

Autonomy, Competence and Relatedness

Engaging building occupants in energy transition

Natalia Romero Herrera

Associate professor @Human-Centered Design department

Industrial Design Engineering

TU Delft

Energy Snack: Natalia Romero Herrera

Design Data Interactions for Self Management

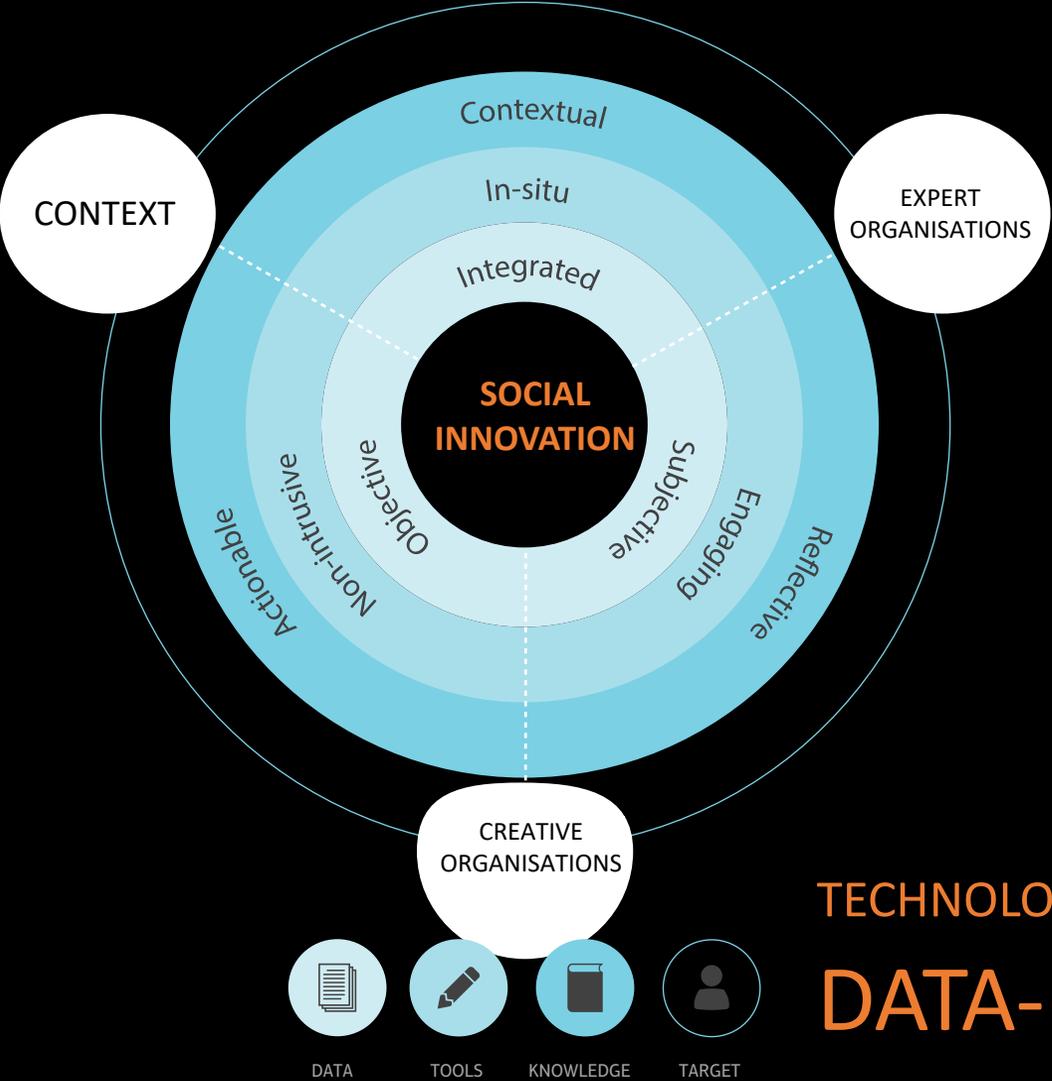


"Energy efficient solutions require long-term investment but can be disruptive to existing buildings. Through my design research I explore how data-interactions enable buildings to develop low-cost energy practices fit for context and needs."

CONNECTING & CONTEXTUALISING

PEOPLE'S
PRACTICES &
VALUES

HEALTH & ENERGY
BEHAVIOURAL
DISCIPLINES



TECHNOLOGIES
DATA-ENABLED

ENERGY PORTFOLIO



SusLab (INTERREG NWE) – social housing renters
2012-2014



BOCS (CLIMA-KIC) – office buildings employers and employees
2015-2017

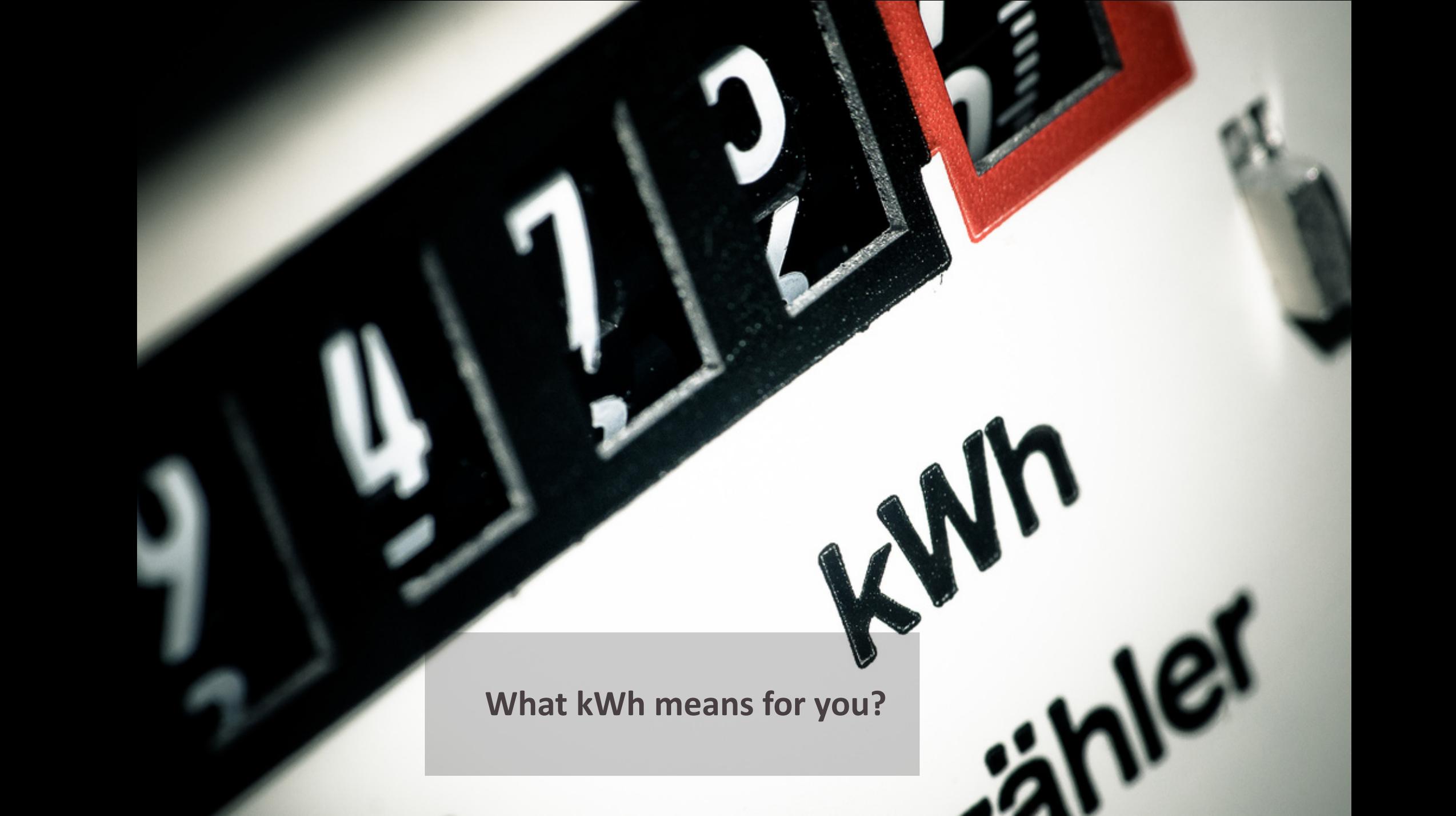
ENERGE (INTERREG NWE) – secondary school building students,
teachers and staff

2019-2023

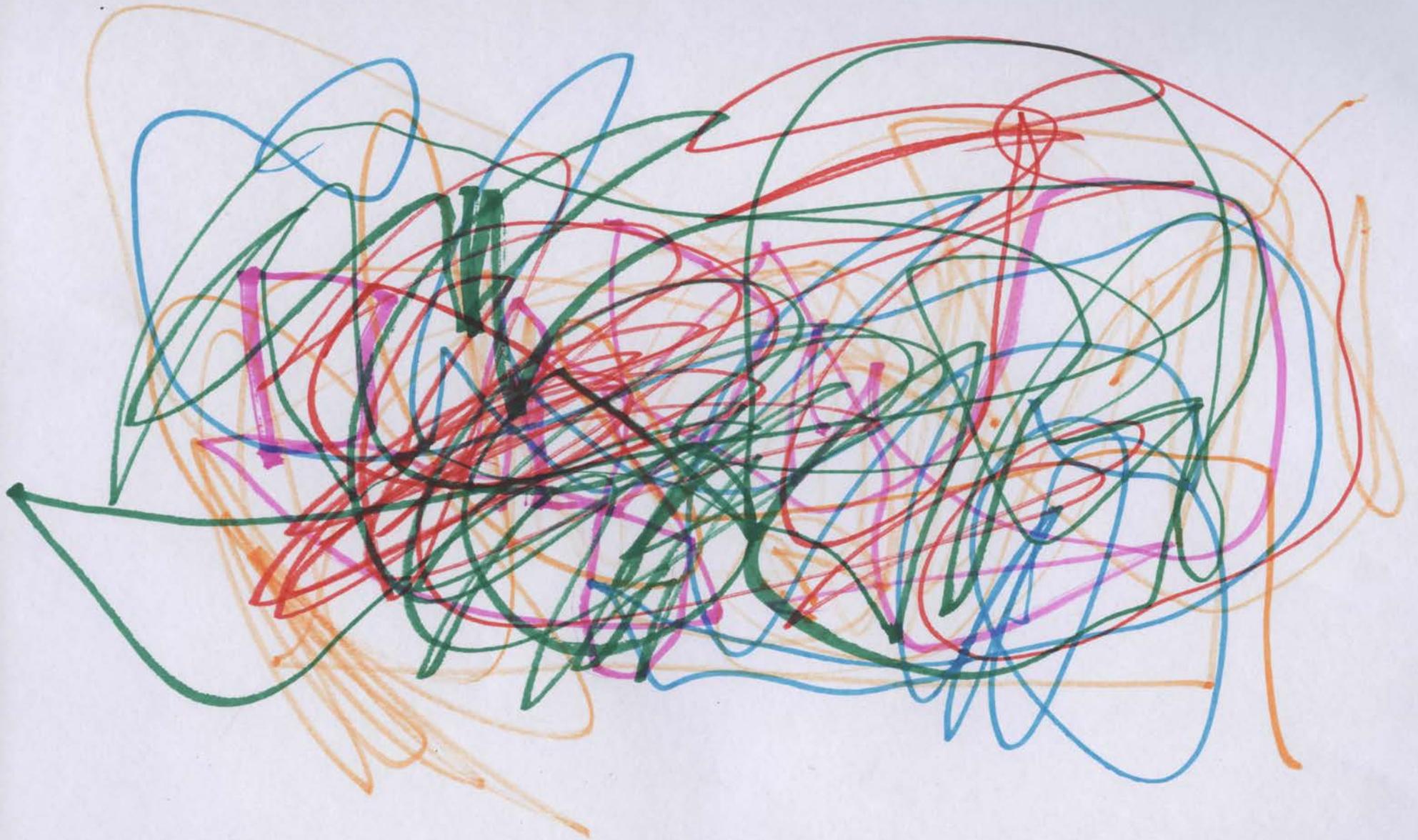


LECTURE OBJECTIVES

- Transition to energy management for building occupants
- Transition to energy learning communities for building occupants

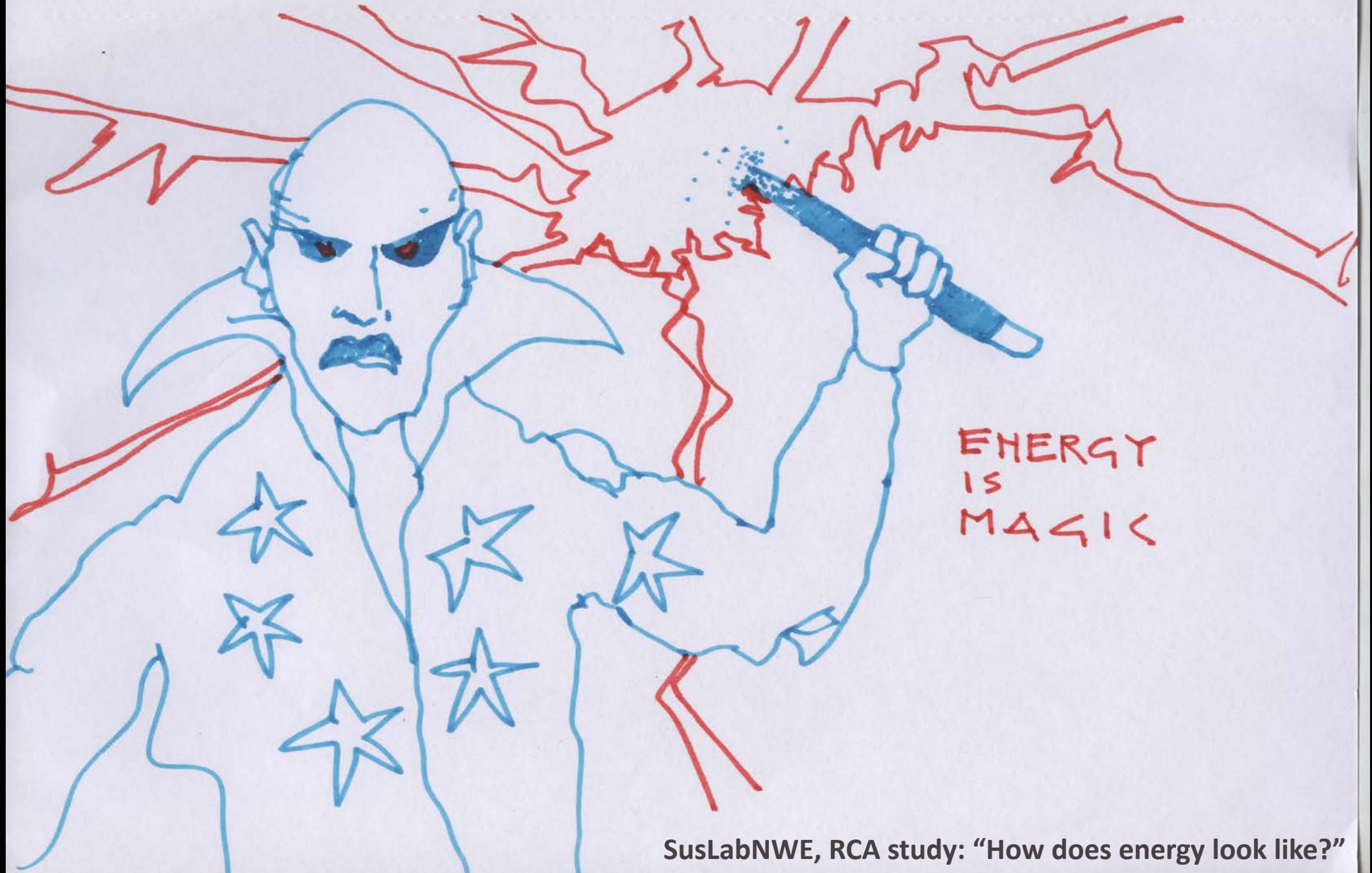


What kWh means for you?



SusLabNWE, RCA study: "How does energy look like?"

