UiT Norges arktiske universitet

[Annex93] 4th Workshop and working meeting

Indoor Climate in Renovated Apartment Building in the Arctic

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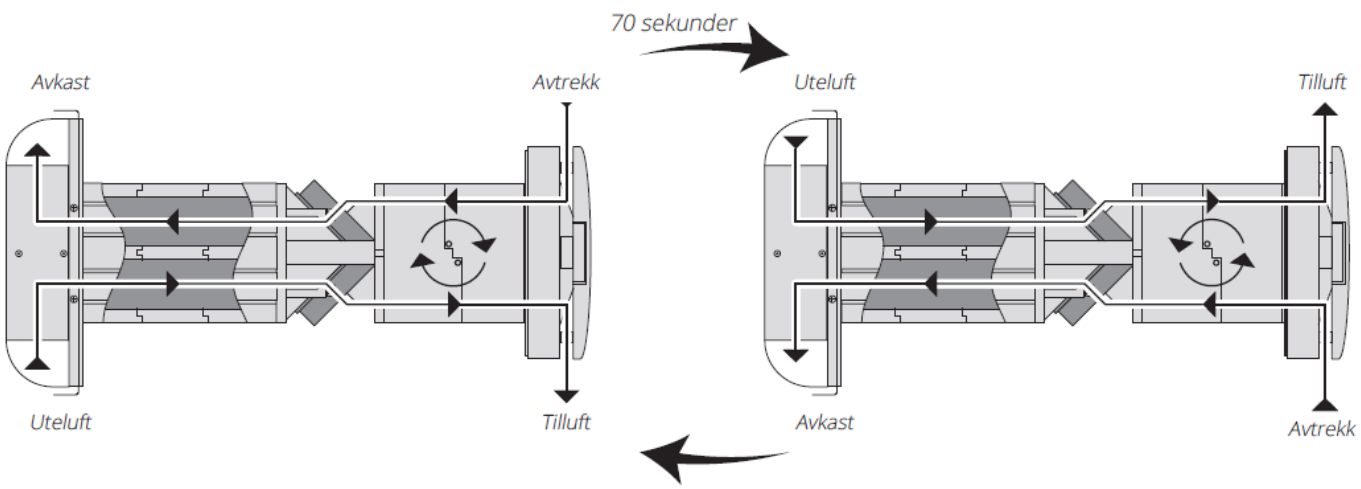
Case buildings and the renovation measures

- Constructed in1968 and 1973
- Renovation in 2015

Renovation in 2015

Room ventilation units (RVUs)



Case buildings and the renovation measures

Table 1. The technical specification of the case building before and after renovation

	Before renovation	After renovation
Exterior wall	U-value 0.440 W/m^{2}K	U-value 0.157 W/m^{2}K
Balcony	Open balcony, area 4.5 m^2	Glazed balcony with extension, area 8 m^2
Window	Double panel, U-value 2.5 W/m^{2}K	Triple panel, U-value 0.77 W/m^{2}K
Air tightness	n_{50} = 1.90 1/h	n_{50} = 1.45 1/h
Ventilation	Centralized exhaust ventilation	Room ventilation units (RVUs) and centralized exhaust ventilation
Heating & cooling	Electrical heating with thermostat, setpoint 21 °C. No cooling system	
General	12 floor. 4 apartments on each floor, 2 with single bedroom and 2 with double bedroom. Floor height 2.6 m.	

