

Towards energy behavior change in Smart Buildings using Artificial Intelligence

Rabab Akkouche, Sandrine Selosse, Gilles Guerassimoff
MINES ParisTech, PSL Research University,
Centre for Applied Mathematics, Sophia Antipolis

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Outline

1

General Context

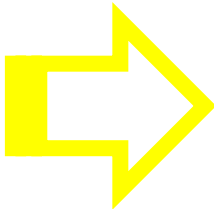
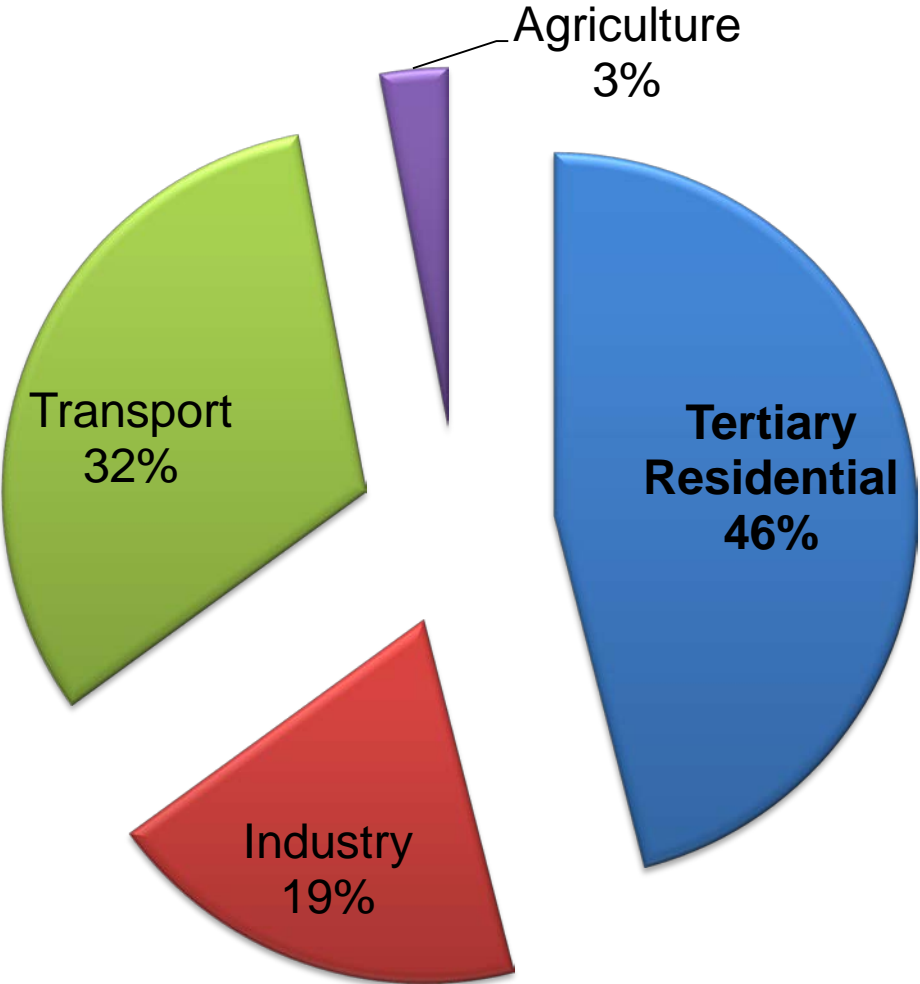
2