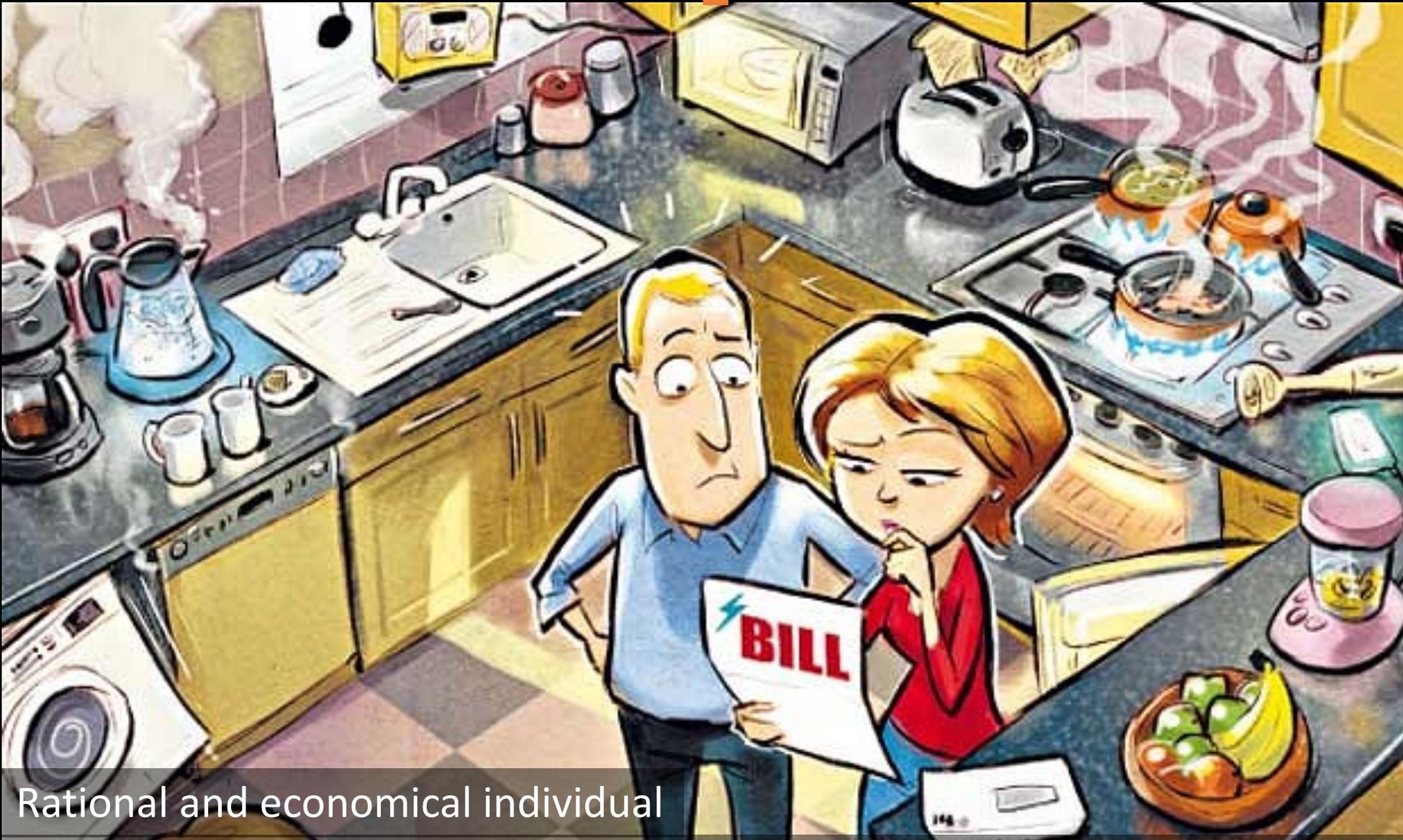




ENERGY
IS
MAGIC

SusLabNWE, RCA study: "How does energy look like?"

Behavioural Gap (Strengers and Mallers, 2014)



Rational and economical individual

Photo: Howard McWilliam, *The Telegraph* 16th October 2014 – “Bills soar by up to £193: how to beat the rise”

People as interveners



Social practices versus individuals

Photo: Howard McWilliam, *The Telegraph* 2nd January 2013 – “Winter energy bills ‘will reach £530 a quarter’”

Flow management (Pink and Mackley, 2014)



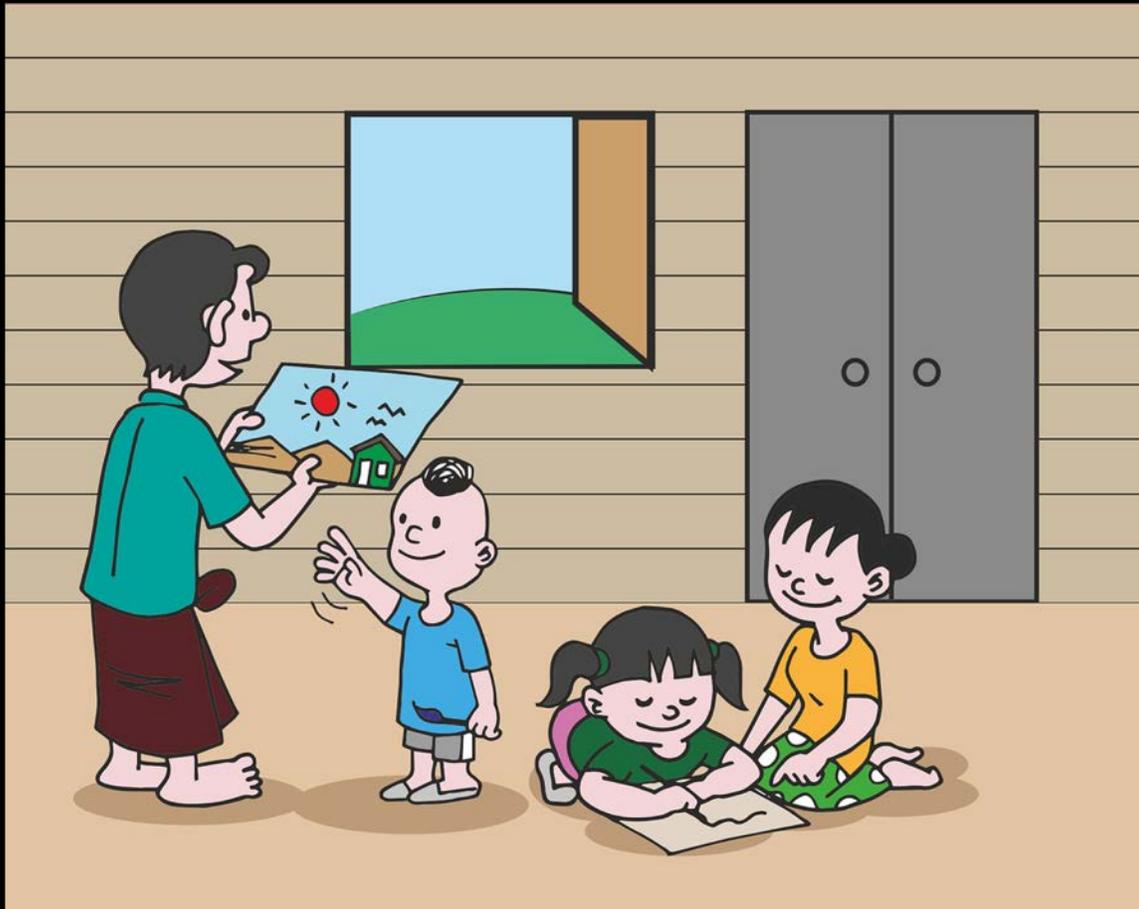
Make and remake our homes to make it 'feel right'

Photos: Pixabay

Interveners of flows (Hargreaves 2011)

ACTIVE

Make everybody feel right
Financial impact



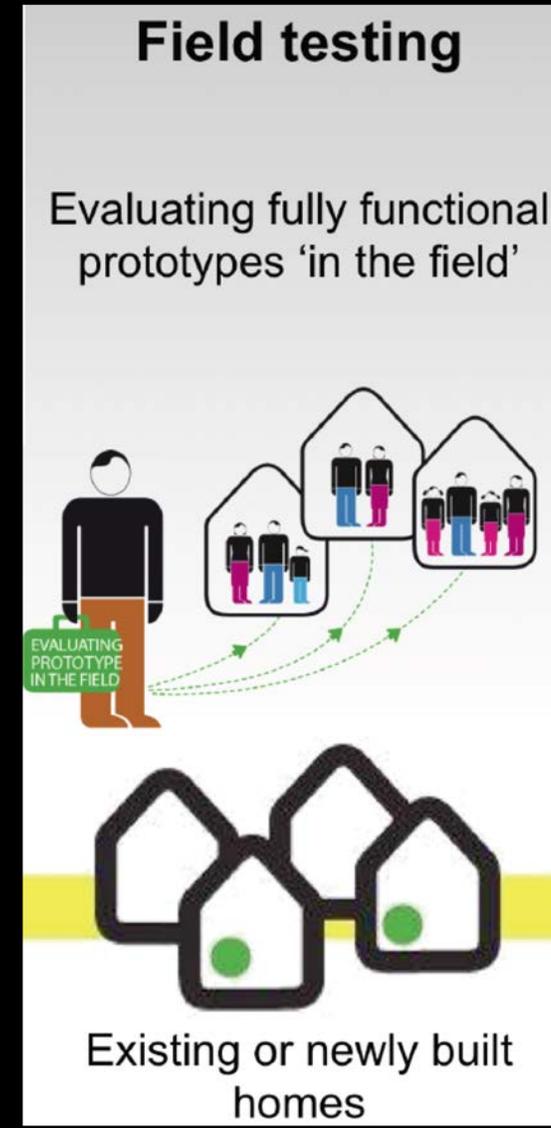
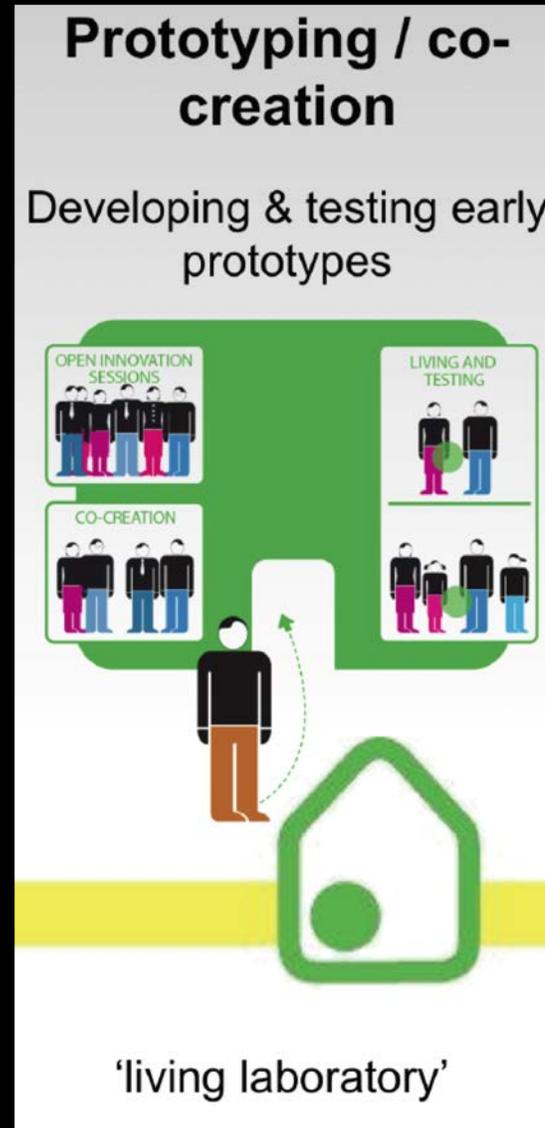
Photos: Pixabay



PASSIVE

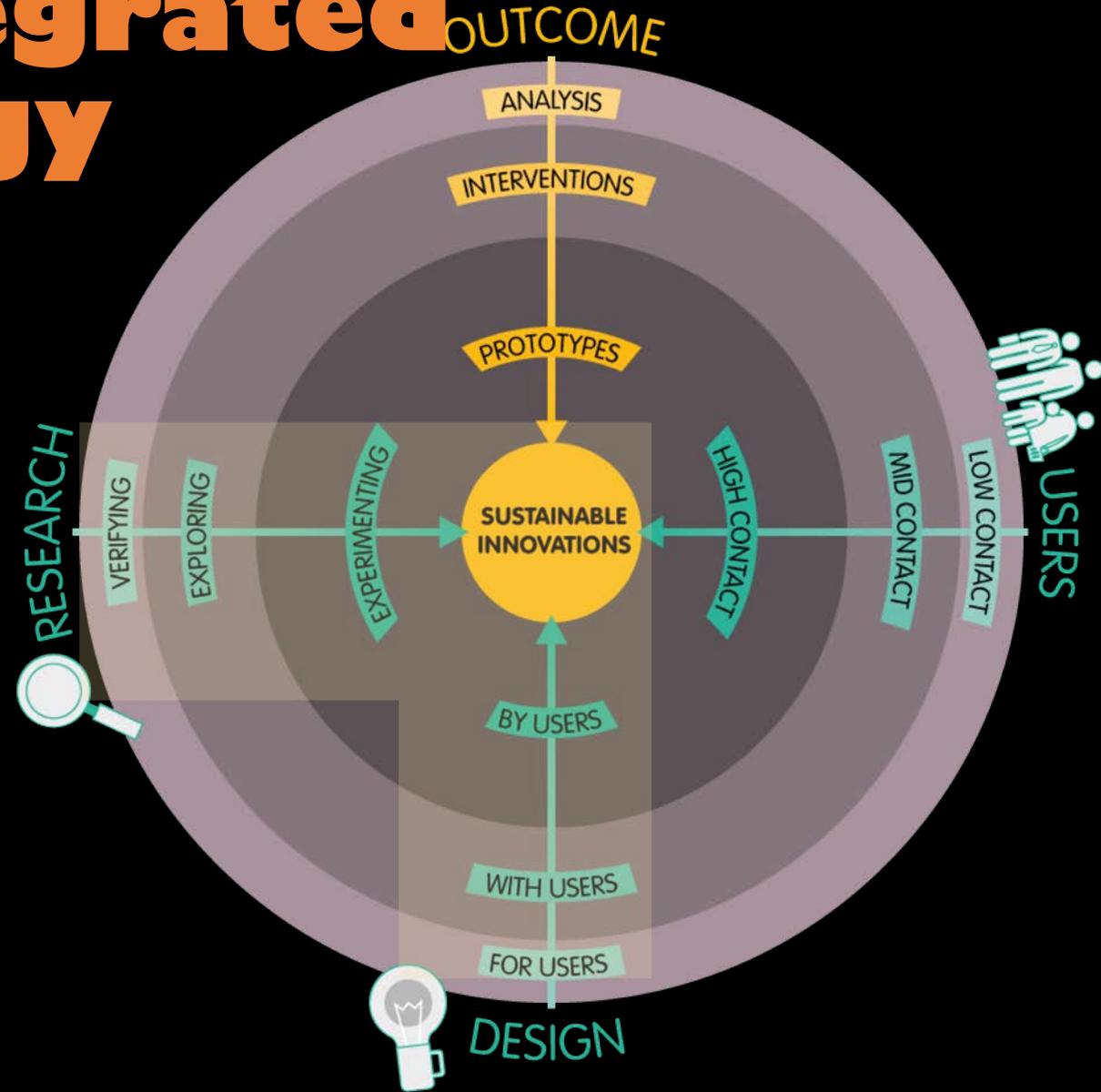
Be productive
No financial concern

Living Labs (Liedtke et al. 2012)



SusLab integrated methodology

Romero Herrera (2016a,b)

