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PROJECT
ENERGY MANAGEMENT

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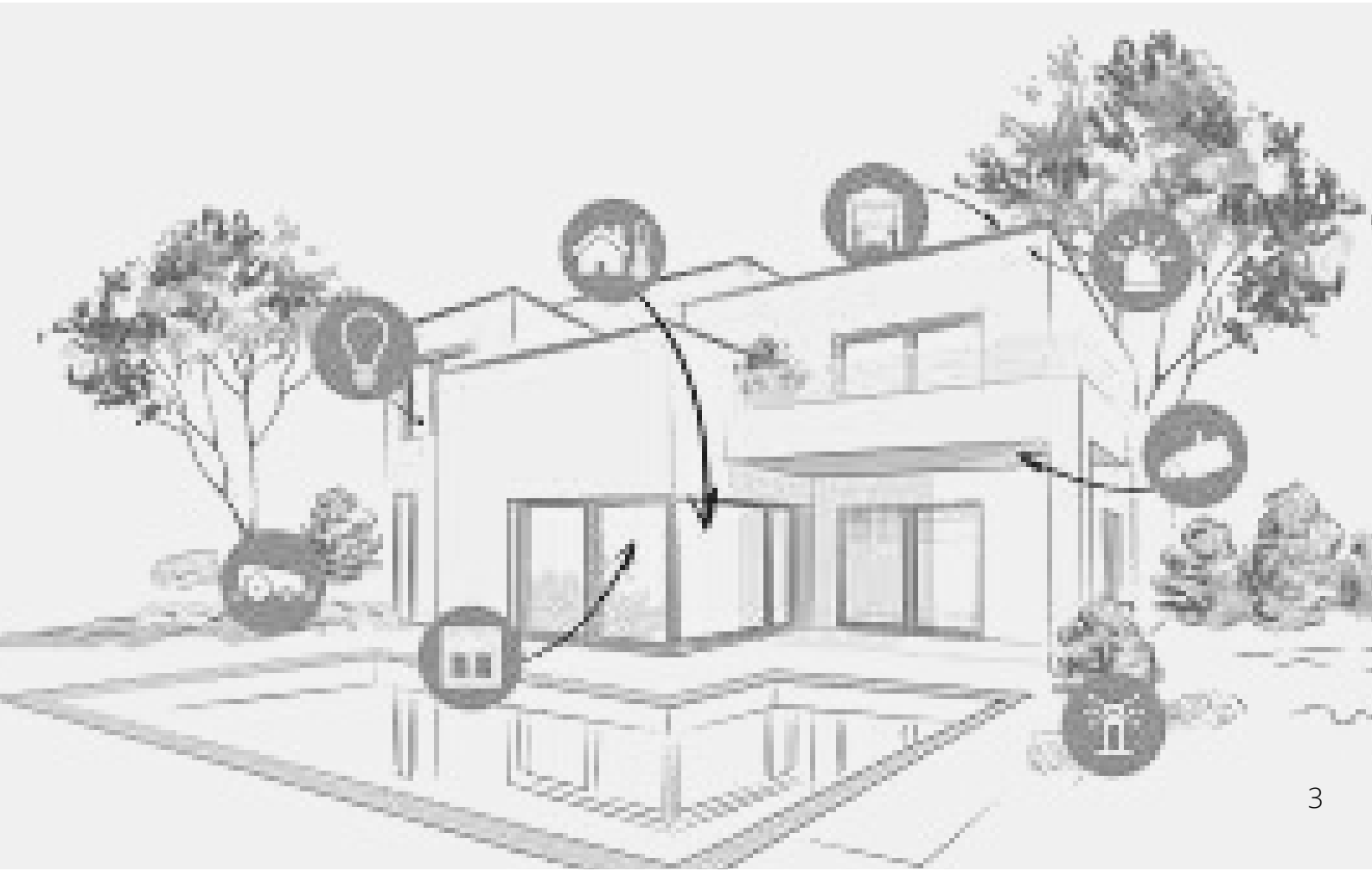
SUMMARY

ABSTRACT

If ecology and saving energy seems to be a turning point recently in politics (for example in France), they stay an scientific issue. In fact, saving energy is one of the most important scientific challenge and it goes with industrials and particulars.

