BTGA

Fachverband
Gebäude-Klima e. V.

RLT
Raumlufttechnische Geräte
Herstellerverband e.V.

IAQ-performance code-compliant ventilation systems

Unter der
Schirmherrschaft des
Bundesministerium
für Wirtschaft
und Energie

R. van Holsteijn

Managing Director VHK BV

Project leader MONICAIR

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IAQ-Performance code-compliant ventilation systems

MONICAIR:

MONItoring & Control of Air quality in Individual Rooms

MONICAIR is a pre-competitive field research project into the real-life IAQ- and Energy Performance of ventilation systems in Dutch residential dwellings.

Final goal:
Further improvement of residential ventilation systems, building codes and energy assessment methods

IAQ-Performance code-compliant ventilation systems

MONICAIR Consortium:

Manufacturers:

BRINK Air for Life

ClimaRad INDOOR AIR QUALITY

itho daalderop

zehnder

Honeywell CUSTOMIZED COMFORT PRODUCTS

Research and Consulting agencies :

Nieman

VHK

Research institutions :

TU Delft Delft University of Technology

TNO innovation for life

IAQ-Performance code-compliant ventilation systems

MONICAIR Project Funding

Total project costs	**: 1,57 million euro**
Contribution Dutch Ministry of Economic Affairs*	: 0,86 million euro
Contribution Consortium Members	: 0,63 million euro
Contribution Housing Corporations	: 0,08 million euro

** Within the framework of TKI (Top Consortia for Knowledge & Innovation)*

IAQ-Performance code-compliant ventilation systems

MONICAIR Project Rationale

Energy-performance of ventilation systems is *estimated* (based on EPBD-calculation methods)

IAQ- performance is *assumed*, and estimated equally for all code compliant ventilation systems

MONICAIR collects **real-life data** on the IAQ- & Energy Performance of code compliant ventilation systems, in order to gain knowledge and improve systems & assessment methods

IAQ-Performance code-compliant ventilation systems

Details of the Monitoring Project

- 62 terraced / semi detached houses
- 10 ventilation systems, tuned to building codes
- Approximately 6 identical dwellings per ventilation system
- Monitoring of CO_2, RH, Temperature and Presence in all rooms
- Monitoring of power consumption of all mech. ventilation units
- Sampling frequency: 5 minutes
- Meteorological data imported from nearest weather stations
- Period: two heating seasons, one summer season

Resulting in a MONICAIR database of over 100 million data-points

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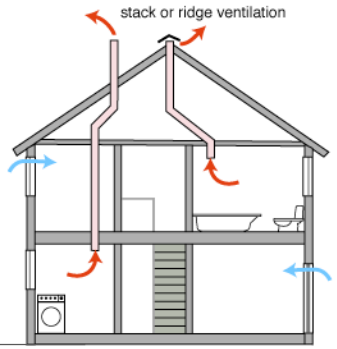
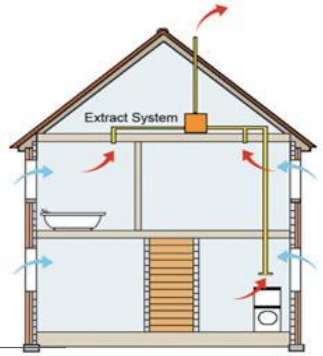
Monitored ventilation systems /1

Type A:
Natural supply in all rooms
Natural exhaust wet rooms



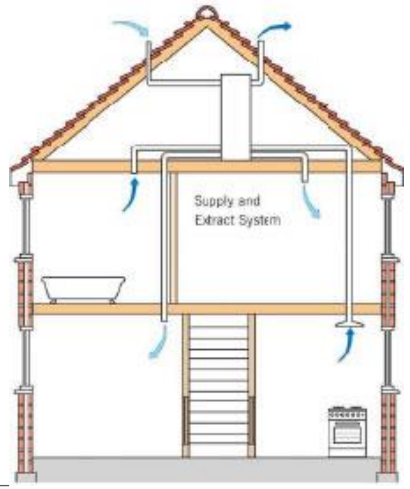
Type C:
Natural supply hab. rooms
Mech. exhaust wet rooms



System type		Section of house that is served	Air exchange provisions			Controls	
			Exhaust	Supply	Heat Rec.	Exhaust	Supply
A.		Whole house	Nat. extraction in wet-rooms	Stnrd nat.supply vents in all rooms	No	No Control	Manual
Type C Systems	C.1	Whole house	Mech. extraction in wet-rooms	Stnrd nat.supply vents in hab.rooms	No	Manual 3-pos. switch	Manual
	C.2c	Whole house	Mech. extraction in wet-rooms	Wind contrl. nat. supply in hab.rooms	No	Manual 3-pos. switch	Manual
	C.4a	Whole house	Mech. extraction in wet-rooms	Wind contrl. nat. supply in hab.rooms	No	CO_2-sensor in living room	Manual
	C.4c	Whole house	Mech. extraction in all rooms	Wind contrl. nat. supply in hab.rooms	No	CO_2/ RH cntrl in all hab.rooms	Manual

