from electricity generation
- Motor vehicle kilometres and related emissions
- Agricultural output, fertiliser use, methane emissions and farmland bird populations
- Manufacturing output, energy consumption and related emissions
- Household consumption, expenditure energy, water consumption and waste generated

Table 9: The basket of indicators for sustainable consumption and production

greenhouse effect, scientists estimate that the earth's average temperature would be –18^{O}C instead of its present 14^{O}C. There is also no scientific debate over the fact that human activity has increased the concentration of the GHGs in the atmosphere (especially CO_2 from combustion of coal, oil and gas). The greenhouse effect is also being amplified by increased concentrations of other gases, such as methane, nitrous oxide, and CFCs as a result of human emissions. Most scientists predict that rising global temperatures will raise the sea level and increase the frequency of intense rain or snowstorms. Climate change scenarios sources of uncertainty and factors influencing the future climate are:

- The future emission rates of the GHGs.
- The effect of this increase in concentration on the energy balance of the atmosphere.
- The effect of these emissions on GHGs concentrations in the atmosphere, and
- The effect of this change in energy balance on global and regional climate.

Wastes

Waste is defined as an unwanted material that is being discarded. Waste includes items being taken for further use, recycling or reclamation. Waste produced at household, commercial and industrial premises are control waste and come under the waste regulations. Waste Incineration Directive (WID) emissions limit values will favour efficient, inherently cleaner technologies that do not rely heavily on abatement. For existing plant, the requirements are likely to lead to improved control of:

- NO_X emissions, by the adoption of infurnace combustion control and abatement techniques.
- Acid gases, by the adoption of abatement techniques and optimisation of their control.
- Particulate control techniques, and their optimisation, e.g., of bag filters and electrostatic precipitators.

The waste and resources action programme has been working hard to reduce demand for virgin aggregates and market uptake of recycled and secondary alternatives (Figure 7). The programme targets are:

- To deliver training and information

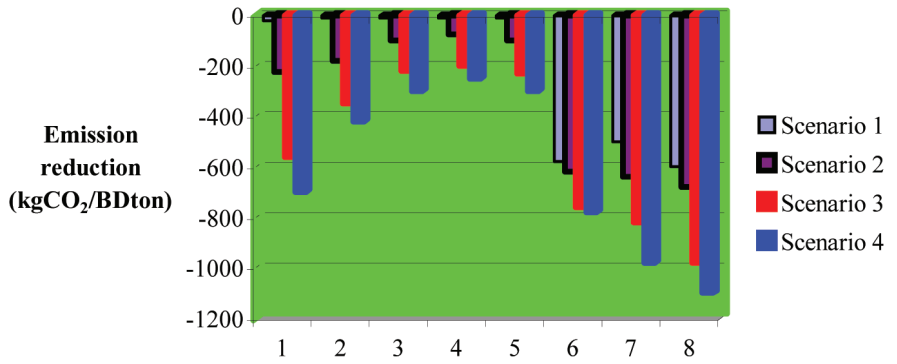


Fig. 7: Comparison of thermal biomass usage options, CHP displacing natural gas as a heat source

on the role of recycling and secondary aggregates in sustainable construction for influences in the supply chain, and

- To develop a promotional programme to highlight the new information on websites.

Lifecycle analysis of several ethanol feedstocks shows the emission displacement per ton of feedstock is highest for corn stover and switchgrass (about 0.65 tons of CO_2 per ton of feedstock) & lowest for corn (about 0.5 ton).

Emissions due to cultivation and harvesting of corn and wheat are higher than those for lignocellulosics, and although the latter have a far higher process energy requirement (Figure 8). GHG emissions are lower because this energy is produced from biomass residue, which is carbon neutral.

Environmental and safety aspects of combustion technology

This review is aimed to introduce historical background for the sustainability concept development. Special reference is given to the resource depletion and its forecast. In the assessment of global energy, water and environment resources attention is focussed in on the resource consumption and its relevancy to the future demand. In the review of the

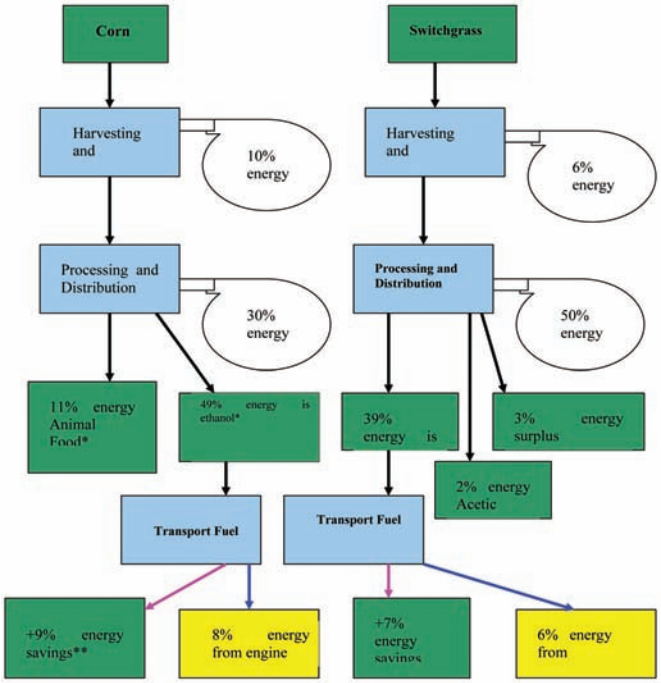


Fig. 8: The lifecycle energy balance of corn and Switchgrass reveal a paradox: corn, as an ethanol feedstock requires less energy for production, ie., more of the original energy in starch is retained in the ethanol fuel. Nevertheless, the Switchgrass process yields higher GHG emissions. This is because most of the process energy for Switchgrass process is generated from GHG emission neutral biomass residue.
**49% actual ethanol energy content, energy content in cattle feed by-product reflects chemical energy content, not lifecycle energy displacement.*
*** Energy savings in the refinery due to the higher value of ethanol compared to gasoline.*

sustainability concept development special emphasize is devoted to the definition of sustainability and its relevancy to the historical background of the sustainability idea. The recent assessment of sustainability is reflecting the normative and strategic dimension of sustainability.

Special attention is devoted to the most recent development of the concept of sustainability science. A new field of sustainability science emerging that seeks to understand the fundamental character of interactions between nature and society. Such an understanding must encompass the interaction of global processes with the ecological and so characteristics of particular places and sectors. With a view toward promoting research necessary to achieve such advances, it was proposed an initial set of core questions for sustainability science. The definition of sustainability concept involves an important transformation and extension of the ecologically based concept of physical sustainability to the social and economic context of development. Thus, terms of sustainability cannot exclusively be defined from an environmental point of view or basis of attitudes. Rather, the challenge is to define operational and consistent terms of sustainability from an integrated social, ecological, and economic system perspective. In this respect the weak and strong sustainability concept are discussed. In order to introduce measuring of sustainability the attention is devoted to the definition of respective criteria. There have been a number of attempts to define the criterions for the assessment of the sustainability of the market products. Having those criterions as bases, it was introduced a specific application in the energy system design. Measuring sustainability is a major issue as well as a driving force of the discussion on sustainability development. Special attention in this review is devoted to the potential sustainable development options. In this respect a following options are taken into a consideration: prevention of the energy resource depletion with scarcity index control; efficiency assessment; new and renewable energy sources; water pollution mitigation, water desalination technologies environment capacity for combustion products; mitigation of nuclear treat to the environment.

Sulphur in fuels and its environmental consequences

Coal is formed from the deposition of plant material according to the peat to anthracite series:

Vegetation □ Peat
□ Lignite (brown coal)
□ Sub-bituminous coal
□ Bituminous coal □ Anthracite

Organic sulphur is bonded within the organic structure of the coal in the same way that sulphur is bonded in simple thio-organics, e.g., thiols. Sulphur contents of coals vary widely, & Table 10 gives some examples.

Control of SO_2 emissions

Emissions will also, of course, occur from petroleum-based or shale-based fuels, and in heavy consumption, such as in steam raising. There will frequently be a need to control SO_2 emissions. There are, broadly speaking, three ways of achieving such control:

- Pre-combustion control: involves carrying out a degree of desulphurisation of the fuel.

Source	Rank	Sulphur content (%)
Ayrshire, Scotland	Bituminous	0.6
Lancs. /Cheshire, UK	Bituminous	Up to 2.4
S. Wales, UK	Anthracite	Up to 1.5
Victoria, Australia	Lignite	Typically 0.5
Pennsylvania, USA	Anthracite	0.7
Natal, S. Africa	Bituminous	Up to 4.2
Bulgaria	Lignite	2.5

Table 10: Representative sulphur contents of coals

- Combustion control: incorporating into the combustion system something capable of trapping SO_2.
- Post-combustion control: removing SO_2 from the flue gases before they are discharged into the atmosphere.

Table 11 gives brief details of an example of each.

The control of NO x release by combustion processes

Emission of nitrogen oxides is a major topic in fuel technology. It has to be considered even in the total absence of fuel nitrogen if the temperature is high enough for thermal NOx, as it is in very many industrial applications. The burnt gas from the flame is recirculated in two ways:

- Internally, by ba ing and restricting flow of the burnt gas away from the burner, resulting in flame re-entry of part of it.

