Reanalysis of an occupant experiment

in the ZEB Living Lab

Kristian Skeie
Stipendiat FME ZEN
NTNU

Trondheim
torsdag 7. november 2019

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.

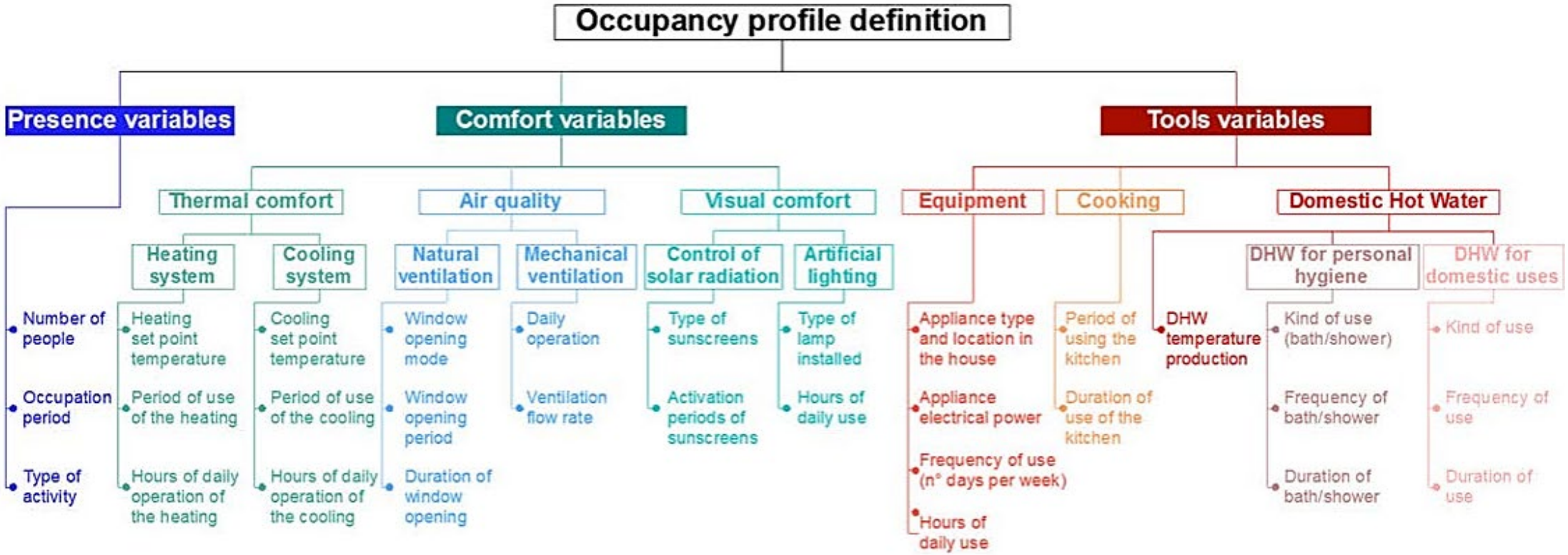


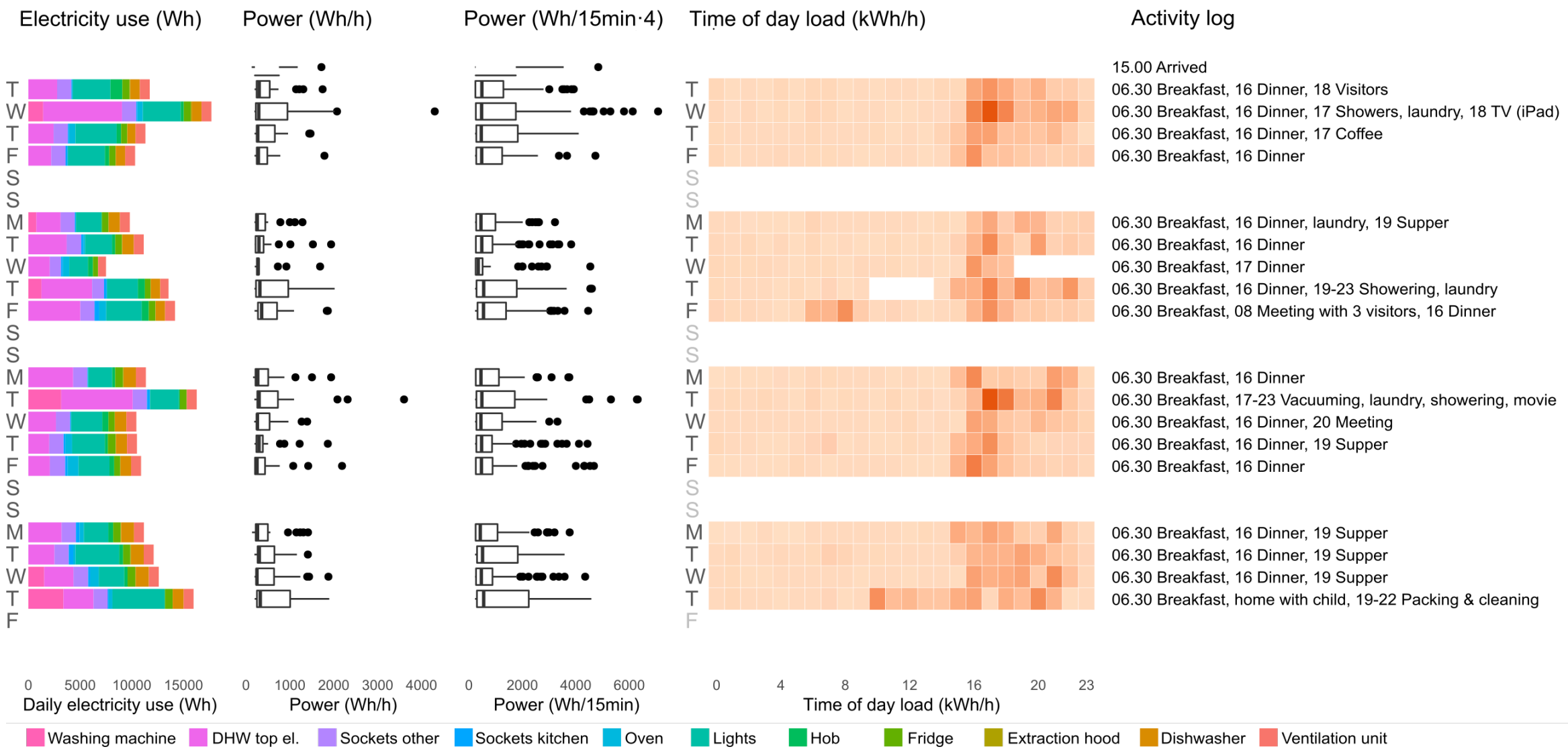
Illustration: IEA EBC Annex 66 “Definition and Simulation of Occupant Behavior in Buildings”

During their stays

The participants kept daily log-books

