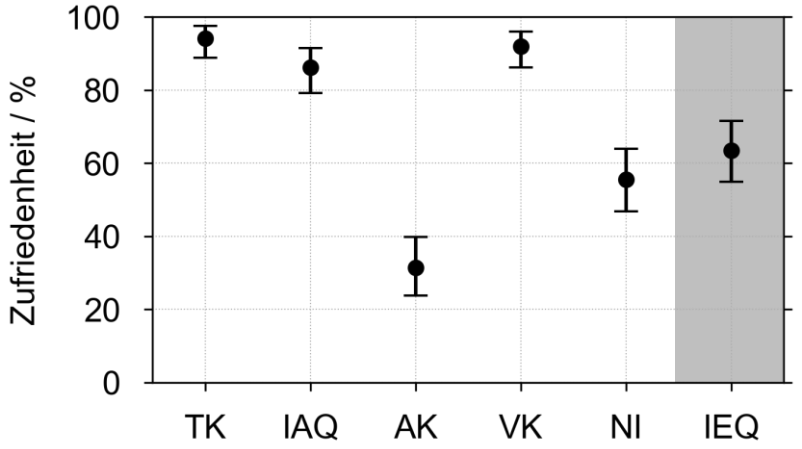
Lukas Schmitt | 37. GLT-Anwendertagung
18. September 2025

Alles eine Frage der Effizienz!?

Energie, Komfort und Gesundheit in Gebäuden

Innenraumqualität

Nutzerbefragungen



- Standort: **Hamburg**
- Zertifizierung: **Silber (BNB)**
- Befragungszeitraum:
  - 08.2022 (wöchentlich)
  - 01.2023 (wöchentlich)
- Stichprobengröße: **147 Gebäudenutzende**

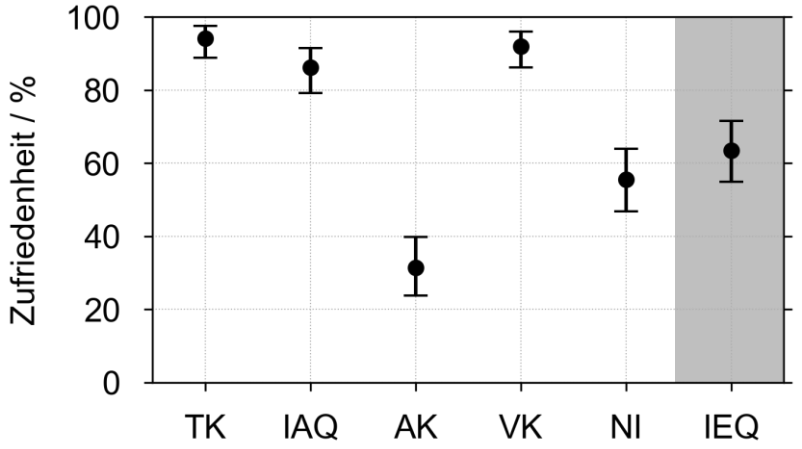
Ordinale logistische Regression

$$\mathrm{IEQ} = \frac{1}{1 + e^{-x}}$$

$$\text{mit} \quad x = \beta_0 + x_1\beta_1 + \cdots + x_i\beta_i$$

Innenraumqualität

Nutzerbefragungen



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  - 08.2022 (wöchentlich)
  - 01.2023 (wöchentlich)
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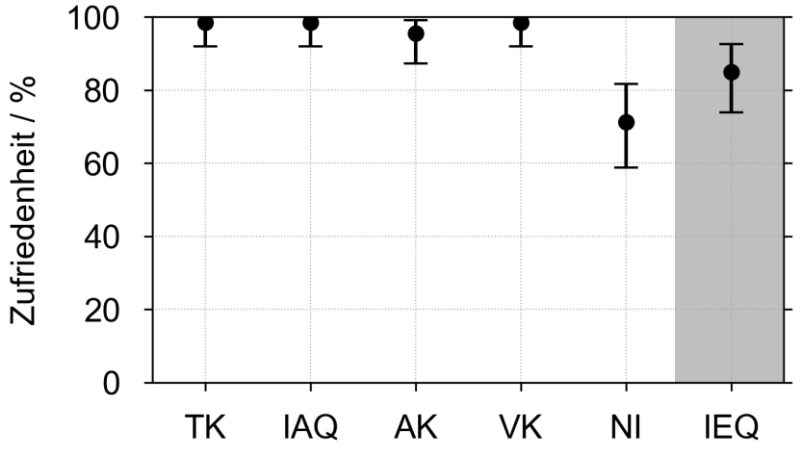
	β	ε
Konstante	**-0.20**	0.17
Thermischer Komfort (**TK**)	**0.24**	0.21
Luftqualität (**IAQ**)	**0.24**	0.13
Akustischer Komfort (**AK**)	**0.12**	0.08
Visueller Komfort (**VK**)	**0.29**	0.17
Nutzerinteraktion (**NI**)	**0.28**	0.09

Innenraumqualität

Nutzerbefragungen



- Standort: **Berlin**
- Zertifizierung: **Silber (BNB)**
- Befragungszeitraum:
  - 05.2023 bis 04.2024 (wöchentlich)
- Stichprobengröße: **79 Gebäudenutzende**

	β	ε
Konstante	**-0.81**	0.39
Thermischer Komfort (**TK**)	**0.02**	0.24
Luftqualität (**IAQ**)	**0.00**	0.23
Akustischer Komfort (**AK**)	**0.68**	0.16
Visueller Komfort (**VK**)	**0.29**	0.17
Nutzerinteraktion (**NI**)	**0.28**	0.09

Innenraumqualität

Was sagt die Literatur?

Review (Danza, 2020)

	Probanden	Staat	TK (%)	VK (%)	AK (%)	IAQ (%)
Heinzerling et al. (2013)	52980	USA	12	29	39	20
Marino et al. (2012)	8	Italy	29	23	25	23
Chiang et al. (2002)	12	Taiwan	24	19	23	34
Ncube et al. (2012)	68	UK	30	16	18	36
Cao et al. (2012)	500	China	38	21	27	14
Wong et al. (2018)	293	China	31	20	24	25
Residovic (2017)	35	Australia	33	17	17	33
Nimlyat (2018)	–	Nigeria	37	16	28	23

TK Thermischer Komfort

IAQ Luftqualität (*Indoor Air quality*)

AK Akustischer Komfort

VK Visueller Komfort

IEQ-Lab


BTGA
daldrop
ST
GEBERIT
ROCKWOOL
wilo
KKF
convecta
BEKA


BTGA
Bundesindustrieverband Technische Gebäudeausrüstung e.V.
Fachverband Gebäude-Klima e.V.
daldrop
ST
KÄLTE KLIMA WÄRME
GEBÄUDETECHNIK GMBH
TROX TECHNIK
The art of handling air
GEBERIT
convecta
ROCKWOOL
wilo
KKF
BEKA
KLIMA-KOMFORT
Unterstützt durch
unsere Projektpartner