IAQ-Performance code-compliant ventilation systems

Monitored ventilation systems /2



Type D:
Mechanical supply
Mechanical exhaust
Heat Recovery

System type		Section of house that is served	Air exchange provisions			Controls	
			Exhaust	Supply	Heat Rec.	Exhaust	Supply
Type D Systems	D.2	Whole house	Mech. extraction in wet-rooms	Mech. supply in hab.rooms	Yes	Manual 3-pos. switch	
	D.5a	Whole house	Mech. extraction in wet-rooms	Mech. supply in hab.rooms	Yes	Manual 3-pos. switch with CO_2-contrl in 2 zones	
	D.5b	Whole house	Mech. extraction in all rooms	Mech. supply in hab.rooms	Yes	CO_2 and RH -controlled ventilation in all rooms	
	D.x	Whole house	Mech. extraction in all rooms	Mech. supply in con.spaces	Yes	CO_2- & RH control in all hab.rooms	

IAQ-Performance code-compliant ventilation systems

Monitored ventilation systems /3

Type X1/C and X1/A

A combination of systems:

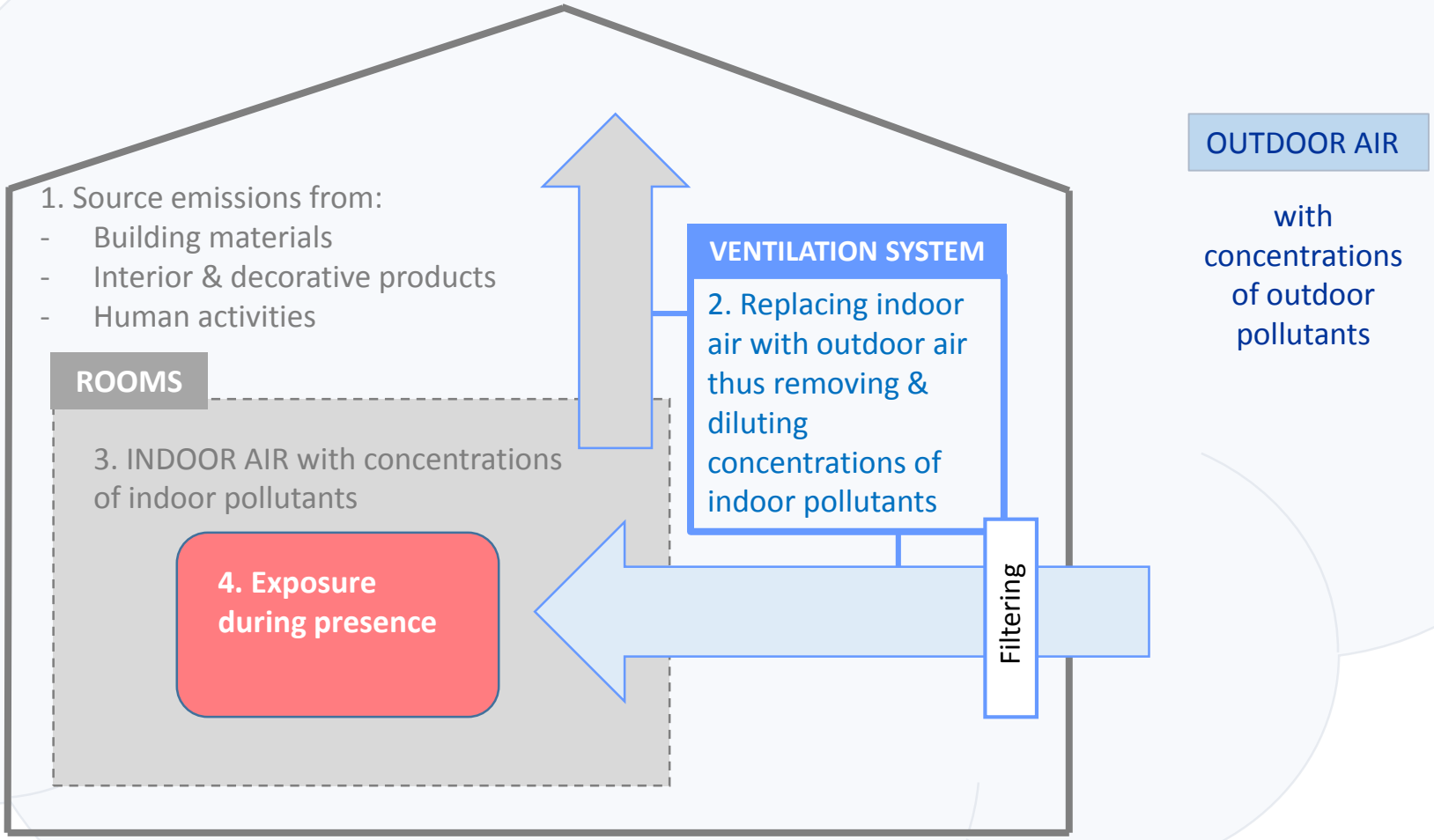
Living section : Mechanical supply & exhaust per room with HR