Type of control	Fuel	Details
Pre-combustion	Fuels from crude oil	Alkali treatment of crude oil to convert thiols RSSR, disulphides; solvent removal of the disulphides
Post-combustion	Coal or fuel oil	Alkali scrubbing of the flue gases with $CaCO_3$/CaO
Combustion	Coal	Limestone, $MgCO_3$ and/or other metallic compounds used to fix the sulphur as sulphates

Table 11: Examples of SO_2 control procedures

- Externally, by diverting up to 10% of the flue gas back into the flame.

Some of the available control procedures for particles are summarised in Table 12.

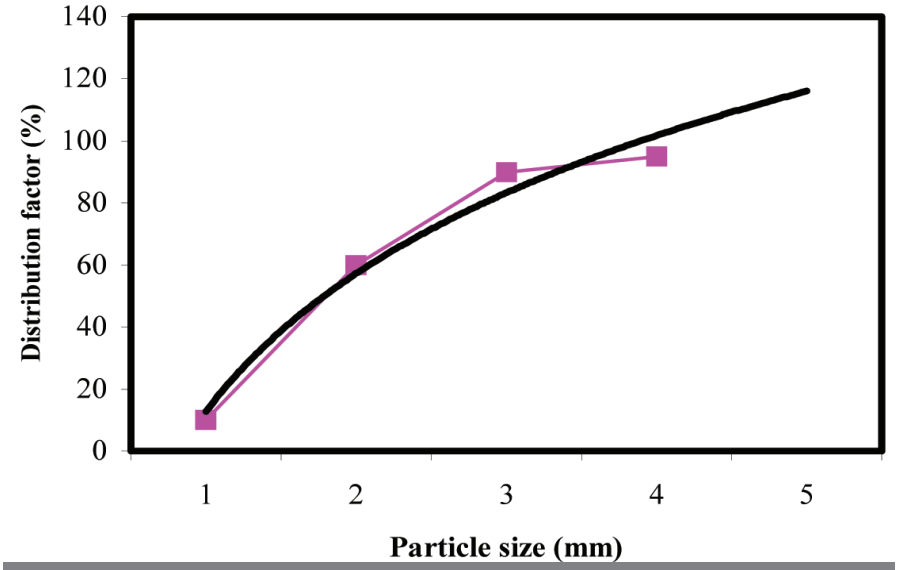


Fig. 9: The variation of distribution factor against particle size for coal undersizes in a classifier. The sizes correspond to mid- point for ranges

Figure 9 shows the variation of distribution factor with particle size.

Gr een heat

The ground is as universal as air and solar radiation. Over the past twenty years, as the hunt for natural low-carbon energy sources has intensified, there has been an increased endeavour to investigate and develop both earth and ground water thermal energy storage and usage. Geothermal energy solutions, although well known, are another in our armoury of renewable energy sources that are within our immediate grasp to use and integrate with an overall energy policy. For high temperature heat storage with temperatures in excess of $50^{O}C$ the particular concerns were:

- Clogging of wells & heat exchangers due to fines and precipitation of minerals.
- Water treatment to avoid operational problems resulting from the precipitation of minerals.
- Corrosion of components in the groundwater system.

Technique	Principle	Application
Gravity settlement	Natural deposition by gravity of particles from a horizontally flowing gas, collection in hoppers	Removal of coarse particles (>50 µm) from a gas stream, smaller particles removable in principle but require excessive flow distances
Cyclone separator	Tangential entry of a particle-laden gas into a cylindrical or conical enclosure, movement of the particles to the enclosure wall and from there to a receiver	Numerous applications, wide range of particles sizes removable, from = 5 µm to = 200 µm, poorer efficiencies of collection for the smaller particles
Fabric filters	Retention of solids by a filter, filter materials include woven cloth, felt and porous membranes	Used in dust removal for over a century
Electrostatic precipitation	Passage of particle-laden gas between electrodes, application of an electric field to the gas, resulting in acquisition of charge by the particles and attraction to an electrode where coalescence occurs, electrical resistivity of the dust an important factor in performance	Particles down to 0.01 µm removable, extensive application to the removal of flyash from pulverised fuel (pf) combustion

Table 12: Particle control techniques

- Automatic control of the ground water system.

As consumers in less-developed countries increase their capacity of electricity and green power, developed nations are starting to realise the benefits of using low-grade thermal energy for green heat applications that do not require high-grade electricity. This shift will not only benefit renewable energies that are designed for space conditioning, but also will contribute to the global mix of green power and green heat capacity. Earth energy (also called geothermal or ground source heat pumps or GeoExchange), which transfers absorbed solar heat from the ground into a building for space heating or water heating. The same system can be reversed to reject heat from the interior into the ground, in order to provide cooling. A typical configuration buries polyethylene pipe below the frost line to serve as the head source (or sink), or it can use lake water and aquifers as the heat medium.

An advantage is gained from the necessity to provide filtered fresh air for ventilation purposes by providing every dwelling with a heat recovery mechanical ventilation system. Incorporation of a heating/cooling coil within the air-handling unit for each of the five blocks allows for active summertime cooling (i.e., collecting heat in summer), which along with the use of roof mounted solar panels to provide domestic hot water produces as well tempered and well engineered hybrid low energy scheme at very low carbon emissions.

Effects of urban density

Compact development patterns can reduce infrastructure demands and the need to travel by car. As population density increases, transportation options multiply and dependence areas, per capita fuel consumption is much lower in densely populated areas because people drive so much less. Few roads and commercially viable public transport are the major merits. On the other hand, urban density is a major factor that determines the urban ventilation conditions, as well as the urban temperature. Under given circumstances, an urban area with a high density of buildings can experience poor ventilation and strong heat island effect. In warm-humid regions these features would lead to a high level of thermal stress of the inhabitants and increased use of energy in air-conditioned buildings.

However, it is also possible that a high-density urban area, obtained by a mixture of high and low buildings, could have better ventilation conditions than an area with lower density but with buildings of the same height. Closely spaced or high-rise buildings are also affected by the use of natural lighting, natural ventilation and solar energy. If not properly planned, energy for electric lighting and mechanical cooling/ventilation may be increased and application of solar energy systems will be greatly limited. Table 13 gives a summary of the positive and negative effects of urban density. All in all, denser city models require more careful design in order to maximise energy efficiency and satisfy other social and development requirements. Low energy design should not be considered in isolation, and in fact, it is a measure, which should work in harmony with other environmental objectives. Hence, building energy study provides opportunities not only for identifying energy and cost savings, but also for examining the indoor and outdoor environment.

Energy efficiency and architectural expression

The focus of the world's attention on environmental issues in recent years has stimulated response in many countries, which have led to a closer examination of energy conservation strategies for conventional fossil fuels. Buildings are important consumers of energy and thus important contributors to emissions of greenhouse gases into the global atmosphere. The development and adoption of suitable renewable energy technology in buildings has an important role to play. A review of options indicates benefits and some problems. There are two key elements to the fulfilling of renewable energy technology potential within the field of building design; first the installation of appropriate skills and attitudes in building design professionals

Positive effects	Negative effects
Transport - Promote public transport and reduce the need for, and length of, trips by private cars.	**Transport** - Congestion in urban areas reduces fuel efficiency of vehicles.
Infrastructure - Reduce street length needed to accommodate a given number of inhabitants. - Shorten the length of infrastructure facilities such as water supply and sewage lines, reducing the energy needed for pumping.	**Vertical transportation** - High-rise buildings involve lifts, thus increasing the need for electricity for the vertical transportation.
Thermal performance - Multi-story, multiunit buildings could reduce the overall area of the building's envelope and heat loss from the buildings. - Shading among buildings could reduce solar exposure of buildings during the summer period.	**Ventilation** - A concentration of high-rise and large buildings may impede the urban ventilation conditions.
Energy systems - District cooling and heating system, which is usually more energy efficiency, is more feasible as density is higher.	**Urban heat island** - Heat released and trapped in the urban areas may increase the need for air conditioning. - The potential for natural lighting is generally reduced in high-density areas, increasing the need for electric lighting and the load on air conditioning to remove the heat resulting from the electric lighting.
Ventilation - A desirable flow pattern around buildings may be obtained by proper arrangement of high-rise building blocks.	**Use of solar energy** - Roof and exposed areas for collection of solar energy are limited.

