The Economist

Air conditioning
No sweat

Artificial cooling makes hot places bearable—but at a worryingly high cost
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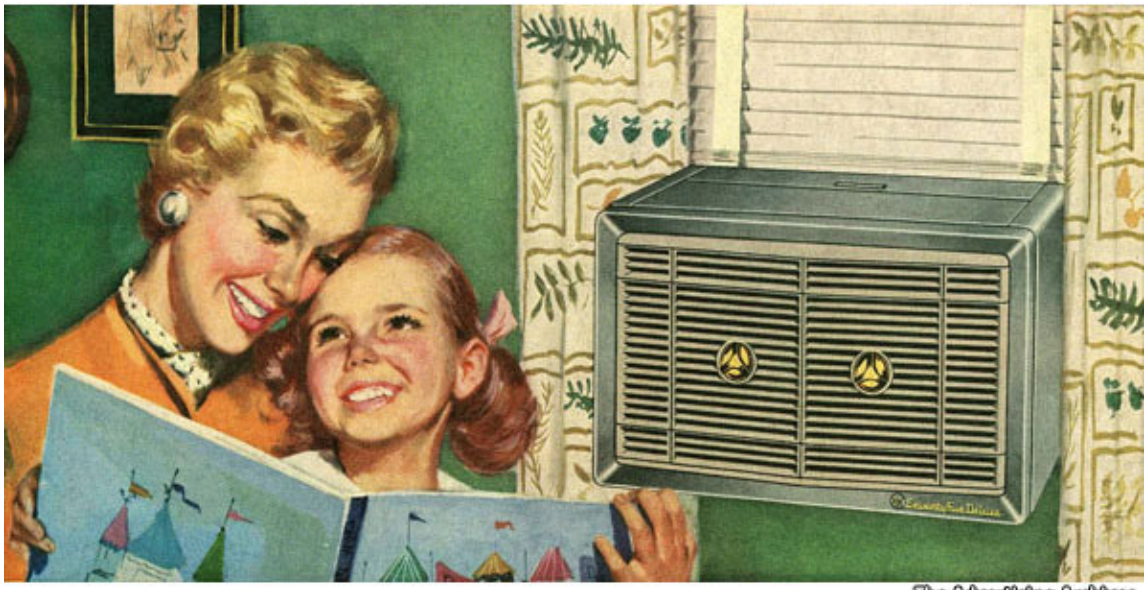


SUMMER humidity in the Gulf often nears 90%. Winds are scant. Even in the shade the heat hovers far above the body's natural temperature. No wonder that before 1950, fewer than 500,000 lived along the whole 500-mile southern littoral. Now, rimmed by the mirrored facades of office towers, gleaming petrochemical works, marinas, highways, bustling airports, vast shopping malls and sprawling subdivisions of sumptuous villas, it is home to 20m people. Their lives are made possible by "coolth"—artificially cooled air.

Yet a chorus of critics counts air conditioning as more a curse than a miracle. Though food refrigeration is an unquestioned part of modern civilisation, chilling a room causes sniffiness. In his book "Losing our Cool" Stan Cox, a polemical plant scientist, blamed it for "resource waste, climate change, ozone depletion and disorientation of the human mind and body". In 1992 Gwyn Prins, a Cambridge University professor, called "physical addiction" to cooled air America's "most pervasive and least noticed epidemic".

Related topics

Puritans sometimes forget that air conditioning was invented with the efficiency of machines, not the comfort of people, in mind. An early success came in 1902, at a printing plant in Brooklyn, New York, where shrinkage of paper due to humidity meant that differently coloured layers of ink could not be properly aligned. By the 1920s air conditioning had spread to public spaces such as cinemas and department stores. Their trade used to slump in the heat-

sodden summer. With cool air indoors, it boomed. The same technology that cools the air also cleans it: the dust-free environments for high-tech manufacturing require air conditioning.

People fare better, too. A study of government typists in 1950s America found that air conditioning raised productivity by a quarter. On factory floors it cut absenteeism and stoppages. "Air-Conditioning America", a book by Gail Cooper, cites a 1957 survey in which 90% of American firms named cooled air as the single biggest boost to their productivity. The late Nelson Polsby, a political scientist at the University of California, Berkeley, suggested that air conditioning reshaped American politics, by enabling the migration of Republican pensioners to the Sun Belt. That helped break the long-standing Democratic lock on southern politics.

