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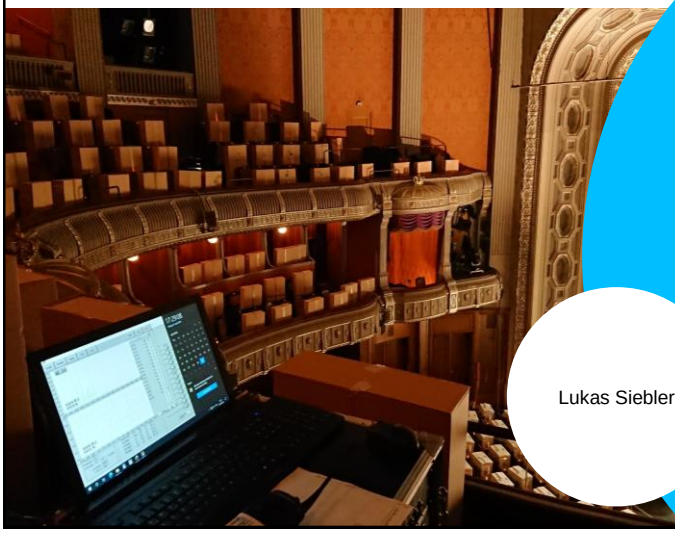
Institute for Building Energetics, Thermotechnology and Energy Storage (IGTE)



Indoor Climate in the Spotlight: Between Health Protection and Energy Efficiency

Lukas Siebler

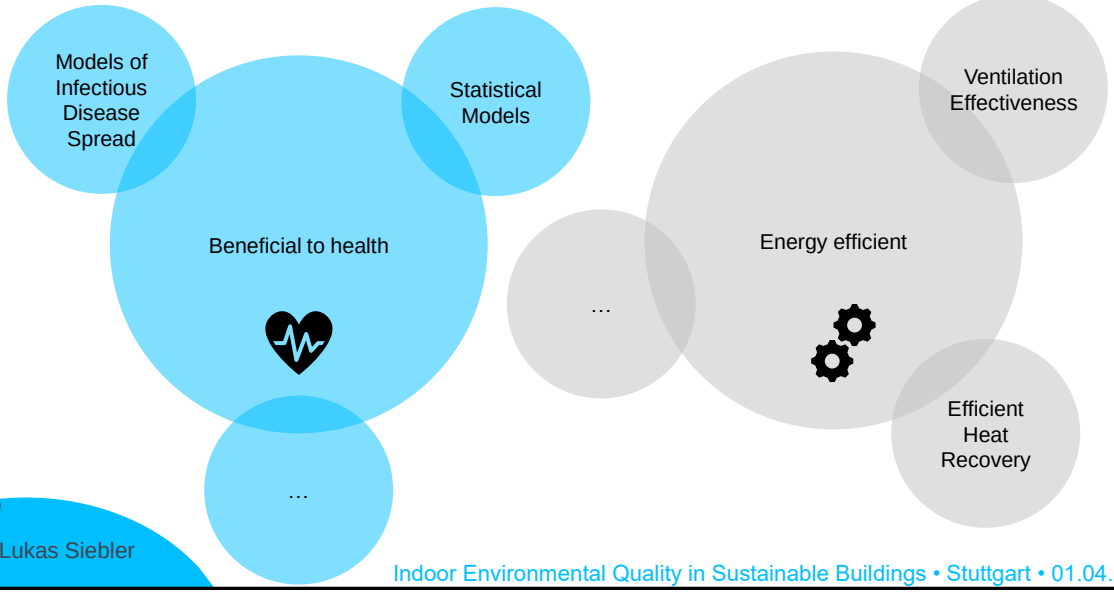
Indoor Environmental Quality in Sustainable Buildings
Workshop, Stuttgart, 01. April 2025

IGTE

1

Research Areas in Indoor Climate Technology

What defines good ventilation?



2

Focus on Health

Experimental Determination of Infection Risks

Sponsored by:
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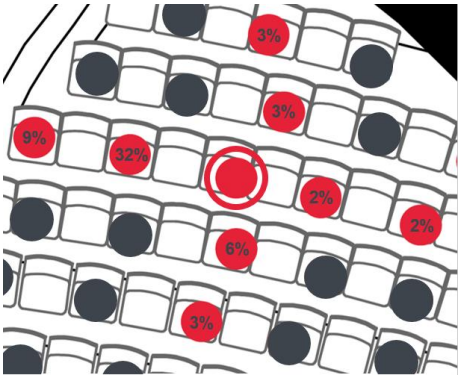
Publication
IJERPH 2022