Table 13: Effects of urban density on city's energy demand

and second the provision of the opportunity for such people to demonstrate their skills. This second element may only be created when the population at large and clients commissioning building design in particular, become more aware of what can be achieved and what resources are required. Terms like passive cooling or passive solar use mean that the cooling of a building or the exploitation of the energy of the sun is achieved not by machines but by the building's particular morphological organisation. Hence, the passive approach to themes of energy savings is essentially based on the morphological articulations of the constructions. Passive solar design, in particular, can realize significant energy and cost savings. For a design to be successful, it is crucial for the designer to have a good understanding of the use of the building. Few of the buildings had performed as expected by their designers. To be more precise, their performance had been compromised by a variety of influences related to their design, construction and operation. However, there is no doubt that the passive energy approach is certainly the one that, being supported by the material shape of the buildings has a direct influence on architectural language and most greatly influences architectural expressiveness. Furthermore, form is a main tool in architectural expression. To give form to the material things that one produces is an ineluctable necessity. In architecture, form, in fact, summarises and gives concreteness to its every value in terms of economy, aesthetics, functionality and, consequently, energy efficiency. The target is to enrich the expressive message with forms producing an advantage energy-wise. Hence, form, in its geometric and material sense, conditions the energy efficiency of a building in its interaction with the environment. It is, then, very hard to extract and separate the parameters and the elements relative to this efficiency from the expressive unit to which they belong. By analysing energy issues and strategies by means of the designs, of which they are an integral part, one will, more easily, focus the attention on the relationship between these themes, their specific context & their architectural expressiveness. Many concrete examples and a whole literature have recently grown up around these subjects and the wisdom of forms and expedients that belong to millennia-old traditions has been rediscovered. Such a revisiting, however, is only, or most especially, conceptual, since it must be filtered through today's technology and needs; both being almost irreconcilable with those of the past. Two among the historical concepts are of special importance. One is rooted in the effort to establish rational and friendly strategic relations with the physical environment, while the other recognises the interactions between the psyche and physical perceptions in the creation of the feeling of comfort. The former, which may be defined as an alliance with the environment deals with the physical parameters involving a mixture of natural and artificial ingredients such as soil and vegetation, urban fabrics and pollution. The most dominant outside parameter is, of course, the sun's irradiation, our planet's primary energy source. All these elements can be measured in physical terms and are therefore the subject of science. Within the second concept, however, one considers the emotional and intellectual energies, which are the prime inexhaustible source of renewable power. In this case, cultural parameters, which are not exactly measurable, are involved. However, they represent the very essence of the architectural quality. Objective scientific measurement parameters tell us very little about the emotional way of perceiving, which influences the messages of human are physical sensorial organs. The perceptual reality arises from a multitude of sensorial components; visual, thermal, acoustic, olfactory and kinaesthetics. It can, also, arise from the organisational quality of the space in which different parameters come together, like the sense of order or of serenity. Likewise, practical evaluations, such as usefulness, can be involved too. The evaluation is a wholly subjective matter, but can be shared by a set of experiencing persons Therefore, these cultural parameters could be different in different contexts in spite of the inexorable levelling on a planet- wide scale. However, the parameters change in the anthropological sense, not only with the cultural environment, but also in relation to function. The scientifically measurable parameters can, thus, have their meanings very profoundly altered by the non-measurable, but describable, cultural parameters.

However, the low energy target also means to eliminate any excess in the quantities of material and in the manufacturing process necessary for the construction of our built environment. This claims for a more sober, elegant and essential expression, which is not jeopardising at all, but instead enhancing, the richness and preciousness of architecture, while contributing to a better environment from an aesthetic viewpoint. Arguably, the most successful designs were in fact the simplest. Paying attention to orientation, plan and form can have far greater impact on energy performance than opting for elaborate solutions. However, a design strategy can fail when those responsible for specifying materials for example, do not implement the passive solar strategy correctly. Similarly, cost-cutting exercises can seriously upset the effectiveness of a design strategy. Therefore, it is imperative that a designer fully informs key personnel, such as the quantity surveyor and client, about their design and be prepared to defend it. Therefore, the designer should have an adequate understanding of how the occupants or processes, such as ventilation, would function within the building. Thinking through such processes in isolation without reference to others can lead to conflicting strategies, which can have a detrimental impact upon performance. Likewise, if the design intent of the building is not communicated to its occupants, there is a risk that they will use it inappropriately, thus, compromising its performance. Hence, the designer should communicate in simple terms the actions expected of the occupant to control the building. For example, occupants should be well informed about how to guard against

summer overheating. If the designer opted for a simple, seasonally adjusted control; say, insulated sliding doors were to be used between the mass wall and the internal space. The lesson here is that designers must be prepared to defend their design such that others appreciate the importance and interrelationship of each component. A strategy will only work if each individual component is considered as part of the bigger picture. Failure to implement a component or incorrect installation, for example, can lead to failure of the strategy and consequently, in some instances, the building may not liked by its occupants due to its poor performance.

Energy efficiency

Energy efficiency is the most cost-effective way of cutting carbon dioxide emissions and improvements to households and businesses. It can also have many other additional social, economic and health benefits, such as warmer and healthier homes, lower fuel bills and company running costs and, indirectly, jobs. Britain wastes 20 per cent of its fossil fuel and electricity use. This implies that it would be cost-effective to cut £10 billion a year off the collective fuel bill and reduce CO_2 emissions by some 120 million tones. Yet, due to lack of good information and advice on energy saving, along with the capital to finance energy efficiency improvements, this huge potential for reducing energy demand is not being realised. Traditionally, energy utilities have been essentially fuel providers and the industry has pursued profits from increased volume of sales. Institutional and market arrangements have favoured energy consumption rather than conservation. However, energy is at the centre of the sustainable development paradigm as few activities affect the environment as much as the continually increasing use of energy. Most of the used energy depends on finite resources, such as coal, oil, gas and uranium. In addition, more than three quarters of the world's consumption of these fuels is used, often inefficiently, by only one quarter of the world's population. Without even addressing these inequities or the precious, finite nature of these resources, the scale of environmental damage will force the reduction of the usage of these fuels long before they run out.

Throughout the energy generation process there are impacts on the environment on local, national and international levels, from opencast mining and oil exploration to emissions of the potent greenhouse gas carbon dioxide in ever increasing concentration. Recently, the world's leading climate scientists reached an agreement that human activities, such as burning fossil fuels for energy and transport, are causing the world's temperature to rise. The Intergovernmental Panel on Climate Change has concluded that "the balance of evidence suggests a discernible human influence on global climate". It predicts a rate of warming greater than any one seen in the last 10,000 years, in other words, throughout human history. The exact impact of climate change is difficult to predict and will vary regionally. It could, however, include sea level rise, disrupted agriculture and food supplies and the possibility of more freak weather events such as hurricanes and droughts. Indeed, people already are waking up to the financial and social, as well as the environmental, risks of unsustainable energy generation methods that represent the costs of the impacts of climate change, acid rain and oil spills. The insurance industry, for example, concerned about the billion dollar costs of hurricanes and floods, has joined sides with environmentalists to lobby for greenhouse gas emissions reduction. Friends of the earth are campaigning for a more sustainable energy policy, guided by the principle of environmental protection and with the objectives of sound natural resource management and long-term energy security. The key priorities of such an energy policy must be to reduce fossil fuel use, move away from nuclear power, improve the efficiency with which energy is used and increase the amount of energy obtainable from sustainable, renewable sources. Efficient energy use has never been more crucial than it is today, particularly with the prospect of the imminent introduction of the climate change levy (CCL). Establishing an energy use action plan is the essential foundation to the elimination of energy waste. A logical starting point is to carry out an energy audit that enables the assessment of the energy use and determine what actions to take. The actions are best categorised by splitting measures into the following three general groups:

- **High priority/low cost**

  These are normally measures, which require minimal investment and can be implemented quickly. The followings are some examples of such measures:

  - Good housekeeping, monitoring energy use and targeting waste-fuel practices.
  - Adjusting controls to match requirements.
  - Improved greenhouse space utilisation.
  - Small capital item time switches, thermostats, etc.
  - Carrying out minor maintenance and repairs.
  - Staff education and training.
  - Ensuring that energy is being purchased through the most suitable tariff or contract arrangements.

- **Medium priority/medium cost**

  Measures, which, although involve little or no design, involve greater expenditure and can take longer to implement. Examples of such measures are listed below:

  - New or replacement controls.
  - Greenhouse component alteration e.g., insulation, sealing glass joints, etc.
  - Alternative equipment components e.g., energy efficient lamps in light fittings, etc.

- **Long term/high cost**

  These measures require detailed study and design. They can be best represented by the followings:

  - Replacing or upgrading of plant and equipment.
  - Fundamental redesign of systems e.g., CHP installations.

  This process can often be a complex experience and therefore the most cost-effective approach is to employ an energy specialist to help.

Policy recommendations for a sustainable energy future

Sustainability is regarded as a major consideration for both urban and rural

development. People have been exploiting the natural resources with no consideration to the effects, both short-term (environmental) and long-term (resources crunch). It is also felt that knowledge and technology have not been used effectively in utilising energy resources. Energy is the vital input for economic and social development of any country. Its sustainability is an important factor to be considered. The urban areas depend, to a large extent, on commercial energy sources. The rural areas use non-commercial sources like firewood and agricultural wastes. With the present day trends for improving the quality of life and sustenance of mankind, environmental issues are considered highly important. In this context, the term energy loss has no significant technical meaning. Instead, the exergy loss has to be considered, as destruction of exergy is possible. Hence, exergy loss minimisation will help in sustainability. In the process of developing, there are two options to manage energy resources:

(i) End use matching/demand side management, which focuses on the utilities. The mode of obtaining this is decided based on economic terms. It is, therefore, a quantitative approach.