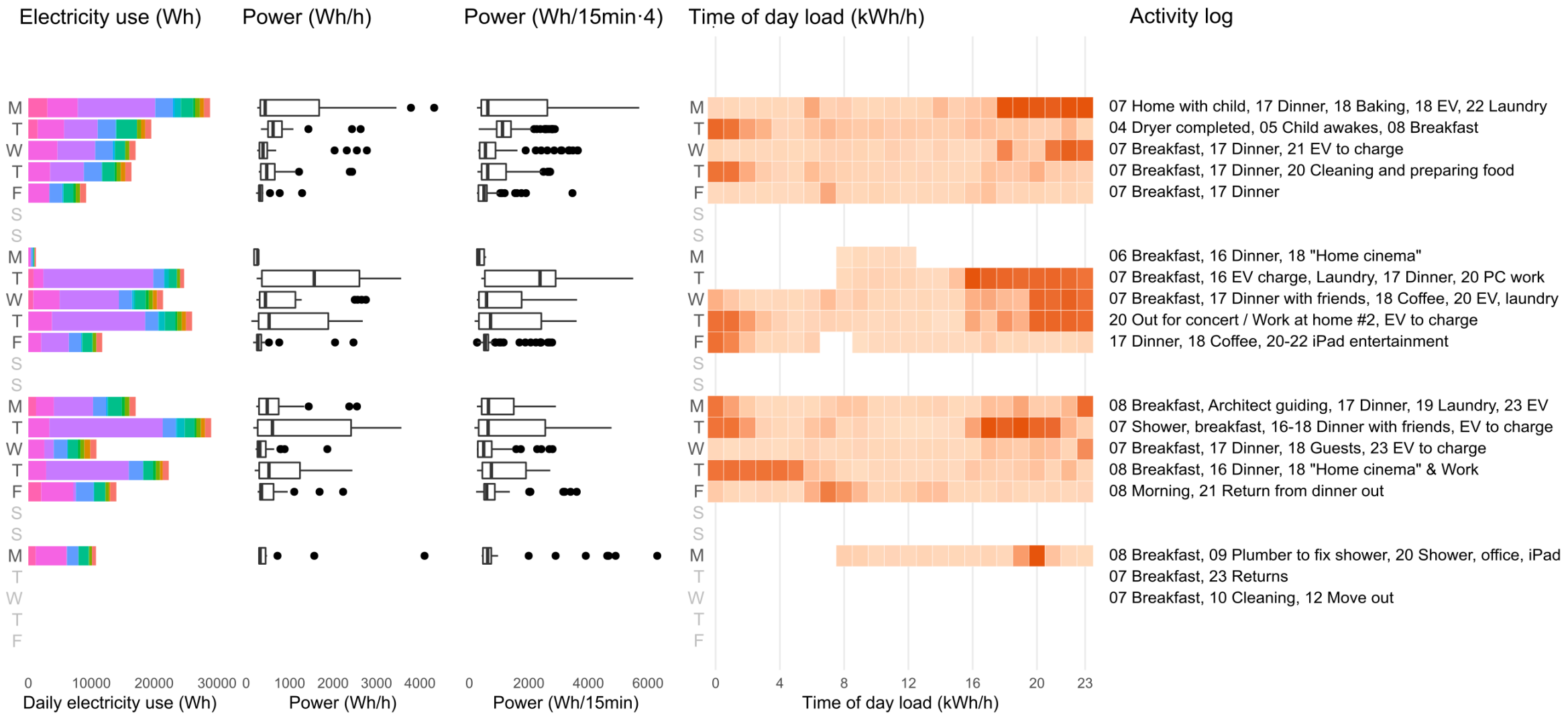
Group	Description
S1 Students	Male and female couple, 22 years old. Live in a 52 m^2 student apartment
S2 Students	Two female friends, 20 and 21 years old. Live in a shared apartment together with three other girls, built 1905
F1 Family	Mother 31 years old and father 36. Son 6 years old and daughter 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)*

