

Reducing energy consumption in buildings using Artificial Intelligence and behavioral change

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

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- 1 General Context
- 2 Dynamic Thermal Simulation
- 3 Nudges for changing behaviors
- 4 Methodology
- 5 Results
- 6 Conclusion and Perspectives

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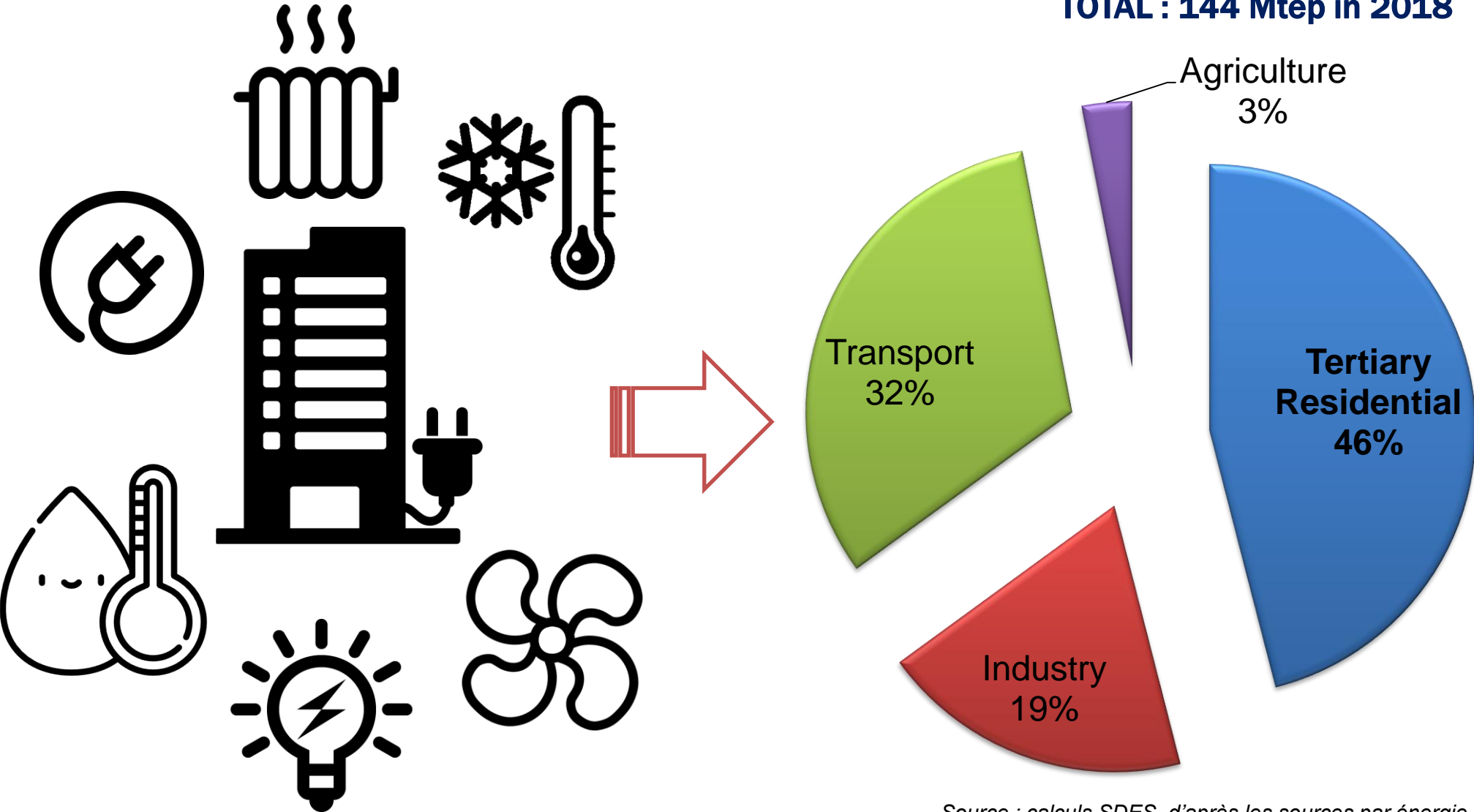