(ii) Supply side management, which focuses on the renewable energy resource and methods of utilizing it. This is decided based on thermodynamic consideration having the resource-user temperature or exergy destruction as the objective criteria. It is a qualitative approach. Two options are explained schematically in Fig. 10. The exergy-based energy, developed with supply side perspective is shown in Fig. 11.

- Clear environmental and social objectives for energy market liberalisation, including a commitment to energy efficiency and renewables.
- Economic, institutional and regulatory frameworks, which encourage the transition to total energy services.
- Economic measures to encourage utility investment in energy efficiency (e.g., levies on fuel bills).
- Incentives for demand side management, including grants for low-income households, expert advice and training, standards for appliances and buildings and tax incentives.
- Research and development funding for renewable energy technologies not yet commercially viable.

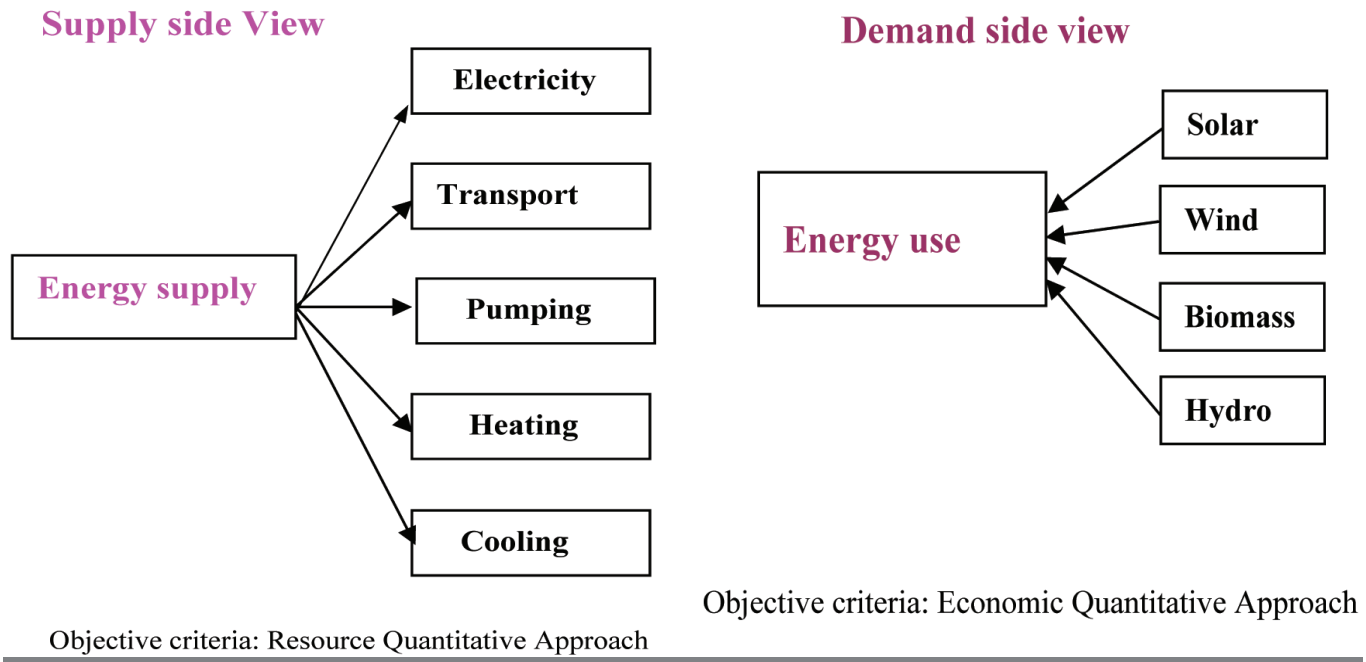


Fig. 10: Supply side and demand side management approach for energy

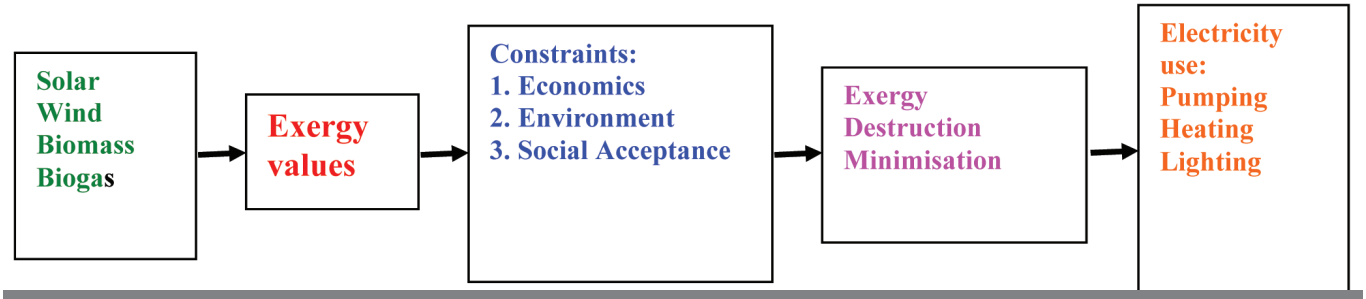


Fig. 11: Exergy based optimal energy model

- Continued institutional support for new renewables (such as standard cost-reflective payments and obligation on utilities to buy).
- Ecological tax reform to internalise external environmental and social costs within energy prices.
- Planning for sensitive development and public acceptability for renewable energy.

Energy resources are needed for societal development. Their sustainable development requires a supply of energy resources that are sustainably available at a reasonable cost and can cause no negative societal impacts. Energy resources such as fossil fuels are finite and lack sustainability, while renewable energy sources are sustainable over a relatively longer term. Environmental concerns are also a major factor in sustainable development, as activities, which degrade the environment, are not sustainable. Hence, as much as environmental impact is associated with energy, sustainable development requires the use of energy resources, which cause as little environmental impact as possible. One way to reduce the resource depletion associated with cycling is to reduce the losses that accompany the transfer of exergy to consume resources by increasing the efficiency of exergy transfer between resources i.e. increasing the fraction of exergy removed from one resource that is transferred to another.

As explained above, exergy efficiency may be thought of as a more accurate measure of energy efficiency that accounts for quantity and quality aspects of energy flows. Improved exergy efficiency leads to reduced exergy losses. Most efficiency improvements produce direct environmental benefits in two ways. First, operating energy input requirements are reduced per unit output, and pollutants generated are correspondingly reduced. Second, consideration of the entire life cycle for energy resources and technologies suggests that improved efficiency reduces environmental impact during most stages of the life cycle. Quite often, the main concept of sustainability, which often inspires local and national authorities to incorporate environmental consideration into setting up energy programmes have different meanings in different contexts though it usually embodies a long-term perspective. Future energy systems will largely be shaped by broad and powerful trends that have their roots in basic human needs. Combined with increasing world population, the need will become more apparent for successful implementation of sustainable development.

Source	Energy (J)	Exergy (J)	CQF
Water at 8o^{O}C	100	16	0.16
Steam at 120^{O}C	100	24	0.24
Natural gas	100	99	0.99
Electricity/work	100	100	1.00

Table 14: Qualities of various energy sources

Heat has a lower exergy, or quality of energy, compared with work. Therefore, heat cannot be converted into work by 100% efficiency. Some examples of the difference between energy and exergy are shown in Table 14.

Carnot Quality Factor (CQF) =

$$(1-T_o/T_s) \quad (5)$$

$$\text{Exergy} = \text{Energy (transferred)} \times \text{CQF} \quad (6)$$

Where T_o is the environment temperature (K) and T_s is the temperature of the stream (K).

Various parameters are essential to achieving sustainable development in a society. Some of them are as follows:

- Public awareness
- Information
- Environmental education & training
- Innovative energy strategies
- Renewable energy sources & cleaner technologies
- Financing
- Monitoring & evaluation tools

The development of a renewable energy in a country depends on many factors. Those important to success are listed below:

- Motivation of the population

The population should be motivated towards awareness of high environmental issues, rational use of energy in order to reduce cost. Subsidy programme should be implemented as incentives to install renewable energy plants. In addition, image campaigns to raise awareness of renewable technology.

- Technical product development

To achieve technical development of renewable energy technologies the following should be addressed:

  - Increasing the longevity and reliability of renewable technology
  - Adapting renewable technology to household technology (hot water supply)
  - Integration of renewable technology in heating technology
  - Integration of renewable technology in architecture, e.g., in the roof or fa□ade
  - Development of new applications, e.g., solar cooling
  - Cost reduction

- Distribution and sales

Commercialisation of renewable energy technology requires:

  - Inclusion of renewable technology in the product range of heating trades at all levels of the distribution process (wholesale, retail)
  - Building distribution nets for renewable technology
  - Training of personnel in distribution and sales
  - Training of field sales force

- Consumer consultation and installation

To encourage all sectors of the population to participate in adoption of renewable energy technologies, the following has to be realized:

  - Acceptance by craftspeople, marketing by them
  - Technical training of craftspeople, initial and follow-up training programmes
  - Sales training for craftspeople
  - Information material to be made available to craftspeople for consumer consultation

- Projecting and planning

Successful application of renewable technologies also requires:

  - Acceptance by decision makers

in the building sector (architects, house technology planners, etc.)