This is all the more important from an ecological and economic point of view because in France the average expenditure of households for housing energy is 1602 euros in 2019 (and we are currently experiencing significant inflation on energy).

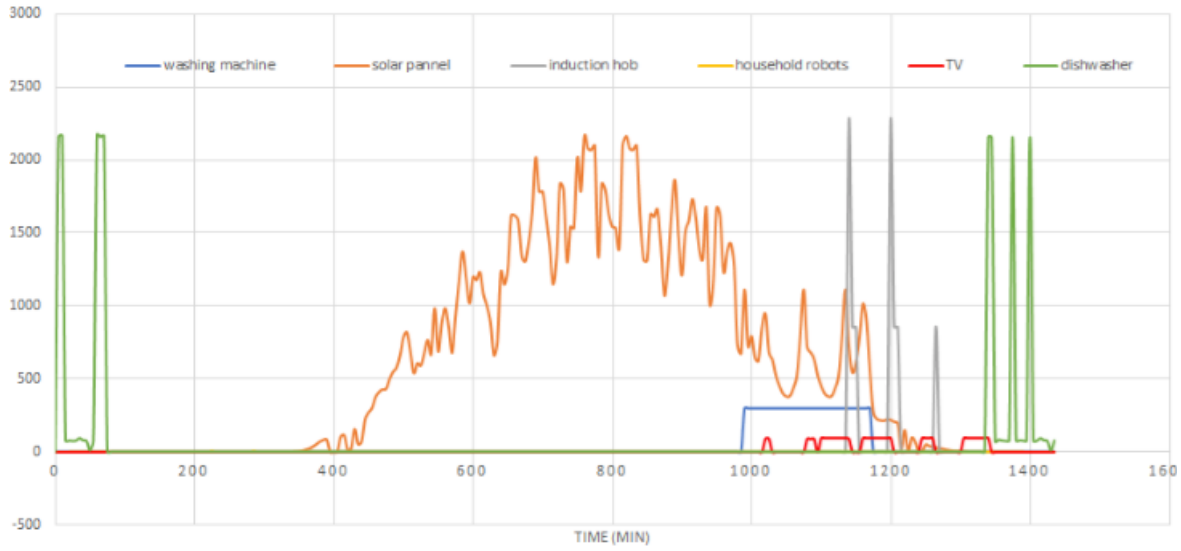
Thus, our work focuses on home automation and how we can optimize the use of energy in a house. More specifically, the following article focuses on how we can optimize the use of our electronic devices, particularly with regard to the production of electricity by solar panels and tend towards self-supply of the house.