A mapping project devised by William Nordhaus, an economist at Yale, revealed more proof that heat wilts economies. Using a global grid system to escape the biases of national data, he identified an almost linear correlation between mean annual temperatures and productivity per head. People in the coolest climes, he found, generate 12 times the economic output of those in the hottest. Far fewer people live at those extremes than in middling climate zones, but even in the crowded temperate band of the globe, the difference in output between hotter and cooler places was big.

Cooling also lowers mortality. In studies of what epidemiologists quaintly call a "harvesting effect", summer heatwaves have been shown to cause sudden rises in the number of deaths from cardiovascular, respiratory and cerebrovascular disease. A 2006 survey of six South Korean cities, for instance, indicated that a rise of just 1°C over normal summer peak temperatures prompted a rise of between 6.7% and 16.3% in mortality from all causes. On the hottest days during a 2003 heatwave in Spain, according to a health-ministry survey, the increase over normal mortality rates was around a quarter.

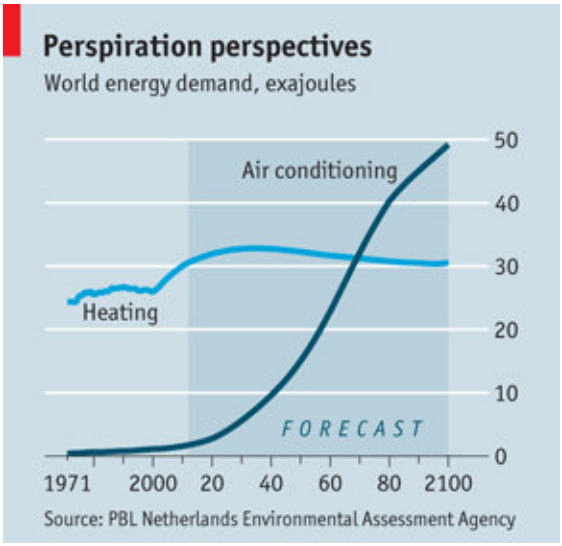
Live cool and long

Studies of heatwaves in American cities during the 1980s and 1990s observed that a good predictor for falling ill was poverty, and specifically a lack of air conditioning in the home. Surveys since then suggest that the dramatic fall in the number of Americans who sicken or die during heatwaves is a direct result of widening air-conditioner ownership, from 68% of American households in 1993 to nearly 90% today. An academic paper on deaths in Chicago related to a 1999 heatwave concluded bluntly that "the strongest protective factor was a working air conditioner."

A statewide study of summer admissions to hospital in California, published in 2010, adjusted for household income, found that for each 10% increase in ownership of air conditioning there was an absolute reduction in cardiovascular disease of 0.76%, and of respiratory disease by 0.52%, for people over 65. For places less blessed than California, where risks include insect-borne diseases such as malaria and dengue fever, or high levels of toxic particulate matter in the air, the benefits of wider air-conditioning use could be far greater.

But what about the health of the planet? America uses more electricity for cooling than Africa uses for everything, notes Mr Cox. Hotter summers and larger homes helped American energy consumption for air conditioning to double between 1993 and 2005. Cooling buildings and vehicles pumps out almost half a billion tonnes of carbon dioxide annually.

That sounds a lot. Yet air conditioning still only accounted for 8% of household power consumption in 2005, according to the most recent comprehensive survey by America's Energy Information Agency. That compares with 41% for heating, and 20% for making hot water, the necessity of which is seldom contested. (Significantly, overall energy use per American household has not risen in 30 years, because of things like better insulation and more efficient gadgetry.) Air conditioning is more energy-intensive than heating. But people use less of it. The shift in America's population from northern to southern states has cut the nation's total energy bill.



