Anomaly detection in

Individual household electric power consumption

Summary

In this study, **we explored the energy consumption on a household in the city of Sceaux for 4 years to find opportunities of value.**

We found that the main part of the consumption is highly seasonal, with maximum consumption in cold months. This part could include electric heating.

We propose to use these data to build an alerting service for alerting a customer when his consumption differs from his usual consumption in a similar context.

Indeed, causes for overconsumption in heating could come from :

- counscious change in inhabitants habits

  example : one inhabitant doesn't work anymore, is staying more often at home

- unconscious change in inhabitants habits

  example : one has increased the thermostat and forgot to decrease it. The family has gotten used to live with a higher temperature at home.

- maintenance needed

  examples : the heating thermostat is not working properly anymore, or the living room sliding door is not perfectly closed anymore.

For the second last items , when informed, the inhabitants could take actions to control their consumption.

➔ **Customers could be willing to subscribe to an alerting service.**

Consumption exploration

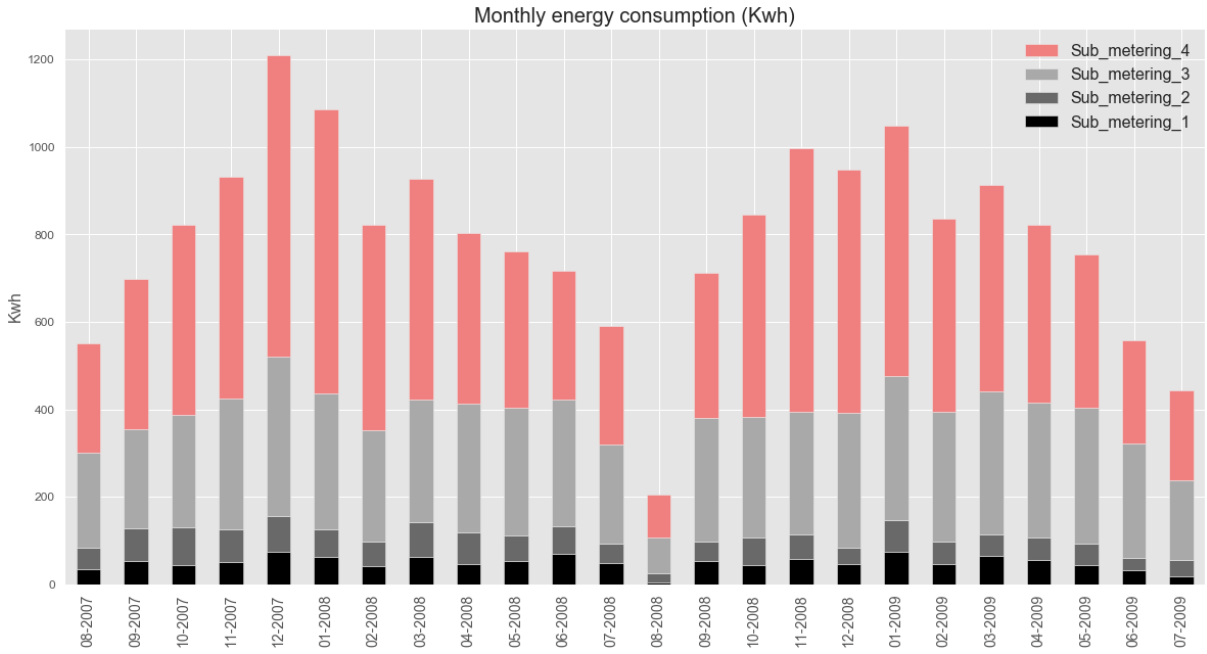
The collected data cover :

global_active_power : household global minute-averaged active power (in kilowatt).
sub_metering_1 : kitchen : a dishwasher, an oven and a microwave.
sub_metering_2 : laundry room : a washing-machine, a tumble-drier, a refrigerator and a light.
sub_metering_3 : a water-heater and an air-conditioner.

We named the remaining part (global active power – sub_metering 1,2 and 3) as “Sub_metering_4”. (red in the figure below)

Sub_metering_4 : represent the main expense in energy for the household
Sub_metering_4 is highly seasonal with maximum consumption in cold months.
We can assume that the household uses an electric heating.

Since Sub_metering_4 is the main energy expense for the household, it could be interesting to **offer this customer a service which will alert him/her when the consumption grows higher than the usual measure**.



Anomaly detection system

The proposed anomaly detection system is built on 2 parts :

1) **A machine learning model** which has learned the Sub_metering_4 consumption habits for this household, based on 1 year of data.

   - with a granularity level on day
   - based on the following variables :
     - min_temperature of the day (temperatures data were collected from public data)
     - max_temperature of the day
     - week
     - day of week

   The Mean Absolute Error of this model when predicting Sub_metering_4 consumption for a day is 3 Kwh.

2) Anomaly detection rules

We don't want to alert a customer whenever he/she ugrades his temperature comfort for only a day.

We propose to alert the customer only if the overconsumption is cumulated over a week. (7 sliding days).

We will raise an anomaly when :

- the actual consumption is greater than the “usual” (predicted) consumption,
- the difference between actual and usual is greater than a threshold.

On the figure below, we applied a threshold equal to 15kwh for the sum of 7 sliding days.

The grey line represents the Sub_metering_4 consumption per day as **predicted** by the machine learning model.

The red line represents the **actual** Sub_metering_4 consumption.

The red points signal anomalies : where the actual consumption is above the predicted consumption, and the difference between these 2 values is greater than the chosen threshold.