Rendering: **Ray Marching**

Rendering: **Raytracing**

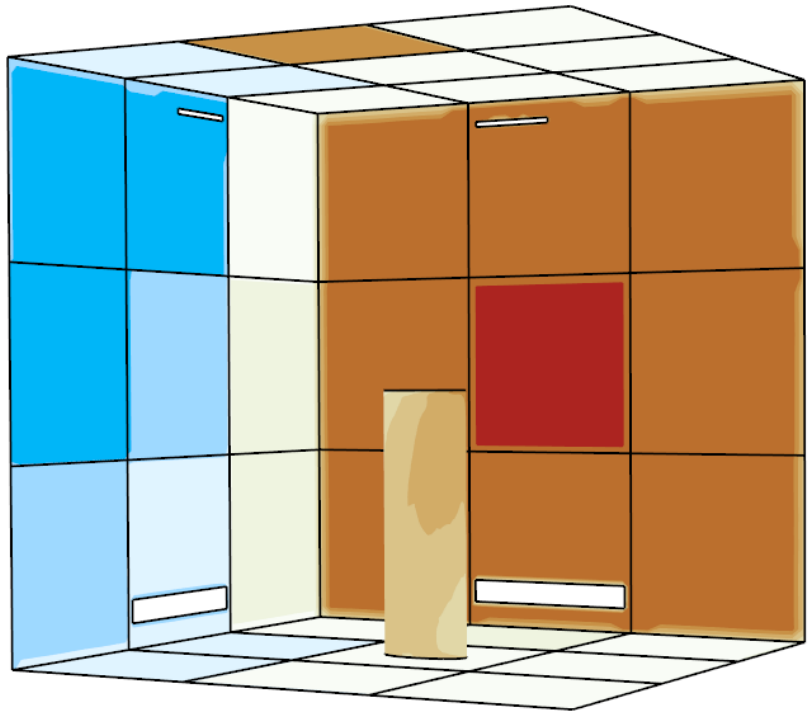
Rendering: **Raytracing**

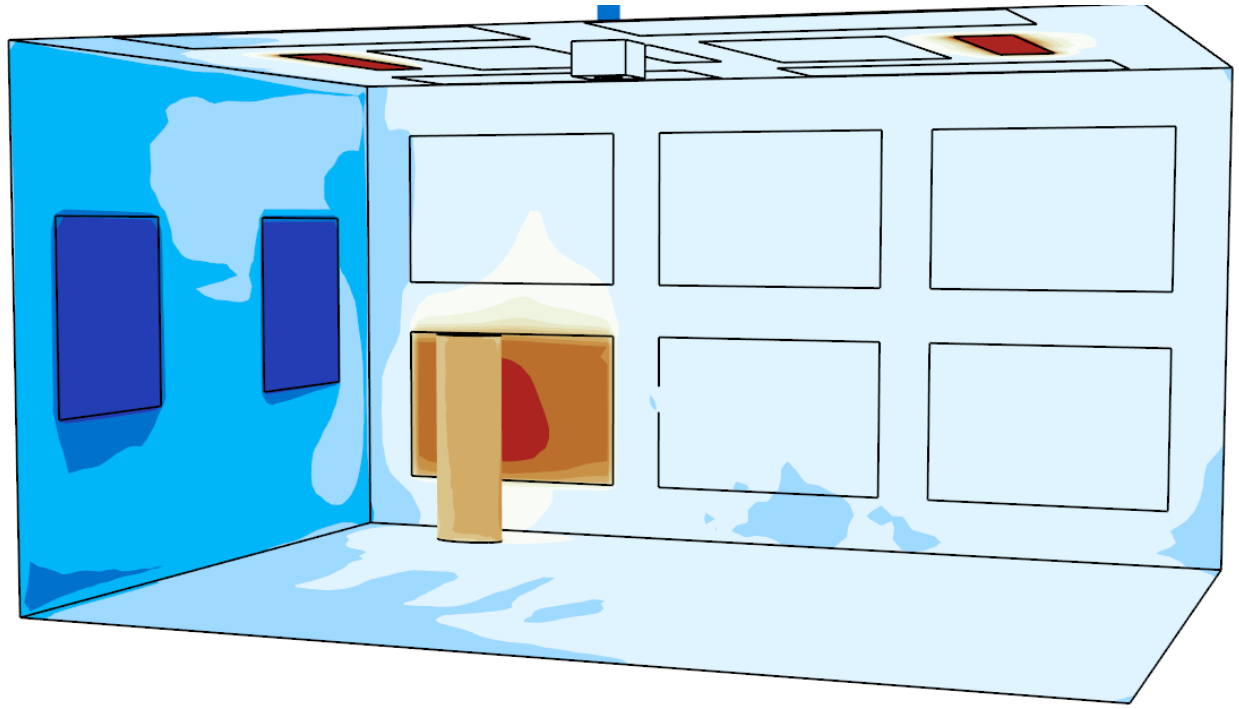
Rendering: **Raytracing**

Rendering: **Raytracing**

IEQ-Lab

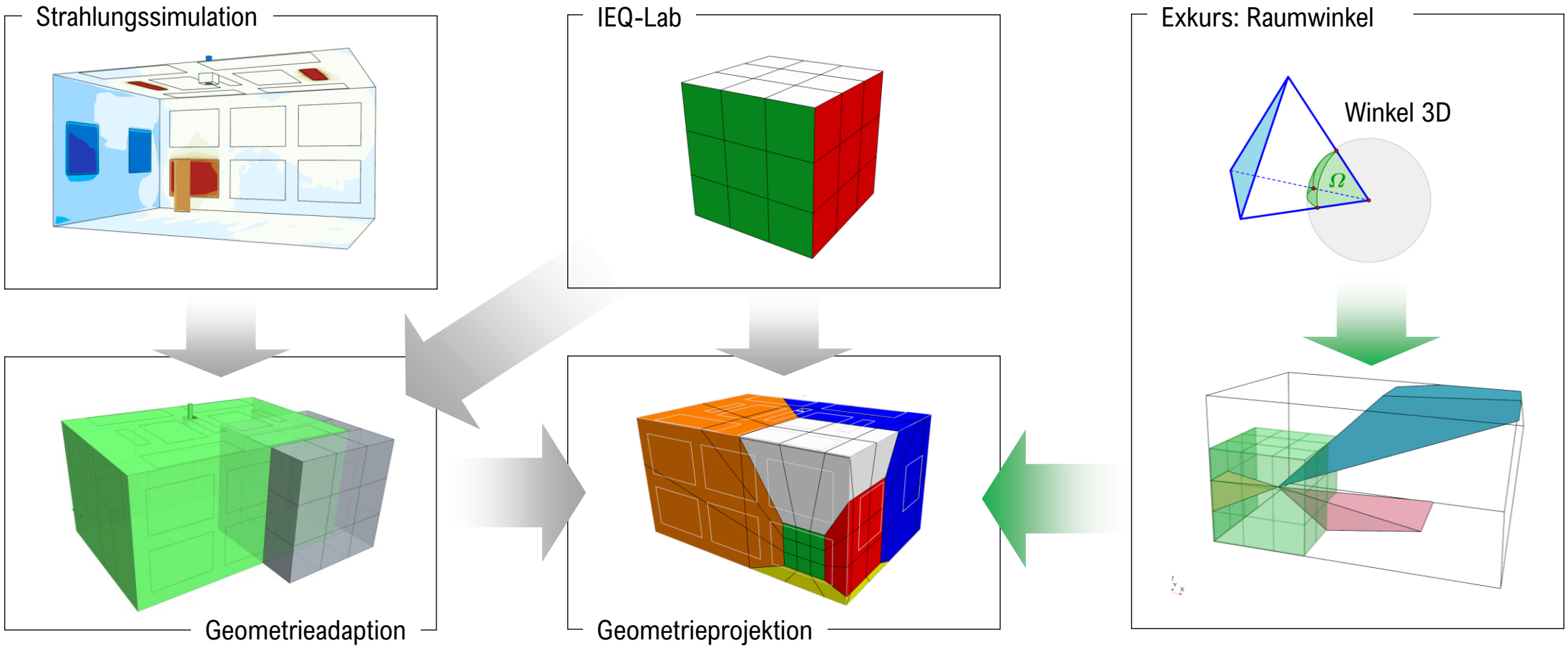
Projektion der Strahlungstemperaturen





IEQ-Lab

Projektion der Strahlungstemperaturen



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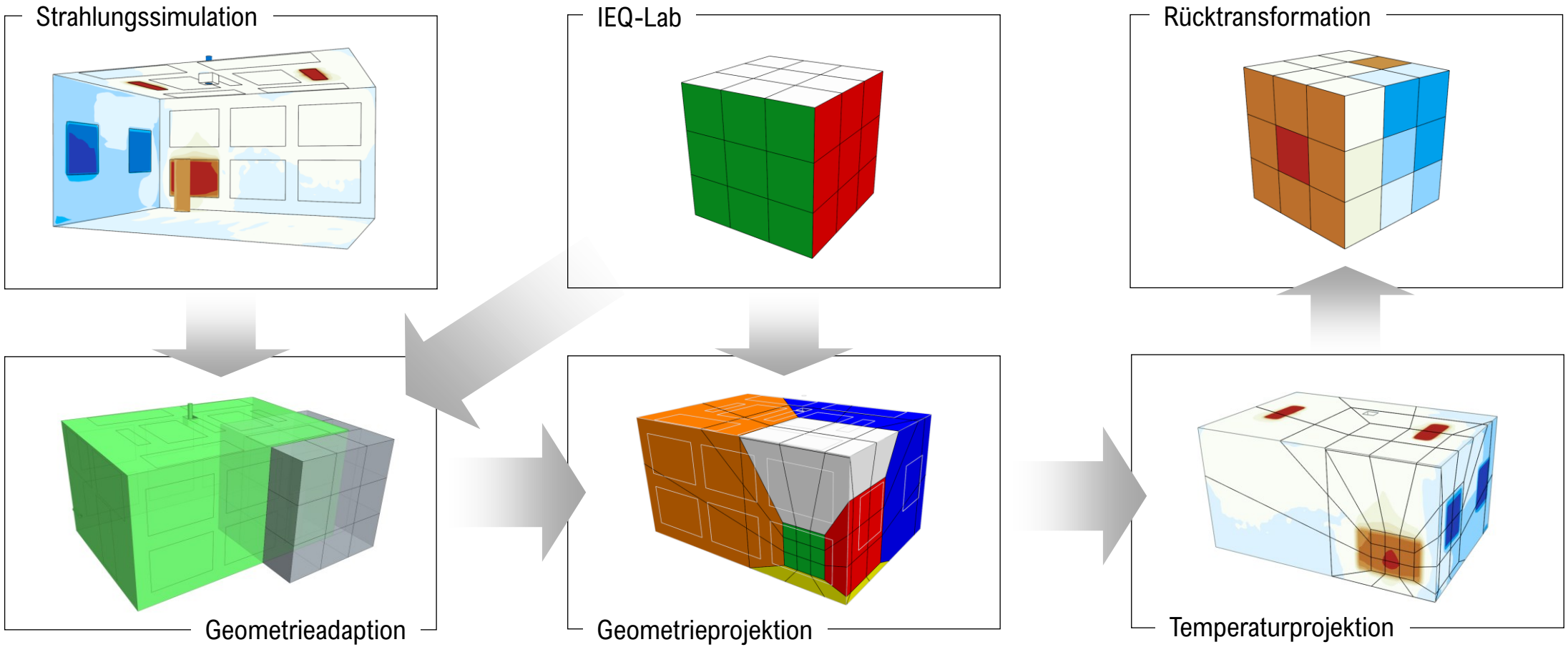
Projektion der Strahlungstemperaturen



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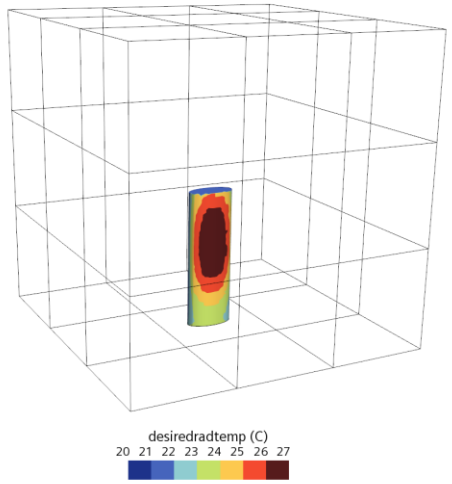
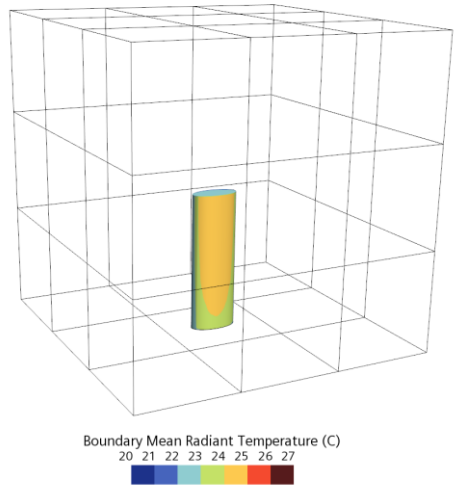
Projektion der Strahlungstemperaturen

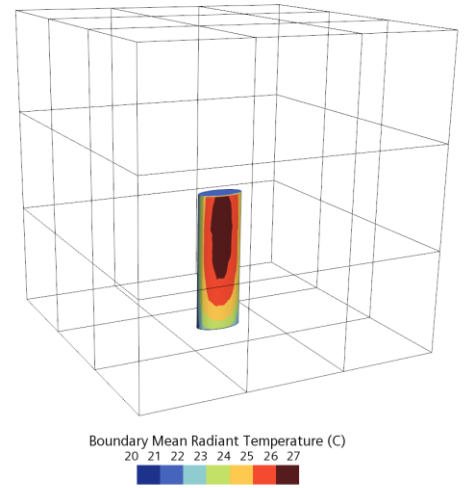
Benchmark



Geometrischer Ansatz



Optimierung



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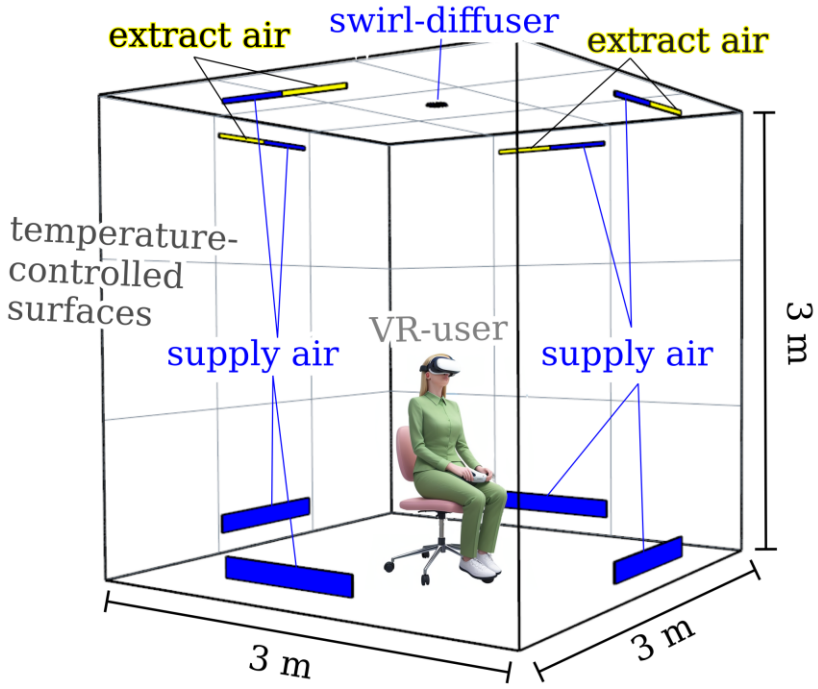
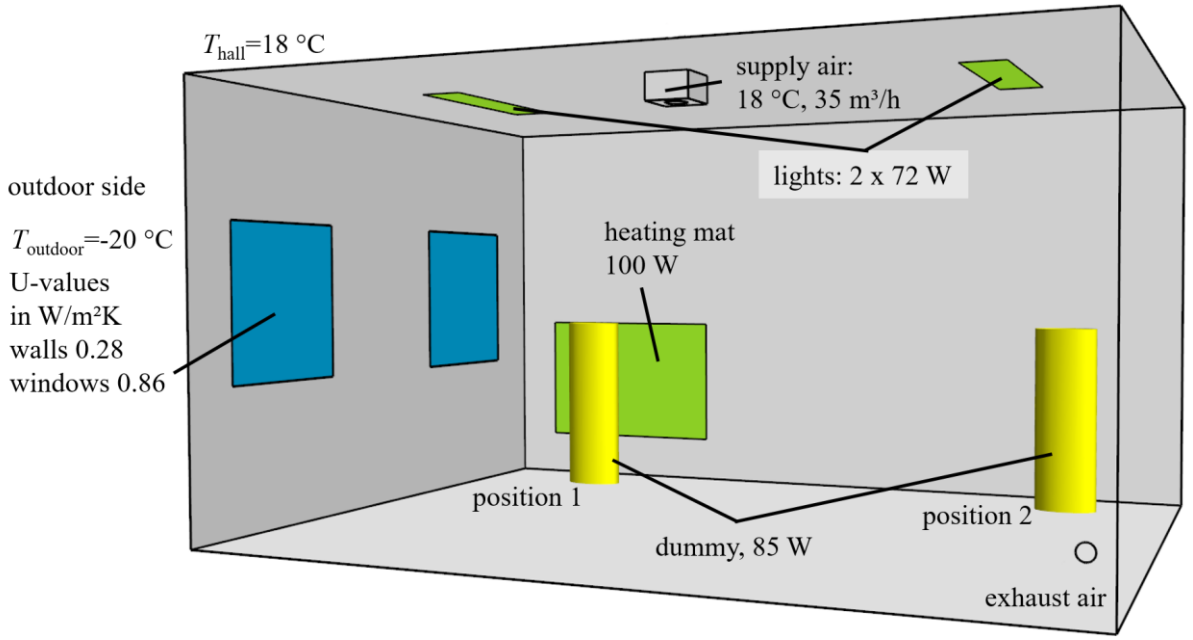
Projektion der Raumluftströmung