Artificial intelligence role

3

How to change occupants behaviour

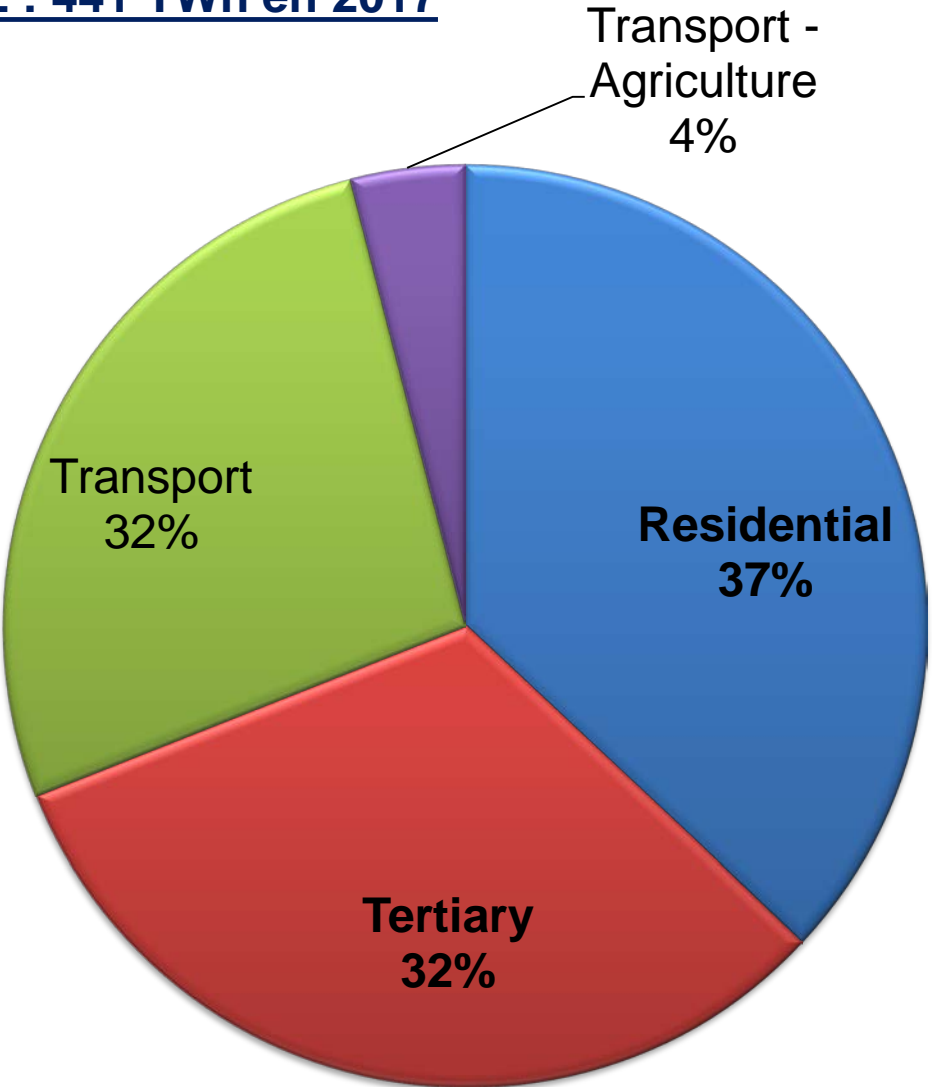
FINAL ENERGY CONSUMPTION BY SECTORS
TOTAL : 144 Mtep en 2018



