GreenHome: Household energy consumption & CO_2 footprint metering environment

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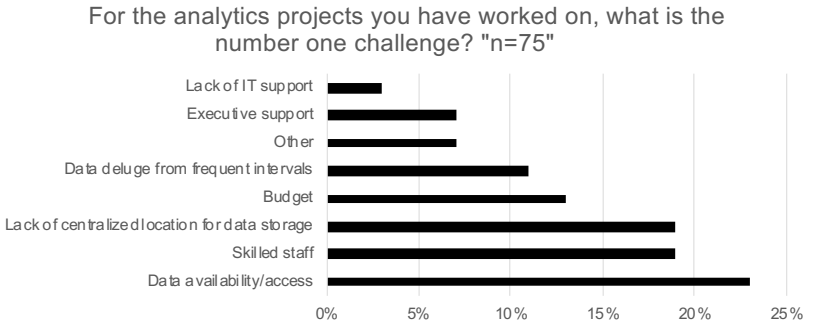
Electric End-use Efficiency In Residential Households

Electric efficiency challenges

- Data provided by smart meters at low voltage level, opens opportunities to improve predictions
- Discovering, analysing and predicting energy consumption in buildings is an emerging research area
- Developing a highly accurate forecast is nontrivial at lower levels
- Current methods do not take into consideration the smart meter data or they apply different models considering different variables

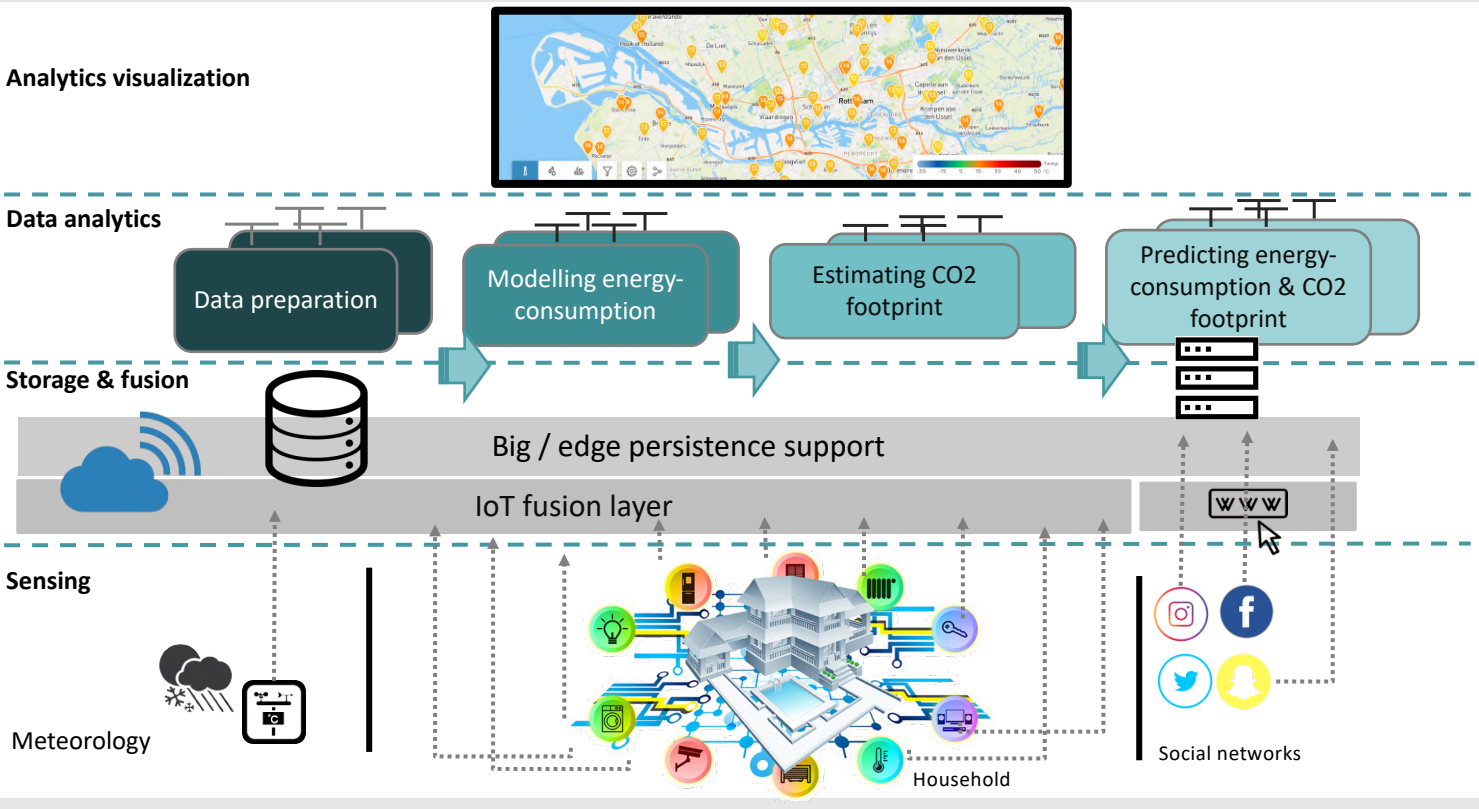
→ **Which is the best & most accurate model? None since this is a multi-facet model & prediction challenge**