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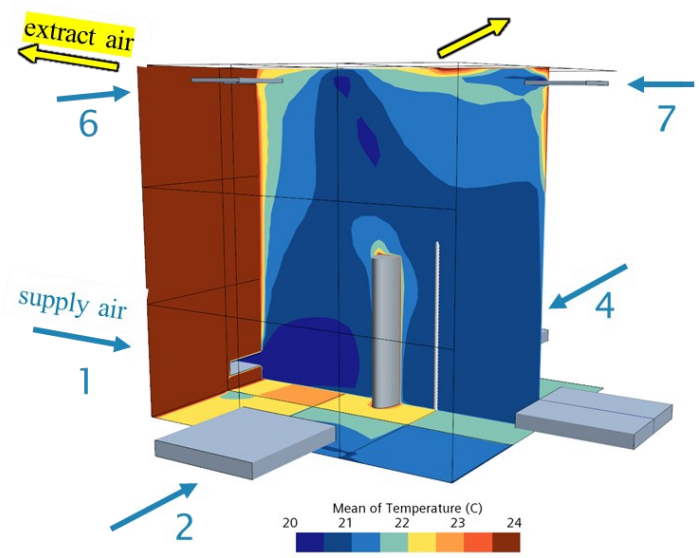
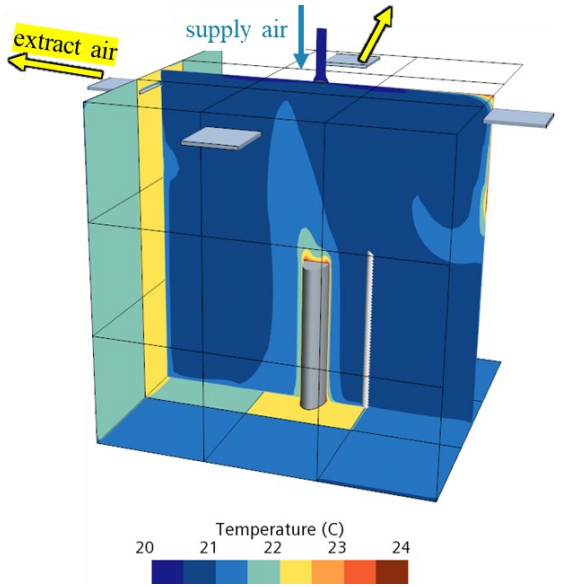
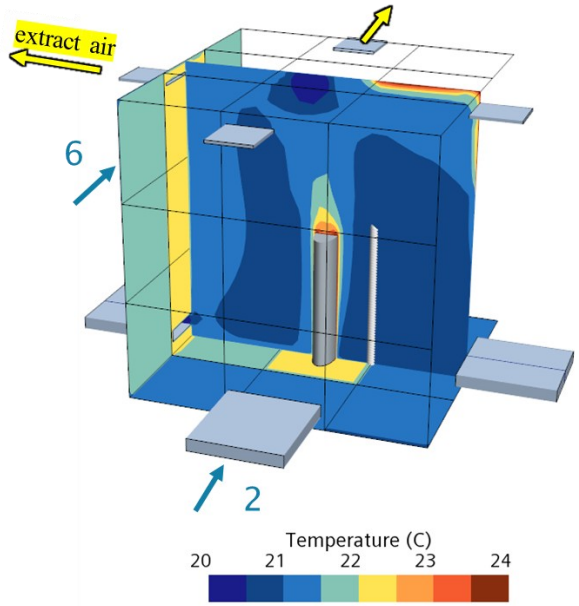
Projektion der Raumluftströmung

Position 1



Position 2





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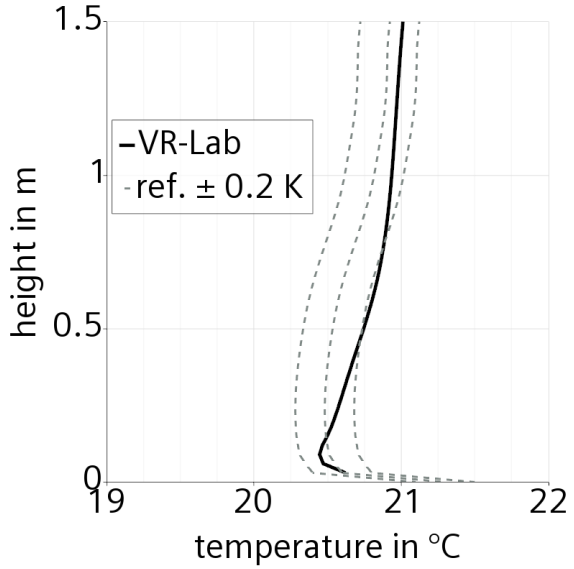
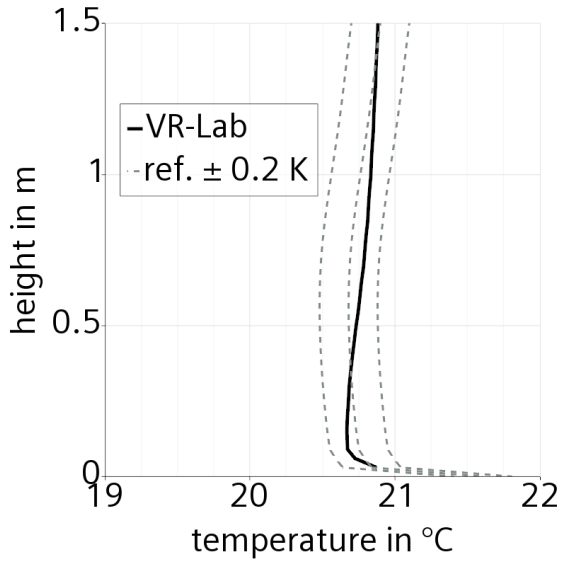
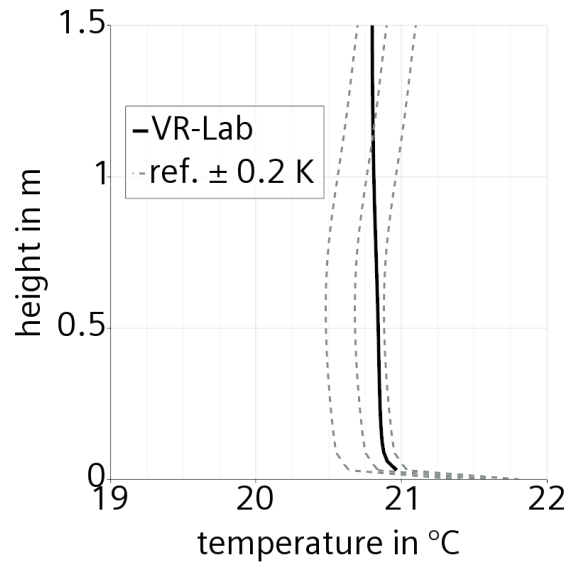
Projektion der Raumluftströmung

