Sensors for behavioural monitoring

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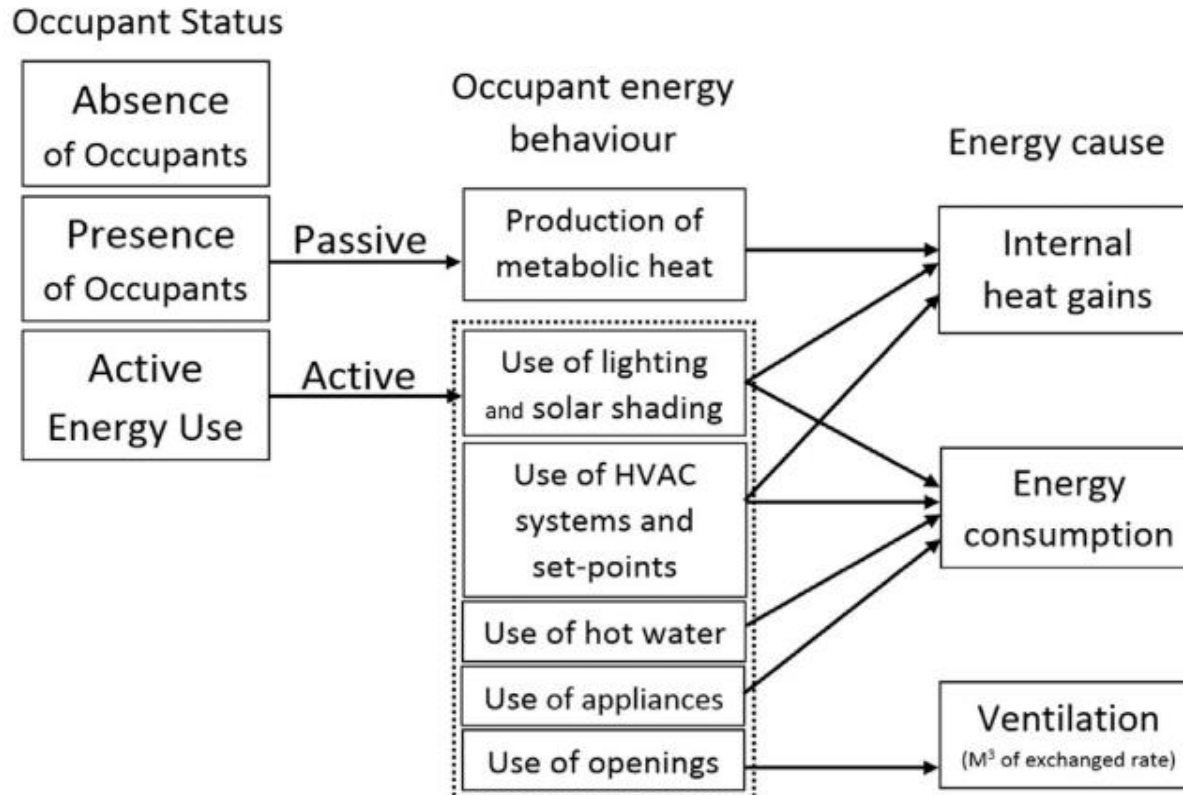# Occupant's impact on energy use of buildings

Figure 1: Impact of occupant behaviour on energy use (Delzendeh et al., 2017)

