SMART HOMES

Xtol - Deep Analytics and Visualization 2017.3

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AGENDA

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2. GOALS
3. DATA MANAGEMENT
4. DATA DESCRIPTION AND LOCATION
5. KNOWN ISSUES
6. DESCRIPTIVE STATISTICS
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BACKGROUND

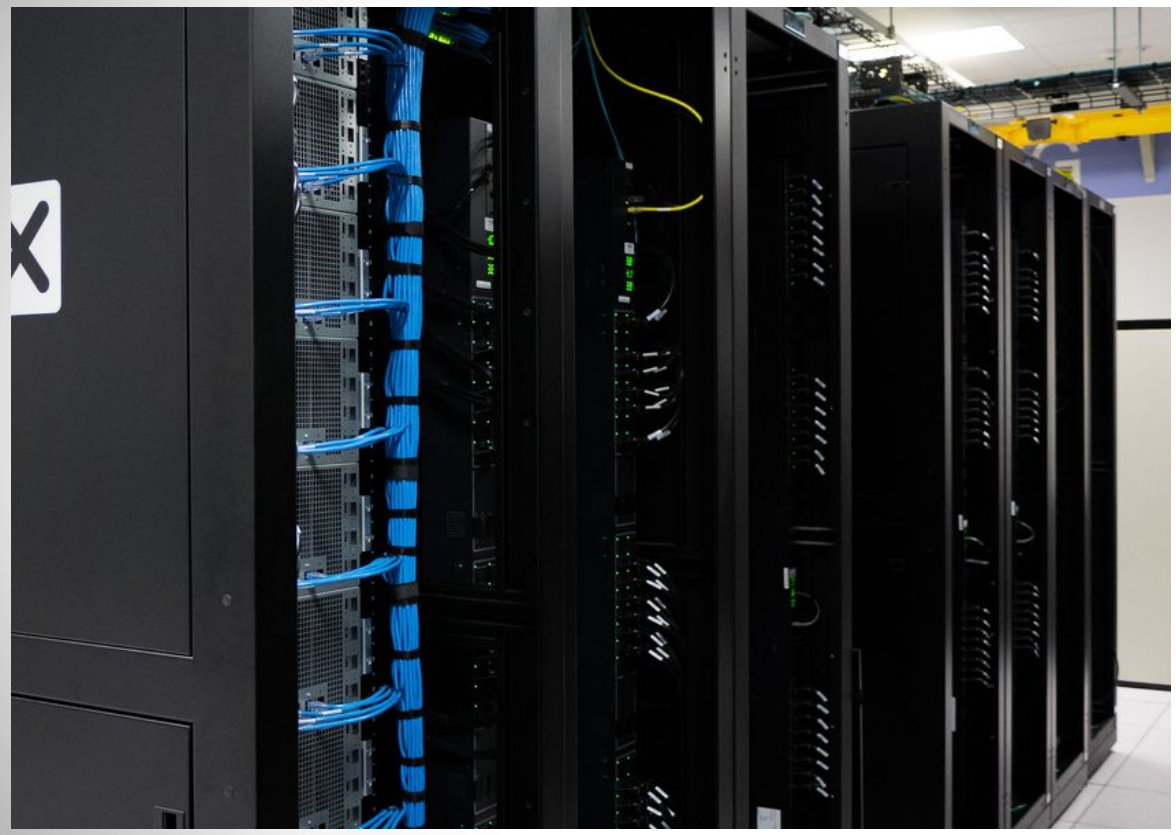
SUB-METERING

Home developers can now integrate electrical sub-metering devices that can be used for advanced power management in Smart Homes.

