Wohnraumlüftung in energieeffizienten Gebäuden in Österreich und Europa

Erkenntnisse aus einem Projekt der Internationalen Energie Agentur

IEA EBC Annex 68 - Webinar 1 von 4

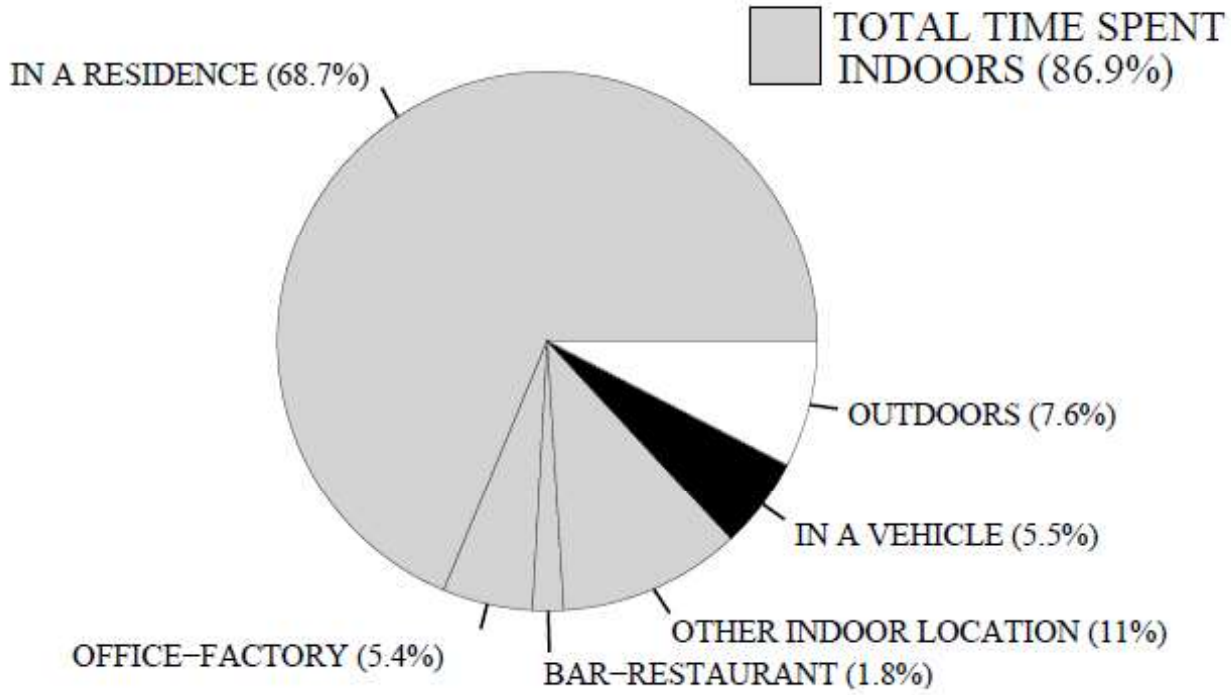
Gabriel Rojas
Fachhochschule Salzburg – Studiengang Smart Buildings
12.11.2020 Online www.bauinformation.com

IEA Forschungskooperation
im Rahmen von open4innovation

FFG
Forschung wirkt.

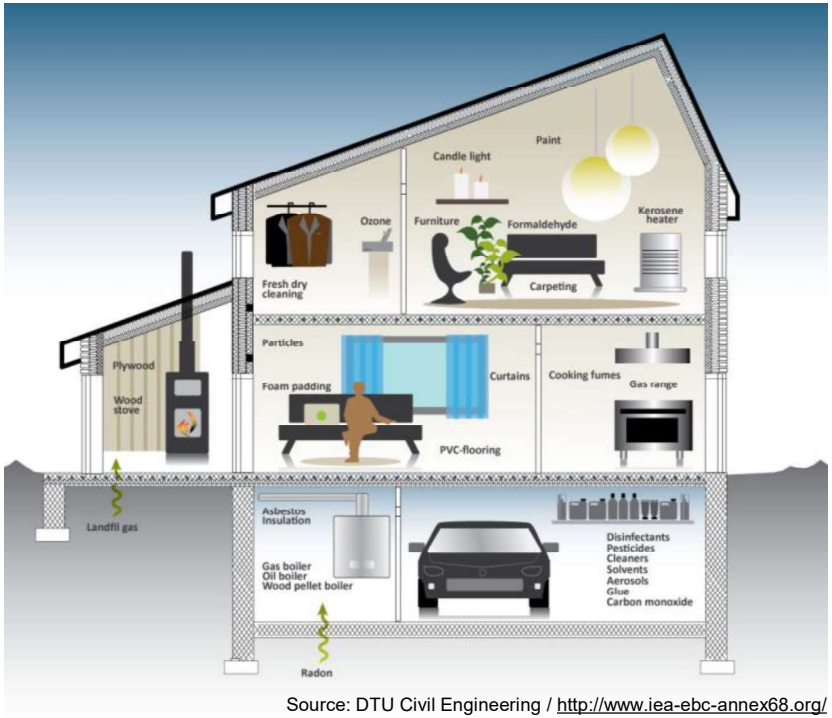
Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

Motivation

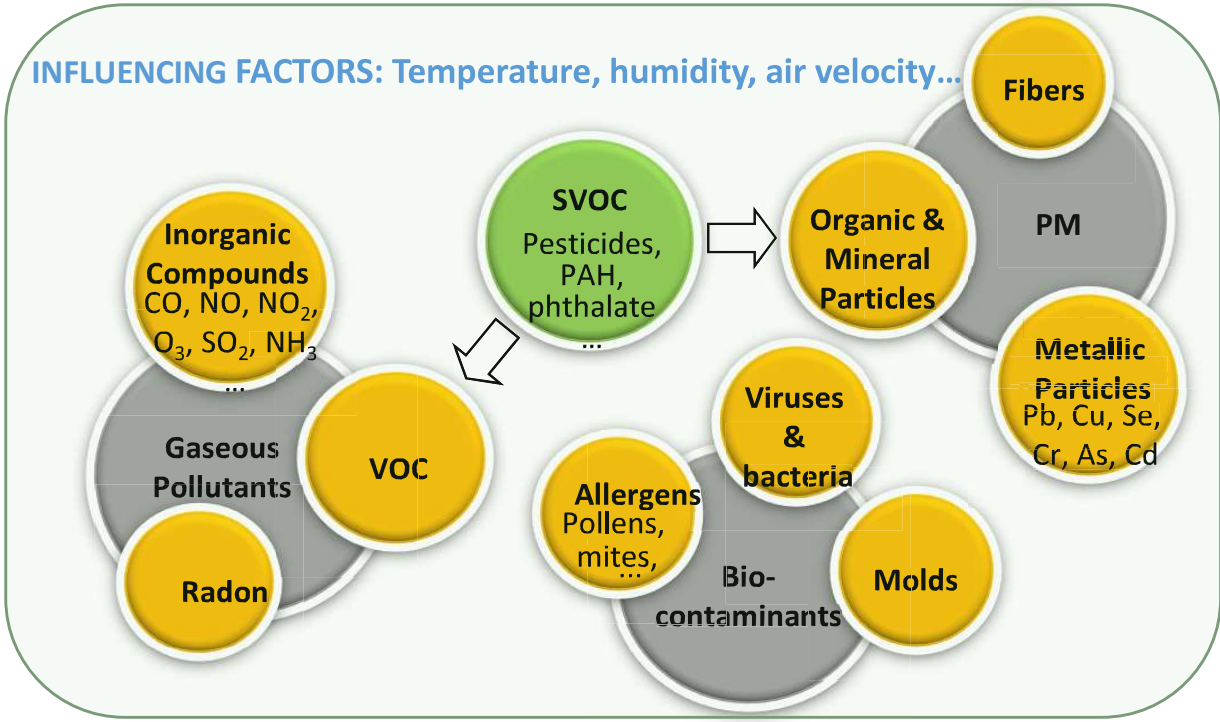


N. Klepeis et.al., "The National Human Activity Pattern Survey (NHAPS) – A resource for assessing exposure to environmental pollutants" Lawrence Berkeley National Laboratory, report, 2001.

