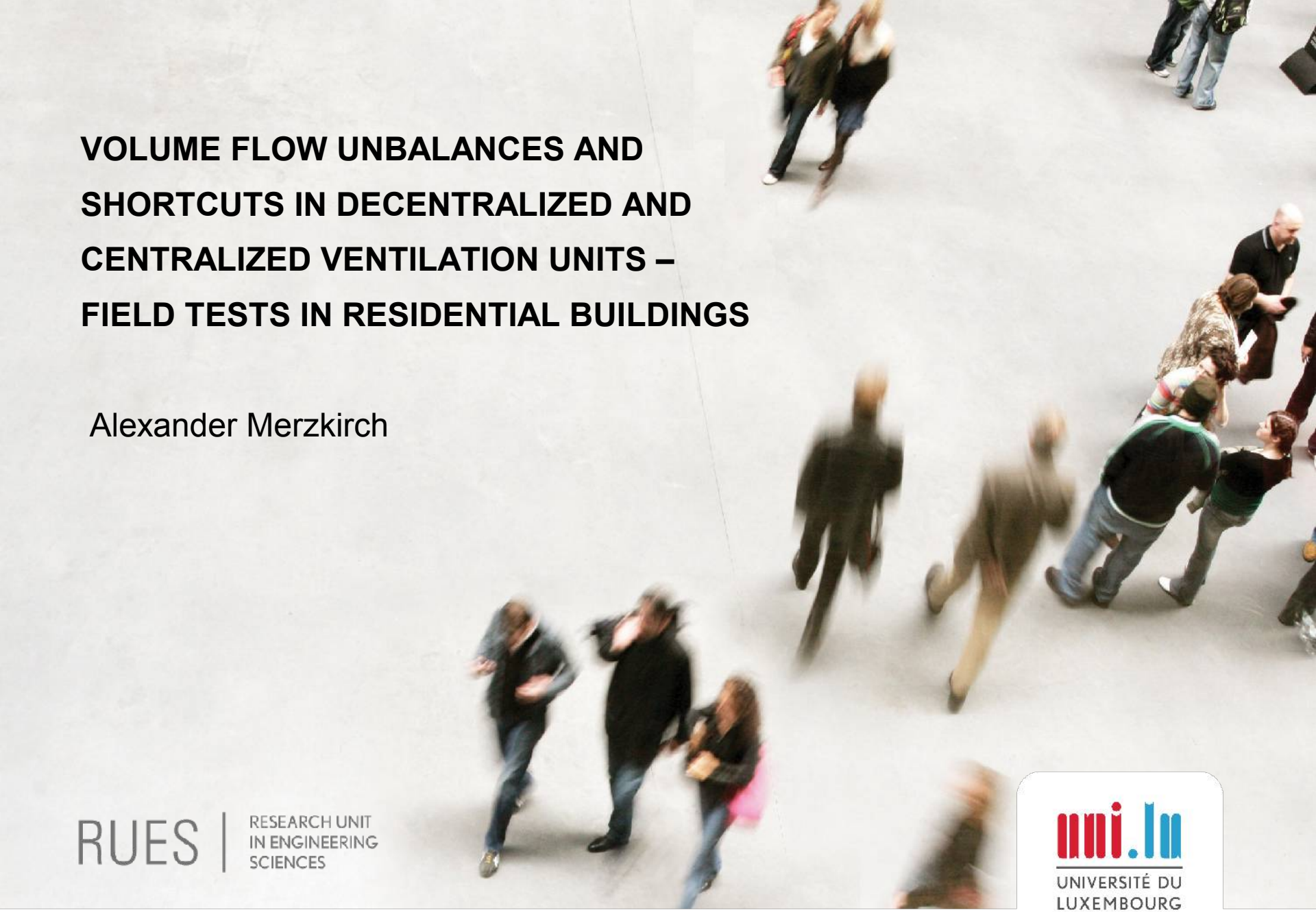

VOLUME FLOW UNBALANCES AND SHORTCUTS IN DECENTRALIZED AND CENTRALIZED VENTILATION UNITS – FIELD TESTS IN RESIDENTIAL BUILDINGS

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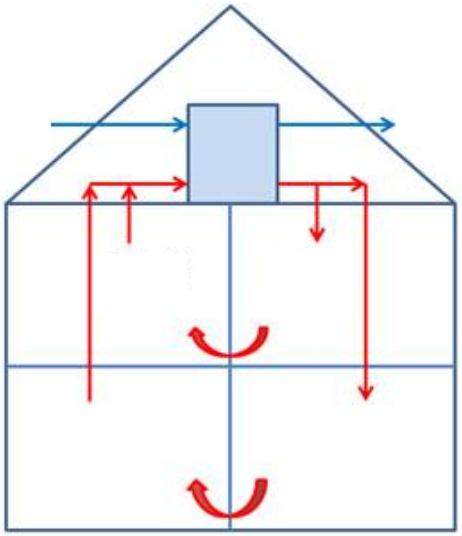
What was done?