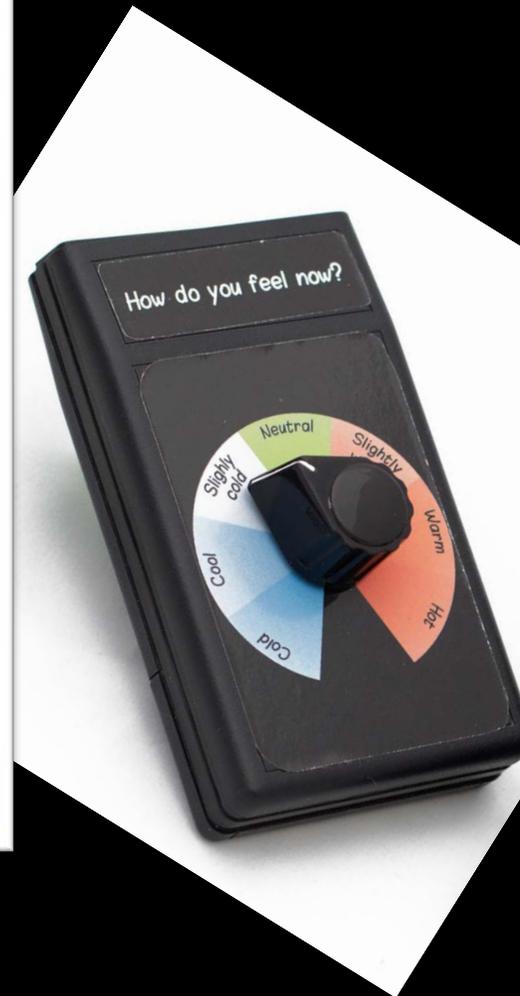
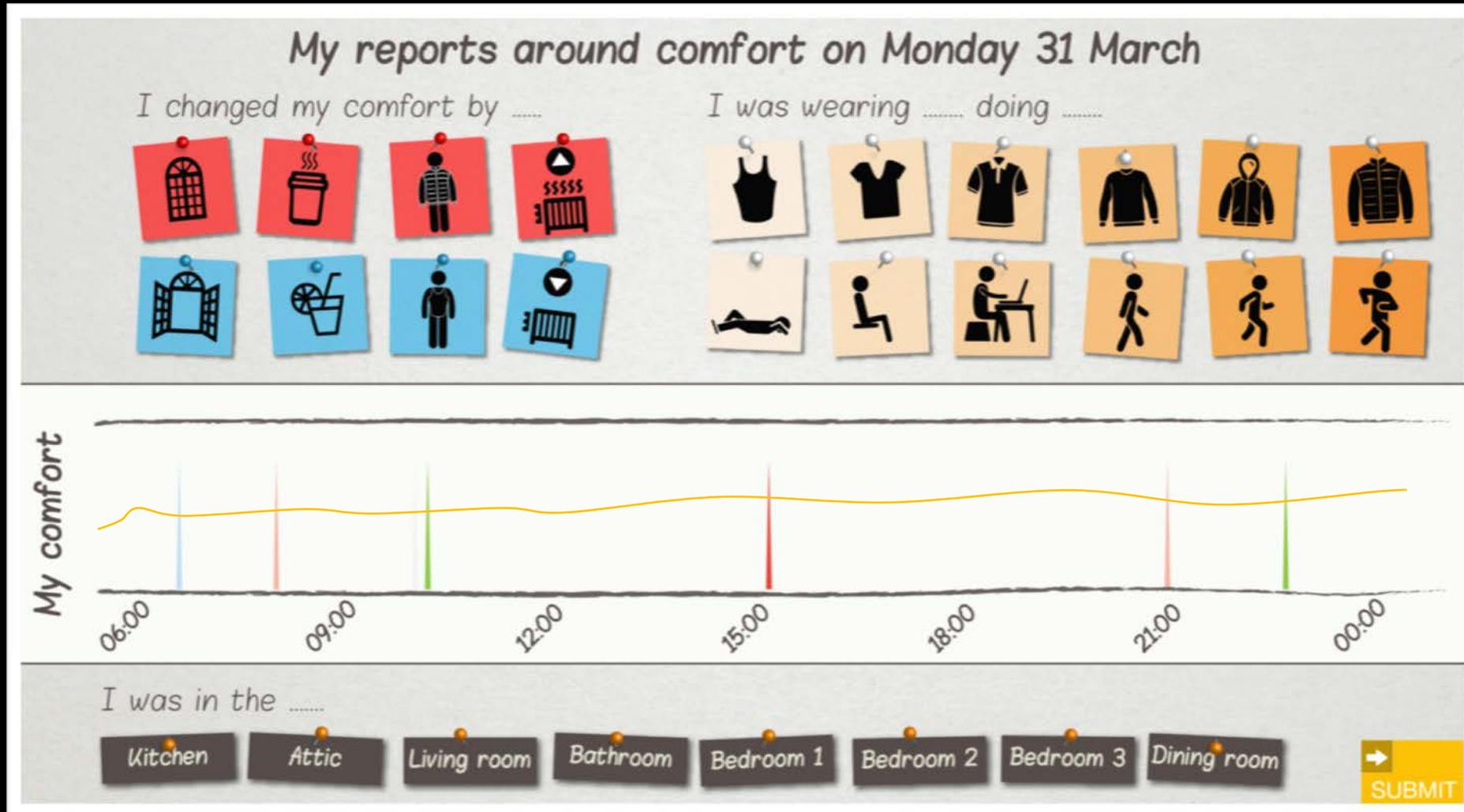


SusLab intended impact

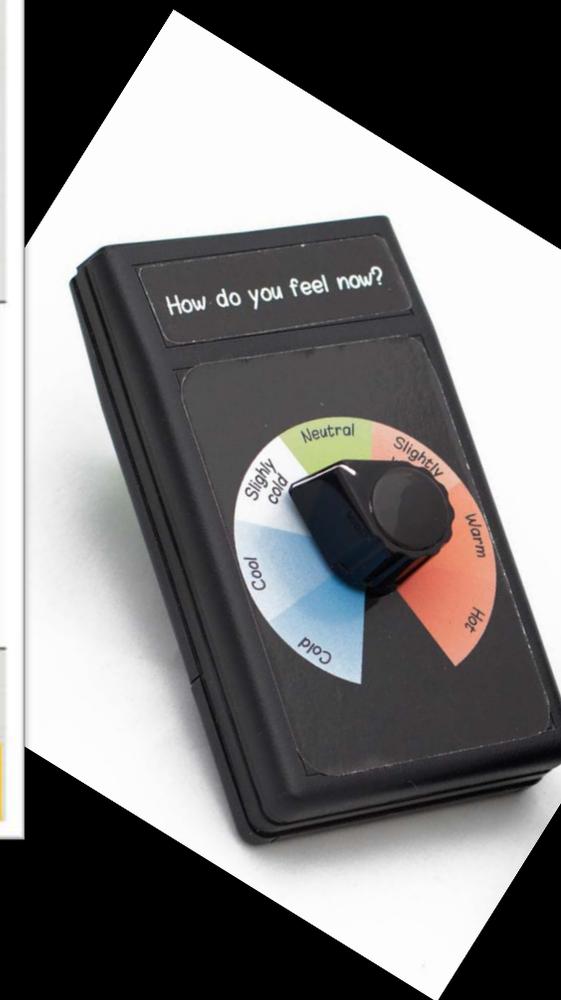
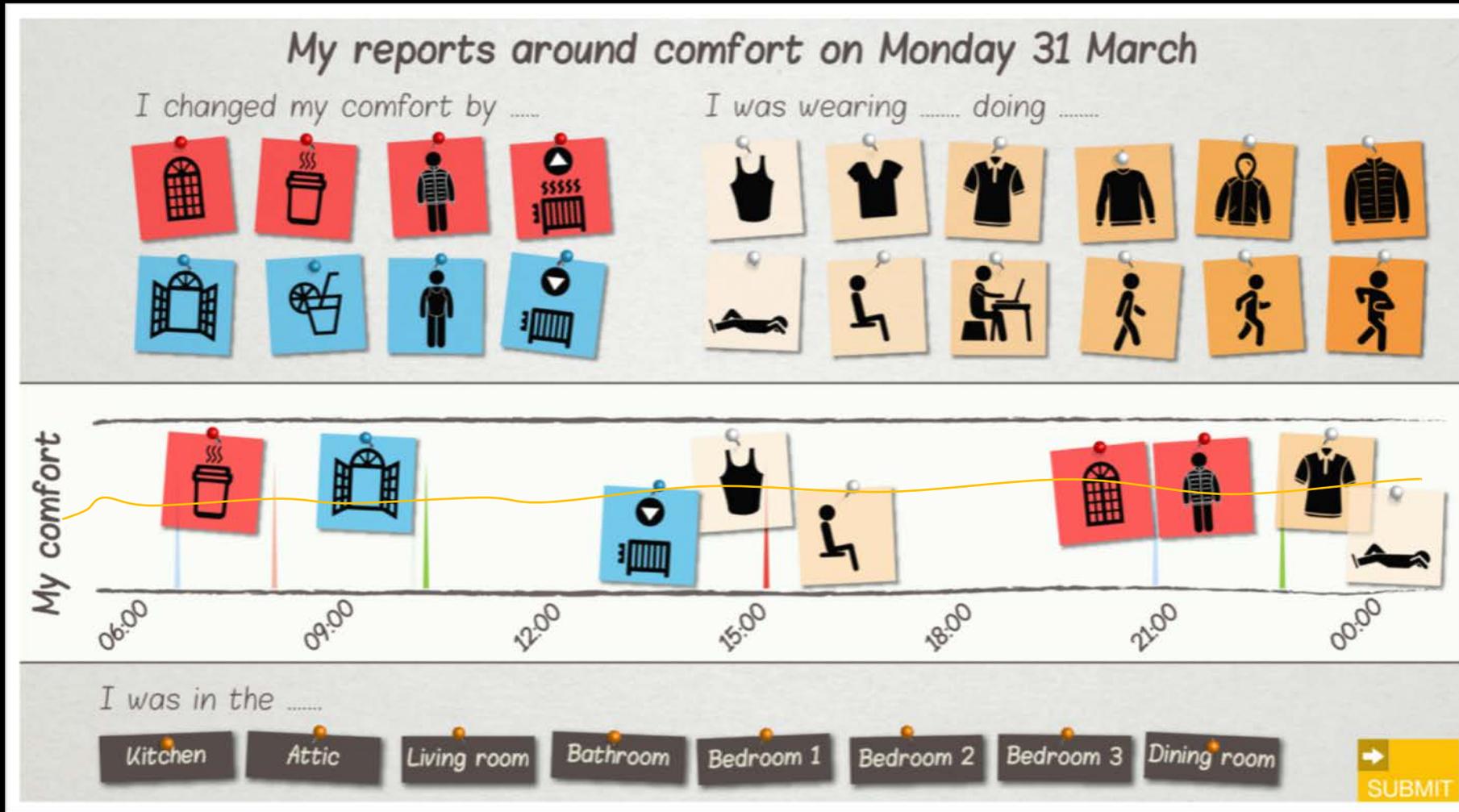
Competence of people to sense and learn about existing practices and comfort

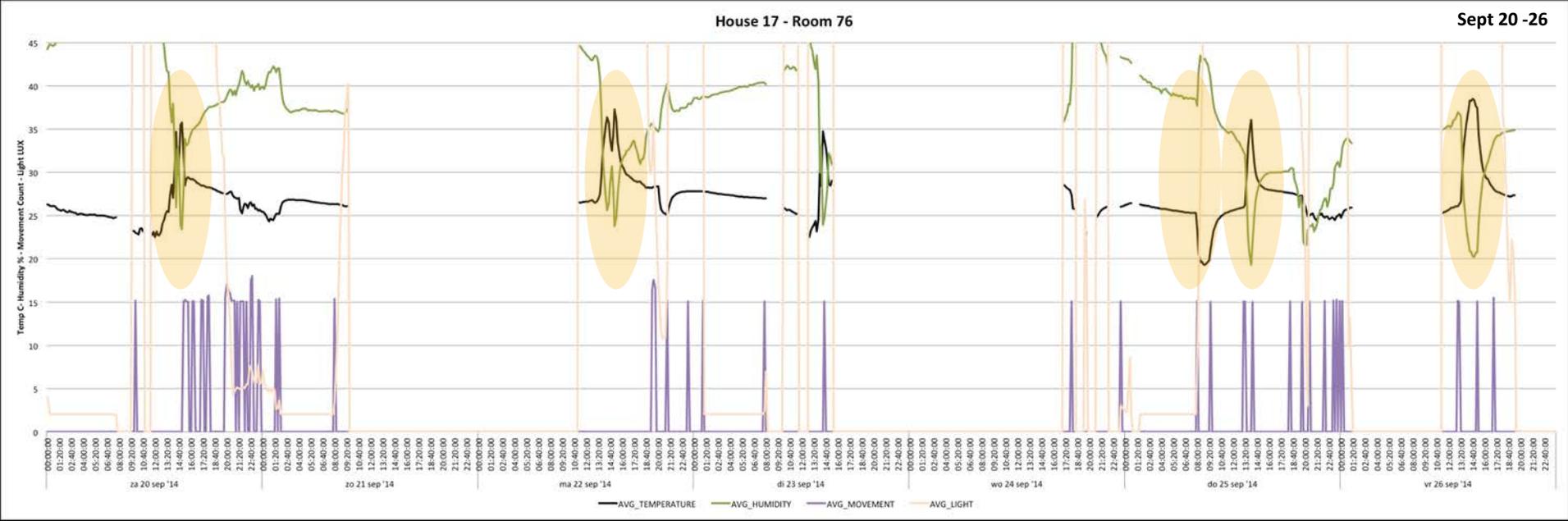
Autonomy of people to prototype and adapt pleasurable and meaningful sustainable practices

SusLab reflective interfaces

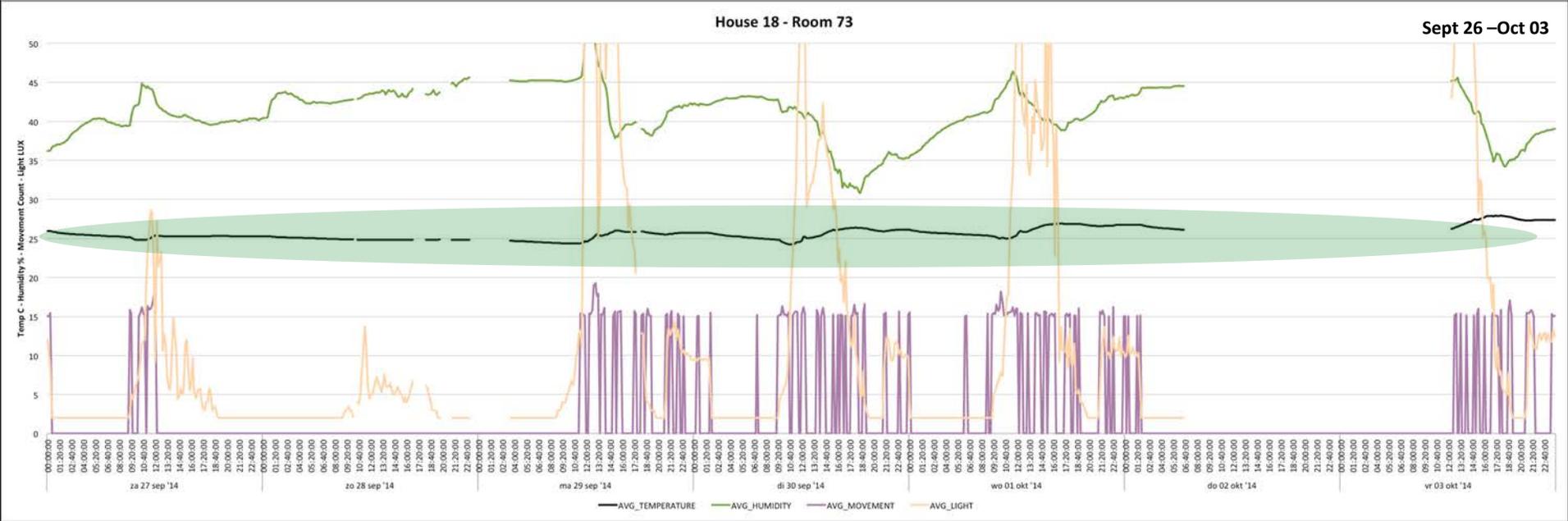
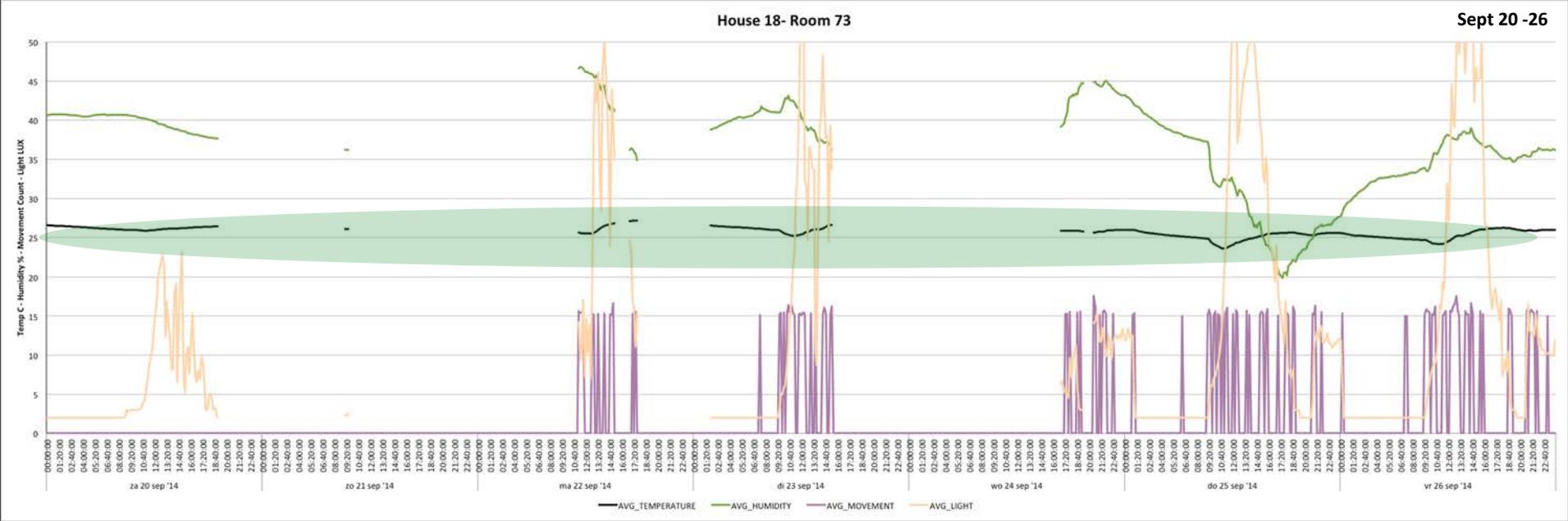


