#1 Global warming? Climate disruption!

'Turning the Earth's thermostat sets many things in motion'
(Niels Souverijns – Climatologist at VITO)

Much has been said and written about global warming. However, experts prefer to talk about climate disruption. This goes beyond the general rise in temperature and emphasises the human cause of the changes. 'Climate disruption indicates that the changes are the result of greenhouse gases that we release into the atmosphere,' says Samuel Helsen, climatologist at Meteosupport.

Four times as many hot days and peaks of up to 50°C by 2050? These are figures from experts that were picked up by the media during previous heat waves. However, it is unlikely to be that bad. 'Studies often pick out the extremes to show what could happen in the worst case scenario, and that naturally makes the headlines,' emphasises Samuel Helsen. 'In Belgium, a temperature of 41.8°C has only been measured once, which was 2°C higher than the previous record. Moreover, it goes beyond the general rise in temperature and the number of hot days per se. Heatwaves are also becoming more intense, with higher peaks. And we can feel that.'

The Flemish Institute for Technological Research (VITO) mapped out the longer-term impact a few years ago for the MIRA climate report. The worst-case scenario did indeed lead to a sobering fourfold increase in the number of hot days. In the current climate, we see a spread of two heatwave days per year on the coast to six or more in heavily urbanised areas. By 2050, this will increase to 12 heatwave days on the coast to more than 24 heatwave days in heavily urbanised areas inland and in the east of Flanders. Researcher Niels Souverijns of VITO immediately counters this worst-case scenario: 'Fortunately, the worst-case scenario is not the most realistic. It is based, among other things, on a continued focus on fossil fuels. A doubling of the number of heatwave days by 2050 is, however, realistic. This could be spread over the entire summer or during a longer period. It does seem likely that longer heat waves will become more frequent.'

A new era
Climate change is nothing new. However, according to climatologist Samuel Helsen, we are currently experiencing an exceptional evolution. 'It is happening incredibly fast, which is clearly a consequence of the greenhouse gases that we humans produce and release into the atmosphere. Instead of the Holocene – the geological epoch from 11,700 years ago to the present – I therefore prefer to talk about the Anthropocene, as a new era,' he says, outlining the seriousness of the situation. 'Anthropos refers to the influence of humans. It is an important signal in the hope of waking people up, because unfortunately, for many, it remains – unjustifiably – a distant concern. Until they are confronted with the consequences themselves, such as the flooding in Wallonia a few years ago.'

The ‘conservative nature’ of our society stands in the way of taking action against climate change. We prefer not to change anything if we don't have to. However, swift action can be taken at the political and economic level. ‘But that costs a lot of money, which we have to invest now in order to reap the benefits later,’ Niels Souverijns points out. ‘Moreover, everyone (read: all countries) must actively jump on board to tackle this global problem effectively and efficiently. We are currently in a status quo: we are trying to limit global warming to 2°C. In principle, this is realistic with the investments that are being made and planned on a global scale. However, everyone must keep the promises they have made, of course.’

No straightforward story

Predicting the exact course of future climate disruption is not easy. The rise in global temperatures triggers certain feedback mechanisms, which in turn can cause the climate in our regions to cool down. For example, the melting ice (fresh water) in Greenland could have an impact on the Gulf Stream in the longer term. The addition of fresh meltwater causes the cold salt water of the Gulf Stream to sink less quickly, which in the worst case could cause the Gulf Stream to come to a standstill. If that happens, our winters could become up to 10°C colder. Niels Souverijns: ‘It's just one of the possible scenarios. Look at it this way: as humans, we are turning the Earth's thermostat. In doing so, we are disrupting a lot, more than most people realise.’

’It goes beyond the general rise in temperature and the number of hot days. Heat waves are also becoming more intense.’ (Samuel Helsen – Climatologist/weatherman at Meteosupport)

‘We need to invest now to reap the benefits later.’
(Niels Souverijns – Climatologist VITO)

‘For many people, climate disruption is a distant concern until they are confronted with the consequences themselves.’ (Samuel Helsen – Climatologist / weatherman Meteosupport)

Video: https://youtu.be/rKkmpbV8MK0
Overheating in buildings is an issue we can no longer ignore. It is undeniably one of the consequences of global warming. Or is ‘climate disruption’ a better term, given the role humans play in it? Niels Souverijns (climatologist at VITO) and Samuel Helsen (weatherman/climatologist) explain.

#2 Health: from heat stress to death

'If our core temperature drops or rises too much, we're in trouble.'
(Hein Daanen – Prof. Dr. Thermophysiology, VU Amsterdam)

Every year, more than 175,000 people die in Europe as a result of extreme heat. Research by VITO and UHasselt shows that the hot summers in Belgium between 2000 and 2019 caused 461 deaths annually among vulnerable population groups, such as babies. And those numbers continue to rise. However, the actual impact of heat stress on our health goes much further: a much larger group of less vulnerable people also experience discomfort due to the heat. 'If your body is not acclimatised, your attention level drops, your alertness decreases and you may experience intestinal problems,' says Dutch thermophysiologist Hein Daanen.

Heat waves have a clear impact on mortality rates. Statistics show that there is excess mortality during hot periods. Joost Declercq (civil engineer- architect / research director at Archipelago Architects and affiliated with KULeuven): 'Three important points to note here: in Europe, ten times as many people die each year from the effects of cold than from heat, influenza also has a significantly greater impact on mortality rates, and not every heat-related death can be attributed solely to high temperatures, but often also to the associated higher ozone levels in the air.'