Evaluation

Field Measurements

- Tracer gas
- Thermography

Questionnaire Survey

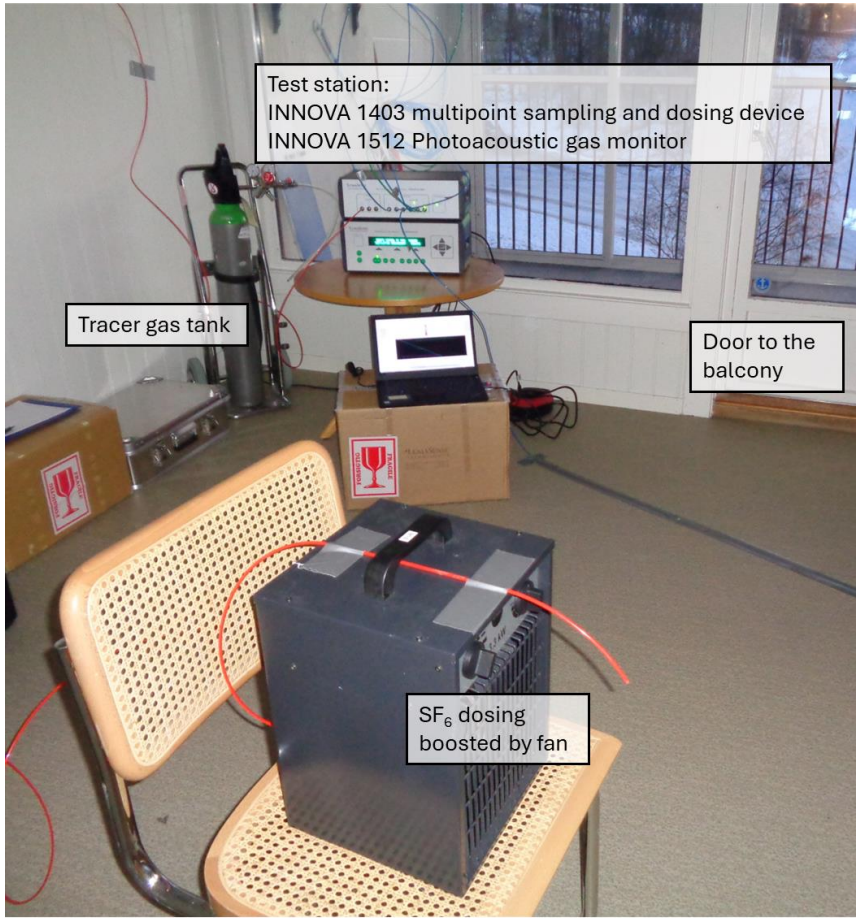
- General
- Thermal Comfort
- Air quality
- Ventilation
- Noise
- Information
- Health and Symptoms

Simulation

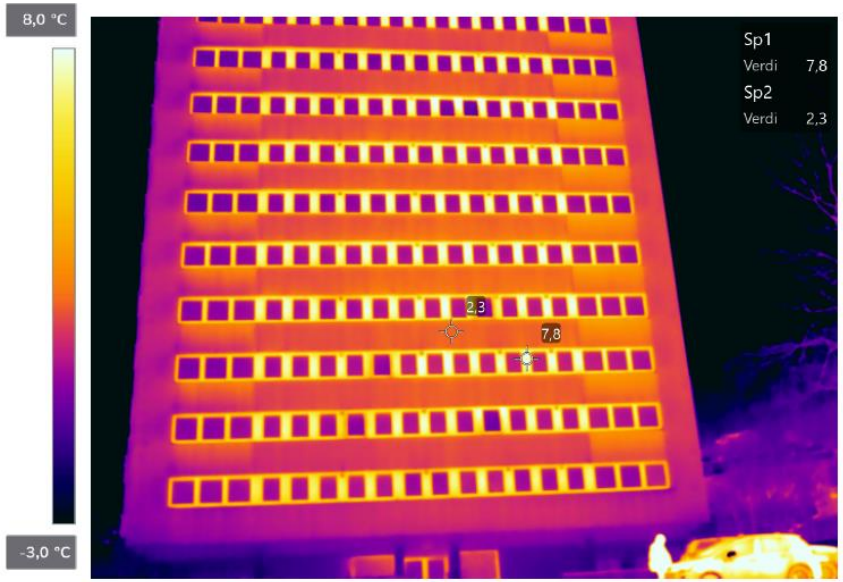
- IDA ICE:

Air quality
thermal comfort
energy performance

Field Measurements



Tracer gas measurement



Thermography

Simulation in IDA ICE

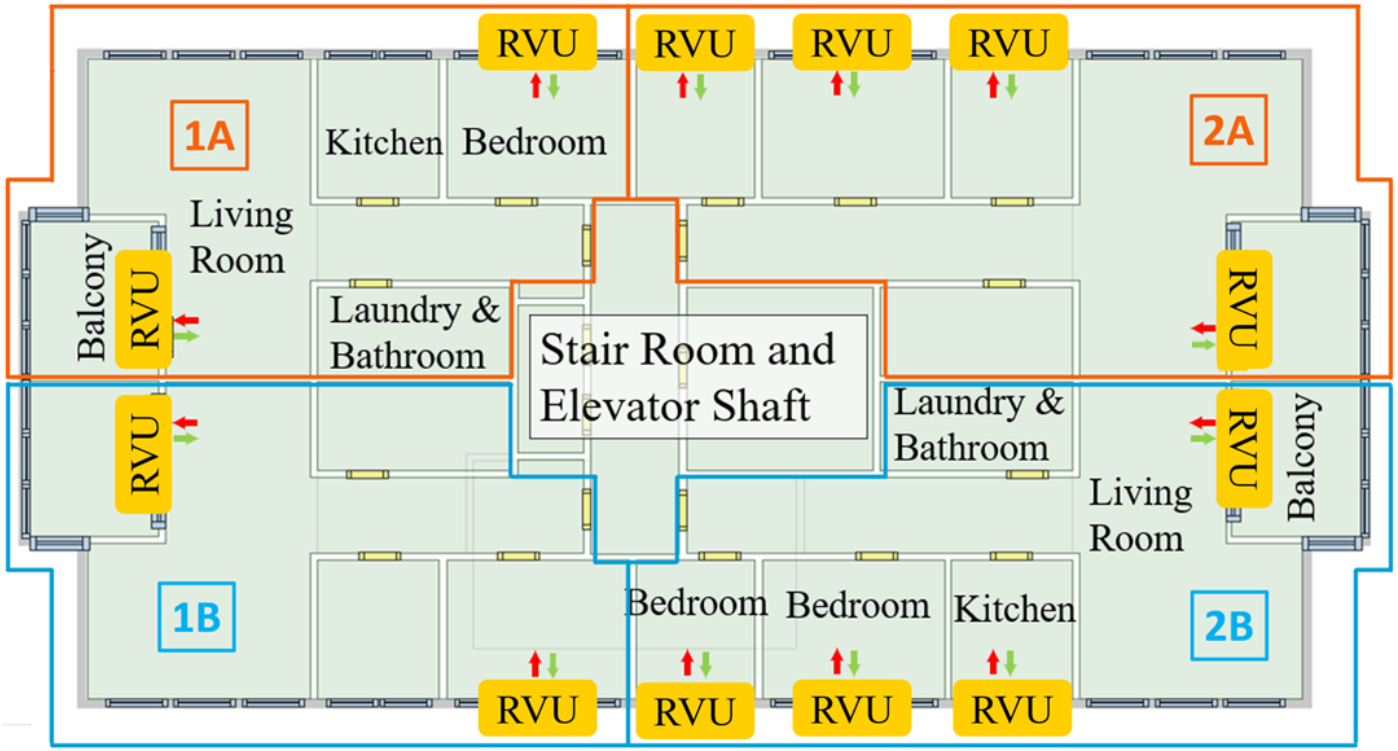


