Cooling the industrial workplace efficiently

Air cooling offers energy-efficient cooling

WHITE PAPER

Cooling

industrial workplaces efficiently

Introduction

In much of the world, cooling is a significant challenge. As average global temperatures rise, a bigger proportion of the world's resources will go towards cooling habitats. On account of sheer scale, the cooling demand for commercial & industrial premises far outweighs the demand from residential properties.

As economies grow and the world gets more urbanized, the power consumed to cool homes and offices is expected to surge 33-fold by 2100.

Traditional methods of cooling are woefully inefficient. Cooling techniques are either too expensive to operate or compromise on ventilation. Well-ventilated cooling solutions are unable to reduce indoor temperatures to a convenient degree.

For too long, indoor cooling has implied employee health, financial or environmental compromises. However, 'air cooling' involves none of these compromises. It offers a greener and more affordable way of cooling.

Rising temperatures and the industrial workplace

Global temperatures have been rising steadily. According to NASA, the average global temperature has risen 0.15-0.20°C per decade since the 1980s [1].

Climate change and minor increases in average global temperatures could make certain parts of the world tremendously hot. As ambient temperatures rise, the demand for cooling is expected to grow. As economies grow and the world gets more urbanized, the power consumed to cool homes and offices is expected to surge 33-fold by 2100[2]. Commercial properties in Singapore, for example, already spend 40% of their energy budget on cooling[3].

India could perhaps bear much of the brunt of this global phenomenon. The country is already located in one of the hottest regions in the world.

In a heat stress report CR-1205 (1), NASA found that temperatures over 75^0F negatively affects both productivity and accuracy of work.

A research study conducted by IIM-Ahmedabad has revealed that worker's productivity can be enhanced up to 12% be increasing the level of thermal comfort at the workplace. Research shows that the optimal range of ambient temprature for enhanced worker's productivity is about 23-30^0C. Improvement in productivity can be gained through establishment of cooling solutions at workplaces.

Traditional Solutions

Air-conditioning

Air conditioning has been the most popular technology for dealing with high temperatures. But, there are obvious disadvantages to this form of cooling. Air conditioning is expensive and offers little ventilation. By lowering temperatures and reducing humidity, air conditioners tend to have an adverse impact on the human body. Constant exposure can cause dry skin, fatigue, chronic illnesses, and breathing problems[4].

For better ventilation, commercial property owners have other options. Circulating fans, roof extractors, and exhaust fans all lower temperatures and offer great ventilation. These systems are far more eco-friendly and require far less energy, which means lower energy costs and a small carbon footprint. However, they are unable to provide the required level of cooling.

Circulating fans

Circulating fans can reduce human skin perceptible temperatures but the difference is negligible and only possible if air speeds are higher than 6.4 kilometers an hour. Exhaust fans and roof extractors can only extract dust and pollutants from indoors and have no effect on ambient temperatures.

These are some of the compromises of traditional cooling technologies. But there is a better solution.

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3. https://www.theguardian.com/sustainable-business/2014/oct/01/energy-efficient-air-conditioning-breakthrough
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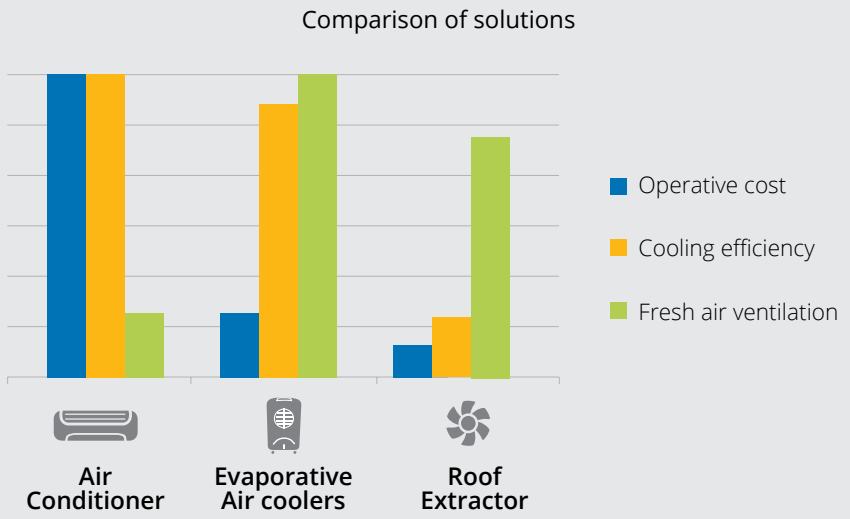
Maximized cooling with minimized costs

Evaporative air cooling is a solution that maximizes cooling while minimizing costs and carbon emissions. It is a well-balanced cooling technique that is significantly more efficient than traditional cooling methods.