'Acute heat stress is one thing,' adds climatologist Samuel Helsen. "However, even more difficult to deal with are prolonged periods of hot weather. When it remains warm at night, especially in cities, our bodies are under constant heat stress. During so-called "tropical nights', when the mercury does not drop below 20°C, our bodies are unable to recover at night. That's when we really start to struggle. It can become dangerous, especially for vulnerable people.'

Hein Daanen, a thermophysiologist at VU University Amsterdam, studies the heat regulation of the human body and therefore knows everything there is to know about heat stress and its consequences. He identifies the vulnerable groups and their risk factors. 'There are actually three groups of vulnerable people: the elderly, (newborn) babies and people with chronic conditions such as asthma or heart problems. Each of these groups has its own specific risk factors.'

1. Research shows that older people sweat half as much as younger people. In addition, they often take diuretic medication and the urge to drink decreases with age. They often wear more traditional clothing instead of choosing lighter outfits during hot periods and rarely open the door in the morning for fear of draughts. These are all factors that increase heat stress on their bodies. We must therefore be extra vigilant, making sure that they drink more during heat waves and seek out cool places in the house.

2. The problem is different for babies. They are not yet able to regulate their own body temperature properly. They are dependent on their parents and carers, who must intervene in good time and take action on their behalf.
3. Among the chronically ill, people with respiratory problems are particularly prone to difficulties. This is not so much due to the heat itself, but rather to the higher ozone levels and air pollution. In hot weather, we also see an increase in problems among people with cardiovascular disease because when it is very hot, a lot of blood goes to the skin (to cool it down) and less returns to the heart. The heart therefore has to work harder to supply the body with blood.

When is heat deadly?
So what is the critical limit and what factors contribute to death from heat stress? We put the question to Daanen. 'By constricting or dilating the blood vessels, our body maintains its temperature, which is ideally 37°C,' says Daanen. 'If that temperature drops or rises too much, we eventually run into problems. In hot weather, this happens when the humidity is too high to sweat sufficiently and cool the body down. In extreme cases, this can lead to heat stroke, which can exceptionally lead to death.'

Heat more deadly than cold by 2080
The good news is that our bodies actually adapt quite well to warmer temperatures. Better than to the cold. To a certain extent, of course, and if the transitions are not too abrupt and too rapid. According to Hein Daanen, we are less well equipped to cope with the cold. 'Adaptations to the cold are mainly behavioural and much less physiological in nature. Our bodies adapt less easily, but we know better what we should or can do to minimise our exposure to it.'

Researcher Niels Souverijns of the Flemish Institute for Technological Research (VITO) sums up the heat/cold balance: 'At the moment, more people still die from the cold than from the heat, but we expect that to change within 40 to 50 years. The tipping point would be somewhere between 2070 and 2080. We must therefore clearly anticipate the increasing heat stress and start thinking about and working on structural solutions to prevent it.'

Research suggests that our bodies are already anticipating longer and more extreme heat. 'Global warming appears to influence mortality characteristics,' explains Hein Daanen. 'In the Netherlands, mortality rates were minimal at 17°C, but now they are already heading towards 18 to 19°C. In Thailand and Bangkok, most people die at 26°C. When it is 22°C there, people talk about cold-related deaths, so it is also relative. But at a certain point, it simply becomes so hot that it is hardly livable anymore. And in the most unfavourable climate scenario of the KNMI (Royal Netherlands Meteorological Institute), the tipping point of more heat-related than cold-related deaths is indeed around the year 2080.'

How can you protect vulnerable people (and yourself) in the heat?
When a heatwave is announced, a heat plan often comes into effect. Niels Souverijns goes one step further and advocates a warning system, such as a tsunami alarm. But

be aware that you can also do a lot yourself for vulnerable people in your area. Thermophysiologist Hein Daanen gives some concrete tips:

1. Encourage elderly people to drink so that they stay hydrated and their bodies can sweat more effectively. This helps them cool down.
2. Call or visit more often, especially if they live alone, to keep an eye on them.
3. Help them find cooler places in the house. If you go outside, keep them out of direct sunlight and make sure they stay in the shade.
4. Keep the heat out with shading, preferably on the outside of the windows.
5. Use a fan if it is not too hot (no more than 35°C), otherwise it will only blow the warm air onto the skin and make you even warmer.
6. Limit physical activity, as this causes the body to heat up further.
7. Eat light meals, as these require less energy to digest, preventing the body temperature from rising further.

Heat stress in non-vulnerable groups

The risk of death from heat is less relevant for non-vulnerable groups. Does this mean they are not affected by hot periods? Certainly not. Heat stress manifests itself in many ways: fatigue, headaches, loss of concentration, sleep problems, etc. A study by Harvard University recently confirmed that students' exam results are significantly lower in hot weather than at lower temperatures. The impact of heat on productivity in the workplace has also been extensively researched and proven.

Hein Daanen: 'If you are completely healthy and regularly exposed to heat, your body adapts remarkably well. We call this heat acclimatisation. For example, if you spend ten days in the heat, you will sweat a little more each day and your core body temperature will drop in the morning. Your body goes into "pre-cooling" mode, as it were. That's why soldiers and top athletes are prepared – acclimatised – in a climate chamber before travelling to a hot destination.'

