

Combined actions of HVAC professionals against Corona and climate crises



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The HVAC professionals are facing the need to adapt their skills and standards to fast changing conditions on a time scale much shorter than the lifetime of the buildings they take care of. This is valid both for the sudden action in response to the COVID pandemic, as well as for the long term climate change with objectives towards carbon neutrality. The report deals with challenges the HVAC professional face in Serbia and elsewhere in Europe.

Keywords: COVID pandemic, EPB, IEQ, building renovation, climate change and adaptation

COVID-19 and Climate crises – a new reality to focus on the European Green Deal

This month (July 21, 2020) the EU leaders reached agreement on their new green package entitled *Next Generation EU*. This package will make fighting climate change central to Europe's recovery from the COVID-19 pandemic, with large sums intended for the 'green' investments and carbon reduction goals. This requires strong efforts of the HVAC professionals to achieve combined objectives in the *Energy Performance of Buildings* (EPB) and the *Indoor Environmental Quality* (IEQ), while reducing the carbon footprint. Obviously, this cannot be reached without adequate innovation of the professional skills and standards and adaptation of the design tools.

A Challenging Time for the HVAC Professionals

The HVAC professionals refer to a wide range of activities, from research, design, installation and maintenance of the building services. Most of them are already focusing on introducing their best practices on low energy systems, on-site renewable energy production and promotion of low carbon footprints solutions. They have already acquired consistent experience but must adapt their practice to the necessary target of very low carbon footprints buildings without any compromises on the IEQ. This means an evolution towards a new definition of optimal building design in terms of installed power, energy performance and cost, as well as of the IEQ that takes account of the COVID-19 virus infection threats.

The European leaders managed to back a progressive recovery plan providing additional financial resources to tackle the challenge of COVID-19 pandemic. The recovery plan secures financial resources to fund public investment and reform that are essential for a sustainable recovery while stimulating private investments in strategic sectors and strengthening those EU instruments that helped during the COVID-19 crisis. The building *Renovation Wave* is a fast track approach to drive the European economy out of the COVID-19 recession. The renovation of the building stock with a strong reduction of the primary fossil energy use and of the carbon footprint of these renovated buildings becomes a priority. In this aspect, the role of HVAC professionals is to ensure the effectiveness of the renovation which must also comply with the long term EU objective of carbon neutrality in 2050.

This is an extremely complex and difficult task. Very often the envelope characteristics and materials of the building to be renovated are not known. Also, the service systems have to be redesigned completely, and the technical solutions for introducing new installation for heating, cooling or ventilation are much more difficult to handle than in a new building, [1]. This complexity in line with the lack of investment makes the projected ambitious renovation dynamics of a rather old building stock in the Serbian capital city of Belgrade much slower than expected, **Figure 1**, [2]. This made the average energy efficiency of the buildings stock rather low irrespective of very good performances of the new built buildings.

Certainly, before the EPB Directive (EPBD), the energy performance buildings was not a priority. The EPBD

is implemented into the Serbian legislative to promote energy performance of new buildings, and those used by public institutions, while the efficiency of commercial buildings and private dwellings is mainly left to their owners. The training of HVAC professionals on the basis of European standards is found beneficial in order to promote a more unified vision, in complement to the national regulations. Developing a common training and mutual recognition of their skills could be a very valuable contribution of HVAC associations [3].

Until recently, the main focus of HVAC professionals was on improving the energy performance of buildings while reducing the direct and indirect CO₂ emission caused by heating, cooling and ventilating, as well as on improving the indoor environmental quality. Today the objective of preventing the spread of the COVID-19 virus must be added. Due to an unprecedented urgency to act, REHVA published its COVID-19 guidance on how the HVAC community have to safeguard a healthy indoor environment to bring the infection risk to a minimum by the correct use of ventilation and air conditioning systems [4]. The first version has been issued in March 2020 and followed by updates in April (2nd version) and August 2020 (3rd version). The third version of the REHVA guidance is focusing on how to reopen and safely use buildings after the lockdown. Particular care is needed by the air systems where air is used not only for ventilation but also for energy transfer (heating/cooling). Renovation of these systems must satisfy both the EPB and IEQ objectives at the same time. This means an evolution towards the new definition of optimal solutions in the system design in terms of IEQ, installed power, energy performance and costs.

