Explorations on motivating microgrid-users to optimize self-sufficiency

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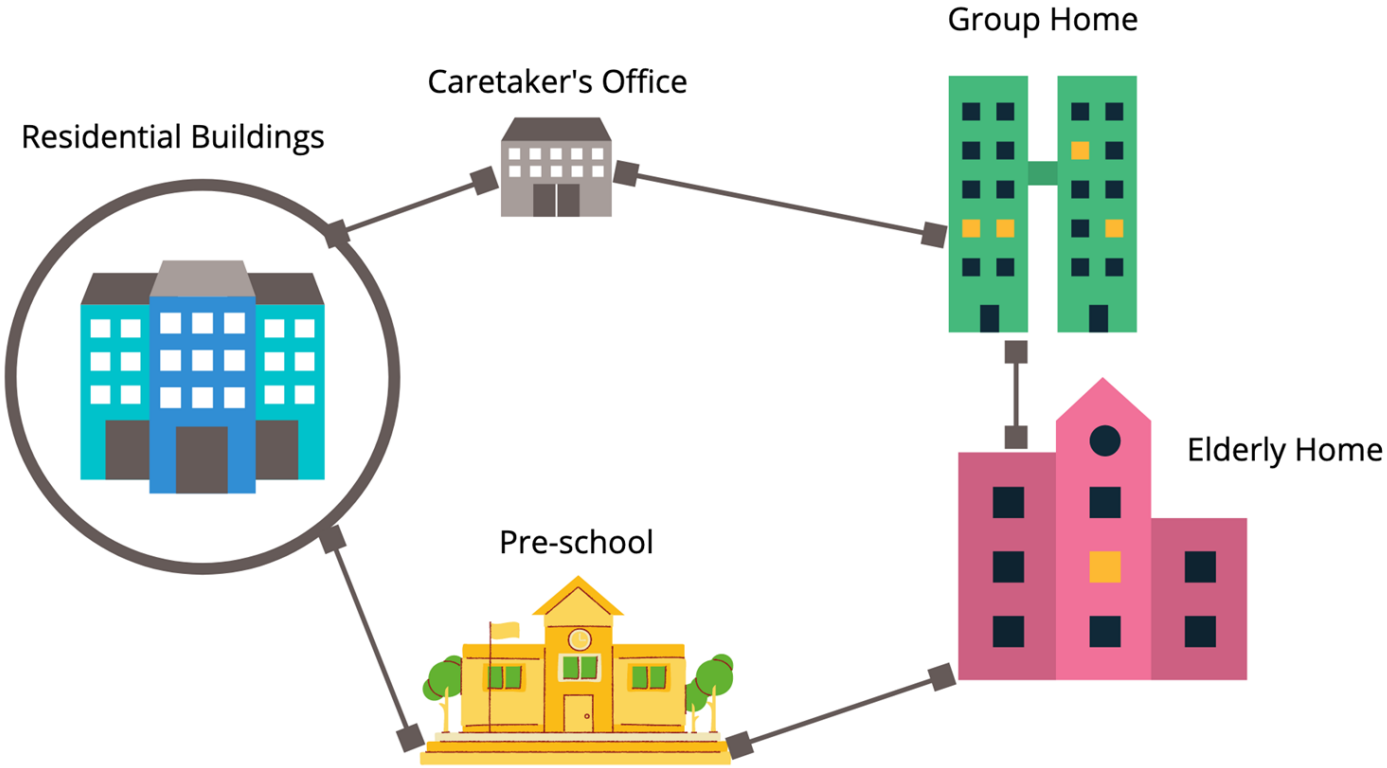
Energy communities for collective self-consumption: frameworks, practices and tools
Session 7 – September 8, 2020
From toll development/spreading to living projects

Case


Group Home
Caretaker's Office
Residential Buildings
Elderly Home
Pre-school

Research goals

The research agenda was to explore

1) the power-flow of the microgrid
2) users' understanding of and sentiments towards it