Smart grids analytics challenges



Objective: propose a multi-perspective house hold energy consumption prediction strategy & estimation of the carbon footprint produced due to the energy consumed

GreenHome general architecture



Case study : Triple-A project

- Accelerate the adoption of low-carbon technologies by homeowners
- Contribute EU 2020 targets:
  - 20% cut in greenhouse gas emissions
  - 20% of energy from renewables
  - 20% increase in energy efficiency

Experiments

Experiment setting

- Working-class house with red bricks built since 1926
- A living space area of 85 m^2 with living room oriented southeast
- Only gas as a heating energy including for water
- One occupant all day all night at home
- Indoor temperature programmed 20°C day and 17°C night

Energy consumption analysis

- Compute energy consumed along a year
- Estimate the carbon footprint resulted from the consumed energy

Data sensing

- Electric & gas meters in the house
- Outdoor temperature and humidity sensing by a weather sensor placed outside, protected from sunlight on the north façade
- Temperature & humidity sensing with a comfort sensor inside the house placed where few temperature and humidity variation
- Meteorological historical data downloaded from Meteoblue

Inhouse observed variables

- Electric consumption
- Indoor temperature
- Indoor humidity
- Gas consumption
- Outdoor temperature
- Outdoor humidity

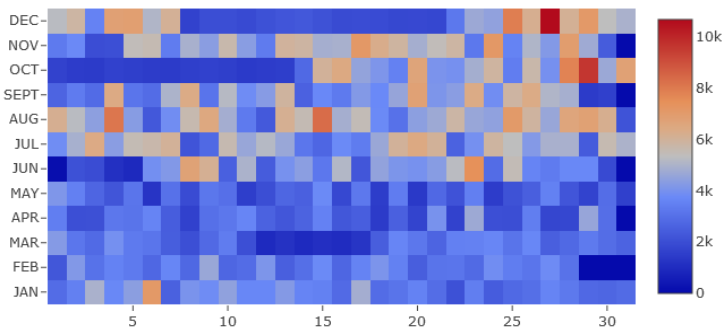
Meteorological variables

- Total precipitation
- Total cloud cover
- Shortwave radiation
- Wind direction
- Snowfall amount
- Sunshine duration
- Wind speed