GOALS

- CONDUCT A RESEARCH ON SUB-METERING TECHNOLOGY
- PERFORM AN INITIAL EXPLORATION OF THE DATA
- RECOMMEND BENEFITS OF DATA ANALYSIS

DATA MANAGEMENT



STORAGE

Data will be stored and backed regularly up on our cloud environment

SECURITY

Only authorized personnel will have access to the data, which will be securely stored (with encryption) on our private company cloud

DATA DESCRIPTION AND LOCATION

- ## POWER DATA SET

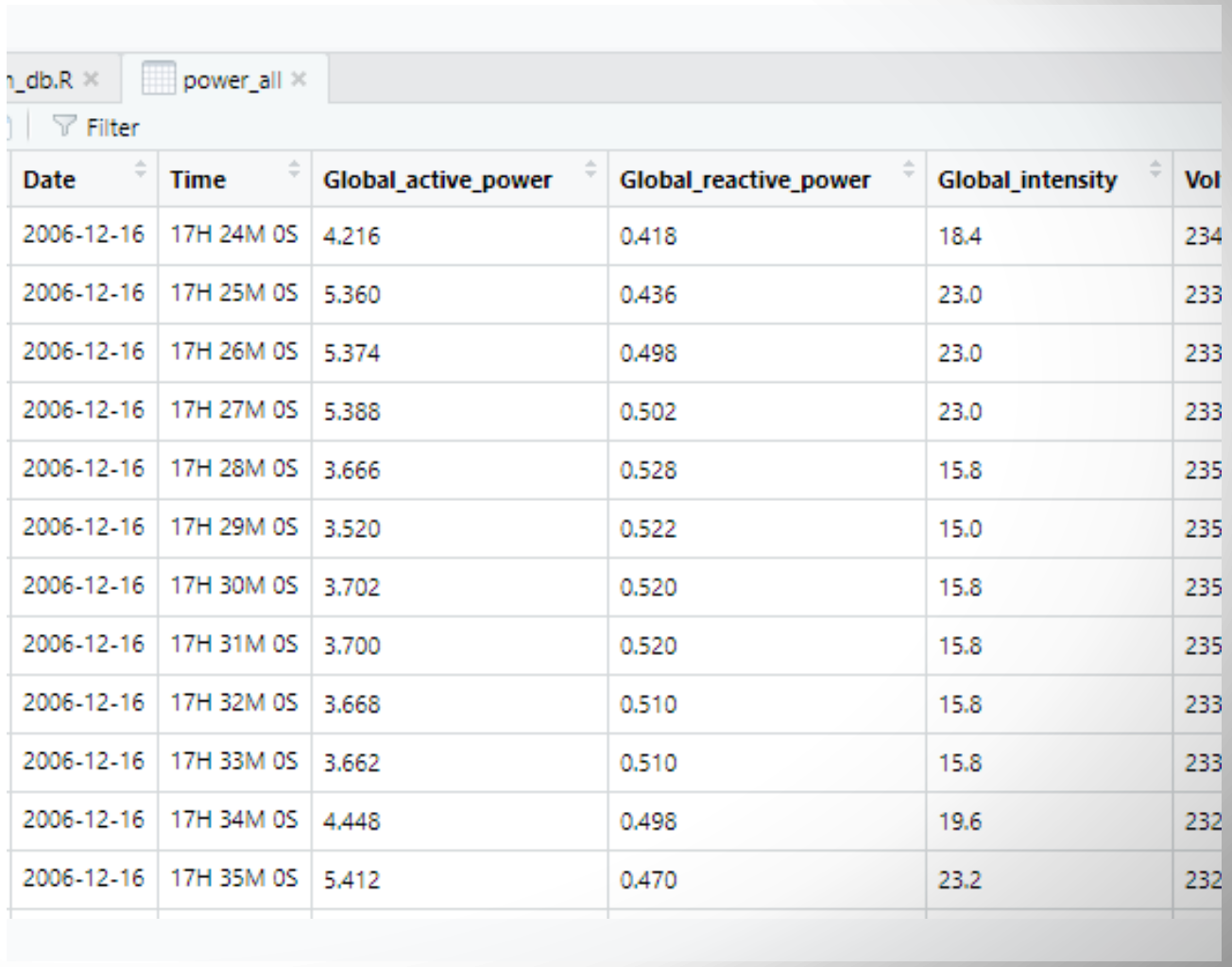
  The data set is comprised of a single hosehold electric power consumptions from 4 different sub-meters from years 2006 to 2010

- ## OBSERVATIONS

  The data set contains over 2 million readings from all sub-meters, taken one per minute.