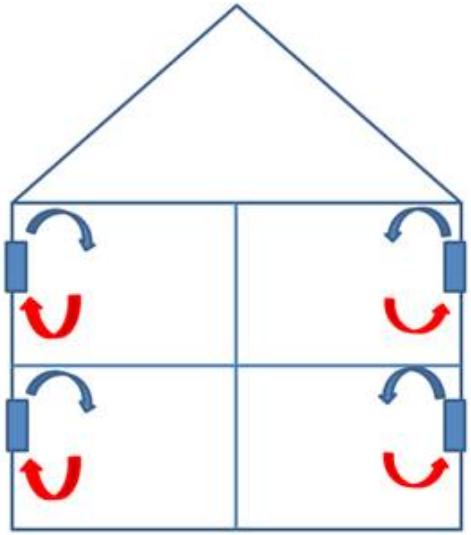
- Assessement of ventilation systems in 20 single family homes and 60 dwellings in multi-family buildings.
- Energy Efficiency / User Comfort / Costs
- This paper addresses:
  - Volume flow and unbalances
  - Shortcuts

Influence on Heat Recovery and Indoor Air Quality

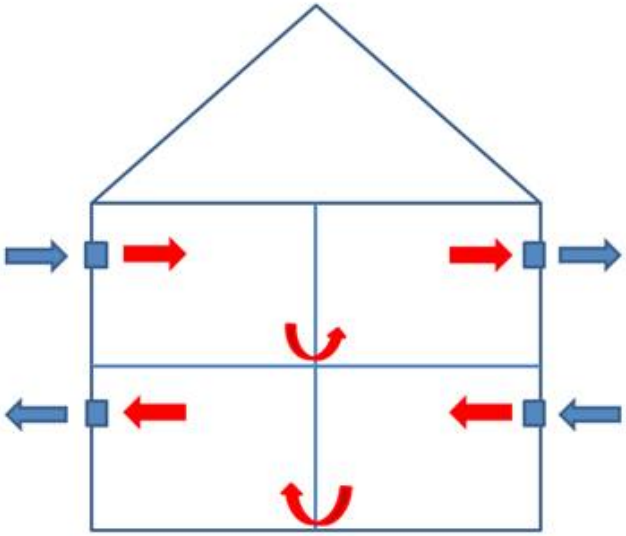
Tested Devices



Centralized