Most energy
 consuming sector



FINAL TOTAL ELECTRICITY CONSUMPTION BY SECTOR
TOTAL : 441 TWh en 2017

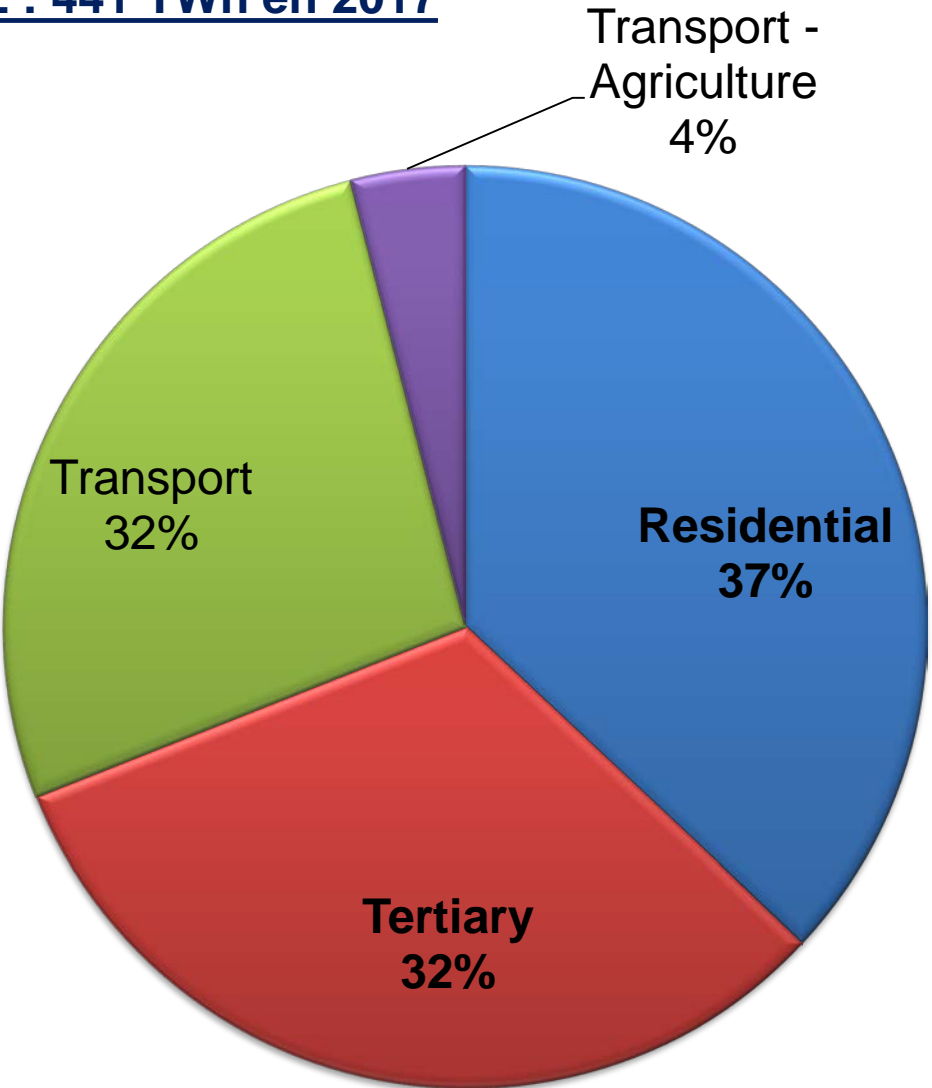


Higher percentage
for total electricity
consumption

Source : calculs SDES, d'après les sources par énergie



FINAL TOTAL ELECTRICITY CONSUMPTION BY SECTOR
TOTAL : 441 TWh en 2017



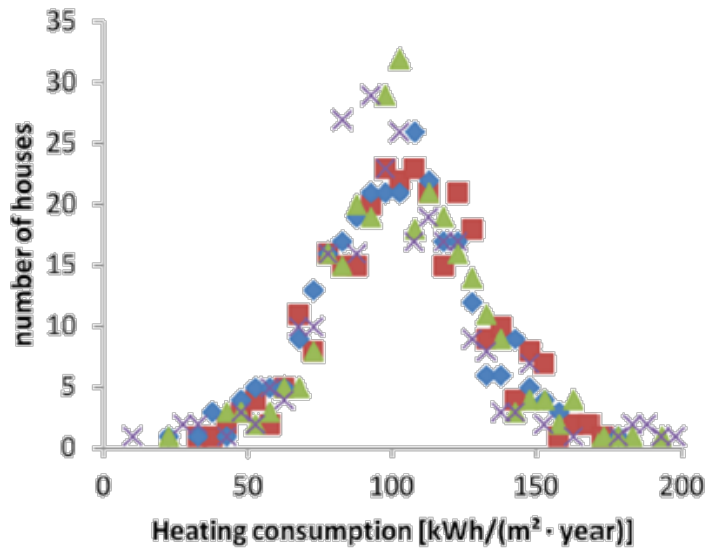
Huge saving Potential !!

Source : calculs SDES, d'après les sources par énergie





Performance Gap:
Difference between predicted energy performance and real measured one



Distribution of heating consumptions for 290 similar houses
(Andersen, 2012)

Data collected from five case study buildings showed that **actual energy consumption** can be five times **higher** than **predicted** one