- ## DATA LOCATION

  The data is available in a database hosted in Amazon Web Services.



_db.R × power_all ×

Filter

Date	Time	Global_active_power	Global_reactive_power	Global_intensity	Vol
2006-12-16	17H 24M 0S	4.216	0.418	18.4	234
2006-12-16	17H 25M 0S	5.360	0.436	23.0	233
2006-12-16	17H 26M 0S	5.374	0.498	23.0	233
2006-12-16	17H 27M 0S	5.388	0.502	23.0	233
2006-12-16	17H 28M 0S	3.666	0.528	15.8	235
2006-12-16	17H 29M 0S	3.520	0.522	15.0	235
2006-12-16	17H 30M 0S	3.702	0.520	15.8	235
2006-12-16	17H 31M 0S	3.700	0.520	15.8	235
2006-12-16	17H 32M 0S	3.668	0.510	15.8	233
2006-12-16	17H 33M 0S	3.662	0.510	15.8	233
2006-12-16	17H 34M 0S	4.448	0.498	19.6	232
2006-12-16	17H 35M 0S	5.412	0.470	23.2	232

KNOWN ISSUES

- ## 2006 DATA

  There is a good amount of data missing, specially for the year 2006, there are only 15 days of valid data, which causes metrics to be distorted. For this reason data from this year was ignored for the analysis

- ## OTHER MISSING DATA

  Around 1.25% of the measurements are missing, although is not a big number, but it will cause issues in the future, when we start doing time series analysis

- ## 2010 DATA

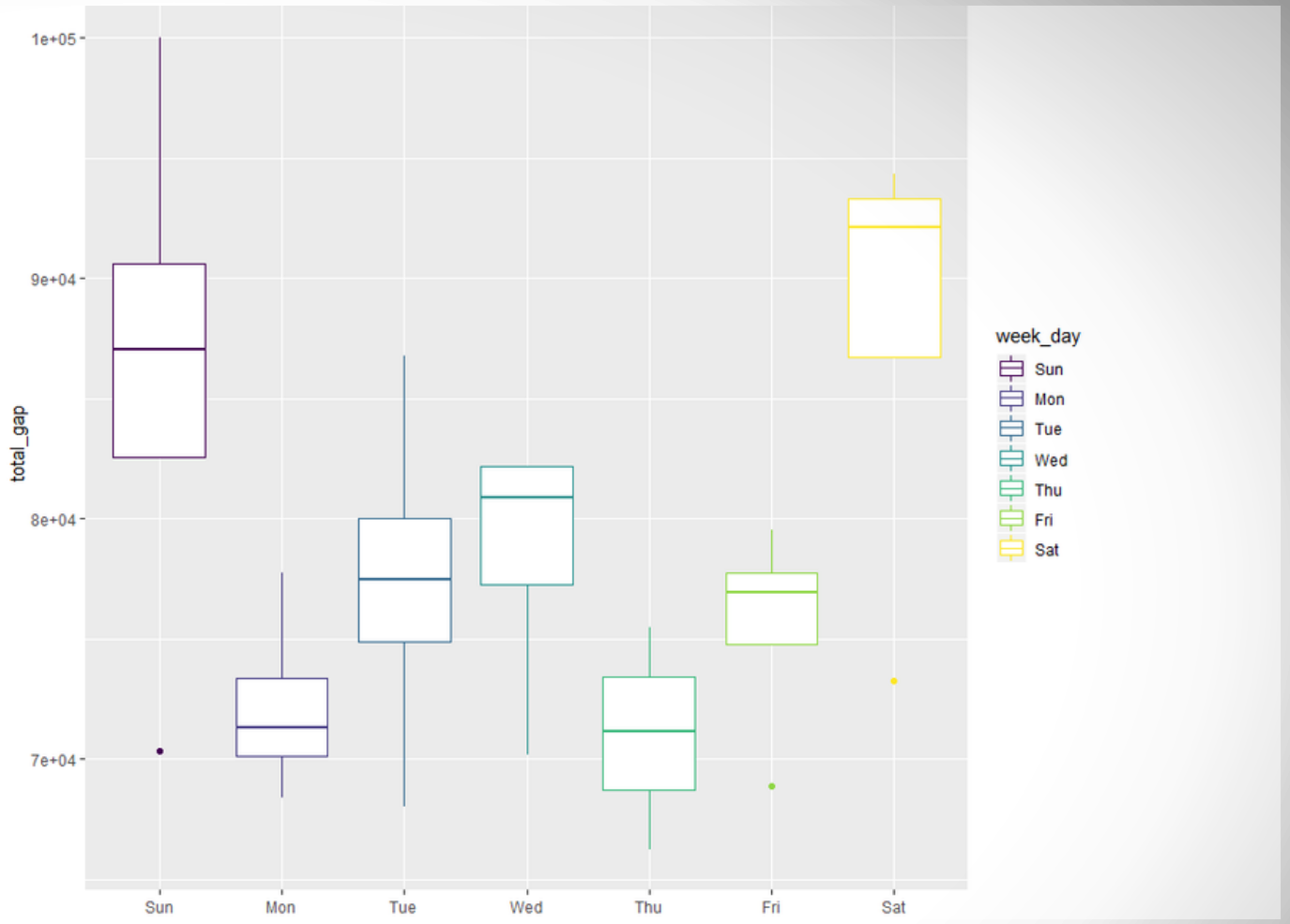
  This year is also incomplete, however at a lower scale compared to 2006. While we have information for approximately 521,000 measurements for the years 2007-2009, for 2010 we only have 457,000 records.