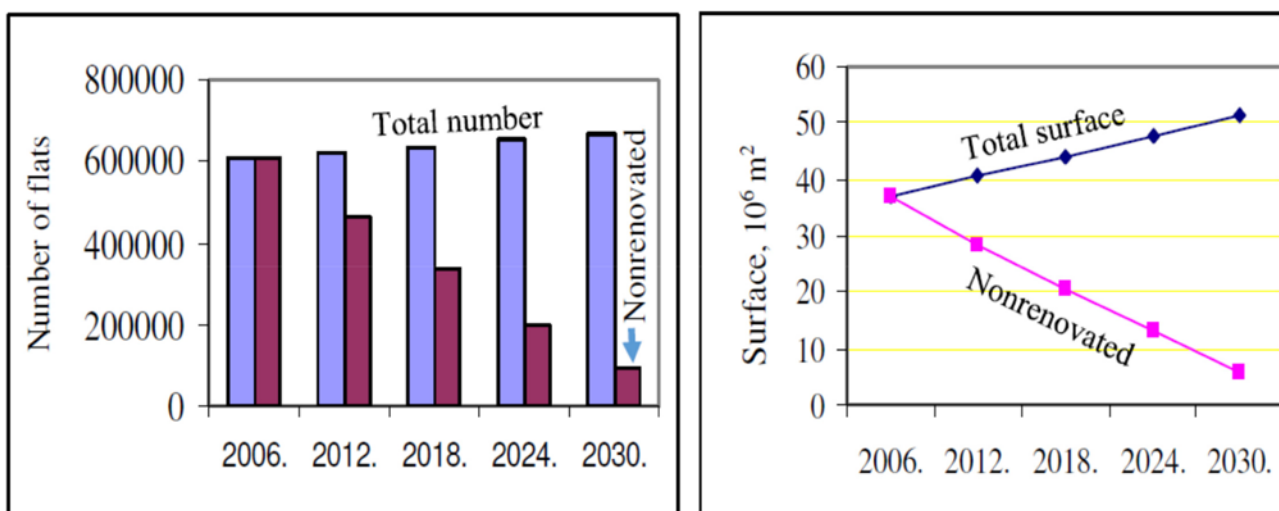


Figure 1. Projected number and surface of flats to be renovated in Belgrade.

While Waiting for the New Ice Age to Come

The new reality brought about by the COVID-19 health crisis has reinforced the need to align the climate goals of the European *Green Deal* with the post-pandemic economic recovery. Implementing the European *Green Deal* would boost demand and encourage investment. Implementation of the international climate agreements provides an investment impulse in the EU economy. Long a leader in progressive climate change legislation, the EU increased those ambitions recently and pushed forward a stimulus package to revive its pandemic-ravaged economies. The building *Renovation Wave* makes the role of the HVAC community of the prime importance to the recovery of the European economy from the COVID-19 recession.

On the way towards carbon neutrality, the HVAC professionals have already introduced their best practices to low energy systems, on-site renewable energy production and promotion of the low carbon footprints solutions, such as the *Nearly Zero Energy Buildings* (nZEB). Now they have to adapt their practices to the very low carbon footprints buildings without any compromises on the *Indoor Environment Quality* (i.e.: comfort, health and safety). Simultaneously, they must be ready to adapt their long term building solutions to potentially changed climatic conditions if the anthropogenic emissions of greenhouse gases continue.

The famous climate accord on the COP 21 climate summit in Paris 2015 aims to limit global warming to well below 2°C, with efforts to keep it below 1.5°C, in order to limit the worst impacts of climate change. To be on track for 2°C of warming, emissions in 2030 would need to be 25% lower than today, while to limit warming to 1.5°C, emissions would need to be slashed by 55%, [5]. However, of the Paris climate commitments by 184 countries, only 36 have made pledges that could conceivably reach the 2030 goal, the rest being not so ambitious or urgent enough. Some even refuse to act. Confirmation that rising emissions are putting existing global goals further out of reach came on the COP 25 climate summit in Madrid.