SusLab reflective interfaces

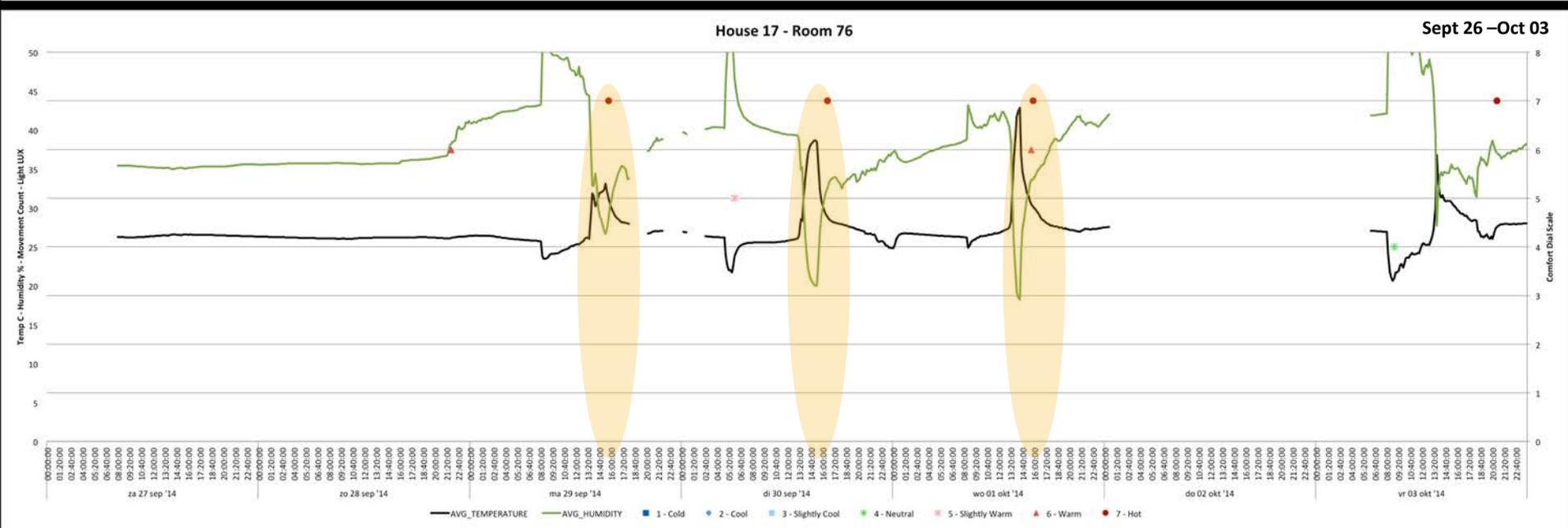
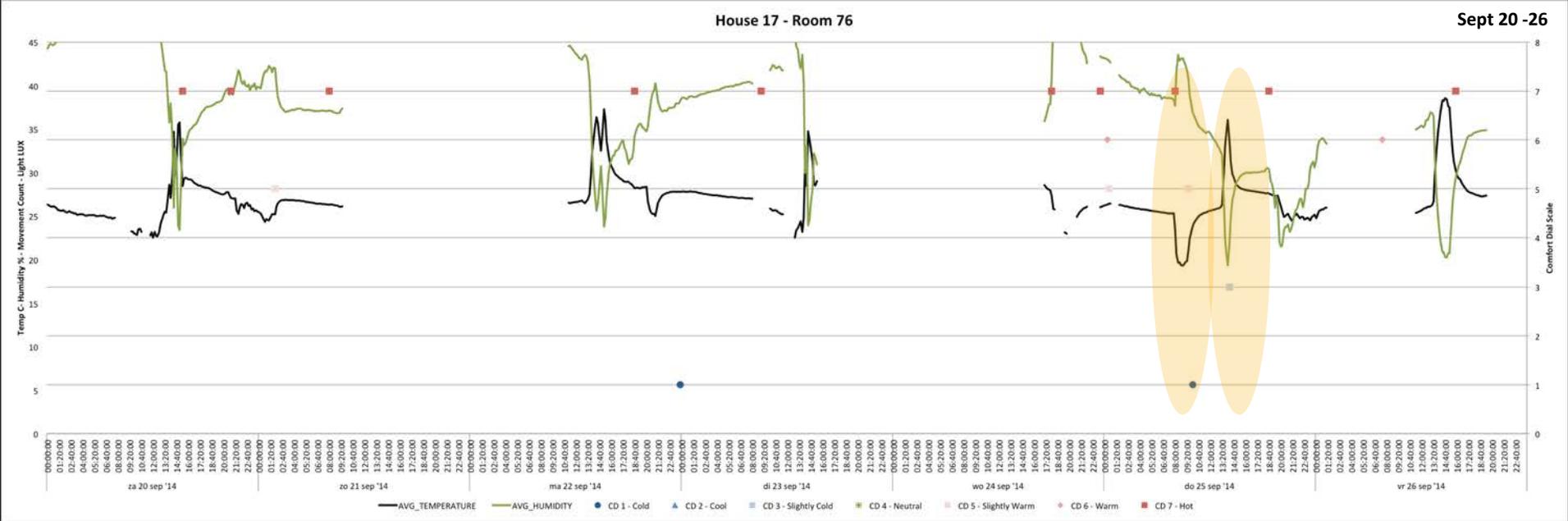




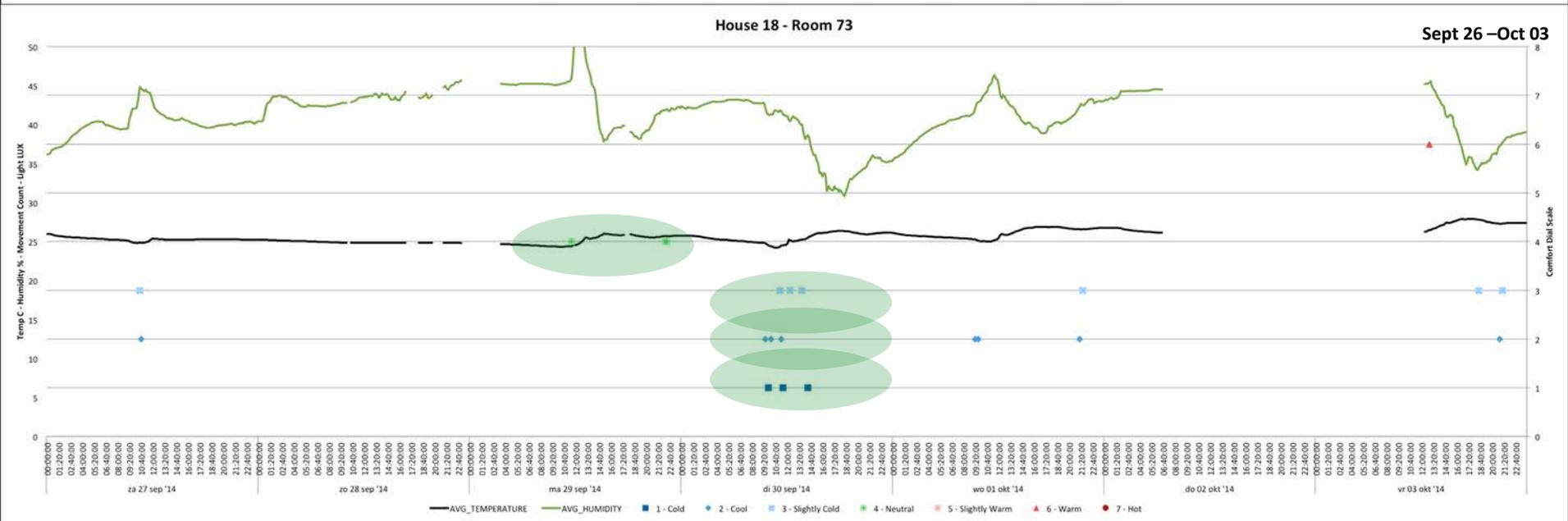
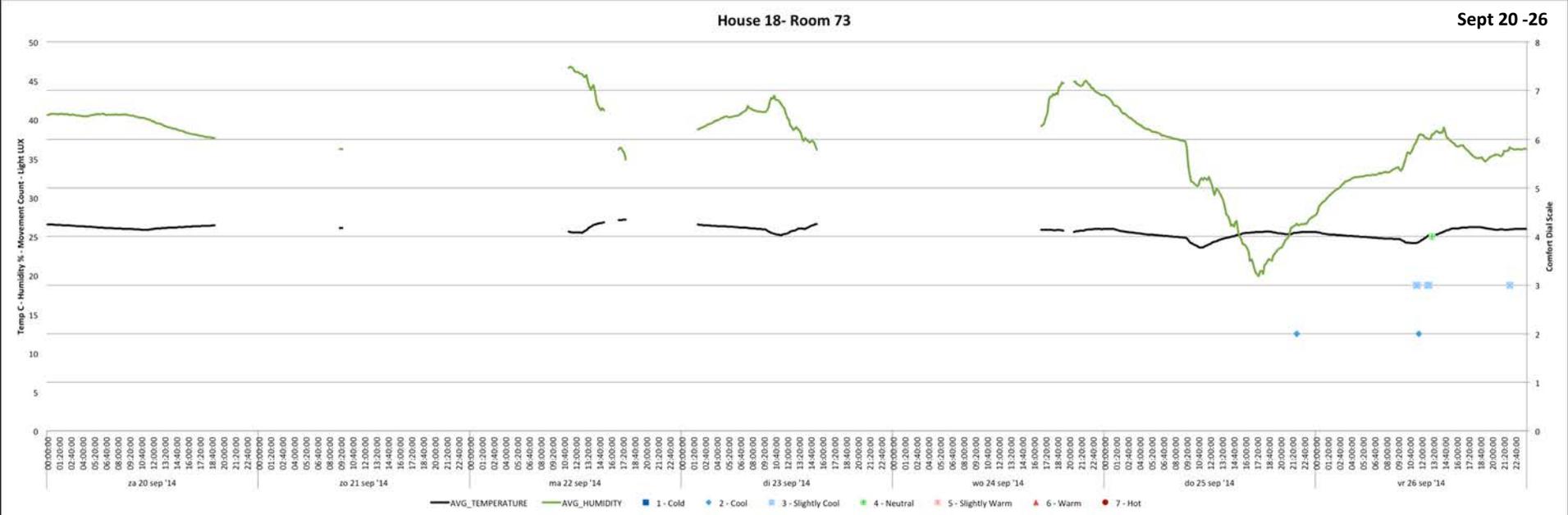
Madrid Pilot: 2 weeks objective data from renovated house (2014)



Madrid Pilot: 2 weeks objective data from non renovated house



Madrid Pilot: 1 week objective & subjective data from renovated house



Madrid Pilot: 1 week objective & subjective data from non-renovated house

BOCS - in-situ comfort assessment

Romero Herrera et al (2018)

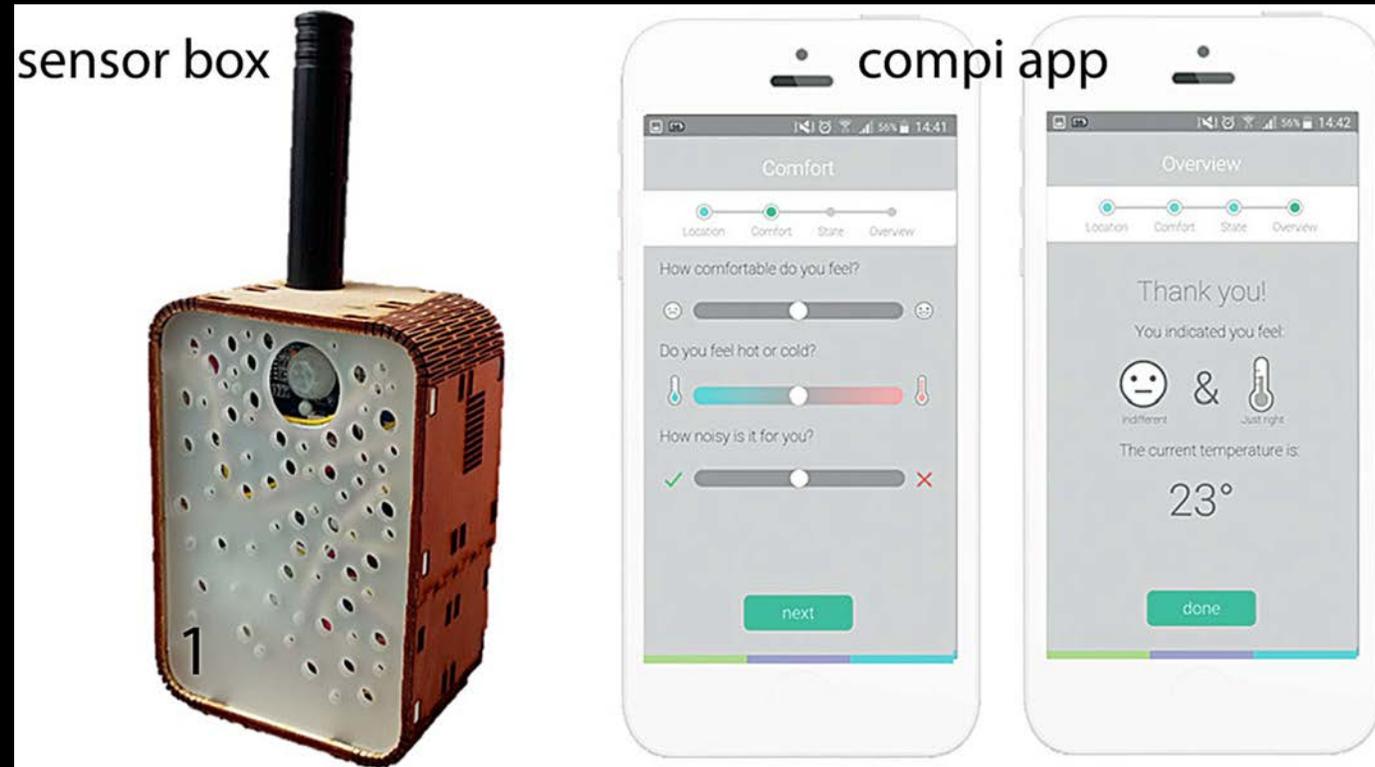
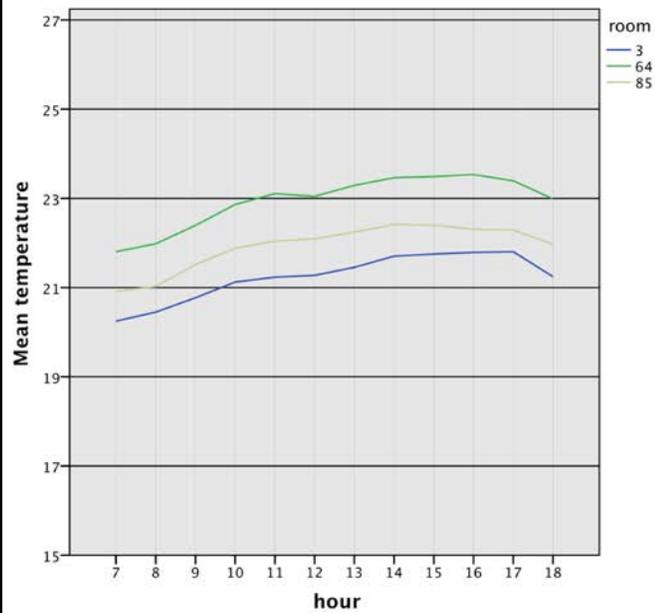


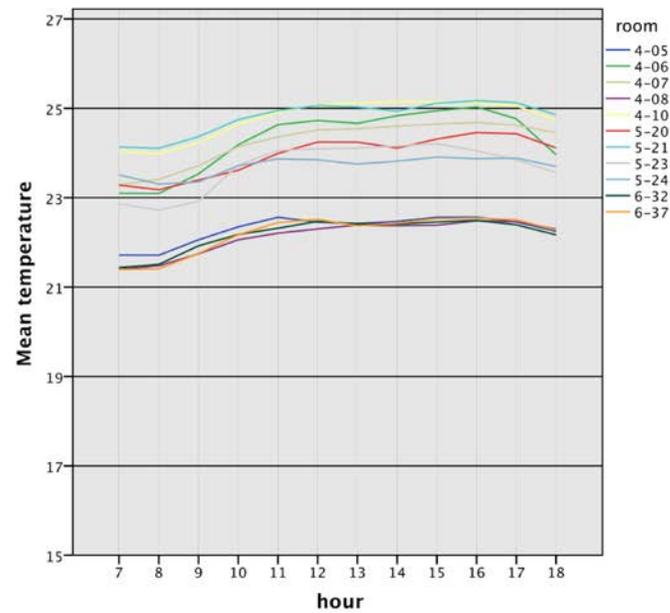
Table 2: Data sources and variables used in the analysis

