New Series of Interviews

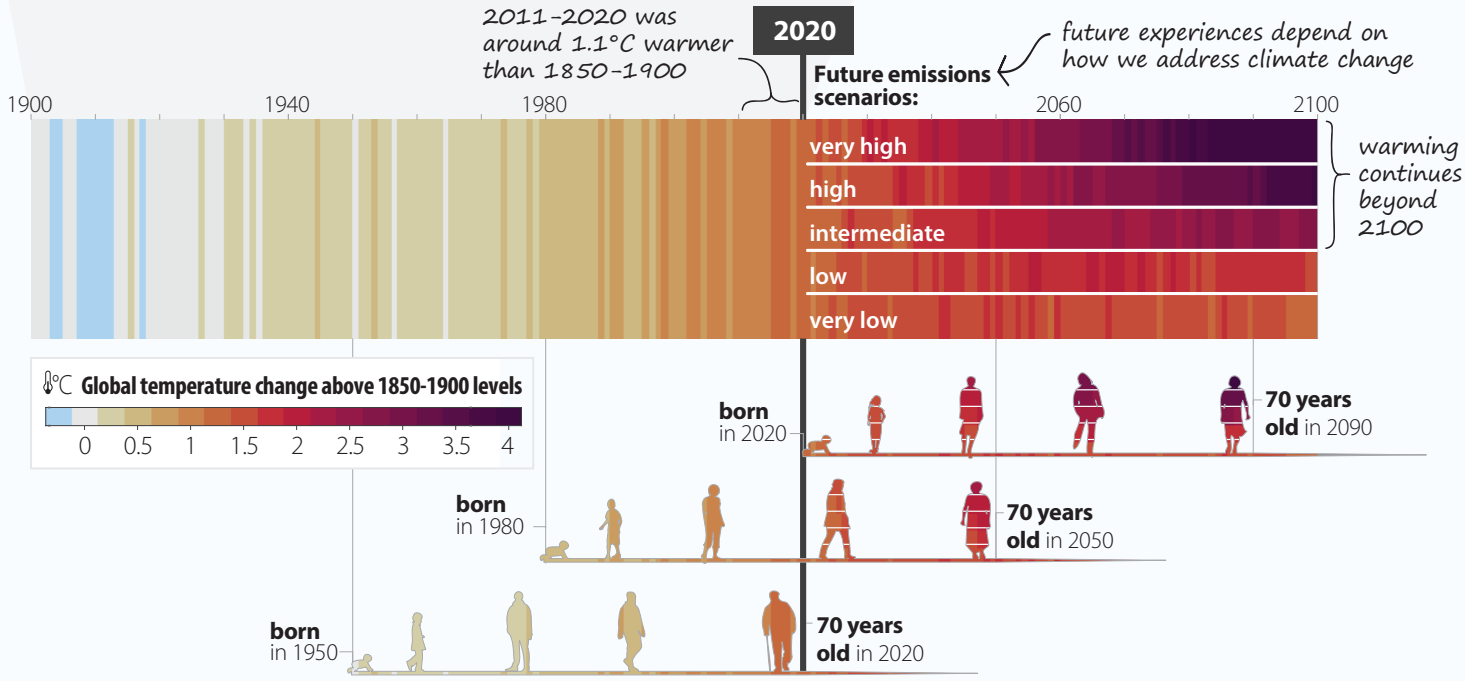
In this new issue of the REHVA Journal, we start with publishing a series of interviews with expert whose work is directly or indirectly related to Climate change.

Climate change related research from different fields is influencing the HVAC industry and, as such, could be relevant for design and operation of buildings, their HVAC systems or just for our daily life. The picture below is from the IPCC Report Climate Change 2023* and shows increasing outdoor temperatures and how this may develop in the future. You can imagine here buildings instead of people and you can see that buildings which are built now, will still be there at the end of the 21st century.