  However this data was used in our analysis since it is abundant.

EXPLORATORY DATA ANALYSIS

DESCRIPTIVE STATISTICS

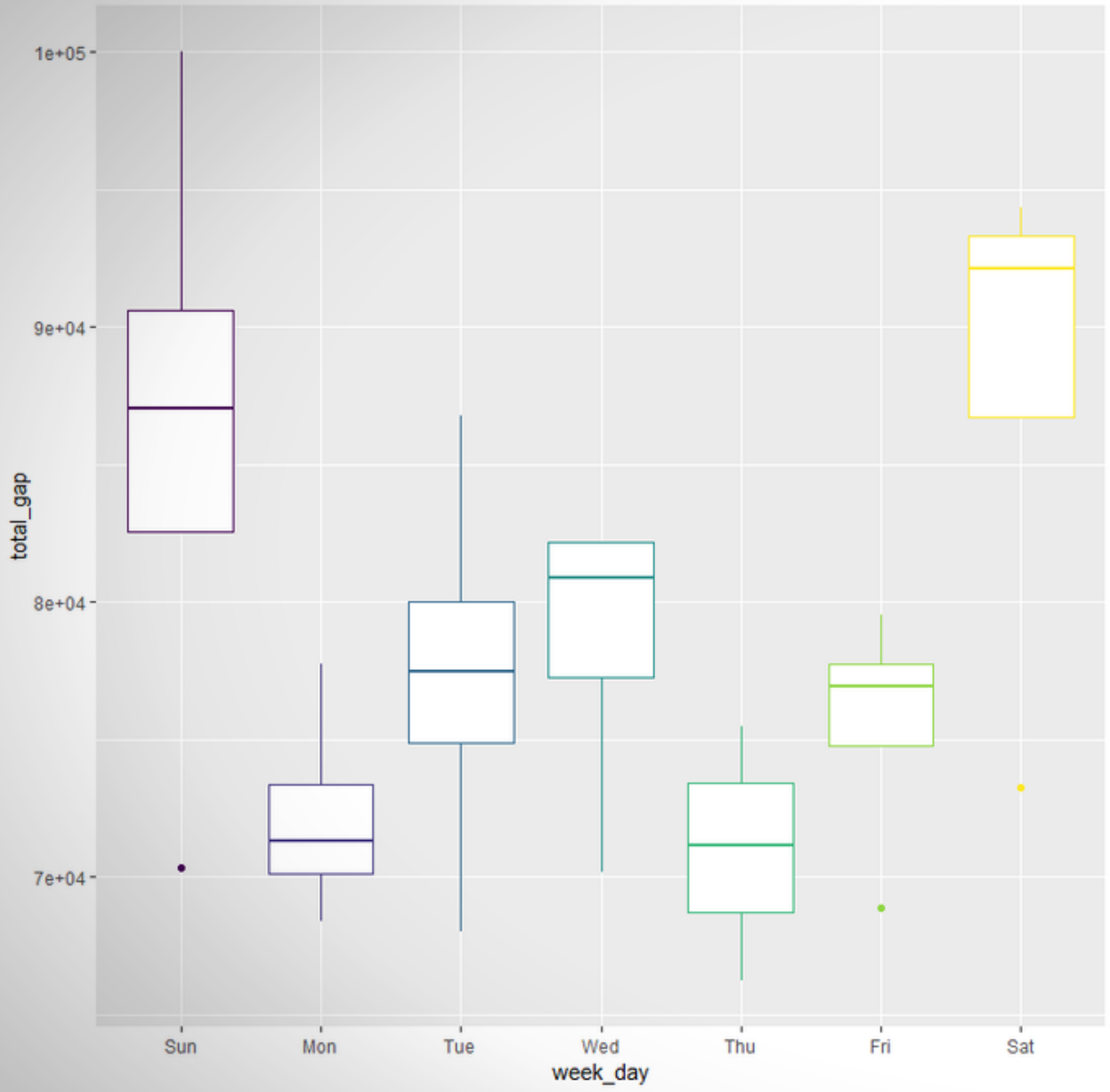
TOTAL ENERGY CONSUMPTION PER WEEK DAY



DATA TAKEN FROM FAMILY HOME, OVER THE PERIOD 2007 TO 2010

NOTE THE ENERGY CONSUMPTION INCREASE OVER THE WEEKENDS

TOTAL ENERGY CONSUMPTION PER WEEK DAY



- **MEANING**

  The graph shows the summarized total consumption of a home over the years 2007-2010

- **BOXES**

  The higher the box, the higher the total power consumption (total_gap axis). The lines in the middle (sort of) of each box shows the mean consumption for that day over the years