But if you're not acclimatised and you're exposed to heat for the first time (or suddenly), you will experience problems, adds Daanen: 'Your attention span and alertness decrease, you sleep less well and you perform less well. We conducted an interesting study on this with a hundred top athletes. They had to perform in a climate chamber at temperatures similar to those in Tokyo on the one hand and in the Dutch climate on the other. In the heat of Tokyo, they achieved on average 29 per cent less than in the Dutch climate. Finally, intestinal complaints are not uncommon either. The blood flows to the skin for optimal heat dissipation, which means that the gastrointestinal tract receives less blood and digestion becomes more difficult.'

'If you are completely healthy and regularly expose yourself to heat, the body adapts extremely well.' (Hein Daanen – Prof. Dr. Thermophysiology, VU Amsterdam)

'At the moment, more people still die from the cold than from the heat, but we expect that to change within 40 to 50 years.' (Niels Souverijns – Climatologist, VITO)

'During so-called "tropical nights", when the mercury does not drop below 20°C, our bodies cannot recover at night.' (Samuel Helsen – Climatologist / weatherman Meteosupport)

Checklist for surviving a heatwave in good health according to thermophysiologist Hein Daanen

1. ***Drink cool drinks. These make it easier to sweat. More blood is pumped to the skin and your core temperature drops more effectively. If you are just below the sweat threshold, warm tea can also help.***
2. ***Adjust your clothing and choose a light outfit.***
3. ***Find the coolest spots in your home. Avoid the top floor of your home, as heat rises. Also look for cooler places in the city. Tip: there are apps that show you the coolest spots in the city.***
4. ***During the hottest part of the day, go to a shopping centre, for example, where the air is actively cooled. This is common practice in the US.***
5. ***Use a fan, provided it is not too hot and you are sweating sufficiently. Otherwise, the fan will only bring extra warm air into contact with your skin. That is why in hot countries, such as Australia, you often see warnings not to use fans when it is very hot.***

Video: https://youtu.be/4mQbAqDTJf8
We spend an average of 90 percent of our time indoors. When it gets too hot, we have trouble sleeping, we become drowsy and suffer from loss of concentration, etc. Overheating puts strain on our bodies and even causes fatalities among vulnerable population groups every year. Prof. Dr Hein Daanen, Professor of Thermophysiology at Vrije Universiteit Amsterdam, zooms in on the impact of warm indoor temperatures on our health.

#3 Liveability in hot periods: city vs. countryside

'Greenery and water, the ideal combination for a liveable city'
(Samuel Helsen – Climatologist / weatherman Meteosupport)

During heat waves, cities are usually a few degrees warmer than the countryside, especially at night. And that makes a big difference to residents. More vegetation and more water are powerful levers in making – and keeping – cities liveable. 'Although it's not that simple to achieve,' climatologist Samuel Helsen adds. 'Many trees are planted, which is a cost-effective solution in itself, but a large proportion of them die within a year because they are planted without sufficient thought.'

You may have heard of the 'heat island effect', but what exactly is it? Climatologist Niels Souverijns of the Flemish Institute for Technological Research (VITO) explains: 'During the day, buildings and concrete absorb solar radiation and store that energy. At night, they release the heat back into the environment. As a result, it is invariably several degrees warmer in the city than in the countryside at night.' To prevent overheating indoors during longer hot spells, it is just as important that it cools down sufficiently during the night so that your home can be "flushed" with cooler air. This means that the challenge of maintaining a pleasant living environment in the city is greater during hot spells.

A double effect
In rural areas, there is simply less dense development and less concrete. This means less thermal mass to store solar radiation. At the same time, there is more green and blue. Both vegetation and water features promote transpiration. This evaporation process extracts heat from the environment and has a cooling effect. The combination of less warming and more evaporation results in an average of four degrees less on the thermometer outside the urban context.

Understanding these effects also offers opportunities to make cities more resilient to climate change. Various cities are investing in more greenery or building fountains to provide cooling during heat waves. This benefits residents directly and indirectly through the evaporation process that they set in motion. And it doesn't have to stop there, according to Dr Glenn Reynders (EnergyVille – KU Leuven): 'In cities, de-paving and greening bring with them "coupling opportunities". In Leuven, for example, there is a project to remove pavement from the streets and green the open spaces. In one fell swoop, they are also improving mobility and renovating the sewer system. At the same time, they are investigating the installation of a sustainable heat network. The result is a more sustainable and liveable neighbourhood.'

Planting trees: lots of potential, little realisation
Planting trees is a smart choice in the fight against the heat island effect. By evaporating water, they contribute to liveable temperatures in the city. Various studies show great potential. For example, 30% tree cover in cities would lower the temperature

sufficiently (by an average of 0.4°C) to keep it liveable and thus reduce the number of heat-related deaths. What's more, it's a cost-effective measure. ‘Yet policymakers often take a short-sighted approach,’ says Niels Souverijns of VITO. ‘Too little thought is given to the types of trees, where they are planted, how they are maintained, etc. In practice, around 30% of planted trees die within five years. It's a waste of effort and resources.’ Climatologist Samuel Helsen agrees: ’Trees are planted without thinking. This results in high mortality rates and little effect. However, we are also seeing some positive developments in this area. Native species, including those from Mediterranean countries, are increasingly being chosen. These are better able to cope with the heat island effect and are therefore a sustainable option.’