Fig. The case buildings' floor plan with RVUs after renovation

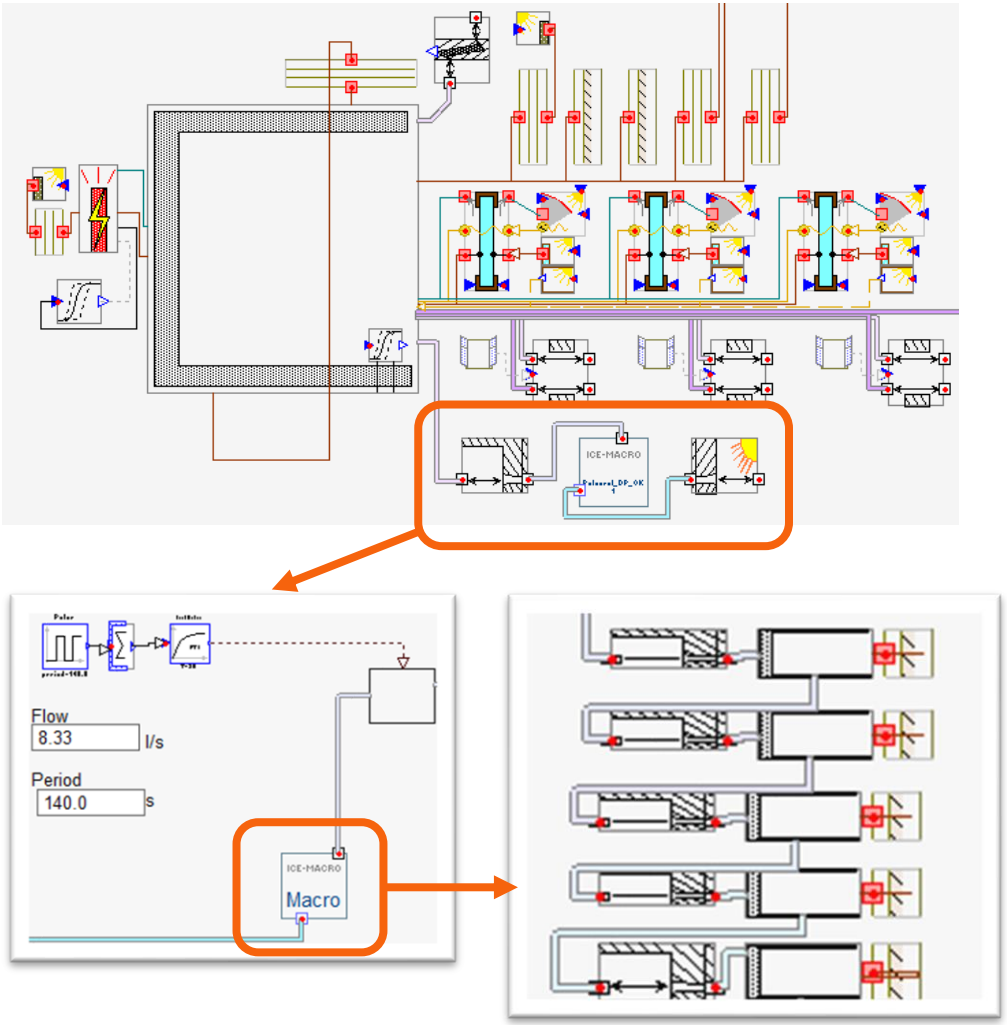
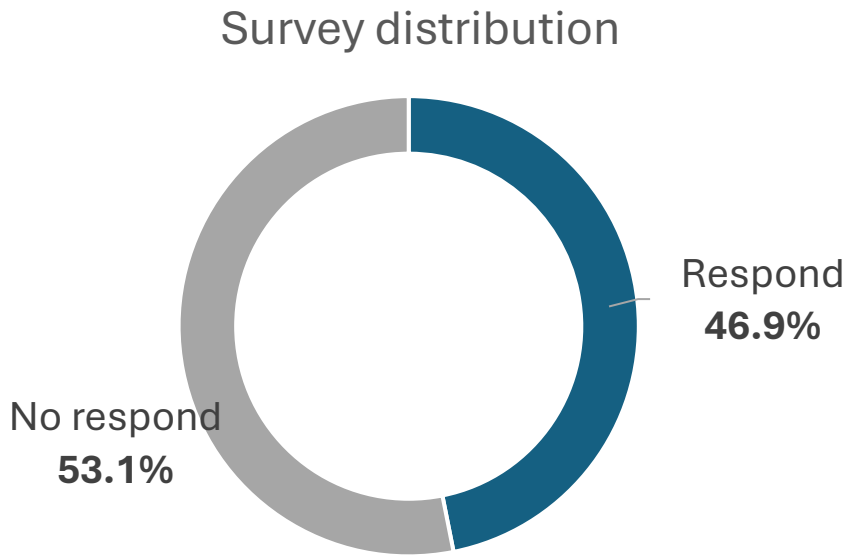