Models of Infectious Disease Spread

Fog Experiments in the Stuttgart State Opera



Seat related infection risks based on trace gas measurement

3

Lukas Siebler

Focus on Health

Statistical Determination of Infection Risks

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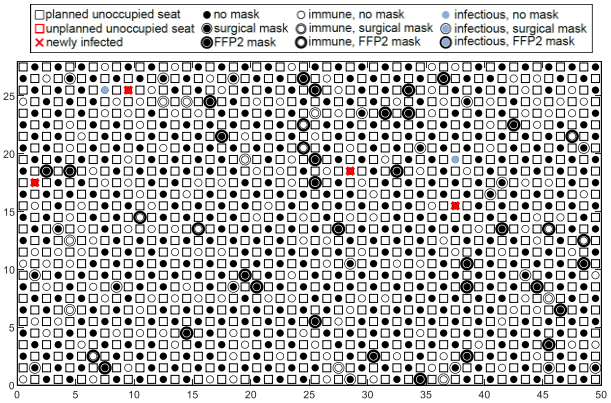
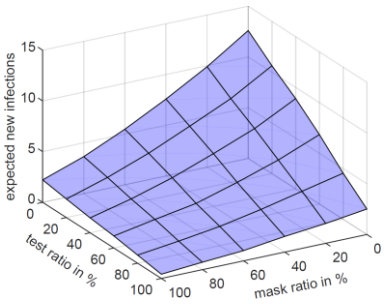
Publication
BMC Public Health 2023

Statistical Models



Agent based Monte Carlo simulation of the Stuttgart State Opera



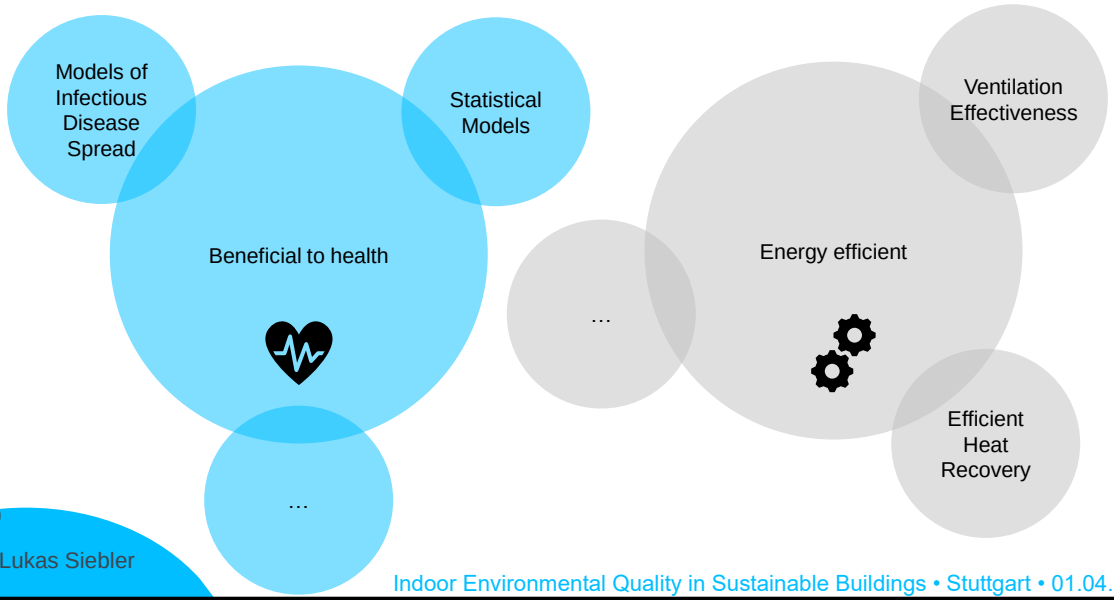
Results for non-pharmaceutical interventions (NPI)

4

Lukas Siebler

Research Areas in Indoor Climate Technology

What defines good ventilation?

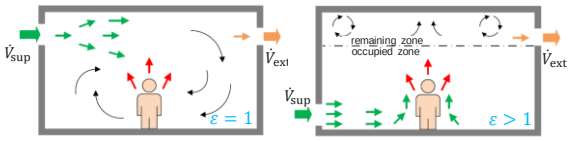


Focus on Energy Efficiency

Ventilation Effectiveness

Ventilation Effectiveness
(assuming no substances in supply air)

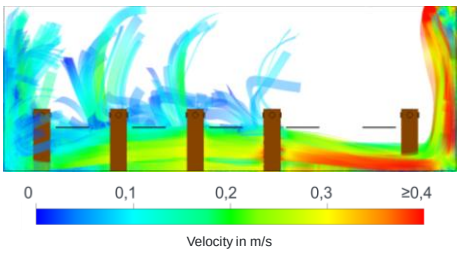
$$\varepsilon = \frac{C_{ext}}{C_{oz}}$$