Family 2 electricity use with electric car

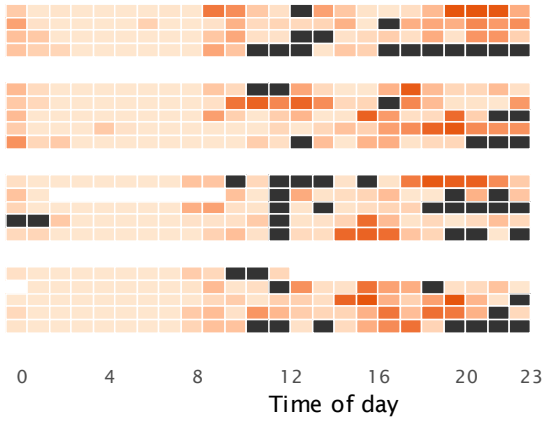


Article for ZEB + Nordic 2019: *Reanalysis of an occupant experiment in ZEB Living Lab, Skeie (2019)*

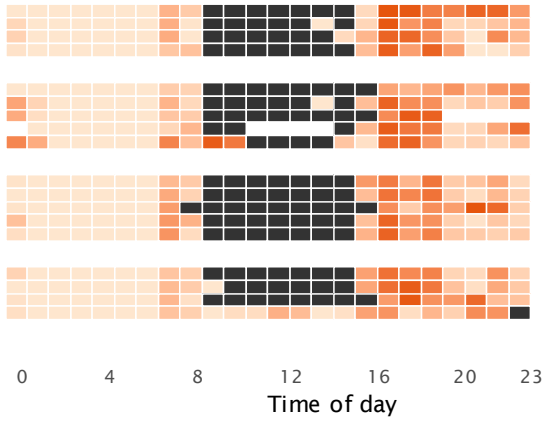
Electricity use on weekdays largely correlated to

time spent in the kitchen (orange)