Sleeping section : System C or system A

System type		Section of house that is served	Air exchange provisions			Controls	
			Exhaust	Supply	Heat Rec.	Exhaust	Supply
Comb. of systems	X1/C	Living section: D	Mech. extraction in hab.rooms	Mech. supply in hab.rooms	Yes	CO_2 and RH -controlled ventilation in living room	
		Sleeping section:C.2c	Mech. extraction in wet-rooms	Wind contrl. nat. supply in bedrooms	No	Manual 2-pos. switch	Manual
	X1/A	Living section: D	Mech. extraction in hab.rooms	Mech. supply in hab.rooms	Yes	CO_2 and RH -controlled ventilation in living room	
		Sleeping section: A	Nat. extraction in wet-rooms	Wind contrl. nat. supply in bedrooms	No	No control	Manual

IAQ-Performance code-compliant ventilation systems

Primary function Ventilation System



IAQ-Performance code-compliant ventilation systems

Primary function Ventilation System:

"To exchange polluted indoor air by cleaner outdoor air in all rooms of a dwelling, thus diluting the concentrations of all possible indoor contaminants".

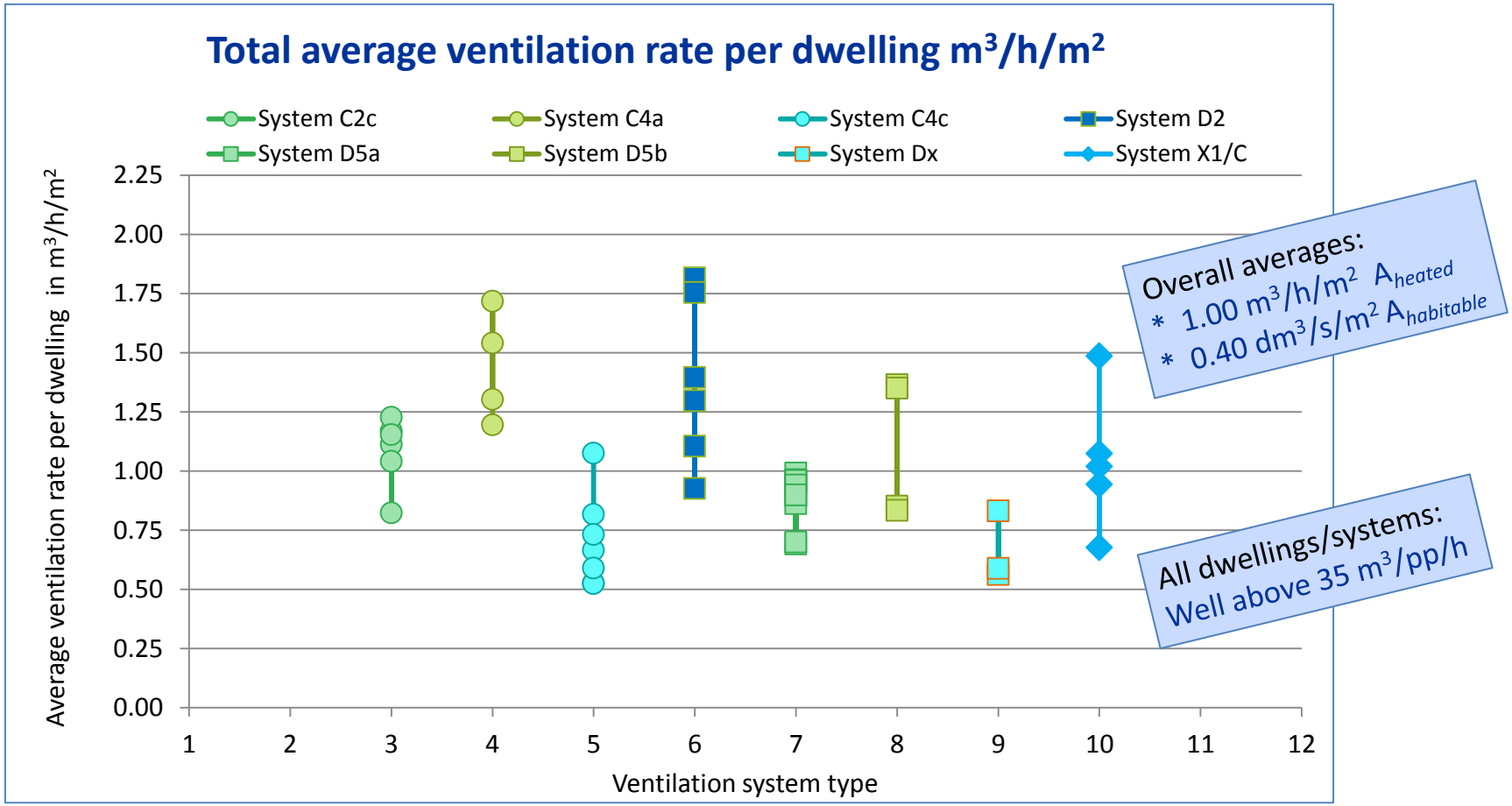
The **IAQ-performance** of ventilation systems is based on their ability to – under all kinds of real life circumstances – *achieve the requested air exchange rates in each individual room*.

