towards energy smart-homes

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PT GREEN

energy issues in residential dwellings

- production
  - 27% of GHG rejection (half for residential) → electricity
  - 3938km² of roofs with 1181km² relevant for PV
    →300TWh/y (20% of national needs, electricity: 410TWh/y)
  - but flexibility required (STEP, EV, practices,…)
- efficiency
  - 1.1% annual renew rate: 86% of 2050 buildings exists
  - retrofitting: factor 10 possible
  - but grey energy and poverty issues
- sobriety
  - highly impacting practices in efficient buildings
  - but annoying at first because of routines

inhabited system

- homes are singular
  - few data (not easy for deep learning)
  - invisible phenomena, simple action with high impact
  - inhabitants (owners) decide and control
  - each dwelling is unique
    - various households
    - various working time and activities
    - regular reconfiguration of the place and of the household

inhabitants have to take complex and impacting decisions taking into account sobriety and flexibility in a variety of evolving configurations

in short

heat and air quality

what should be the temperature set-point in each room? when? how long?

what should be the ventilation set-point?

open close door? when? how long?

where to go?

open close window? when? how long?

open or close shutter/ flap? when? how long?

do I use my electric appliance properly? fridge? freezer? cooker? computer? washing machine? lighting?…

should I switch on/off heating/cooling?

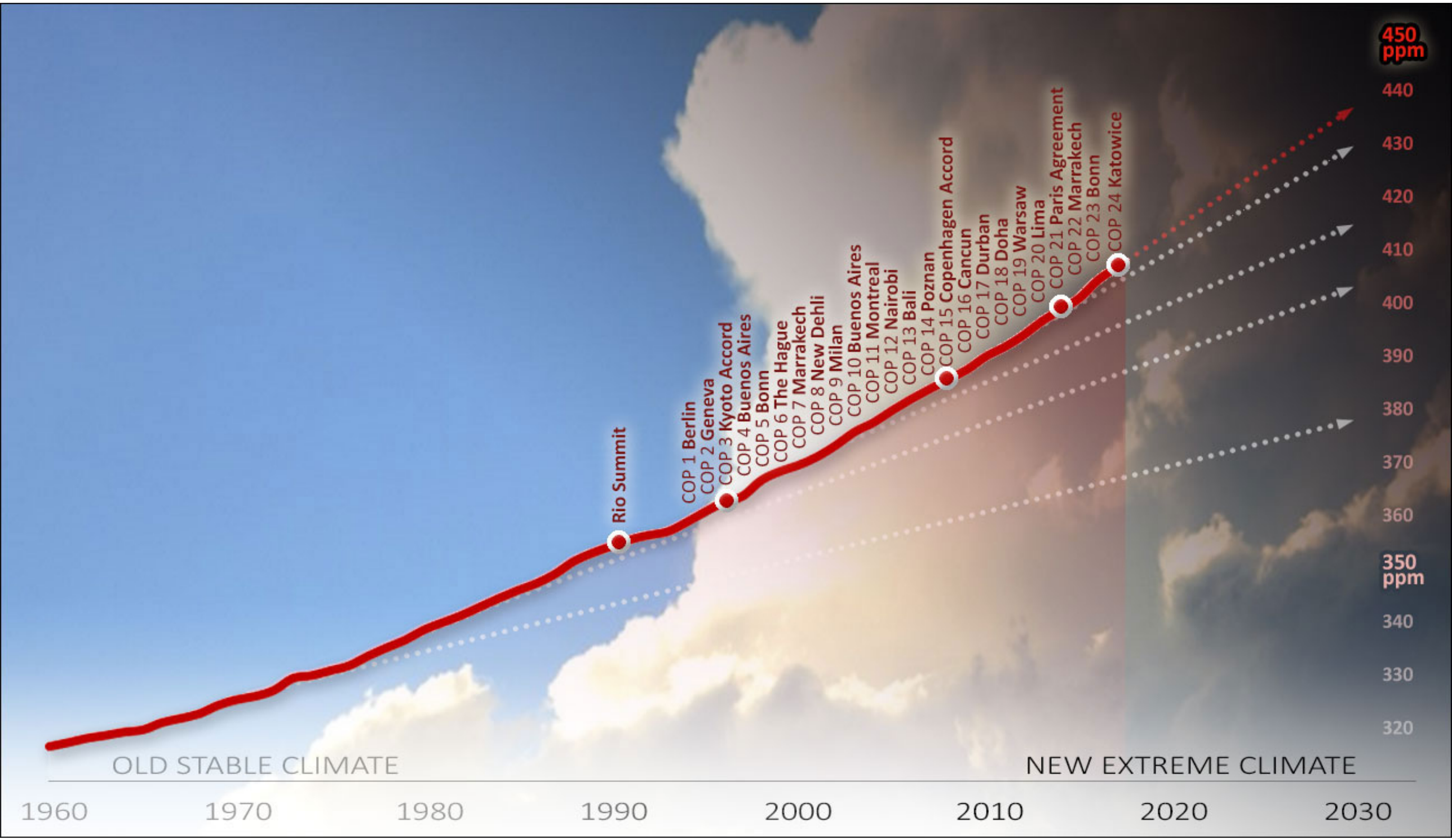
should I switch on complementary heater?

do I use properly the kettle?

do I use properly domestic (hot) water?