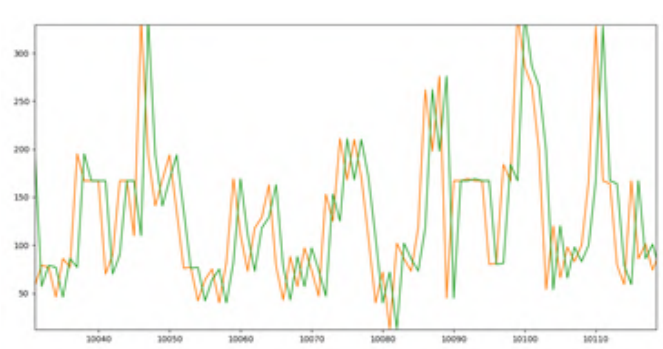
→ *Compares a naïve forecast, an ARIMA & an ARX models for best designing an energy forecast model*

Modeling Energy Consumption & Estimating CO_2 footprint

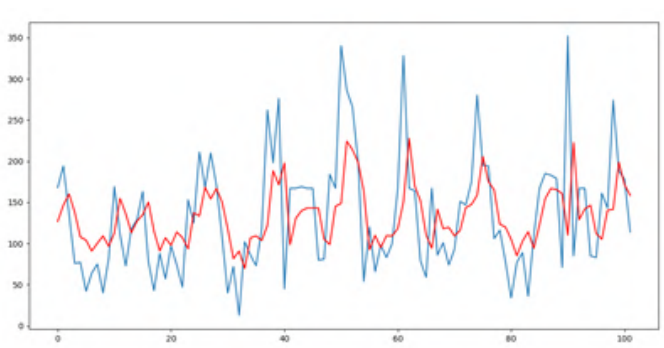
Daily energy consumption in 2018



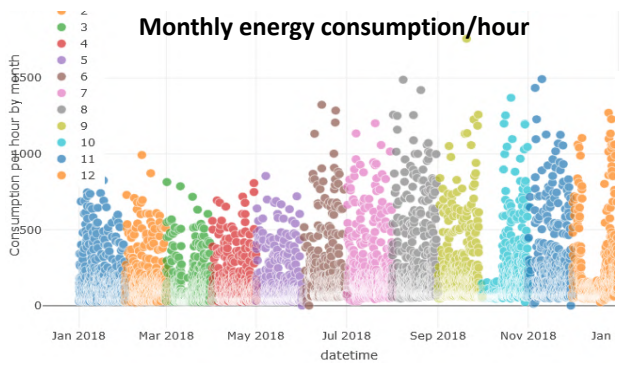
Persistence model with RMSE= 77.835



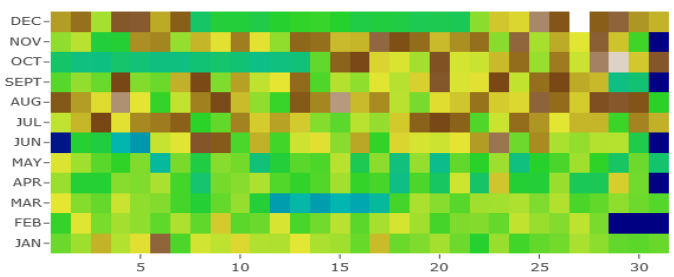
ARIMA model with RMSE= 64.043



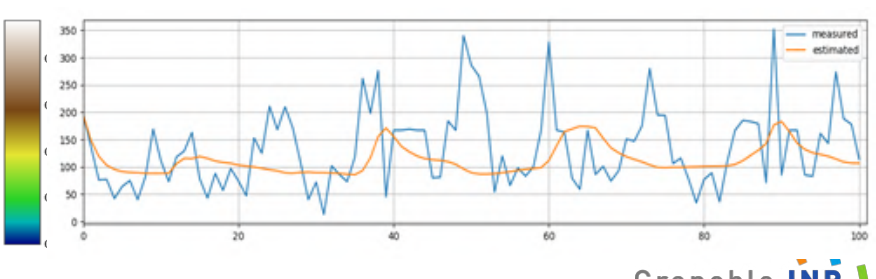
Monthly energy consumption/hour



Carbon footprint of hourly energy consumption



ARX model with RMSE= 55.843230



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