For habitable rooms: CO_2-concentration (< 1200 ppm = 7 l/s per person *equals* 25 m3/h pp)
The CO_2-concentration is generally accepted as indicator, not only for hygienic thresholds, but also for the actually occurring air-exchange-rates in a room during presence.

For wet rooms: RH (preferably between 30 -70%)
Since dwell time in wet rooms is limited, RH is used as indicator for the IAQ-performance in wet rooms.

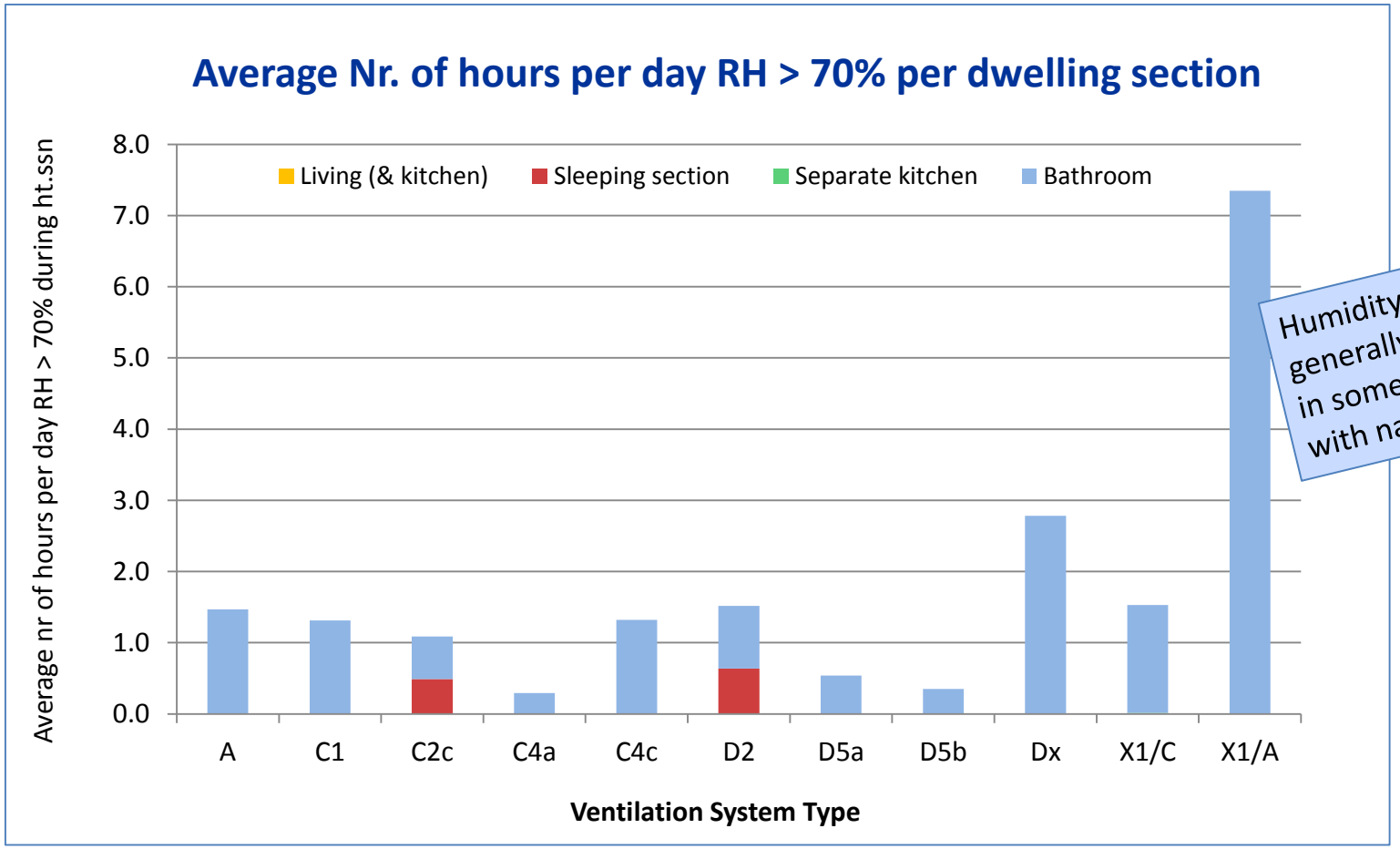
IAQ-Performance code-compliant ventilation systems