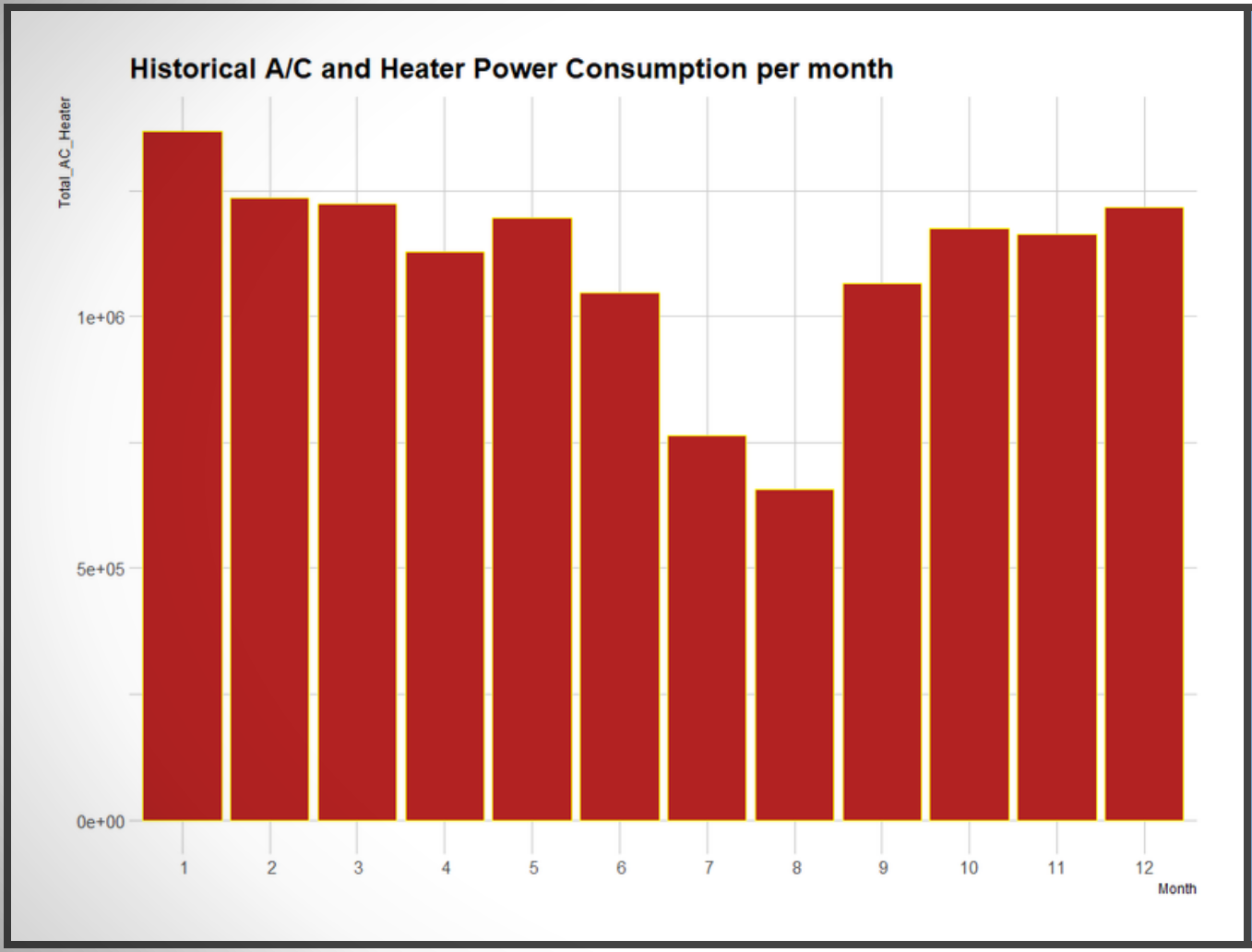
- **WEEKENDS TREND**

  There is a higher consumption over the weekends, specially on Saturdays

TOTAL POWER CONSUMPTION PER HOUR AND WEEK DAY

MEANING

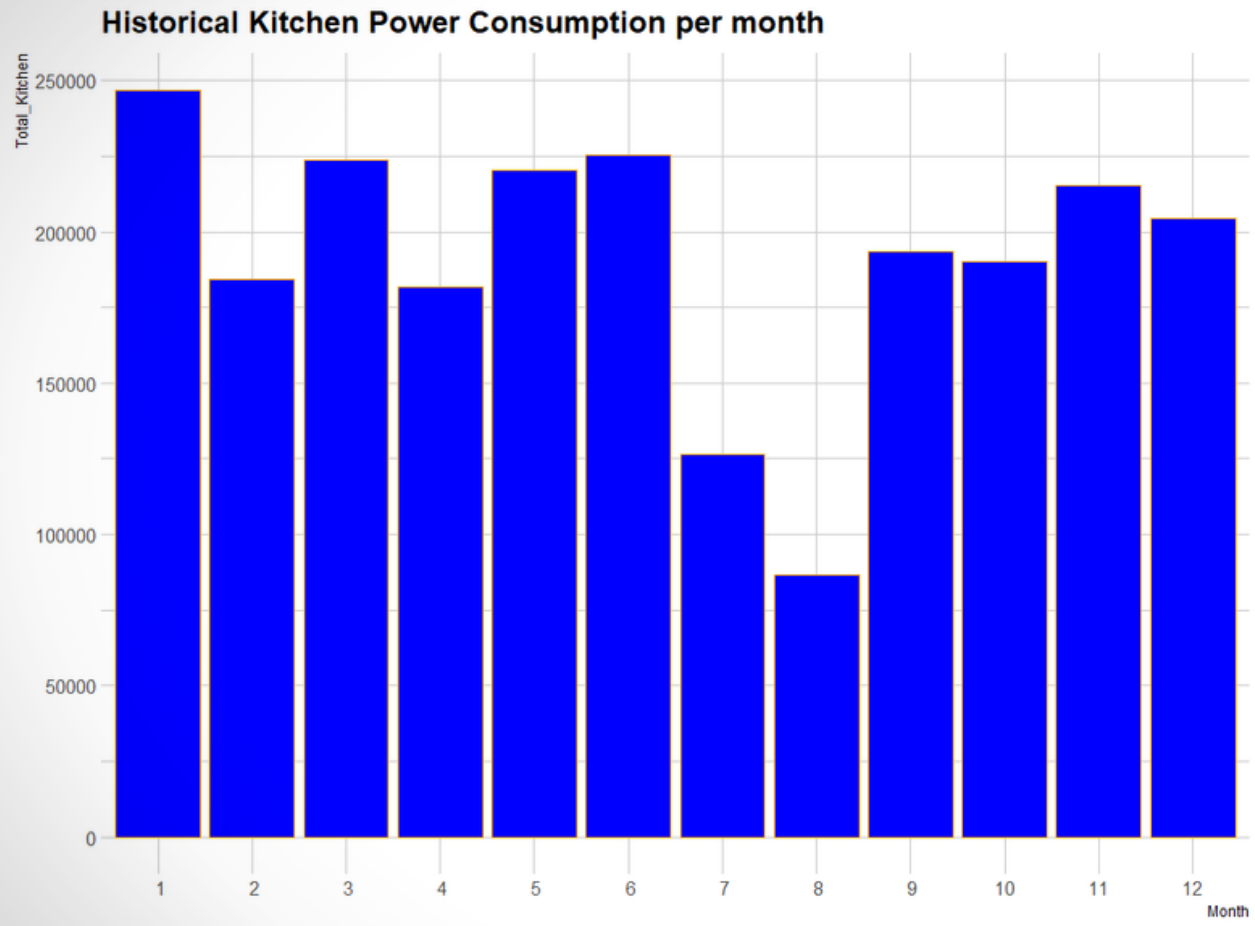
- Each circle represents the summarized power consumption for a given day at a given hour for the period 2007-2010
- The bigger the circle (and the more reddish), the higher the power consumption
- During work days (Mon-Fri) There is a trend of more electricity usage between 6am and 8am, then it lowers significantly and increases again during evening hours, between 6pm and 9pm
- The power consumption over the weekends is higher but shows an even usage between 7am and 11pm.