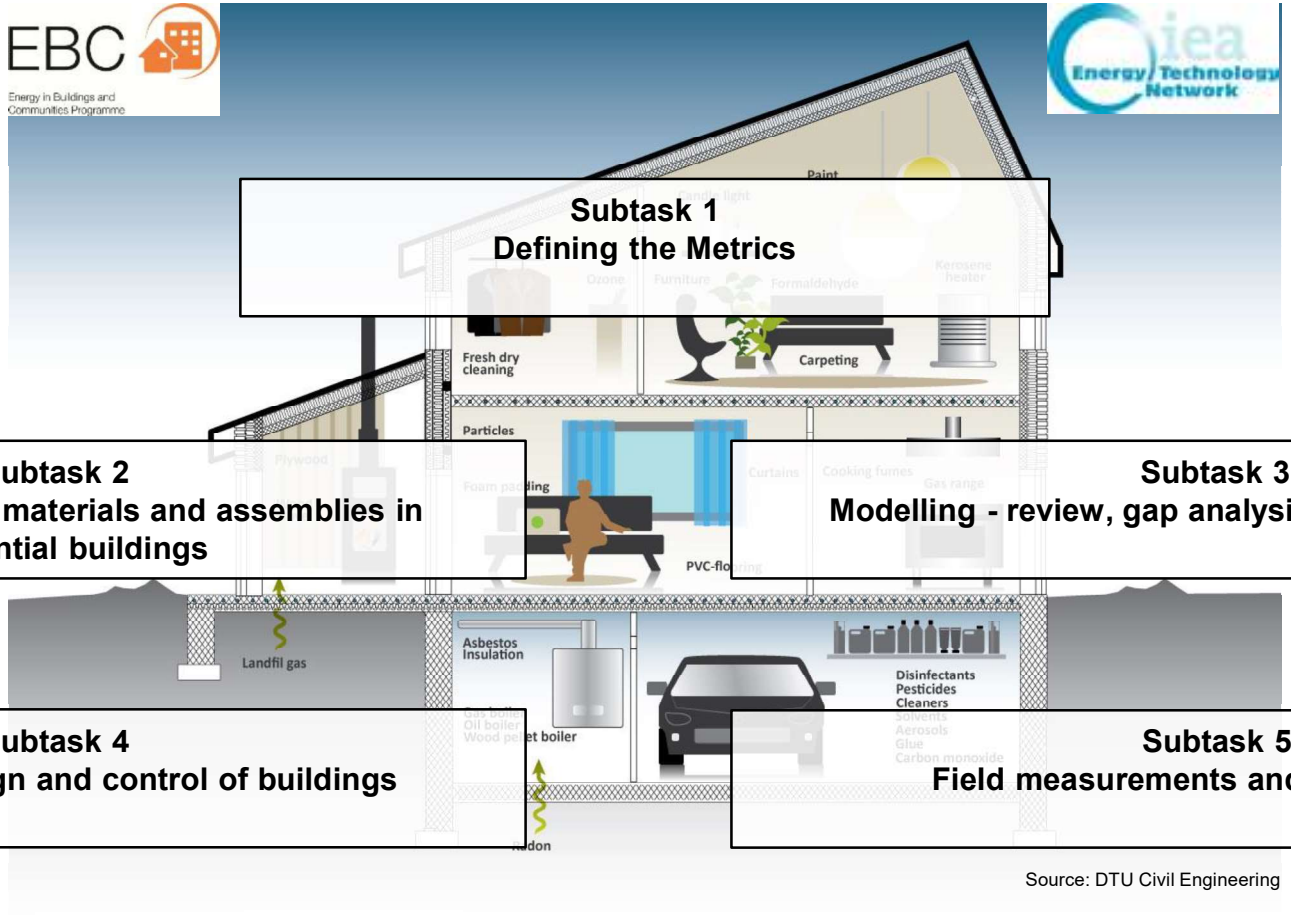
Motivation



Source: DTU Civil Engineering / http://www.iea-ebc-annex68.org/



IEA EBC Annex 68 - Raumluftqualitätsoptimierte Planung und Betriebsführung von energieeffizienten Wohngebäuden



Source: DTU Civil Engineering

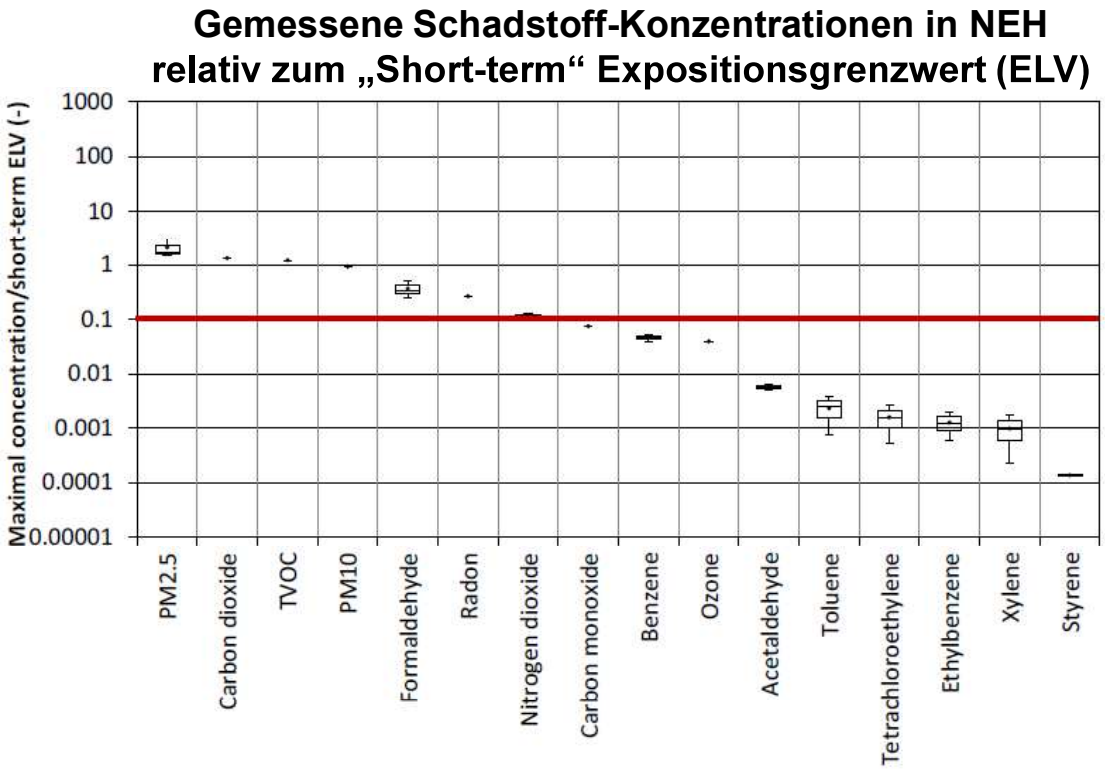
IEA Forschungskooperation
im Rahmen von open4innovation