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1 General Context



**FINAL ENERGY CONSUMPTION BY SECTORS
TOTAL : 144 Mtep in 2018**



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

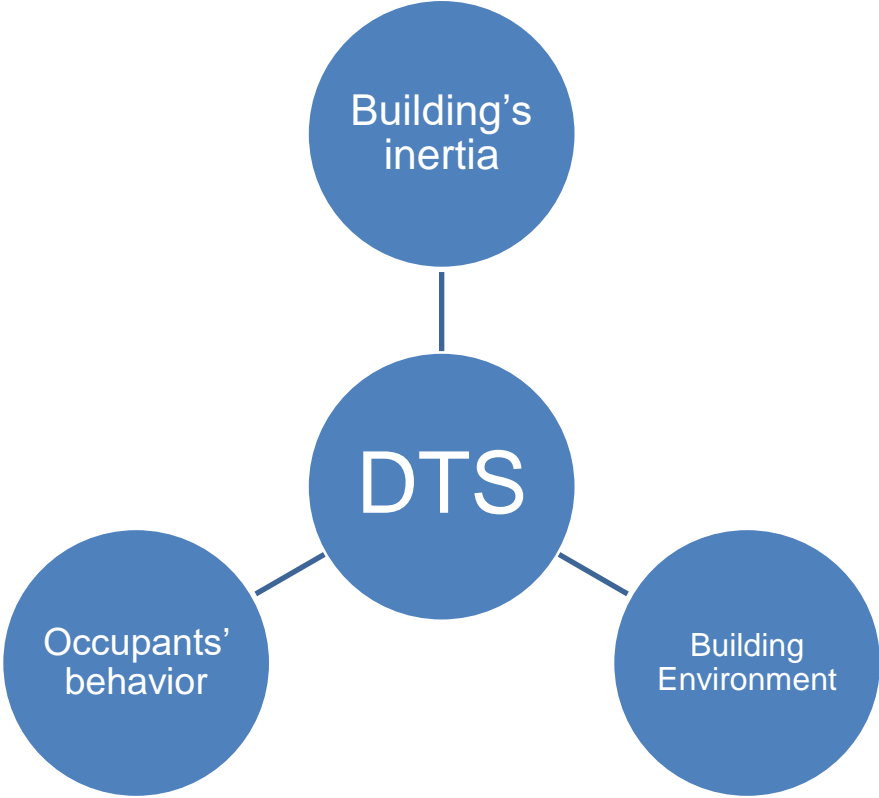
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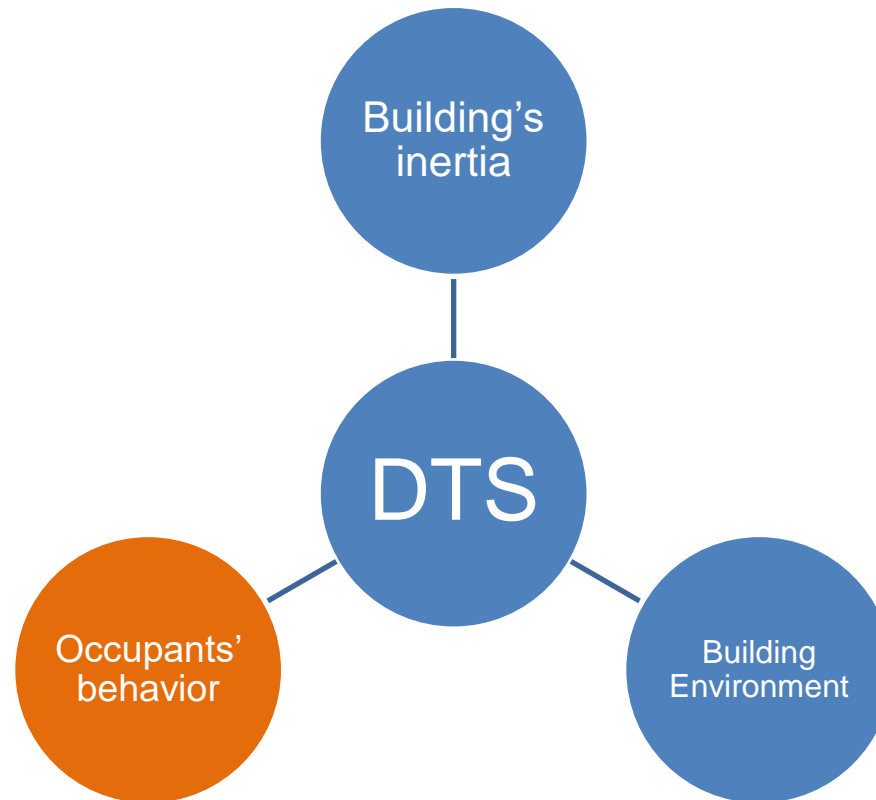
2 Dynamic Thermal Simulation