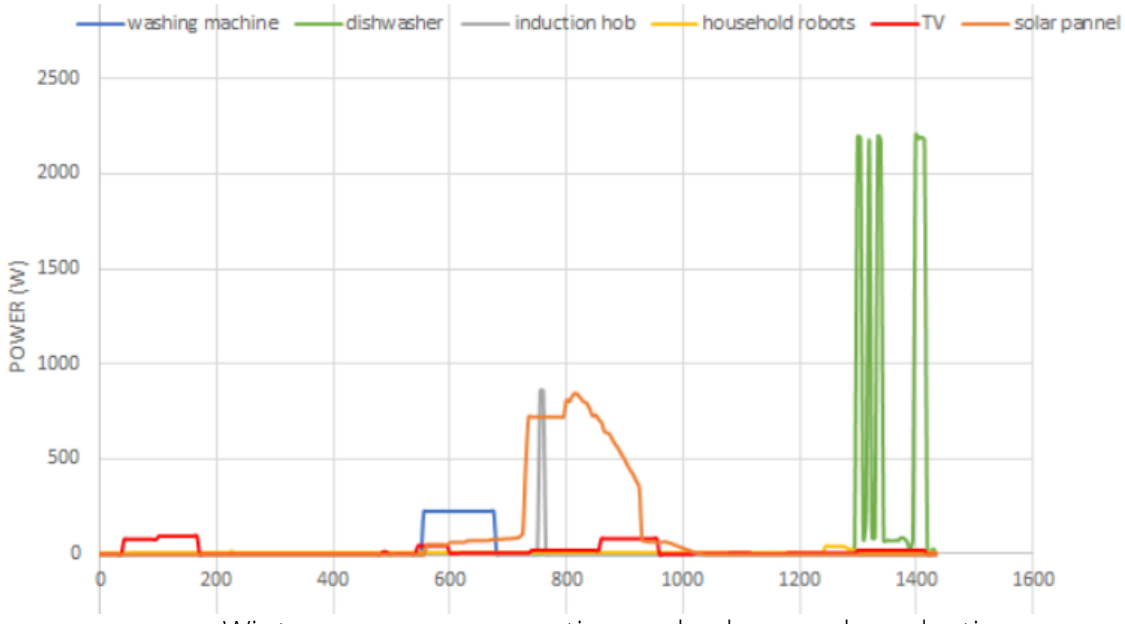
DETERMINATION OF THE APPLIANCES CONSUMING THE MOST IN THE HOUSE

First of all, to simpify our work we will focus on the devices that need to be used ponctually and consume a lot.

The graph below shows the electricity consumption of various appliances over two days (one in winter and one in summer) :



Summer energy consumption and solar panel production



Winter energy consumption and solar panel production

These graphs show that there are espacially two devices that consume a lot : the dishwasher and the washing machine.

Furthermore, these two devices can be programmed offline and so easily optimized according the power supplied by the solar panels.

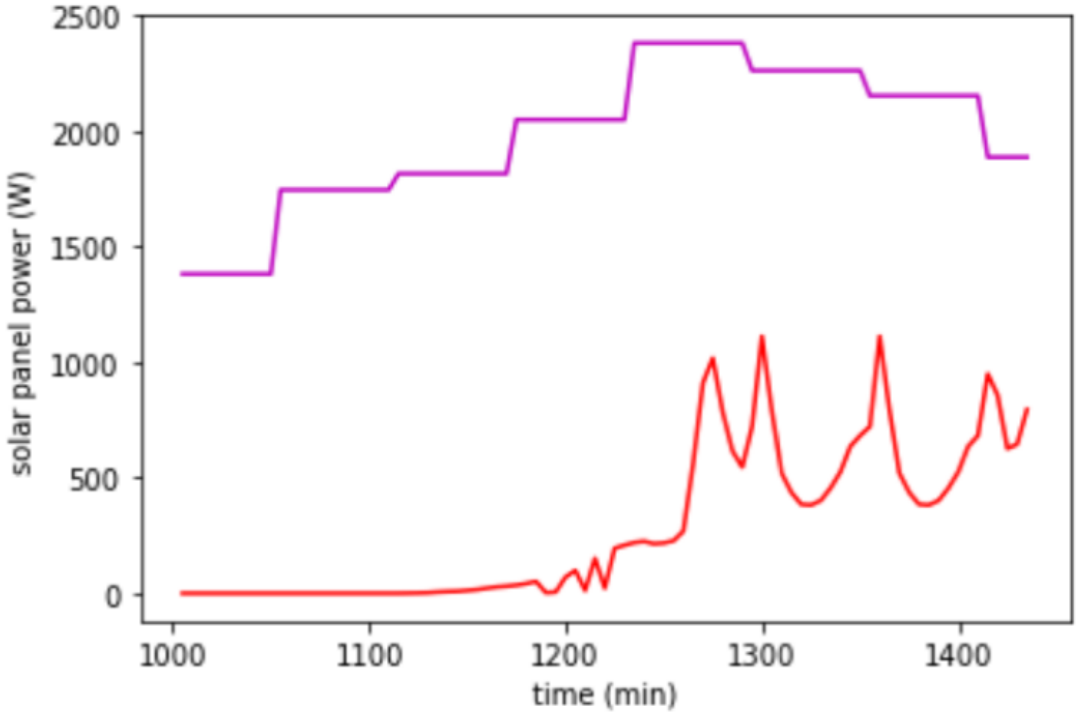
Induction plates are not taken into account because they cannot be programmed to be used as desired.

IMPLEMENTATION OF PRODUCTION PREDICTION

The purpose of our study is to predict using the weather, sunshine and other parameters the power produced by solar panels depending on the time of day. Thus, a system could send to the inhabitant of the house whether the dishwasher or the washing machine can start and therefore use the energy of the solar panels available at that time and not that of the network.

In our study we are mainly interested in the summer data (from 22 mi 2022) as well as in the optimisation of the dishwasher only, the household appliance that requires the most energy for one cycle. The challenge is to estimate from part of the data the power produced by the solar panels. This is necessary to predict at what time the energy produced will be maximum and sufficient to operate the dishwasher.