- Integration of renewable technology in training
- Demonstration projects/ architecture competitions
- Renewable energy project developers should prepare to participate in the carbon market by:
  - Ensuring that renewable energy projects comply with Kyoto Protocol requirements.
  - Quantifying the expected avoided emissions.
  - Registering the project with the required offices.
  - Contractually allocating the right to this revenue stream.
- Other ecological measures employed on the development include:
  - Simplified building details
  - Reduced number of materials
  - Materials that can be recycled or reused
  - Materials easily maintained and repaired
  - Materials that don't have a bad influence on the indoor climate (i.e., non-toxic)
  - Local cleaning of grey water
  - Collecting and use of rainwater for outdoor purposes and park elements
  - Building volumes designed to give maximum access to neighbouring park areas
  - All apartments have visual access to both backyard and park
- Energy saving measures

The following energy saving measures should also be considered:

- Building integrated solar PV system
- Day-lighting
- Ecological insulation materials
- Natural/hybrid ventilation
- Passive cooling
- Passive solar heating
- Solar heating of domestic hot water
- Utilisation of rainwater for flushing

Improving access for rural and urban low-income areas in developing countries through energy efficiency and renewable energies will be needed. Sustainable energy is a prerequisite for development. Energy-based living standards in developing countries, however, are clearly below standards in developed countries. Low levels of access to affordable and environmentally sound energy in both rural and urban low-income areas are therefore a predominant issue in developing countries. In recent years many programmes for development aid or technical assistance have been focusing on improving access to sustainable energy, many of them with impressive results.

Apart from success stories, however, experience also shows that positive appraisals of many projects evaporate after completion and vanishing of the implementation expert team. Altogether, the diffusion of sustainable technologies such as energy efficiency and renewable energies for cooking, heating, lighting, electrical appliances and building insulation in developing countries has been slow.

Energy efficiency and renewable energy programmes could be more sustainable and pilot studies more effective and pulse releasing if the entire policy and implementation process was considered and redesigned from the outset. New financing and implementation processes are needed which allow reallocating financial resources and thus enabling countries themselves to achieve a sustainable energy infrastructure. The links between the energy policy framework, financing and implementation of renewable energy and energy efficiency projects have to be strengthened and capacity building efforts are required.

Conclusions

There is strong scientific evidence that the average temperature of the earth's surface is rising. This is a result of the increased concentration of carbon dioxide and other GHGs in the atmosphere as released by burning fossil fuels. This global warming will eventually lead to substantial changes in the world's climate, which will, in turn, have a major impact on human life and the built environment. Therefore, effort has to be made to reduce fossil energy use and to promote green energies, particularly in the building sector. Energy use reductions can be achieved by minimising the energy demand, by rational energy use, by recovering heat and the use of more green energies. This study was a step towards achieving that goal. The adoption of green or sustainable approaches to the way in which society is run is seen as an important strategy in finding a solution to the energy problem. The key factors to reducing and controlling CO_2, which is the major contributor to global warming, are the use of alternative approaches to energy generation and the exploration of how these alternatives are used today and may be used in the future as green energy sources. Even with modest assumptions about the availability of land, comprehensive fuel-wood farming programmes offer significant energy, economic and environmental benefits. These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. The nations as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest – plantation cover, a nation's resource base would be greatly improved. The international community would benefit from pollution reduction, climate mitigation, and the increased trading opportunities that arise from new income sources. The non-technical issues, which have recently gained attention, include-

- Environmental and ecological factors, e.g., carbon sequestration, reforestation and revegetation.
- Renewables as a CO_2 neutral replacement for fossil fuels.
- Greater recognition of the importance of renewable energy, particularly modern biomass energy carriers, at the policy and planning levels.
- Greater recognition of the difficulties of gathering good and reliable renewable energy data, and efforts to improve it.
- Studies on the detrimental health efforts of biomass energy particularly from traditional energy users. ■

Glasgow: landmark building gets advanced air conditioning solution by Toshiba

A new landmark building in the heart of Glasgow, St Vincent Plaza, is being equipped with an advanced Toshiba air conditioning system to deliver outstanding energy efficiency and comfort for occupants.

Designed to have a BREEAM rating of Excellent, the 10-storey iconic office development will be cooled and heated by a Toshiba 3-pipe SHRM-i VRF air conditioning system, with full heat recovery.

The striking granite and glass-clad building, by developer Abstract Securities Group and main contractor Bowmer & Kirkland, will provide 170,000 sq ft of Grade A office accommodation with panoramic views across the city. The state-of-the-art building includes shower rooms, changing facilities and secure internet shopping storage.

The Toshiba air conditioning is being installed by Castle Building Services of Hebburn, Tyne & Wear, as part of a £5m M&E contract. The installation comprises 21 high efficiency Toshiba SHRM-i VRF systems, plus a twin-ducted system, providing simultaneous heating and cooling.

Excess heat generated in areas of the building subject to high solar gain or internal heat sources will be harnessed for use elsewhere, or be used as energy to power cooling via a sophisticated thermodynamic conversion system.

The project required a combination of long refrigerant pipe runs, high SEER and SCOP values, and exceptionally quiet indoor fan coil units. The Toshiba solution selected was able to deliver all these performance criteria in a comprehensive and competitive package.

Some 316 ducted fan coil units are being installed, linked to 41 outdoor condensing modules, with the system connected into the building's BMS using Toshiba's recently developed Black Pear interface.

The Modbus-based interface gives the building supervisor access to each fan coil, plus access to overall system timing schedules and temperature and air speed settings, enabling continuous optimisation of energy efficiency and occupant comfort.

Castle Building Services used Toshiba Air Conditioning UK Limited's design and selection software, which takes into account system loading, pipe runs and design temperatures for summer and winter, to determine actual cooling and heating values for each of the building's indoor units.

Allan Carr of Castle Building Services said, "It's a great tool and helps in the development and validation of system designs. It shows how conditions can be precisely met with the equipment selected, and provides confirmation that the installed system will deliver as specified."

The project marks a first for the contractor with Toshiba equipment. Carr commented, "We had initially considered going with a different manufacturer.

However, we were introduced to the latest Toshiba range just at the right time, and were very impressed with the quality of the technology and the company's whole approach. They were very responsive and provided excellent technical support. It has enabled us to deliver a high performance, high efficiency solution for the client, and opened some exciting new opportunities on the installation front."

St Vincent Plaza is due to be completed in Spring 2015. ■

Staircase Pressurisation

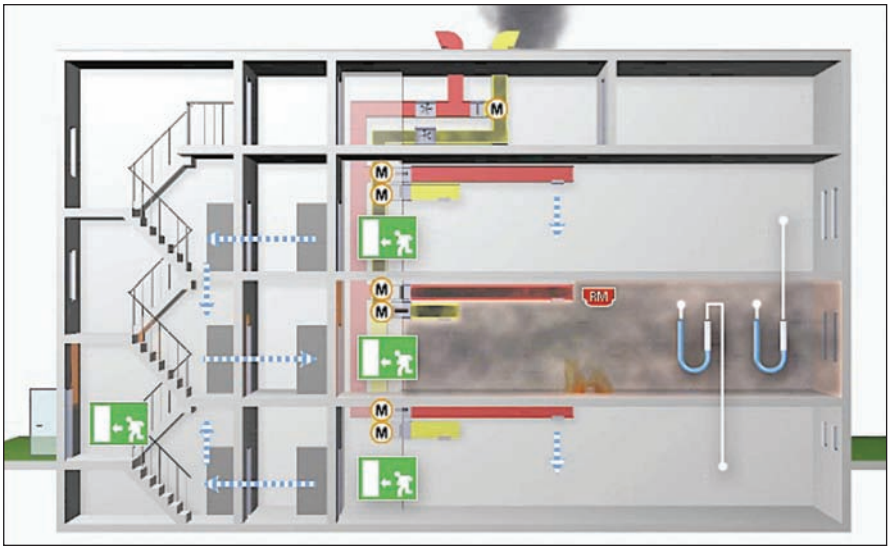
Need of the Time

Recent fire accident at Lotus Business Park, Mumbai has once again underlined the fact that despite the rules as Maharashtra Fire Prevention and Life safety Act, 2006; regular fire audits are not carried out and fire-fighting and/or detection systems are non- operational in most of the structures. Glass fa□ade systems are creating hurdles in fire-fighting operations by reducing ventilation and pushing smoke to other floors or part of the building. Fire incident which took place on 21st floor, shortly spread to 20th floor. Should the Smoke control systems in place, it could restrict the fire and smoke travel from the fire affected zone to other zones/ floors. If staircase pressurization would have been in place, 30-35 firemen would not have trapped and family of one fireman would have not lost their loved one.

BMC will strengthen the policies regarding glass facades in high rise buildings, will add ladder which will enable them to reach 90 meters height, will start dedicated cell of 99 officers to carry out fire audits and to look after fire prevention, will construct more fire stations etc. But unless everybody takes fire prevention seriously, fire incidents will occur again and again. Hence it is important for everybody to take care of fire-fighting installations, to do regular fire audits, mock drills and make sure that fire alarm systems, wet risers, smoke control systems are in place and are functioning. Since fire produces both heat & smoke, it is apparent to deal with both. It is well known fact that it is smoke that is responsible for death toll rise than heat due to inhalation of carbon monoxide and other toxic gases. Smoke can block visibility thereby blocking escape routes, rescue operation & fire fighting operations. People should be able to move away from the fire accident spots up to final exits through the escape routes. Provisions of escape routes are of critical importance.