As the emissions continue to rise (last year, global CO₂ emissions rose 1.7%), for every year that action is delayed, emissions reductions need to be much steeper, **Figure 2**, [6]. Some scientists even warn that, otherwise, the global climate stability might be endangered. **Figure 3** shows the pathway of the reversal of

the Earth climate system from its pathway towards so called *Hothouse Earth* and stabilise within the glacial–interglacial cycles ([7, 8]), thus ensuring survival of many current species on Earth.

The greater the delay in reducing emissions within the remaining carbon budgets for 1.5 and 2°C, the more difficult will be for the HVAC professionals to timely adjust their standards and practices to the dynamics needed to achieve the objectives of the Paris Agreement (**Figure 2**). One could hardly imagine how difficult it would be for them if the humanity fails to stabilise the climate system (**Figure 3**). Based on their historical experience with the short-term climate variation, the HVAC community established good standards and design tools, that, with necessary upgrades, could meet the requirements arising from such variations and associated weather extremes, such as heat waves, for example. More difficult for them, as well as for the human population as a whole, would be to adapt to a climate beyond the known variations.

Some scientists are denying the anthropogenic impact on global warming (even claiming that the Earth is experiencing a global cooling instead) so that emissions do not have to be cut down since the climate changes are exclusively driven by the natural phenomena, as already experienced during long preindustrial history, [8]. Climate science, however, does not deny, but takes due account of all the known natural phenomena that drive the climate change and combines them with those arising from the human activities.

Natural climate change is driven primarily by the orbital dynamics of the solar system which produces regular warm and cold cycles on Earth in intervals roughly 100,000 years long. Exactly a century ago (1920), Serbian astronomer and mathematician Milutin Milanković was first to explain the episodic nature of the Earth's glacial and interglacial periods which have been caused primarily by the cyclical changes in the Earth's circumnavigation of the Sun, [9]. More precisely, variations in the Earth's eccentricity, axial tilt and precession comprise the three dominant cycles, collectively known as the Milanković's Cycles, as he is generally credited also with precise calculation of their magnitude. Taken in unison, variations in these three cycles create alterations in the seasonality of solar radiation reaching the Earth's surface. These times of increased or decreased solar radiation directly influence the Earth's climate system, thus impacting the advance and retreat of the Earth's glaciation.

The solar radiation (insolation), regularly changed according to Milanković's cycles, has direct or indirect effects on the atmospheric concentration of greenhouse gasses such as water vapour and CO₂, with the levels being determined by a variety of complex feedback mechanisms that tend to turn the climate from warm to cold and back again, [10]. Currently, the natural global

warming and cooling that work in slow, complex cycles, is being overridden by the human activities particularly increasing since the inception of industrial revolution. Even if the CO₂ emissions stop, their effects would continue for centuries, a long time by human standards. As Milanković's theory predicts, the Earth would resume its slow descent into the next *Ice Age* many tens of thousands of years from now. Climate variation and weather extremes will resume as well.

Today, a reliable, physically sound determination and prediction of the global climate changes, as well as predictions of the relevant global, regional and local climate parameters is particularly important for the sustainable, life cycle energy efficient buildings/HVAC systems holistic design, [11]. Not all European citizens enjoy a relatively mild climate, so that HVAC standards and practices may vary. Major change of the temperature is expected in the North Europe due to melting of the ice-caps and consequent changes of the oceanic current system. If warm currents carrying heat from the tropics to Europe would rearrange, it could make most of the current HVAC infrastructure unsuitable. The HVAC