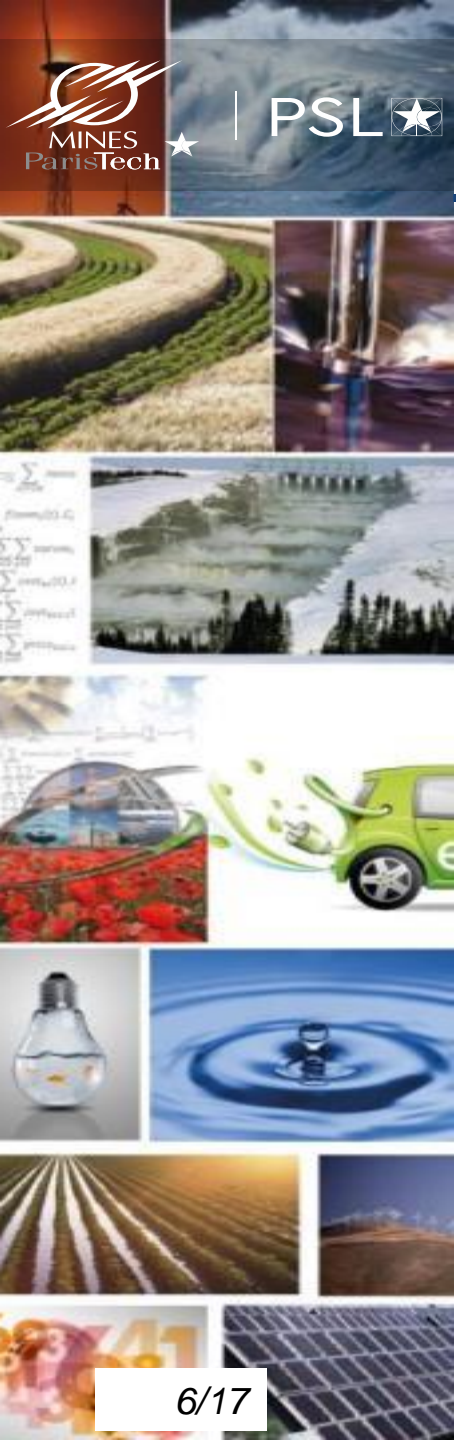
- Dynamic Thermal Simulation (DTS) is used to predict the way a building responds when subject to external environmental factors
- It is also a way to prove the energy performance of buildings and achieve certain ratings.



2 Dynamic Thermal Simulation

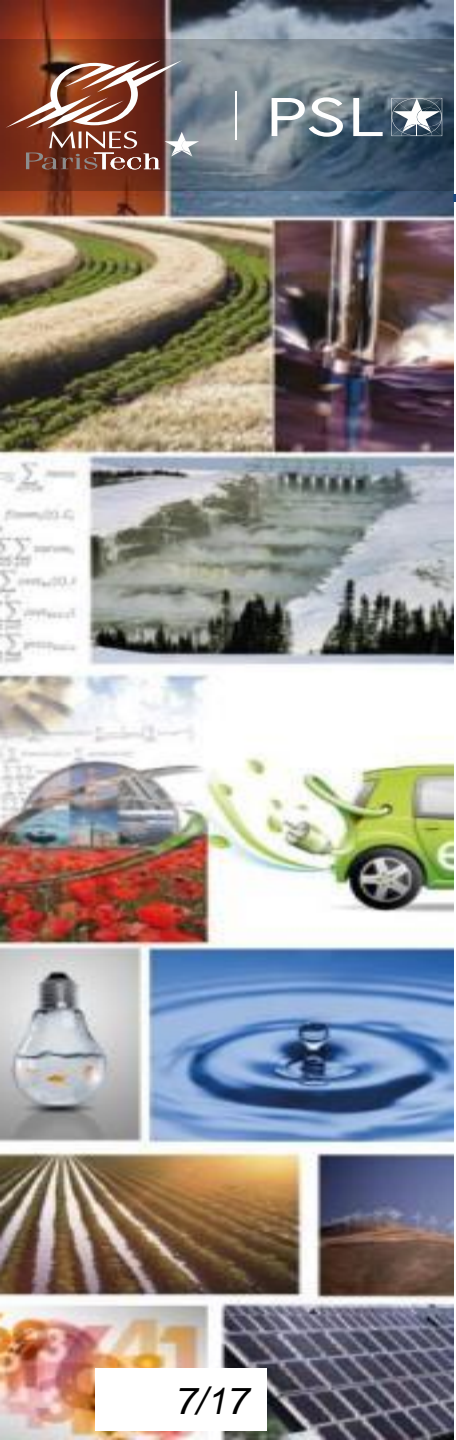
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2 Dynamic Thermal Simulation