electricity

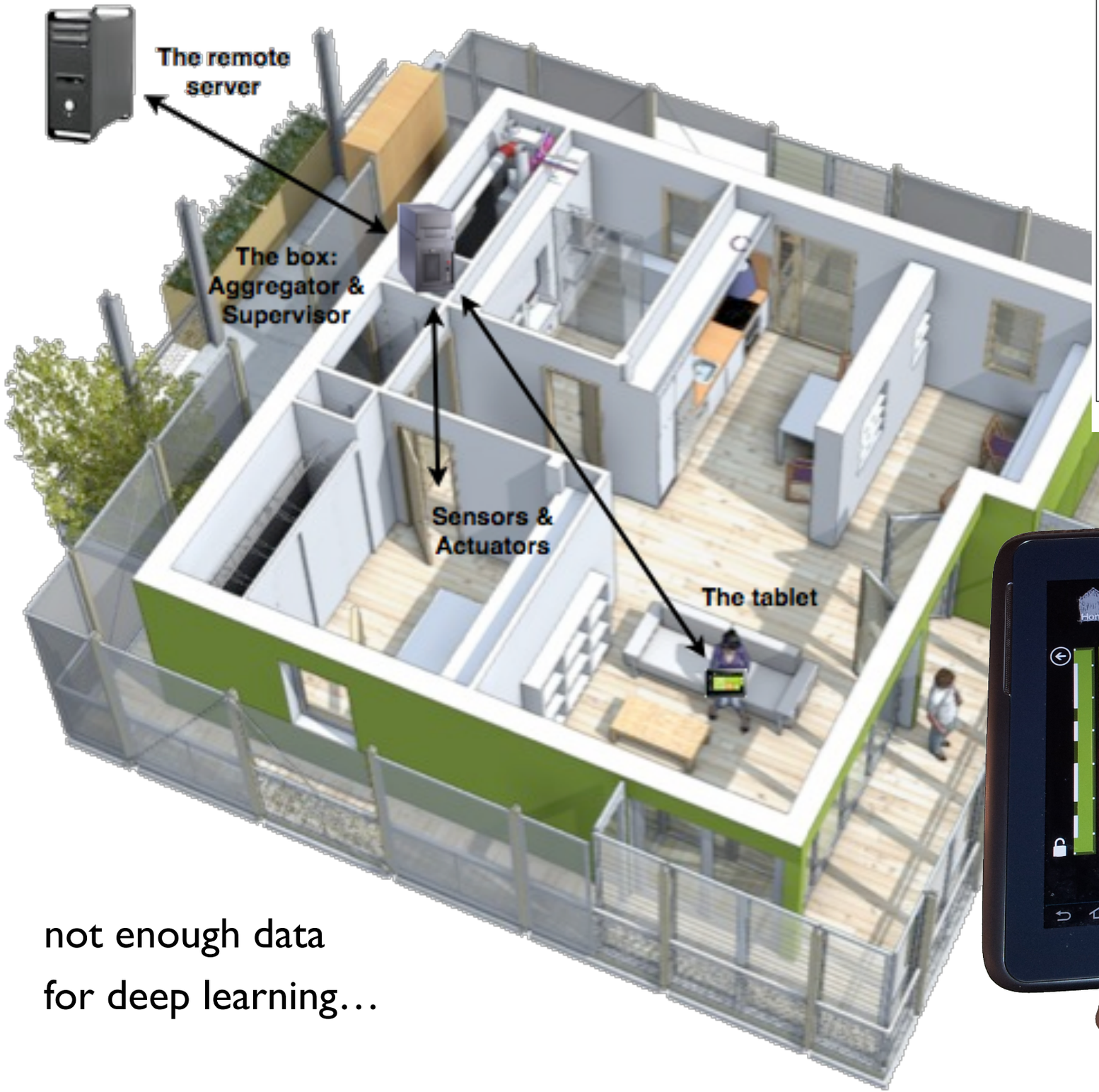
in short

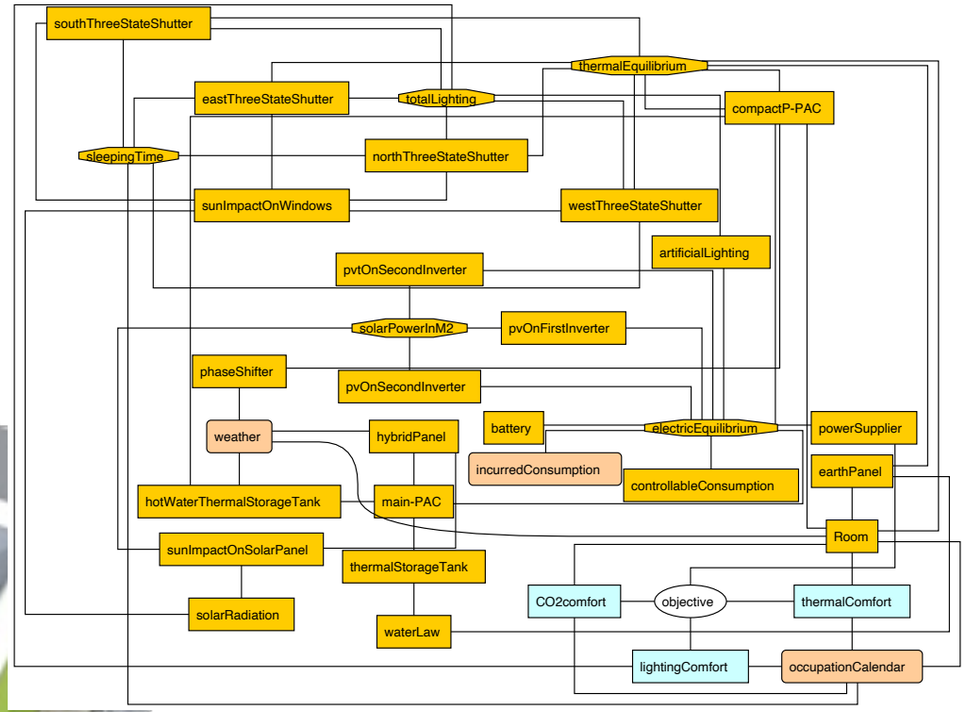

Rio Summit
COP 1 Berlin
COP 2 Geneva
COP 3 Kyoto Accord
COP 4 Buenos Aires
COP 5 Bonn
COP 6 The Hague
COP 7 Marrakech
COP 8 New Dehli
COP 9 Milan
COP 10 Buenos Aires
COP 11 Montreal
COP 12 Nairobi
COP 13 Bali
COP 14 Poznan
COP 15 Copenhagen Accord
COP 16 Cancun
COP 17 Durban
COP 18 Doha
COP 19 Warsaw
COP 20 Lima
COP 21 Paris Agreement
COP 22 Marrakech
COP 23 Bonn
COP 24 Katowice
450 ppm
440
430
420
410
400
390
380
370
360
350 ppm
340
330
320
OLD STABLE CLIMATE
NEW EXTREME CLIMATE
1960
1970
1980
1990
2000
2010
2020
2030

outlines

- context and problematic
- requirements
  - what can't be done
  - responsible household manifesto
  - privacy and sobriety
  - being more flexible
  - modeling services
  - modeling phenomena
- propositions
  - analysis aiding service
  - experiment aiding service
  - explanation generation service

what can't be done





not enough data

for deep learning…

responsible household manifesto

- household
  - has to pay attention to its environmental impacts
  - deserve contextualized information about what it should do regarding sobriety and flexibility
  - has not to worry about its privacy
  - has to feel free to behave in its own way, with its singularities
  - can benefit of cheap aiding services, if any
  - has not to adapt to an aiding service, if any, but the opposite
  - can stop any aiding system bothering him
  - has not to be forced to feed an aiding service with data
  - can gather with others to improve its capability