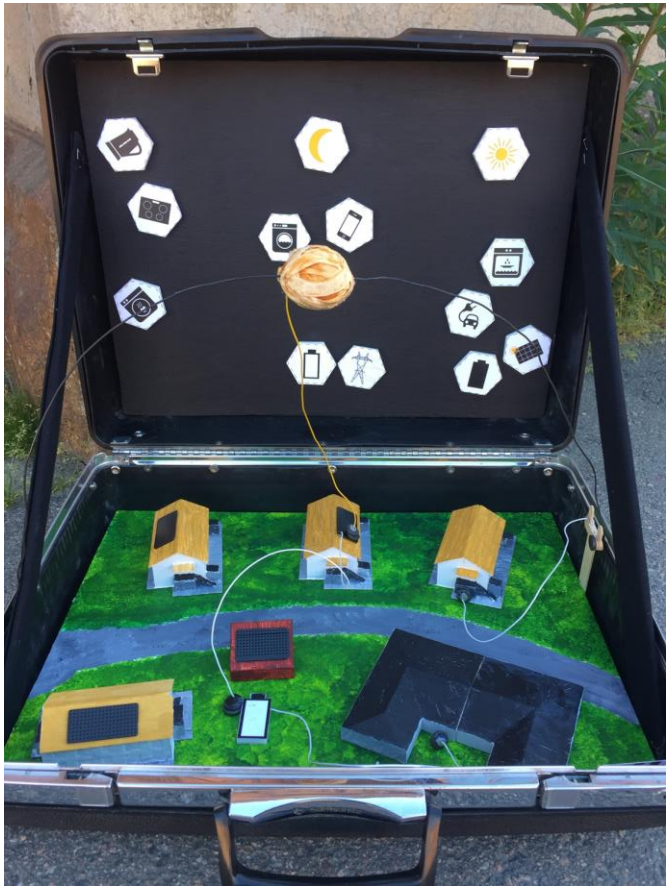
in order to develop a proposal for fostering user engagement and encourage self-consumption

Process

- Exploratory
    - Quantitative analysis - understanding the microgrid’s power flows
    - Qualitative analysis - understanding the users through design interventions
- Proposal:
    - Price Model
    - Communication Platform

The Microgrid Toolbox

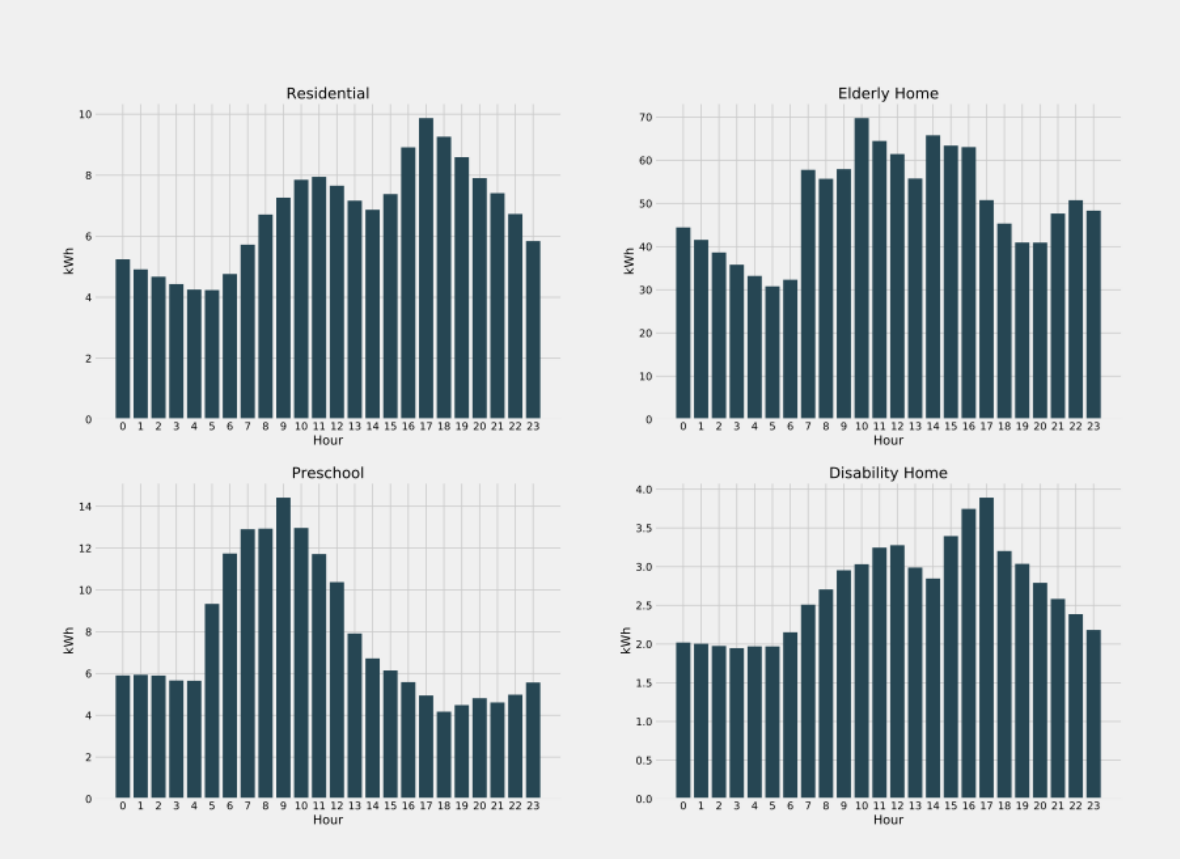
- To explore what the users thought of the microgrid and how they interacted with it
- To probe dialogue around energy flows, flexibility, sharing PV electricity & identity aspects