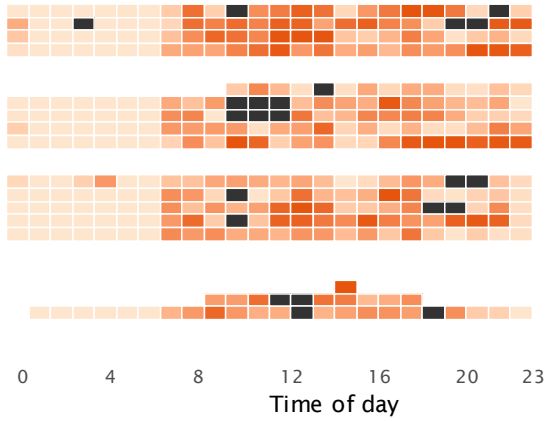
Students #1 — 5 hours away per day



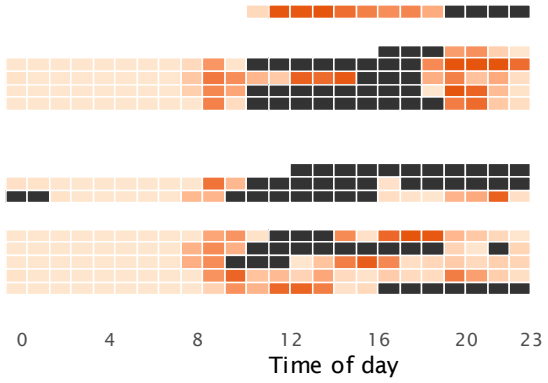
Family #1 — 8 hours per day



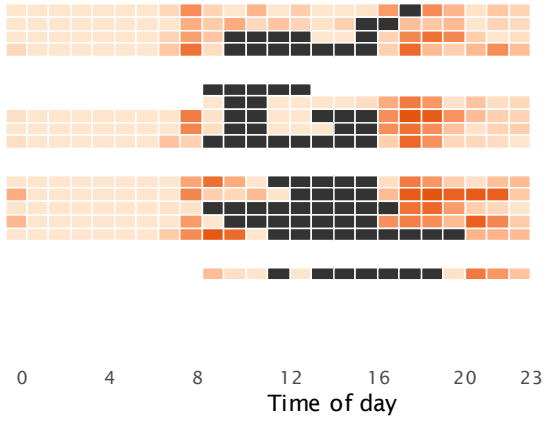
Elderly #1 — 3 hours per day



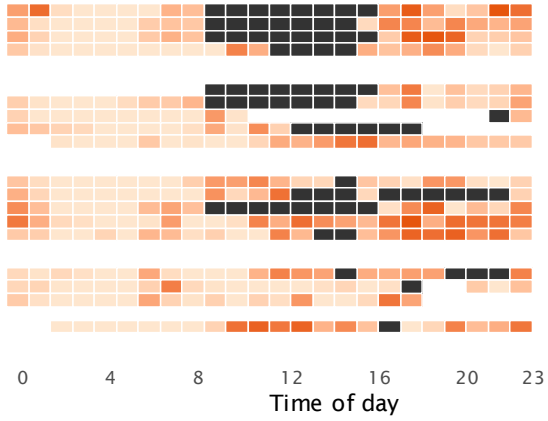
Students #2 — 8 hours per day



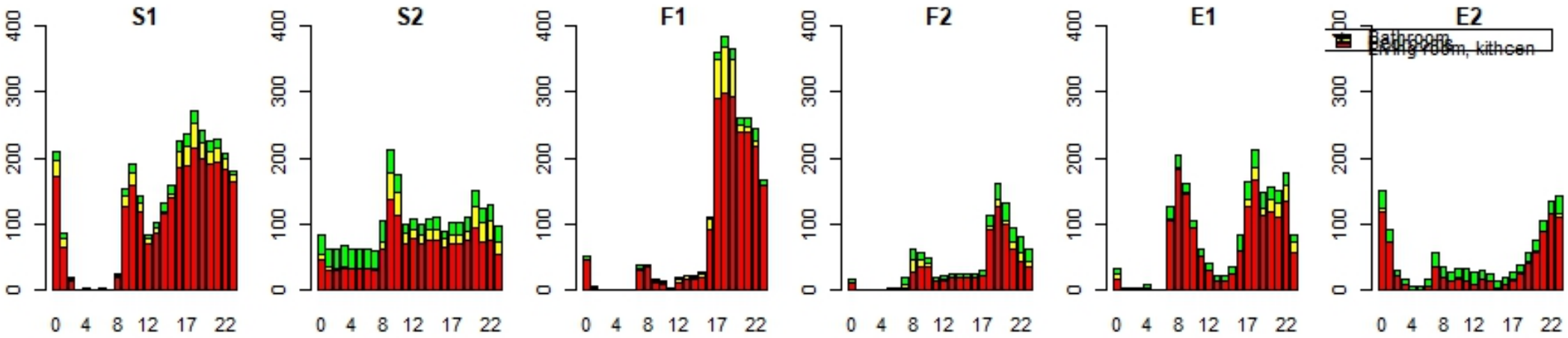
Family #2 — 7 hours per day



Elderly #2 — 6 hours per day



Daily lighting use



Max power draw of the various end-uses

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

	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

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