Ideal mixed ventilation

Displacement ventilation

Motivation: $\dot{V}_{out} = \frac{\dot{V}_{out\,stand}}{\varepsilon}$



Cold fog experiment and simulation results

Ventilation Effectiveness

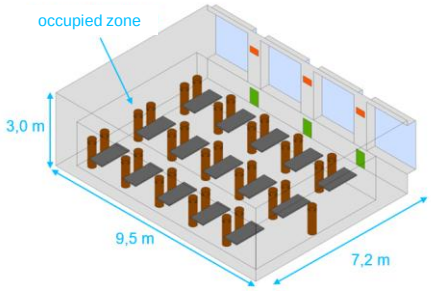
Focus on Energy Efficiency

Ventilation Effectiveness

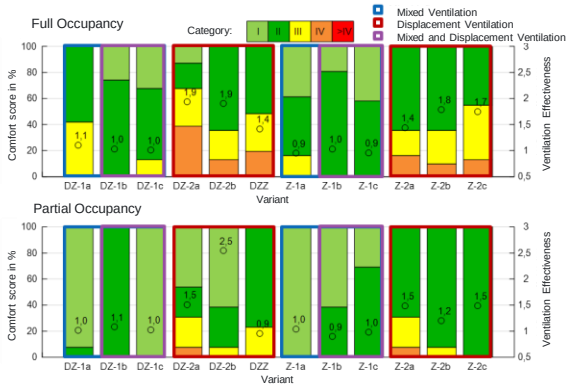
Flow simulation of a reference classroom (ventilation effectiveness & thermal comfort)

- 12 Air Flow Concepts
- Full/Partial Occupancy
- Table rows, table groups
- Winter and summer case

Ventilation Effectiveness



Reference classroom layout



Simulation results: Winter case, table rows, supply air temperature 16°C

Research Areas in Indoor Climate Technology

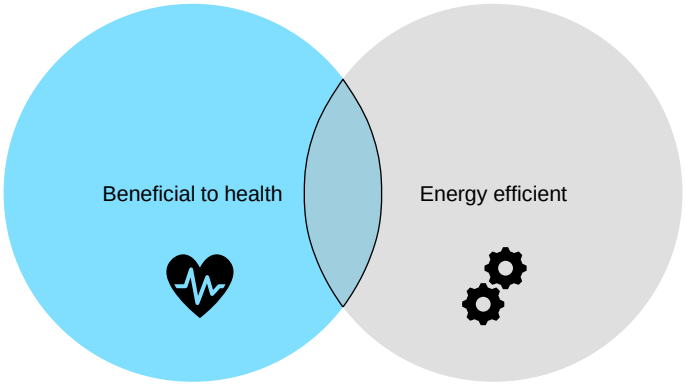
What defines good ventilation?

Beneficial to health

Energy efficient

Research Areas in Indoor Climate Technology

What defines good ventilation?

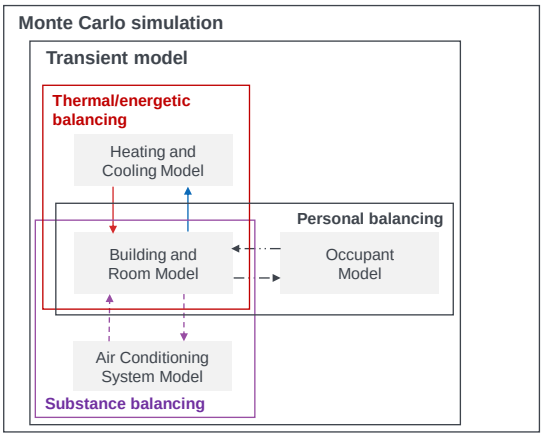


Health vs. Energy

An Optimization Study in an Office

- **Task:**
  - Ventilation strategies with an economic optimum
    - Work incapacity costs (infections at the office)
    - Energy costs (ventilation, heating, cooling, …)
- **Conditions:**
  - Simulation period: 2022
  - Stuff: 41 persons
  - Epidemiological data: SARS-CoV-2 (Omikron)

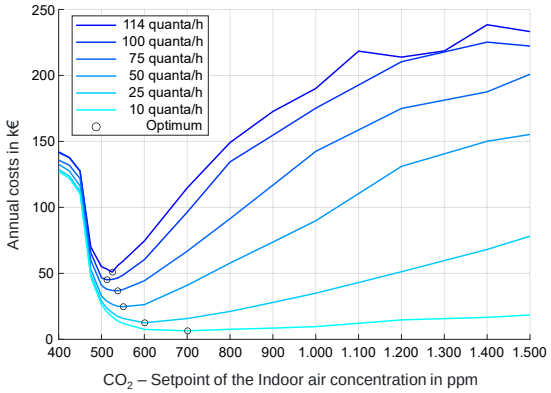
- **Approach:**



Health vs. Energy

Results and Outlook

Economical comparison of different ventilation strategies



Outlook:

- Challenging the Pettenkofer-Number
- Holistic simulation model of social life
- Modelling Scale-up

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Lukas Siebler

E-Mail lukas.siebler@igte.uni-stuttgart.de
Phone +49 (0) 711 685 - 60785
www.igte.uni-stuttgart.de

University of Stuttgart
Institute for Building Energetics, Thermotechnology and Energy Storage (IGTE)
70550 Stuttgart
Germany