BS - 5588 Part-4 1978 states "It is the smoke and toxic gases, rather than the flame, that will in the first instance inhibit this movement and the exclusion of the smoke and gases from the protected routes is thus of great importance".

Since lifts are not to be used in case of fire, staircase is integral part of recommended escape route. It is of prime importance to keep the staircase free of smoke generated by fire. Hence smoke management is of utmost importance by smoke extraction and/or creating barriers by pressurization methods.



There were very few staircase pressurization system installations before 15 years in India. The installations in past 15 years have increased a lot due to new high rise buildings, malls, shopping complexes etc. and will become integral part of HVAC design.

Smoke can travel from one part to another part of the building through cracks, pipes, ducts and other openings etc. Fire proof or fire resistant walls and ceilings have proved to be an effective way of fire protection. However allowing HVAC ducting to pass through these walls and ceiling means their effectiveness is seriously compromised.

That is the reason, NFPA 90A and National Building Code of India (NBC – Part 4) stipulate that escape routes like staircases, common corridors and lift lobbies shall not be used as return air passage and no ducts serving the main floor area should pass through a staircase enclosure. It also asks for the following criteria to meet.

- The external enclosing walls of the staircase shall be of the brick or the R.C.C. construction having fire resistance of not less than two hours. All enclosed staircases shall have access through self-closing door of one-hour fire resistance. These shall be single swing doors opening in the direction of the escape. The door shall be fitted with the check action door closers.
- The staircase enclosures on the external wall of the building shall be ventilated to the atmosphere at each landing.
- Permanent vent at the top equal to the 5% of the cross sectional area of the enclosure and openable sashes at each floor level with area equal to 1 to 15% of the cross sectional area of the enclosure on external shall be provided. The roof of the shaft shall be at least 1 m. above the surrounding roof. There shall be no glazing or the glass bricks in any internal closing wall

System Class	Area of Use	Mode -1 (Normal)	Mode-2 (Escape)	Mode- 3 (Fire Fighting)
A	Residential, sheltered housing & buildings with three door protection	50 Pa with all doors closed	0.75 m/s through open fire door	
B	Protection of firefighting shafts	50 Pa with all doors closed		2.0 m/s through open fire door & final exit door open. 50 Pa in firefighting lift at all times.
C	Commercial premises (using simultaneous evacuation)	50 Pa with all doors closed	0.75 m/s through open fire door with exit door closed & 10 Pa with final exit door open	
D	Hotels, hostels and institutional- type buildings, excluding those in Class A	50 Pa with all doors closed	10 Pa & 0.75 m/s velocity through open fire door & with final exit door open	
E	Buildings using phased evacuation	50 Pa with all doors closed	10 Pa with final exit & two non-fire floor doors open & 0.75 m/s through open fire floor door with final exit & one non-fire floor door open	

of staircase. If the staircase is in the core of the building and cannot be ventilated at each landing, a positive of 5-mm. w.g. by electrically operated blower/blowers shall be maintained.

- The mechanism for pressurizing the staircase shaft shall be so installed that the same shall operate automatically on fire alarm system/ sprinkler system and be provided with manual operation facilities.

The two basic principles of smoke control can be stated as:

- Air pressure difference across a barrier between staircase & occupied zone.
- If the average air velocity is of sufficient magnitude, air flow by itself can control smoke movement.

Five classes of pressurization system as mentioned in BS5588: Part 4: 1998 are summarized in Table herein above.

By having positive pressure inside staircase, there is movement of air from staircase shafts to the occupied areas whenever the fire doors open thus ensuring that smoke does not travel to the staircase.

Requirements

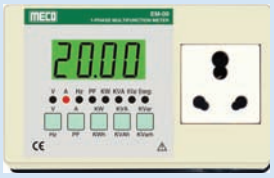
- A minimum of one fan per staircase shaft is required for staircase pressurization system. Provision of isolating dampers or combination of fire/ smoke damper is done on downstream of fan discharge. Fire dampers should be UL 555 certified and smoke dampers should be UL 555S certified.
- Activation of any building smoke detector gives signal through DDC controller / fire alarm system to open the motorized dampers and start all fans when the dampers are at full open position to achieve pressurization of the stairwell. Damper actuators should be fast running so as to start the air flow in minimum time.
- A pressure sensor installed in each staircase shaft will, through the DDC controller, modulate the respective fan motor's variable speed drive as required to maintain the staircase shaft at a positive pressure with respect to the occupied spaces as required by NFPA depending on system class of the building.
- A smoke detector must be installed in the respective fan intake or supply air duct as well which will stop respective fan motor and close related fire/ smoke dampers.
- Each staircase shaft fan should also be individually controlled, through the building fire alarm system, by a manual local on-off switch on the Fireman's Control Panel. This manual control will override all other control sequences. During normal operation, if any of these manual switches on the Fireman's Control Panel are in the off position a non-cancellable alarm will be activated at the operator's Workstation.
- A differential pressure switch is normally installed across the fan inlet & outlet to monitor run status and will raise alarm to operator in case the command is given to start the fan motor and there is no differential pressure.

Ensuring safe escape route is the basic purpose behind providing staircase pressurization system. Besides this, one can attract foreign investments easily by adhering strictly to fire safety norms. Also, it becomes effective tool while negotiating with general insurance companies on insurance premium.

We at Belimo offer complete range of control products such as UL 555 & UL 555S rated actuators for fire & smoke dampers, Thermal tripping devices, fast running actuators, DP switch and DP transmitters required for smooth functioning of staircase pressurization systems. ■

Bhavesh Wagh,
Regional Application Consultant
Belimo Actuators India Pvt Ltd.

MECO:1 Phase Multifunction Appliance Meter-TRMS (Model : EM09)



MECO offers a Single Phase Multifunction Appliance Meter – TRMS, Model EM09 (1A, 5A and 20A). It measures 10 parameters on 10 display pages on a large LCD display (20mm). It is equipped with 5 keys to view all the parameters and for programming of the meter. The meter is ideal for HVAC industry.

Features

Can be used for Continuous Monitoring.
Auto / Manual Scroll Display (User Selectable).
State of Art Microcontroller Design.
LCD Display with Backlight.
RS-485 Port (5kV Isolated) with MODBUS RTU Protocol (Optional).
POWER MASTER Software for MIS Reports (Optional).

Applications

Appliances Testing (AC, Refrigerator, Washing Machine, Air Cooler, Microwave Oven etc.); LED Lights Testing;
Studying Energy Efficiency of Electrical Equipment. ■

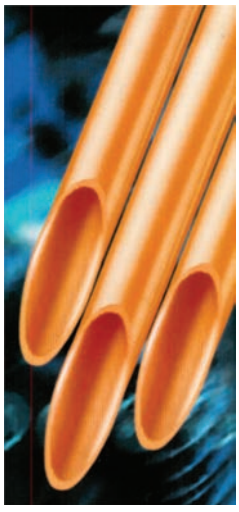
Website:
www.mecoinst.com

E^{x}V: electronic expansion valve by CAREL S.p.A.

E2V; E3V; E4V are professional electronic expansion valves activated by a two-pole stepper motor. Control is performed using a calibrated stem that slides through on an opening, with 14 mm travel. The stem is positioned by a stepper motor with a range of around 500 steps. The correct mechanical balance guarantees significant stability of superheat control according to the set point and a rapid response to transient situations. The proportional control also ensures no pulsation in pressure on the refrigerant lines and greater control over the return of liquid to the compressor. EXV is available in different sizes, with cooling capacities of up 250kW, with different types of fitting (copper, brass, and stainless steel). The most suitable size valve can be selected easily using the E2V SELECTION software. ■

Website:
www.carel.com

Inner Grooved Tubes from Halcor



Halcor has developed its own standard with regard to the design of new high thermal efficiency tubes with inner grooves.

With these tubes, the thermal efficiency of refrigeration units is improved, enabling the reduction of the size of these units, whilst reducing the quantity of the refrigeration mixture required.

Material

Copper phosphorous deoxidized (DHP-Cu), having minimum copper content 99.9% and P=0.015% -0.040%. ■

Website:
www.halcor.gr

Gandhi Automations offers Automatic Industrial Overhead Doors

Gandhi Industrial Overhead Doors ensure a better use of inside space as the side guides vertically move the door along the wall and parallel to the ceiling. The doors are installed above the opening, thus ensuring a better use of the transit opening.

Easy and practical to open and operate:
As these doors slide vertically, stopping in the proximity of the ceiling, they blend in with the architectural features of the building. Their compact size ensures more available space both inside and outside of the premises.

Light and aesthetically pleasing environments: The panels can also be manufactured with the addition of practical portholes or full aluminium sections featuring polycarbonate or unbreakable glass panels, wire meshing or air grilles.