- **Two solutions :**
 - Improve occupants' behavior models in order to recreate real behavior in simulation tools.
 - Educate occupants by changing their behavior without any restriction and by respecting their comfort
- **Questions:**
 - How can we change behavior without restrictions on occupants ?
 - How can we simulate this change without experiment ?



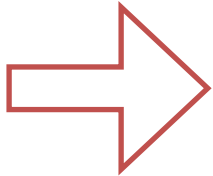
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3

Changing behaviours: NUDGE CONCEPT

NUDGE



Transform incentives to actions by making individuals choose the wished decision

A low cost solution

Use of cognitive biases

No use of financial incentives or order

Doesn't affect choices based on explicit preferences



Giving information is not enough



“To count as a mere nudge, the intervention **must be easy and cheap to avoid**. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not.”
 [Thaler et Sustein , 2008]



3 Methodology



Social Comparison

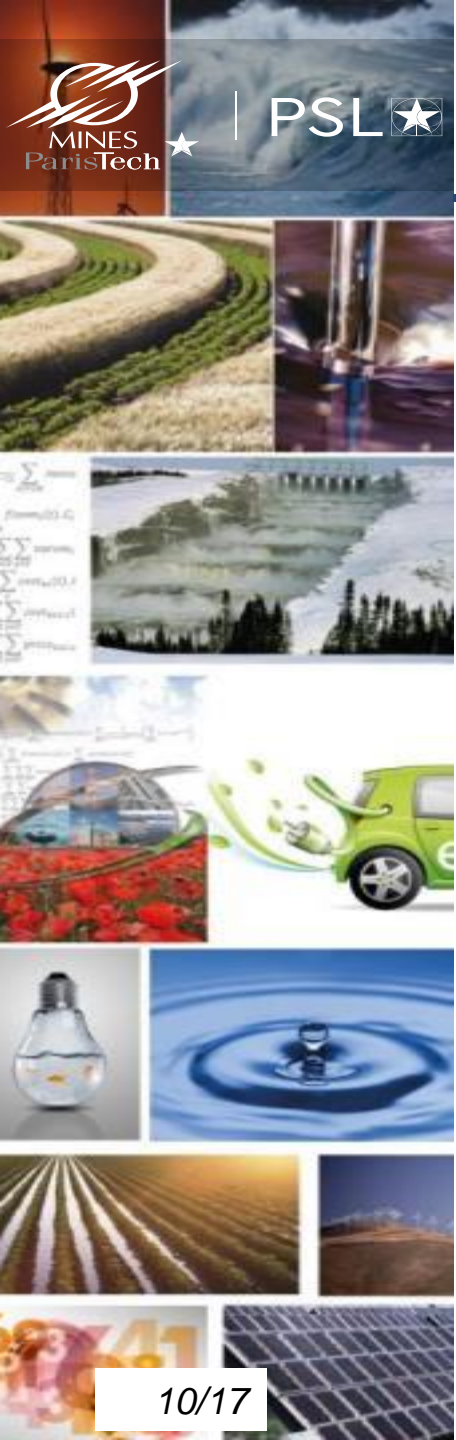
- Based on social norms
- Comparing occupants' consumption to their colleagues
- Giving suggestions in order to reduce consumption

Feedback

- Giving feedback to occupants about their energy use and through which behaviors they can reduce it
- Encouraging occupants by using encouraging messages and smileys

Moral appeal

- Messages expressing a responsible consideration, human consequences of global warming
- Using pictures