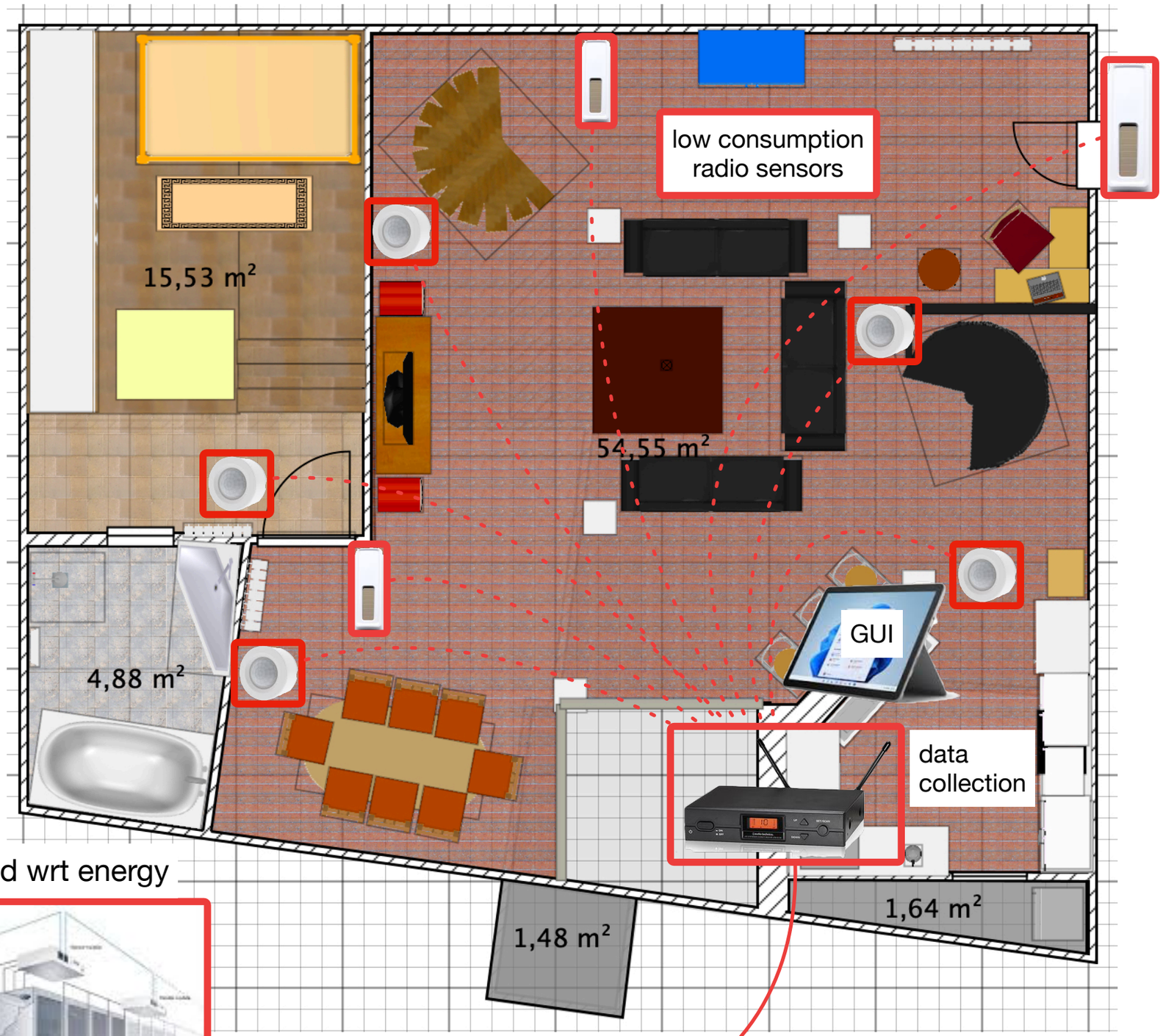
privacy and sobriety

knowledge model should be avoided:

- costly
- partial
- regular update
- calibration issues

deep learning should be avoided:

- few data
- regular gaps
- evolutive sensor configuration

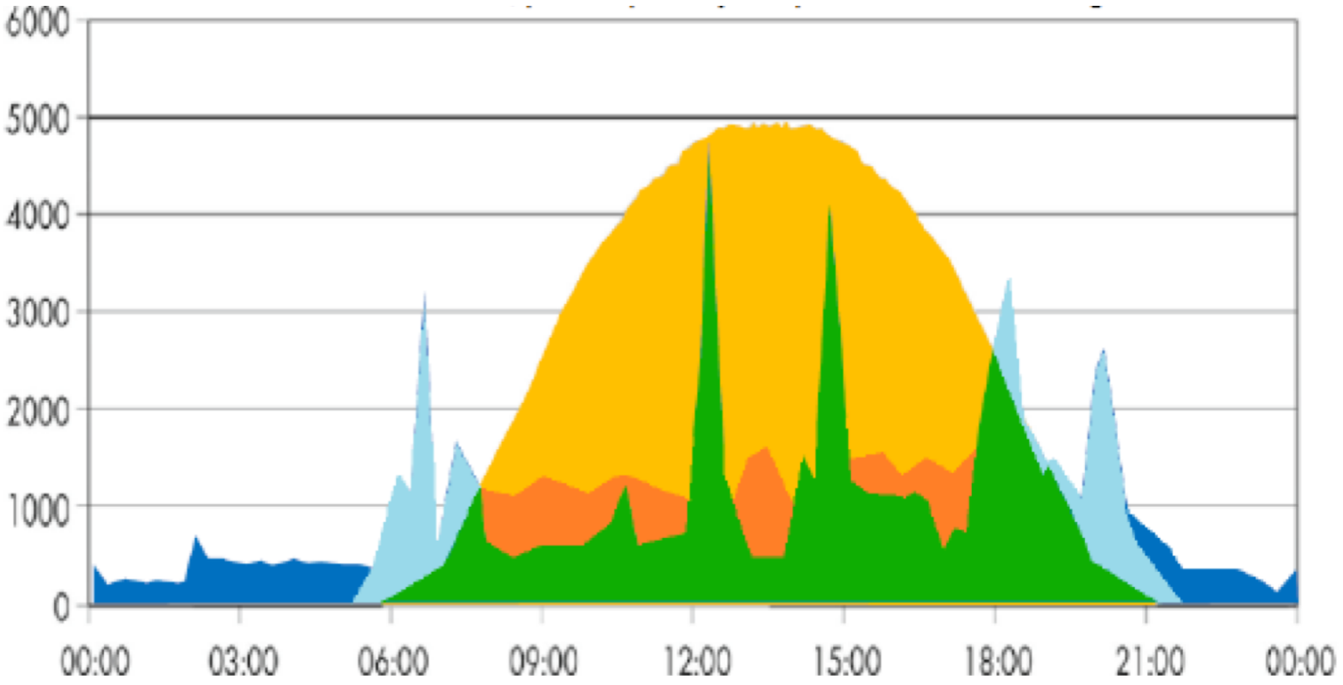


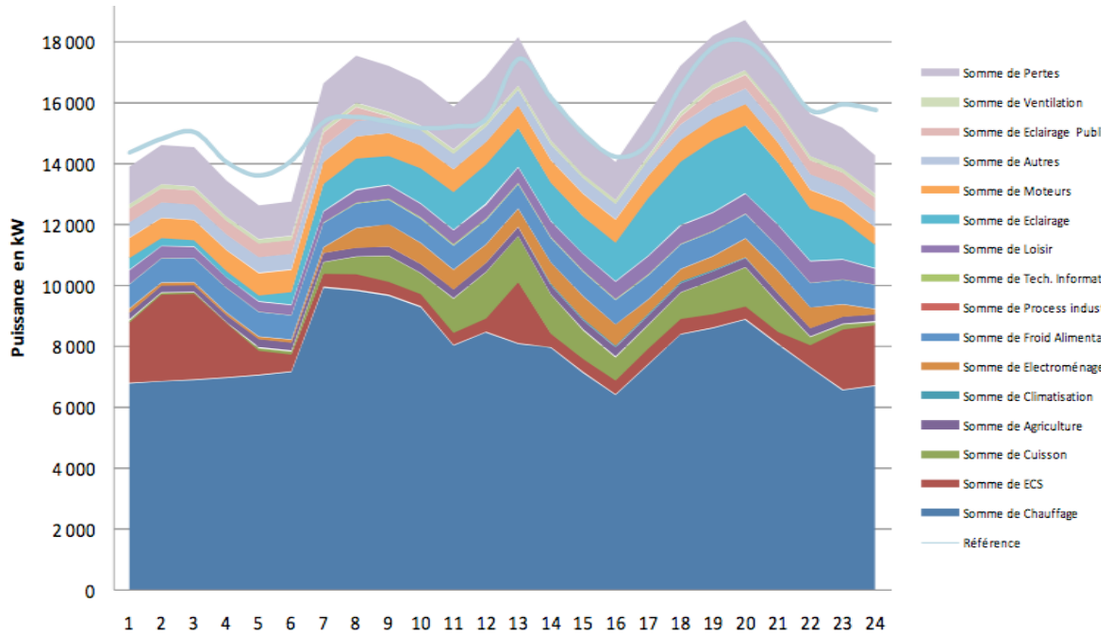
trusted site, optimized wrt energy

secure connexion

being more flexible

- individual and collective (energy communities) actions





production overage

