A cool way to beat the heat

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SMART SYSTEMS

16 | HOME BUY EXPRESS | JANUARY '16

A cool way to beat the heat

Instead of air-conditioner units in individual homes, it is more efficient to have community cooling towers so that the ambient heat does not surge

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Rapid urbanisation has resulted in congested cities and many buildings are constructed cheek-by-jowl. Buildings made of materials such as concrete have high thermal mass which means that a lot of heat from the sun gets absorbed by the material. Where there is good wind circulation, the heat gets absorbed by the moving air and released into the upper atmosphere through convective currents.

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energy efficiency of apartments in their design and air-conditioners are installed by occupants themselves. Since the buildings are not designed to be air-conditioned, significant cooling is lost through un-insulated walls and windows. Furthermore, as explained earlier, condensers end up getting stacked up one atop the other and this results in heat build-up.

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Rapid urbanization has resulted in congested cities and many buildings are being constructed too close to one another. Closely spaced buildings obstruct the flow of wind and heat gets trapped in their premises. Buildings made of materials such as concrete have high thermal mass which means that lot of heat from the sun is absorbed and stored by the material. In areas with good wind circulation, this heat is absorbed by the moving air and is released into upper layers of the atmosphere through convective currents. But when air is stagnant, buildings are not able to release heat into the atmosphere and the temperature of air around buildings increases. There is documented evidence of higher temperatures of up to 7^{o}C in heavily built-up areas compared to open areas. This phenomenon is widely known as urban

heat island effect. Because of this effect, areas where the temperature had previously been around pleasant 27 ^{o}C have now very uncomfortable temperatures of above 34 ^{o}C.

As temperatures rise and people feel uncomfortable, they install air conditioners in their homes. Split unit air conditioners have become very affordable and their sales have been rising exponentially. What many people do not realize is that these systems aggravate the urban heat island effect. The split units work by pumping heat from inside the building to the outside. In the indoor unit, the refrigerant is forced to evaporate through suction pressure and in the process, it absorbs the heat from the room (latent heat of vaporization). In the outdoor unit, the compressor pressurizes the refrigerant gas causing it to condense back to liquid and release the latent heat. This heat is released to the exterior by blowing air over the condenser coils. In multi-storey buildings there are many flats with air conditioners and their condensers are stacked up outside the building at close spacing. The hot air from one condenser rises to the one vertically above which prevents the second one from rejecting heat efficiently. The efficiency of air conditioning drops when the ambient air temperature rises and heat is not rejected efficiently. Then the equipment consumes more electricity to remove the same amount of heat. The additional electrical energy consumed by the equipment also gets converted into heat. This causes further heat buildup. As temperatures keep rising, neighbors are also forced to install air conditioners to reduce discomfort. This is a vicious cycle.

The ideal solution to prevent the above phenomenon is to avoid air conditioning. However, this idea is not easily accepted by most people, because thermal comfort is generally given greater importance than energy and environmental issues. Thermal comfort is also linked to higher work productivity and occupant satisfaction. In Singapore, the Housing Development Board (HDB) wanted to discourage air conditioning in residential apartments and all the buildings were designed to be naturally ventilated. However, today most HDB flats have air conditioners installed by occupants themselves. In India, we face a similar situation. Most developers do not consider energy efficiency of apartments in their design and air conditioners are installed by occupants themselves. Since the buildings are not designed to be air conditioned, significant cooling is lost through un-insulated walls and windows. Furthermore, as explained earlier, condensers end up getting stacked up one over the other and this results in heat build-up.

In this situation, developers can take steps to reduce the magnitude of the problem. Instead of letting occupants install split units themselves, if provision is made for centralized cooling and heat rejection, some of the problems can be eliminated. The concept of district cooling has been tried successfully in many countries. In district cooling, chilled water needed to cool many apartments are produced centrally and supplied to individuals based on demand. Occupants simply need to connect the chilled water supply pipes to their apartments and install indoor units that use the chilled water for cooling. The occupants are billed based on actual usage of chilled water. The centralized plant enables higher cooling efficiency. The cooling efficiency is measured using a parameter called the Coefficient Of Performance (COP). A normal split unit has a typical COP of around 3. This means that three units of heat can be removed using one unit of electricity. High capacity chillers used in centralized air conditioning have COP values as high as 6. This results in a reduction of 50% of air conditioning energy compared to a split unit. Again, since the heat is rejected using centralized cooling towers typically

installed on roof tops, heat does not accumulate around the building facade. Large cooling towers are more efficient in rejecting heat compared to the outdoor units of split units. Natural heat sinks such as water bodies and spray ponds have also been used for heat rejection in district cooling systems.

Installing district cooling involves additional capital expenditure which could increase the cost of flats. This might be a barrier to its adoption. However, it should be noted that clients are increasingly aware of issues related to sustainability and energy consumption. People now understand that if the current steep increase in energy demand continues, we will soon end up in a situation of severe power cuts and consequently, it will incur higher costs for ensuring reliable power supply through alternative means. Any measure to reduce energy consumption benefits the society in general, and the district cooling solution seems to be one that is easily implementable.