Position 1

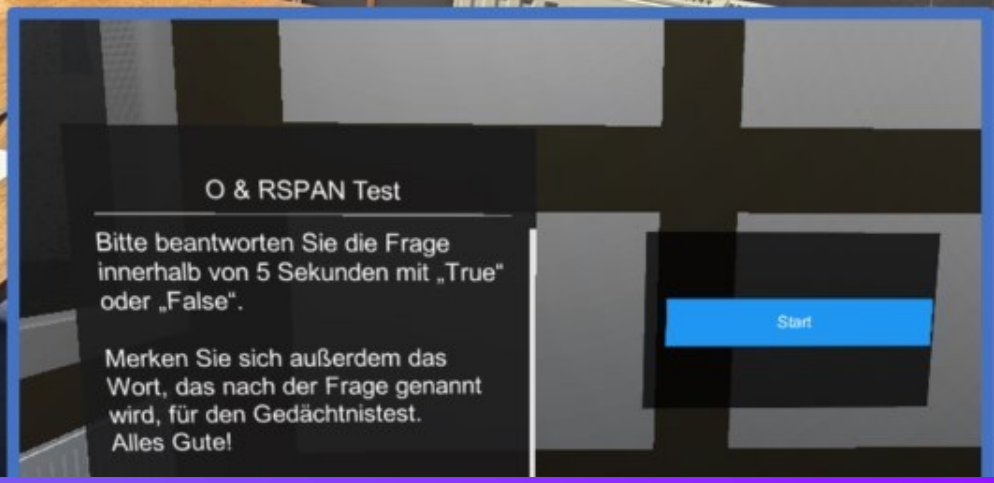


Position 2



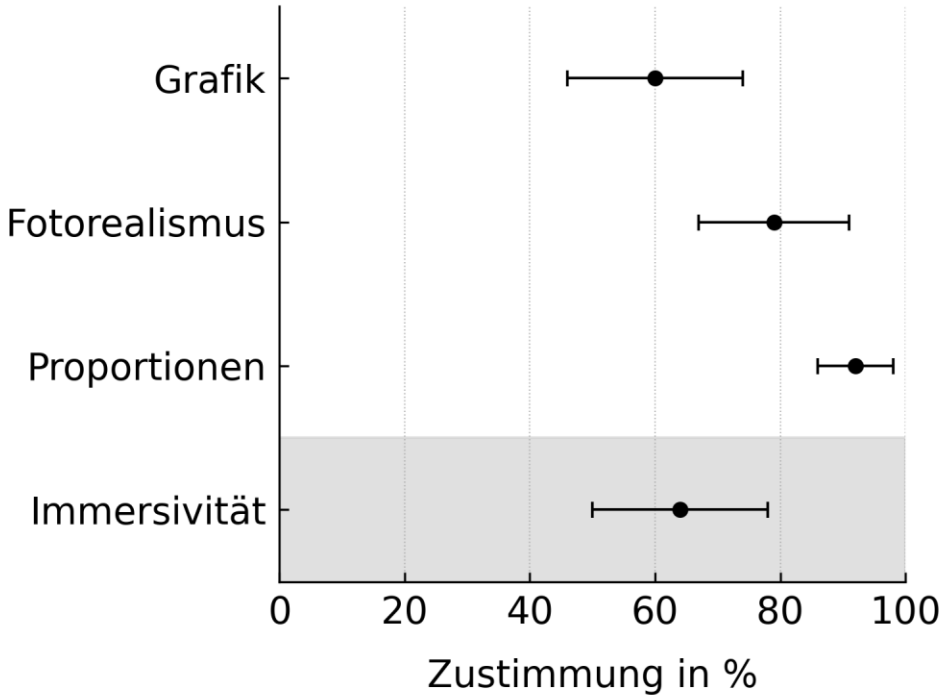


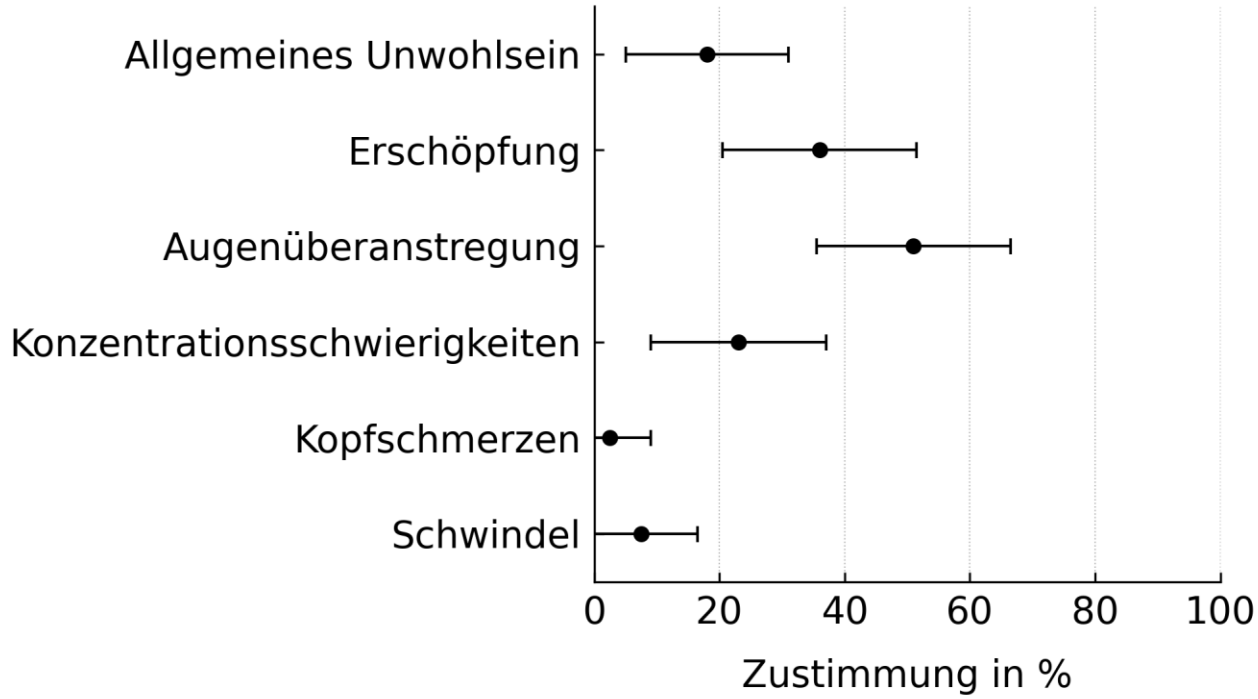
Studie 1: Komfort in der virtuellen Realität



Studie 1

Komfort in der Virtuellen Realität





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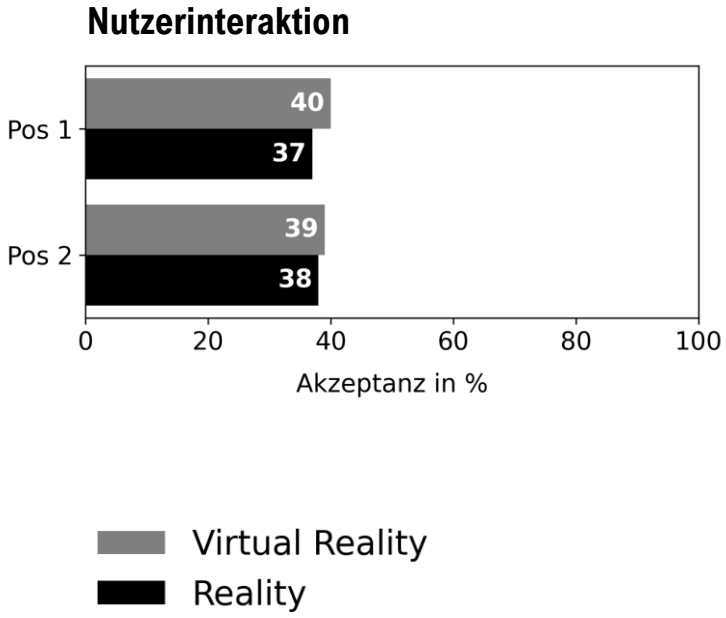
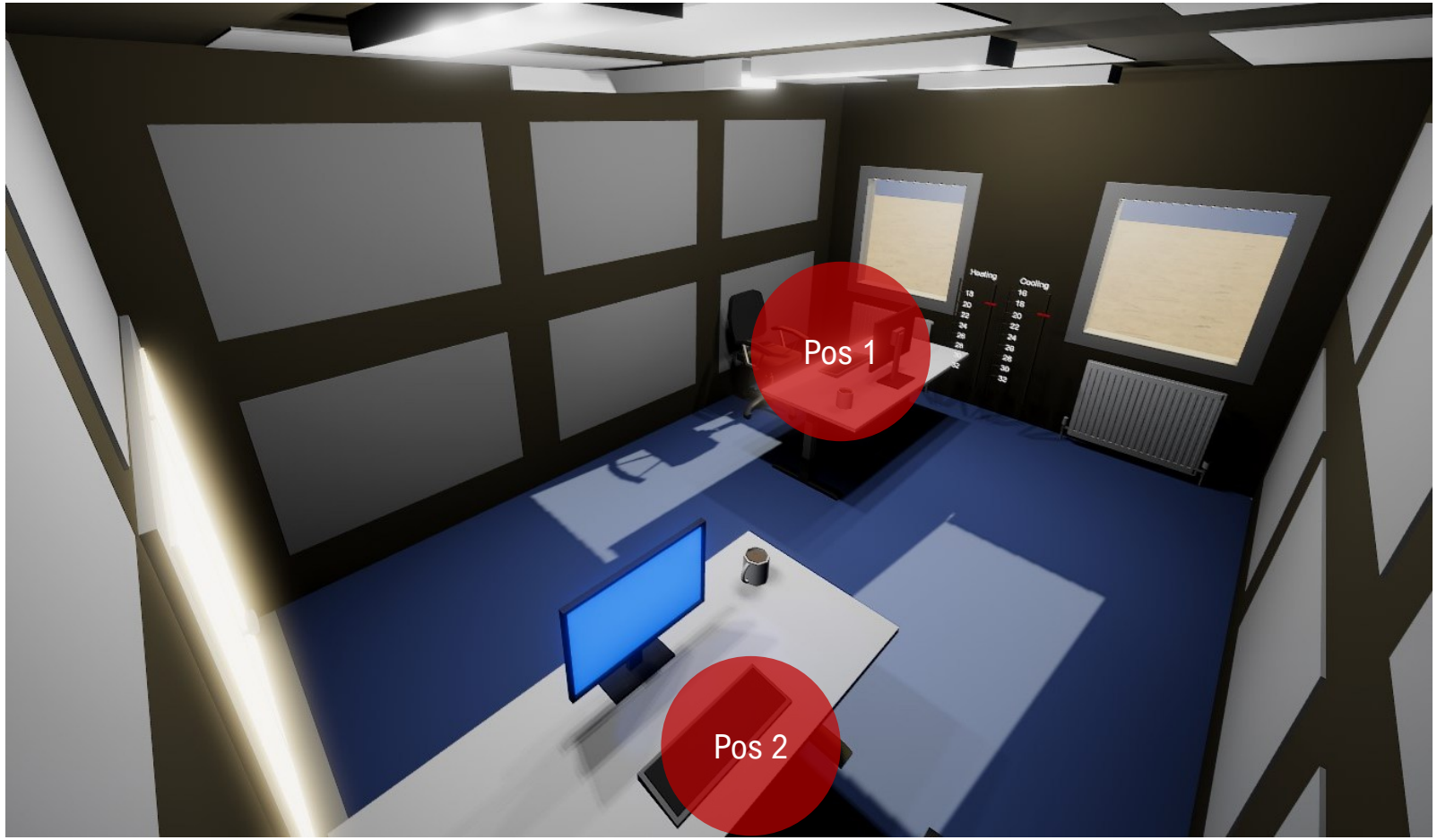
Komfort in der Virtuellen Realität





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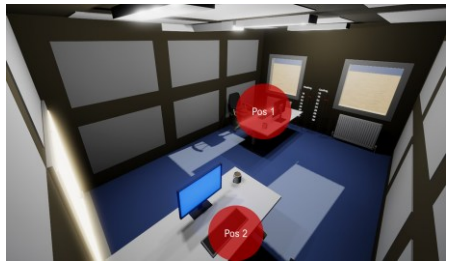
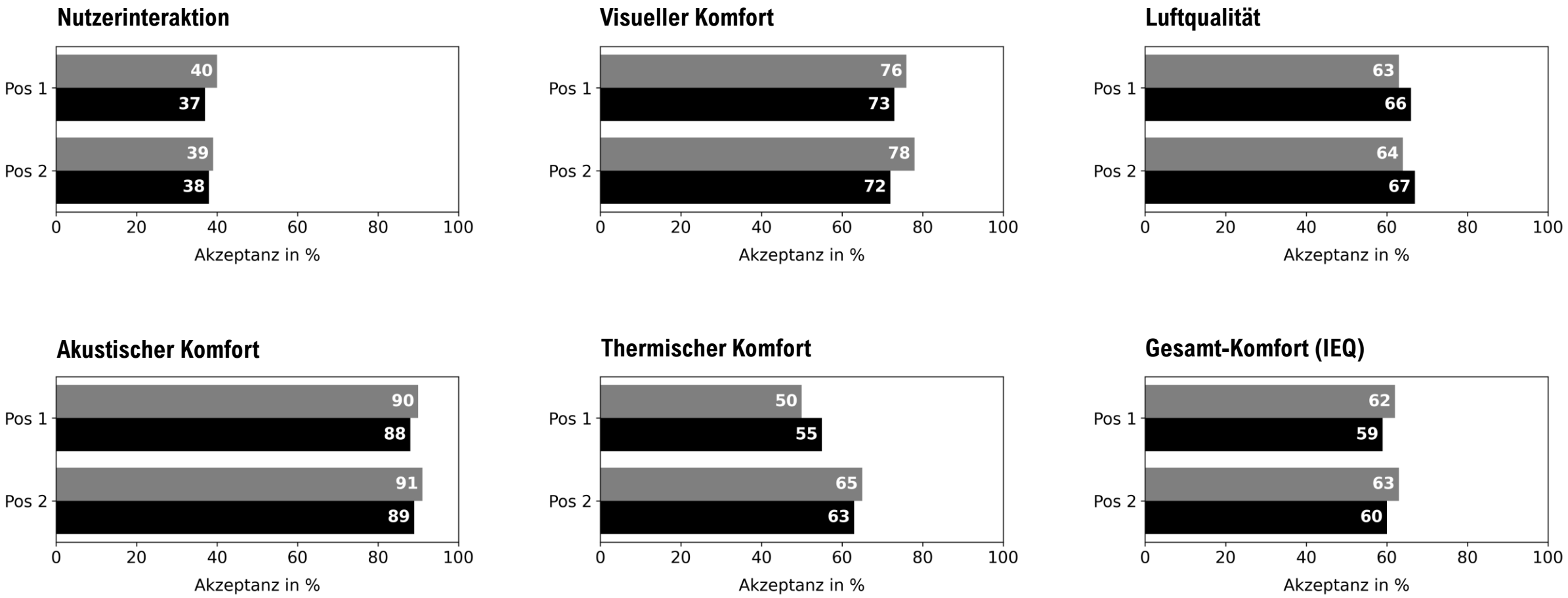
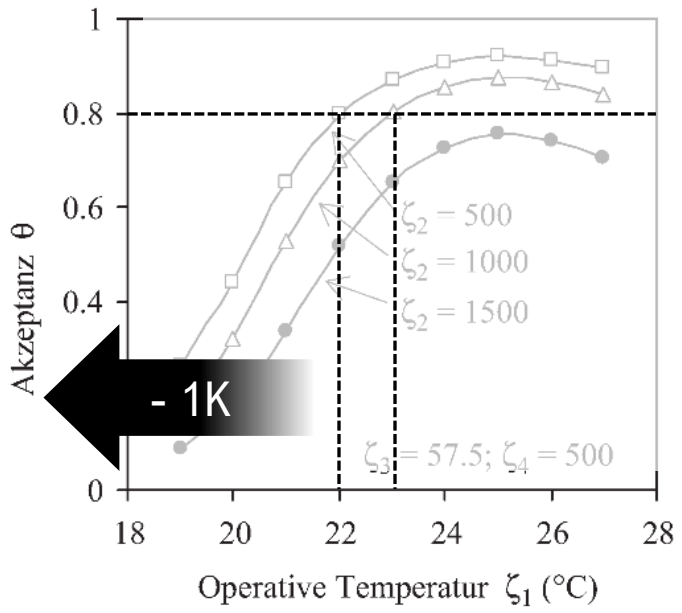