To estimate the power of the solar panels, we will use the meteorological data, i.e. wind speed, cloud cover and humidity (in percentage).



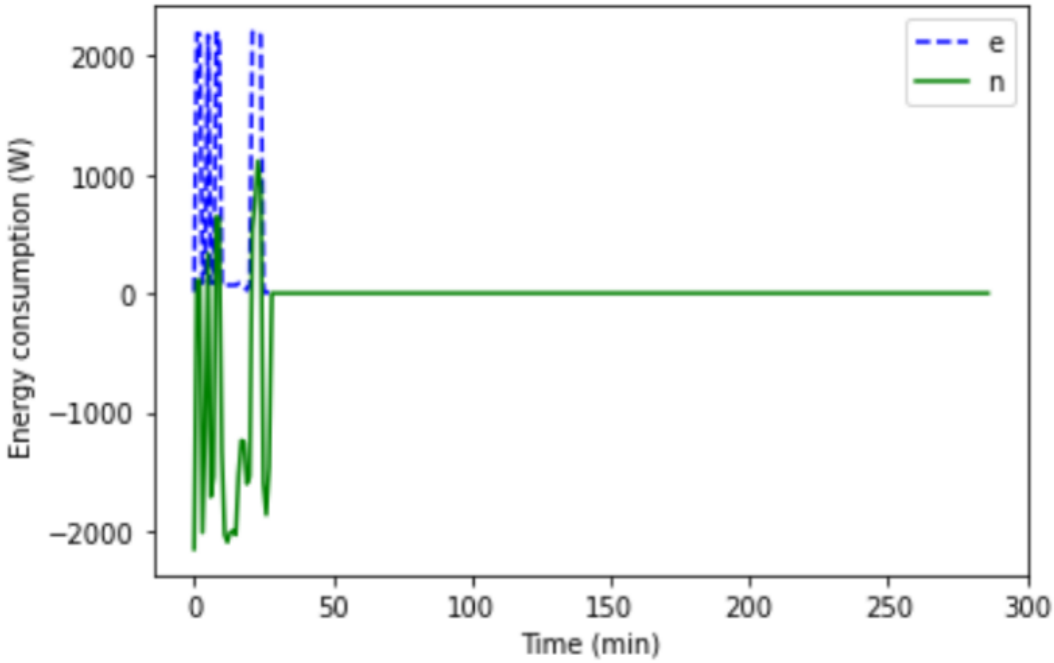
We obtain in red the real curve (with the data of the solar panels) and in magenta the estimated curve.
These curves are not at all identical. The power is very badly estimated probably because of the low number of features we considered. However, the first peak at the maximum value is obtained at the same time for both cases, so we can determine with the predictions the ideal time to operate the dishwasher.

CALCULATION OF THE SAVINGS GENERATED

We will now use the solar panel data to calculate how much energy we save if we use the instantaneous power from the solar panels to power the dishwasher.

We note the first peak in the output of the solar panels. At this point, it is assumed that the washing machine is being run simultaneously.

The following graph is obtained.



The green curve shows the energy consumption with the help of the solar panels and the blue curve shows the energy consumption without the solar panels over a period of operation of the dishwasher.
The power is negative when the solar panels produce more than the dishwasher needs.

The needs of the dishwasher can be summarised according to the two cases:

required grid power with solar panel in parallel	required grid power without installation of solar panels
5 157.12 Watts	21 225 Watts

We conclude that using the instantaneous power of the solar panels allows the inhabitant to divide his electricity consumption by 4.

CONCLUSION

According to our study, optimizing the timing of household appliances is one way to better manage energy consumption.

Ideally, the appliances that consume the most energy should run when the solar panels are producing energy. We have seen that by doing this, the washing machine consumes 4 times less energy from the grid if it was run at 12:40 (for 22/05/2022). We could do the same with the washing machine for example.

However, our prediction results have shown us that it is difficult to predict the output of solar panels. This is not a big problem because the most important thing is to know when this power reaches a near maximum value. Thanks to this, it is possible to predict in the morning at what time the inhabitant will have to switch on (by manual or digital activation) his appliances.

Obviously the efficiency of this method will not be as great in the winter because the solar panels produce much less energy and over a shorter period.