Qualitative	Variables	Values
Survey	experiences with self-reporting	preferences, suggestions
Email communication	experiences with platform and study	issues, complains
Quantitative	Variables	Values
Self-reported data ¹	thermal sensation vote	-3 (very cold) ... 0 ... 3 (very warm)
	pleasantness vote	1 (unpleasant) ... 5 (pleasant)
	noise level vote	1 (not noisy) ... 5 (noisy)
Monitored data ¹	Indoor temperature, CO2, humidity, light and movement	numeric scale

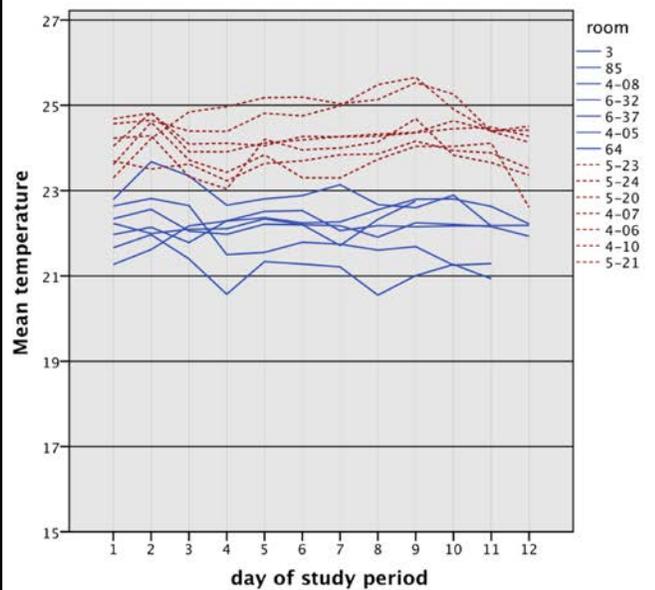
¹ analysis focuses on working days (Monday to Friday) and working hours (7 to 19)



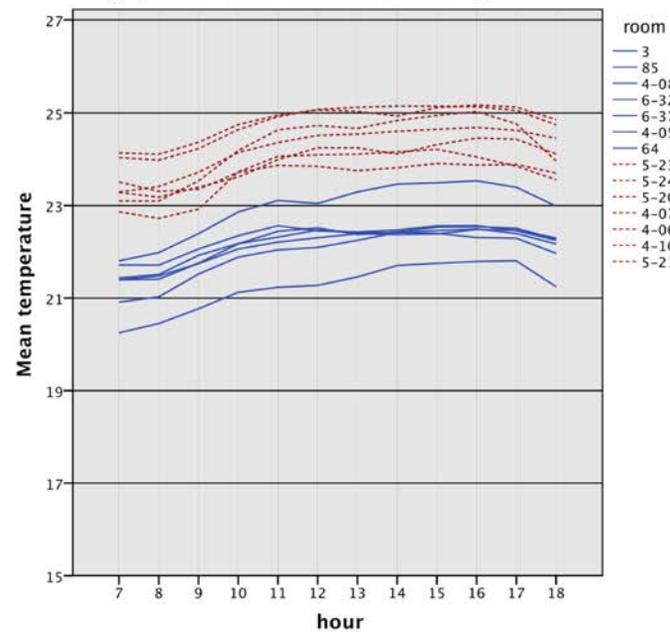
(c) A-mean hourly temperature



(d) B-mean hourly temperature



(e) thermal daily profiles



(f) thermal hourly profiles

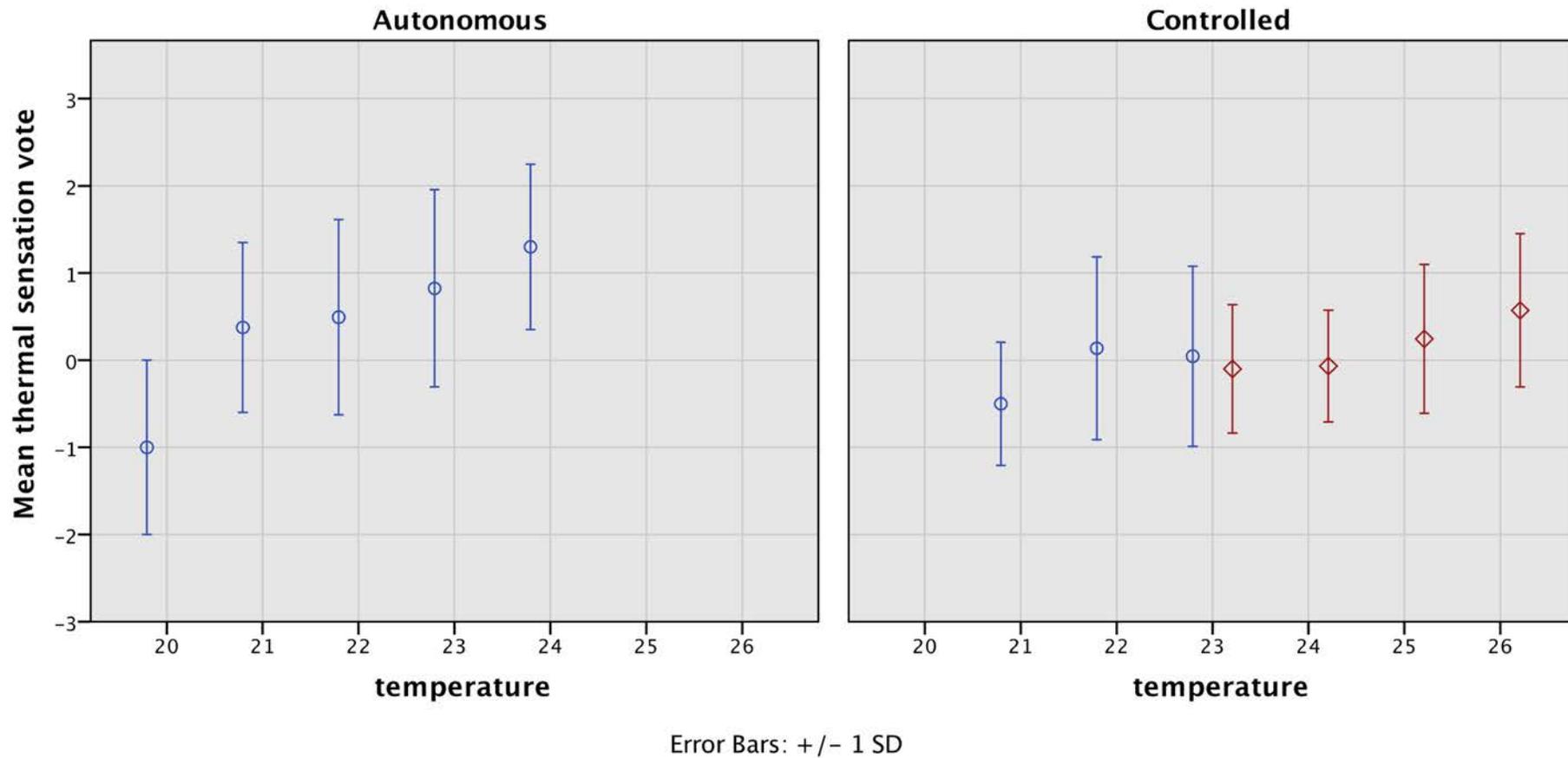
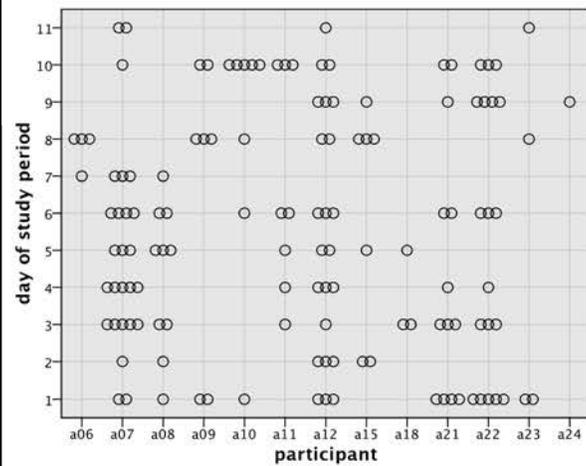
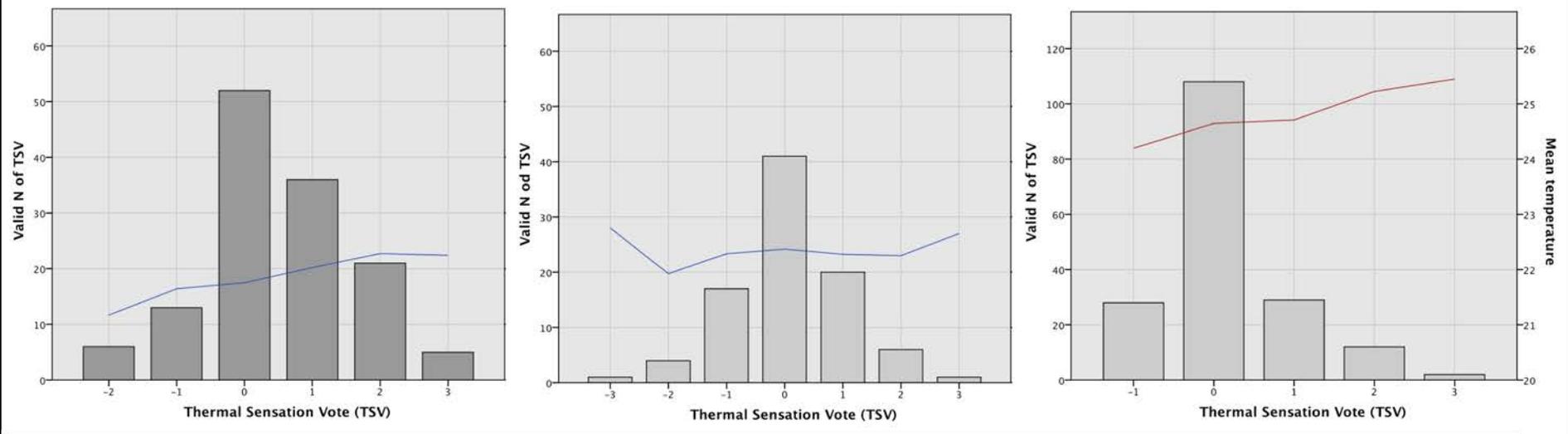
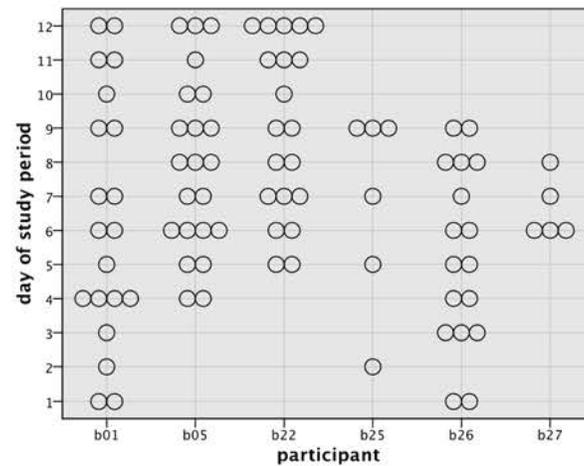


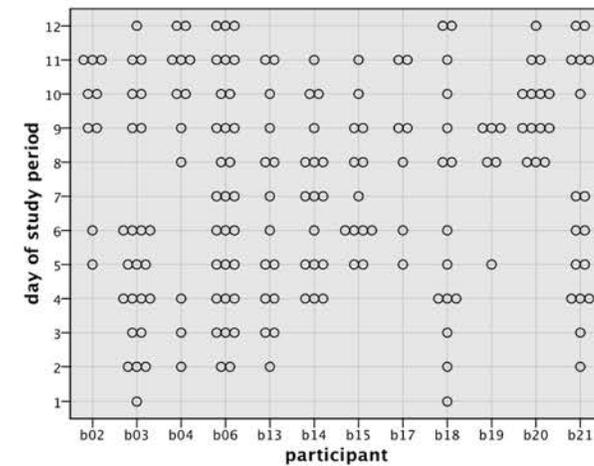
Fig. 6: Mean TSV with error bars representing the variation of the mean per "bins" of 1 degree of indoor temperature; diamonds represent warm rooms



(a) auton-comf



(b) controlled-comf



(c) controlled-warm

Fig. 9: 2-D dot plots of participants daily frequency overtime: number of circles in a cell represent the number of reports from participant x in day y ('null' or no reporting is represented by an empty cell)

2 types of reporting behaviour

Autonomous

Controlled

Sample representation

Distribution of reports across participants/rooms

Inconsistent & low (half reports by less than $\frac{1}{4}$ of autonomous reporters)

Consistent & high (half reports by more than 40% of controlled reporters)

Longitudinal representation

Distribution of reports across participants/time

Sporadic & decreasing

Frequent & constant

Voting representation

Distribution of reports across voting scale

High variability (half of autonomous voting covers a wider range (1.6 C) than the controlled profile)

High uniformity (half of autonomous voting covers a narrower range (0.9 C) than the controlled profile)

Completeness

Granularity

Conclusion

The typology of reporting behaviour could be used to assess the completeness and granularity of the dataset

Participation strategies could adjust for controlled and autonomous reporting styles by considering differences in fixed versus flexible reporting protocols, authoritative versus suggestive styles of reminders

Self-reported analysis should assess the methodological accountability of embedding reporting behaviour analysis and contextual factors in the assessment of comfort to consider contextual explanations of a quantified observed phenomenon.

Insights from occupants

Competence: most people feel that they could do little to be more efficient

Competence/relatedness: most feel the need to be commonly guided to 'act right'