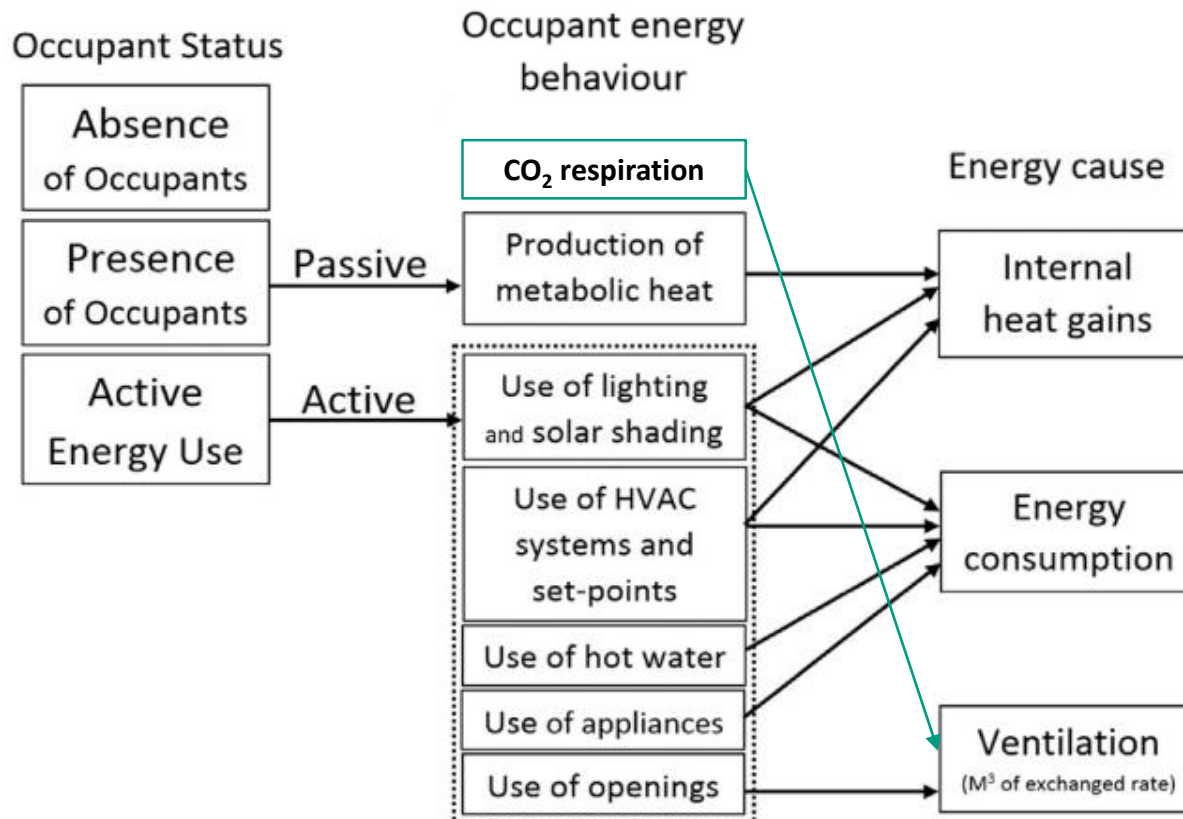# Occupant's impact on energy use of buildings

Figure 1: Impact of occupant behaviour on energy use (Delzendeh et al., 2017)

Passive occupant presence

Occupant energy behaviour	Energy cause	Measured parameter	Sensor
Metabolic heat input	Internal heat gains	Occupant presence	▪ Threshold and mechanical sensing ▪ Image-based sensing ▪ Motion sensing ▪ Radio Signal sensing ▪ Mixed sensing (IEA Annex 66, 2018)

Sensors for monitoring occupant presence

Threshold and mechanical sensing	Image-based sensing	Motion sensing	Mixed sensing
Reed contacts (Agarwal et al., 2011)	Visible light cameras (Zou et al., 2017)	Passive infrared (PIR) (Azghandi et al., 2015)	PIR + reed contacts (Agarwal et al., 2011)
Door badges		Ultrasound (Shih & Rowe, 2015)	CO_2, RH and T (Szczurek et al., 2017)
Piezoelectric mats			
Infrared beams			

Passive occupant presence

Occupant energy behaviour	Energy cause	Measured parameter	Sensor
Metabolic heat input	Internal heat gains	Occupant presence	- Threshold and mechanical sensing - Image-based sensing - Motion sensing - Radio Signal sensing - Mixed sensing (IEA Annex 66, 2018)
CO_2 respiration	Ventilation	Electricity consumption (plug load)	Electricity meter
		Air velocity in air handling system	Pitot tube, anemometer (Dols & Persily, 1995)
		Differential pressure	Differential pressure meter (Lai et al., 2018)

Active occupant presence

Occupant energy behaviour	Energy cause	Measured parameter	Sensor
Use of lighting	Internal heat gains, energy consumption	Electricity consumption (plug load)	Electricity meter
Use of solar shading	Solar heat gains		
Use of HVAC systems	Energy consumption	Energy use	Electricity/gas/heat meter
		Temperatures	Temperature sensor
		Supplied heat (per room/radiator)	Energy meter (flow, T1 and T2)
Use of hot water	Energy consumption	Energy use	Electricity/gas/heat meter
		Supplied heat	Energy meter (flow, T1 and T2)
Use of appliances	Internal heat gains, energy consumption	Electricity consumption (plug load)	Electricity meter
Use of openings	Ventilation	Opening of windows/doors	State contacts (D'Oca et al., 2014; Fritsch et al., 1990; Lai et al., 2018; Schweiker et al., 2012)

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