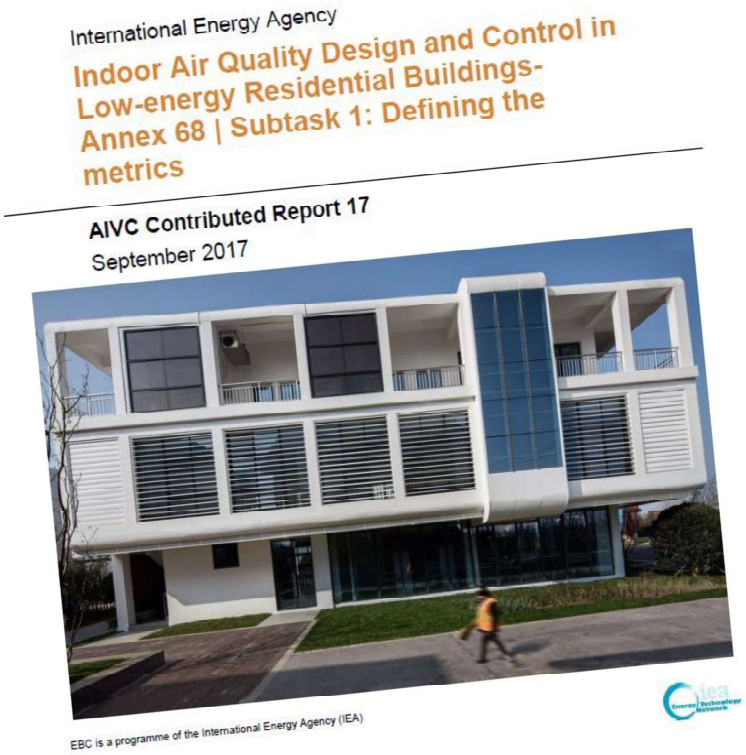
FFG
Forschung wirkt.

Bundesministerium
Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie

https://nachhaltigwirtschaften.at/de/iea/technologieprogramme/ebc/iea-ebc-annex-68.php
http://www.iea-ebc-annex68.org

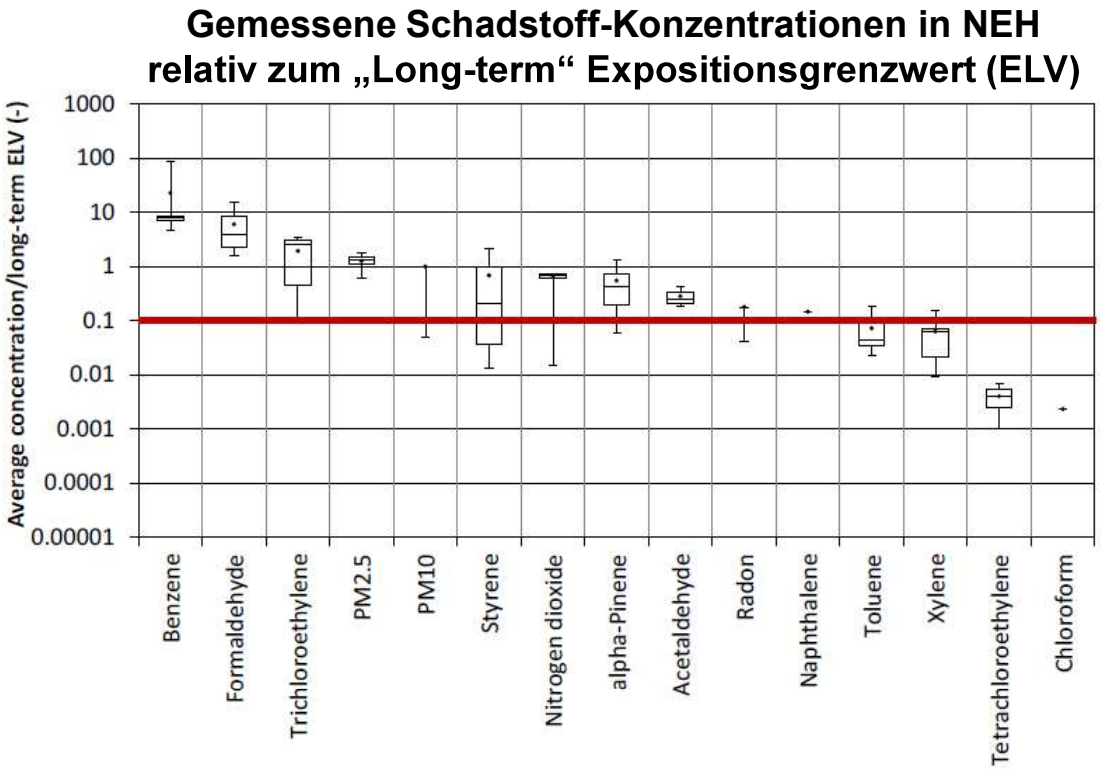
Relevante Schadstoffe

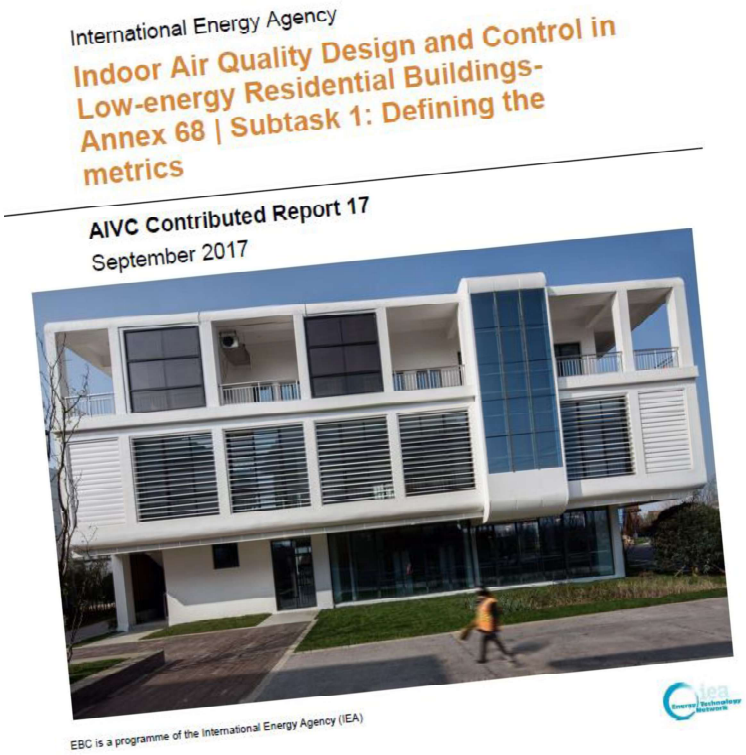




M. Abadie, P. Wargocki
IEA EBC Annex 68 Subtask 1 report - Defining the metrics
auch AIVC Contributed Report 17
https://www.aivc.org/sites/default/files/AIVC_CR17_0.pdf

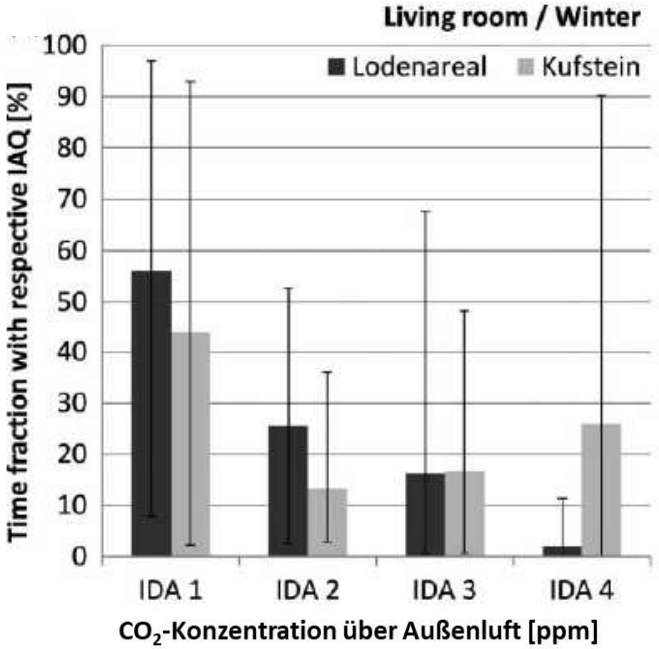
Relevante Schadstoffe





M. Abadie, P. Wargocki, 2017
IEA EBC Annex 68 Subtask 1 report - Defining the metrics
auch AIVC Contributed Report 17
https://www.aivc.org/sites/default/files/AIVC_CR17_0.pdf