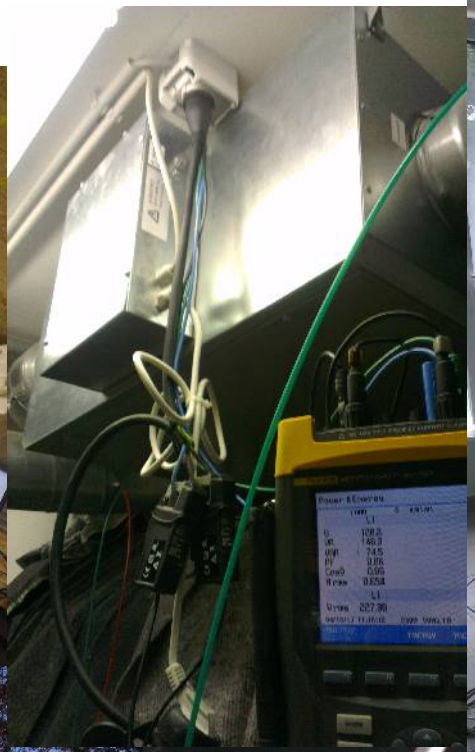


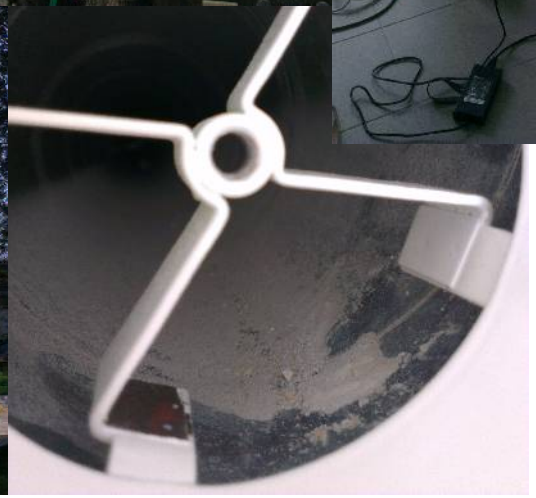
Decentralized
Single Room



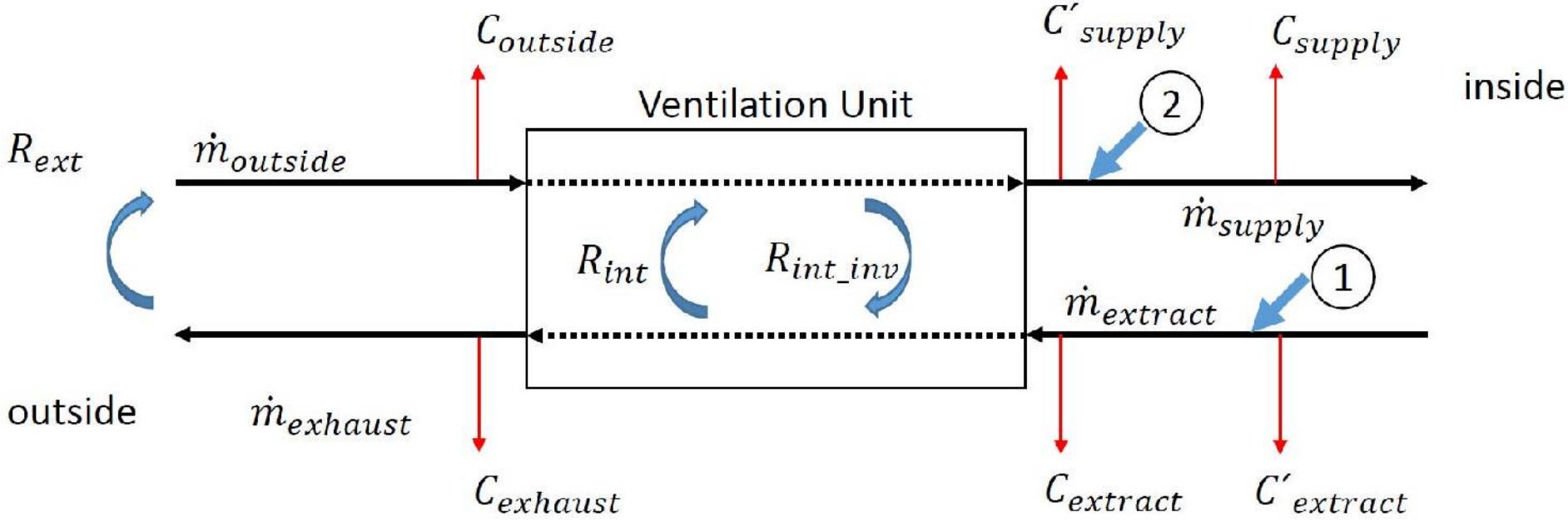
Decentralized
Pair-wise

Field Measurements





Air flows of ventilation system



Air flow and Shortcuts

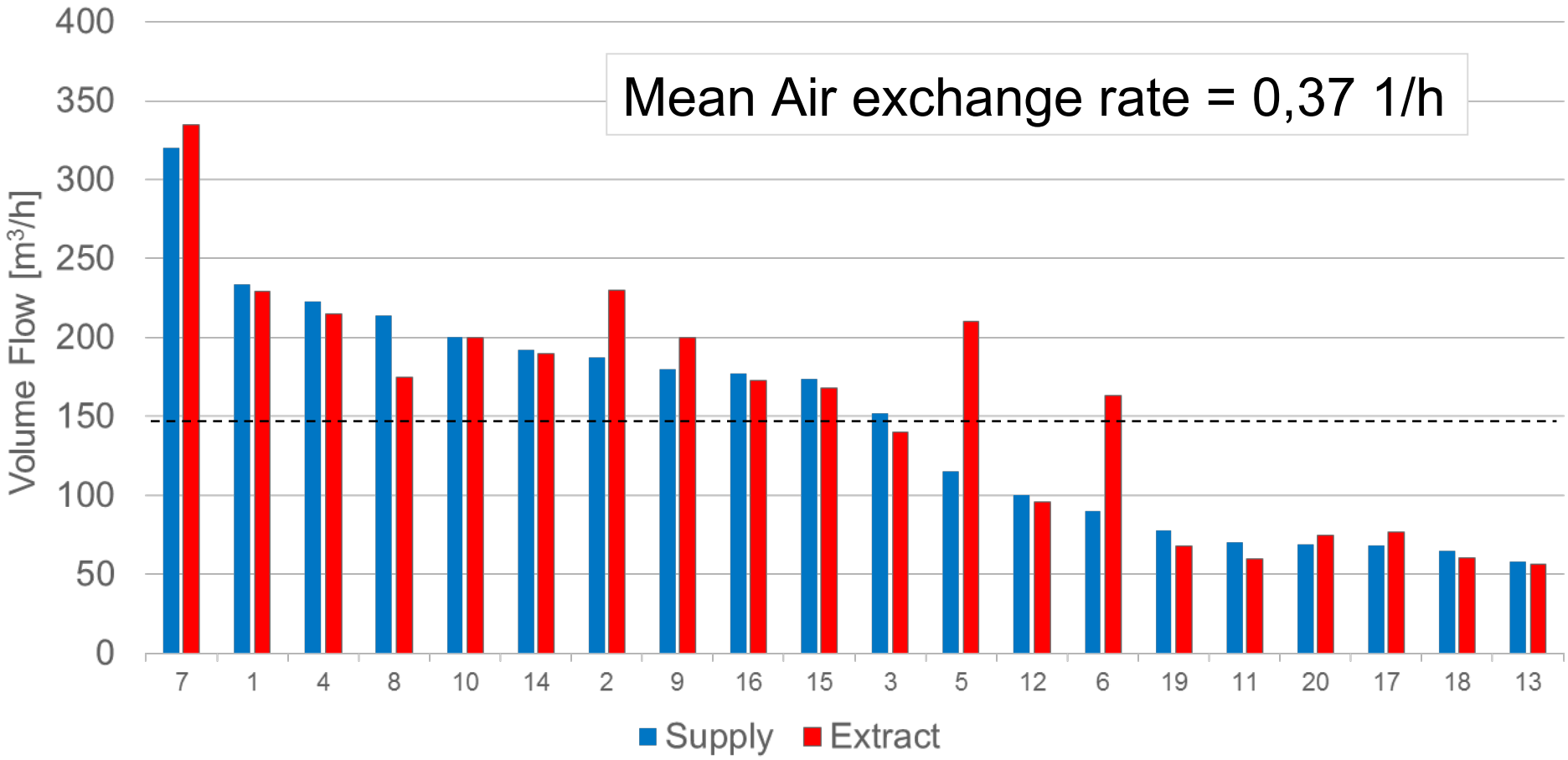
$$\dot{m}_{extract} = \frac{\dot{I}_{extract}}{C'_{extract} - C_{extract}}$$