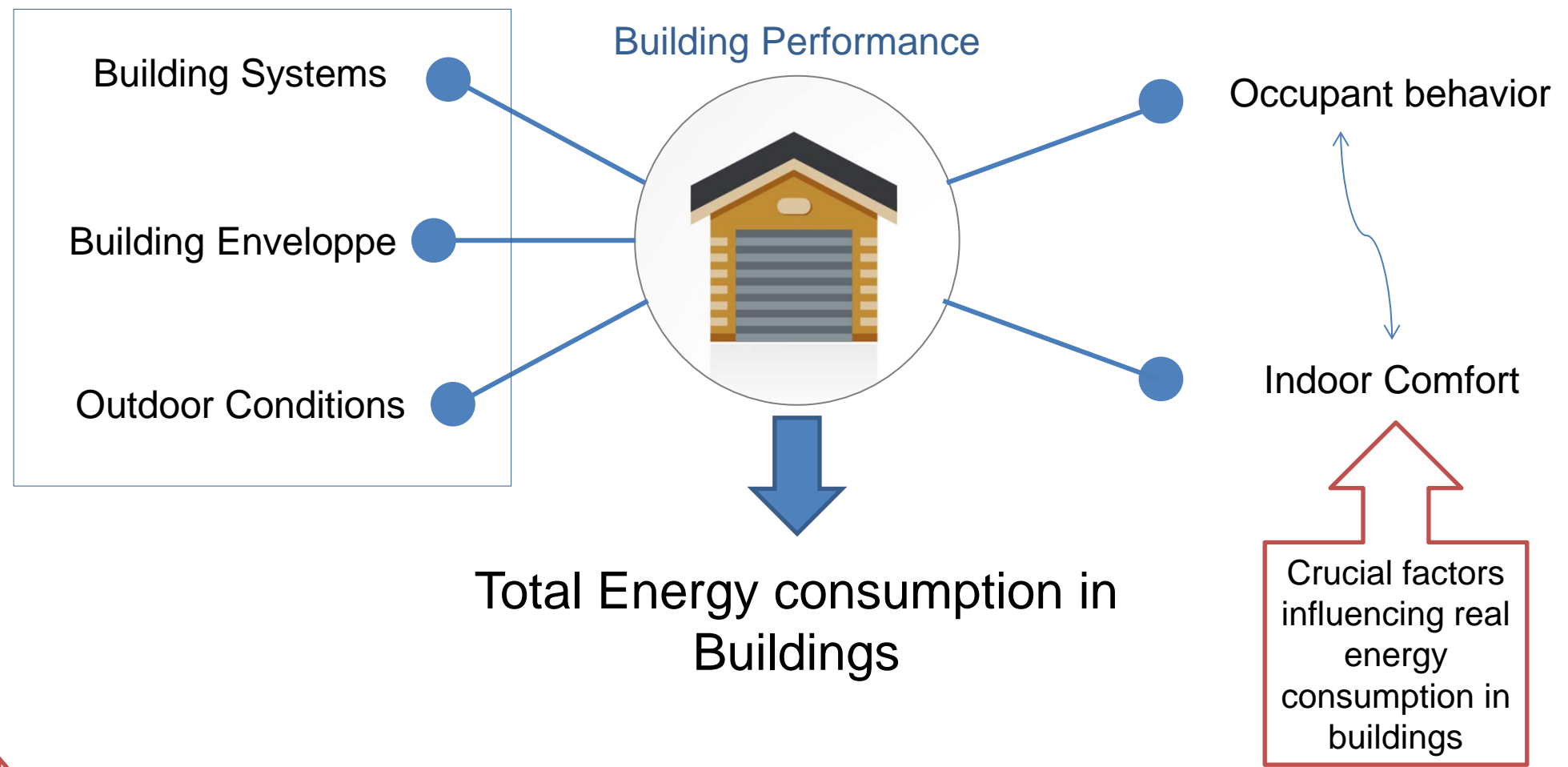
(Carbon Trust, 2011)

Energy consumption can vary **enormously** even for neighbours living in the **same type** of house.
Difference of **51%**, **37%** and **11%** in heat, electricity and water consumptions between **similar** houses.
(Gill et al., 2010)

➡ **“Buildings don’t use energy: people do” [Janda, 2011]**

Technical and physical Factors

Human Factors



➔ Importance of understanding occupant's behavior in buildings



DTS

Dynamic Thermal Simulation

Validation of the final performance of a building by representing its thermal characteristics

Time consuming and unique for each building

Occupant scenarios are deterministic and far from the reality

AI

Artificial Intelligence

No need to have building characteristics, but data

Assessment of the whole building behavior

Possibility to re-use in other buildings with similar characteristics; easier simulations for several scenarios



- AI, when combined with BD, can increase the energy efficiency of buildings by reducing energy consumption while providing occupants with a comfortable indoor living environment.
- Many research works aiming the prediction of building energy consumption using AI:
 - Study of variable effects by Maching Learning
 - Neural Networks Models to predict building energy consumption
 - Deep learning to predict cooling and heating loads ...