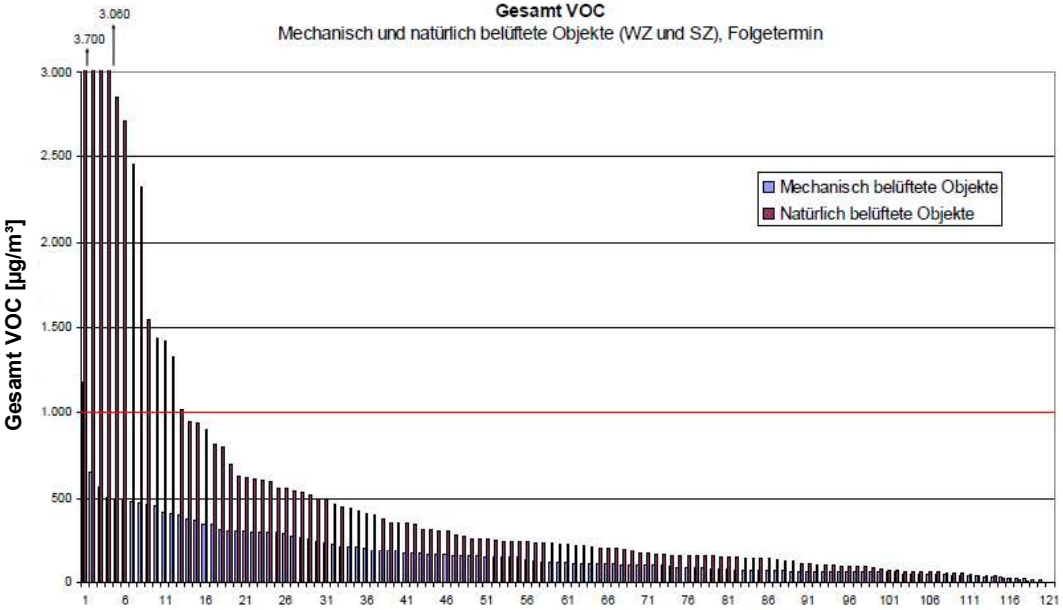
Gemessene Raumluftqualität - Vergleichsstudien



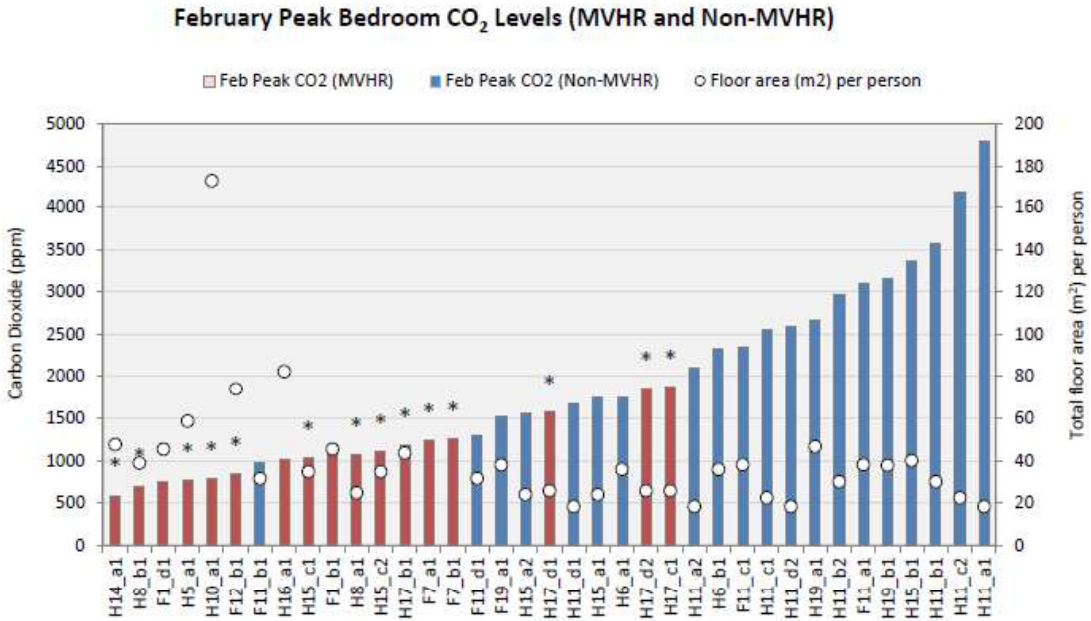
Nach EN 13779	<400	<600	<1000	>1000
	Hoch	Mittel	Mäßig	Niedrig

G. Rojas, W. Wagner, J. Suschek-Berger, R. Pfluger, and W. Feist, "Applying the passive house concept to a social housing project in Austria – evaluation of the indoor environment based on long-term measurements and user surveys," Adv. Build. Energy Res., vol. 10, no. 1, pp. 125–148, 2016.

Gemessene Raumluftqualität - Vergleichsstudien



Tappler, P., Hutter, H.-P., Hengsberger, H., & Ringer, W. (2014). Lüftung 3.0 - Bewohnergesundheit und Raumluftqualität in neu errichteten, energieeffizienten Wohnhäusern. http://innenraumanalytik.at/pdfs/lueftung_2014.pdf



Sharpe T. et.al. (2016) Characteristics and performance of MVHR systems. A meta study of MVHR systems used in the Innovate UK Building Performance Evaluation Programme.

Lüftungsanforderungen in Wohngebäuden

in diversen EU-Ländern

Country	Austria	Belgium	Denmark	Estonia	France	Norway	UK
Natural ventilation (NV)/airing*	Allowed	[3]Allowed if dedicated NV system. Only window airing not allowed	[5]Allowed	[6]Allowed	[9]Allowed but rarely compliant with [10]EP regulation for new dwellings. [9]Only window airing not allowed	Allowed	[13]E&W: Allowed [15]S: Not suitable if airtightness < 5 $m^3/h/m^2$ (50 Pa)
Mechanical ventilation (MV)	[1]Not required	[3]Recommended only when $n_{50} < 3h^{-1}$ (MVHR recommended only if $n_{50} < 1h^{-1}$)	[5]MVHR recommended	[6]MVHR promoted; other ventilation strategies allowed if energy, IAQ and thermal comfort req. are met	DCV-MEV or MVHR required to reach the target of the [10]EP regulation for new dwellings. MSV not allowed	[12]MVHR recommended	[13, 15]MEV MVHR recommended

D. Zukowska et.al. (2020): Ventilation in low energy residences – a survey on code requirements, implementation barriers and operational challenges from seven European countries, International Journal of Ventilation, DOI:10.1080/14733315.2020.1732056
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Umfrage bei Stakeholdern in der Bauwirtschaft

Probleme und Hürden im Zusammenhang mit mechanischer Lüftung (Zu-/Abluft und Abluftsysteme)