To improve the quality of life in cities, there is also an increasing focus on de-paving. This creates space for water absorption and thus prevents both flooding during heavy rainfall and overheating during hot periods. However, dense buildings are often an obstacle to the de-paving of urban areas.

Roofs as a secret weapon?
The logical alternative to scarce ground space may well be found in roofs. In addition to green roofs, which once again focus on increasing evaporation and thus reducing heat, so-called ‘white roofs’ are also an option. White materials reflect the sun's rays to the maximum and prevent excessive heating inside the buildings in question. ‘In practice, the direct impact of interventions on roofs on people in the city is unfortunately quite limited,’ says Niels Souverijns. ‘We walk around at street level, not on the roofs. A case study in Bilbao confirms this. The use of 30% green roofs resulted in a difference of barely 0.2°C at ground level, although this can of course make a bigger difference to the indoor climate, depending on the type of roof, the roof insulation and so on. At street level, trees and other vegetation in squares and streets are more interesting. Their shade provides more shelter and comfort during the day. It is therefore important to make well-considered choices that reinforce each other and keep the heat island effect within limits in the long term.’

The combination of less warming and more evaporation results in an average temperature of four degrees lower in rural areas than in cities.

‘Trees are planted without thinking. This results in a lot of loss and little effect.’
(Samuel Helsen – Climatologist / weatherman Meteosupport)

Useful tool for policymakers

Making cities more climate-proof requires targeted investments and smart choices. To make those choices, you need insight into the impact of specific interventions. VITO and the VMM (Flemish Environment Agency) have jointly developed a tool to calculate the microclimate of cities: the Climate Portal. This tool provides policymakers with valuable information about the effects of possible choices on temperature and water management, as well as other factors such as biodiversity. This allows them to test the impact of decisions before they are made, ensuring that the available budget is invested wisely.

Video: https://youtu.be/4VfxZwGGVkg
The heat island effect causes cities to heat up faster than rural areas. Climatologist/weatherman Samuel Helsen, climatologist at VITO Niels Souverijns and Joost Declercq (research director at achipelago architects and affiliated with KULeuven) explain the causes and possible solutions.

#4 Indoor climate and the risk of overheating

'Finding the right balance between daylight and the risk of overheating'
(Hilde Breesch - Prof. Dr. Ir. Building Physics and Sustainable Construction KULeuven)

Longer hot spells and higher temperature peaks are making it increasingly challenging to keep indoor temperatures pleasant and healthy. What exactly are the risk factors for overheating? This is an important question, because the answers are essential for anticipating this growing problem in a smart and efficient way. Here are two hints: insulation is not the culprit, and the heat does not come solely from the sun.

More and more homes are struggling with overheating. However, a well-insulated home keeps the heat in during winter and out during summer. The weak spots are the openings in the façade, such as windows, through which the sun's rays find their way inside. Dr Glenn Reynders agrees: 'Insulation helps in both summer and winter. However, well-insulated buildings are more susceptible to overheating (especially during the mid-season) because heat that finds its way inside is also more difficult to get out again.'

'Incidentally, this heat is not only attributable to the sun,' emphasises Hilde Breesch, Prof. Dr. Building Physics and Sustainable Construction. 'Don't forget the heat we produce ourselves, through all kinds of electrical appliances and everyday activities such as cooking.' So it's a good idea to switch off appliances you're not using during heat waves, and a great excuse to leave the ironing until it's a bit cooler.

Not just a summer problem
The hottest periods usually occur in summer. However, overheating is no longer just a challenge during these months. Even in the off-seasons and during winter, it can sometimes become uncomfortably warm indoors. This is confirmed by Prof. Dr. Ir. Arch. Shady Attia, head of the Laboratory of Sustainable Building Design at the University of Liège. 'Due to better insulation, airtightness and larger windows, we are seeing more and more overheating in the spring and autumn and even on sunny winter days. Especially in well-insulated buildings, heat that gets inside stays there longer.' Hilde Breesch confirms: 'Climate change is extending the overheating season. In the past, there were three months with a risk of overheating, but now we have to take overheating into account in spring and autumn as well. So it's a problem that lasts for longer periods throughout the year.'

According to Glenn Reynders, the overheating problem is much easier to control outside the summer months, when it is still sufficiently cool outside. 'This means that, unlike during a heatwave, the home cools down quickly with adequate ventilation.'

East-west facades more sensitive than north-south
Contrary to what you might think, a south-facing façade does not pose the greatest risk of overheating. East-west-facing buildings heat up the fastest. 'The solar load is simply greater on an east-west façade than on a south façade in summer,' explains Joost Declercq, civil engineer and architect with a sustainable approach to climate-proof construction. 'In the south, the sun is at its highest point. This radiation can easily be solved with an overhang. An east-west-facing façade is exposed to the sun for much longer. What's more, the sun is still quite low, so the sun's rays shine directly onto the glass.'