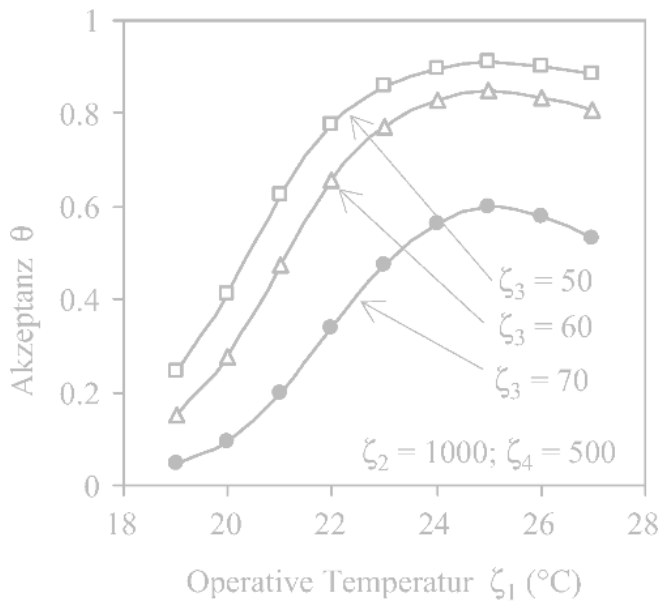
IEQ-Gesamtbewertung

Quelle: Wong et al. 2008
Definition: Akzeptanz des Raumklimas: $\Theta = f\,(\,\zeta_1, \zeta_2, \zeta_3, \zeta_4\,)$

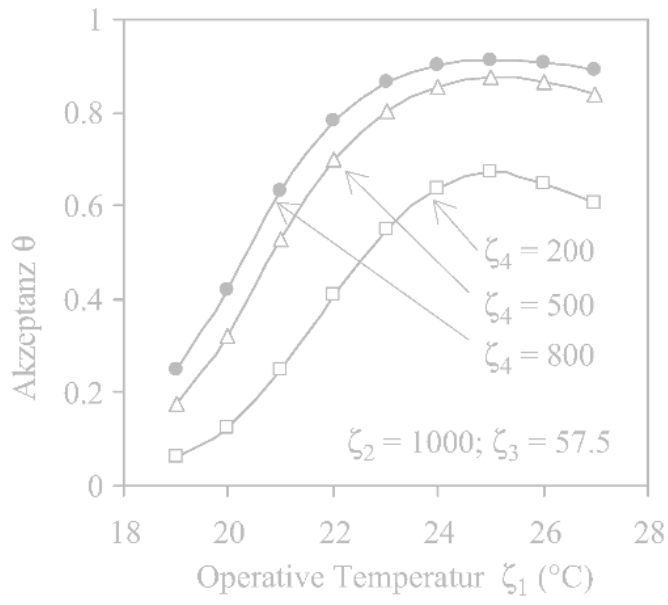
ζ_2: CO_2-Konzentration (ppm)



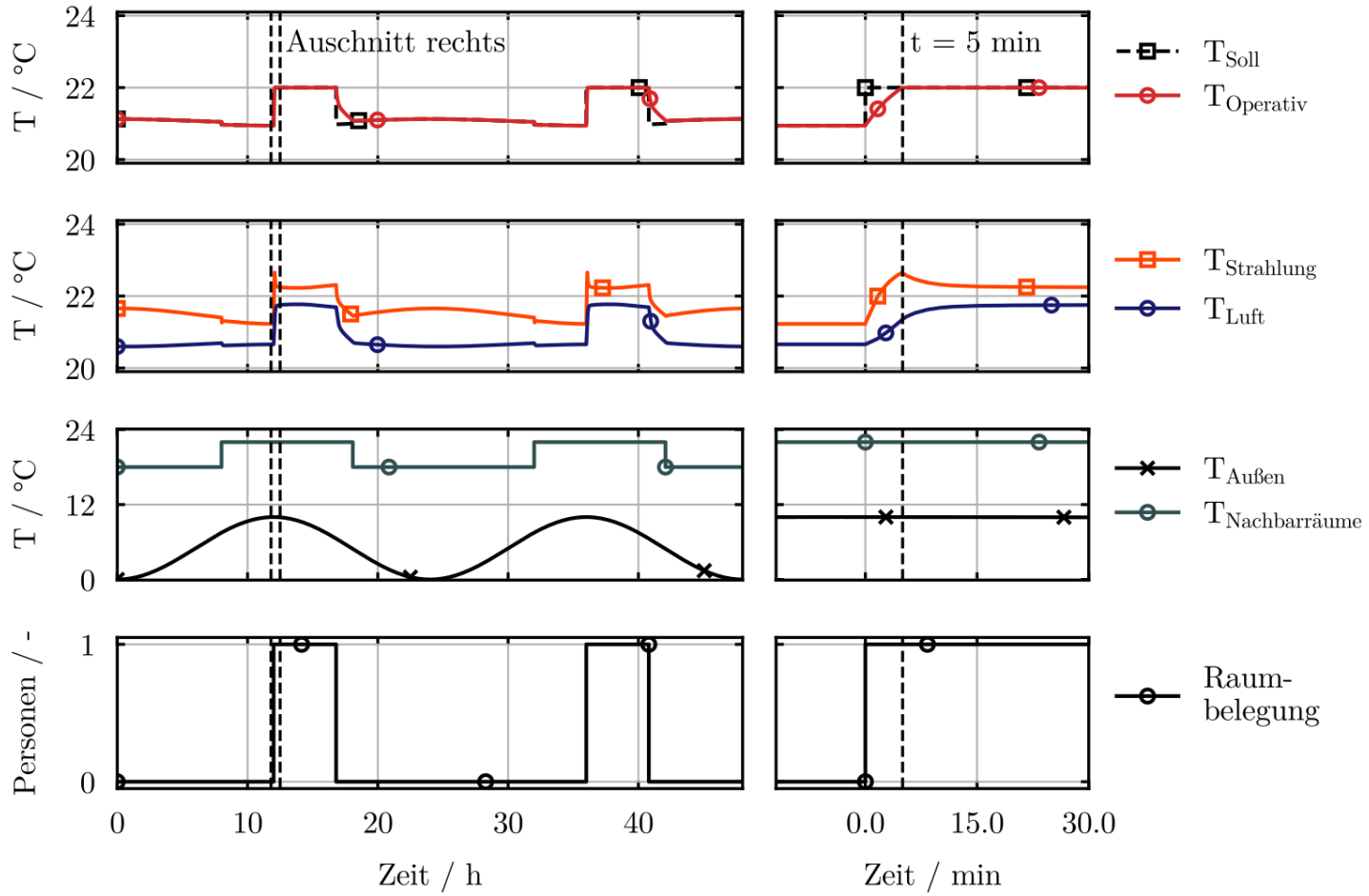
ζ_3: Äq. Schallpegel (dBA)

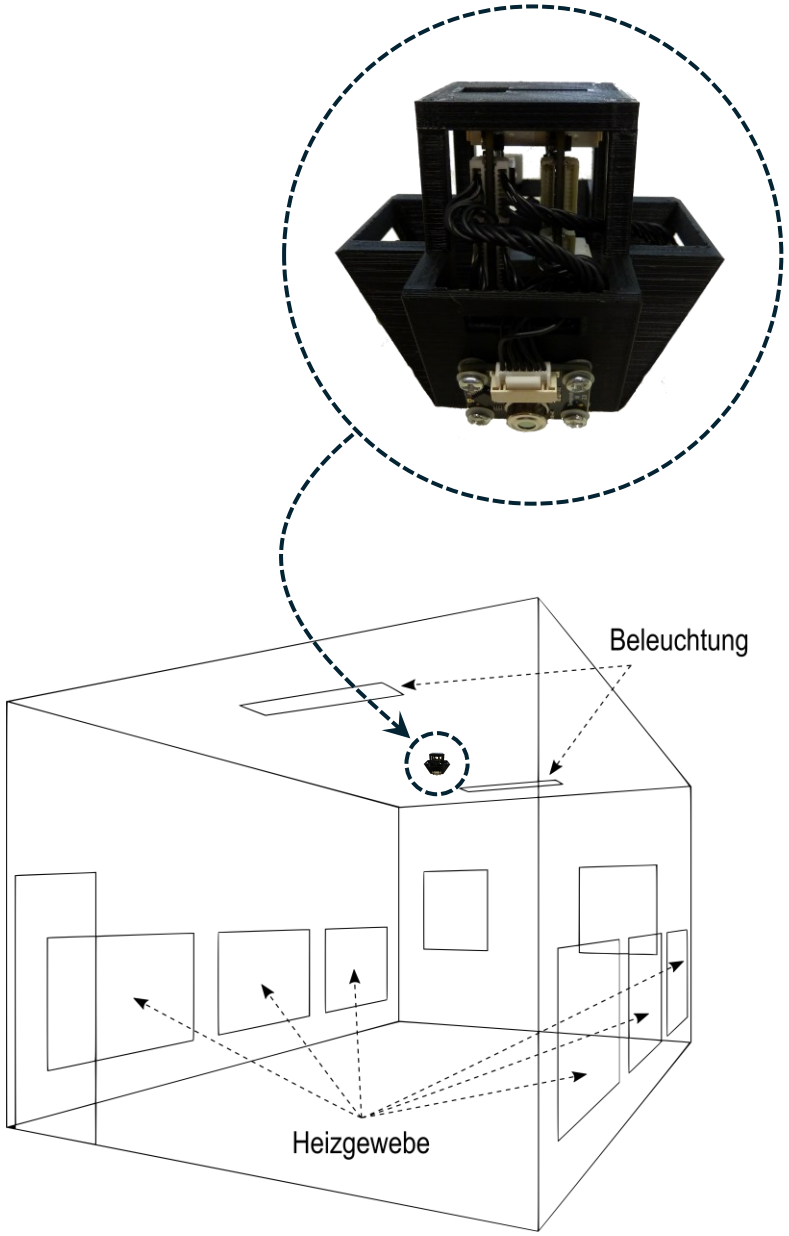


ζ_4: Beleuchtungsstärke (lux)