$$R_{ext} = \frac{C_{outside}}{C_{exhaust}}$$

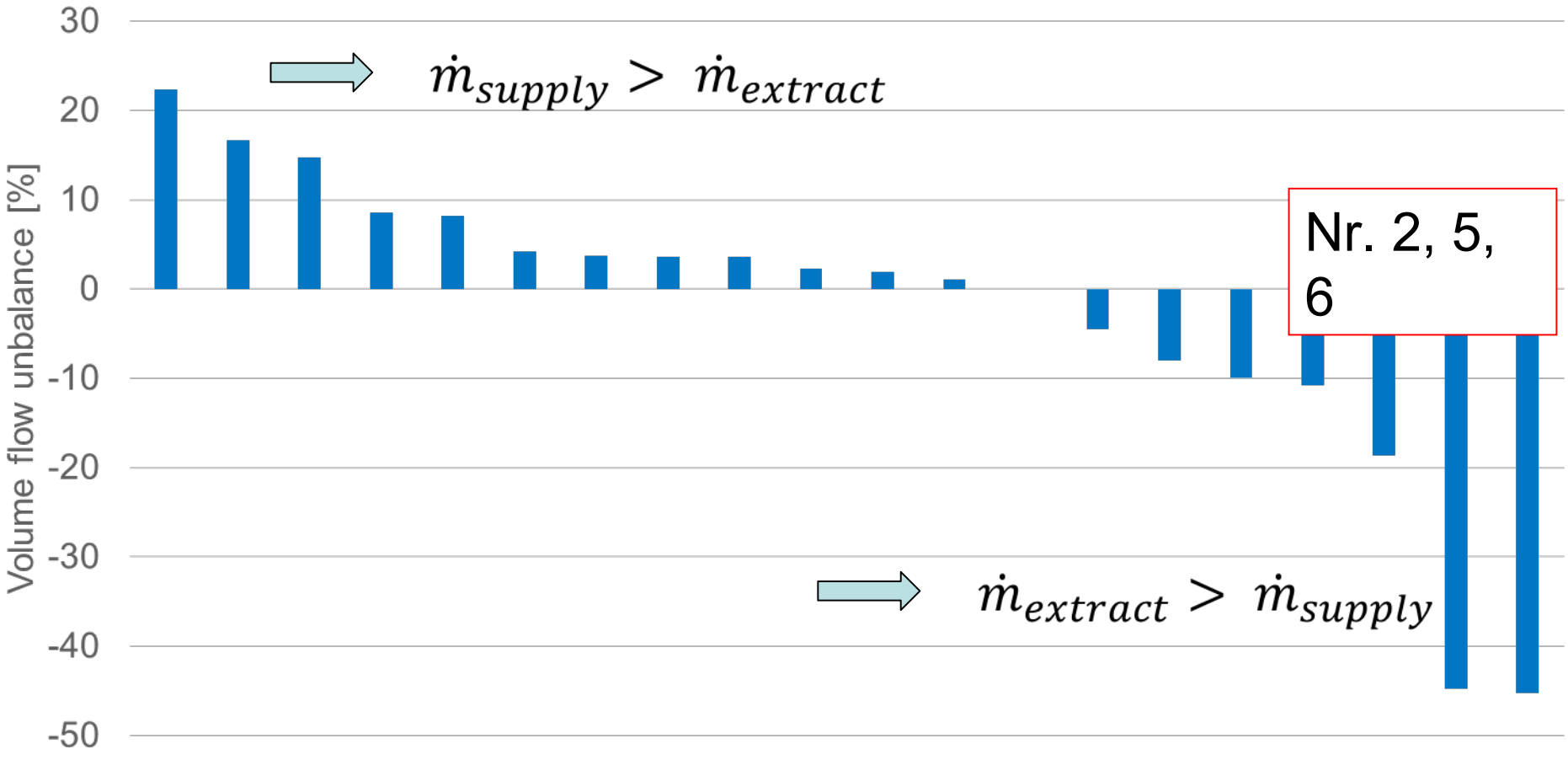
$$R_{int} = \frac{C_{supply} - C_{outside}}{C_{exhaust} - C_{supply}}$$