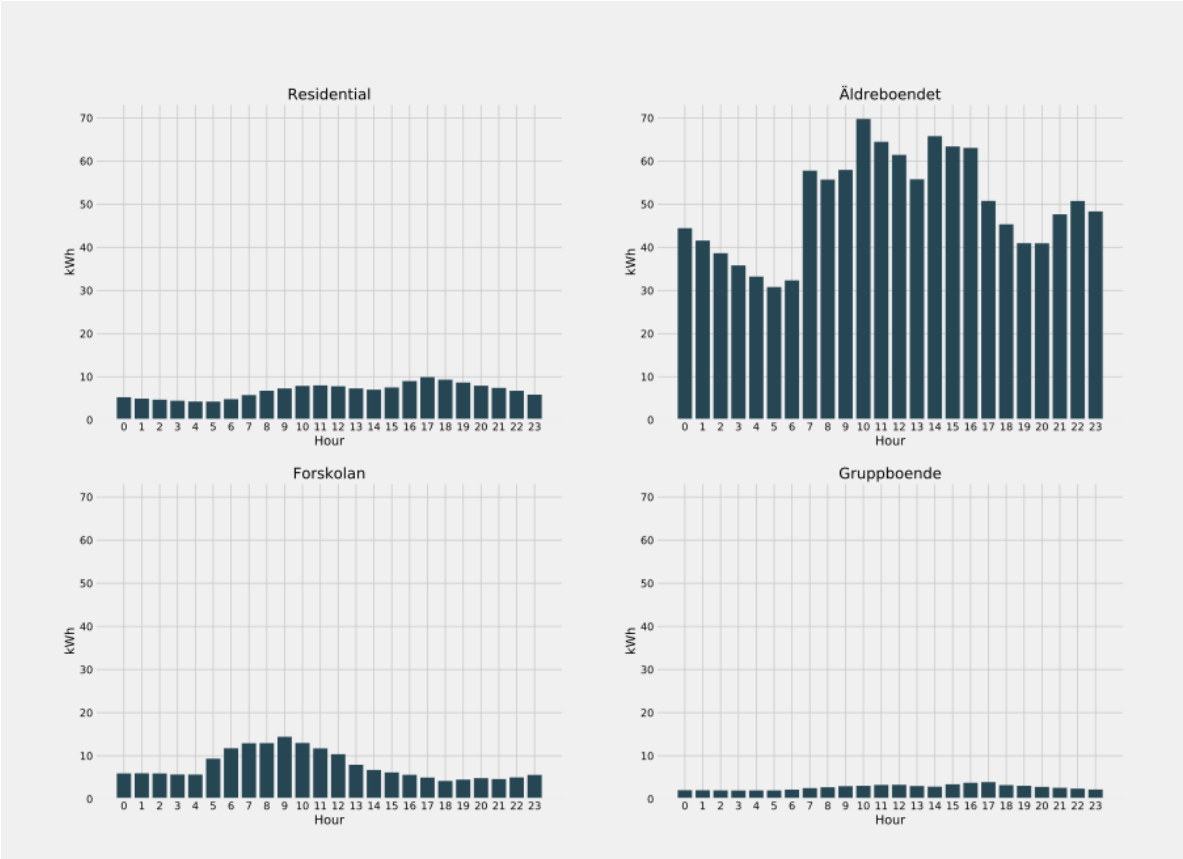
The Board Game

Results

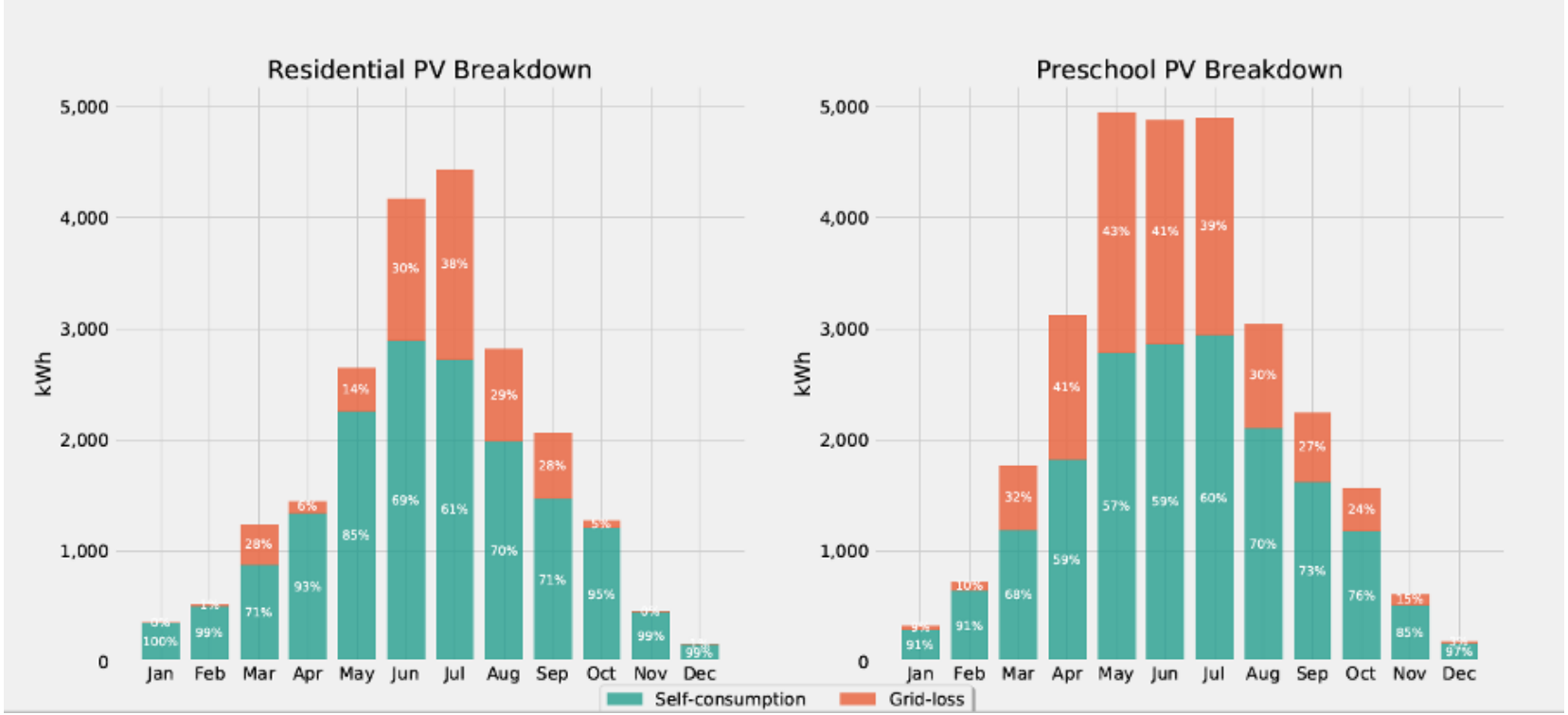
Power-Flow Analysis



Scaled


Residential
Äldreboendet
Forskolan
Gruppboende
kWh
Hour
0 10 20 30 40 50 60 70
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