A/C AND HEATER

Historical Power consumption of years 2007-2010

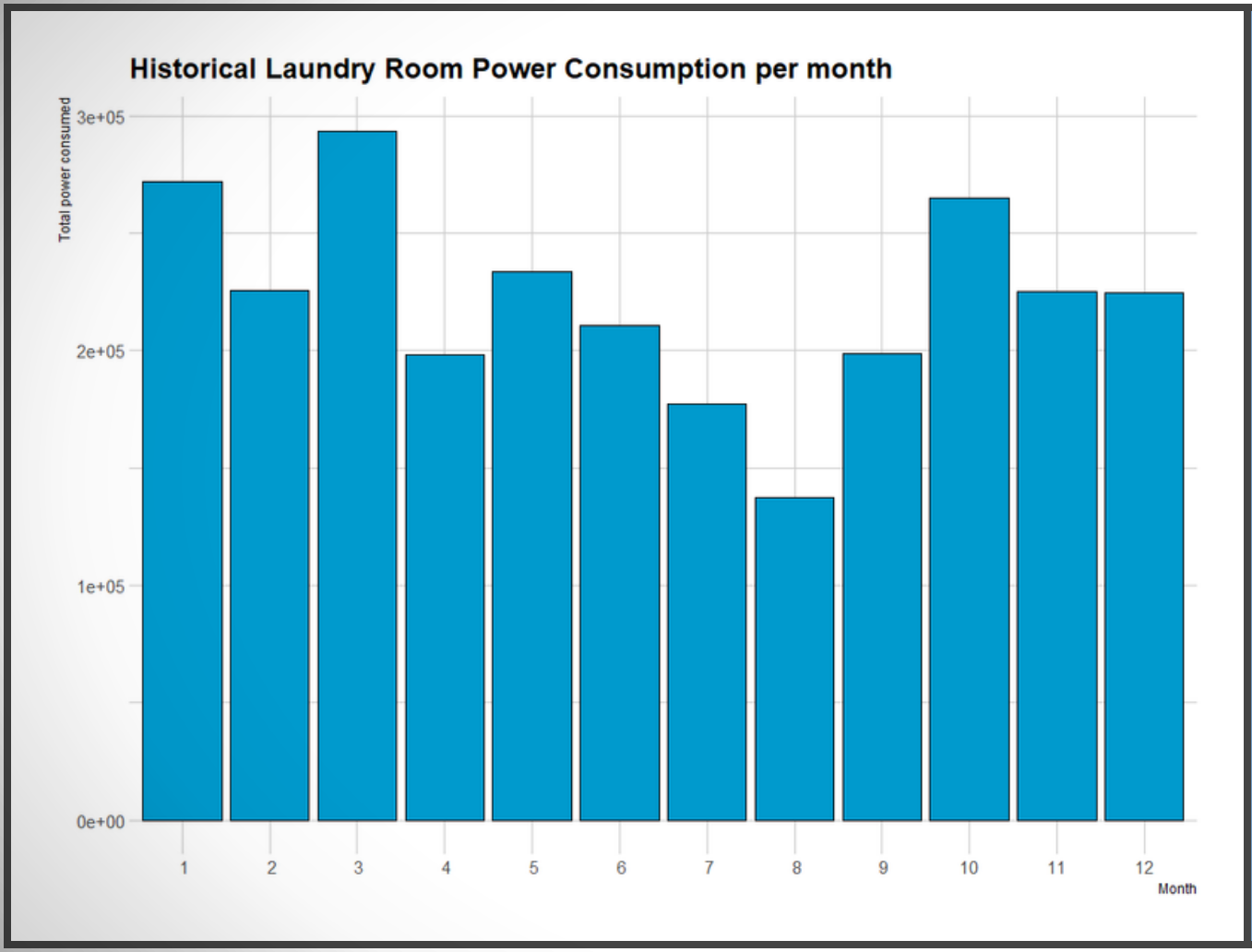
The home where the measurements were taken is located in France, note how the electricity consumption goes down during the summer months (7-8)