They add value to the premises and meet all requirements: The design and different solutions offered ensure the door to be aesthetically pleasing and perfectly suited in any architectural environment – from modern and traditional industrial buildings to fine commercial buildings. The doors can meet any industrial and commercial requirement and add value to the building they are installed on. All products are affixed with a CE mark. ■

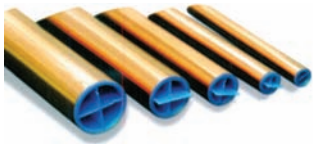
Website:
www.geapl.co.in

Hongsen Vibration Eliminator

VAH vibration eliminators: Hongsen has launched VAF series. VAF vibration resistant corrugated metal hose improves the vibration damping ability, as its stainless steel angularly corrugated hose has excellent elasticity and vibration damping ability. VAF Vibration resistant corrugated metal hose features safety, high mechanical strength, corrosion resistance and heat-resistant as they offer low noise and perfect vibration resistant. Other features of 'VAF' model is good compensation for the heat displacement, installation deviation and foundation settlement. VAF is a welded assembly of corrugated metal hose, metal connector, braided metallic wire sleeve, metal clamping ring and red copper tube. Extra metal connector having welding at both inside and outside ensure Zero leakage after years of use. VAF vibration resistant corrugated metal hose is used on the suction piping and exhaust piping of a compressor in the refrigeration, cold storage and air conditioning unit. Vibration Eliminators are capable of working on -40˚c to + 150˚c temperature range, hence suitable for both Air Conditioning and refrigeration. Hongsen Vibration Eliminators and all other controls can be used both for HFC and HCFC Refrigerant. Depending upon size of Vibration Eliminator, Hongsen Vibration Eliminators can withstand almost 50% higher pressure than permissible operating pressures. ■

For further details:
marketing@smartmarketing.co.in

Seamless Copper Tube for Medical Gas Systems - by Soldia Corporation



Sampo Industrial manufactures a range of seamless copper tube supplied for use in medical gas systems, identified as type K & L – fitted with plastic caps after cleaning to maintain the clean interior surface. Their type K and L (cleaned and capped) is also specially cleaned for use in medical gas systems and meets the same allowable residue limit of 0.038g/m^2 of interior tube surface area.

Physical Properties of Copper Tube
Composition: Alloy C12200 Copper = 99.90% min; Phosphorus = 0.015 ~ 0.040%.
Melting Point: 9810F (1083 0C).
Density: 558lb / ft 3 (8.94 x 10 3kg / m3).
Modulus of Elasticity: 2.46 106psi (17,000 MPa). ■

Website:
www.soldia.com.cn

V Type Plunger Check Valves from Type Plunger Check Valves

Nantong OEM Refrigeration Equipment Co., Ltd brings V type plunger check valves which can be used in commercial refrigeration systems, civil and industrial air conditioning equipments. It was designed with piston close and seal, forged brass body, and max. flow rate and min. pressure drop.

Feature
The valve ensures the correct flow direction only.
Prevents back-condensation from warm to cold evaporators.
Oversize connections provide flexibility in use.
Easy disassembly and assembly design. ■

Website:
www.filterdrier.cn

Metaflex offers Hinged Insulated Doors

This product is specially developed for use in vegetable fruit, dairy and fish industries. State of the art option for modern food facilities. For manual as well as forklift carriage of goods, where the space is a constraint and only personnel entry is required. Life span is 15 years.

Benefits
Metaflex doors helps to maintain the insulation values, prevent loss of refrigeration, through hermetic sealing. Coated or stainless steel sheet encasing a polyurethane foamed core injected under pressure, combined with efficient sealing of a chiller or freezer room hinged doors. Door frame with an aluminium still installed flush with the floor, for freezer applications. Both the sill and the door frame are fitted with a heated tape.

Applications
It is applicable for agri-horticulture, dairy, meat and fisheries, food processing, warehousing, cold chains, ripening chambers, CA chambers. ■

Website:
www.metaflexdoors.in

Güntner Refrigeration App:
Now even more expertise at a click

At the Symposium in 2013, GÜntner presented an own Refrigeration App. With its handy functions in clearly arranged categories, the app provides access to the GÜntner refrigeration engineering know-how and to company tools – also when being out and about. The numerous useful functions have been further expanded and improved. Now, the first comprehensive update is available in app stores. In addition to the overall handling improvement, there are also general software adjustments such as the update to the latest Apple system IOS 7. For Android tablets, programming was optimised in order to achieve a better presentation and thereby a simpler handling of the functions. The GÜntner Refrigeration App is available for free at Apple, Android & Blackberry app stores!

Various languages

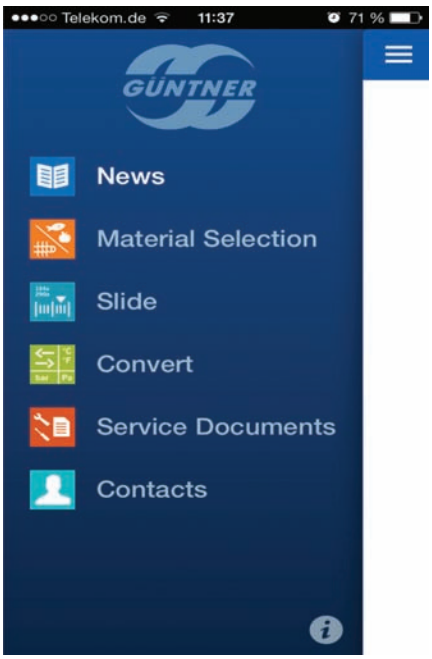
Not only German and English are available as application languages, but now also French, Russian, Spanish, Portuguese, Chinese, Japanese, Hindi and Indonesian.

Uni que material recommendations

After numerous tests and laboratory analyses, GÜntner have published recommendations for material combinations for components depending on the planned application. This unique information overview, much sought-after for years, is now also an implemented app function. It lets you check the ambient conditions for a suitable unit design at any time.

Refrigerant slide

The app function "Slide" displays the pressure-temperature correlation for more than a dozen of the most commonly used refrigerants. These include refrigerants that are relevant today such as 245fa. Users enter a specific temperature as required and the refrigerant slide



shows the corresponding gauge pressure in bar. Naturally, the refrigerant-specific ODP (Ozone Depletion Potential) and GWP (Global Warming Potential) values are also shown.

Converter for easy conversion

Using the converter for everybody, there will no longer be unanswered questions with regard to unit conversion. A total of 18 refrigerating variables such as pressure, temperature, volume and mass flow density, can be converted into every unit globally used and then displayed. As a result, users will always find a common basis for measurements – regardless of where in the world a construction site happens to be.

Service Document s - a complete collection of documents

The "Service Documents" function provides you with documents for all the GÜntner lines of business and units. Documents are first sorted regionally. This is done automatically depending on the basic mobile phone or location settings. Users can then select the required documents according to the sorted languages and units. From info brochures to operating instructions, information is just a click away. This is particularly useful for service technicians and others who might want to take a glance at the unit's operating instructions on site.

Contact information immediately available

The "Contacts" function offers an overview of all the GÜntner field representatives. All stated contact data are active, meaning users can plan their route from their current location on the basis of the address, they can call/e-mail a contact directly, share information with others or add the details to their own list of contacts. The contact information also includes details for the Service and Spare Parts departments. As a result, you will always reach the right contact person.

Always upto date with New s

Keep up to date with all the latest GÜntner news with the "News" function: As soon as information is published on the GÜntner website, it will also be available via smartphone. Depending on the basic smartphone settings and the selected language respectively, this function always displays the latest news from the relevant region, e.g. Europe, Asia or America.

Communication in both directions

Naturally, GÜntner is not only keen to provide information – we look forward to receiving direct feedback, too. A feedback function allows you to directly contact the app contact person at GÜntner in case you have questions or suggestions in terms of other or improved functions. ■

Courtesy:
GÜntner GmbH & Co. KG

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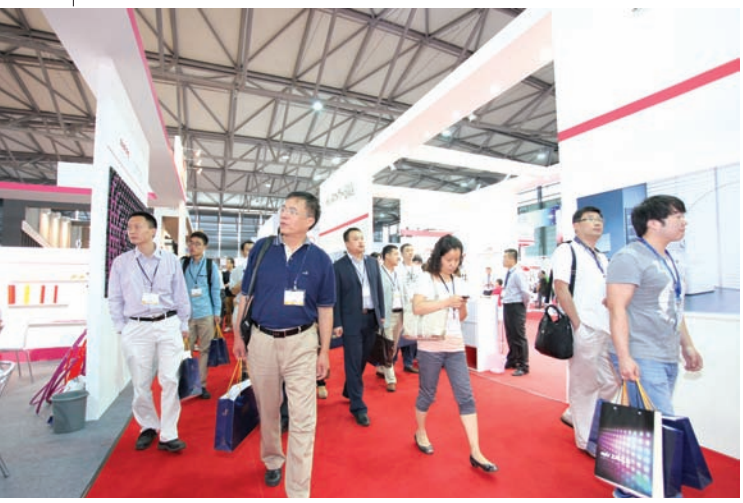

ISH Shanghai & CIHE 2014
European Pavilion participates once again

The third edition of ISH Shanghai & CIHE – Shanghai International Trade Fair for Heating, Ventilation & Air-Conditioning will be held from September 3-5 at Shanghai New International Expo Centre (SNIEC). Co-organised by Messe Frankfurt (Shanghai) Co Ltd, Beijing B & D Tiger Exhibition Co Ltd, Shanghai Zhanye Exhibition Ltd and China Council for the Promotion of International Trade (CCPIT) – Shanghai Pudong Sub-Council, the Shanghai fair was positioned purposely for catering to East and Central China's individual heating market needs.