Power-Flow Analysis



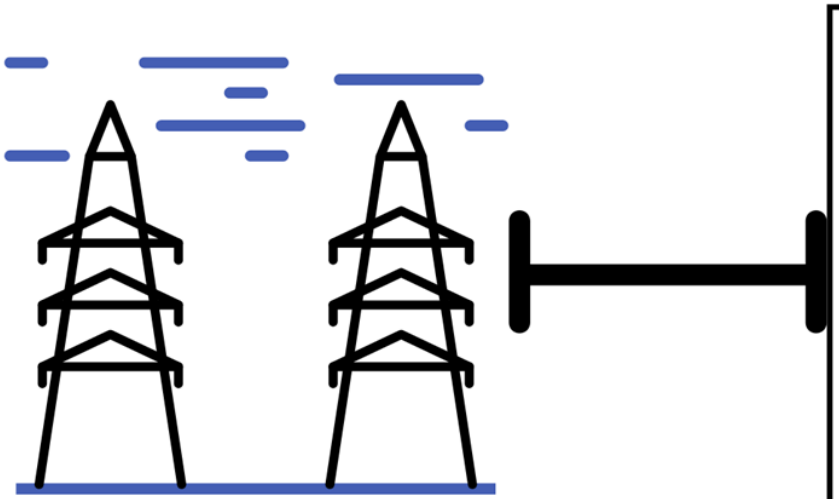
Qualitative Findings

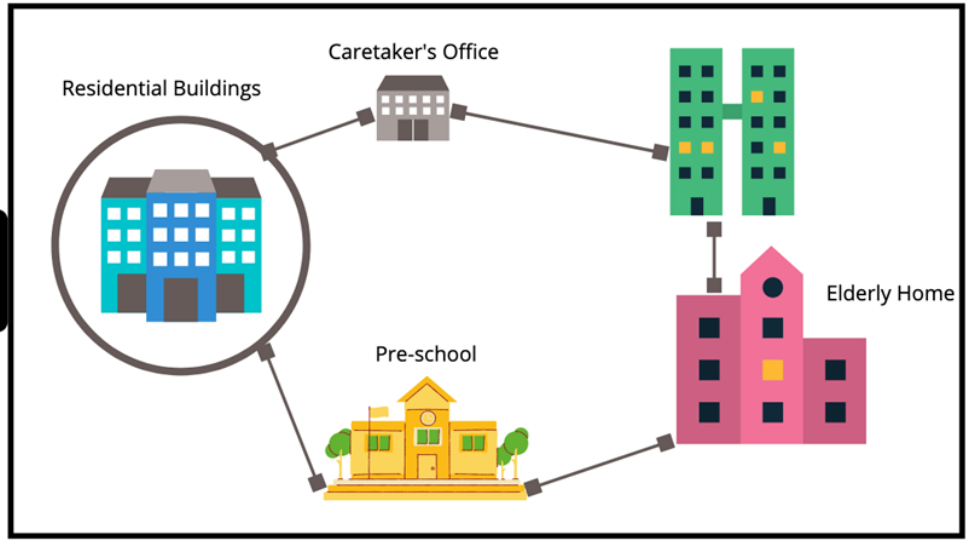
- Awareness contrast
  - Passive buildings
  - Solar panels
  - Battery
  - Microgrid
- Energy use & energy pattern
  - Peak load
  - Energy use needs to be flexible
  - Who would be interested?
- Energy feedback
  - Lack of bills
  - Environmental
  - Sense of community