Evaporative cooling is the most natural way to cool structures. It works by evaporating cool water to cool air around it. The water vapor is able to significantly reduce surrounding air temperature.
A study conducted in Thailand concluded that office-goers and factory workers were able to adapt to this natural, non-refrigerated cooling much better if their bodies were not already accustomed to artificial cooling from air-conditioners[5]. In other words, the body is more comfortable when the surroundings are cooled naturally.

Air cooling offers considerable advantages over traditional cooling technologies



There are a number of other advantages of air cooling:

- Evaporative air coolers are more cost-effective since the process consumes 80% less energy.
- Air cooling devices are weather resistant and require less maintenance.
- Efficient air coolers can reduce dry air temperatures to nearly 95% of the wet-bulb temperature[6].

Here's how the technique stacks up against the most popular cooling technology - air conditioners. As the figure above denotes, air conditioners offer considerable cooling efficiency and can lower the temperature to a set degree. However, this system is also remarkably energy-hungry, which leads to higher operating costs. A study found that the parasitic power consumption of air conditioners was just as high as the operational consumption, which effectively doubled the cost of running an air conditioner[7]. AC units also severely block ventilation and circulation of fresh air within a confined space.

Roof extractors are cheaper alternatives, but they compromise on the cooling efficiency.

Only evaporative air coolers can offer great ventilation and effective cooling at lower operational costs.

References:

5. http://www.sciencedirect.com/science/article/pii/037877889290016A
6. https://www.ashrae.org/resources--publications/handbook/2016-ashrae-handbook-hvac-systems-and-equipment
7. http://www.nrel.gov/docs/fy15osti/60801.pdf

Air coolers vs. air conditioners

	Air Conditioner	Air Cooler
Fresh Air Ventilation	Poor	Excellent (reduces age of indoor air)
Suitable For High-Temperature Environments	No	Yes
Suitable For Dry Climates	No	Yes
Air Blast	Low	High (+ Air Chill Effect)
Capital Costs	High	Low (1/8th of air conditioners)[8]
Power Spike	Yes (at startup)	No (due to lack of compressor)
Carbon Footprint	High	Low

Evaporative air cooling vs. air conditioning

Industrial Air Cooler Model	Dry bulb Temp, ^{0}C	Humidlty, % RH	Drop in Temp, ^{0}C	Air Delivery, kg/s	Cooling Power, kW	Evap Air Cooler's Power Consumption Watt	Evaporative Air Cooler EER, w/w	Total Carbon Foot-print savings six months in using evaporative air cooler vs. air conditioner	Tonnes of natural gas to be burnt to generate heat equivaient to the heat released by air conditioner in 6 months
SPS60	44	20	17.1	33.9	583.1	18400	31.7	1051	258
SPS28	44	20	17.1	15.3	262.4	11040	23.8	459	116
SPS18	44	20	17.1	10.2	174.9	5520	31.7	315	77
SPS09	44	20	17.1	5.1	87.5	2208	39.6	160	39
SPS06	44	20	15.2	3.4	51.8	736	70.4	98	23
SPS04	44	20	15.2	2.3	34.6	552	62.6	65	15
CFD48	44	20	15.2	12.4	190.1	1472	129.1	366	84

An apples-to-apples comparison of air coolers and air conditioners shows how industrial coolers can significantly reduce the carbon footprint and the tonnes of natural gas required to cool a commercial space over a six month period.

Consider an example: the Symphony SPS60 model would reduce the carbon footprint by over 1051 points and save 258 tonnes of natural gas consumption over a six month period (assuming a steady level dry bulb temperature and humidity). Bigger and more powerful air coolers deliver more air (ventilation) and have a more noticeable impact on ambient temperatures. The energy savings scale alongside the size of the commercial cooling equipment.

In other words, air coolers consume just 1/10th the power need for an air conditioner.

This effectively means:

- Low size transformer
- Low size captive power requirement
- Low sized cable
- Low size control switchgear

References:

8. "Evaporative cooler/ Evaporative cooler". Waterlinecooling.com.