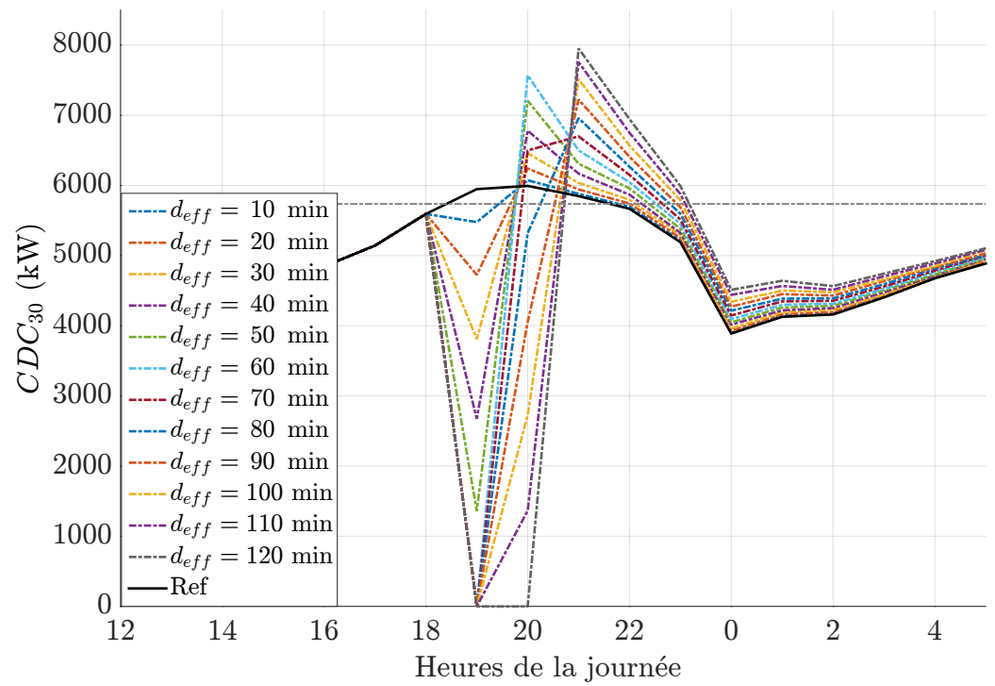
consumption covered by local production

total site consumption

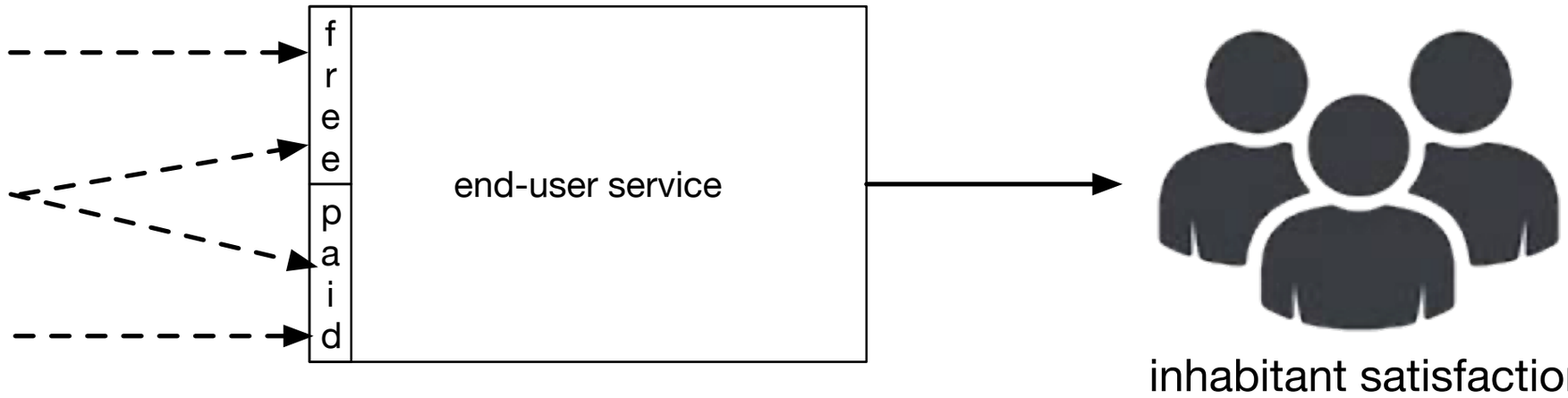
production locally stored

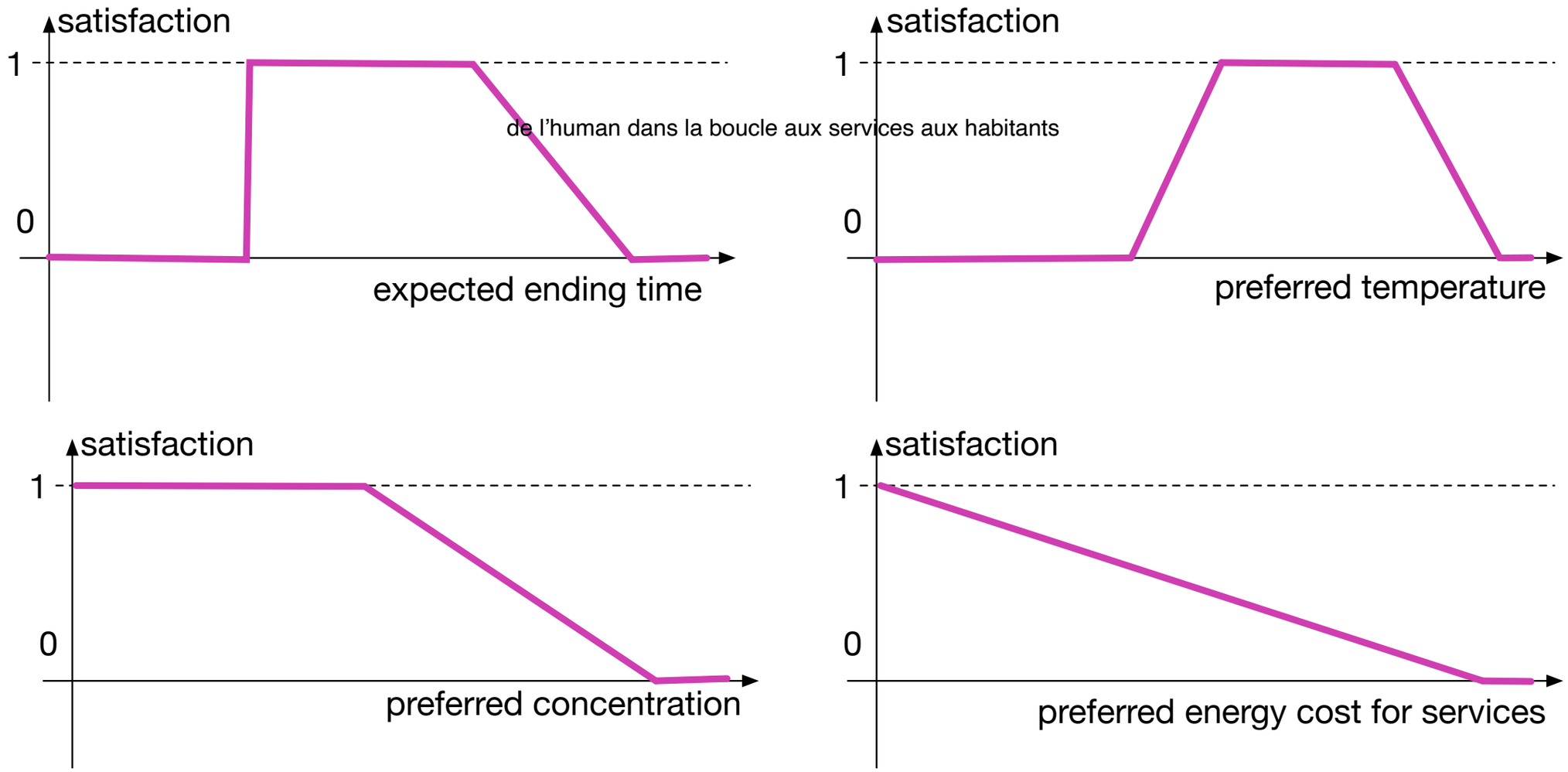
consumption covered by local storage

self-consumption = (+) / (+ +)