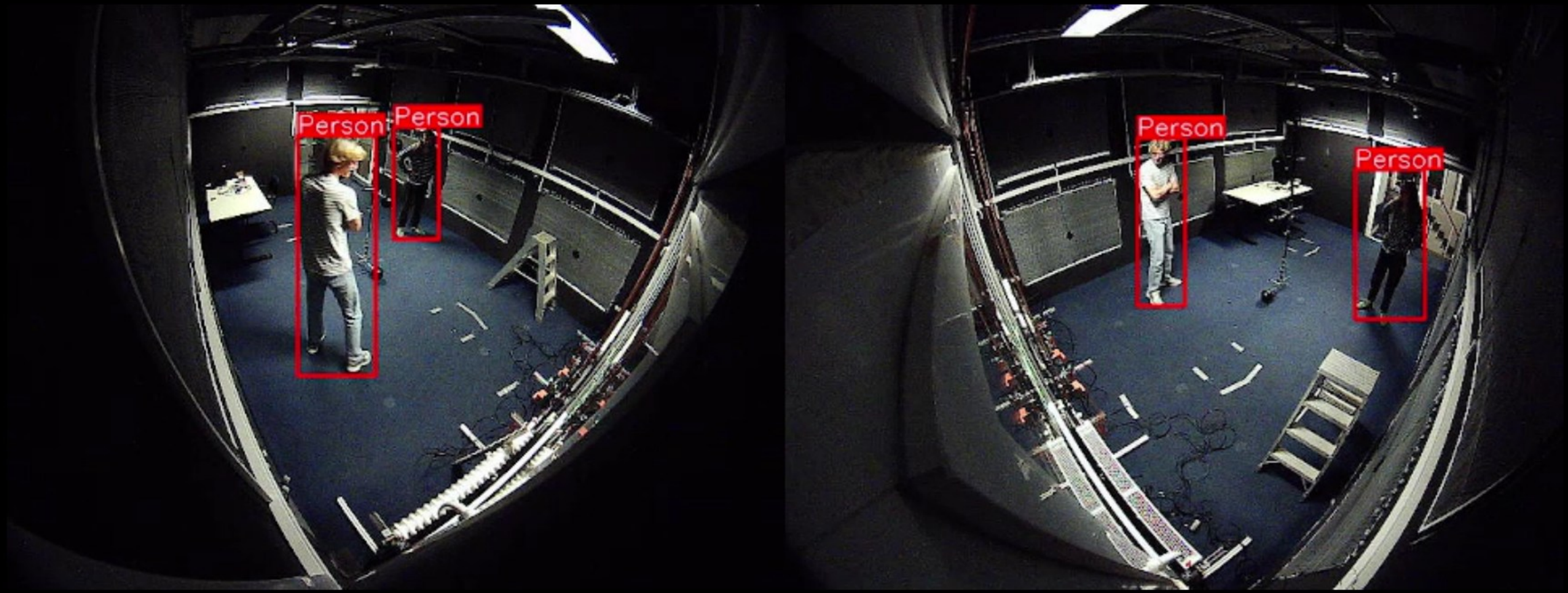


Energetische Optimierung durch Temperaturabsenkung



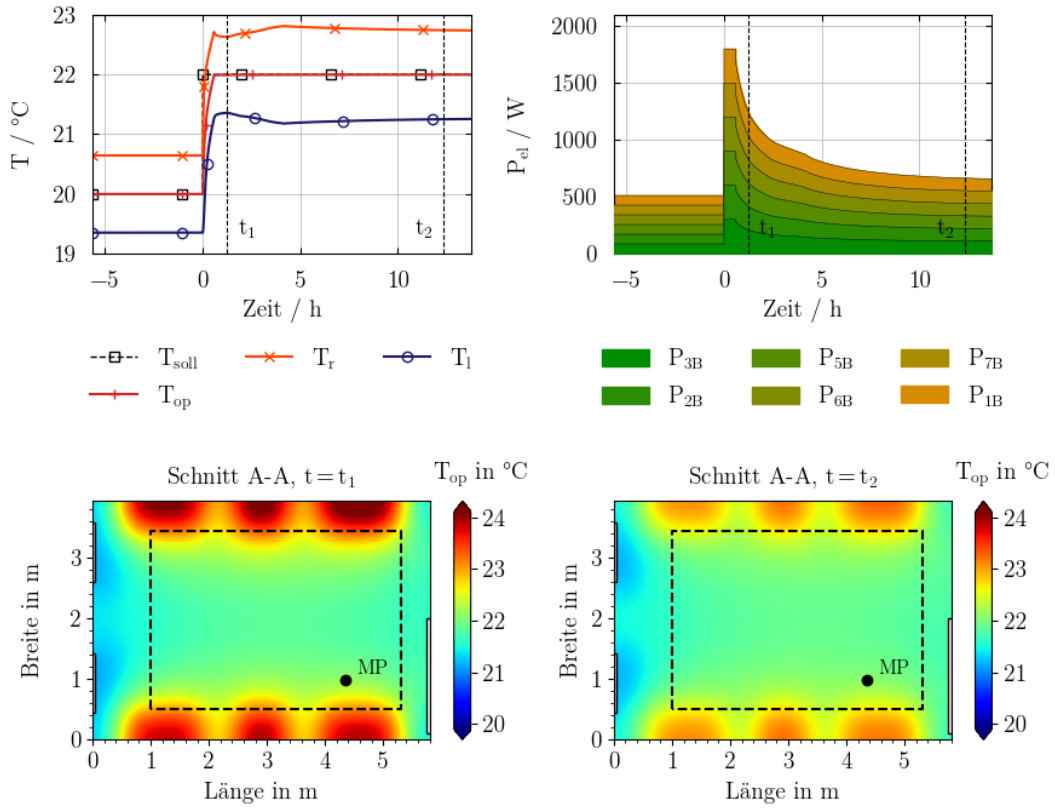


Energetische Optimierung durch Lokale Beheizung

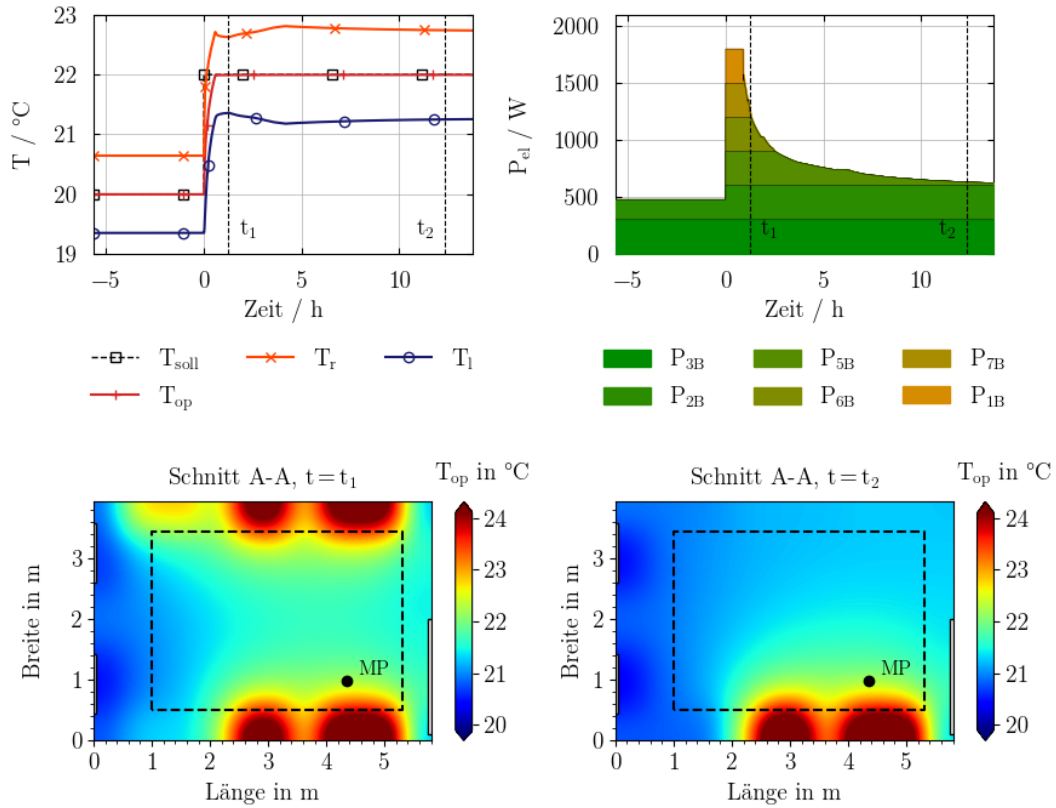


Energetische Optimierung durch Lokale Beheizung

Globale Beheizung



Lokale Beheizung



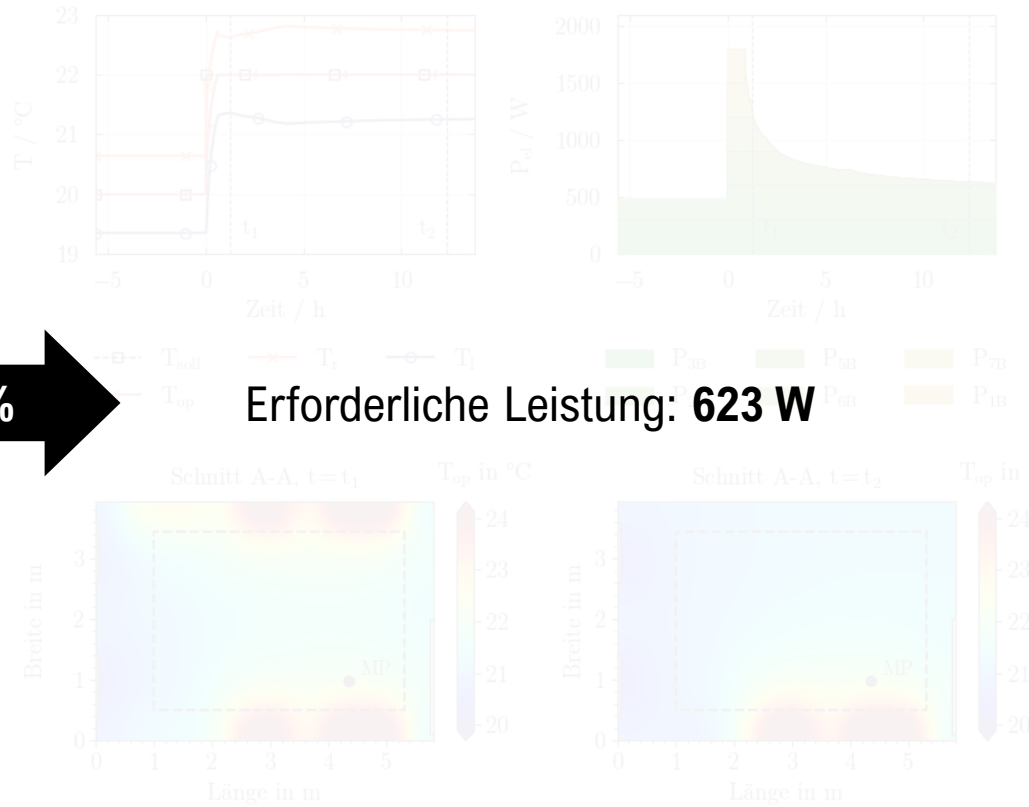
Energetische Optimierung durch Lokale Beheizung