Smart building design, right from the start
The problem of overheating is a complex interplay of factors. However, a few basic techniques and rules of thumb for smart building design will take you a long way. Joost Declercq: 'We have forgotten how to design a façade. Yet it is logical: start with the orientation and distribute the windows cleverly across the façades, according to their solar radiation. Then provide sufficient shading where necessary, with canopies or blinds.' Thermal mass also plays an important role. There must be enough of it to buffer the heat. 'Think of a building as a sponge that absorbs heat. Of course, you also need to be able to wring out a sponge from time to time. By opening the windows and doors at night, you create a chimney effect that cools your building. Except during periods when the outside temperature remains higher than inside at night, but these are very exceptional and will remain so. And rest assured: a building with passive measures such as these to prevent overheating does not necessarily have to cost more, it just has to be well designed.'

By looking at the here and now, we can already take major steps in the fight against future climate disruption. A building is designed for the next 40 to 50 years, but the ways we can make it climate-proof today will still be the most effective in decades to come. It therefore makes no sense to wait for future heat waves to make our buildings climate-proof. Joost Declercq is adamant: 'Building a fully glazed building now should be banned.'

'Due to better insulation, airtightness and larger glass surfaces, we are seeing more and more overheating in the spring and autumn and even on sunny winter days.'
(Shady Attia – Prof. Dr. Ir. Arch. In Sustainable Architecture & Building Technology ULiège)

'The solar load is greater in summer on an east-west façade than on a south façade.'
(Joost Declercq – civil engineer-architect / research director at archipelago architects and affiliated with KULeuven)

'Building a fully glazed building should be prohibited.'
(Joost Declercq – civil engineer-architect / research director at archipelago architects and affiliated with KULeuven)

Trial and error
'If it gets too hot inside because of the sun, technology will solve the problem.' This reasoning allows the market to continue to grow with ad hoc solutions and means that a constructive approach to overheating is often given too low a priority. However, the origin of this lack of prevention can mainly be found in education. Skills are still not sufficiently taught in schools and are given too little attention in the press. After all, in the combination of strategies, none should be overlooked if a good, sustainable and comfortable result is to be achieved.

Fortunately, architecture teachers are increasingly recognising the need for a preventive approach to overheating and are explicitly focusing on this. Hilde Breesch, senior lecturer at the Faculty of Industrial Engineering Sciences at KU Leuven, lets her students experience the impact for themselves and look for sustainable solutions. "I have them renovate an old small office building to make it energy-efficient and airtight, so that it

complies with EPB legislation. I then have them run the design through a tool that maps out the risks of overheating. They are shocked to see how high the temperature can rise.

The challenge is to counteract this effect without active cooling, i.e. by combining various passive measures. With this thought exercise, I hope to plant a seed that will grow into a reflex that they will apply to every future building design."

Video: https://youtu.be/vZiDq1E_H-o
During a warm period or heatwave, one building may be pleasantly cool, while another is barely bearable. Several factors determine how quickly it heats up indoors and, therefore, how you can anticipate this, according to Hilde Breesch (Prof. Dr. Ir. Building Physics and Sustainable Construction – KU Leuven), Joost Declercq (Research Director at achipelago architects and affiliated with KULeuven) and Niels Souverijns (Climatologist – VITO).

#5 Solutions for overheating: home, garden and kitchen vs. structural

'Smart building design eliminates up to 80 percent of the cooling demand, so you can even build offices without active cooling systems.'
(Joost Declercq – civil engineer-architect / research director at archipelago architects and affiliated with KULeuven)

If you are really too hot in your home, you just want a solution. Preferably one that provides immediate cooling. But what really works? And how do you keep your head cool during the next hot spell without resorting to all kinds of makeshift solutions? Our experts have explored a wide range of immediate and structural solutions and tell you the dos and don'ts.

Too hot in your home? Thermophysiologist Hein Daanen provides useful tips for greater comfort:
1. Drink cool beverages.
2. Choose light clothing.
3. Avoid strenuous activity.
4. Find cool spots in your home.
5. Eat light meals.

This limits the heat produced by your body and allows your skin to perspire as much as possible to keep your core temperature under control. A fan can also provide relief and help cool your skin, provided that the indoor temperature is not higher than your skin temperature. Around 35°C is a good limit to keep in mind. If you find yourself in such exceptional circumstances, combining a fan with active cooling is still a very good idea. The air movement that promotes the evaporation of your sweat means you can set the cooling 4 to 6°C lower and save a lot of energy.

Quick measures to cool down your home
Although these tips can make the heat more bearable for you, they do not eliminate the cause. However, there are many solutions to prevent your home from becoming too hot, some more effective and efficient than others. 'The essential reflex is to keep everything closed during the day during a heatwave,' says Prof. Dr. Hilde Breesch, Building Physics and Sustainable Construction at KU Leuven, setting out the basic rule. 'You need to know your house and keep an eye on the thermometer. Sometimes you feel a breeze outside, but it's not cooler than inside. It's a bad idea to open everything up at that point. If you think about it carefully, ventilation via the chimney effect is a simple and inexpensive way to cool things down a bit inside. By opening a window or door downstairs and upstairs, you allow cooler night air to circulate through your home and cool the thermal mass so that it can buffer heat again the next day. Fresh oxygen and a few degrees on the thermometer, without much effort.' Limiting the use of electrical appliances is also recommended. These produce heat that stays inside.