KITCHEN

Historical Power consumption of years 2007-2010

The home where the measurements were taken is located in France, note how the electricity consumption goes down during the summer months (7-8), which is more likely the months the family goes on **vacation**



LAUNDRY ROOM

Historical Power consumption of years 2007-2010

Same behavior as the kitchen sub-meter, which suggest the family is not usually at home during the months of July and August.

RECOMMENDATIONS

WITH THE CURRENT DATA, HOME OWNERS COULD...

1. **PREDICT FUTURE POWER CONSUMPTION BASED ON HISTORICAL DATA**

2. **ACCESS INTERACTIVE DASHBOARDS WITH RECENT POWER CONSUMPTION ACTIVITY**

3. **RECEIVE ALERTS WHEN THERE IS ANOMALOUS POWER USAGE**

4. **PRECISELY MEASURE POWER USE IN DIFFERENT AREAS OF THE HOUSE**
   - Kitchen
   - Laundry room
   - A/C, heater

5. **USE OF INTELLIGENT DEVICES TO REDUCE ENERGY CONSUMPTION BASED ON THE FAMILY LIVING PATTERNS**

DATA RECOMMENDATIONS

- **EVALUATE THE REASON THERE IS MISSING DATA FROM THE SUB-METERS**

  Missing data will cause issues when predicting sequential events, reducing the amount of missing data will increase predictions accuracy.

- **INCREASE THE NUMBER OF SUB-METERS IN EACH HOME**

  There is too much power used that we can't give granular explanation, because it was measured by the master meter, and not a sub-meter.

- **SEPARATE AC AND HEATER SUB-METERS**

  With the current data, we can't tell which is the consumption of each appliance.

- **HAVE A SUB-METER PER EACH BIG APPLIANCE**

  By adding a sub-meter for each of the big appliances, we can give even more granular statistics and predictions

  We could think about one sub-meter for the refrigerator, the stove (if electric), a/c, water heater, TVs, etc.

THANK YOU

SAVINGS
MOBILE PHONE POWER
MANAGEMENT INSIGHTS
SMART COMPUTER WEB ELECTRICITY HOUSE
LIGHT SAVINGS DASHBOARD
EQUIPMENT APP SYSTEM
DESKTOP NETWORK
HOME