We must design buildings and their systems for future climates right now! That is why all interviews in 2024 will be related to Overheating & Summer comfort, the theme which is very much related to work of REHVA experts all over Europe and beyond.

Lada Hensen Centnerová
Member of the Editorial Board of the REHVA Journal
& Vice President of REHVA

The extent to which current and future generations will experience a hotter and different world, depends on choices now and in the near term



Observed (1900–2020) and projected (2021–2100) changes in global surface temperature (relative to 1850–1900), which are linked to changes in climate conditions and impacts, illustrate how the climate has already changed and will change along the lifespan of three representative generations (born in 1950, 1980 and 2020). Future projections (2021–2100) of changes in global surface temperature are shown for very low (SSP1–1.9), low (SSP1–2.6), intermediate (SSP2–4.5), high (SSP3-7.0) and very high (SSP5–8.5) GHG emissions scenarios. Changes in annual global surface temperatures are presented as 'climate stripes', with future projections showing the human-caused long-term trends and continuing modulation by natural variability (represented here using observed levels of past natural variability). Colours on the generational icons correspond to the global surface temperature stripes for each year, with segments on future icons differentiating possible future experiences.

* https://www.ipcc.ch/report/ar6/syr/

The Concepts of Comfort and Health May Be Related but Are Not Synonyms

Wouter van Marken Lichtenbelt is a Professor of Ecological Energetics and Health at the Maastricht University in the Netherlands, where he is leading the group Thermophysiology & Metabolism.

Besides basal physiological research, his current research puts emphasis on how daily environmental conditions (indoor climate, light) relate to thermal comfort, thermal behavior, long-term health and prevention of the metabolic syndrome (obesitas, type 2 diabetes and related cardiovascular diseases).

Recently, he wrote a Dutch popular scientific book ('Van Rillen tot Zweten') about thermoregulation which includes aspects of the built environment.

You are known for your research related to thermoregulation and its influence on health. Could you summarize the main findings from your groundbreaking paper published in 2017 "Healthy excursions outside the thermal comfort zone" [1]?

– Yes, the main findings are that we see if you expose yourself regularly to temperatures slightly outside the thermal neutral zone (the zone where your body is physiologically doing the least to keep the temperature at the level) then that creates a healthier body.

What do you mean by 'temperatures slightly outside the thermal neutral zone'? Could you explain it using the seven-point thermal sensation scale – PMV index (used in ISO 7730)? Would that mean –1 and +1? (Figure 1)

– Yes. But there's also temperature. In that paper is also mentioned that it is understandable why there is

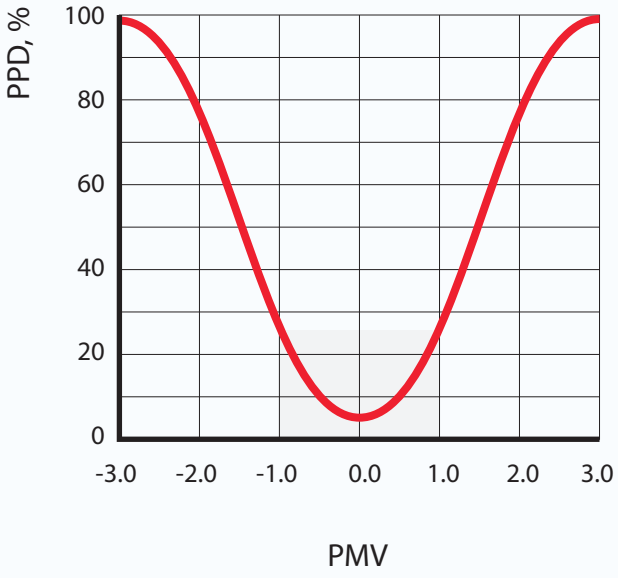


Figure 1. Adaptive Thermal Comfort and Predicted Mean Vote (PMV)

a comfort zone. The thermal neutral zone is linked to it. I think that in a more natural environments comfort is very useful because people have a drive to go to more comfortable environments. You don't want to be in a too cold environment, because you use then lots of extra energy to keep warm. And you don't want to get too warm because you use up too much water for sweating. But since we nowadays are hardly ever forced anymore outside the comfort zone, your body gets more or less 'lazy' and that's not healthy.