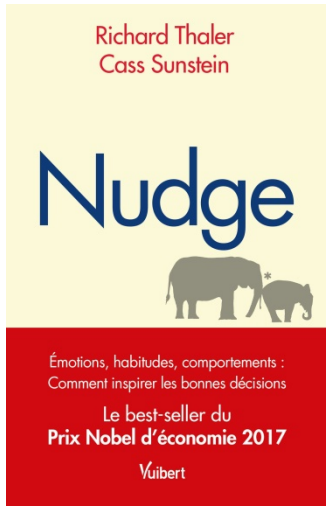
- Objectives:

- Giving more importance to the human factor while predicting energy consumptions
- Studying the impact of occupants' behaviour change on the reduction of energy consumptions by exploring different scenarios
- Developing a global solution that can be applied to different types of buildings in order to estimate energy consumptions while taking into consideration occupants activities

➤ How can we change occupant behaviour in buildings in order to reduce energy consumptions ?

3 Changing behaviours: NUDGE CONCEPT

“A nudge is any aspect of the **choice architecture** that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives.”
 [Thaler et Sustein , 2008]

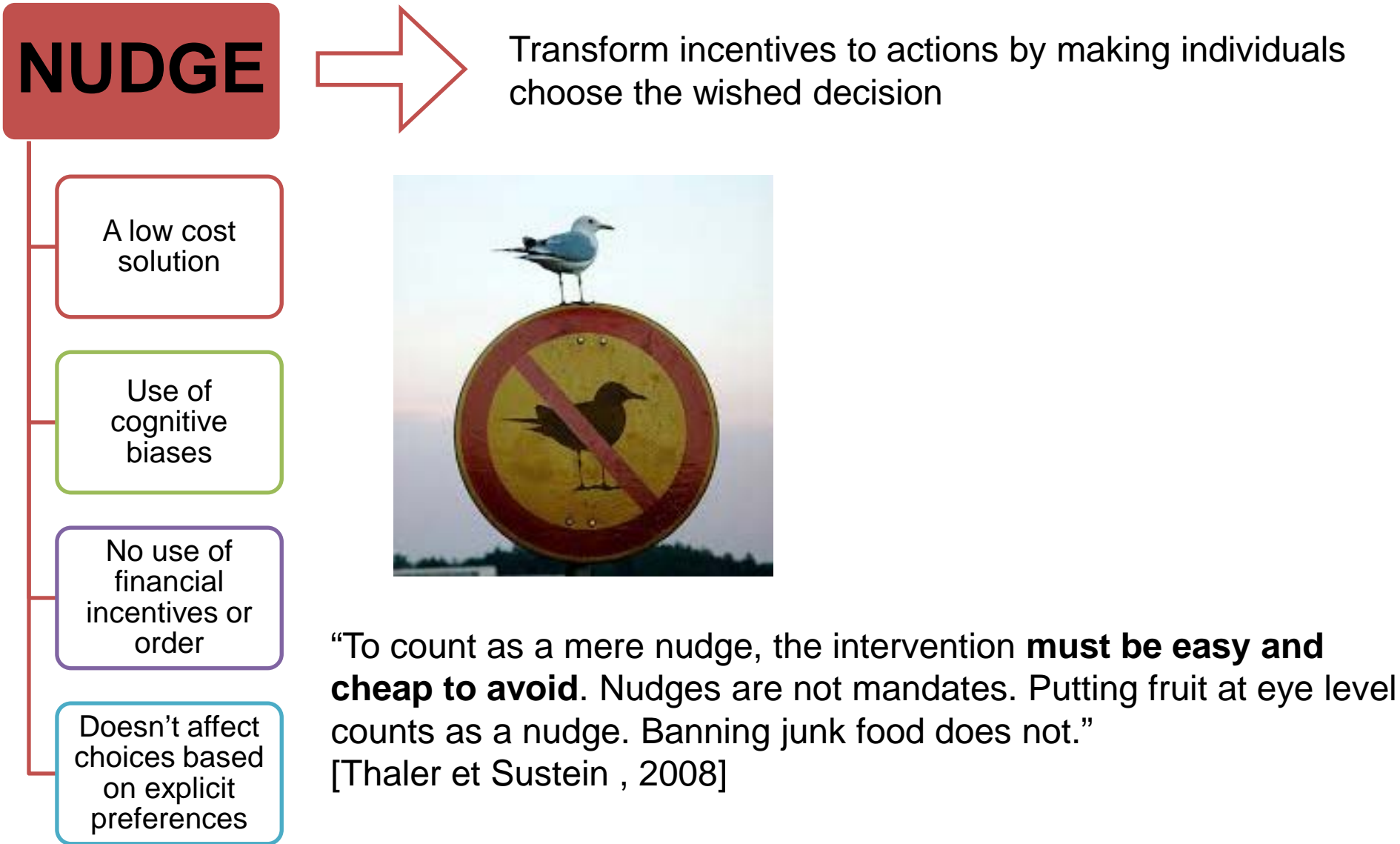


3 Changing behaviours: NUDGE CONCEPT

- Without any message
 ➡ **2,5 %** turned off the lights
- “Please turn off the lights when you leave”
