The actual loads (62 kWh/m²) were superior to the guaranteed performance value, essentially because of a "rebound effect" on the heating setpoint : average temperatures measured in winter after the renovation approached 23 °C (compared to 20.2 °C before). Guarantee obviously cannot longer apply if the requirements of the inhabitants increase after the renovation. For such a heating setpoint (red curve), the guaranteed performance would have been 75 kWh/m².

Table 4. Thermal characteristics of the building

Facades	U = 0.22 W/(m².K)	Thermal bridges	Psi = 356 W/K
Loggias	U = 0.23 W/(m².K)	Mechanical ventilation flow	0.3 vol/h
Low floor	U = 0.49 W/(m².K)	Air infiltrations flow	0.15 vol/h
Roof terrace	U = 0.29 W/(m².K)	T° setpoint before works	20.2 °C
Windows	U = 1.9 W/(m².K)	T° setpoint after works	22.8 °C

CONCLUSION

A comprehensive stochastic model of occupants' behaviour in residential buildings is proposed. It integrates an original model for the creation of virtual individuals described by a set of socio-demographic parametres. This allows a high degree of refinement in the generation of schedules and in the attribution of equipment to households according to statistical data. The use of appliances and lighting is modeled on the basis of inhabitants' activities with a higher accuracy than existing models from the literature, through data from several large measurement campaigns. A reference model for interactions of occupants with windows was adapted. The whole model is coupled to a dynamic BES tool with no more necessary input than the building description (but any available information on inhabitants' characteristics or equipment can be filled by the user). The distribution of the simulation outputs is than obtained using the Monte-Carlo method. In the case study, it was observed that the monitoring of temperature setpoints in winter is essential in a process of EPG (knowing that it can be easily and reliably implemented at low cost). If not, considering the possibilities of evolutions of the temperature setpoints leads to a wide distribution, unexploitable in this context. However, this aspect being under control, a commitment on a guaranteed value becomes possible. In this case the guaranted value would be 38 % higher than the value calculated with conventionnal deterministic scenarios.

In further studies the whole coupled model will be encapsulated within the statistical software R. The influence of different parametres of the integrated model will be analysed to identify the aspects on which attention should be paid in terms of improvement and data collection. The outputs of interest will include heating loads but also domestic electricity consumptions and comfort indicators.

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