Stage	Barrier or problem	Austria (6)	Belgium (10)	Denmark (5)	Estonia (4)	France (5)	Norway (7)	UK (7)	Total (44)
Design	Spatial requirements & duct routing	3	8	4	1	1	6	1	24
	High capital cost of MVHR systems	4		2	1	2		1	10
	Coordination within all design stakeholders (and customer)		5					1	6
	Complexity of MVHR (incl. auxiliary systems, e.g. frost / fire protection)			1	1	1			3
	Difficult to find an appropriate location for exterior in-/outlets		2				1		3
	Difficult to position the units to minimise noise						1	1	2
Construction	Poor quality in system installation & commissioning/ rare			1		5		3	9
	Lack of qualified/experienced installers and lack of quality	1	2					1	4
	Balancing and adjustment of flow rates		1				1	1	3
	Designers are often not involved in commissioning			1			1		2
Post-handover	Maintenance issues	2	4	3		1	3	3	16
	Noise	4	2		2		1	2	11
	No proper support for tenants / Lack of occupant knowledge	1	1	2	1				5
	Draughts / covering grids		2	1	1				4
	Odours		1		1				2

D. Zukowska et.al. (2020): Ventilation in low energy residences – a survey on code requirements, implementation barriers and operational challenges from seven European countries, International Journal of Ventilation, DOI:10.1080/14733315.2020.1732056
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Umfrage bei Stakeholdern in der Bauwirtschaft

Probleme und Hürden im Zusammenhang mit mechanischer Lüftung (Zu-/Abluft und Abluftsysteme)

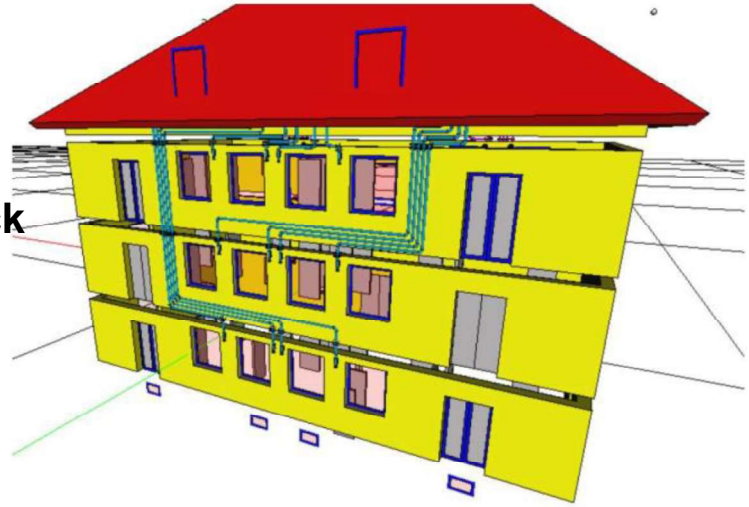
Stage	Barrier or problem	Austria (6)	Belgium (10)	Denmark (5)	Estonia (4)	France (5)	Norway (7)	UK (7)	Total (44)
Design	Spatial requirements & duct routing	3	8	4	1	1	6	1	24
	High capital cost of MVHR systems	4		2	1	2		1	10
	Coordination within all design stakeholders (and customer)		5					1	6
	Complexity of MVHR (incl. auxiliary systems, e.g. frost / fire protection)			1	1	1			3
	Difficult to find an appropriate location for exterior in-/outlets		2				1		3
	Difficult to position the units to minimise noise						1	1	2
Construction	Poor quality in system installation & commissioning/ rare			1		5		3	9
	Lack of qualified/experienced installers and lack of quality	1	2					1	4
	Balancing and adjustment of flow rates		1				1	1	3
	Designers are often not involved in commissioning			1			1		2
Post-handover	Maintenance issues	2	4	3		1	3	3	16
	Noise	4	2		2		1	2	11
	No proper support for tenants / Lack of occupant knowledge	1	1	2	1				5
	Draughts / covering grids		2	1	1				4
	Odours		1		1				2

Platzbedarf
Kosten

D. Zukowska et.al. (2020): Ventilation in low energy residences – a survey on code requirements, implementation barriers and operational challenges from seven European countries, International Journal of Ventilation, DOI:10.1080/14733315.2020.1732056
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Reduktion des Platzbedarfs

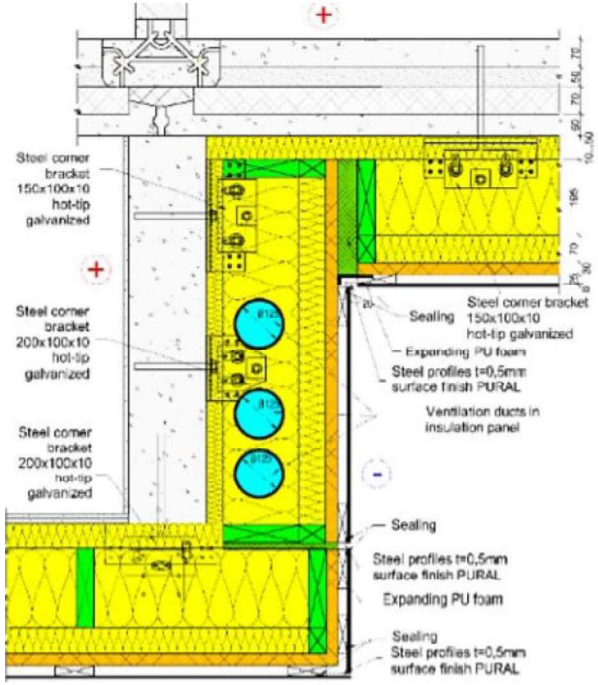
Kanalführung in Dämmebene - Mehrere Projekte in Innsbruck
(auch kostengünstig umsetzbarer Brandschutz)



Music, Admir. 2018. “Luftverteilung: Erschließung über die Fassade - Erfahrungen aus dem Forschungsprojekt Sinfonia (A).” In AKKP 54: Neue Konzepte der kontrollierten Lüftung: Fassadenintegrierte Lüftung, ed. Wolfgang Feist. Darmstadt, Germany: Passive House Institute, 127–35.
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Reduktion des Platzbedarfs

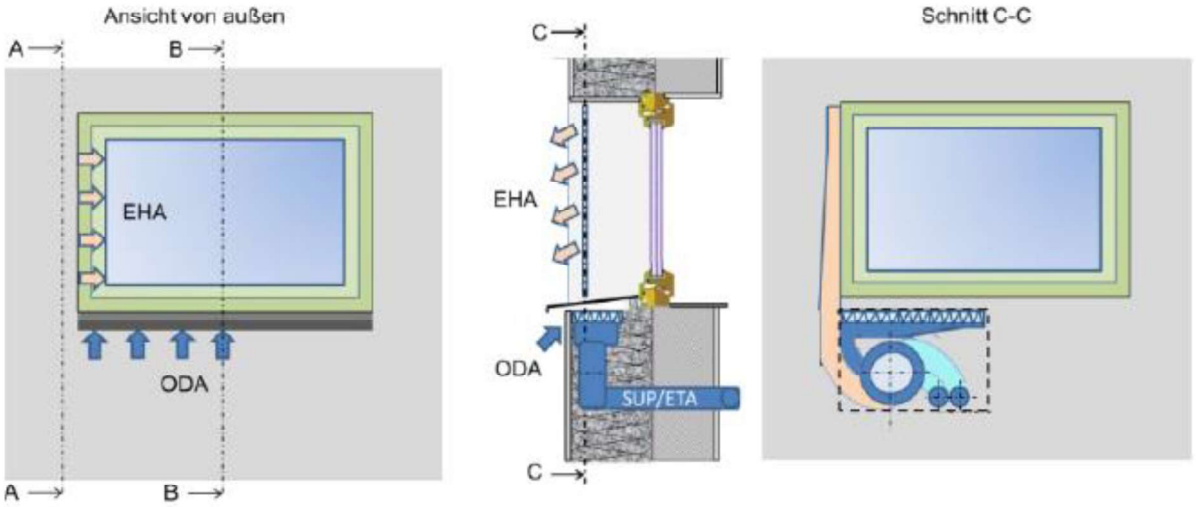
Kanalführung in Dämmebene - Projekt aus Estland
(mit vorgefertigten Fassadenelementen)