$$R_{int\_inv} = \frac{C_{extract} - C_{exhaust}}{C_{extract} - C_{supply}}$$

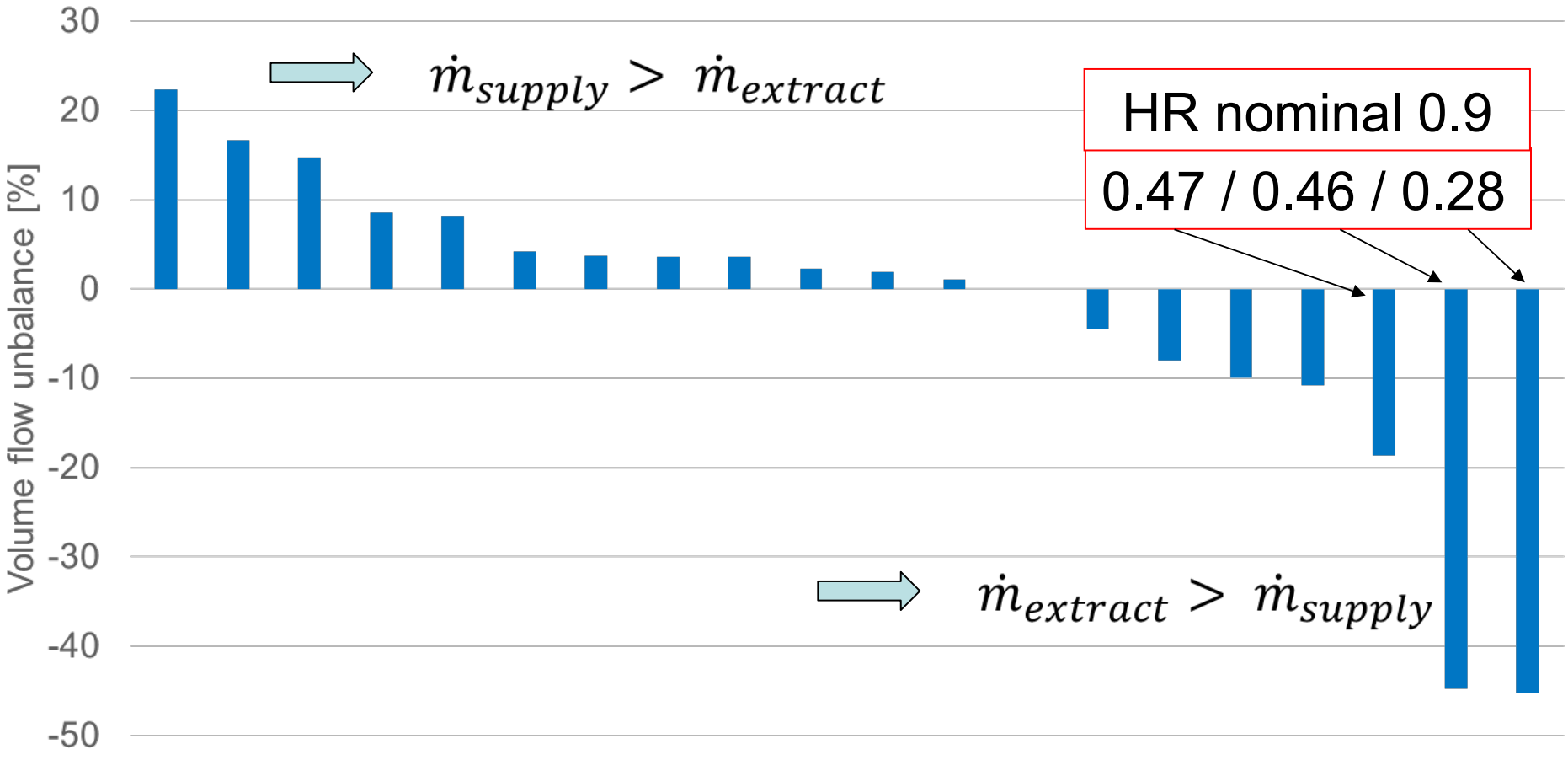
Volume flow – Centralized Devices



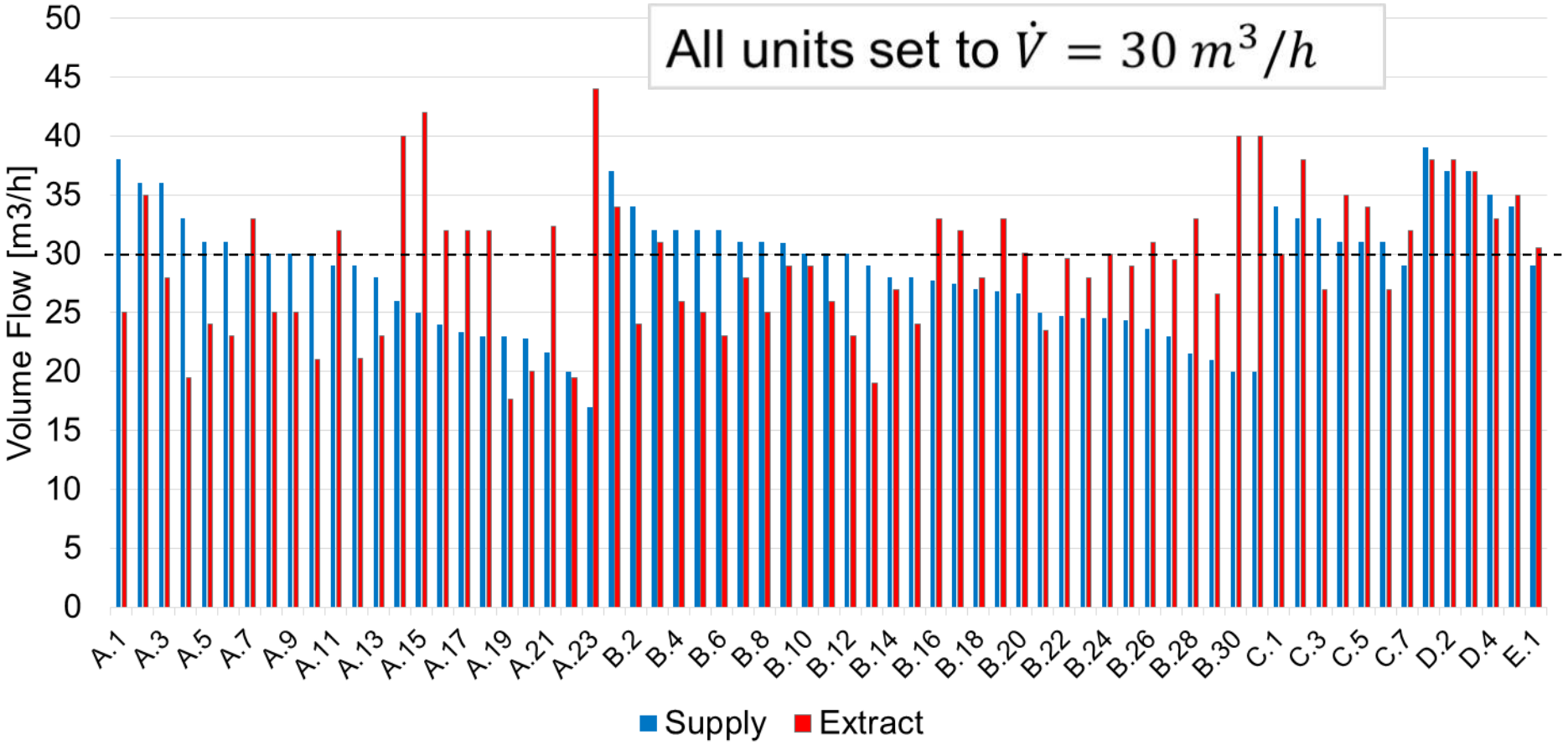
Flow unbalances – Centralized Devices



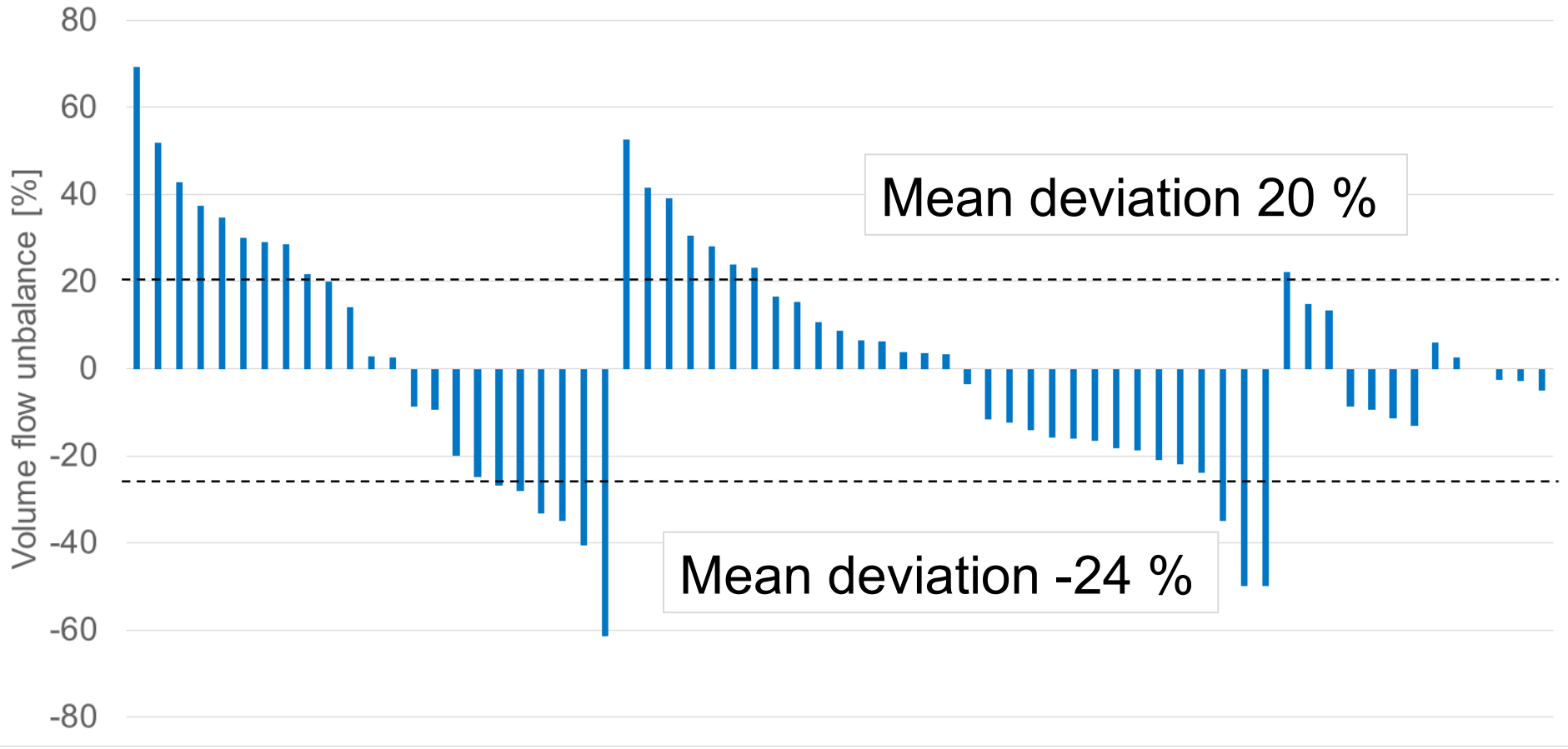
Flow unbalances – Centralized Devices



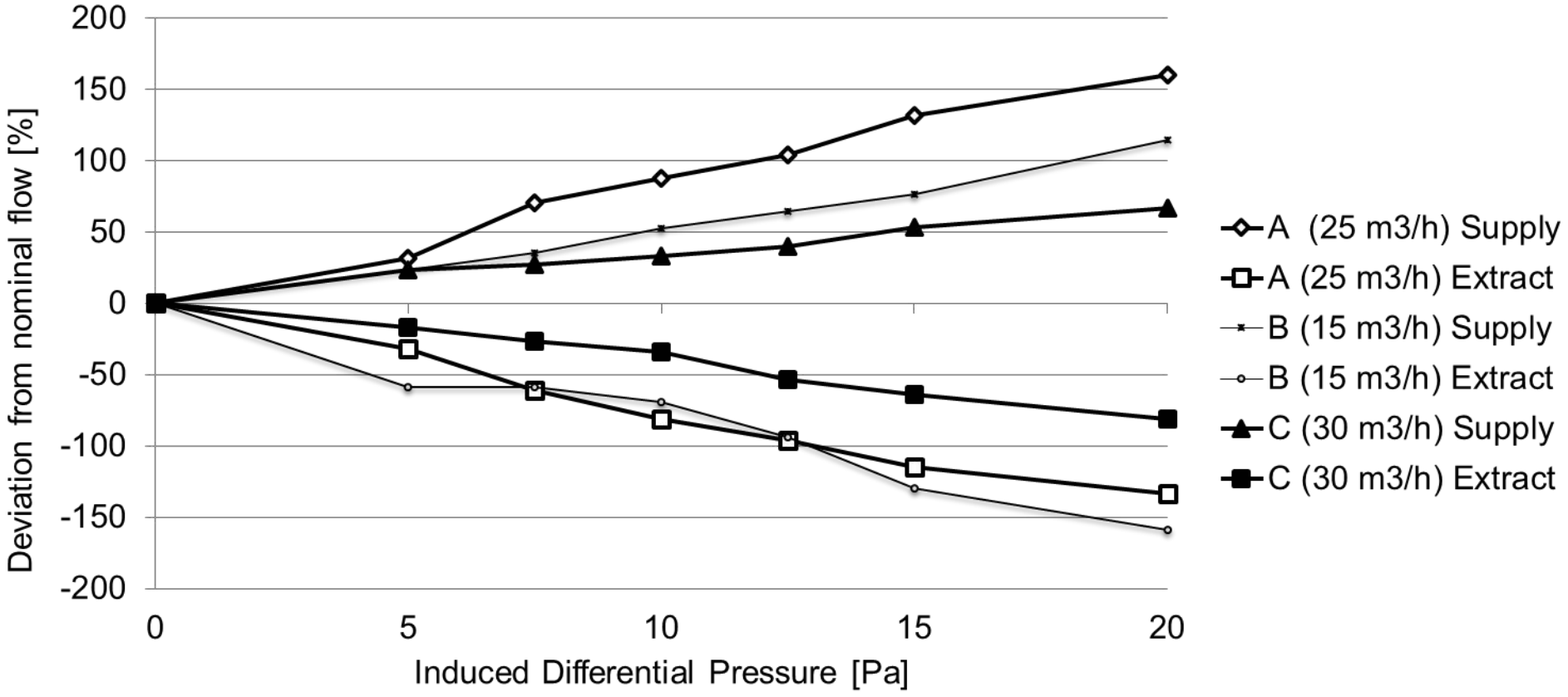
Volume flow – Decentralized Devices



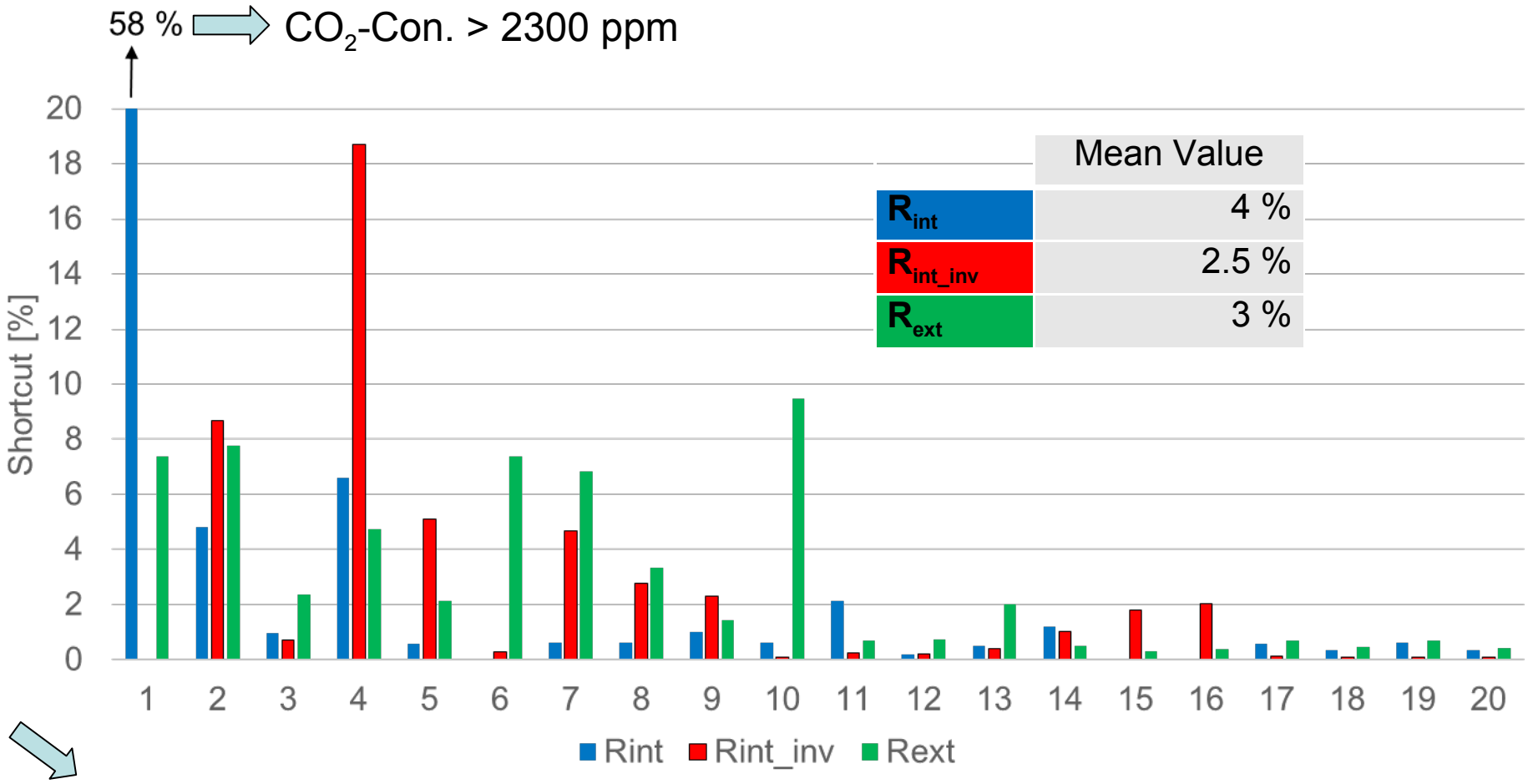
Flow unbalances – Decentralized Devices



Sensitivity to Differential Pressure