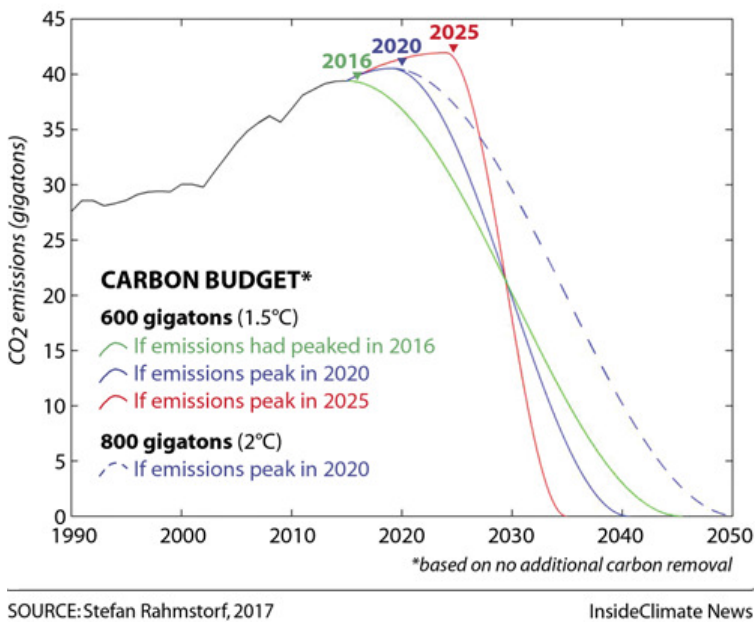


Figure 2. Use of Carbon budgets for 1.5 and 2°C goals.

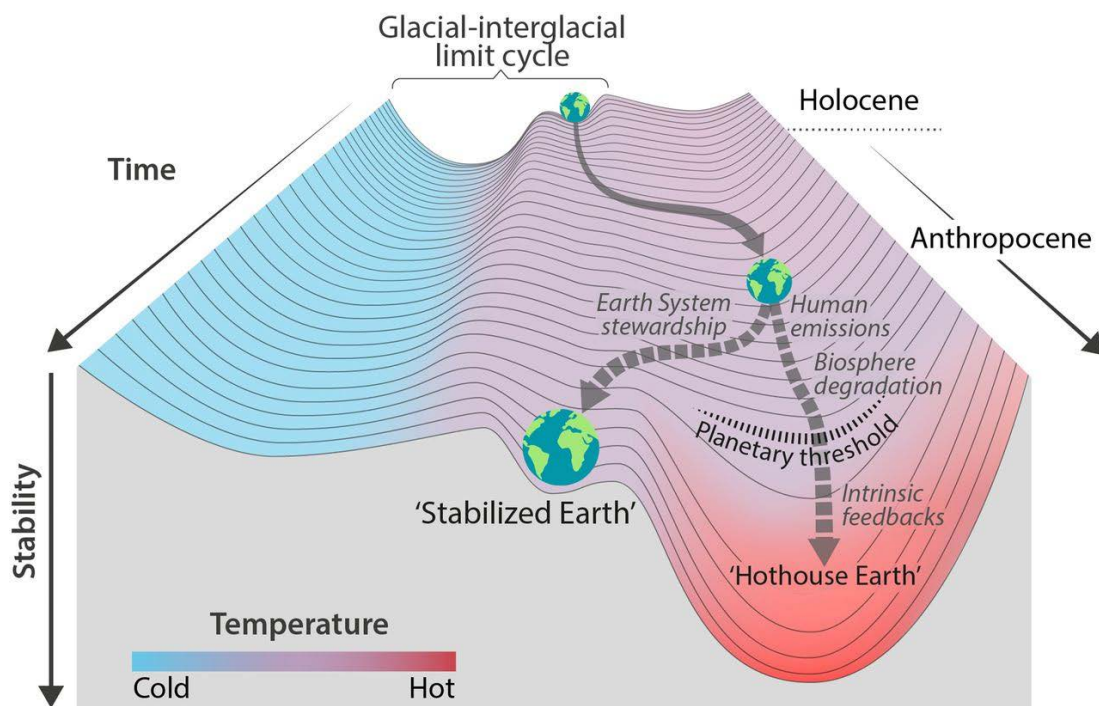


Figure 3. Earth's climate on the crossroads.

community will also be in difficulties even if the current pledges are fully implemented, as they would not lead to 1.5°C or 2°C goals but to 3°C to 4°C temperature rise above preindustrial level, [12]. It should be noted that the temperature on land where humans live is above these land-ocean averages, Figure 4 [5, 13].