Autonomy: of people to attach values to energy dynamically

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ERGIZING
EDUCATION
REDUCE
REENGAS
MISSIONS





architecture

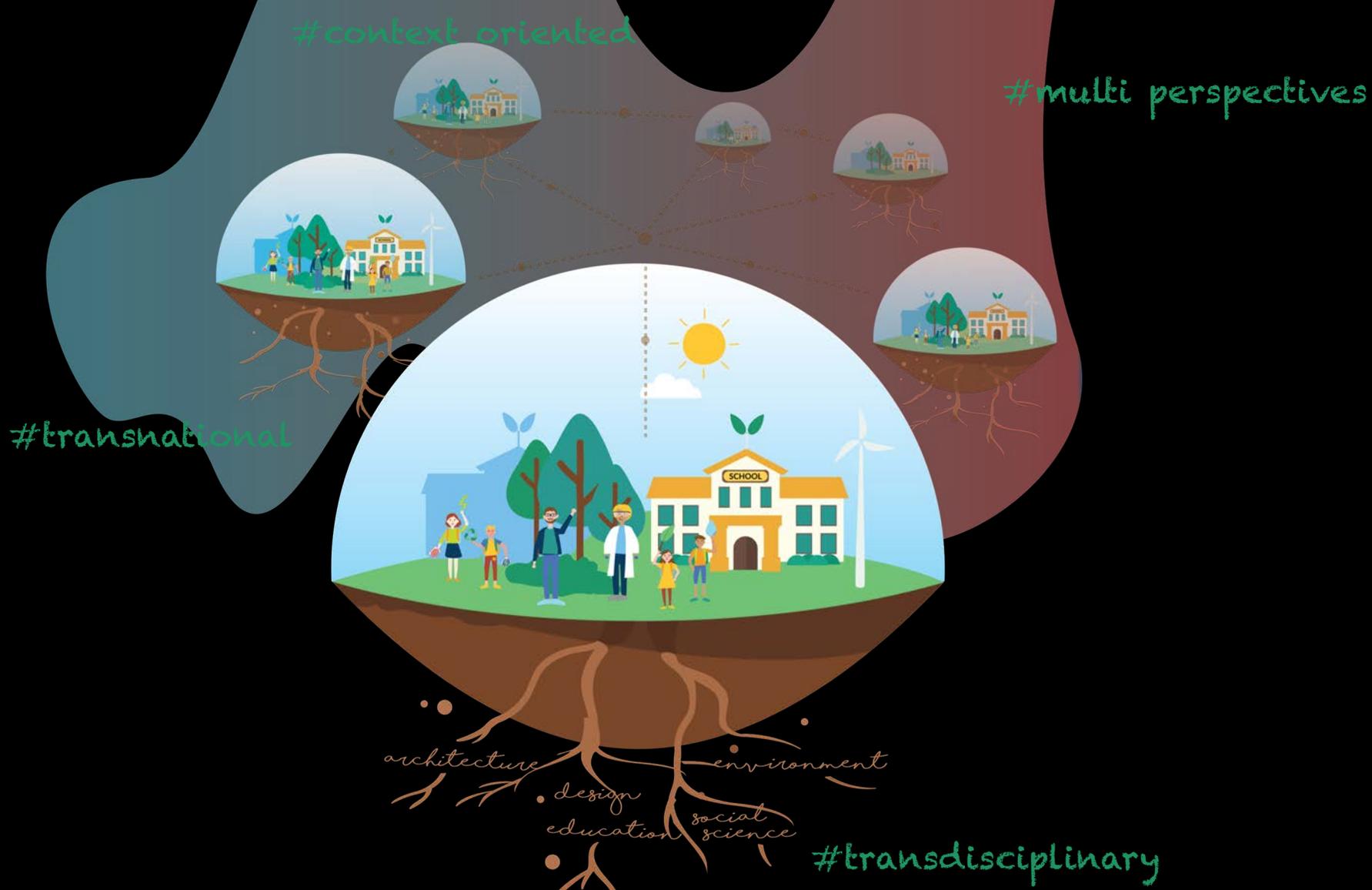
environment

design

education

social science

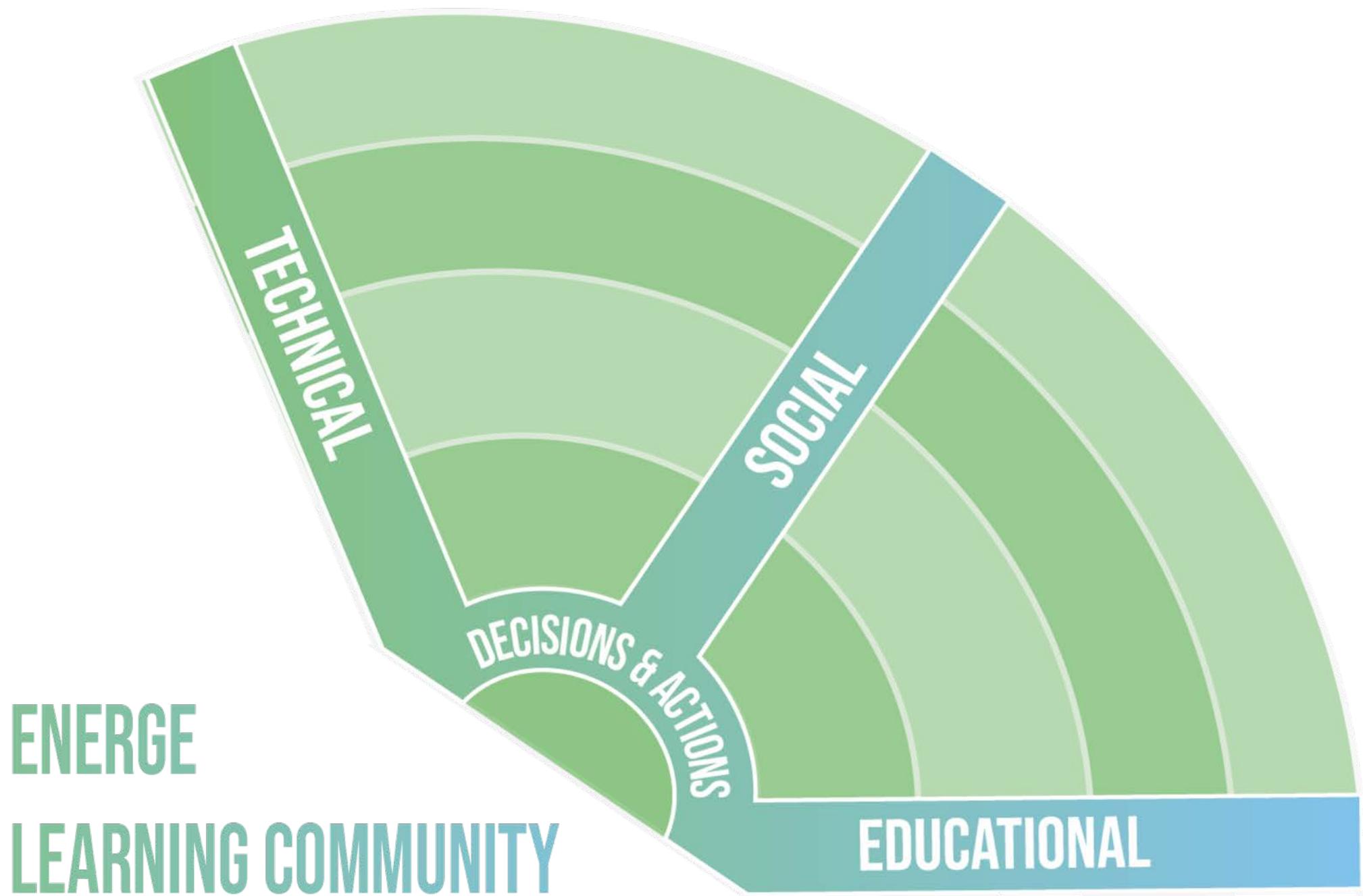
#transdisciplinary



ENERGE

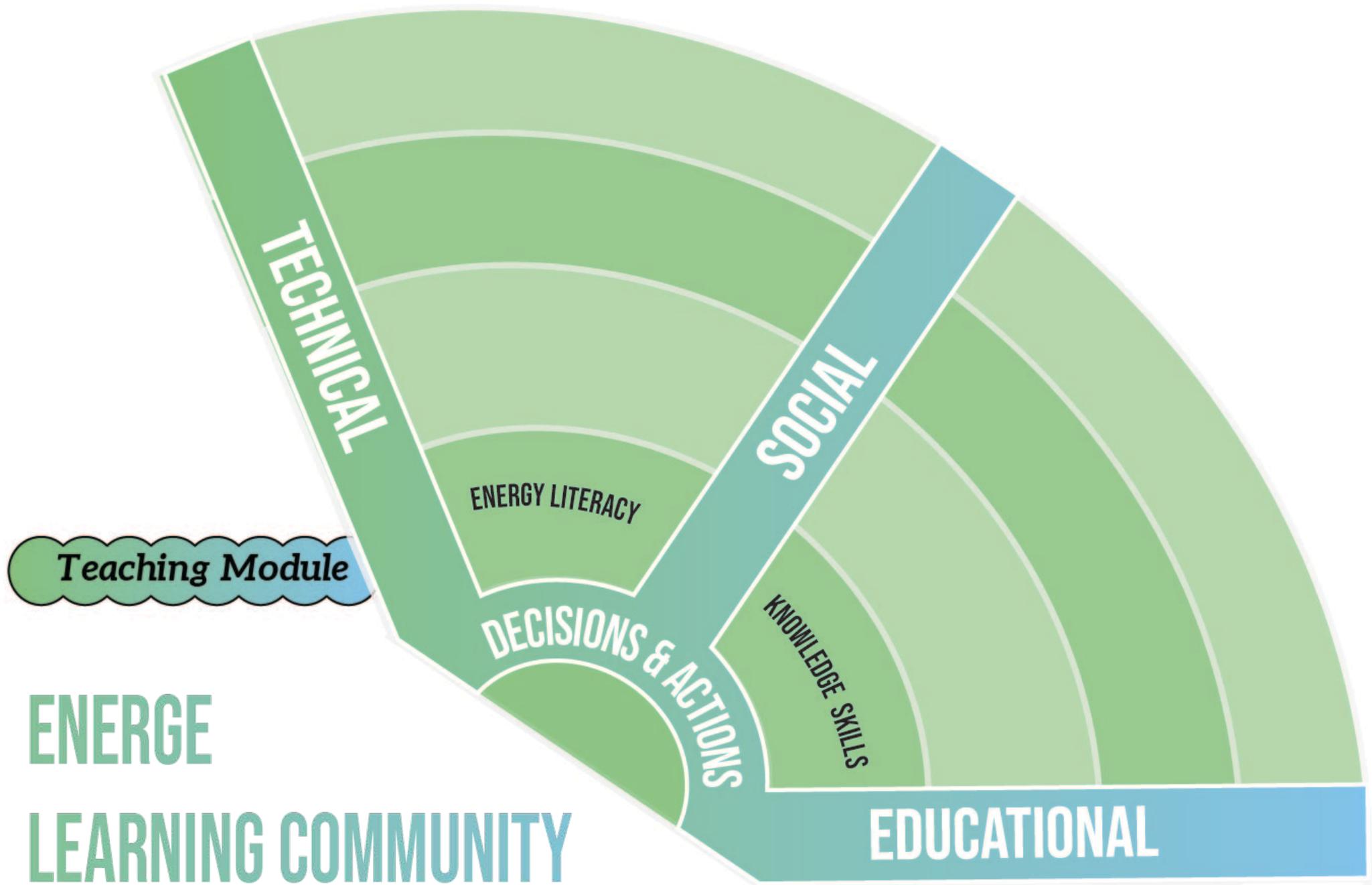
LEARNING COMMUNITY





ENERGE

LEARNING COMMUNITY



Teaching Module

ENERGE LEARNING COMMUNITY

TECHNICAL

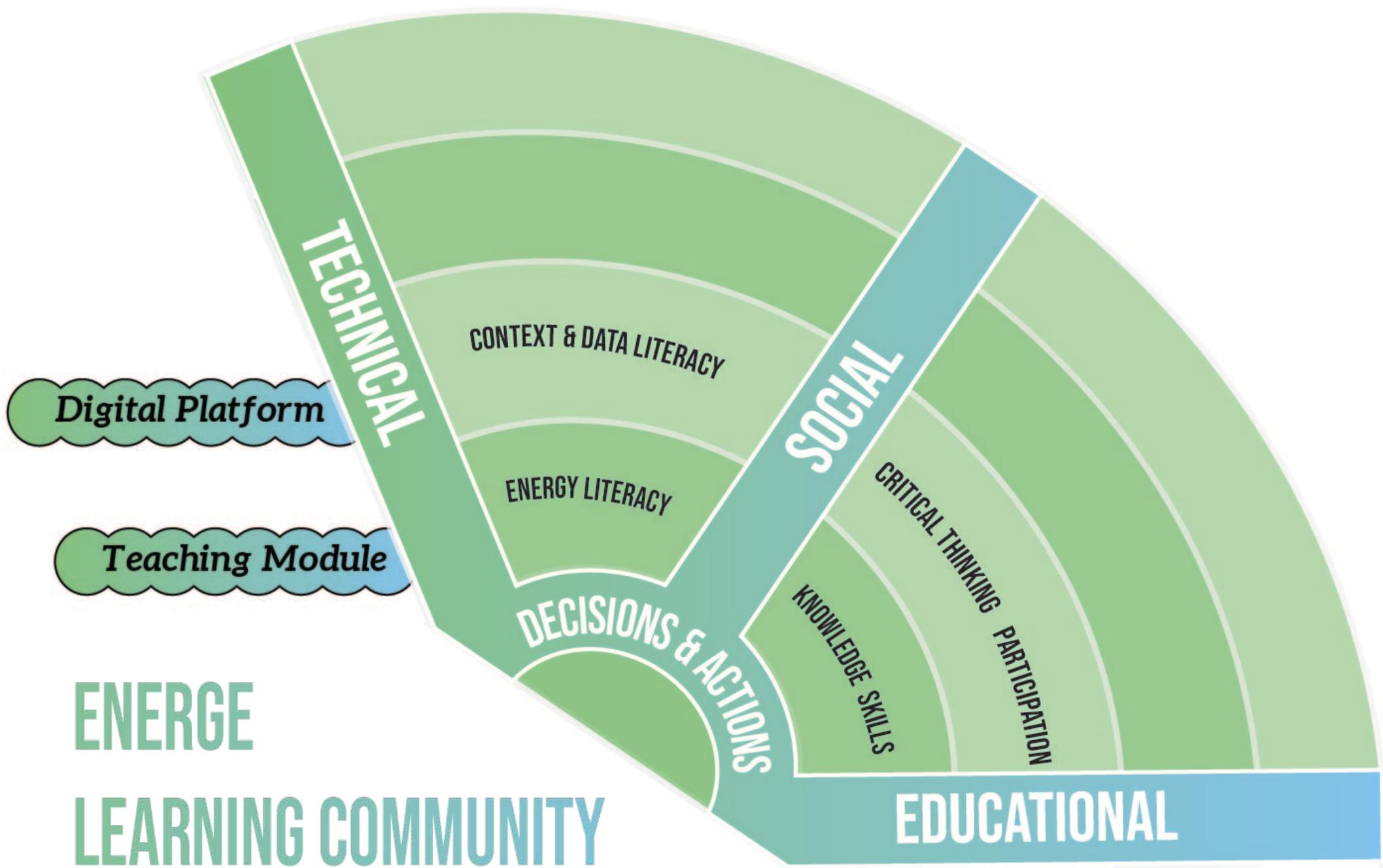
SOCIAL

EDUCATIONAL

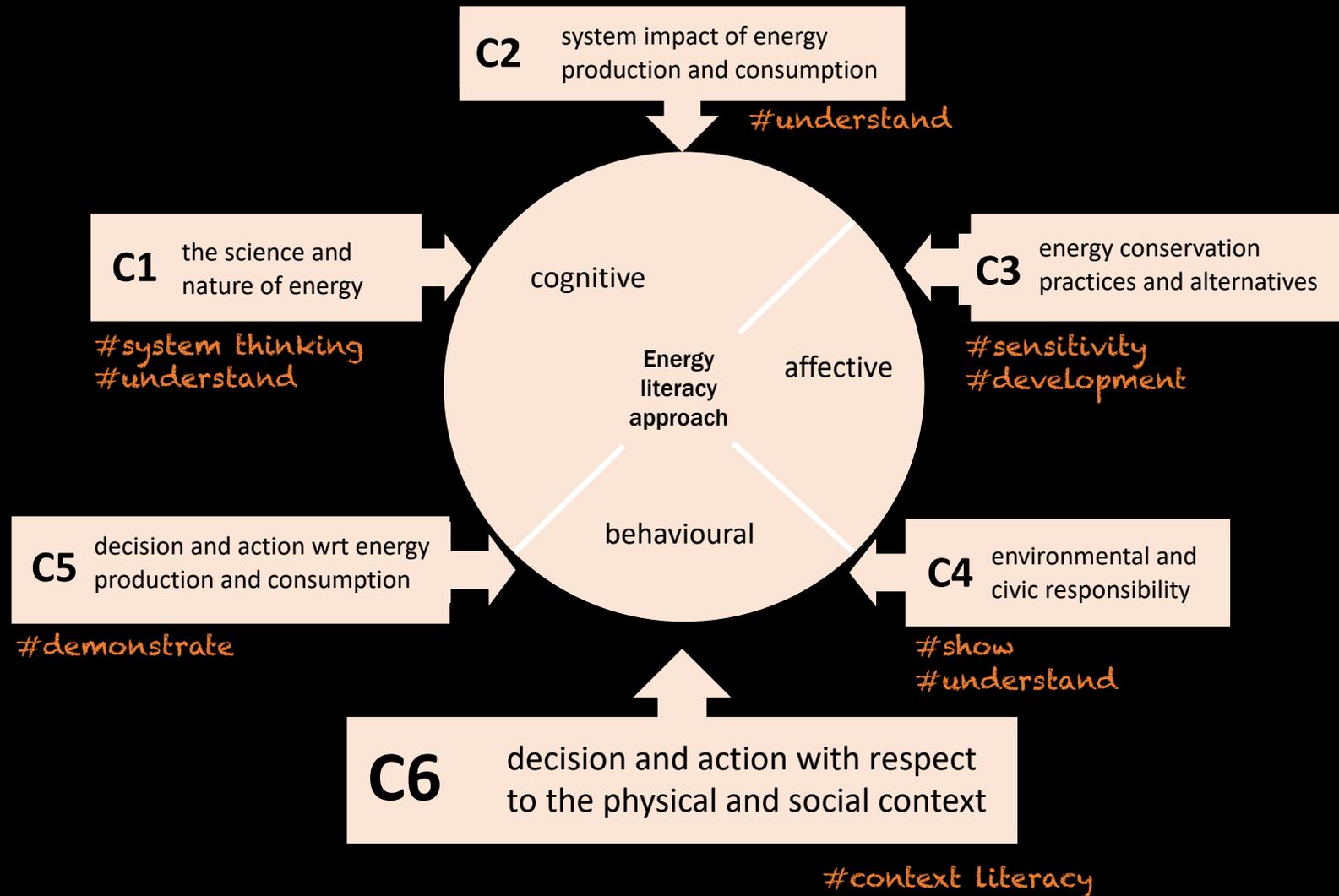
DECISIONS & ACTIONS

ENERGY LITERACY

KNOWLEDGE SKILLS



ENERGIE COMPETENCE FRAMEWORK



WHAT DOES IT TAKE TO MAKE CHANGE?