Yet rising incomes in poor countries are associated with American-style spending on air conditioning there. Between 1995 and 2004 the proportion of homes in Chinese cities with air conditioning rose from 8% to 70%. Asia already accounts for more than half the global air-conditioning market, and China alone for 70% of production. Sales of air conditioners there, boosted by government schemes that also encourage purchase of more efficient models, have rocketed. Global warming will further stoke demand. Research in the Netherlands (see chart) by Morna Isaac and Detlef van Vuuren reckons that energy demand for air conditioning will rise forty-fold this century.

Given that dirty coal-fired plants still produce some 70% of China's current energy output, anything that stokes its electricity consumption is particularly damaging in global-warming terms. But with the use of air conditioners rising inexorably, their share in energy consumption is rising too, with the added trouble that heatwaves bring sudden spikes in use, meaning that spare capacity has to be built in to provide for summer peaks in power demand. The big blackouts over swathes of India in the summer of 2012 were widely blamed on its burgeoning middle class's desire to keep cool. That may be unfair: though air-conditioning certainly stokes demand, political meddling in the power industry hampers its ability to keep the current flowing.

Thankfully for lovers of coolth, air conditioning is becoming more efficient. In the past 30 years, more stringent standards for air conditioners in developed countries have more than doubled the energy efficiency of new units. For decades, air conditioning has used the same compressor technology that runs refrigerators. But Coolerado, an American company, claims to have cut energy costs by 90%, using only water as a coolant: its devices feature specially designed plastic plates that chill by evaporation. They blast half the air, sodden and warm, back outside and send the rest, cool and dry, inside. The machines can even be solar powered (though their thirsty habits may not suit all hot places).

Where's my desiccant?

Conventional air conditioning has to overcool the air in order to rid it of moisture. This dehumidifying is the most expensive part of the process. An Israeli-founded firm called Advantix is one of a number of companies using "liquid desiccant" technology: it forces air through a strong brine solution which sucks out the moisture. Advantix says its machines cut energy consumption by half. Using plentiful night-time energy to iron out daytime peaks can work, too. A Californian company has a product called Icebear that makes and stores ice cheaply at night to cool buildings during the day.

Such changes are even more beneficial if they avoid using refrigerant chemicals such as freon. These air-conditioning coolants leak into the atmosphere and are among the more potent greenhouse gases. Even less polluting coolants that have widely replaced earlier kinds produce warming effects that are 2,000 times more powerful than carbon dioxide's. International protocols have only slowly phased out the worst, ozone-eating gases. But in the meantime, much slow-to-replace old equipment in rich countries, as well as factory-fresh units in poor ones, still rely on older pollutants which are, to boot, still smuggled in large quantities to countries where they are meant to be banned.

What may be harder to mitigate are the subtler negative impacts that air conditioning has had on the environments where people live and work. Since the 1940s, climate control has prompted architects to lower ceilings and scrap such pleasant features as balconies and porches, which leak costly cooled air into the outside world. Instead of being spaced to allow air to circulate, or being built around courtyards, buildings have tended to be boxlike and tightly packed together. That can create "heat canyons" where each building's air-conditioning unit runs at full throttle in a futile race against its neighbours. In the sprawling conurbations of the American South, as in the Gulf and cities such as Singapore, people seeking company find fewer free communal open spaces, and are herded instead into commercialised indoor venues such as shopping malls.

Fan dances

Perhaps the most ambitious response to such problems comes from Amory Lovins, of the Rocky Mountain Institute, a think-tank that promotes energy efficiency. He argues that a combination of thoughtful design and new technology can minimise or even eliminate the need for air conditioning. His approach starts with architecture: avoiding dark-coloured external surfaces, using trees and other shade providers, and installing proper insulation and modern windows that let in light but reflect heat. These may be expensive to install, but hugely cut the need for cooler air—and hence the cost of providing it.

Nor is air conditioning the only way to lower the temperature indoors. Spraying water on a roof provides natural chill through evaporation, as do draught towers. "Many civilisations mastered these arts millennia ago," Mr Lovins notes. A profusion of indoor plants help cool a room, as do cleverly designed floors that conduct heat into the ground. Modern fans and mesh chairs can reduce the sensation of uncomfortable heat: the aim, after all, is to cool people, not buildings. For all that, the millions who have experienced the invigorating blast of cold, dry air on a hot muggy day will be loth to abandon it.

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