

Fig. 8. Example of electricity consumption management of a washing machine using a smart plug.

### B. Management of the cost of electricity consumption using a storage system

As can be seen in Figure 9, the storage system is used by the management system to postpone the electricity consumption in peak hours. The strategy is based on the choice of the storage capacity.

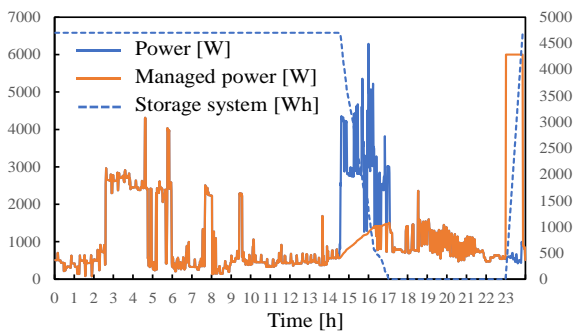


Fig. 9. Example of management with storage system.

The characterization results of the reference houses highlight that the mean daily electricity consumption of houses equipped with electric heating (*i.e.*, 17,858 Wh) during the peak hours is higher than the houses equipped with gas heating (*i.e.*, 4,792 Wh). Regarding the houses equipped with electric heating, the mean daily electricity consumption strongly depends on the season (*e.g.*, 10,228 Wh in the summer; 13,536 Wh in the autumn; 23,385 Wh in winter; 25,179 Wh in the spring).

Figure 10 shows a cost-benefit analysis of a management system equipped with a storage system coupled with a converter.

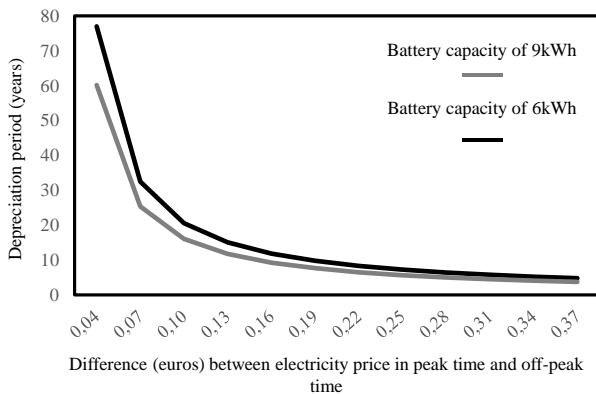


Fig. 10. Depreciation period of a management system (battery + inverter) according to the price of electricity.

The simulations were performed with the following assumptions: the prices of the storage system, the inverter, and the installation are about 200 euros/kWh, 800 euros, and 1,500 euros. From Figure 10, the higher the price at peak hours, the greater the savings.

## 5. Conclusions

In this article, a new software tool is proposed to get a better understanding of the cost of electricity consumption in individual housing. This software tool, named ECCO, is based on real consumption patterns of AC loads.

Two case studies are proposed to manage the cost of electricity consumption. The first one, which uses smart plugs, shows that electricity savings can be achieved by shifting the electricity consumption of energy-inefficient appliances (*e.g.*, washing machines...) to the off-peak hours. The second one, which is based on a storage system (*e.g.*, batteries) coupled with a converter, shows that it is possible to postpone the electricity consumption in peak hours.

The analysis of the depreciation period of a management system using batteries highlights that such a system is not profitable in France, because the difference between the electricity prices in peak time and off-peak time is low. However, this strategy may be interesting in other countries where this gap is significantly higher. For example, such a system implemented in a house located in Victoria (Australia) may have a depreciation period lower than ten years (the difference between the electricity prices in peak time and off-peak time equals 0.25 euro/kWh).

## Acknowledgement

These research activities are currently supported by “Région Centre Val-de-Loire” (research project number: 2015-00099656). The authors of this manuscript thank our colleagues from this institution who provided insight and expertise that greatly assisted the project.

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