Reanalysis of an occupant experiment in the ZEB Living Lab



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Use occupant log books and measurement data in a Reanalysis of the first occupant experiment

Did the self-logged activities correspond to the highly-energy consuming activities?



Are there significant differences between groups concerning energy use and embodied emissions?

the role of occupant life phase, age and family situation

Background

variables that influence occupancy profiles such as socio-demographic driving-factors

variables influenced by occupancy impacting

the use of equipment, building services and energy consumption.

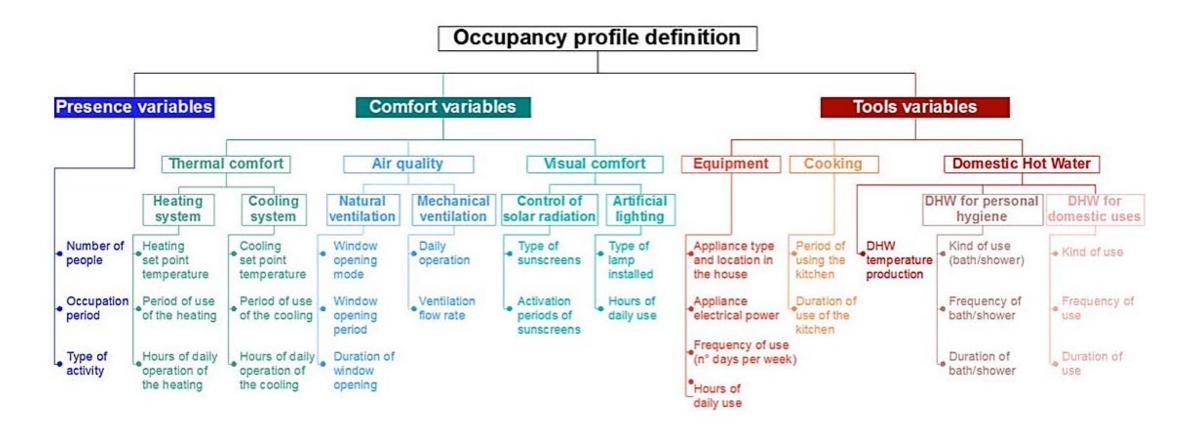
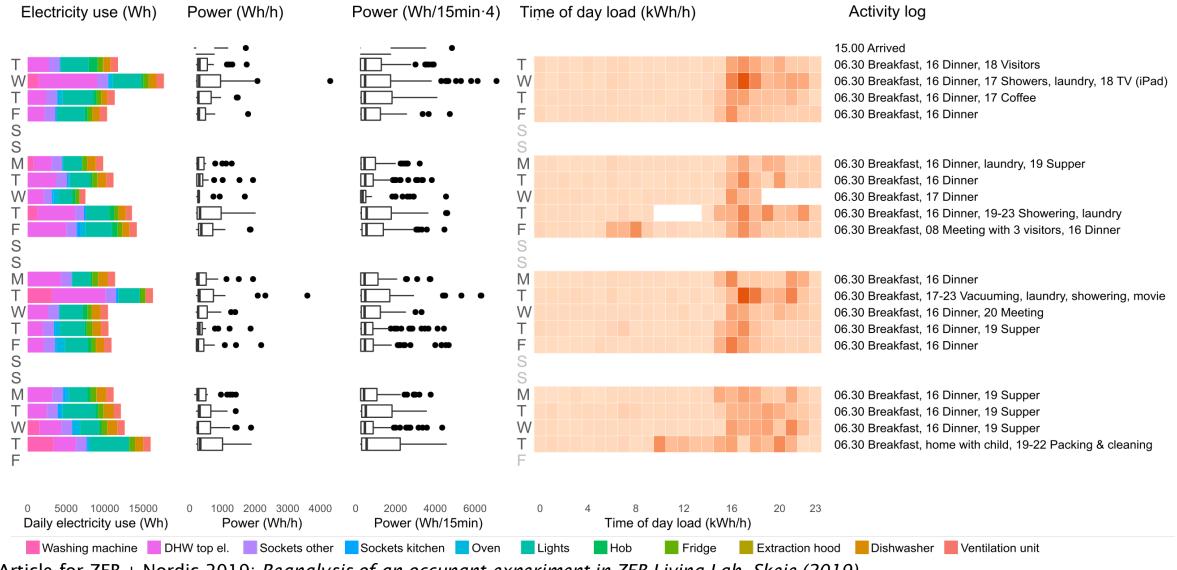


