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Monitor

In the moment of the heat

One way to keep warm is to heat people rather than expending energy heating the buildings they are in

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BUILDINGS are horribly inefficient consumers of heat. In winter, a vast amount of energy is wasted heating empty homes during the day, and warming empty commercial buildings at night. Even when buildings are in use, unoccupied spaces are routinely kept at the same temperature as those that are occupied. Some spaces in particular are spectacular heat wasters. The huge atriums that for many firms serve as corporate status symbols are usually occupied by no more than a handful of people, yet every cubic foot is kept warm around the clock. Small wonder that the heating, ventilation and air conditioning (HVAC) of buildings accounts for 13% of total energy consumption in America.

A 2012 paper published in the journal *Energy and Buildings* unsurprisingly found that the operation of HVAC systems in two buildings at the Massachusetts Institute of Technology (MIT) closely tracked factors such as outside temperature. But it also revealed a distinct lack of correlation between building occupancy and the amount of energy supplied by its HVAC. This makes little sense, because apart from the modest ambient heat required to stop water pipes from freezing, it is people rather than buildings who care about being comfortably warm.

Carlo Ratti, director of MIT's Senseable City Laboratory and a co-author of the paper, was



musings on this while sitting outside a restaurant being warmed by one of those tall, mushroom-shaped infra-red heaters. Might it be possible, he wondered, to aim such heat more accurately at people as they move around? Thus was born his lab's "Local Warming" project, a prototype of which is on display at the 14th International Architecture Exhibition being held in Venice until November 23rd.

The installation in Venice, along with one which Dr Ratti and his team set up in the exterior "porch" beneath MIT's stately main entrance, uses a combination of powerful infra-red lamps, clever optics and servo motors to direct beams of heat at people. The location and trajectory of the people are tracked by a Wi-Fi-based system that was also developed by the university. Another more compact and cost-effective prototype replaces the moving lamps with arrays of infra-red LEDs and "targeting" optics that simply switch on and off as people come and go. The LED arrays have no moving parts and could, for example, easily replace false ceilings in office buildings.

Warm encounters

Local Warming can work with a smartphone app that enables each person to set their own preferred temperature. Each individual is warmed by a number of LEDs to avoid the feeling—all too common in the vicinity of mushroom lamps—that only part of their body is being heated. "It's almost like having a personal sun following you around," says Dr Ratti, although if you inadvertently leave your phone on your desk you get to shiver at whatever baseline temperature the building's general HVAC system is maintaining. And if two or more people are chatting at the water cooler, they may find their temperature preferences momentarily mixed.

Local Warming's efficiency and cost savings are hard to calculate. If there are enough people in a locally warmed space the system will reach saturation, and its efficiency will be no greater than a conventional HVAC installation. But in a large, intermittently populated space such as an atrium or lecture hall, Dr Ratti believes the energy used for heating could in theory be cut by up to 90%. As his team develops the technology and installs it more widely, it will glean more accurate data on savings.

Whether such "active" heating systems gain widespread adoption will depend on those numbers, and also on how costly they would be if mass-produced. But Local Warming is clearly sparking heated interest. The American government's Advanced Research Projects Agency-Energy, which backs research and development of energy technologies, has already set aside \$30m to help get similarly heart-warming projects off the ground.

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