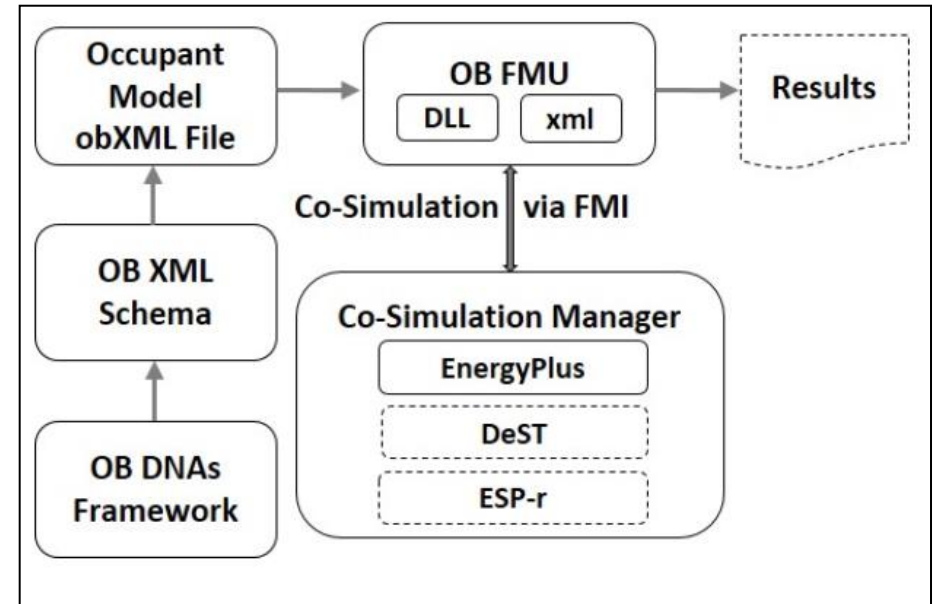
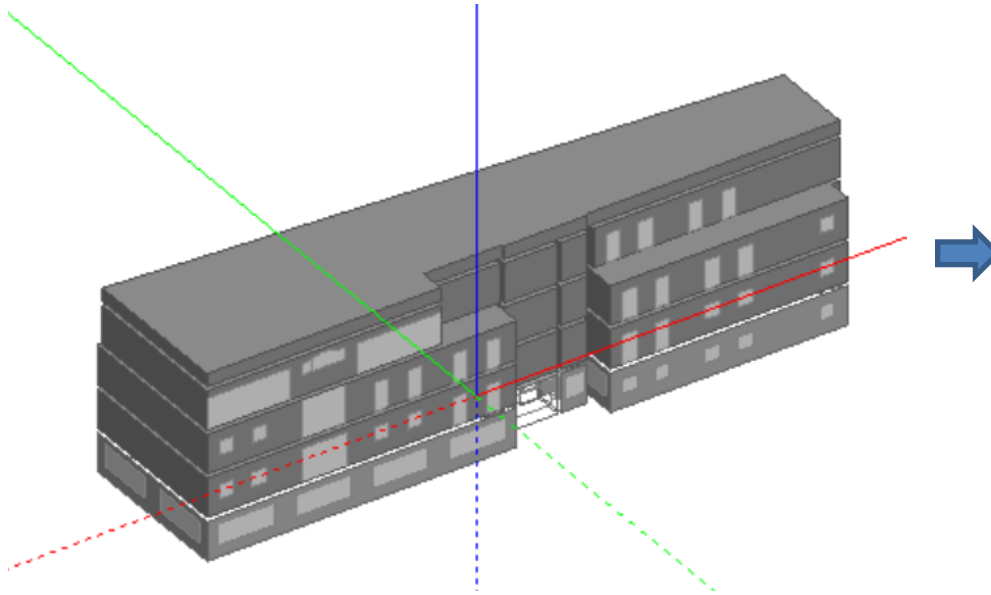