modeling services



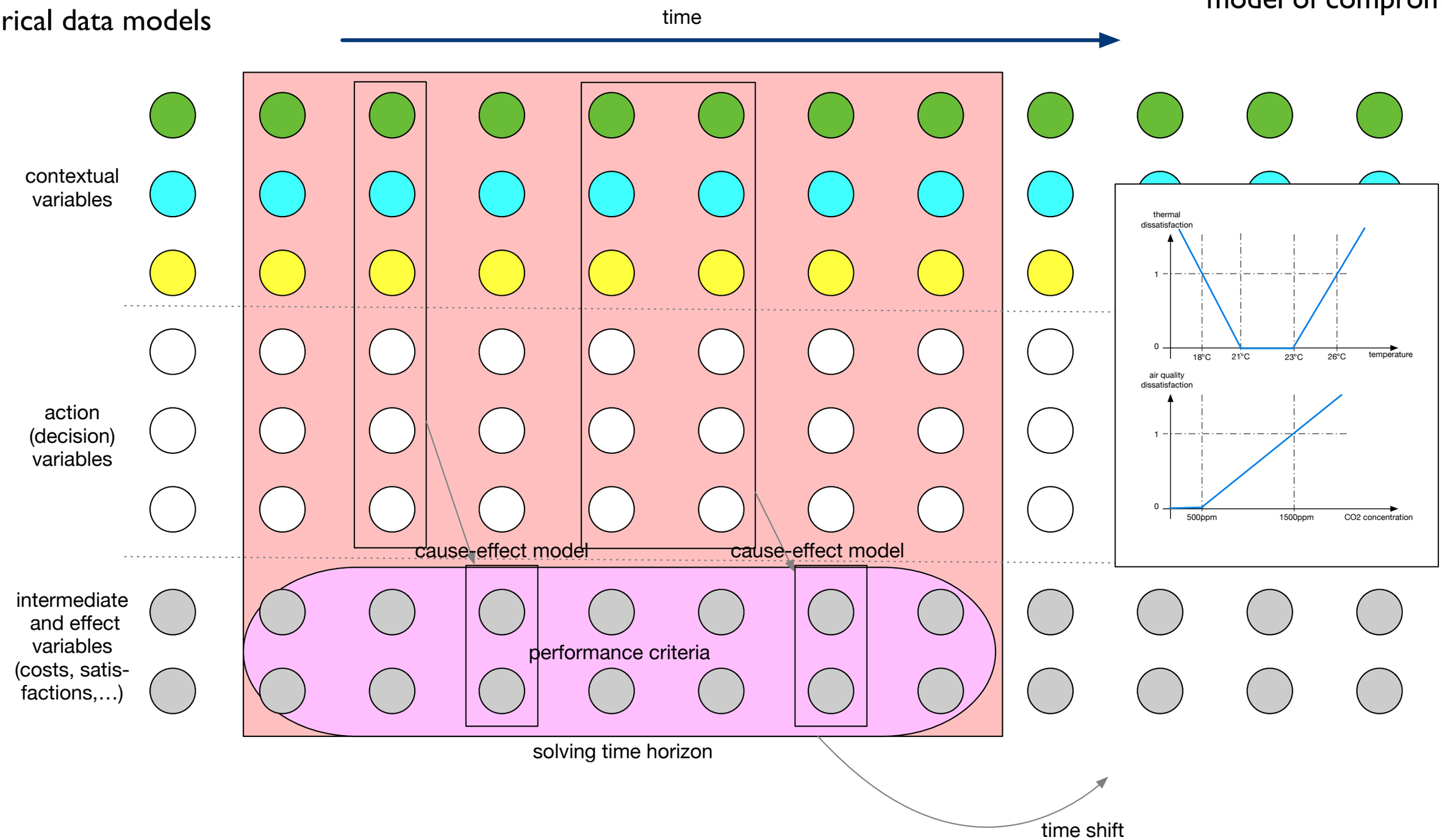


from human in the loop to aiding services for residents

modeling phenomena

causal models
regressive models
knowledge models
historical data models

satisfaction function
cost model
model of compromises



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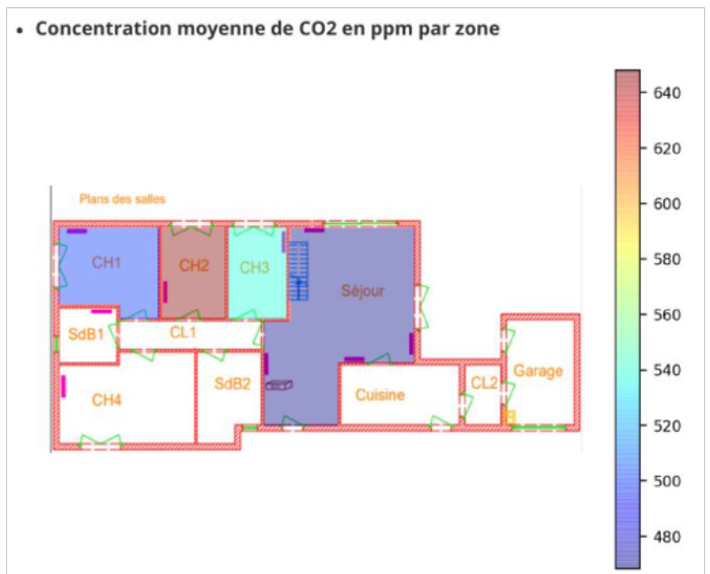
analysis aiding service

adaptive report generator

CO2:

- Concentration moyenne de CO2 en ppm par zone

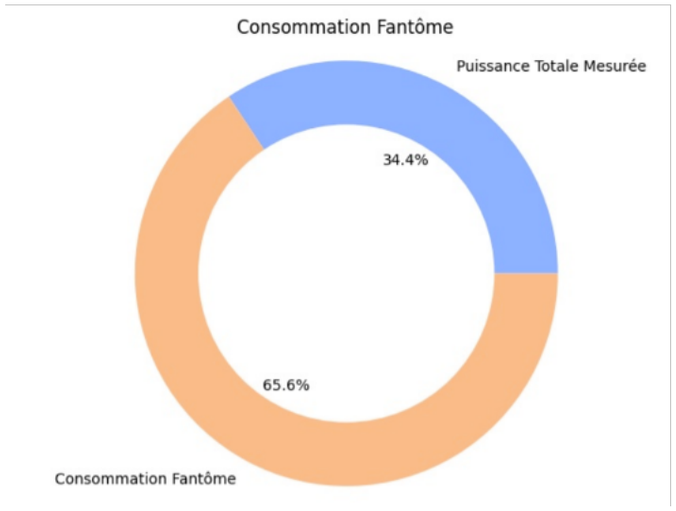


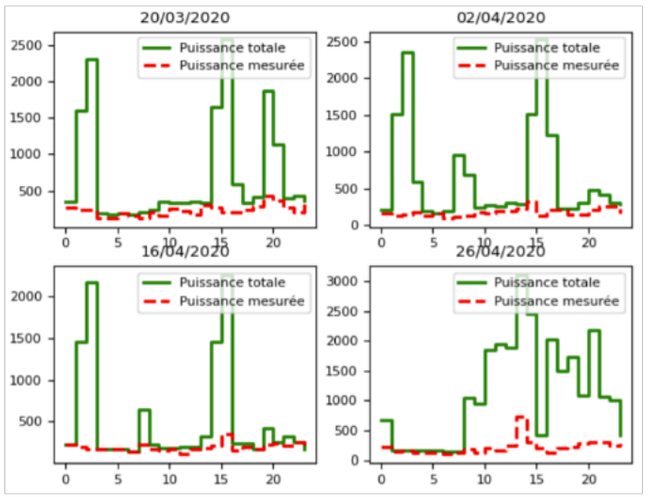
>1000 PPM | >1700 PPM

$$ICONE = 8.3 \log(1 + f_1 + f_2)$$

ICONE	Etat de confinement
0	Confinement nul
1	Confinement faible
2	Confinement moyen
3	Confinement élevé
4	Confinement très élevé
5	Confinement extrême