Curtains may seem like a logical solution, but unfortunately they are only a stopgap measure against overheating. They only block the sun's rays once they have passed through the glass and the heat is already inside. Sun-resistant glass or films on the outside of the windows have a less pleasant side effect. Civil engineer - architect Joost Declercq: 'Both distort the daylight spectrum. So you think you are sitting in daylight, but the receptors in your eye are missing part of the daylight spectrum and, biologically speaking, you are sitting in the dark, as it were. This can cause fatigue, among other things.'

The cooling ladder
The first priority is therefore to prevent your home from becoming too hot again during the next hot spell. This requires a well-thought-out approach and measures that will also provide long-term relief. The Dutch OSKA (Overleg Standaarden Klimaatadaptatie, Climate Adaptation Standards Consultation) has drawn up the Cooling Ladder, a clear guideline for a sustainable, structural approach to the problem of overheating in buildings. They put prevention first and use four steps (Dr Shady Attia added a fifth, ed.), which are particularly important to follow in chronological order:

1. Provide natural cooling in the vicinity of buildings. Water and greenery play an important role.
2. Prevent heat from entering the home. Take into account the orientation, size and location of openings in the façade, and shading (via canopies, strategically placed trees or blinds).
3. Passively expel heat from the home, for example with (night) ventilation via a chimney effect.
4. Only use active cooling systems that do not contain refrigerants and are not harmful to the climate as a last resort.

'Resilient buildings and cities are able to adapt to extreme weather conditions without major external intervention,' emphasises Prof. Dr. Ir. Arch. Shady Attia. 'Climate resilience means maintaining comfort during heat waves, sufficient night-time cooling, protection of vulnerable groups and energy independence. A climate-adaptive approach therefore focuses not only on comfort, but also on limiting risks, damage and energy dependence. In this way, well-designed buildings also contribute to collective climate resilience.'
'The goal is actually to make step four of the ladder redundant through smart building design,' adds Joost Declercq. 'In our current climate, that is perfectly possible. A few basic principles will take you a long way in designing climate-adaptive buildings.'

Prevention is better than cure
In addition to making the outdoor environment liveable – with less heat-absorbing concrete and more greenery and water that contribute to cooling through evaporation – it is therefore important to prevent indoor heat as much as possible. Joost Declercq: 'There are a few important rules of thumb for this: smart orientation of the building, the right ratio of glazing, sufficient thermal mass (which absorbs heat and prevents the interior from heating up too quickly), etc.' Laura De Wilde, advisor to the research department at NAV, agrees and adds: 'The basis of a climate-adaptive building lies in the design of a high-performance building envelope. Passive methods such as natural ventilation, solar shading and thermal mass are ideally incorporated into the design from the outset. Within the current EPB/EPC methodology, this balance is skewed, which leads to the possibility of focusing more on technical installations than on the performance of the building envelope, resulting in resources often being used incorrectly. And this, in turn, means that a lot of energy is still needed for cooling.'

External solar shading blocks the sun's rays before they reach the glass and heat up the interior. 'In my opinion, solar shading is one of the most underrated investments in current residential construction, because of its significant positive impact on cooling demand and comfort levels,' says Dr Glenn Reynders, making a clear statement. Overhangs on the south façade are also an effective architectural measure, provided they are correctly calculated and well designed to completely shade the windows. An advantage of both preventive measures is that in winter you still get the maximum benefit from the free heat of the low standing sun.

Passive cooling with a heat pump
If you have a geothermal heat pump, you can also use it for passive cooling. This keeps the house a few degrees cooler by pumping cold water through the underfloor heating. A solution for winter that can also be used in summer. ‘However, passive cooling is slow,’ Hilde Breesch immediately points out. ‘This means that it is not sufficient as a cooling technique during a real heatwave, with the risk that you will still have to use active cooling.’ Dr Glenn Reynders nuances this by saying that, from his point of view, this passive cooling, in combination with other passive measures such as shading and minimal insulation, is sufficient for residential applications.

Nevertheless, the considerable investment in geothermal energy is worth considering. Climatologist Samuel Helsen chose a geothermal heat pump for his new-build home, which will be completed in 2023, out of conviction. ‘Since then, the temperature in the house has not risen above 24 degrees Celsius, and in winter we maintain a pleasant 21 degrees Celsius. So it was a good choice, both for ourselves and for the climate.’ What's more, passive cooling during the summer is beneficial for your geothermal installation, adds Glenn Reynders: ‘Passive cooling during the summer allows the borefield to “regenerate”, so that by the end of the summer the temperature is higher again and the system is ready for winter.’

Joost Declercq adds a nuance: ‘This cooling is not completely free. The circulation pumps have to run continuously, and these are the hidden energy consumers in our homes. This type of technology is often referred to as ‘free cooling’. The term ‘free’ here refers to energy that is freely available in the environment and not to ‘free’ in the sense of ‘free of charge’, as is often mistakenly translated and interpreted.’

Active cooling as a last resort
Is it really not bearable in your home? Then an air conditioner is an option. Be aware, however, that this actually contributes even more to climate change due to its high energy consumption and the residual heat that ends up in the outside air. Moreover, cooling with air conditioning is often unnecessary. ‘It starts with our expectations of comfort,’ says Joost Declercq. ‘If it is a few degrees cooler inside than outside, that is perfectly fine. Intensive cooling to, say, 10 or 15°C cooler than outside is simply not necessary and even downright unhealthy.’