The 2014 edition will be held concurrently with Shanghai Intelligent Building Technology Fair, Building Solar China Conference and Exhibition and the inaugural Shanghai International Lighting Fair. Collectively known as the "Intelligent Green Building" exhibition platform, the four events expects to gather 600 exhibitors, covering 40,000 sqm of exhibition space. This exhibition platform not only creates synergy to all visitors and exhibitors, but also provides a one-stop destination to all concurrent events.

With growing demands for HVAC products and solutions in East and Central China, the Shanghai fair continues to play an important role in attracting key global industry players. Due to the increasing popularity of the show, the European Pavilion has once again confirmed their participation at the 2014 edition to showcase Europe's latest HVAC technologies and solutions. The Pavilion features over 10 leading brands from Denmark, Germany, Italy, Spain and Turkey, including UK: John Guest
Germany: Afriso, Keidel, Poloplast, Testo Germany
Denmark: Meibes
Italy: Aquatechnik/Gnali Bocia, Nuova Imas
Spain: Global Piping Systems
Turkey: Dizayn

Leading HVAC brand, Dizayn Group from Turkey, shows high expectations towards the Shanghai fair. Ms Anna Ulak, Brand Communication Executive of Dizayn Group expresses: "China is currently one of the biggest HVAC markets in the world. We aim to tap into the Chinese market by showcasing our highly crafted and innovative products. For this year's show, we will introduce our latest PPR piping systems as well as accessories and provide HVAC efficient installation solutions to accommodate our Chinese client's needs."

Shanghai International HVAC Forum debuts at the 2014 show to highlight HVAC needs in East and Central China

For the 2014 edition, ISH Shanghai & CIHE will introduce its first ever "Shanghai International HVAC Forum", designed specifically to promote knowledge exchange among industry professionals and experts. The Forum is composed of two main sessions including:

- **Shanghai International HVAC Forum – Floor Heating Session**

Co-organised with the association of Floor-heating Committee of China Construction Metal Structure Association, session will gather some of the most prominent governments, companies and industry experts to discuss future developments within the intelligent floor-heating sector as well as technical installation know-how.

- **Shanghai International HVAC Forum – Heat Pump Session**

Partnered with HVAC&R Sub-council of China Architectural Society, "New Source of Energy for a Greener Life" will serve as the main theme of this session. Interactive discussions will cover national polices along with active sharing on the latest heat pump trends, products as well as technologies. Some of the invited speakers to the forum include Mr Liu Zhongcheng, Heat Pump Specialist from the China Committee of Ground Source Heat Pump; Cao Feng, Heat Pump Specialist from Xian Jiaotong University; Sun Fuqiang, Sales Manager of Bosch Thermo technik and more.

Additional concurrent event at the 2014 edition includes-

- **Competition on Floor Heating Installation**

Organised by one of the leading HVAC media in China, n3.com.cn, the Floor Heating Installation Competition serves as a showcase of the installation craftsmanship of various floor heating brands.

ISH Shanghai & CIHE is headed by the biennial ISH event in Frankfurt, the world's leading trade fair for the Bathroom Experience, Building, Energy, Air-conditioning Technology and Renewable Energies, taking place from March 10 – 14, 2015.

Furthermore, the next edition of ISH China & CIHE – China International Trade Fair for Sanitation, Heating, Ventilation and Air-Conditioning is scheduled to take place at the New China International Exhibition Center from May 13-15, 2015 in Beijing, China. ■

Solar Refrigeration for Cooling

Fishermen in the village of Maruata, which is located on the Mexican Pacific coast 18 degrees north of the equator, have no electricity. But for the past 16 years they have been able to store their fish on ice: Seven ice makers, powered by nothing but the scorching sun, churn out a half ton of ice every day. There's a global scramble to drive down emissions of carbon dioxide: the electricity to power just refrigerators in the U.S. contributes 102 million tons annually. Solar refrigeration can also be inexpensive and it would give the electric grid much-needed relief.

A group of students last year at San Jose State University built a solar-powered ice maker with $100 worth of plumbing and a four-by-eight-foot (1.2-by-2.4-meter) sheet of reflecting steel. No moving parts, no electricity but give it a couple hours of sunshine and it can make a large bag of ice. The key is the energy exchanged when liquids turn to vapor and vice versa. The process that cools one when one sweat. By far the most common approach, the one used by the refrigerator in your house, uses an electric motor to compress a refrigerant - say, Freon - turning it into liquid. When the pressure created by the compressor is released, the liquid evaporates, absorbing heat and lowering the temperature. Absorptive chillers like solar refrigerators use a heat source rather than a compressor to change the refrigerant from vapor to liquid. The two most common combinations are water mixed with either lithium bromide or ammonia. In each case, the refrigerating gas is absorbed until heat is applied, which raises the temperature and pressure. At higher pressure, the refrigerant condenses into liquid. Turning off the heat lowers the pressure, causing that liquid to evaporate back into a gas, thereby creating the cooling effect. As with most technologies, the efficiency of such absorptive refrigeration depends on the degree of engineering (and expense) brought to bear. Single-effect devices have a coefficient of performance of 0.6 to 0.7 - that is, they create 60 to 70 Btus (British thermal units) of cooling for every 100 Btus of input heat. That low level of efficiency can be achieved with something as crude as some pipe, a bucket of water, some calcium chloride (as absorbant), ammonia (as refrigerant), and a sheet of shiny metal (the solar collector). If what one want to do is heat or cool, using solar energy this way is probably more efficient and certainly cheaper than converting it first into electricity. It would take a fair-size collector - 86 sq ft (eight sq mtr), assuming 40 percent panel efficiency - just to deliver the cooling of a small (6,000 Btu per hour or half-ton) window air conditioner. And central air-conditioning units are often 30,000 Btu or more; few homeowners could spare the space for that. In the developing world, solar powered ice makers allow locals to store the village's food or medicine without any electricity. ■

©Felix Möckel/istockphoto.com

Bio Refrigerator cools Food with Future Gel

Russian designer Yuriy Dmitriev has unveiled a fresh-looking, gel-filled appliance of the future. His Bio Robot Refrigerator utilizes a special gel-like substance that suspends and cools food once inserted. Dmitriev's design is one of 25 finalists in the Electrolux Design Lab competition, which challenged entrants with the task of redesigning modern appliances for the future. The Bio Robot Refrigerator mounts on a wall. It can be mounted horizontally, vertically or even on the ceiling. The fridge does not have a motor or other traditional technology like most refrigerators, the gel does all the work so, 90% of the appliance is actual usable space. To use the fridge you basically shove food into it's biopolymer gel which has no odor and is not sticky, it is suspended and cooled until you need it again. Dmitriev notes that the cooling agents are the "bio robots" inherent in the gel that use luminescence light generated in cold temperatures to preserve food. Viability aside, the fridge is definitely a huge step forward in terms of rethinking the design of one of their most-used appliances. Probably the best thing about this concept machine is that it uses zero energy for cooling. It just needs energy for it's little control pad. Compared to the typical modern fridge, which uses about 8% of a household's energy, this nifty-looking gadget of the future could cut our energy use significantly. ■

Aerosense - Air Flow Measuring Station

ALM Engineering & Instrumentation P Ltd, an ISO 9001 certified company is basically into instruments related to measure and control of pressure including differential pressure, flow, temperature, relative humidity and level, The company is either manufacturing or importing quality precision instruments for HVAC, BAS, EMS, textile and industrial automation. The company offers Duct Mounted and Airflow Measurement Station. The air flow measuring station is easy to install. The instrument utilizes an airflow averaging element in a head-type device, generating a differential (velocity) pressure signal similar to the orifice, ventury and other head producing primary elements.

Strategically located sensing ports continuously sample the total and static pressures when inserted normal to flow. Total pressures sensed by the upstream ports are continually averaged within the airflow element in an isolated chamber.

The static sensing ports are averaged in a second isolation chamber. Multiple element are joined together for connection to a differential measurement device (gage, transmitter, etc) for flow measurement and indication purposes.

Specifications

Accuracy: +/- 3%; Temperature: Maximum operating, 350 deg f.; Maximum designed flow: 6000 feet per minute; Casing: CRCA duly powder coated; Pressure Sensors: SS 304 duly buffed; Pressure ports: SS 304. ■

Website:
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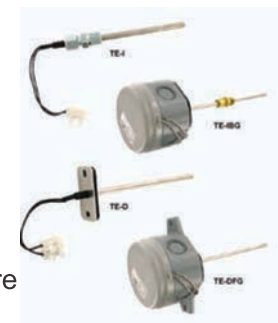

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