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4 Methodology

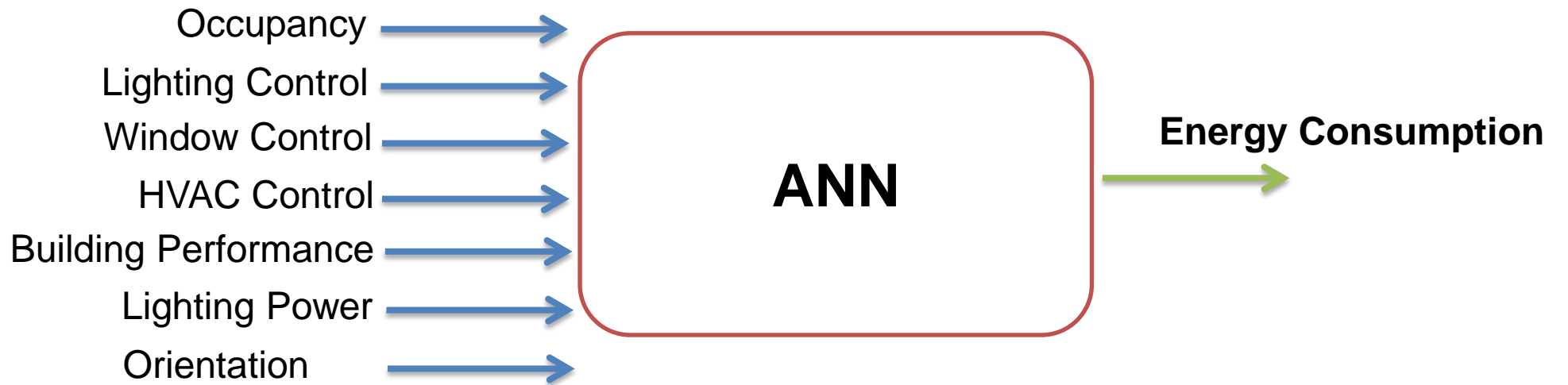
Objective: Using DTS results in order to develop an ANN model to predict energy consumption depending on behavior change



Hong T., Sun H., Chen Y., Taylor-Lange S.C., Da Yan. An Occupant Behavior Modeling Tool for Co-Simulation. Special Issue: Advances in building energy modeling and simulation in Energy and Building, 2015

4 Methodology

- The behavior models used are:
 - Occupancy
 - Occupant lighting Control
 - Occupant window Control
 - Occupant HVAC Control



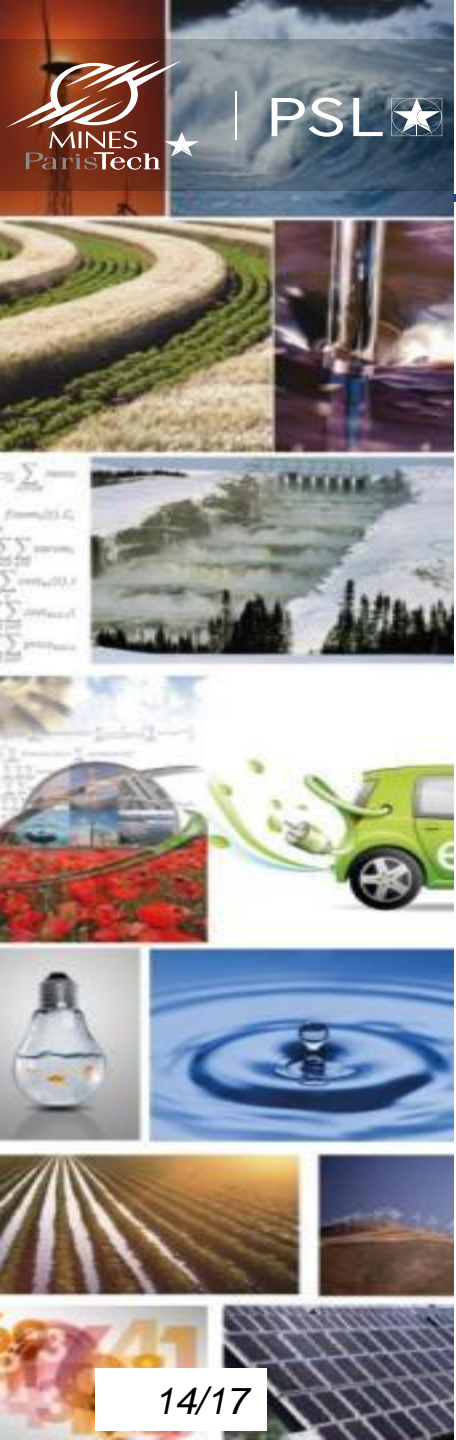
4 Methodology

Experimental Study in the simulated building: **Collecting Data**



- ✓ Validate the ANN model
- ✓ Quantify the impact of using Nudges





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5 Conclusion and Perspectives

- Using collected Data to improve occupants' models
- Defining occupants' patterns depending on experimental results in order to quantify the impact of Nudges
- Suggesting the type of Nudges to use depending on occupant's response to the different intensives used