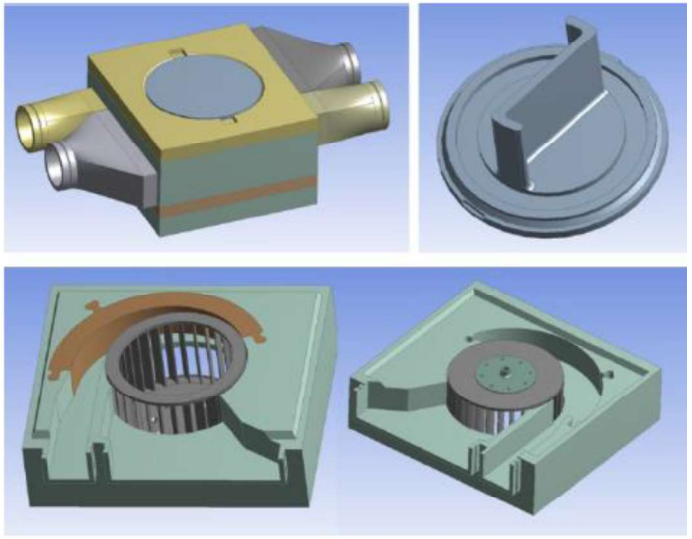


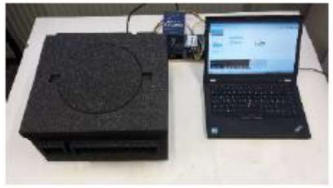
Reduktion des Platzbedarfs

Entwicklung eines kompakten Lüftungsgeräts mit WRG

(Schaufelblätter = regenerative Wärmerückgewinnung)



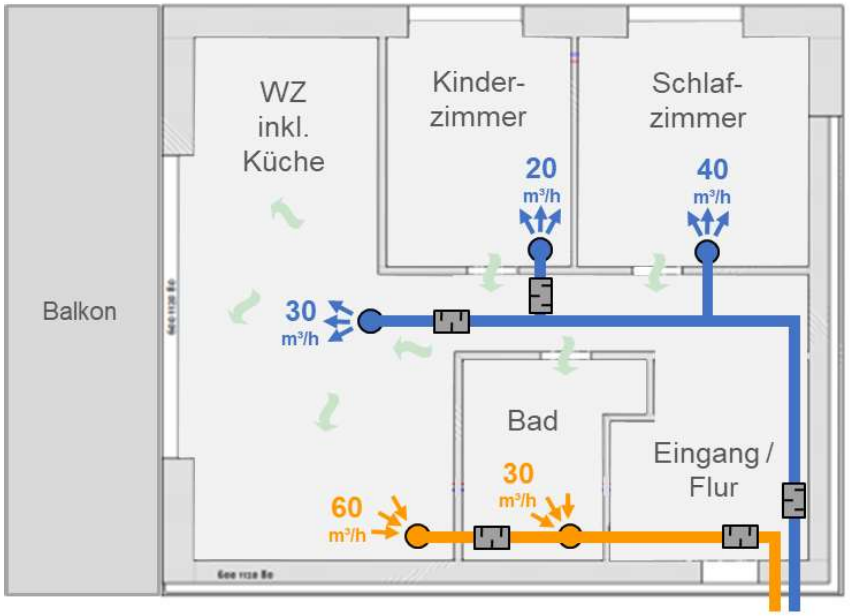




Speer, C., Pfluger R. (2017). Development and measurement results of a compact Counterflow Heat Recovery Fan for single/double room ventilation. AIVC Conference Proceedings p.439-446, Nottingham
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Kanalarme Luftführungskonzepte

Standard Kaskade



Kanalarme Luftführungskonzepte

Erweiterte Kaskade

E. Sibille, G. Rojas, M. Rothbacher, R. Pfluger, and H. K. Malzer, "'Doppelnutzen' - Komfort- und kostenoptimierte Luftführungskonzepte für energieeffiziente Wohnbauten." Endbericht, Haus der Zukunft / bmvit, 2013.

Siehe auch https://phi-ibk.at/luftfuehrung/

Kanalarme Luftführungskonzepte

Erweiterte Kaskade

E. Sibille, G. Rojas, M. Rothbacher, R. Pfluger, and H. K. Malzer, "'Doppelnutzen' - Komfort- und kostenoptimierte Luftführungskonzepte für energieeffiziente Wohnbauten." Endbericht, Haus der Zukunft / bmvit, 2013.

Siehe auch https://phi-ibk.at/luftfuehrung/

Aktive Überströmer

E. Sibille, Optimized Integration of Ventilation with Heat Recovery in Residential Buildings through the Implementation of innovative Air Distribution Strategies and Pre-Fabricated Components, Dissertation, Univ. Innsbruck 2015.

Kanalarme Luftführungskonzepte

Erweiterte Kaskade

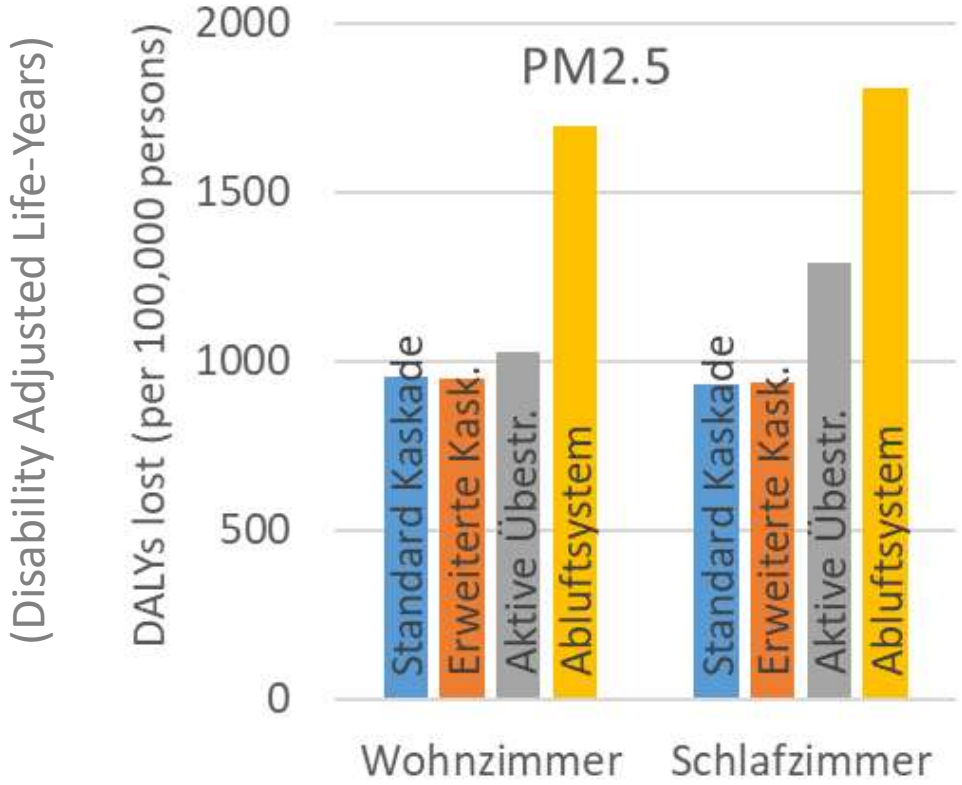
Aktive Überströmer

E. Sibille, G. Rojas, M. Rothbacher, R. Pfluger, and H. K. Malzer, "'Doppelnutzen' - Komfort- und kostenoptimierte Luftführungskonzepte für energieeffiziente Wohnbauten." Endbericht, Haus der Zukunft / bmvit, 2013.