Monitoring Results:



IAQ-Performance code-compliant ventilation systems

Monitoring Results:



Humidity wet rooms generally okay, except in some bathrooms with natural exhaust

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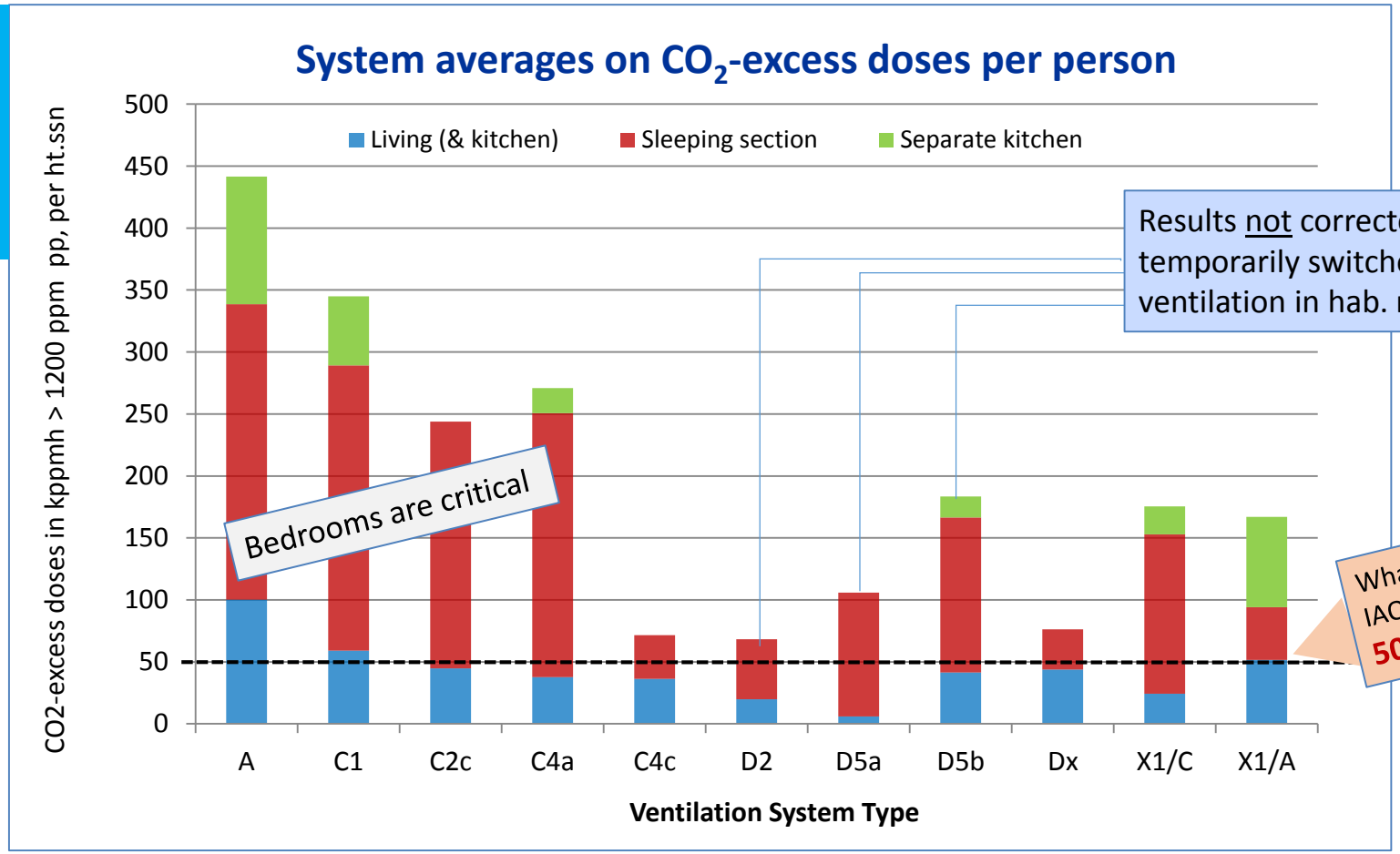
Monitoring Results:

IAQ-Performance



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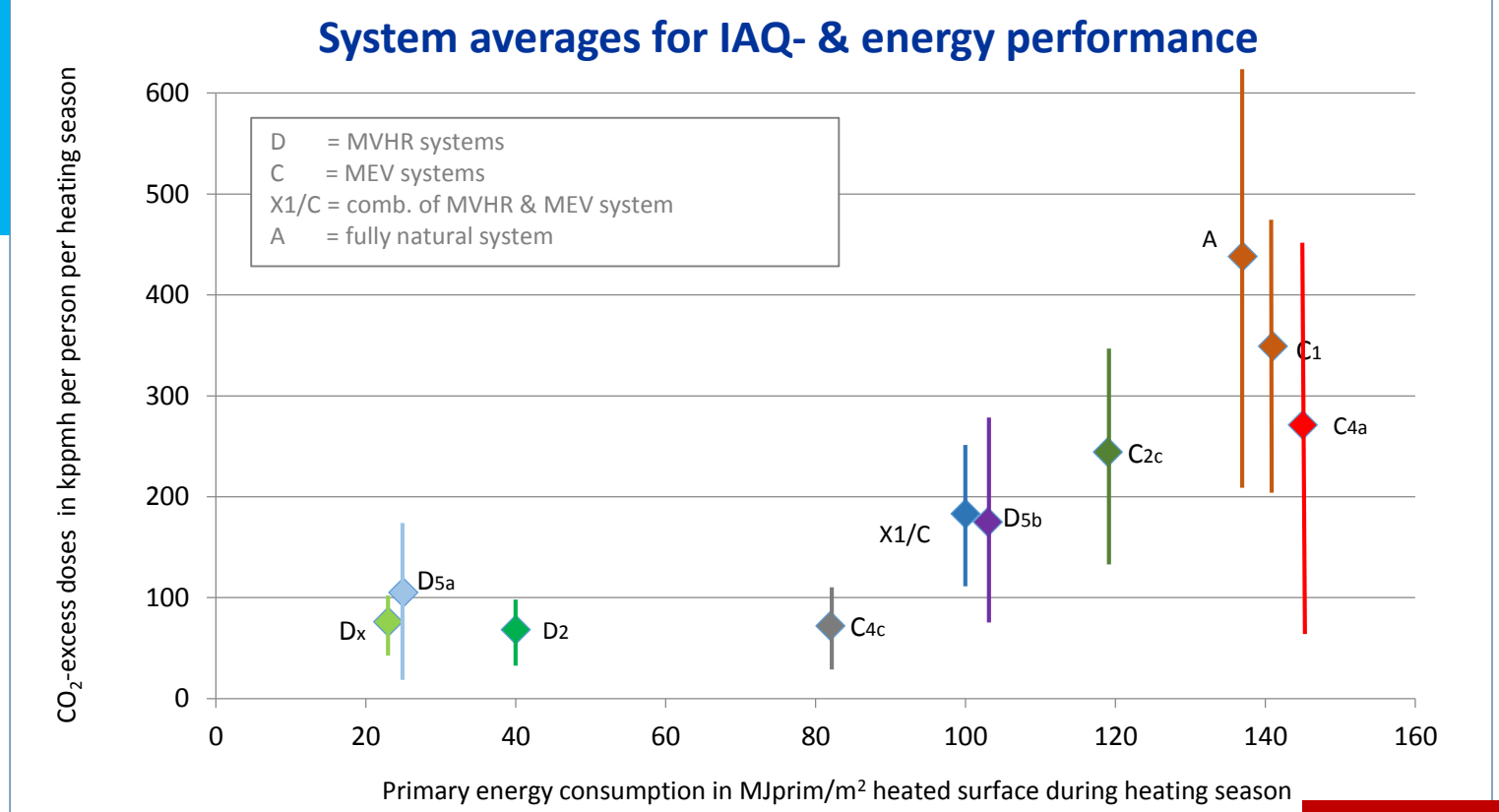
Monitoring Results:

IAQ-Performance

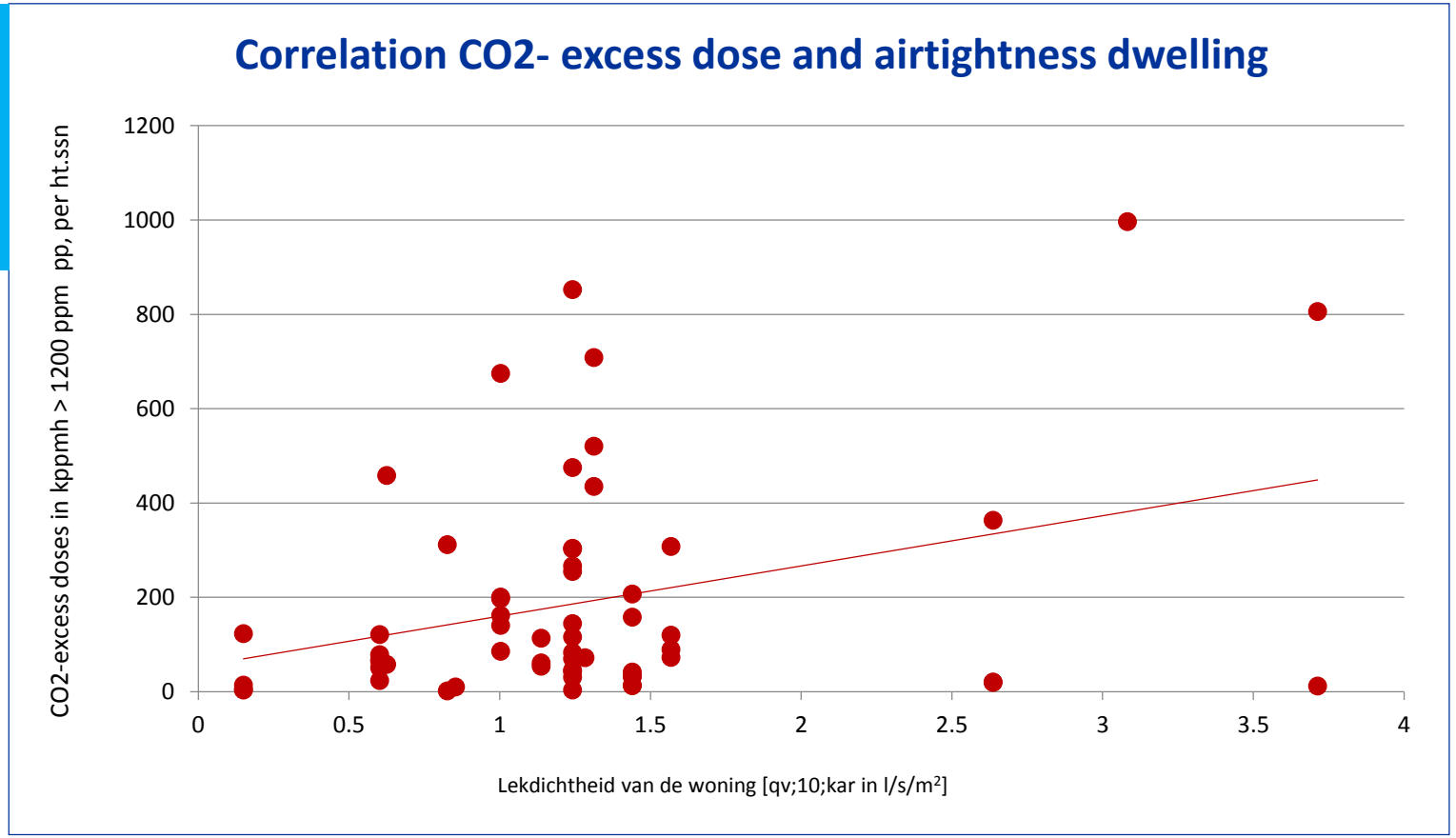


Energy Performance

IAQ-Performance code-compliant ventilation systems

Monitoring Results:

IAQ-Performance



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Summary monitoring results /1

1. At dwelling level, all ventilation systems achieve av. flowrates of > 35 m3/h/pp
2. Humidity levels in all rooms well below 70% RH during > 22 hours per day
3. Ventilation systems show large differences in their ability to achieve requested air-exchange rates of 25 m3/h/pp in habitable rooms during presence.
4. As a results there are large differences in CO_2-excess doses, varying from 0 – 853 kppmh/pp/heating season; bedrooms are critical.
5. Systems that use a mechanical component in the air-exchange provisions in habitable rooms have a significantly better IAQ-performance.
6. Inhabitants do not react on high CO_2-levels (> 3000 ppm CO2).

IAQ-Performance code-compliant ventilation systems

Summary monitoring results/2

7. Leaks in dwellings façade or roof do not necessarily improve the IAQ in habitable rooms
8. For dwellings with only natural air- supply and extract provisions in habitable rooms, an increase in flow rate does not improve the IAQ
9. Noise and draught are reasons to temporarily switch off mech. vent. units.
10. There are significant differences in real-life energy performance and the EPBD assessment methods

IAQ-Performance code-compliant ventilation systems

Main Conclusions

- Current Building codes do not suffice to guarantee good IAQ in habitable rooms
- Code-compliant ventilation systems show large differences in their IAQ-performance in habitable rooms
- EPBD-assessment methods on energy-performance result in another ranking of ventilation systems compared to *real-life* energy performance
- Ranking ventilation systems on energy-performance only, without assessing their IAQ-performance, makes no sense

Buildings codes and assessment methods need further improvement

IAQ-Performance code-compliant ventilation systems

Reviewing Existing Legal Framework

- There are no requirements related to the actual IAQ-performance (only requirements related to flow-rate capacity of air-exchange provisions).
- Existing legal framework is partly based on the assumption that people are capable of assessing the IAQ-levels in their rooms and act upon it by operating the ventilation provisions; this is a questionable assumption.
- There is no proper test-procedure for determining the performance of ventilation systems on their primary IAQ-function (only test standards on individual components)
- There is no officially accepted definition of the minimal IAQ-performance, nor of any ranking in IAQ-performances.