Illustration: IEA EBC Annex 66 "Definition and Simulation of Occupant Behavior in Buildings"

During their stays The participants kept daily log-books

Group	Description				
S1 Students	Male and female couple, 22 years old. Live in a 52 m ² student apartment				
S2 Students	Two female friends, 20 and 21 years old. Live in a shared apartment together with three other girls, built 1905				
F1 Family	Mother 31 years old and father 36. Son 6 years old and daughter 2. Live in a row house of 185m ² , built 2007				
F2 Family	Mother 31 years old and father 37. Two daughters of 3 and 2 years old. Live in a detached house of 135 m ²				
E1 Elderly	Husband 81 and wife 68. Live in a detached house of 170 m ²				
E2 Elderly	Husband 61 and wife 56. Live in a detached house of 120 m ²				

Family 1 electricity use



Article for ZEB + Nordic 2019: Reanalysis of an occupant experiment in ZEB Living Lab, Skeie (2019)

Electricity use (Wh) Power (Wh/h) Power (Wh/15min·4) Time of day load (kWh/h) Activity log Μ Μ ... W W S S M Μ Т Т W W M W F M W W Т 20 23 0 10000 20000 30000 0 1000 2000 3000 4000 0 2000 4000 6000 0 12 16 Daily electricity use (Wh) Power (Wh/h) Power (Wh/15min) Time of day load (kWh/h)

Family 2 electricity use with electric car

07 Home with child, 17 Dinner, 18 Baking, 18 EV, 22 Laundry
04 Dryer completed, 05 Child awakes, 08 Breakfast
07 Breakfast, 17 Dinner, 21 EV to charge
07 Breakfast, 17 Dinner, 20 Cleaning and preparing food
07 Breakfast, 17 Dinner

06 Breakfast, 16 Dinner, 18 "Home cinema" 07 Breakfast, 16 EV charge, Laundry, 17 Dinner, 20 PC work 07 Breakfast, 17 Dinner with friends, 18 Coffee, 20 EV, laundry 20 Out for concert / Work at home #2, EV to charge 17 Dinner, 18 Coffee, 20-22 iPad entertainment

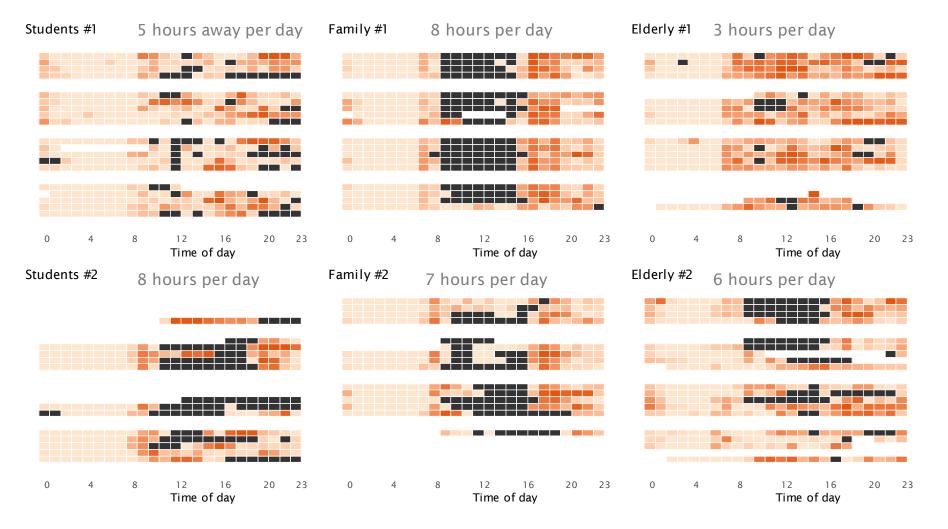
08 Breakfast, Architect guiding, 17 Dinner, 19 Laundry, 23 EV 07 Shower, breakfast, 16-18 Dinner with friends, EV to charge 07 Breakfast, 17 Dinner, 18 Guests, 23 EV to charge 08 Breakfast, 16 Dinner, 18 "Home cinema" & Work 08 Morning, 21 Return from dinner out