Fig. Schematics of the RVUs

Results

Questionnaire survey



❑ Sample size is **96**; response rate is **46.9%**

❑ **Additional engagement:**

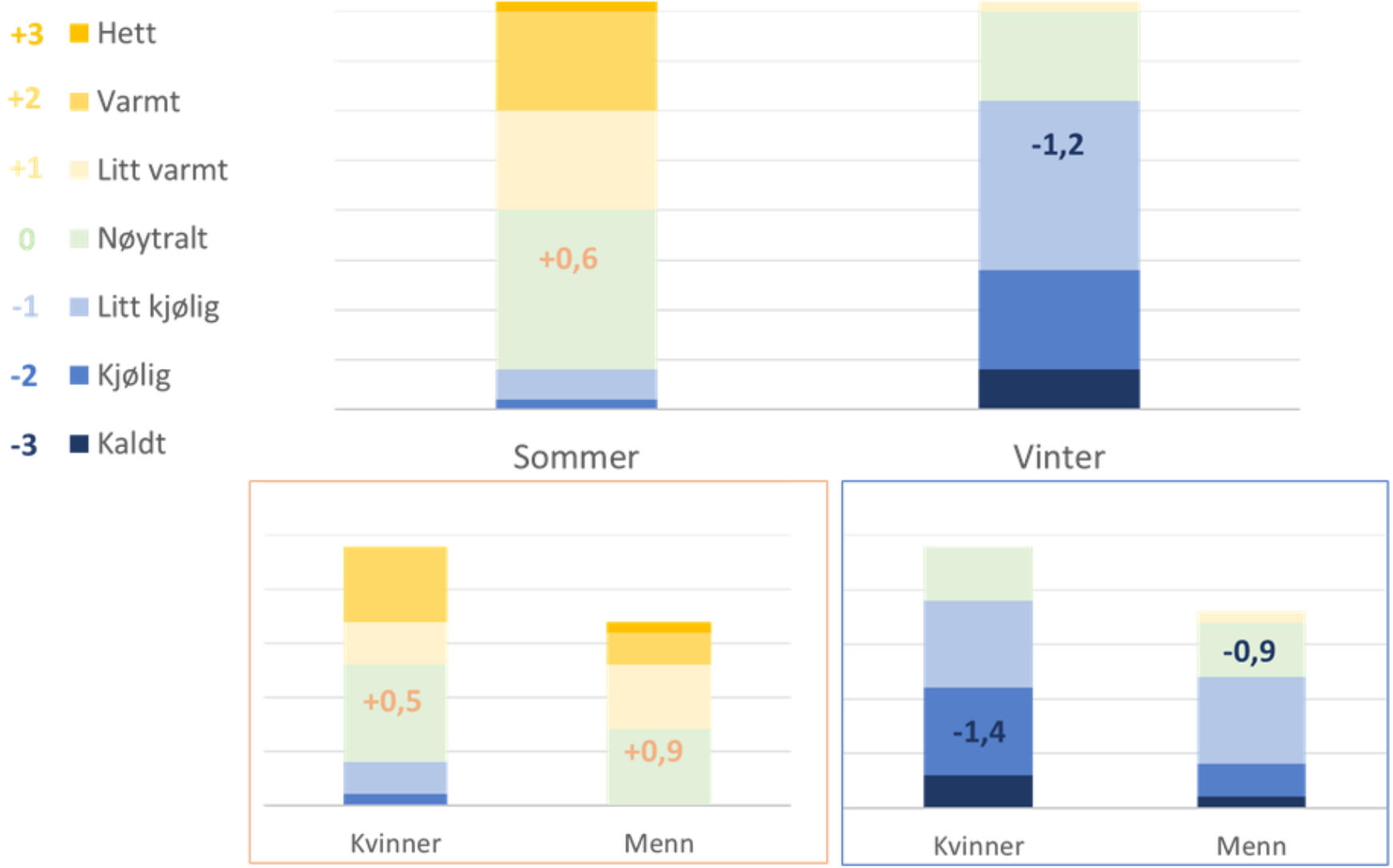
Two follow-up meetings with residents' representatives and general assembly

Dates: 24th May 2022 and 31st January 2023

Results

Questionnaire survey

How do you perceive the room temperature?



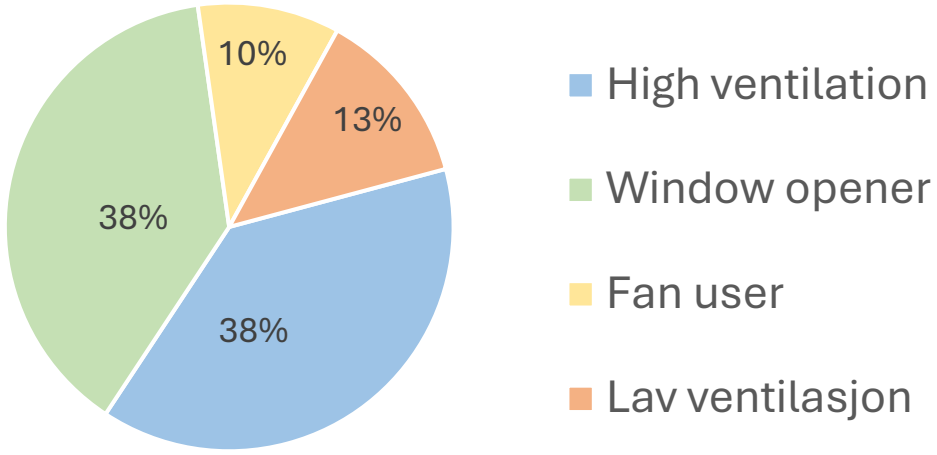
Ventilation Habits

Summer	Window, **daily**	Window, **often**	Window, **sometimes**	Window, **never**
Mechanical fan, **always**	5	3	2	0
Mechanical fan, **daily, with demand**	7	0	0	1
Mechanical fan, **often**	0	0	1	1
Mechanical fan, **sometimes**	2	0	1	1
Mechanical fan, **never**	13	0	2	0