Siehe auch https://phi-ibk.at/luftfuehrung/

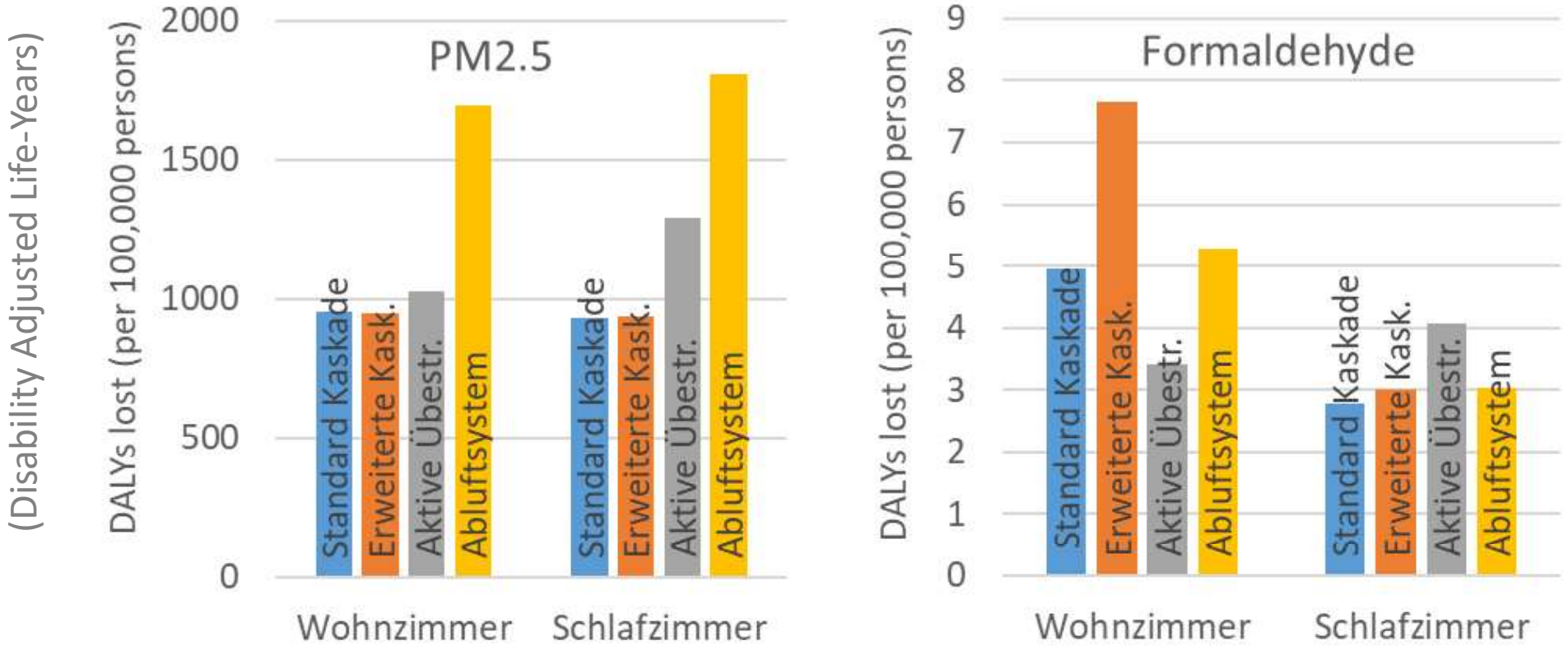
E. Sibille, Optimized Integration of Ventilation with Heat Recovery in Residential Buildings through the Implementation of innovative Air Distribution Strategies and Pre-Fabricated Components, Dissertation, Univ. Innsbruck 2015.

Bewertung der kanalarmen Luftführungskonzepte



G. Rojas, "IAQ simulation – going beyond CO2 concentration for the assessment of two innovative ventilation concepts" Proceedings of BauSim2020, ibpsa / TU Graz, 2020, pp 426-433.

Bewertung der kanalarmen Luftführungskonzepte



G. Rojas, "IAQ simulation – going beyond CO2 concentration for the assessment of two innovative ventilation concepts" Proceedings of BauSim2020, ibpsa / TU Graz, 2020, pp 426-433.

Umfrage bei Stakeholdern in der Bauwirtschaft

Probleme und Hürden im Zusammenhang mit mechanischer Lüftung (Zu-/Abluft und Abluftsysteme)

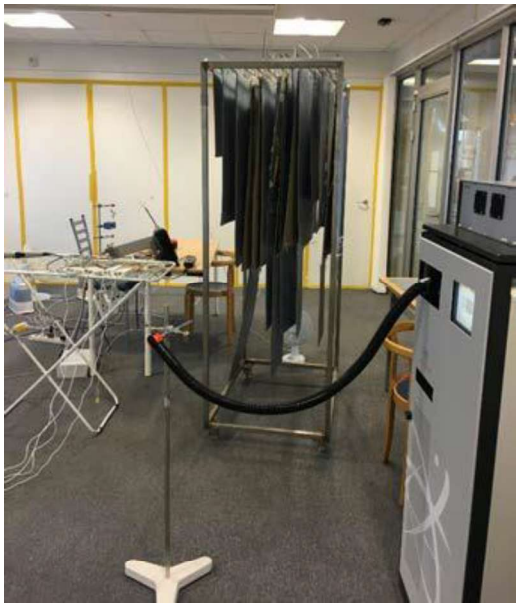
Stage	Barrier or problem	Austria (6)	Belgium (10)	Denmark (5)	Estonia (4)	France (5)	Norway (7)	UK (7)	Total (44)	
Design	Spatial requirements & duct routing	3	8	4	1	1	6	1	24	
	High capital cost of MVHR systems	4		2	1	2		1	10	
	Coordination within all design stakeholders (and customer)		5					1	6	
	Complexity of MVHR (incl. auxiliary systems, e.g. frost / fire protection)			1	1	1			3	
	Difficult to find an appropriate location for exterior in-/outlets		2				1		3	
	Difficult to position the units to minimise noise						1	1	2	Qualität Umsetzung &
Construction	Poor quality in system installation & commissioning/ rare			1		5		3	9	Inbetriebnahme
	Lack of qualified/experienced installers and lack of quality	1	2					1	4	
	Balancing and adjustment of flow rates		1				1	1	3	Einregulierung /
	Designers are often not involved in commissioning			1			1		2	Volumenstromregelung
Post-handover	Maintenance issues	2	4	3		1	3	3	16	Wartung
	Noise	4	2		2		1	2	11	
	No proper support for tenants / Lack of occupant knowledge	1	1	2	1				5	Bedienung
	Draughts / covering grids		2	1	1				4	
	Odours		1		1				2	

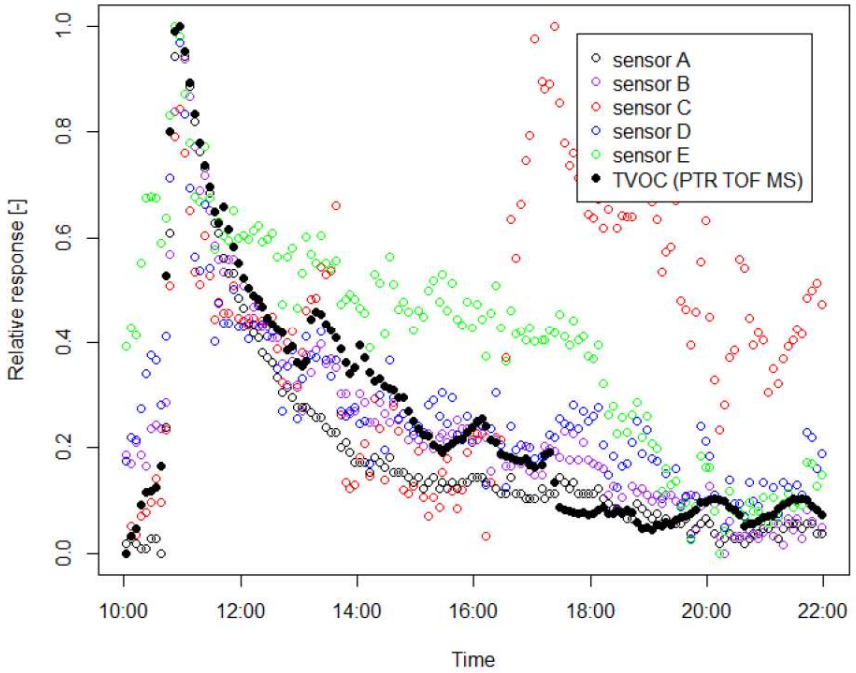
D. Zukowska et.al. (2020): Ventilation in low energy residences – a survey on code requirements, implementation barriers and operational challenges from seven European countries, International Journal of Ventilation, DOI:10.1080/14733315.2020.1732056
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Intelligente Regelung / Automatischer Balanceabgleich