So-called temperature shocks when moving from indoors to outdoors and vice versa do indeed put a considerable strain on the body, as thermophysiologist Hein Daanen confirms: ‘When you go from an overly cooled room into the heat outside and back again, the body has to adjust each time. The blood vessels in the skin contract every time you go into the cold to keep the heat in the body, causing the blood pressure to rise. Excessive temperature differences between indoors and outdoors thus lead to fluctuations in blood pressure, which is particularly harmful for people with a weak cardiovascular system. Many people set the air conditioning too cold. This is a shame, because it is unpleasant and a waste of energy. What works very well is setting the air conditioning to 26°C and combining it with a fan, which ‘circulates’ the cooler air.

And then there are a few comments to be made about air conditioning technology. ‘The refrigerants they contain have an enormous global warming potential. Even when you're not using the appliance, it's a potential climate bomb,’ warns Joost Declercq. Niels Souverijns of VITO (Flemish Institute for Technological Research) draws attention to the rising demand for energy: ’Take India, for example. Today, 8 to 10 per cent of people there have air conditioning, powered by energy from coal-fired power stations. Due to rising prosperity, the air conditioning market is booming there. By 2050, it is estimated that half of the more than one billion

inhabitants will have an air conditioner. This will create a huge new demand for energy. If we don't have renewable energy to meet this demand, we will generate enormous amounts of additional CO_2 emissions, with all the consequences that entails.'

A story of 'and-and'

There is already a clear consensus that it is complementary choices that make a building truly climate-proof and future-proof, in the order set out in the Cooling Ladder. 'If you need instant solutions to control the indoor temperature, that is a sign that there is something wrong with the building design,' says Joost Declercq. 'In our part of the world, it is perfectly possible to design a building that does not require mechanical cooling. As architects, we must therefore focus on this en masse. In our own offices, such smart building design eliminates 80 per cent of the cooling demand, and we can actually do it without active cooling.'

'Even when the air conditioning isn't running, it's a potential climate bomb because of the refrigerants.'
(Joost Declercq – civil engineer-architect / research director at Archipelago Architects and affiliated with KULeuven)

'The essential reflex is to keep everything closed during the day.' (Hilde Breesch, KULeuven)
'A few basic principles will take you a long way in designing climate-adaptive buildings.' (Joost Declercq – civil engineer-architect / research director at Archipelago Architects and affiliated with KULeuven)

'Thanks to our geothermal heat pump, the temperature in our house never rose above 24 degrees Celsius, and in winter we maintain a pleasant 21 degrees Celsius.' (Samuel Helsen – climatologist/weatherman at Meteosupport)

Free cooling with renewable energy?

You generate your own energy via the solar panels on your roof. So active cooling with air conditioning costs you nothing at all, right? According to the experts, it's not quite that black and white. 'The climate problem doesn't stop at the walls of our houses or at the boundaries of our plots,' Joost Declercq states clearly. 'Europe is still struggling with a shortage of green energy. During the summer, power stations sometimes run at a lower level due to peak consumption. The green energy that we are fortunately already generating on a large scale must therefore be used for our daily consumption and to prevent energy shortages. 'Free cooling' with air conditioning simply does not exist."

Video: https://youtu.be/quY3UOkFR2Y
Ann Van Eycken (Secretary-General of Verozo), Hilde Breesch (Prof. Dr. Ir. Building Physics and Sustainable Construction – KU Leuven), Joost Declercq (Research Director at achipelago architects and affiliated with KULeuven) and Samuel Helsen (climatologist/weatherman) discuss useful tips, but above all swear by 'anticipating' and 'acting in the right order' to prevent overheating.

#6 Legislation:
No home should be built without solar shading

'Minimum standards for cooling in buildings are needed'
(Shady Attia – Prof. Dr. Ir. Arch. in Sustainable Architecture & Building Technology ULiège)

While buildings are subject to the risk of overheating, legislation continues to focus primarily on energy performance in winter. It is precisely this focus on keeping heat inside that leads to an increasing need for cooling. However, heat also has an impact on our bodies and – if we resort to active cooling – on our energy consumption. Is it time for new calculation methods, insights and corresponding regulations?

The Netherlands, France and Germany, among others, already have regulations aimed at limiting overheating problems in buildings. In Belgium, only the VIPA regulations, specifically for care institutions, impose obligations in this regard. The question arises as to why this should not apply to every building, now that warm periods are often longer and we are increasingly dealing with extreme temperatures. Engineer-architect Joost Declercq outlines the contradictory situation: 'When we convince a building owner of the need for solar shading, his EPB reporter says it is not necessary after all. EPB uses a static method, which is insufficient to correctly calculate summer comfort and cooling energy demand.'

Shady Attia, head of the Laboratory of Sustainable Building Design at the University of Liège, confirms this feeling. 'Current calculation methods are strongly focused on energy performance in winter, while cooling requirements and the risk of overheating remain underexposed. They often simplify the actual conditions by not correctly taking into account internal heat loads, user behaviour and the functioning of solar shading or thermal mass. In addition, we often work with incorrect or outdated climate data that underestimates actual solar radiation and the impact of heat waves. The urban context and the heat island effect are usually ignored, leading to a structural underestimation of the risk of overheating and acute cooling demand. Furthermore, too little attention is paid to the health impact on vulnerable people. Passive measures such as solar shading, natural ventilation, thermal mass and smart material choices must be prioritised. These must be validated with dynamic simulations based on future climate scenarios. This should be supplemented with user-friendly and practical tools for use during the design process.'