Winter	Window, **daily**	Window, **often**	Window, **sometimes**	Window, **never**
Mechanical fan, **always**	1	1	7	1
Mechanical fan, **daily, with demand**	2	3	1	2
Mechanical fan, **often**	0	0	0	2
Mechanical fan, **sometimes**	2	0	2	0
Mechanical fan, **never**	5	4	5	1

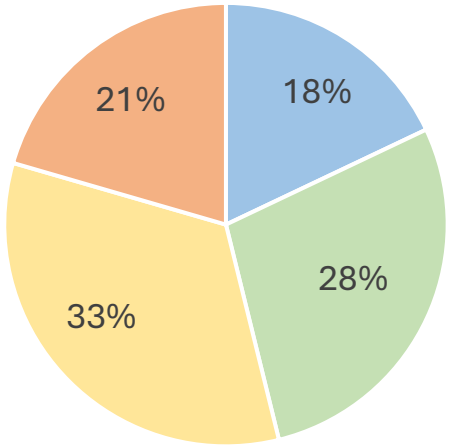
Occupant Group by Ventilation Habits

Summer



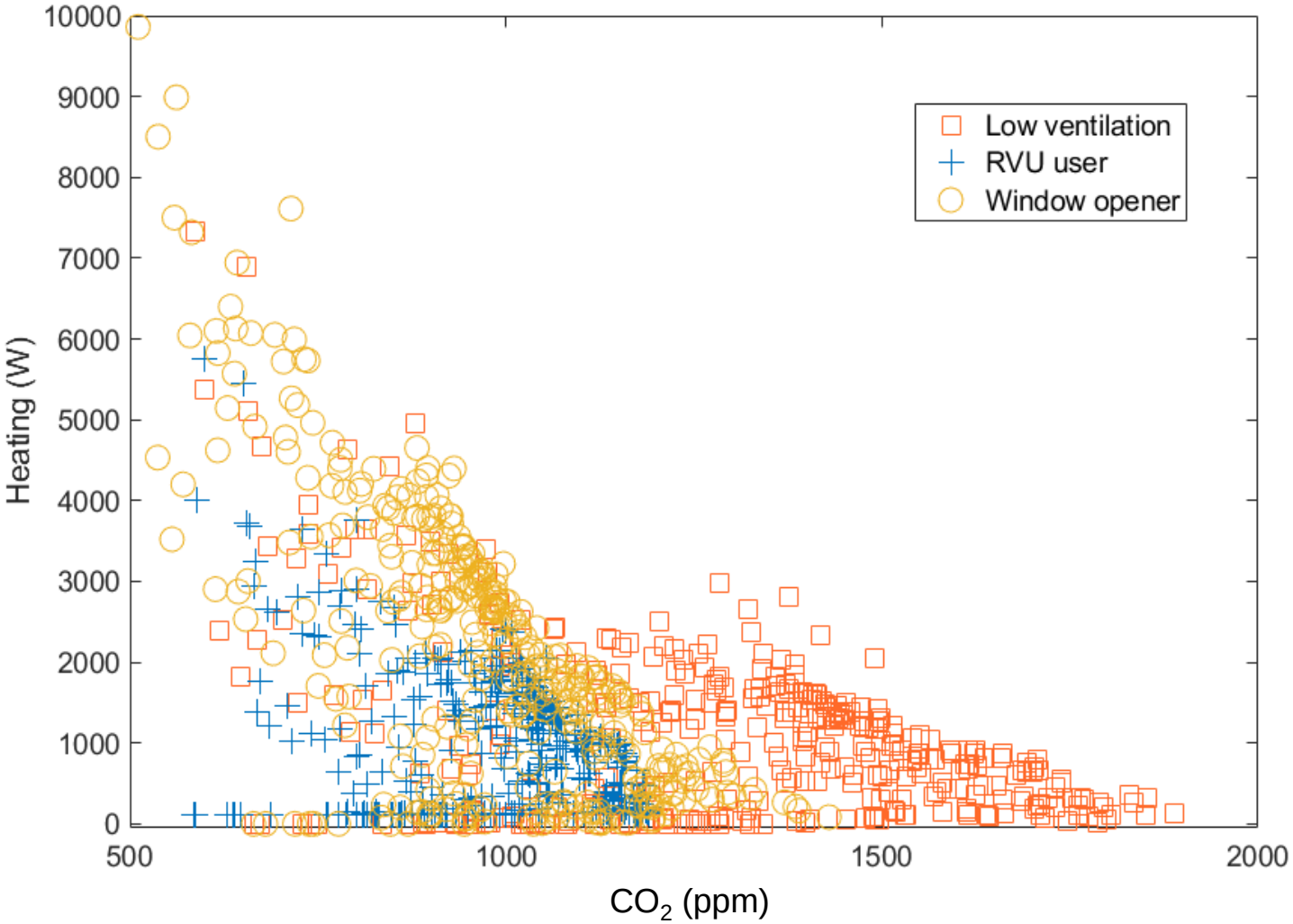
Occupant Group by Ventilation Habits

Winter



Results

Air Quality and Ventilation Performance with Different Ventilation Practices



- 3650 occupied hours (22:00-08:00)
- 48 bedrooms across 12 floors

Fig. Distribution of CO_2 concentration and heating load in master bedrooms with three ventilation operations.

Results

Thermal Performance of the Glazed Balcony

	T out	Balcony North	Balcony South
JAN	-2.6	-1.1	-0.9
FEB	-2.3	-0.8	-0.5
MAR	-0.5	1.5	2.6
APR	3.4	5.1	7.2
MAY	7.1	9.9	12.4
JUN	11.3	13.8	15.2
JUL	14.1	16.8	17.7
AUG	13.1	15.3	16.4
SEP	9.0	10.8	11.9
OCT	4.6	6.7	7.5
NOV	1.1	2.4	2.5
DEC	-0.4	0.8	0.9