08 Breakfast, 09 Plumber to fix shower, 20 Shower, office, iPad 07 Breakfast, 23 Returns 07 Breakfast, 10 Cleaning, 12 Move out

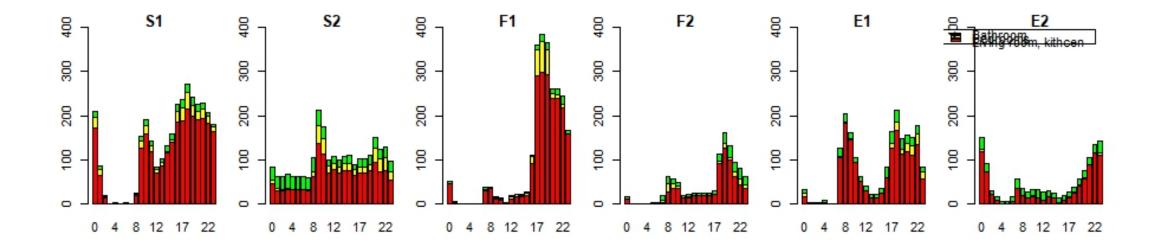
Washing machine DHW top el. Socket EV Sockets other Sockets kitchen Oven Lights Hob Fridge Karticle for ZEB + Nordic 2019: Reanalysis of an occupant experiment in ZEB Living Lab, Skeie (2019)

Extraction hood Dishwasher Ventilation unit

Electricity use on weekdays largely correlated to time spent in the kitchen (orange)



Daily lighting use



Max power draw of the various end-uses

	Maximum power load in kW (kWh per 15 min · 4 / kWh per 1 hour)						
	S1	S2	F1	F2	E1	E2	
Kitchen sockets	0.7 / 0.6	0.7 / 0.3	0.6 / 0.2	0.5 / 0.2	0.7 / 0.4	0.7 / 0.4	
Living S sockets	0.6 / 0.1	0.1 / 0.1	1.4 / 1.0	0 / 0	0.9 / 0.3	0.8 / 0.2	
Living N sockets	0.5 / 0.2	0 / 0	0.8 / 0.4	0.2 / 0.2	0.1 / 0.1	0.1 / 0.1	
Bedrooms sockets	0.1 / 0	0.1 / 0.1	0.1 / 0.1	0 / 0	0.5 / 1	0 / 0	
Bathroom sockets	0.2 / 0	0.3 / 0.1	0 / 0.1	0.2 / 0	0.7 / 0	0.2 / 0	
EV-charge socket	-	-	-	2.2 / 2.1	-	-	
Washer & dryer	2.1 / 1.2	2.0 / 0.6	2.1 / 1.4	2.1 / 0.9	1.7 / 0.6	2.1 / 1.4	
Fridge & freezer	2.0/0.9	1.8 / 0.7	0.1 / 0.1	0.1 / 0.1	0.1 / 0.1	0.1 / 0.1	
Induction hob	1.3 / 0.6	1.6 / 1.0	1.7 / 0.6	1.0 / 0.4	2.4 / 1.1	1.7 / 0.9	
Oven	0 / 0	0 / 0	1.8 / 0.8	1.7 / 0.8	2.2 / 1.1	1.7 / 0.7	
Dishwasher	1.7 / 0.8	1.6 / 0.6	2.1 / 1.1	1.7 / 0.6	2.1 / 0.6	1.9 / 0.7	
Extraction hood	0.1 / 0.1	0.1 / 0	0.1 / 0.1	0.1 / 0	0.1 / 0	0.1 / 0.1	
Indoor lighting	0.8 / 0.8	0.8 / 0.7	0.8 / 0.8	0.7 / 0.7	0.5 / 0.4	0.5 / 0.5	

Maximum registered power (kW) per 15 minutes and per hour on weekdays.

Recap



Excluding space heating from the analysis, the most energy consuming activities are related to showering, cooking and EV-charging.

Kitchen presence and building vacancy were found to correlate with electricity use, time spent at home and the meals cooked there, both varying on a day to day basis.

Occupancy profiles matter

planning and operation of ZEB buildings to optimize self-consumption, or energy storage solutions

Next: Dataset for occupancy detection and modelling