_meaning
_competence
_material

#social practice theory



WHAT'S COMFORTABLE FOR ME? AND FOR OTHERS? ♡

WHAT'S OPTIMAL ENERGY USE? 🌱

WHY SHOULD I / WE BOTHER? ❓



BEYOND THE USUAL SUSPECTS

_autonomy
_competence
_relatedness

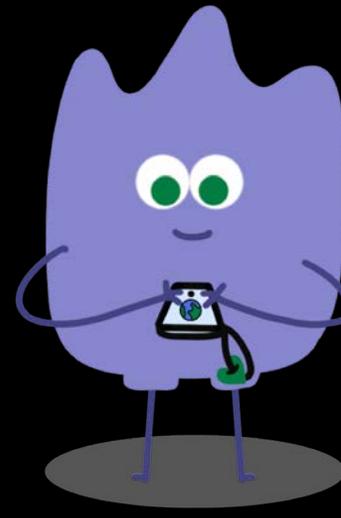
#self-determination theory



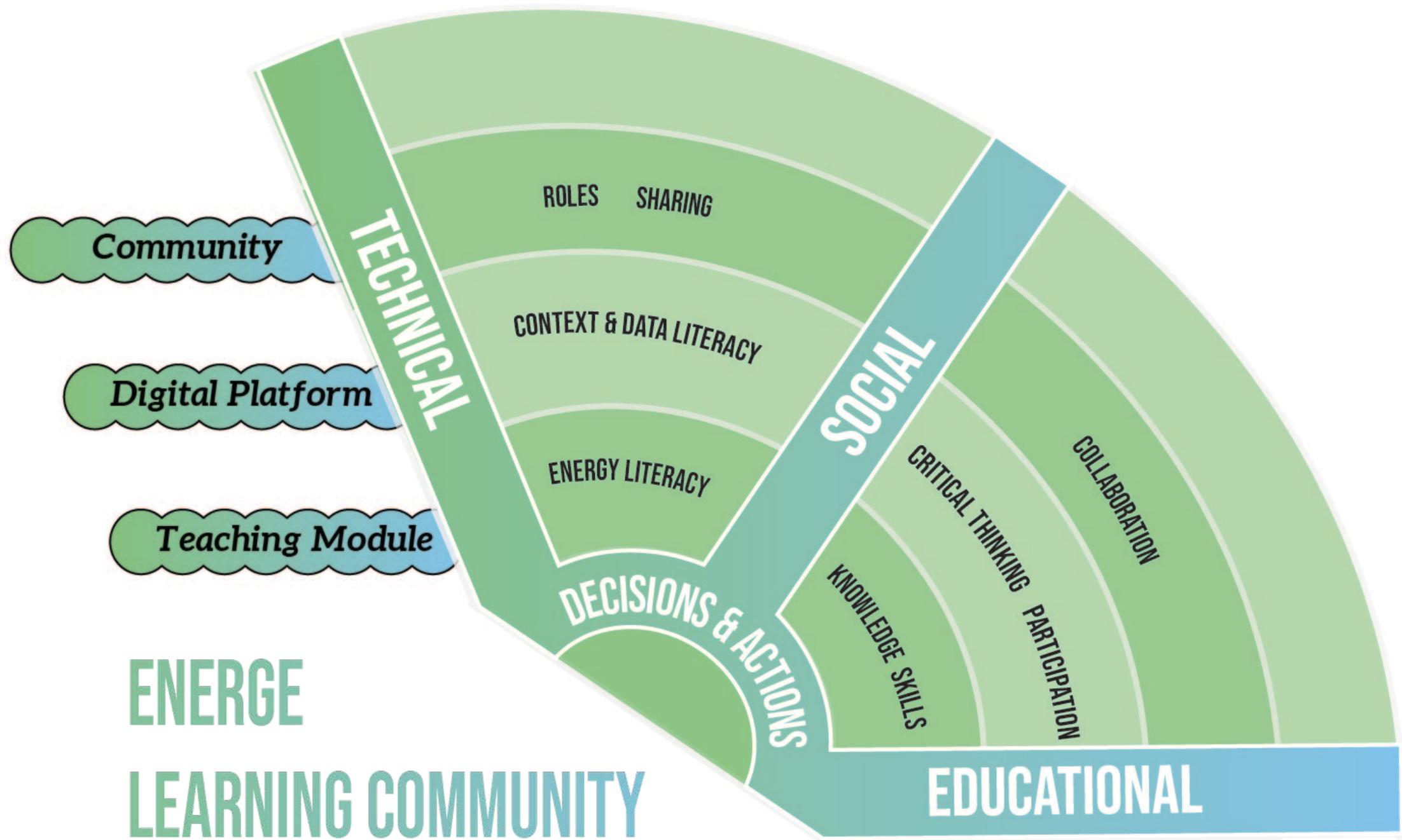
I want to involve others in trying greener ways to deal with high temperatures, not enough sunlight, and stuffy air



I wonder whether to do something greener (like others) when bothered by heating or lack of fresh air

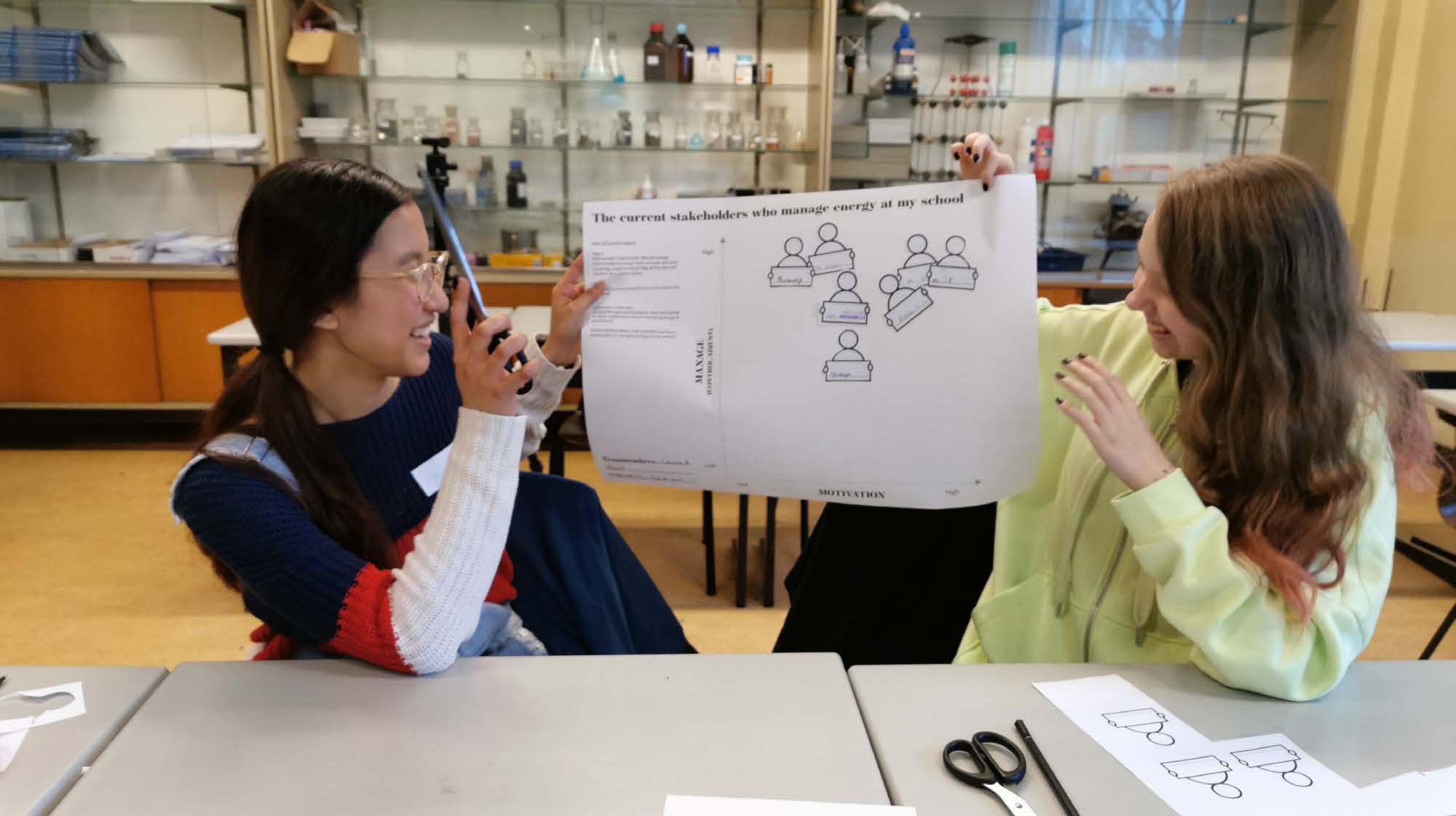


It doesn't seem worth or not in my hands to do anything greener when feeling uncomfortable

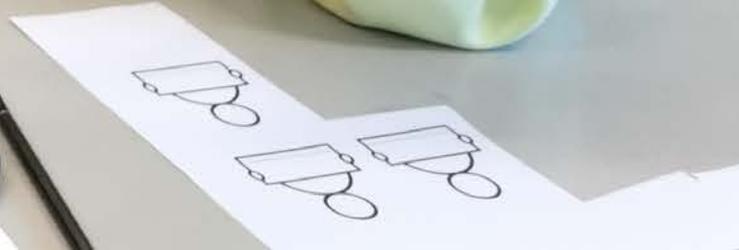
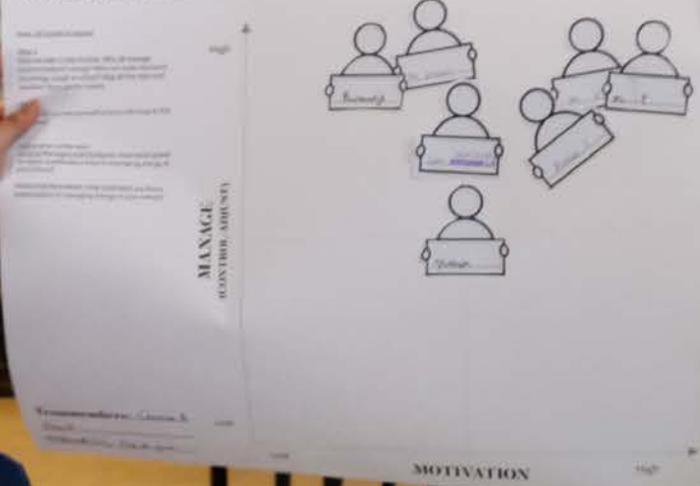








The current stakeholders who manage energy at my school





Interreg
North-West Europe
ENERGIE

ENERGIE REGION
LOW CARBON

1 billion of €
www.nw.eu

GREEN
CHANNEL
TV

"HAZARD AREA"
"CHEMICAL PRODUCTS"









MESSAGES

Public Chat

NOTES

Shared Notes

USERS (3)

Suzan ... (YOU)

60209 Jens Höger

60209 Wieland St...

Konferenz teilzunehmen, wählen Sie: +49-6131-63736-609. Die Konferenz-PIN lautet: 23156. Um das Mikrofon per Telefon zu aktivieren/deaktivieren, drücken Sie die „0“

This server is running BigBlueButton operated by ...

Um jemanden zur Konferenz einzuladen, schicken Sie ihm diesen Link: <https://bbb-schulen.rlp.net/j/602-aan-cmz-qub>

Achim Hill (online) 10:52 AM
Hello, I finally managed to join the meeting.

Achim Hill (online) 10:53 AM
I stop video transmission to reduce data

60209 Jens Höger 10:55 AM
jst a second...

Achim Hill (online) 10:55 AM
I am going to leave cause I am losing connection several times. Bye and have a nice meeting.

Send message to Public Chat

ENERGE BBS Präim

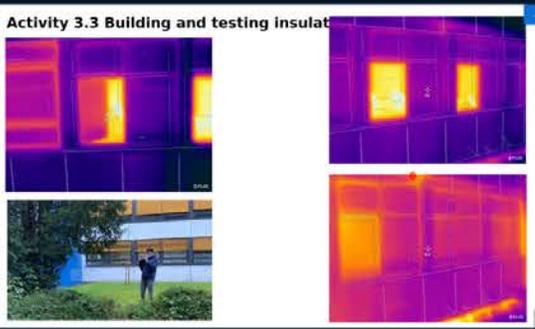
60209 Jens Höger

Suzan Gunbay ...

60209 Jens Höger

60209 Wieland St...

Activity 3.3 Building and testing insulation



Zoom

Energy Lens

eneige-modul...

travel documents

data reading activity

paper Syst. Rev.

Dec1

Dec2

Dec3

ENERGE activity vj...

Zotero

ENERGE Tsache...

Suzan Gunbay ...

WhatsApp Image 2021...

Pictures2

Zoom

Energy Lens

eneige-modul...

travel documents

data reading activity

paper Syst. Rev.

Dec1

Dec2

Dec3

ENERGE activity vj...

Zotero

ENERGE Tsache...

10:21
17/12/2021



Chen Hao



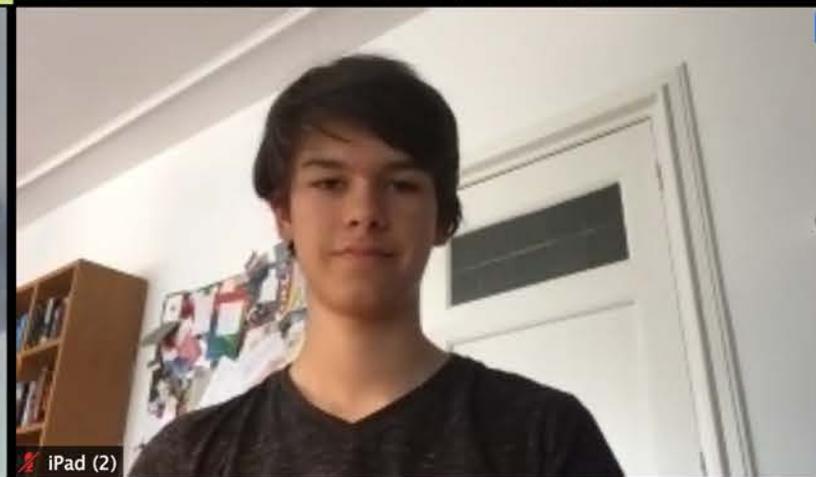
Lina



Abhigyan Singh



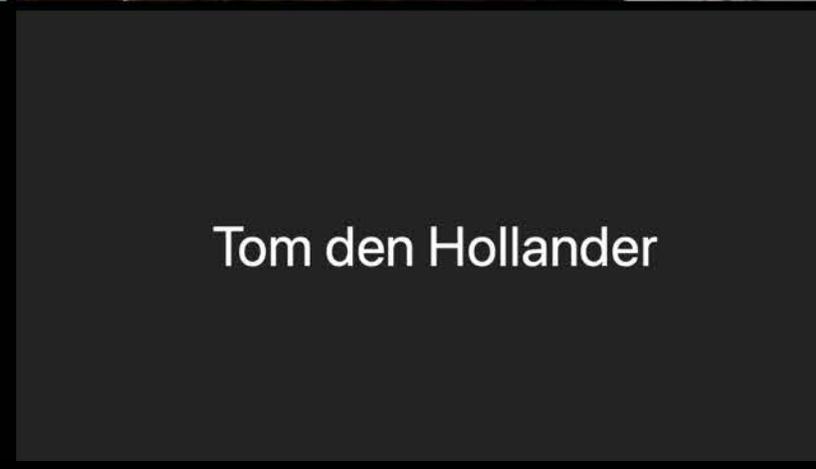
Quinten



iPad (2)



floris



Tom den Hollander

10 Start assignment (Introduction exercise)

11 Assignment 1

12 Assignment 1

13 Assignment 1

14 Assignment 1

Let's start!

Step 2 📷 ✍️

Where in your house is your favorite place that you use the three electrical devices that you described in Step 1? Describe at least one. How do you use these electrical products? Make a photo of your place at home and describe why and how.

Step 3 📷 ✍️

Do the same exercise as in step 2, and now for within the school. Where in school is your favorite place to use the three electrical devices? How do you use these electrical products? Make a photo of your place in school and describe why and how.