"That this is a passive building and that you're not supposed to open windows in order to save energy, everybody knows that. But that there would be a connection to [buildings] next door here, I'm not sure actually. And storage possibilities, whatever that means and so on, I don't think is something people know" (Preschool)

"I think this challenge that you said, that is not unsolvable technically... But it is just like you say, if it's anything that is difficult to implement then it's how people [behave].. I mean we eat lunch at 12 and we eat dinner at 5- 6 so it might be difficult to shift those routines, then one probably does not think it is that interesting anymore to live and pay rent to [the housing company] if you have to eat lunch at 2." (Caretaker 2)

Price Model

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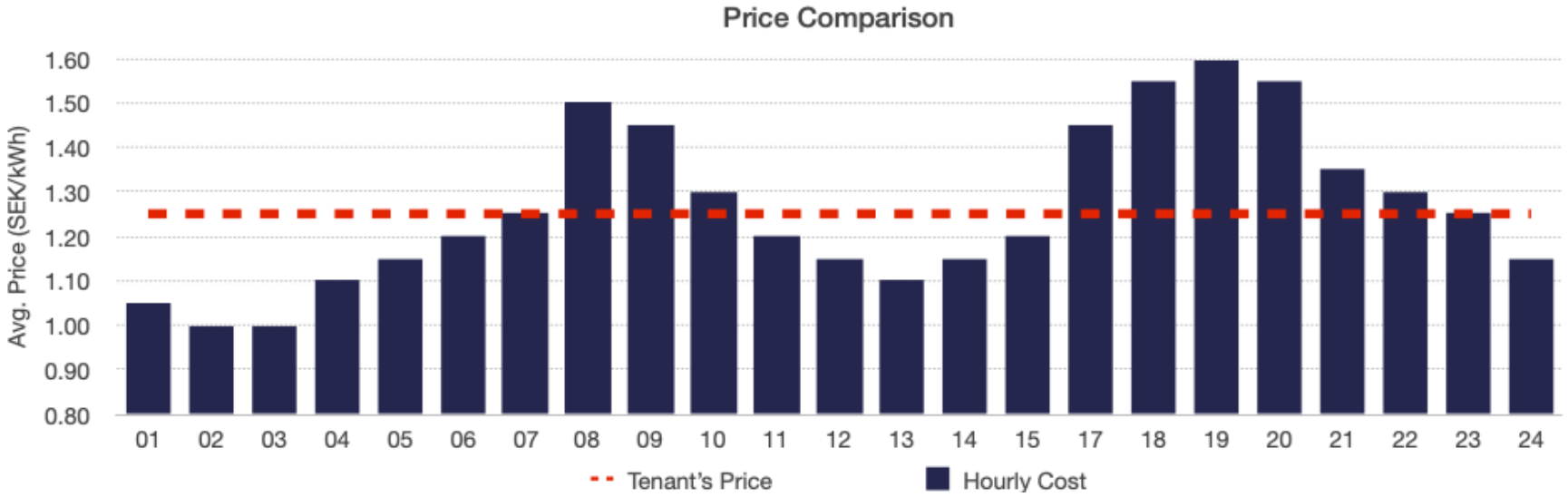
Price Model


Price Comparison
Avg. Price (SEK/kWh)
1.60
1.50
1.40
1.30
1.20
1.10
1.00
0.90
0.80
01
02
03
04
05
06
07
08
09
10
11
12
13
14
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17
18
19
20
21
22
23
24
Tenant's Price
Hourly Cost

Real-time-pricing (RTP)

$$C_h = R_h \cdot C_f \cdot E_h \quad (1)$$

C_h : Hourly cost incurred by given tenant

R_h : Hourly rate paid by housing agency to the electricity providers

C_f : Consumption factor, the proportion of electricity imported from the grid. Solar electricity is free.

E_h : The energy used by the given tenant for the designated hour.

Critical Pricing

$$S_h = 0 \quad (2)$$

$$N_h = R_h \cdot m \cdot E_h \quad (3)$$

S_h : Cost of “solar hours”

N_h : Cost of “non-solar hours”

R_h : Hourly rate paid by housing agency to the electricity providers

m : margin applied to ensure revenue neutrality

E_h : The energy used by the given tenant for the designated hour.