Low-cost Raumluftqualitätssensoren (für Regelungsaufgaben in der Lüftungstechnik)

Quelle: www.tinkerforge.com



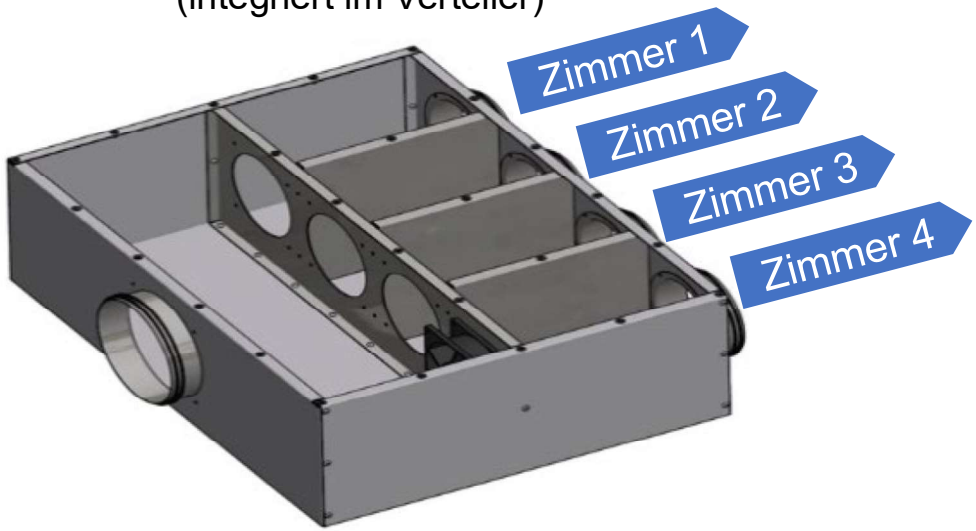


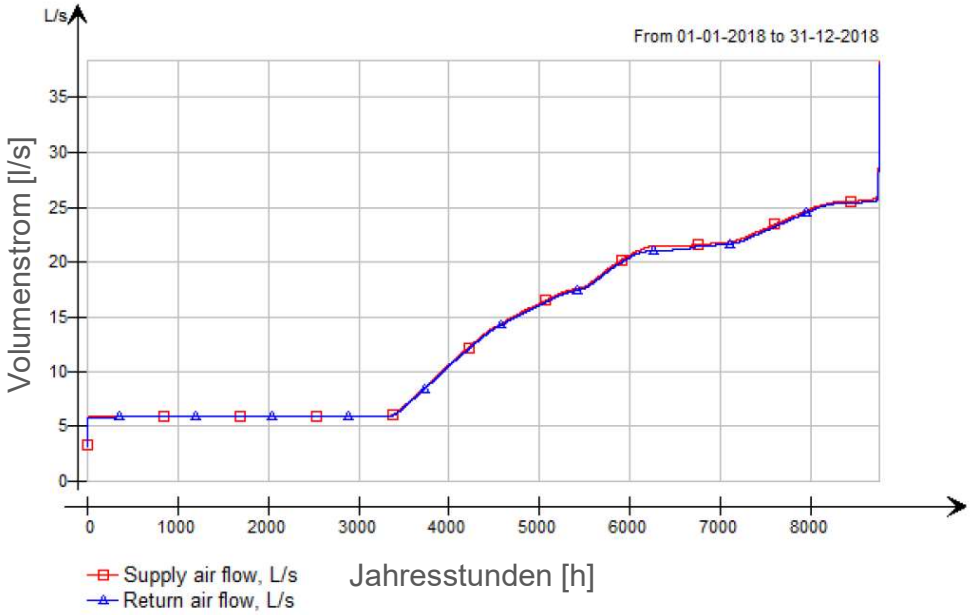
Kolarik, J., Lynge Lyng, N., Laverge, J. 2020 Metal Oxide Semiconductor sensors to measure Volatile Organic Compounds for ventilation control. Report from the AIVC Webinar: "Using Metal Oxide Semiconductor (MOS) sensors to measure Volatile Organic Compounds (VOC) for ventilation control", held on September 4, 2018, Air Infiltration and Ventilation Centre, www.aivc.org

Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Intelligente Regelung / Automatischer Balanceabgleich

Raumweise Volumenstromregelung
(integriert im Verteiler)





Smith, K. & Kolarik, J. 2019. Simulations of a novel demand-controlled room-based ventilation system for renovated apartments. In Proceedings of IAQVEC 2019, 10th international conference on indoor air quality, ventilation & energy conservation in buildings, Bari, Italy.
Auch in: IEA EBC Annex 68 Subtask 4 report - Current challenges, selected case studies and innovative solutions covering indoor air quality, ventilation design and control in residences, J. Kolarik (Ed.), G. Rojas (Ed.), (2020), https://www.iea-ebc-annex68.org/results/final-reports

Zusammenfassung

- Gesicherte Raumluftqualität im Niedrig-Energie Wohnbau
  -> mechanische Lüftung erforderlich

- Viele Vorzeigeprojekte mit hoher RLQ und Nutzerzufriedenheit…
  -> energieeffizienter und kostengünstig

- ABER auch noch Probleme und Hürden in breiteren Umsetzung
  - Platzbedarf (vor allem in der Sanierung)
  - Qualitätssicherung / Einregulierung / Bedienung / Wartung

- Neue Entwicklungen und innovative Lösungsansätze vielversprechend

FH Salzburg

universität innsbruck

Vielen Dank! / Fragen?

Dieses Projekt wurde im Rahmen der IEA-Forschungskooperation im Auftrag des Bundesministeriums für Klimaschutz, Umwelt, Energie, Mobilität, Innovation und Technologie (vormals Bundesministerium für Verkehr, Innovation und Technologie) durchgeführt.

Weitere Webinare in diesem Zusammenhang:

- 10.12.2020: Experience with Low-cost (MOS VOC) sensors for residential ventilation – Response to typical pollution activities and suitability for demand control, Dr. Jakub Kolarik, Technical University of Denmark
- 20.1.2021: Küchendunstabzüge in Kombination mit Wohnraumlüftung, Dr. Gabriel Rojas, FH Salzburg
- 18.2.2021: Nachträgliche Integration der Wohnungslüftung im Bestand – mit einfacher, kostengünstiger und effizienter Luftführung, Dr. Rainer Pfluger, Universität Innsbruck

IEA Forschungskooperation
im Rahmen von open4innovation

FFG
Forschung wirkt.

Bundesministerium
Klimaschutz, Umwelt,
Energie, Mobilität,
Innovation und Technologie

https://nachhaltigwirtschaften.at/de/iea/technologieprogramme/ebc/iea-ebc-annex-68.php

bau information .com

Live & Online.
Aktuelles Bauwissen aus erster Hand.