

Title	Evaluating indoor climate interventions: Balancing sustainability and health outcomes
Authors	Mishra, Asit Kumar;Wargocki, Pawel;O'Reilly, Éilis J.
Publication date	2024-07-07
Original Citation	Mishra, A. K., Wargocki, P. and O'Reilly, E. J. (2024) 'Evaluating Indoor Climate Interventions: Balancing Sustainability and Health Outcomes', Indoor Air 2024, Honolulu, Hawaii, 7-11 July.
Type of publication	Conference item
Link to publisher's version	https://indoorair2024.org
Rights	https://creativecommons.org/licenses/by/4.0/
Download date	2026-09-25 20:11:17
Item downloaded from	https://hdl.handle.net/10468/16039

Evaluating Indoor Climate Interventions: Balancing Sustainability and Health Outcomes

AK Mishra^{1,2*}, P Wargocki², EJ O'Reilly¹

¹School of Public Health, University College Cork, Ireland

²DTU Sustain, Technical University of Denmark, Copenhagen, Denmark

*Corresponding email: AKumarMishra@ucc.ie

SUMMARY

Over the past 20 years, we have moved from low energy buildings to sustainable buildings. With this shift, life cycle energy and emissions analysis (LCA) has taken precedence. To design buildings that are sustainable, an analysis of the resources that go into constructing and operating building needs to be complemented with an analysis of how buildings impact our life. In this work, we propose elements of building design can be optimised for occupant health and the consequent environmental impact of these benefits can be incorporated into the LCA.

KEYWORDS

indoor air quality; occupant wellbeing; life cycle analysis; healthcare; public health

1 INTRODUCTION

A significant portion of an energy-efficient building's embodied energy and emissions can be ascribed to its indoor conditioning system and HVAC (Shirazi and Ashuri, 2020). Sustainability modifications for buildings can also affect occupant health. To achieve global sustainability goals, a building's energy use, emissions, as well as the impact on occupant health need to be evaluated holistically. There is a growing awareness of co-benefits of sustainable building designs that consider impact on occupant health. Yet, there is little research that includes the positive health impacts of indoor climate interventions in building performance evaluation or LCA. For example, appropriate air filtration can reduce asthma exacerbations during everyday use or cardio-respiratory hospitalizations during a wildfire. We propose that such evaluations should be part of built environment LCA to ensure optimal assessment of design alternatives.

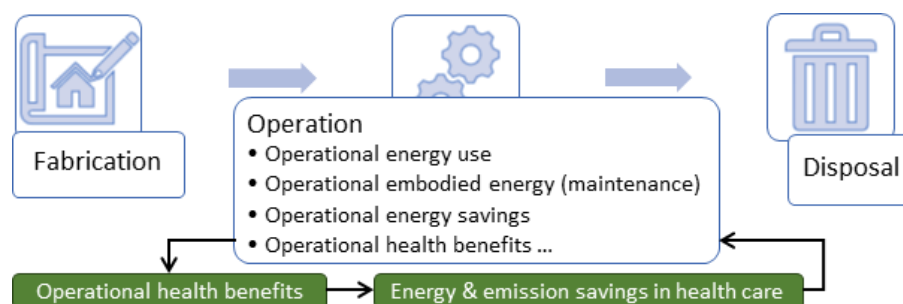


Figure 1. LCA for built environment elements including fabrication, operation, and disposal. The operational phase of certain elements can be optimised for occupant health and the consequent environmental impact of these benefits can be incorporated into the LCA.

2 METHODS

It is well accepted that indoor climate conditioning contributes a notable fraction of a building's operational energy use and embodied energy. Indoor climate can also directly affect occupant

performance, health, and wellbeing. These impacts have been translated into health (Asikainen et al., 2016) and economic metrics (Walker et al., 2018). We propose that LCA of indoor climate conditioning interventions consider the reduced burden of disease to provide a more comprehensive comparison of designs (Fig. 1).

3 RESULTS AND DISCUSSION

Taking the example of mechanical air filtration, previous studies have modelled the benefits of air filtration on hospitalizations (Fisk and Chan, 2017; MacIntosh et al., 2010), and doctor visits (Lanphear et al., 2011). These data can be combined with the LCA data from healthcare. Here, the recently developed open access, living database on healthcare LCA becomes a vital asset (Drew et al., 2022). For example, the LCA global warming potential of a portable air cleaner can be 408-670 kg CO₂ equivalent (Tichá et al., 2016) while the avoidance of each asthma exacerbation, requiring a GP visit, can save ~68 kg CO₂ equivalent emissions (Drew et al., 2022). Intervention effectiveness can be improved by focusing on vulnerable and susceptible populations (Fisk and Chan, 2017).

A significant amount of further work is needed to ensure such analyses can be widely adopted. LCA indicators, for both the built environment component and health events, will be needed for the same or similar regions, instead of global values. Studies regarding indoor climate interventions will also need to focus on health benefits as one of the accessed outcomes.

4 CONCLUSIONS

As the energy and climate-change crisis evolved, our grasp of sustainability also evolved. Sustainable development goals have a planetary nature, requiring inter-sectoral cooperation. The built environment sector has a consequential impact on global energy use and emissions. We submit that this impact can be mitigated not only by constructing energy efficient buildings but also healthy buildings that influence the health sector's energy and emission burdens.

ACKNOWLEDGEMENT

AKM is funded by the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 101034345.

5 REFERENCES

- Asikainen, A et al. 2016. *Environmental Health*. 15(1), pp.61-72.
- Drew, J et al. 2022. *The Lancet Planetary Health*. 6(12), pp.e1000-e1012.
- Fisk, WJ and Chan, WR. 2017. *Indoor Air*. 27(1), pp.191-204.
- Illankoon, ICS and Lu, W. 2019. *Building and Environment*. 161, p.106247.
- Lanphear, BP et al. 2011. *Pediatrics*, 127(1), pp.93-101.
- Shirazi, A. and Ashuri, B., 2020. *Building and Environment*. 171, p.106644.
- Tichá, M et al. 2016. *Integrated Environmental Assessment and Management*, 12(3), pp.478-485.
- Walker, I et al. 2018. Lawrence Berkeley National Lab. LBNL-2001244.