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Recommendations

The IAQ-performance of MEV and MVHR-systems can be further improved. Key requisites for achieving these improvements are:

- Development of a validated and internationally accepted IAQ test-protocol for ventilation systems (testing their ability to achieve the requested air-exchange rates under normally occurring circumstances in all rooms)
- Define minimum IAQ-requirements, to be embedded in buildings regulations.
- Development and introduction of a labelling system, indicating the IAQ-performance of ventilation systems
- Further improvement of the energy-performance assessment methods (validation with real-life monitoring data).
- Energy-performance can only be communicated when linked to the IAQ-performance

IAQ-Performance code-compliant ventilation systems

Spin-off

- Dutch standardization body NEN recently started a project to revise NEN1087, the standard that described the methods for determining the performance of ventilation systems in new buildings in the Netherlands.

- Findings of the MONICAIR-project are incorporated in the R&D strategies of the Dutch manufacturing ventilation industry.

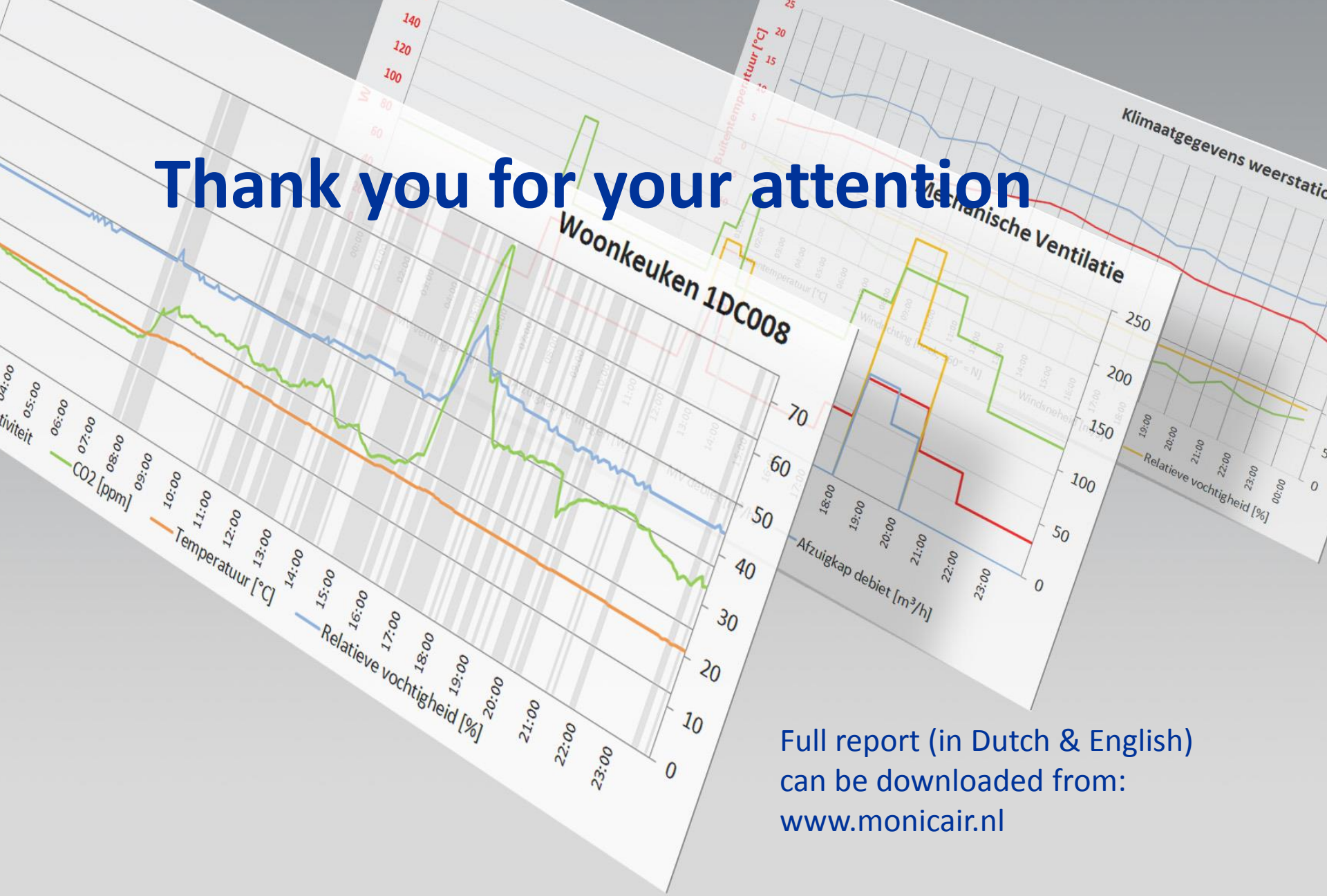
IAQ-Performance code-compliant ventilation systems

Questions

Are there any monitoring project similar to MONICAIR being performed in Germany?

Are the findings of the MONICAIR-project also applicable to Germany (and other EU-member-states)?

Thank you for your attention



Full report (in Dutch & English) can be downloaded from: www.monicair.nl