You write in your paper also about 'the metabolic syndrome'. Could you explain that?

– We were quite surprised to find that being exposed to mild cold or warm environments, it not only helps you to create better resilience to heat and cold, but also that, for instance, your sugar metabolism improves. We could even prove that there's an increased insulin sensitivity, which is the hormone that regulates the glucose levels in the body. Also, fat metabolism is improved. So, it's not only directly related to thermal physiology, but also to our metabolic health. The metabolic syndrome is generally related to obesity (to overweight) and has a high risk of developing type 2 diabetes but also cardiovascular diseases. We also see that if you get adapted to the heat, not the first exposure, but being regularly exposed to warm that your blood pressure decreases and the same you see in the cold. All these symptoms that are linked to the metabolic syndrome are improved.

I'm not saying this is the lifestyle number one. No, I think it's still food and physical activity rank higher, of course, but then the environmental properties may follow. Temperature can add to it and can have a significant effect combating the metabolic syndrome.

You speak about adaptation to heat but others speak about acclimation or acclimatization. Could you explain the differences?

– Adaptation is a broad way of saying that people adapt to the environment. Changes may occur within the lifetime or be the result of genetic differences. Acclimation and acclimatization are more specific adaptations of individuals and generally more short term. When it is happening in the lab (laboratory) we call it acclimation and when it is occurring in daily environment it is called acclimatization. It is in fact the same process.

The interesting thing is that we find repeatedly that the first exposure to heat or cold is more a stress like response. But if you are exposed several days, let's say for a couple of hours per day, then you see acclimatization occurring, for instance lowering of heart rate and lowering of blood pressure or a better sweating response. It resembles to what happens with regular physical activity. If you for the first time run the marathon, you get very stressed. You get your muscles are aching. But after training for a week your performance improves. Temperature acclimatization has much in parallel to physical training. That's why I sometimes call it temperature training.

In the abstract of your article from 2017 you write that the concepts of comfort and health may be related but are not synonyms. Could you elaborate on that?

– In natural conditions it is very good to get such signals from your body to your brain: Don't get too cold. Don't get too warm. If we're getting too cold, we seek for a warmer environment or put on clothes. That is a good response and it protects us and therefore it is healthy. But if we are always in the comfort zone, we don't get any more such signals, then we create a kind of lazy body, just like we never do any physical activity. So, our body needs to get outside these comfortable conditions in order to stay healthy.

Actually, the temperature variations are also needed for thermal comfort. Do you know the book Thermal Delight in Architecture written by Lisa Heschong [2]? She writes there that "One factor that can help us to appreciate the thermal function of a place or object is variability" and "To enjoy being warmed and cooled we need some awareness of the process".

– Yes, this is a nice concept. If you go from a little too cold environment to a little too warm, then too warm may be pleasant. So instead of just only striving after comfort, you could even create environments where you experience thermal pleasure. And what's nicer than pleasure? And that's in fact what people search for in holidays. They go to environments close to the sea, sunbath, become much too warm and then they go into water, which is way too cold. But the change makes them feel good.

Everything is then about thermal variation. But what is more important, seasonal variations or daily variations?

– The adaptive comfort model (**Figure 2**) is closely linked to what we find in physiology. What you see is that if people are in naturally ventilated buildings and they have some own control of the environment, they like the variations and the comfort ratings are much better. You can do it by changing throughout the day, but also in the seasons.