Globale Beheizung

Erforderliche Leistung: **657 W**

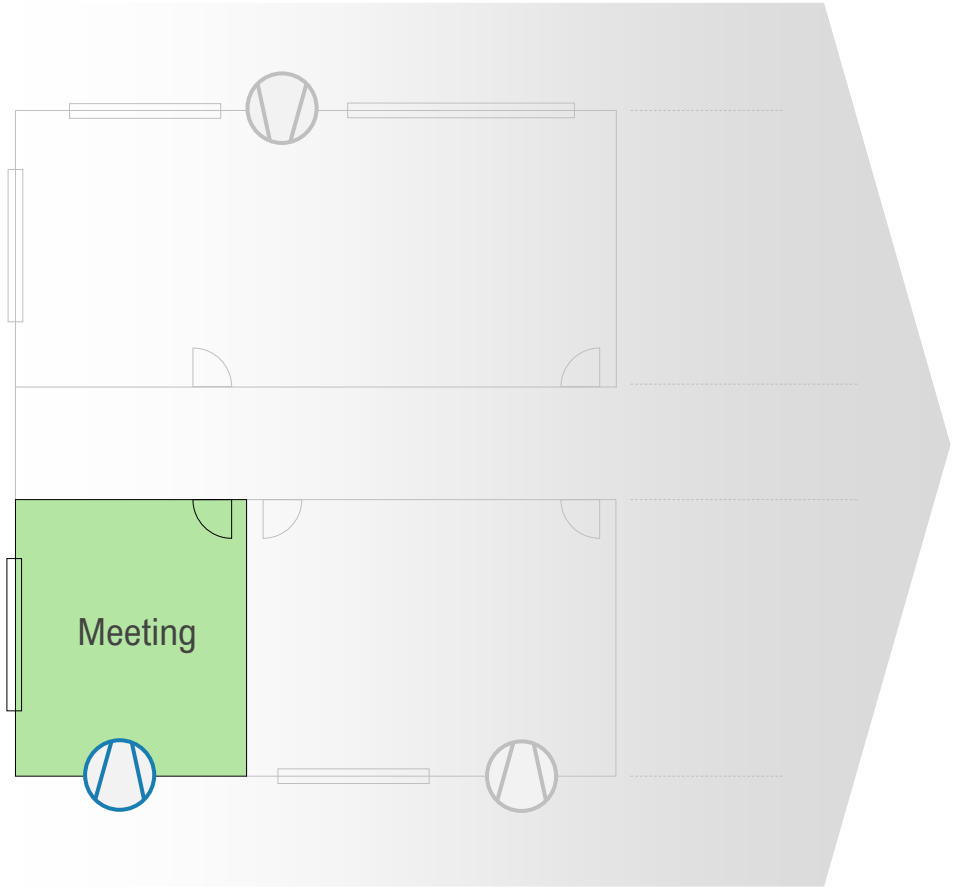
- 5,2 %

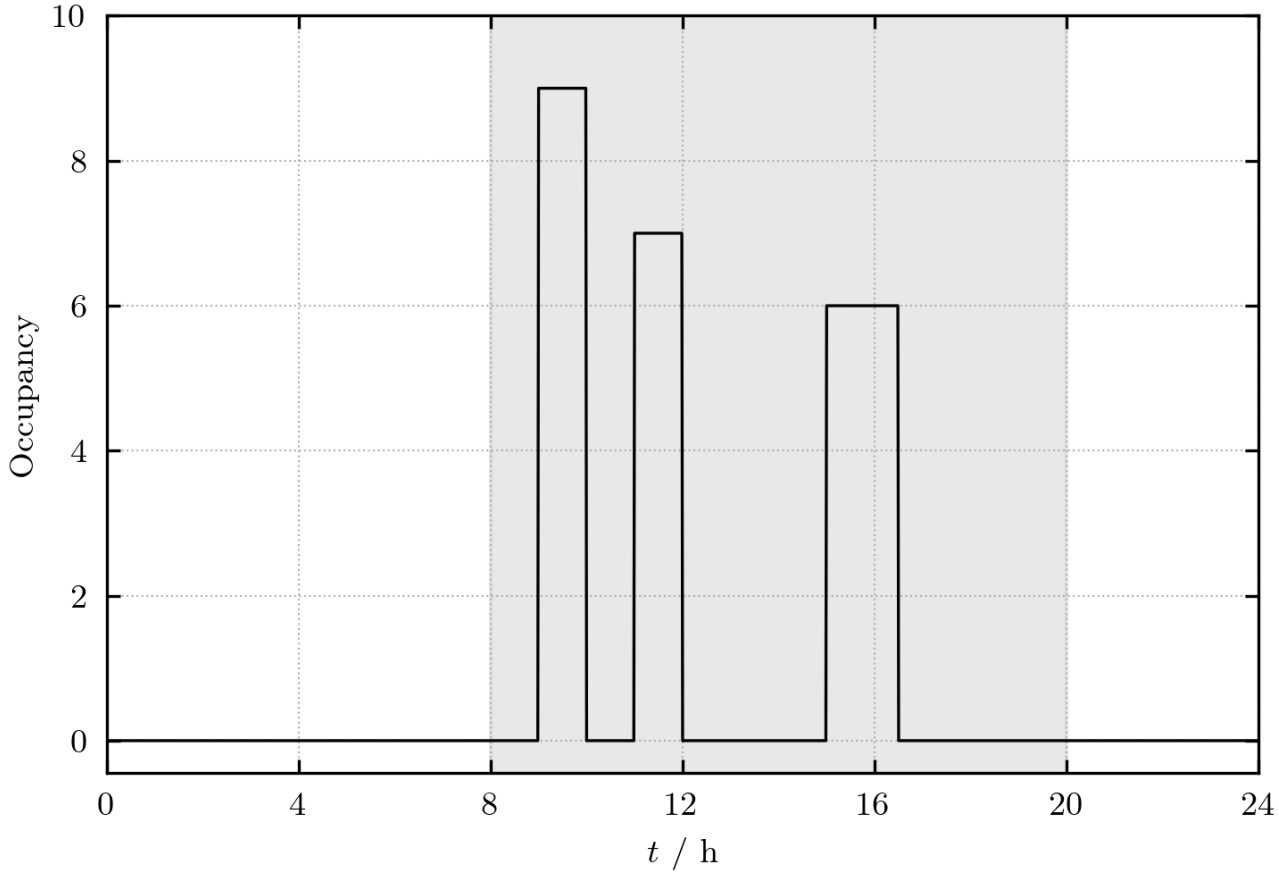
Lokale Beheizung



Erforderliche Leistung: **623 W**

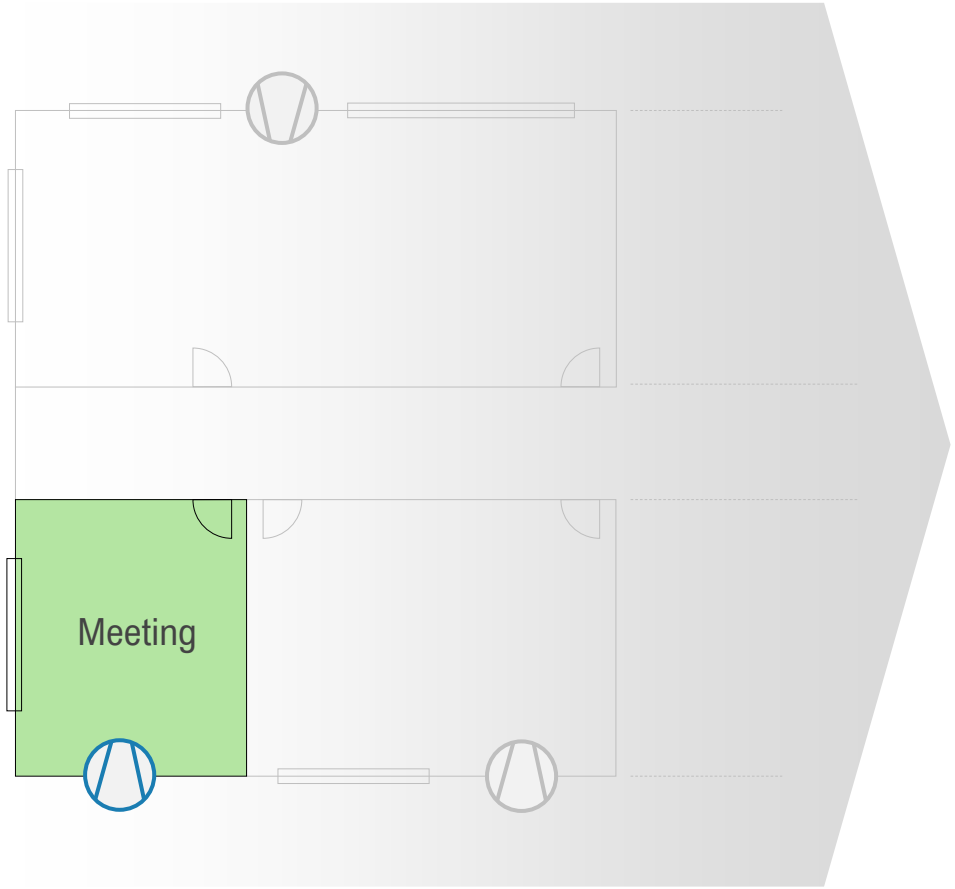
Effizienzsteigerung durch Minimierung des Energiebedarfs

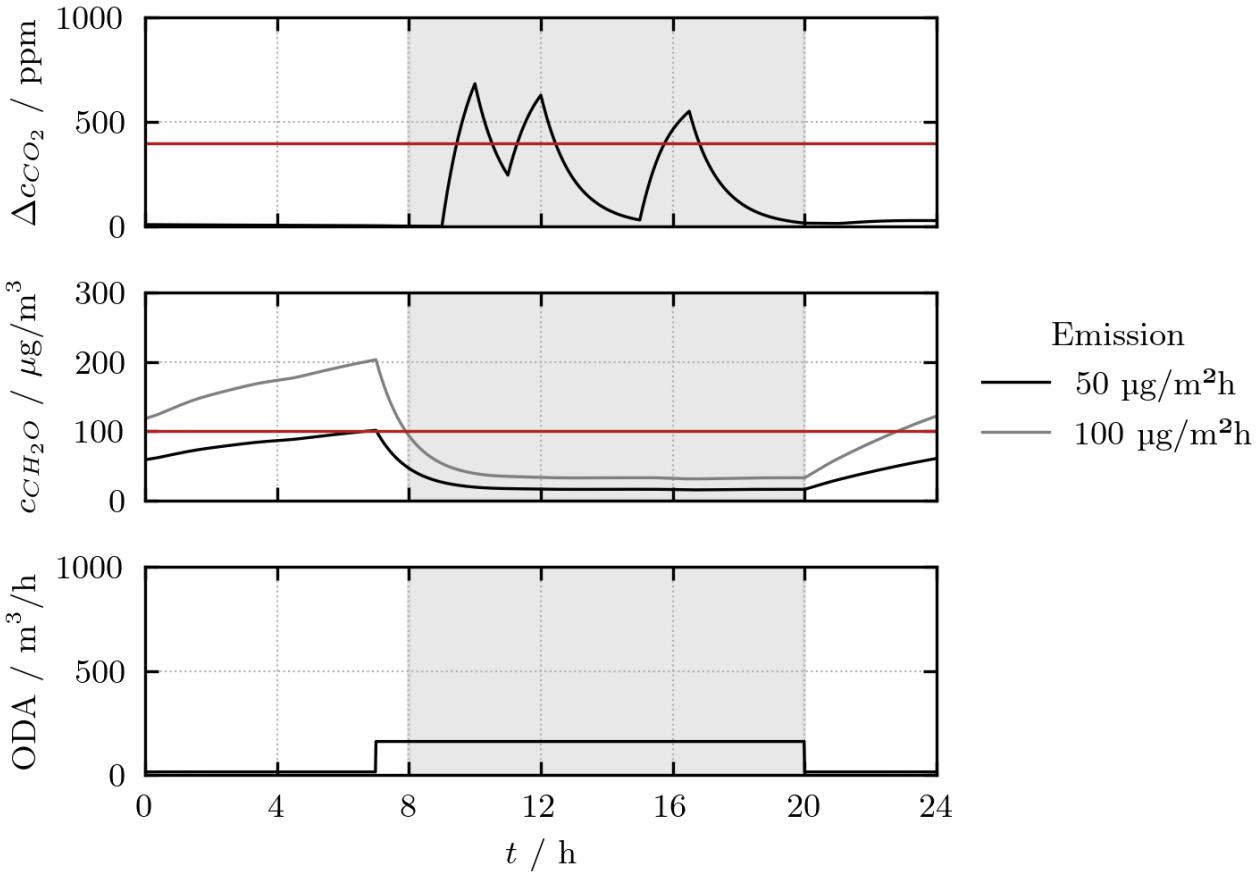




Steuerung/Regelung der Lüftung

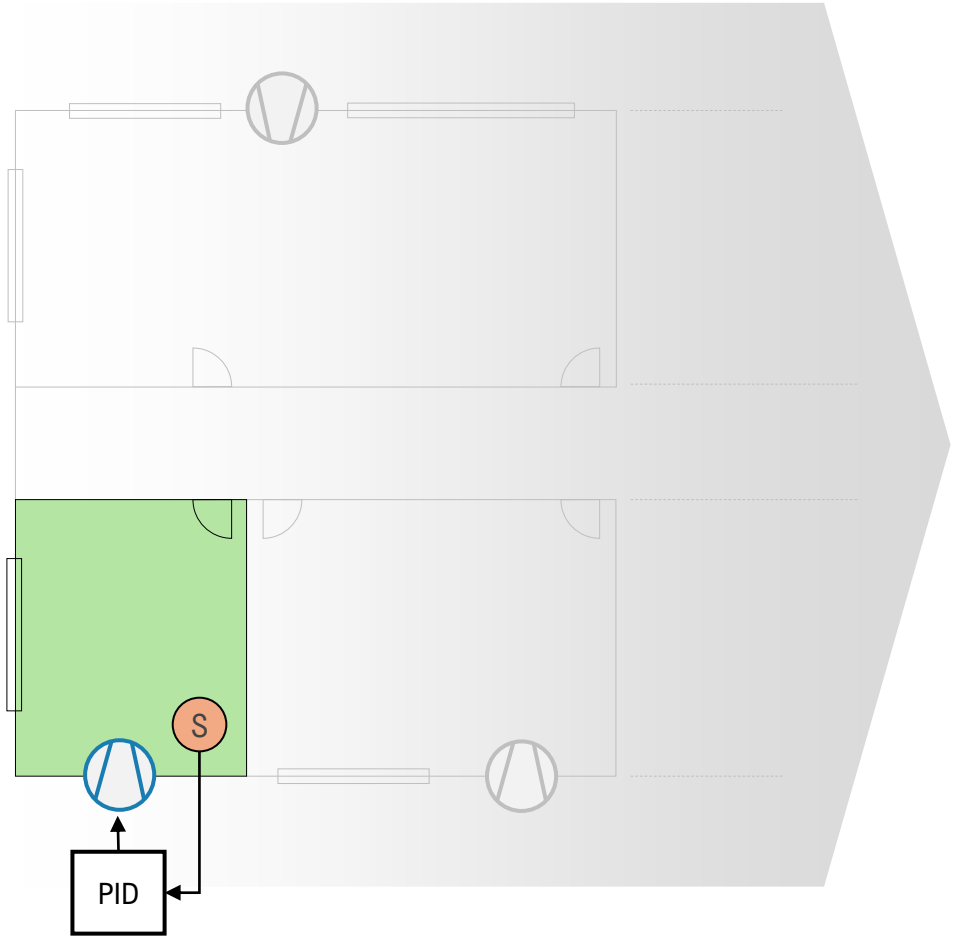
Konstant (Luftwechsel: 1 h^{-1})

