Climate Change : Climate Solutions

Heat from the Street

Engineers are experimenting with innovative systems that capture and recycle energy from the heat generated by human bodies packed into train stations or the solar energy absorbed by the asphalt on roads.

Road energy system like this installed in Rotterdam, Netherlands can deliver enoug energy to heat huge buildings (Photo: Ooms Avenhorn Holding)

Depending on the level of activity, the human body generates about 60 to 100 Watts of energy in the form of heat, about the same amount of heat given off by the average light bulb. All day, every day, the body is switched on.

About 250,000 human light bulbs hurry through Stockholm Central Station each day, burning brightly as they rush to catch trains, giving off enough heat to raise the temperature of the cavernous building to a constant 22-25 degrees Celsius (71-77 degrees Fahrenheit).

This is too warm, and so the station uses power to cool the air inside. This is doubly wasteful: wasteful of the excess warm air, and wasteful of the power used to cool that air.

People powered vs. central heating

The energy-efficient answer, devised by state-owned Swedish property developer Jernhusen, is to draw the excess body heat out of the station through heat exchangers in the ventilation system. That energy then heats water that is piped to theKungsbrohuset, a new 40,000 square-meter complex designed by Jernhusen. In this way, the Kungsbrohuset will get about 30 percent of its heating from Stockholm Central Station. Karl Sundholm, the project leader, says the system will cost only between 30,000 and 40,000 Euros.

“The pipes are already in the ground,” says Sundholm. “Payback time is just a few years. And if we include the reduction of cooling in the station the deal is even better.”

Through this and other measures, the goal is for Kungsbrohuset to use half the energy typically used by conventional buildings of similar size.

This concept has been applied elsewhere. The largest shopping mall in the world, the Mall of America in Minnesota, does not have a central heating system, despite the region's freezing winters. It relies on the body heat of busy shoppers, along with sunlight and superior insulation.

The Kungsbrohuset project in Stockholm, however, is perhaps the first attempt to transfer body heat from one building to another. If successful, it could spark some radical thinking about how to use the energy generated by ever-expanding urban populations.

"Say you could move energy (heat) from all residential areas to offices during the morning hours, and vice versa during the afternoon," says Sundholm. "Is it possible? And what would be the effect?"

Asphalt to aquifer

Humans are not the only under-used source of heat. Cities like New York and Tokyo swelter in the summer because the dark asphalt on the roads absorbs the sun's rays so efficiently, pushing temperatures up to 45 degrees Celsius (113 degrees Fahrenheit).

A Dutch building company, Ooms, is now trying to harness that energy via a series of connected water pipes embedded in the asphalt, using it to both heat and cool its headquarters. The Ooms technology, called Road Energy Systems, works a little like heat pumps, only it's not the Earth but the asphalt that heats the water in the pipes in summer. The hot water is then pumped into an underground aquifer where heat exchangers extract the energy from the circulating water before it returns to the surface.

The aquifer acts as a heat store, which in winter can be tapped by pumping water through the aquifer, up to the surface, and into the building. It can also be circulated through the pipes in the asphalt, preventing the road from icing up.

Once that water cools, it is sent underground to a second aquifer – a cool water store – thatis used in summer to keep the Ooms building cool. It also prevents the asphalt from overheating and softening in the summer heat.

Such systems are now installed on a motorway flyover in Rotterdam and also in Scotland, where an installation by Invisible Heating Systems (IHS) generates 108 megawatts a year from a 400-square-meter parking lot, which heats a 1,500-square-meter office building and adjacent workshops.

Positive energy balance

"We can extract about 270 kilowatts per square meter a year, about half that of a solar panel on a roof," says Henk Verweijmerem, technical

director at IHS. “But the cost is about a twelfth that of a solar panel, and there are a lot more square meters of tarmac available. If all the motorways in Holland were covered, we could create more power than all the power stations in Holland. People don’t realize how much power the sun has.”

The problem, however, is that while the sun provides the power, the Earth does not always provide a place to store it, and not every parking lot or motorway is close to a suitable aquifer.

To avoid using too much energy ripping up roads when installing the system, the pipes should be installed during road maintenance or when new roads, car parks, or airport runways are constructed. As for the environmental cost-benefit equation, Verweijmerem claims that for every kilowatt of electricity his system needs to pump water around the pipes, it generates 25 kilowatts of heat. “

A supermarket, with a heating and cooling system spread over 5,000 square meters, could reduce its carbon footprint by 70 percent,” he says.

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