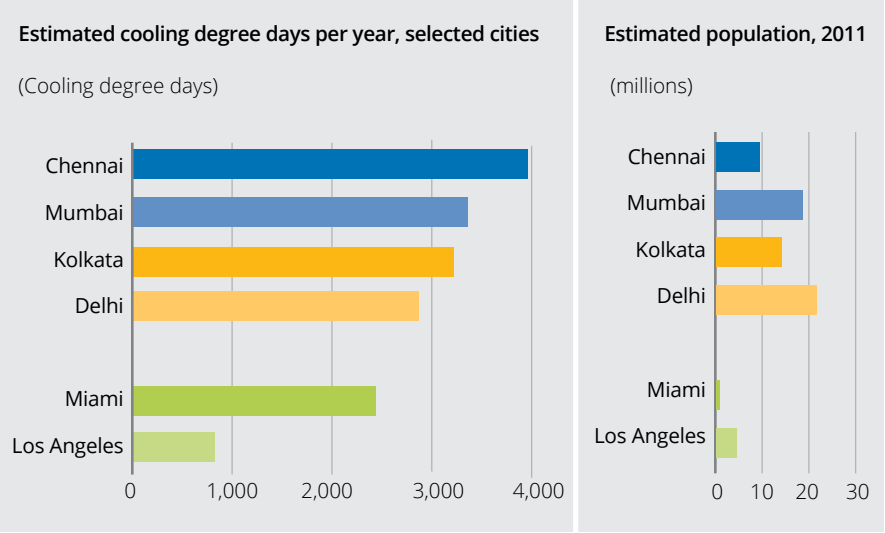
Need for regulatory incentives in emerging nations

Governments and local authorities are under renewed pressure to limit carbon emissions. Commercial entities are offered incentives to limit the carbon footprint of their equipment and properties.

The state government of California, for example, offers an interest-free loan for commercial projects that can reduce the carbon footprint of the business. California also offers a rebate of up to $300 for replacing air conditioners with air coolers. Similar rebates and incentives are available in other states[9]. The EU also has a number of rebates and incentives for projects that can boost energy-efficiency in this way[10].

These schemes can be replicated in emerging economies like India and China. Currently. neither country offers any special incentive or rebate for energy-efficient cooling projects. A tax rebate, subsidy, tax exemptions, or low-interest loans could help institutions replace their air conditioners and invest in eco-friendly air coolers.

Implementing energy efficient solutions for comfort cooling in industrial and commercial applications will have a vast and long lasting effect on the overall energy scenario in the country. The Indian Bureau of Power and Bureau of Energy Efficiency (BEE) can help encourage this technology through programs and incentives[11]. Authoritative actions and decisive implementation will reduce the energy and environmental impact of the growing demand for cooling in India.



Source: U.S. Energy Information Administration, based on Energy Policy
Note: Cooling degree days shown here are based on a 65 °F (18 °C) base temperature.

Considering the demand for cooling in India, the BEE has already implemented minimum standards for air cooling technologies throughout the country. According to the Lawrence Berkeley National Laboratory, these standards could potentially help save 27 terawatt hours of energy use by 2020 (14% of total energy use for cooling)[12].

References:

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10. https://ec.europa.eu/energy/en/topics/energy-efficiency
11. http://eco3.org/news/Technical%20Session%20I/BEE-SANJAY%20SETH.pdf
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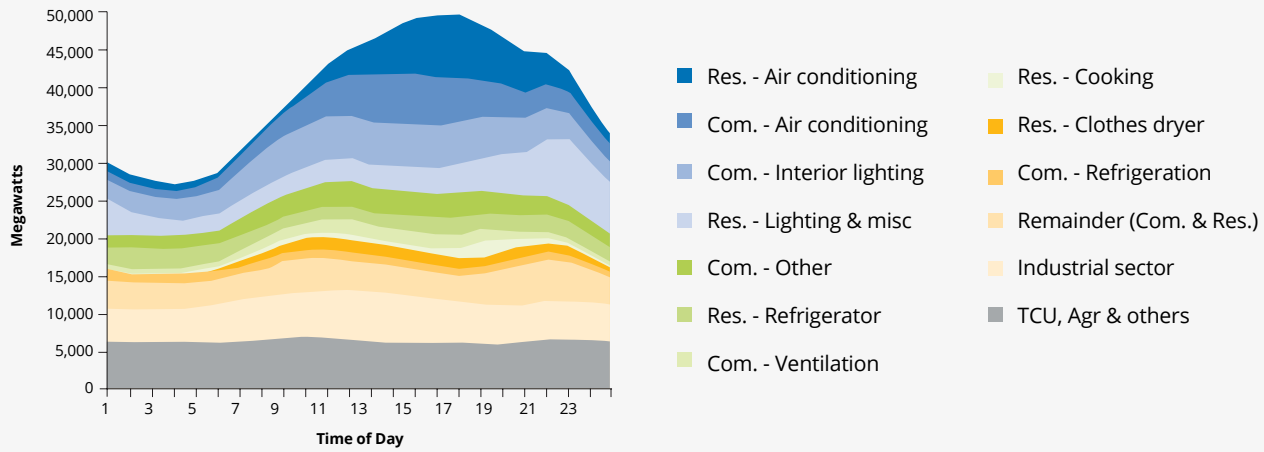
Need to reduce peak demand

India's energy grid is unable to keep up with rising demand. During 2012, cities across the country frequently experienced rolling blackouts during the summer season. Similarly in 2015, the country experienced an intense heat wave where average temperatures were consistently a couple of degrees higher than historical averages and the heat was intense enough to melt roadways[13].