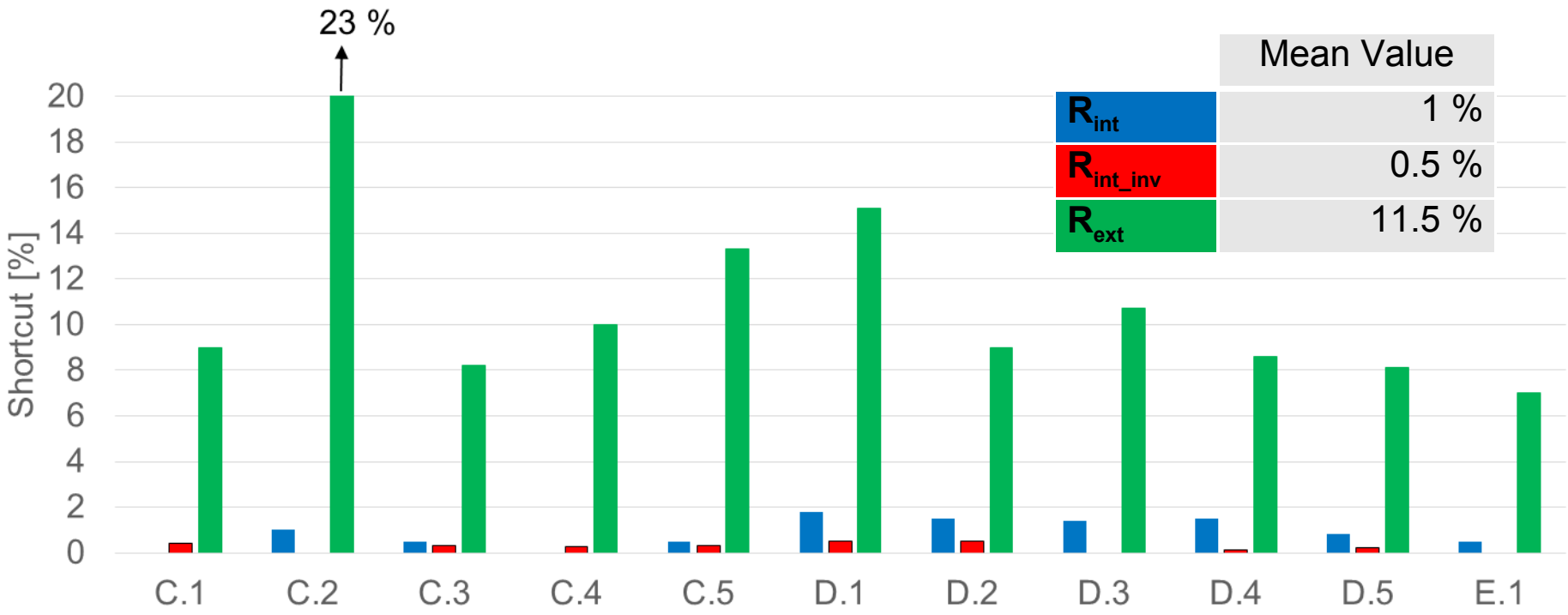


Shortcuts – Centralized Devices

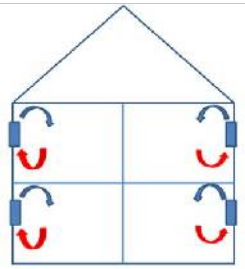


Decreased Fresh Air flow (by approx. Rint+Rext [%])

Shortcuts – Decentralized Devices



- Placement of inlet / outlet
- Same situation inside
- Ventilation efficiency of 0.43



Results

- Volume Flow Unbalances lead to low heat recovery rates (in this case below 50 %).
- Volume Flow Unbalances lead to In-/Exfiltration, reducing the heat recovery of the whole building even further
- High Sensitivity to Differential Pressure of decentalized units can lead to low heat recovery rates, in-/exfiltration and draught risk

Results

- High shortcuts lead to lower indoor air quality and possible to lower heat recovery rates if shortcut happens before heat recovery device
- Mean fresh airflow reduced due to shortcuts about 7 % for centralized and 12.5 % for decentralized devices
- That increases also specific fan power values ($mean_{centr.}$ = 0.47 Wh/m³ / $mean_{decentr.}$ = 0.23 Wh/m³)

Conclusion

- Reducing Volume Flow Unbalances and Shortcuts is crucial to good system performance.
- Mean values indicate that ventilation systems show higher values than expected → high heat recovery rates, good indoor quality and low specific fan power as promised may not be achieved in practice.
- Airtight casings, well positioned in-/outlets, air flow balanced fans, tight building envelopes, good hydraulic balancing.

Thank you

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