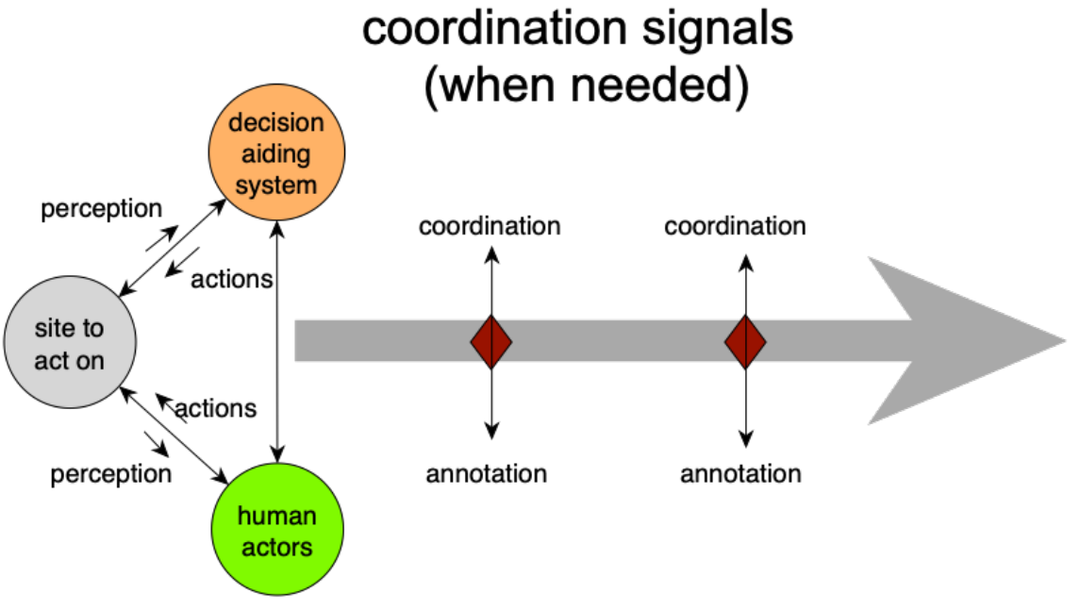
Ghost Consumption



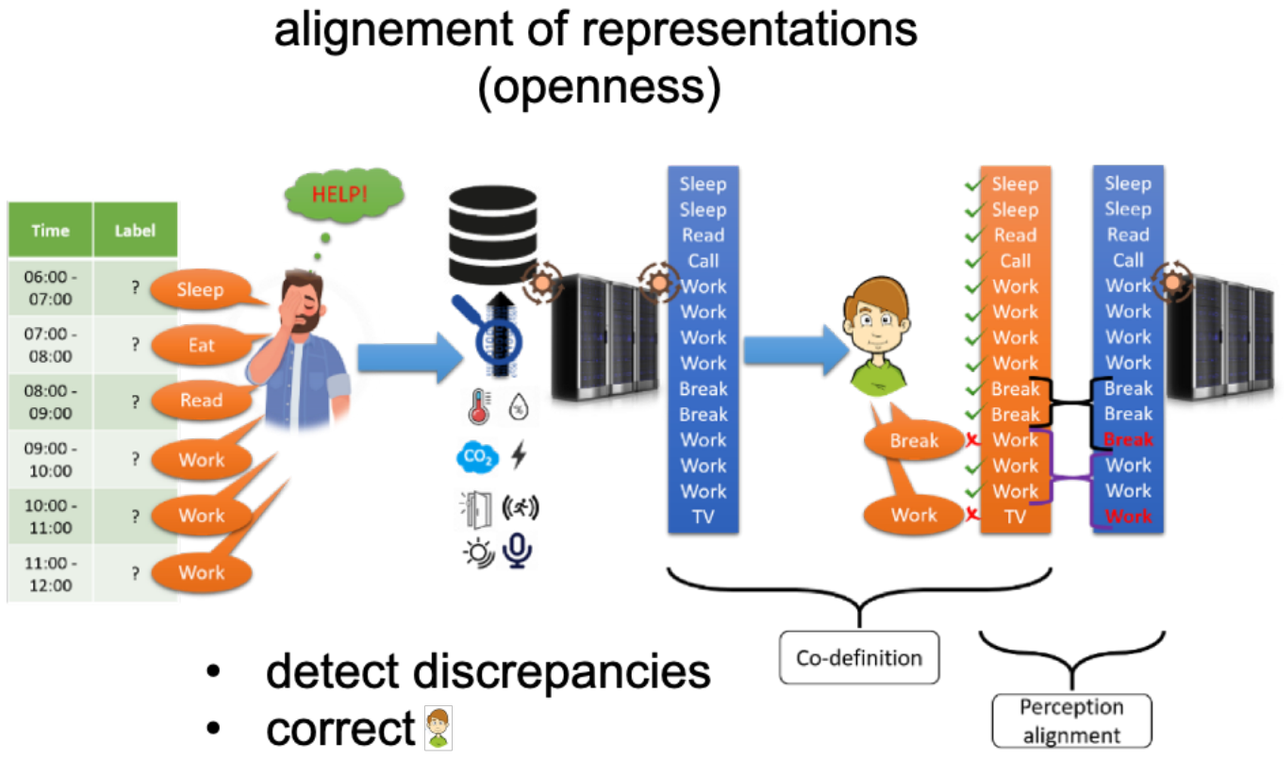


analysis aiding service

Adaptation to people representation while avoiding cognitive over load



- suggest annotations
- annotate when needed
- validate



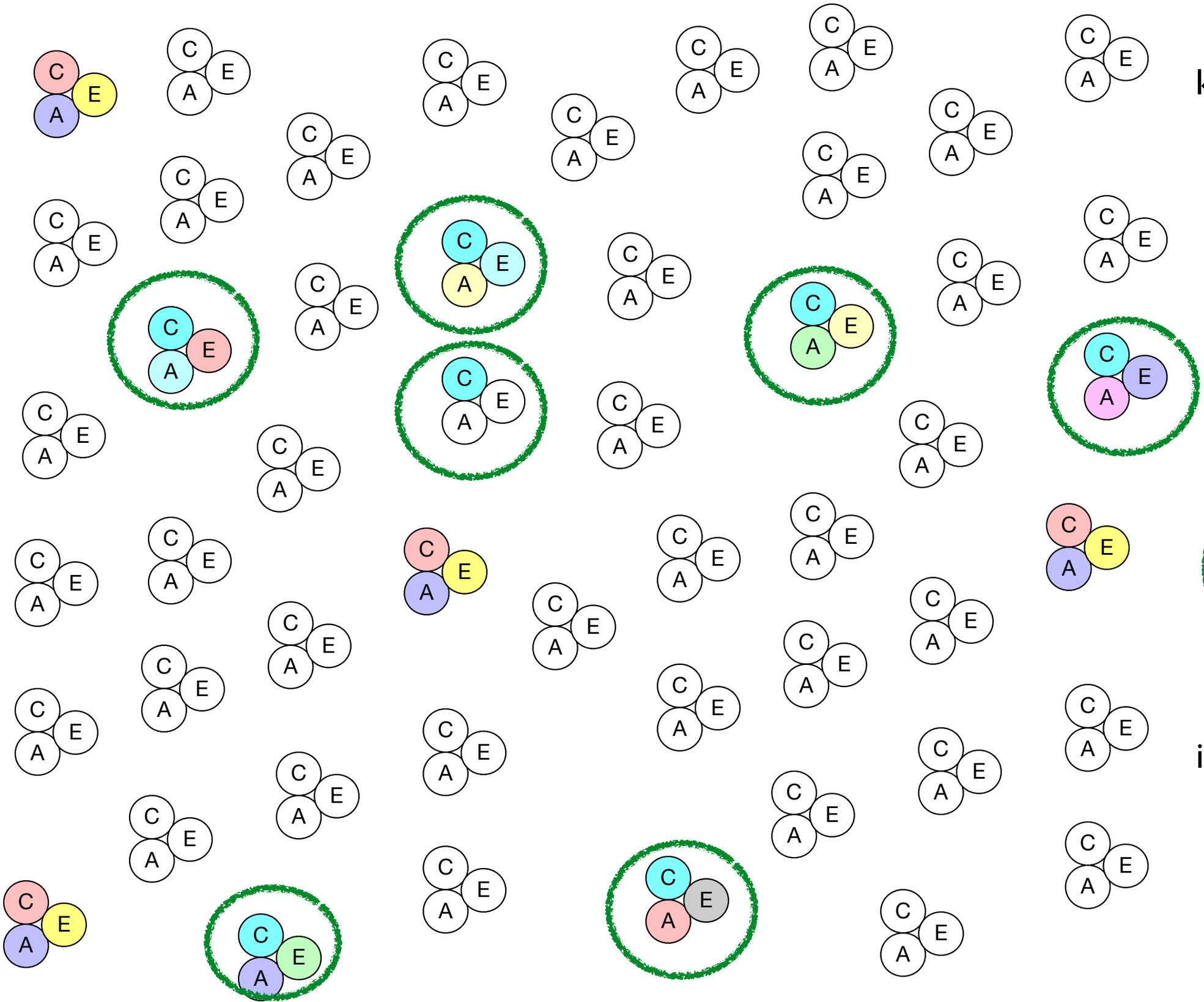
- detect discrepancies
- correct

140 sensors, max 4 displayed
10 seconds: ≈ 5 years

openness and interactivity in learning

dedicated smart annotator embedding knowledge

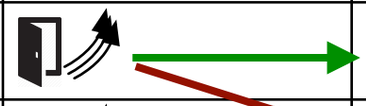
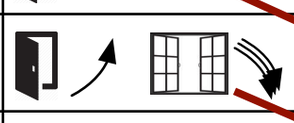
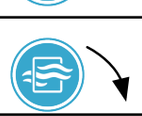
experiment aiding service



kind of case based reasoning with more or less interesting cases

if number of cases to be adapted is low, exploration strategy

explanation generation service

hour	Δ actions	Δ effects	Δ intermediates
08:00			
09:00			
10:00			
11:00			
12:00			
13:00			
14:00			
15:00			
16:00			
17:00			
18:00			
19:00			
ALL			