<p>Step 2 - favorite place at home</p> <p>Name of the place: <u>my bedroom</u></p> <div style="border: 1px dashed gray; padding: 5px; margin: 5px 0;">  </div> <p>why and how?</p> <p>i use my laptop all the time in my room as it is where i would use it for entertainment. Like watching a film or going on youtube.</p>	<p>Step 3 - favorite place at school</p> <p>Name of the place: <u>Bathroom</u></p> <div style="border: 1px dashed gray; padding: 5px; margin: 5px 0;">  </div> <p>why and how?</p> <p>the bathroom is my favorite place in the school as its the only place where we can use our phones because it is prohibited.</p>
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Abhigyan Singh



iPhone

Search

LL Lina Li (Co-host, me)

CH Chen Hao (Host)

alan curran

CO Cormac O'Sullivan Moran

G Gavin

L Lucy An Coffey

GS Gretchen Salik

M: Mia :)

AS Abhigyan Singh









a) $\Phi = 50\,000\text{ W}$
b) $\Phi = \frac{Q}{\Delta t}$
 $\Rightarrow Q = \Phi \Delta t = 50\,000 \cdot 3\,600 = 180\,000\,000\text{ J}$
 $180\,000\,000\text{ J} \quad (10 \rightarrow 10^7) \quad 180\,000\,000\text{ J}$
c) $\frac{0,001\text{ m}}{0,001\text{ m}} \quad R_{\text{eff}} = \frac{L}{kA} = 5\,000\text{ K/W}$
 $\frac{0,001\text{ m}}{0,001\text{ m}} \quad C = \frac{Q}{\Delta T}$

La température finale de l'eau est ?
 $Q = c m \Delta T$
 $\Rightarrow Q = c m (\theta_f - \theta_i)$
 $\Rightarrow Q = c m \theta_f - c m \theta_i$
 $\Rightarrow c m \theta_f = Q + c m \theta_i$
 $\Rightarrow \theta_f = \frac{Q + c m \theta_i}{c m}$
 $\Rightarrow \theta_f = \frac{180\,000\,000\text{ J} + 4\,180\text{ J/K} \cdot 1\,000\text{ kg} \cdot 20\text{ K}}{4\,180\text{ J/K} \cdot 1\,000\text{ kg}}$
 $\theta_f = 42,7\text{ K}$
 $\Delta T = 42,7\text{ K} - 20\text{ K} = 22,7\text{ K}$





STEP 3. REPORTING QUICK NOTES - USED SCENARIO



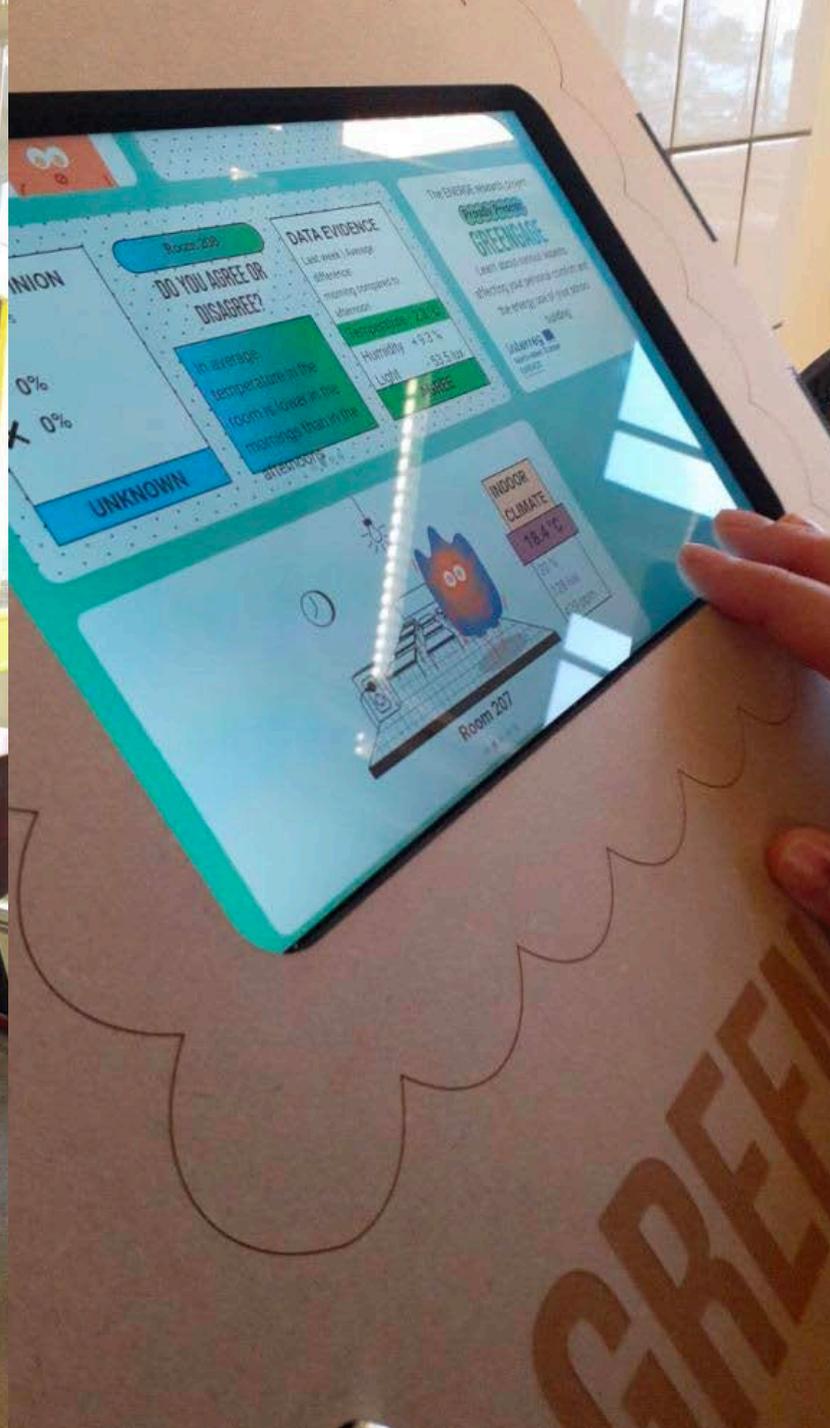
USED scenario:
How people are using
Coverage in your
school.



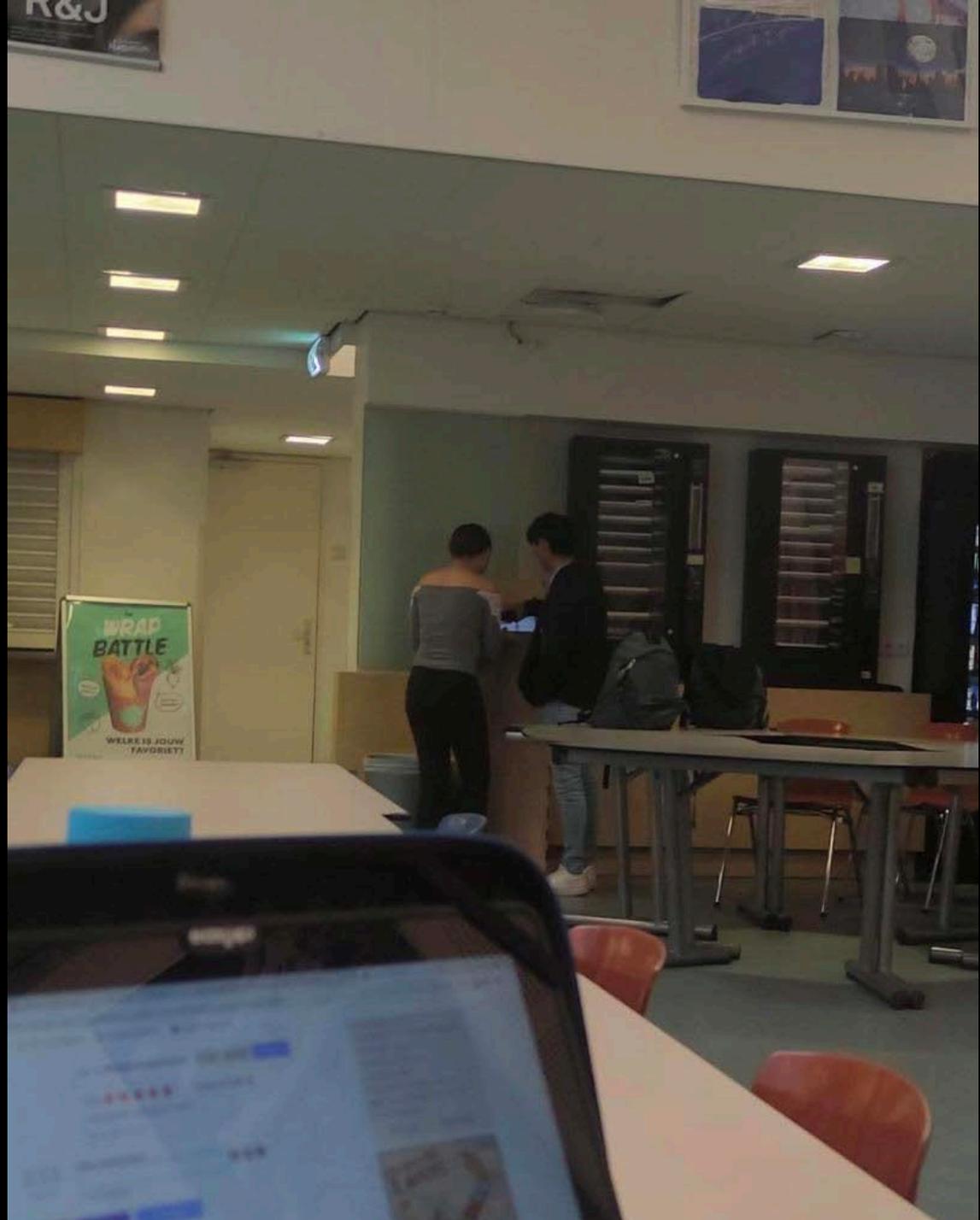


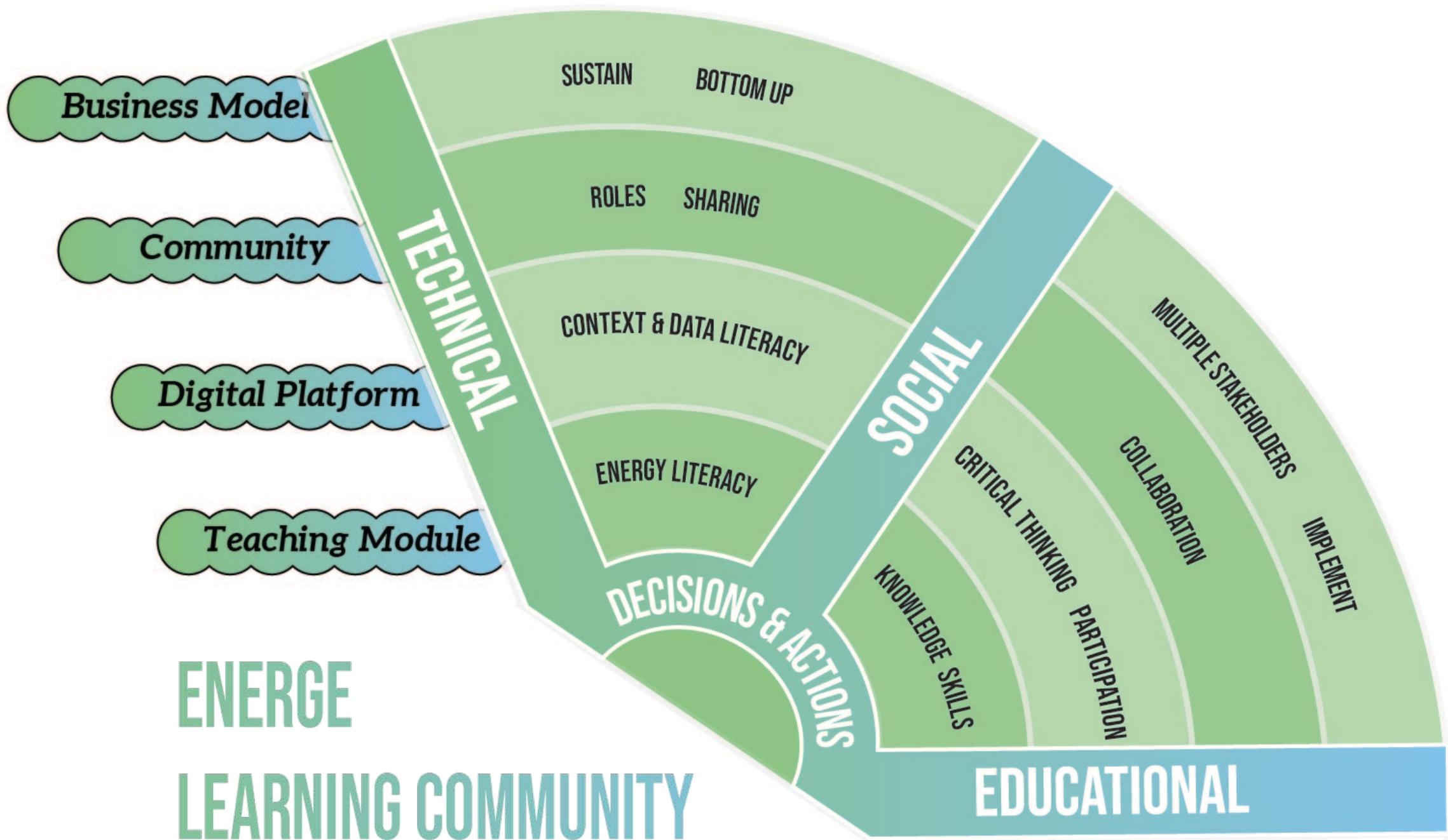












ENERGE INTENDED IMPACT

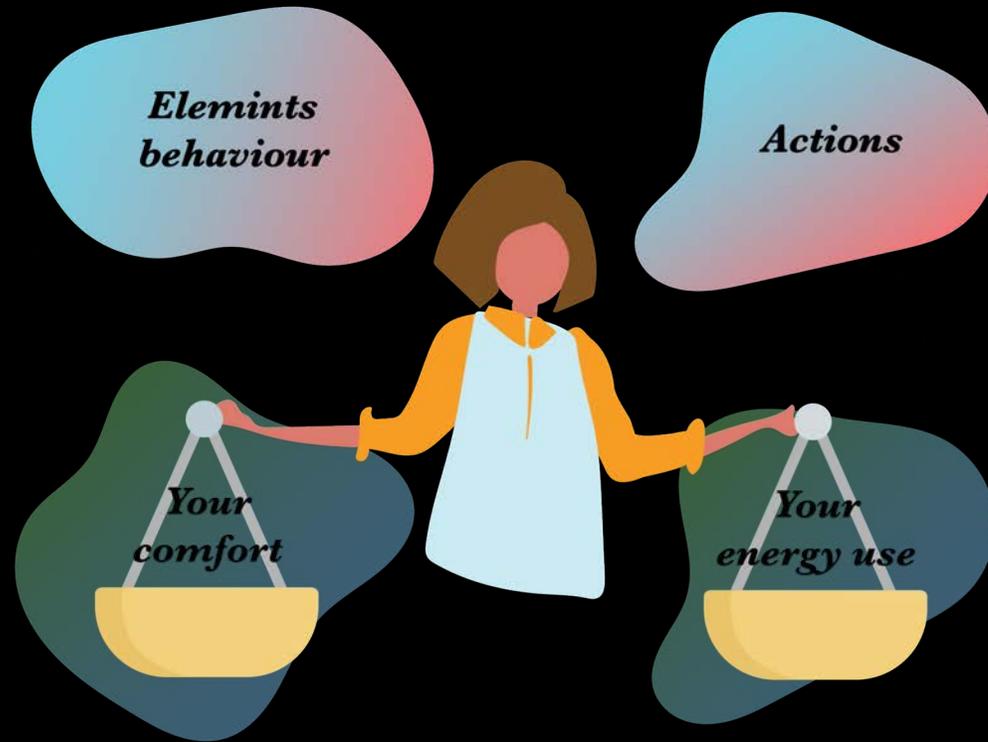
Competence: energy literacy, context literacy, data literacy

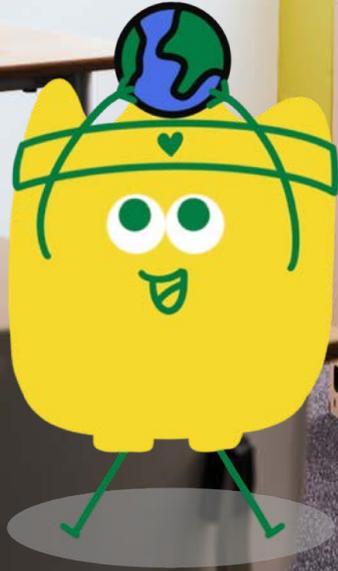
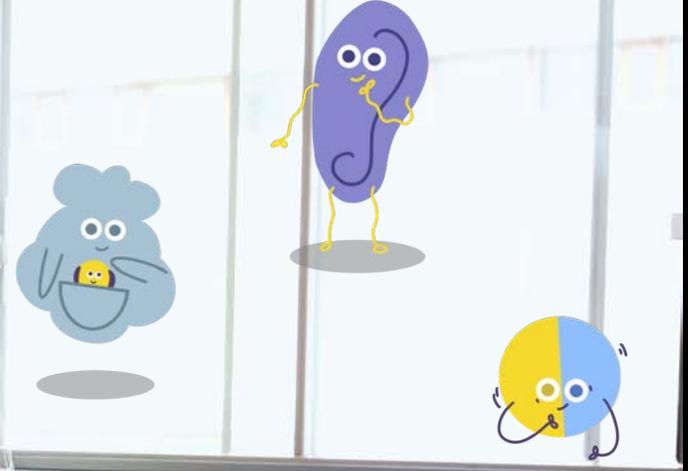
Relatedness: a collaborative space to teach and learn about energy and comfort practices

Autonomy: a collaborative space for different engagement profiles (energy values)

GREENGAGE 1.0

Let's critically think about the energy use and comfort in our schools





LECTURE OBJECTIVES

- Transition to energy management for building occupants
 - Awareness, ownership and social structures in the design of Energy Management for building occupants
 - Engagement with the physical and social context in the interaction with Smart technologies
- Transition to energy learning communities for building occupants
 - Competence: Energy, Context & Data literacy
 - Autonomy: The social practice nature of energy values
 - Relatedness: collaboration in teaching & learning