Conclusion

The HVAC professionals play an important role in implementing energy efficient solutions, especially in building renovation where HVAC systems are often replaced or upgraded in shorter intervals. The new challenge is a dynamic compliance with future building performance requirements and higher degree of sophistication and details, when moving towards nearly zero energy and carbon neutral building. ■

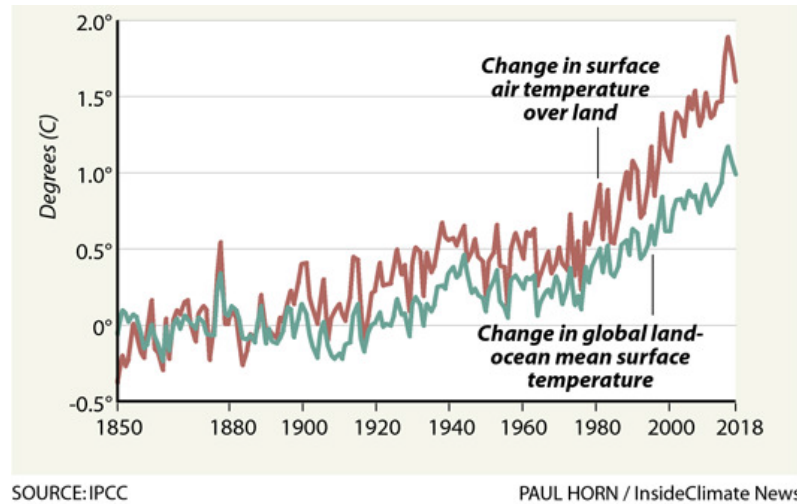


Figure 4. Difference between land and land-ocean surface temperature rises.

References

- [1] Allard, F. Interview on new challenges of HVAC professional, REHVA journal, Vol.57, Issue 3, June 2020, p. 5-6
- [2] Energy development strategy of the city of Belgrade, - Section 3: Projected energy demand Energoprojekt, Belgrade, 2008
- [3] Hogeling, J., COVID-19 and Climate crises – a new reality to focus on the European Green Deal, REHVA journal, Vol.57, Issue 3, June 2020, p. 4.
- [4] www.rehva.eu/activities/covid-19-guidance, Approached 03.08.2020.
- [5] Berwyn, B., IPCC: Radical Energy Transformation Needed to Avoid 1.5 Degrees Global Warming, www.insideclimate.org, Approached 04.08.2020.
- [6] Gustin, G., The Paris Climate Problem: A Dangerous Lack of Urgency, *InsideClimate News*, Nov 7, 2019.
- [7] Steffen, W. et al., [Trajectories of the Earth System in the Anthropocene](https://doi.org/10.1073/pnas.1811732115), PNAS 2018; 115:33. pp 8252-8259, ©2018 by National Academy of Science, Washington DC.
- [8] Mesarović, M., Scientific Uncertainties Feed Scepticism on Climate Change, *Thermal Science*, 19 (2015), Suppl. 2, pp. S259-S278.
- [9] Milanković, M., *Mathematical Theory of the Thermal Phenomena Caused by the Solar Radiation* (in French), Gauthier-Villars, Paris, 1920.
- [10] Mesarović, M., Global Warming and Other Climate Change Phenomena on the Geological Time Scale, *Thermal Science*, 23 (2019), Suppl. 5, pp. S1435-S1455.
- [11] Todorović, M. S., In Search for the Global Warming Proof – Milutin Milanković's Earth Mathematical Climate and Ice Ages, *ASHRAE Transactions*, 2014.
- [12] <https://feu-us.org/behind-the-climate-pledges1/>, Approached 04.08.2020.
- [13] Berwyn, B., [The Worst-Case Scenario for Global Warming Tracks Closely With Actual Emissions](http://www.insideclimate.org), *InsideClimate News*, www.insideclimate.org, Approached 02-08-2020.