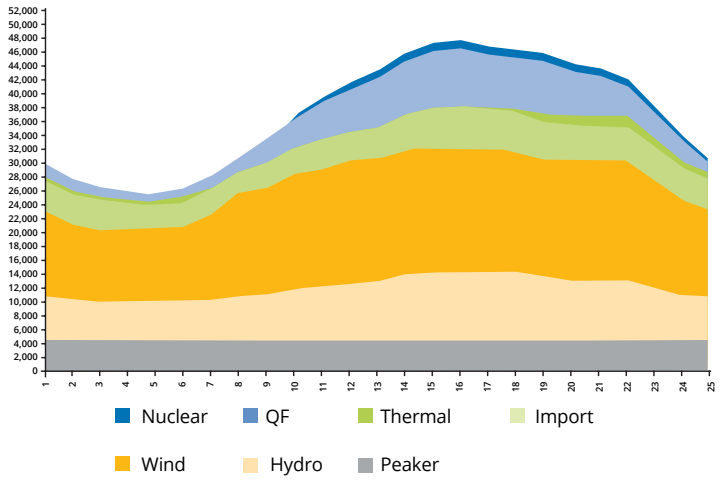
Cooling has the biggest impact on the nation's power grid and the current level of infrastructure is unable to keep up with rising demand. Authorities may have to act on this sooner than later.

The impact of air conditioners on peak demand



Source: White paper published by Turbine Inlet Association Cooling (TICA) in Nov 2009 in US

Power generation costs increase with peak demand



Source: TICA 2009 USA

Reducing peak demand and power consumption would mean setting standards for the inductive load of cooling machines. This will also lead to a reduction in the carbon footprint of commercial premises. A regulatory push for higher efficiency will reduce the load on the power grid, push down electricity costs and collectively boost the country's GDP[14]. BEE and the Ministry of Power may find that setting higher efficiency and green standards for cooling in India is inevitable[15].

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14. http://www.cleanenergyministerial.org/News/sead-and-india-bureau-of-energy-efficiency-host-workshop-on-enhancing-space-cooling-efficiency-and-demand-response-565
15. http://powermin.nic.in/en/content/energy-efficiency

Conclusion

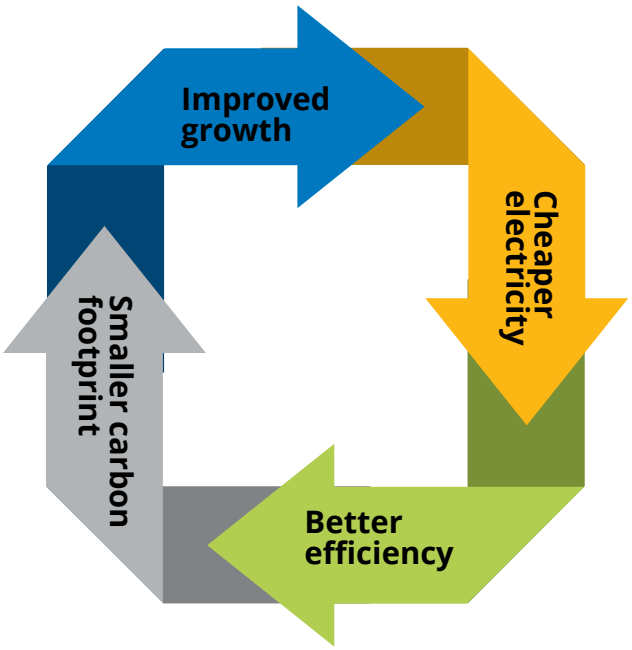
Energy efficient solution for industrial cooling

Air cooling strikes a fine balance between costs, environmental concerns and effectiveness.

Air coolers are cheaper than air conditioners, offer better cooling than circulating fans, and better ventilation than roof extractors. Perhaps the biggest advantage of air coolers is their impact on the carbon footprint. Air cooling is remarkably eco-friendly, which is why governments around the world offer incentives and rebates for companies that install them. These rebates and incentive schemes can be replicated in emerging economies like China and India.

The alignment of all these benefits could encourage commercial entities to replace their air conditioners and roof extractors with comprehensive air cooling technology. Air coolers finally make affordable and green cooling accessible.

Government interventions for energy efficiency will reduce costs as the need for cooling grows. The aggregate value of these cost reductions could have a noticeable impact on India's economy over the long-term. As the country becomes more energy secure resources could be better utilized to drive economic growth.



About Symphony

Symphony is the world's #1 air cooling company. We have been cooling the world since 1939. We don't just create game-changing air cooling solutions; we evolve air cooling through a pioneering spirit that is unequalled in the industry.

For more information, contact corporate@symphonylimited.com
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