Temperature, °C: 20, 15, 10, 5, 0, -5

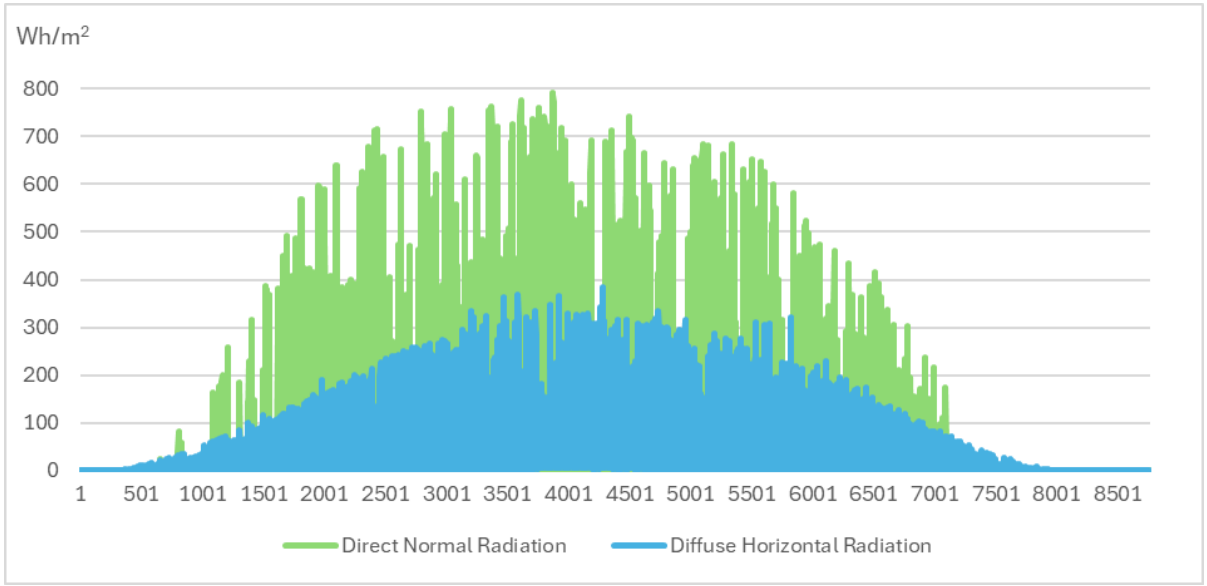
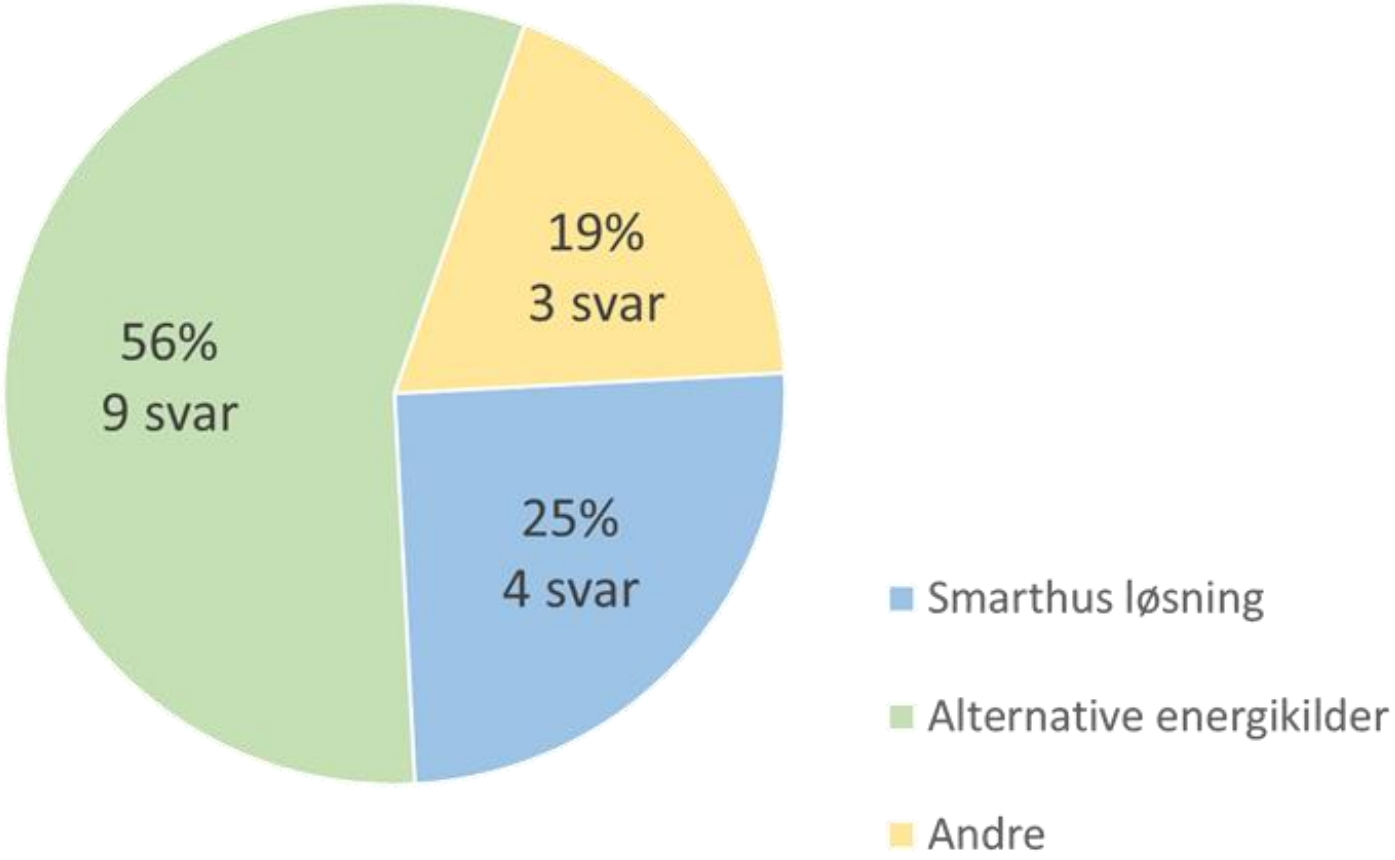
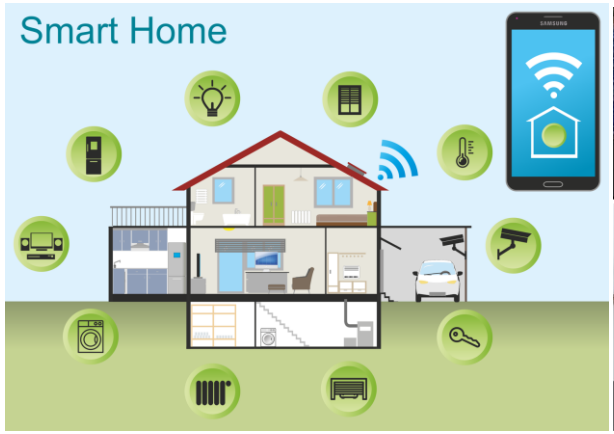


Fig. Yearly distribution of direct normal radiation and diffuse horizontal radiation

- Monthly average temperature distribution in the glazed balcony comparing to outdoor temperature

Are there any improvement measures you would like to have in the future?





Thank you for your attention

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