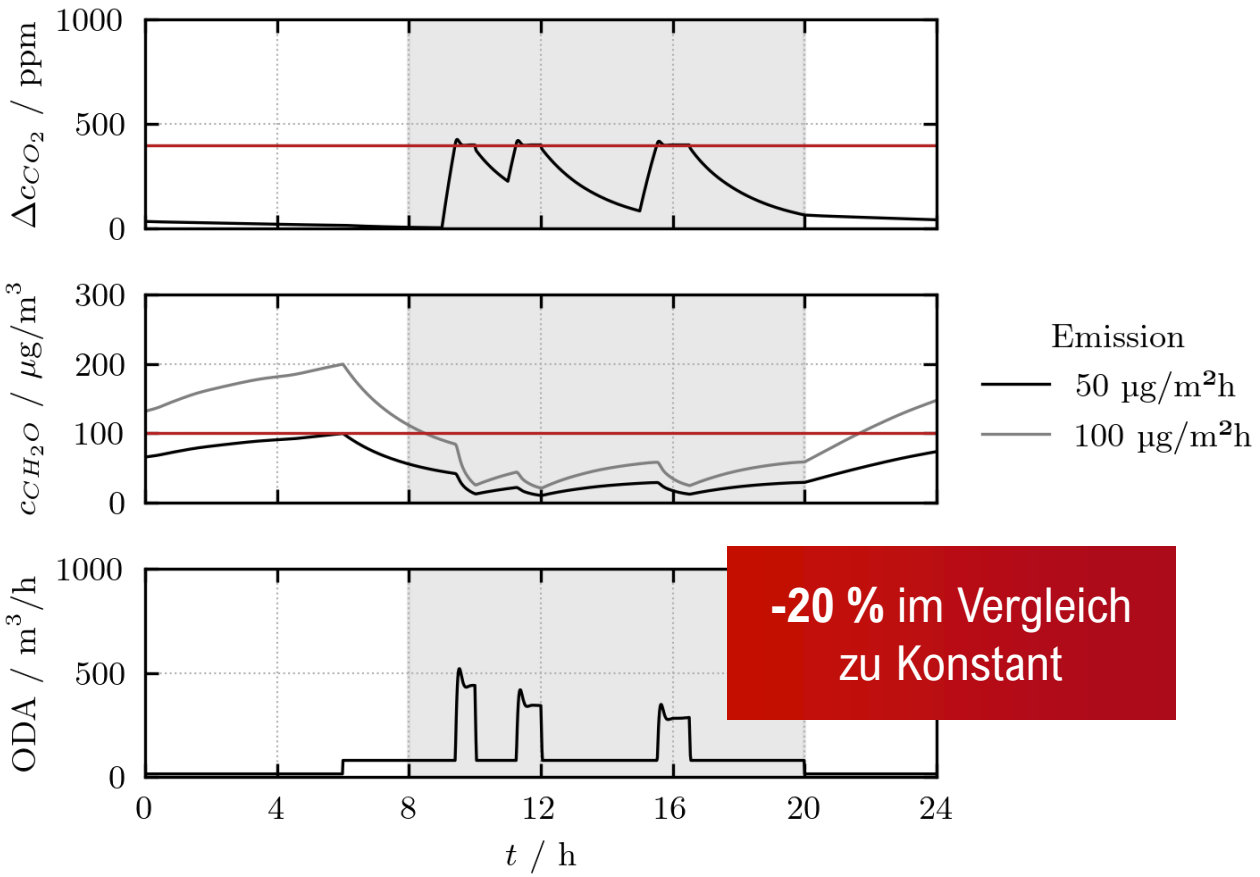




Steuerung/Regelung der Lüftung

Bedarfsgerecht (CO_2) + Luftwechsel (Minimum): 0.5 h^{-1}

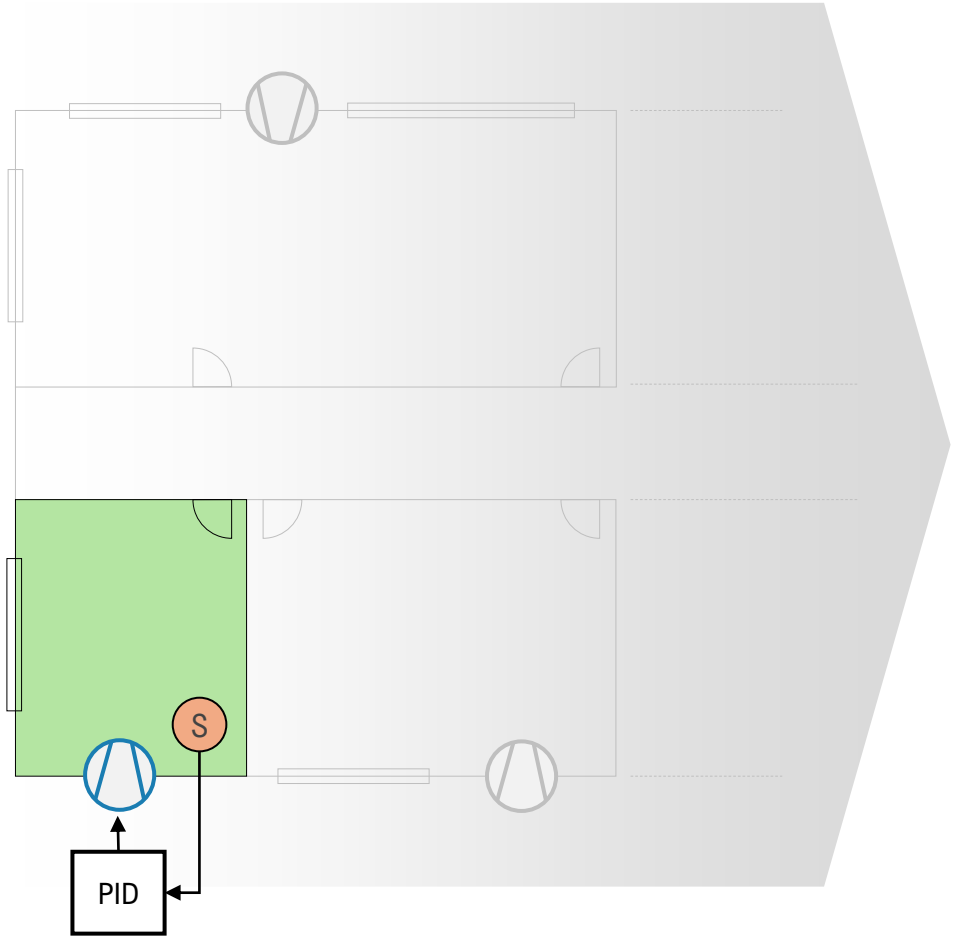


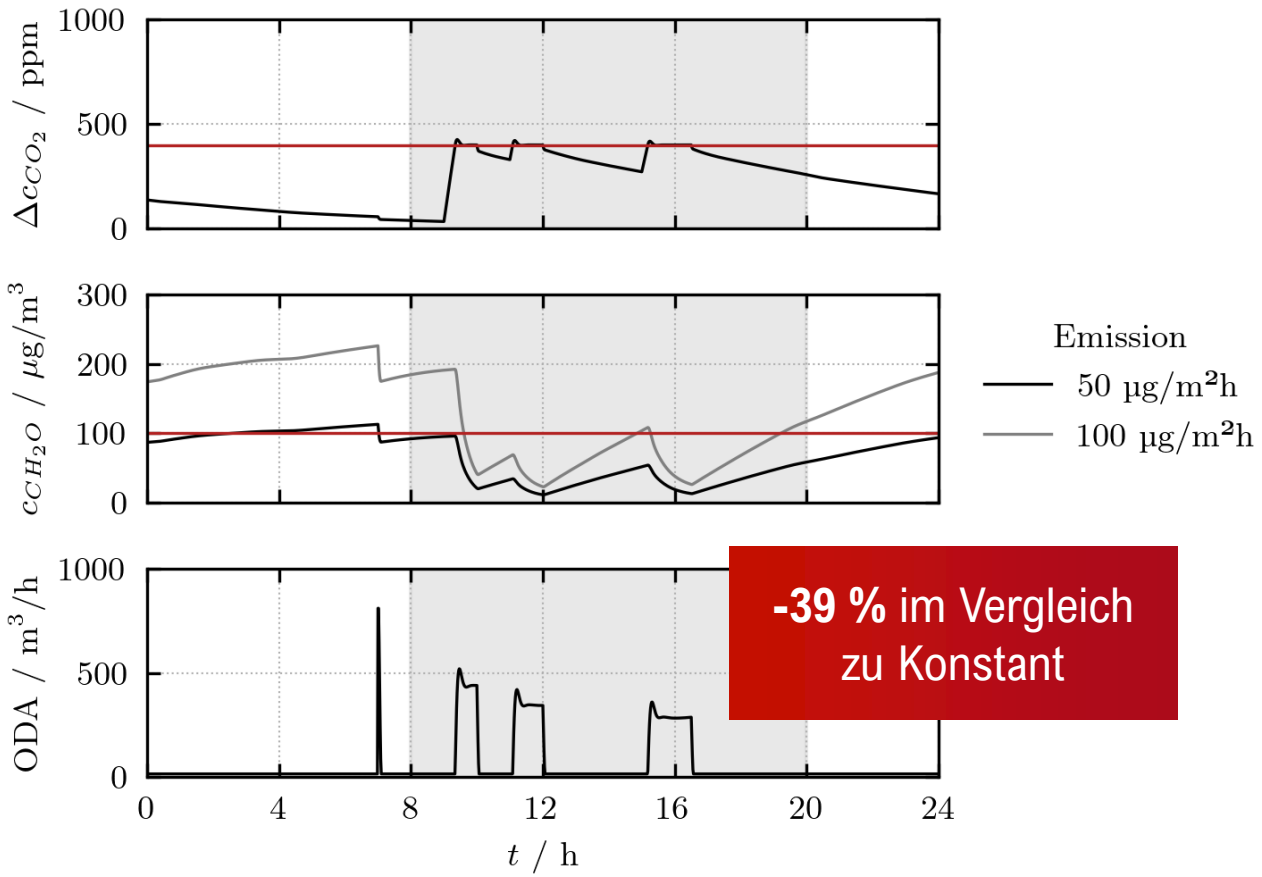


-20 % im Vergleich zu Konstant

Steuerung/Regelung der Lüftung

Bedarfsgerecht (CO_2 and CH_2O)





-39 % im Vergleich zu Konstant

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Hermann-Rietschel-Institut, Technische Universität Berlin

Mail: **lukas.schmitt@tu-berlin.de**
Website: **hermann-rietschel-institut.de**

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Bundesministerium für Wirtschaft und Klimaschutz
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