In the time slot 12h-13h, if you had left the door open much longer, the thermal comfort would have increased a lot, the air quality a little bit and the thermal comfort from 13h-14h would have been impacted, because of the augmentation of the airflow to the corridor

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conclusions

- less GHG means
  - more renewables
  - more efficiency

  → expensive and important impact on LCA
  - more flexibility
  - more sobriety

  → cheap but assistance is needed

- sobriety and flexibility (EC) are coming to the fore
- not necessary to install decision aiding system permanently
- easy to deploy and to setup
- ready for transfer and pass?

GRENOBLE INP UGA

G-SCOP
SCIENCES POUR LA CONCEPTION, L'OPTIMISATION ET LA PRODUCTION

Stephane Ploix
Manar Amayri
Nizar Bouguila *Editors*

Towards Energy Smart Homes

Algorithms, Technologies, and Applications

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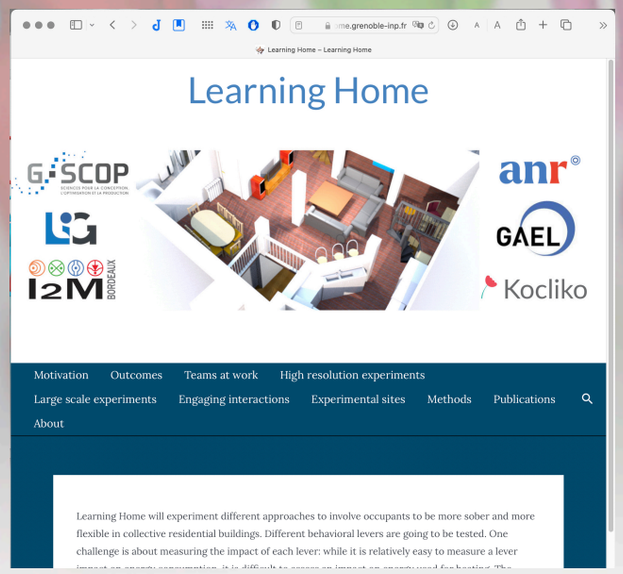

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