The perverse cycle of a warming climate and the rise of air conditioners

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"Mad dogs and Englishmen go out in the midday sun," Noel Coward famously sang in 1931, mocking British colonials who ventured out into the scorching midday sun at the hottest time of day. "The Dutch also still think the sun is their friend," says researcher Lenneke Kuijer. During the August 2020 heat wave she investigated how Dutch households deal with hot weather. "It's time for change while it's still possible," she believes.

"Less air conditioning, more outdoor shading and a different way of dealing with heat."

The number of tropical days in the Netherlands is increasing rapidly. Only a hundred years ago, the temperature rose above 30 degrees Celsius on average about one day a year. Now it is already an average of five times a year, with a peak of 8 days in 2020.

And the problem will only get worse in the coming decades, not only in the Netherlands, but also elsewhere in Europe. According to the latest models, heat waves (five consecutive days above 25 degrees Celsius, including three above 30) will not only become more frequent in the second half of this century, but also hotter and longer lasting. The cause, it is now generally accepted, is the greenhouse effect.

Air conditioners: easy and fast

What to do? You can of course try to prevent the greenhouse effect (or mitigate it, as attempted in the Paris climate accords), but many people are not waiting for that. "They are already choosing the easiest and fastest solution: air conditioning," says Lenneke Kuijer, researcher at the Future Everyday Group at the Faculty of Industrial Design. Through interviews, she investigated into how Dutch households deal with hot weather.

"As a society, we're in danger of becoming more and more dependent on mechanical cooling to keep our heads and bodies cool, which is not only inefficient, but also unhealthy. Look at what happened last year, during the August heat wave here in the Netherlands. Essent, one of our main energy providers, saw energy demand increase by 30 percent then."

"This is something that concerns me greatly. The increasing demand for air conditioners and the increasing energy consumption of these devices

are jeopardizing our goal of reducing CO_2 emissions. Not to mention the fact that the coolants in many air conditioners act like a super greenhouse gas. The irony is that in our effort to stay cool, we are actually making the earth—and our immediate environment—even hotter."

How does an airconditioning system work?

There are two forms of air conditioning. The simplest (and least sustainable) form is the mobile air conditioner, which dissipates heat through a hose to the outside. Mobile air conditioners are eagerly sought after during tropical days, but they don't work as well then, especially if the hole through which the hose goes is not properly sealed.

The second system is known as split air conditioning, a fixed air conditioner that consists of two parts. The indoor unit contains a fan that picks up heat from the air and transfers it to a heat exchanger containing a refrigerant (usually hydrofluorocarbons, a notorious greenhouse gas). By evaporating, it removes the heat from the air and thus cools the room.

A compressor carries the hot gas to the condenser in the outdoor unit. There the gas condenses and becomes cold refrigerant again. A heat pump, increasingly in demand to generate heat from air, is also a type of air conditioning, but works in reverse.

There are also heat pumps that can cool. A key difference between these pumps and air conditioning is that heat pumps cool the home itself and not the air, making the effect more permanent. In addition, ground source heat pumps are extra efficient because they can store heat while cooling. This can later be used again as 'free' heating.

One in five Dutch households now has an air conditioning system and 15 percent are considering buying one. Worldwide, some 3.6 billion cooling

devices are in use, reports the UN. That number could rise to 14 billion by 2050, if everyone who needs cooling can afford it.

According to Kuijer, people often purchase air conditioners for two reasons: they want a cool bedroom and to be able to work cool. Especially during the corona pandemic, when many people were forced to work fromo home, the latter was the deciding factor.

Research

Kuijer interviewed 21 households, with a total of 60 residents between the ages of 0 and 70, both renters and homeowners. They lived in houses built between 1910 and 2019. According to her, the interviews and the diaries provide a representative picture of how the Dutch deal with heat and offer good leads for further research into healthy and energy-efficient summer comfort in Dutch households.

The interviews show that people already often suffer from heat, as illustrated in Figure 1. During the heat wave in August 2020, the temperature experienced by almost all respondents was well above their preferred temperature (especially during activities such as sleeping and working) and partly also above the recently introduced Dutch guideline for preventing overheating in homes, which starts at 27 degrees.

"My research clearly shows two things," says Kuijer. "One, Dutch homes are not built for heat, and two, Dutch people are not well prepared to cope with heat." By the latter, the researcher refers to the relationship many Dutch people have traditionally had with the sun and the outdoors. "Both are seen as friends, and warmly welcomed into the home".

Nothing wrong with that, you might say, but this attitude is working less well now that we are experiencing more and more extreme heat. "When it gets hot, we tend to open the windows, which of course brings in the

heat. Also, people find sweat, which after all helps to cool the body, annoying and gross. Furthermore, we still eat and work at times when it is too hot, and we do not adjust our clothing enough, especially in the work situation."

Heat tolerance

Kuijer sees roughly three sustainable ways to reduce the need for cooling: outdoor shading, night ventilation and acclimatization. One problem is that it is precisely these solutions that must compete with the less sustainable air conditioners. They are often cheaper than blinds and provide immediate results. "But what's worse, air conditioners make it harder for people to get used to heat. So the dependence on cooling is increasing."

"Cooling inhibits the process of acclimatization because the temperature of the air conditioner does not change with the outside temperature. We know from physiological research that people can tolerate up to one degree higher temperatures every day under certain conditions. So your heat tolerance increases naturally, which also increases your freedom of movement in hot weather. Cooling gets in the way of that process".

Incidentally, Kuijer is not entirely against mechanical cooling. "It will become increasingly necessary to keep homes livable for certain vulnerable groups. But it should never be the only solution."

Wake-up call

In her report, Kuijer suggests a number of promising solutions that could contribute to energy-efficient, healthy summer comfort:

- Consider subsidizing blinds so they can better compete with air

conditioners.
- Provide cooling systems in which cooling and ventilation work together intelligently and the target temperature rises gradually to promote acclimatization;
- Give extra attention to lower-income households in urban apartments. This group suffers disproportionately from the harmful effects of warming.
- And finally: Commit to behavioral and cultural change. A healthy and efficient indoor climate needs the cooperation of residents, and a different approach to the body, the sun and outdoor air.
"The latter is perhaps the most important, but also the most difficult," says the researcher. "In that respect, my report is a wake-up call."

Provocations

The researcher emphasizes that her research is not yet complete. The next phase of the VENI project (funded by the Dutch Research Council) is to think about provocative design concepts that look beyond cooling when it comes to summer comfort. "For example, one of our provocations is a 'sweatshirt' that automatically distributes sweat throughout the body so that you cool down better."

In the third phase, we want to further develop the suggested solutions into practical and realistic recommendations, with which housing associations, governments, the refrigeration and ventilation industry and private individuals can immediately get to work."

Lenneke Kuijer's research project began in 2019 and will continue until 2023. More information can be found on this page. The entire report can be read here.

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