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Air-conditioning units at the back of shophouses in Amoy Street in 2022. Air-conditioning has become an integral of part of the daily lives of Singaporeans, be it at home, in the office or at the shopping mall, says the writer. But this love affair comes at a cost – both economic and environmental. ST PHOTO: LIM YAOHUI

Homes need central cooling systems in a hotter Singapore

Conventional air-conditioners are not only energy-intensive, but also rely on harmful refrigerants, which contribute to ozone depletion and global warming.

Kavickumar Muruganathan

Air-conditioning was, in the words of Mr Lee Kuan Yew, the visionary founding father and first prime minister of modern Singapore, perhaps one of the "signal inventions of history".

"It changed the nature of civilisation by making development possible in the tropics," he said.

"Without air-conditioning, you can work only in the cool early-morning hours or at dusk. The first thing I did upon becoming prime minister was to install air-conditioners in buildings where the civil service worked. This was key to public efficiency," he added during an interview in 2009 published in the New Perspectives Quarterly.

Situated just about 137km north of the Equator, Singapore has always had to grapple with hot weather and humidity. Hardly surprising, therefore, that it is among the top countries in the world in terms of air-conditioning use.

Air-conditioning has become an integral part of the daily lives of Singaporeans, be it at home, in the office or at the shopping mall. About 80 per cent of all Singapore households have air-conditioners. And 99 per cent of private residences here are equipped with air-conditioners.

THE COST OF AIR-CONDITIONING

But this love affair with air-conditioning comes at a cost – both economic and environmental. Household electricity consumption has surged by over 17 per cent in the past decade, mostly due to the increased use of air-conditioning.

Air-conditioning alone accounts for a quarter of an average household's electricity consumption. Collectively, both residential and commercial buildings contribute significantly to Singapore's carbon emissions, with air-conditioning playing a significant role.

Ironically, while air-conditioning helps us stave off the heat outdoors, it contributes to global warming at the same time. Air-conditioning alone could account for up to 40 per cent of the world's remaining carbon budget by 2050, according to the World Economic Forum. Singaporeans must hence balance their personal comfort with environmental responsibility.

Conventional air-conditioners are not only energy intensive, but also rely on harmful refrigerants, which contribute to ozone depletion and global warming. Thus, there is an urgent need to shift to environmentally sustainable alternatives.

THE TENGAH MODEL

Cooling with chilled water via centralised systems is one such option that leads to lower energy consumption and cost savings.

The centralised cooling system built in Tengah new town, a first of its kind in Singapore, is said to be 30 per cent more energy-efficient when compared with the use of split-unit air-conditioners in households. Any reduction in energy consumption will go some way in contributing towards Singapore meeting its carbon emissions reduction targets of peak emissions in 2030 and net zero by 2050.

Both the centralised chilled water cooling system and the conventional split-unit air-conditioning system use indoor cooling units to absorb warm air from inside the home before cooling it. The fundamental difference is that one uses chilled water for cooling and the other relies on refrigerants.

Split-unit air-conditioners have individual indoor units that connect to outdoor compressors that contain refrigerants. On the other hand, centralised cooling systems rely on efficient commercial-grade chillers installed on the rooftops of apartment blocks that produce chilled water piped directly to the indoor cooling units within each HDB flat. Heated air absorbed by the system is channelled back to the chiller and released into the atmosphere.

With the centralised cooling system in Tengah, home owners will know the exact amount of chilled water used to cool the flat, allowing them to control usage. Centralised cooling systems also do away with the need for condensers, reducing the hassle of maintenance and its associated cost.

But, like any new system being implemented, there are bound to be implementation issues. Recently, some residents in Tengah complained about water leakages from piping systems.

From an engineering perspective in land-scarce Singapore, it is certainly challenging to install chillers that take up space, and design a chilled water piping network system to ensure energy efficiency and commercial viability. In Tengah, chillers were placed on rooftops to preserve communal spaces. Unsightly trunking due to the piping system was also a concern raised by residents, but these can be improved upon in subsequent designs for other new estates.

These teething issues should by no means be considered a setback for Singapore's plans for centralised cooling systems using chilled water for public housing. In fact, Tengah should be regarded as a stepping stone that paves the way forward to scale implementation to support the Republic's long-term climate goals.

There is a clear business case for home owners, too, with higher energy efficiency for cooling translating to lower utility bills. Given Singapore's tropical climate and the lack of land and natural resources, we need to acknowledge there are limitations on how we can keep ourselves cool and reduce our energy use at the same time, and find the best ways to achieve that.

PROVEN TECHNOLOGY

The use of chilled water as a medium for cooling is a proven viable alternative. There are numerous instances of its use elsewhere in the world in residential as well as industrial settings. In Europe, centralised cooling systems are being used to cool homes. The 2022 football World Cup matches in Qatar took place in air-conditioned stadiums, with the Khalifa International Stadium cooled using chilled water.

Even in Singapore, chilled water has been used in commercial buildings in the Central Business District (CBD). The Marina Bay CBD cooling system is set to be expanded to cool 28 commercial buildings by 2026. This is expected to lead to a reduction of 20,000 tonnes of carbon emissions annually.

Singapore's largest industrial district cooling system using chilled water will also be operational in Ang Mo Kio in 2025 – ST Microelectronics' TechnoPark. When ready, it is expected to reduce carbon emissions by up to 120,000 tonnes annually, and cut the TechnoPark's electricity consumption by 20 per cent.

The net environmental benefits for the use of chilled water in cooling systems are clear. The project in Tengah should serve as a blueprint for broader implementation across public housing developments.

FIT NEW HDB FLATS WITH CENTRAL COOLING SYSTEMS

While the retrofitting of existing HDB flats will certainly be costly, installing centralised cooling systems in new public housing developments is a win-win for residents, Singapore's climate ambition and, most importantly, the environment.

From a demand perspective, residents may be incentivised to opt for centralised cooling systems given their electricity and water bill savings, and generous warranty periods for the cooling system piping and trunking. Broadly, there should also be greater awareness creation and education among residents on the merits of centralised cooling systems.

From a supply perspective, government tenders should incorporate requirements for the installation of centralised cooling systems. These initiatives can help to scale up the development and adoption of such systems.

Staying cool is going to be even more crucial as temperatures in the tropics, including Singapore, soar because of global warming. Heat-related issues are likely to affect those who are vulnerable the most, including the elderly and sick.

Mr Lee's acknowledgement of its centrality to Singapore's growth story is a reminder that technological advancements can shape our lives in profound ways. A centralised cooling system will provide respite from the heat, and ought to be a key part of public housing.

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