Right to comfort
Everyone has the right to heating. The question arises whether the same applies to cooling. 'Perhaps we need to take a more general view,' was the consensus during the expert panel, 'and talk about the right to comfort.' But what is comfort? It is a complex concept that is highly personal and also requires an adaptive parameter. Joost Declercq picks up on this: 'Above all, we must avoid a situation where a minimum standard leads to even more cooling technologies. The aim is to keep the net energy demand for heating and cooling sufficiently low. The ultimate goal is, of course, always to do without cooling systems, and this is possible in the current circumstances provided that the building is well designed.'

How best to ensure sustainable living comfort in times of extreme heat differs between renovation and new construction. New buildings offer many more options for integrating passive cooling strategies, while the existing structure often imposes limitations on renovation projects. Location is also crucial: in cities, the urban heat island effect plays a major role, causing temperatures to rise much higher than in rural areas. 'Calculations must therefore take

this context into account and apply stricter requirements for urban areas than for rural environments,' says Shady Attia. 'In my opinion, EPB legislation should make overheating analyses mandatory for both new buildings and major renovations. The emphasis should be on passive solutions, such as dynamic solar shading and ventilation strategies, before active cooling is permitted. Concrete limit values for indoor climate and health must be established, linked to clear responsibilities within the design & build consortia. This will create measurable performance in terms of summer comfort and health.'

VEROZO also supports this idea and has immediately formulated a concrete proposal. 'In addition to ventilation and insulation, solar shading should also be a mandatory part of a building,' says Secretary General Ann Van Eycken. 'We must advocate for dynamic solar shading. You use it when necessary. This way, you still get maximum solar radiation in winter (and in between seasons) for free solar heat, while keeping the heat out in summer.'

'When we convince a client of the need for solar shading, his EPB reporter says it's not necessary after all." (Joost Declercq – civil engineer-architect / research director at Archipelago Architects and affiliated with KULeuven)

'The urban context and the heat island effect are usually ignored, which leads to a structural underestimation of the risk of overheating and the acute demand for cooling.'
(Prof. Ir. Arch. in Sustainable Architecture & Building Technology ULiège)

'In my opinion, EPB legislation should make overheating analyses mandatory for both new buildings and major renovations.' (Prof. Ir. Arch. in sustainable architecture & building Technology ULiège)

Inspiration from Sweden

How can such a change in mentality and legislation be achieved in practice? Sweden provides inspiration, says Shady Attia: 'Intensive workshops were organised there with politicians, policymakers and regulatory bodies, from the local to the regional and federal levels. Strong practical examples and concrete case studies demonstrated the potential impact and created support. These insights were ultimately enshrined in law.'

Video: https://youtu.be/9_U9yVHzQ-w
In the Netherlands, preventive measures against overheating are already mandatory, in addition to floor, wall and roof insulation. In Belgium, the government has already imposed guidelines for healthcare institutions, but there are no concrete preventive guidelines for private buildings. Which ones are still desirable?

#7 Summary and recommendations

Overheating is clearly not a future problem, but a current challenge. It is a complex reality that affects multiple areas: climate change, health, spatial planning, architecture and regulations. Experts have highlighted the causes, consequences and possible solutions from six perspectives. Dr Shady Attia summarises the most important findings and conclusions:

Key insights

1. **Overheating is becoming structural and seasonal.**
   Due to climate change and construction trends, the risk is not limited to summer, but extends over six months and even to sunny winter days.
2. **Cities are warming up faster than rural areas.**
   Greening, softening and smart spatial planning are essential for liveability.
3. **It is not only vulnerable groups that experience heat stress.**
   Heat stress not only affects the elderly, babies and the chronically ill, sometimes even fatally, but also affects the concentration, sleep and productivity of the general population.
4. **Well-insulated buildings without solar shading are vulnerable.**
   Large windows and a lack of night-time cooling increase the risk of overheating.
5. **Active cooling is a symptom treatment, not a solution.**
   It increases energy demand and CO_2 emissions and undermines climate goals.

Policy recommendations

- **Embed overheating in regulations.**
  Make dynamic overheating analysis mandatory for new buildings and major renovations.
- **Make dynamic solar shading mandatory.**
  Prioritise passive measures in EPB/EPC methodology.
- Set minimum standards for cooling comfort.
  Define and embed comfort thresholds linked to health and quality of life.
- Invest in design education.
  Give future architects and engineers the tools to prevent overheating from the design stage onwards.
- **Encourage climate-resilient urban planning.**
  Make room for greenery, water and shade in urban redevelopment projects.

Call to action

Everyone has a role to play in limiting overheating:

- **Designers** can lay the foundations for summer comfort through orientation, solar shading and choice of materials.
- **Policy makers** must provide structural conditions and incentives.
- **Residents** can make simple changes themselves that make a difference.

Shady Attia concludes: ‘Encourage the development of resilient buildings and neighbourhoods that can withstand extreme heat without relying on active cooling. This requires a long-term vision in design, material selection and urban planning. The time for mere awareness is over.

What is needed is concrete action. Don't let these insights gather dust on the shelf; use them as leverage for healthier buildings, liveable cities and a resilient future.'

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