Communication Platform

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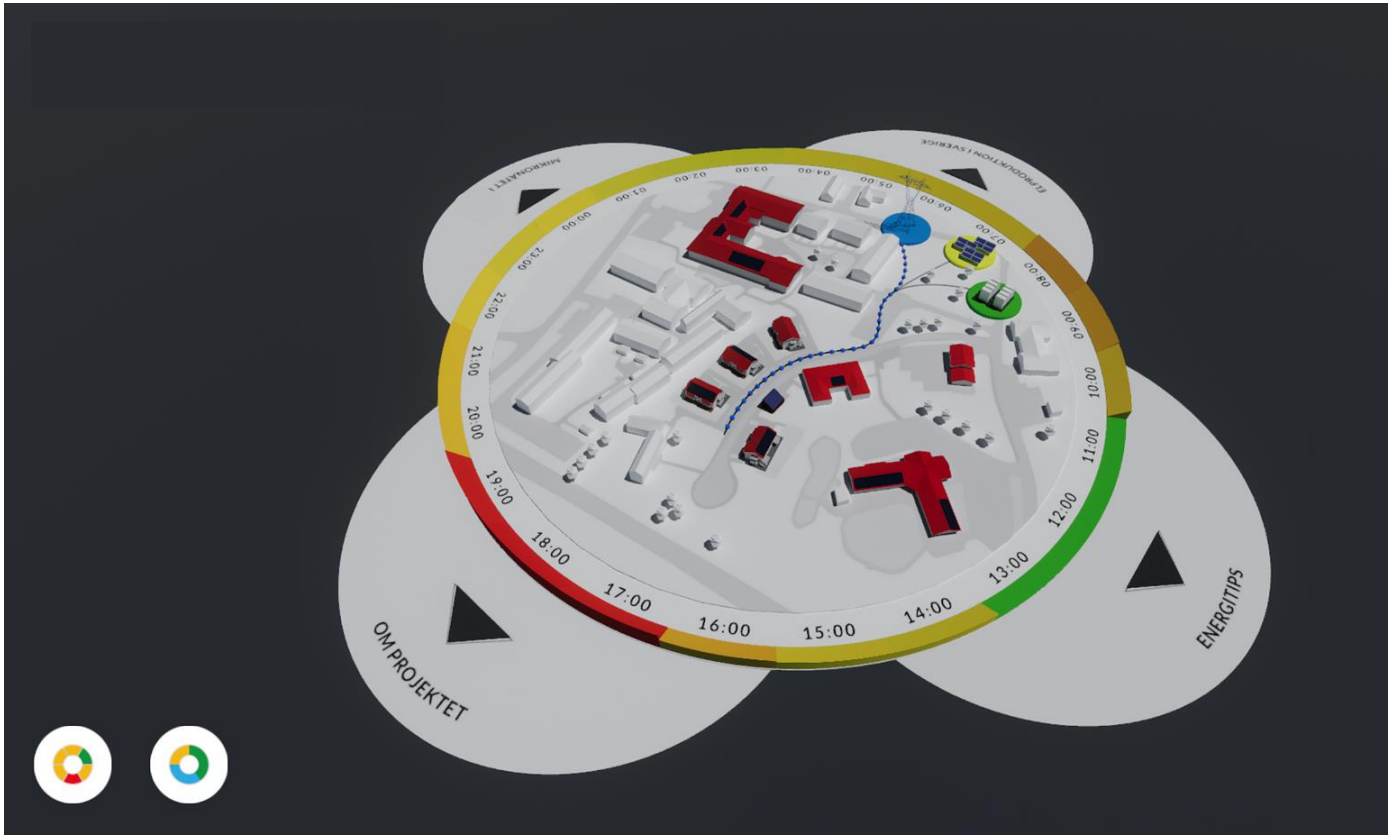

Conclusions

- Impedance of price signals
- Trade-offs between cost reflection and microgrid goals
- Reflectively understanding the system through design interventions
- Communicating to (different) users

Thank you!