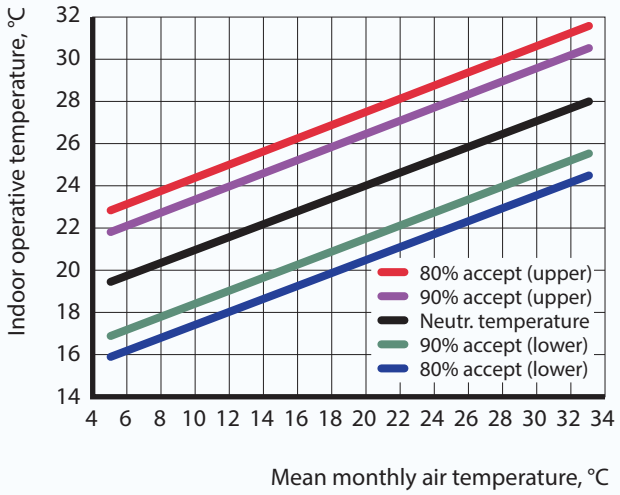


Figure 2. The adaptive comfort model.

This is of course very much building dependent. If you have a building with very high thermal mass (high heat capacity), it is very difficult to create a dynamic indoor environment during the day, because there is so much heat storage in the building.

Recently, you were co-author of an essay "Establishing resilience in times of climate change – a perspective on humans and buildings" [3] published in 2023. You write there that the adaptive thermal comfort model is generally only used for buildings without air conditioning and for the evaluation of their properties, but not for actual temperature control. Do you advocate using the adaptive thermal comfort model for design of all buildings?

– Yes. But we have to keep in mind that we want sustainable buildings, in term of energy, building materials, etc. and we want healthy buildings. We have to think of how to create a dynamic indoor environment in new buildings. Not only during their design but how to control the building when it's really in use. We have to let the buildings temperature follow to some extent to what's happening outside. Create a more dynamic indoor environment.

Do you mean, let indoor temperature flow during the season or also during the day?

– During the season is relatively easy but to have temperature variations during the day it is more difficult. You have to change the mindset for designing new buildings. There should always be possibility of some own control.

Let's move to climate change and overheating. You say that higher indoor temperatures are more easily accepted after acclimatization. Knowing that there will be heat waves or outbreaks of energy, how can we actually use this?

– We learned a lot from the heat wave in 2003. We (at least in France and the Netherlands) have since then improved heat plans and when heat wave is coming, instructions are disseminated by RIVM (Dutch National Institute for Public Health and the Environment) and by social media. Don't sit in the sunlight, drink enough, be less active, etc. But I think one thing is missing. That is that you can also acclimatize to the heat and if we take care of that during the spring or in the run up to a heat wave and expose ourself to the warmth, we can get used to temperatures of 27 degrees and feel happy with it. So, go outside when it's warm. And as soon as there's a real heat wave, you are much more resilient against the heat. It's not only healthy, but also makes you resilient.

More and more people want to live a healthy life. You already said that nutrition and exercise are the most important factors, but an additional factor is exposure to high and low temperatures. What can we (REHVA members) do to support that?

– Promote designing buildings which make a more dynamic indoor climate possible, including more local variation in temperatures. Very important, in addition, is that users have at least some own control of the temperature they are exposed to. This can be by opening windows, personal control systems, or thermostat. In the end it will create both a healthier environment and more resilience to extremes weather conditions.

Citated papers and book

[1] W. D. van Marken Lichtenbelt, M. Hanssen, H. Pallubinsky, B. R. Kingma, and L. Schellen, "Healthy excursions outside the thermal comfort zone," *Build. Res. Inf.*, vol. 45, no. 7, pp. 819–827, 2017, doi: 10.1080/09613218.2017.1307647.

[2] L. Heschong, *Thermal Delight in Architecture*. The Massachusetts Institute of Technology, 1979.

[3] H. Pallubinsky, R. P. Kramer, and W. D. van Marken Lichtenbelt, "Establishing resilience in times of climate change—a perspective on humans and buildings," *Clim. Change*, vol. 176, no. 10, p. 135, 2023, doi: 10.1007/s10584-023-03614-0. ■