 ➡ **5%** turned off the lights
- “93 % of people are caring about the planet. What about you ? »
 « So, why don't you turn off the lights when you leave ?
 ➡ **40% turned off the lights**



3 Changing behaviours: NUDGE CONCEPT



3 Changing behaviors: MUFFINS: a field experiment

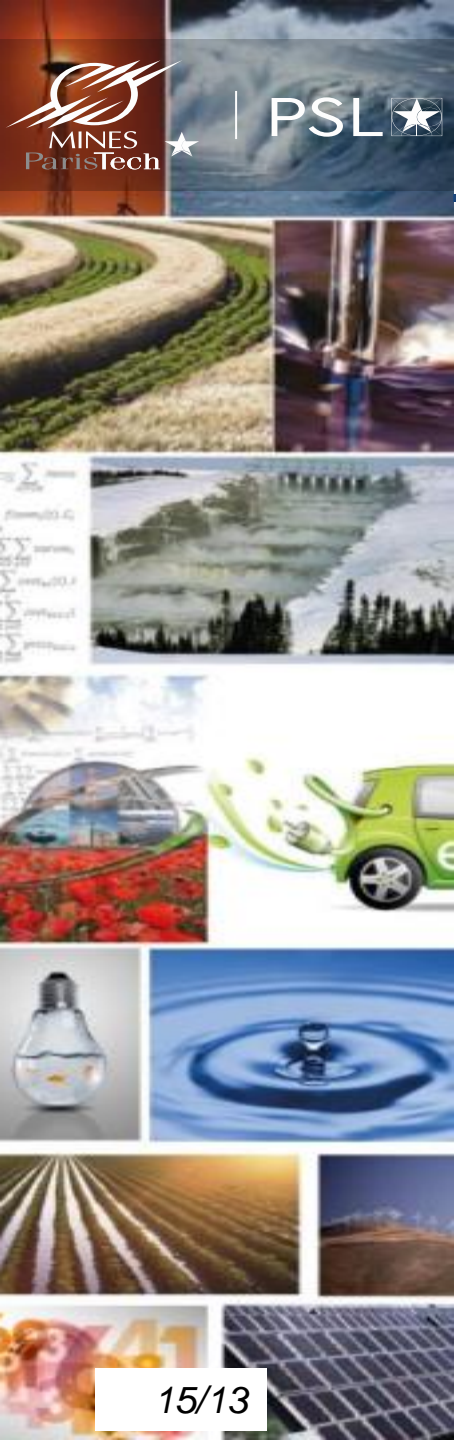
- 3 nudges tested in office building (tertiary environment)
 - Moral appeal (weekly messages expressing a responsible consideration, human consequences of global warming)
 - Social comparison (weekly reports with peer comparisons of electricity use)
 - Stickers (simply give information on good practices on energy consumption)



Christophe CHARLIER*, Gilles GUERASSIMOFF**, Ankinée KIRAKOSIAN** and Sandrine SELOSSE**

* University Côte d'Azur, CNRS, GREDEG, France

** MINES ParisTech, PSL Research University, Centre for Applied Mathematics, France



CONCLUSION

