Project One
"Energy Management"

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Hypothesis

Project: → Food Processing Factory: → Products A-B

Hypothesis

The weather climate variables that involves the production has a direct impact on the production, energy consumption (efficiency variables) and the cost of production through a year.

Questions

- What are the main climate variables that affect the factory production?
    - Understand if climate affects the production or not
- What are the main climate variables that affect the energy consumption?
    - Understand if and how climate variable affect the performance of process
- How is the production correlated to the energy consumption?
    - Discover and highlight the importance of the production for the energy consumption planification
- Energy consumption curve for each month of the year.
    - Maintenance? Production planning? Discover anomalies and possible failures.
- Energy consumption curve for each season of the year.
    - Understand how the energy consumption will be affected by the seasonality of the year
- For each group of devices, rank them by cost.
    - Extract the energy consumption cost of each device
- Annual base line for each device.
    - Create a snapshot of the actual behavior of the plant and associated costs
- Make recommendations, based on the optimal production.
    -

Data

- Energy (kWh)
  - March 1st, 2019 to February 29th, 2020
  - 12 devices
    - 9 Refrigerator Compressors
    - 3 Frost Tunnels
- Climate Data (World Weather Online API)
  - Temperature, UV Index, Precipitation MM, Humidity, Heat Index, Dew Point, Wind Chill, Feels Like
- Production
  - Product A
  - Product B
- CFE Tariffs
  - Base, Intermedio, Punta

Data Exploration and Cleanup Process

- Hourly Data
  - Cost
  - Hourly analysis
- Daily Data

Merge energy and climate data

  - Base lines
  - Correlation analysis
  - Monthly analysis
- Unpivot the data. Columns vs Rows
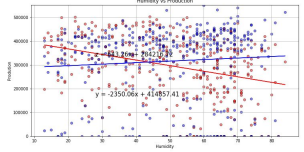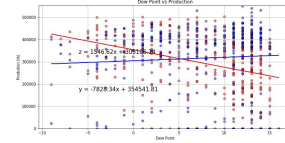- "Date" format
  - "%d/%m/%Y"

Data Analysis

- What are the main climate variables that affect the factory production?

DP VS Production (lb)

- Cor Product A: `-0.36`
- Cor Product B: `0.06`

Humidity VS Production (lb)

- Cor Product A: `-0.33`
- Cor Product B: `0.07`

The more increase the correlation of the variables of Dew Point and Humidity, the more it affects the production

It is just half ot the things that we can see at first sight.

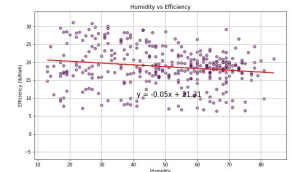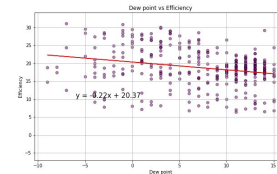- What are the main climate variables that affect the energy consumption?

$$Efficiency = \frac{Production\ A + Production\ B}{Consumed\ Energy} = \frac{lbs}{kWh}$$

DP VS Efficiency(lb/kWh)

- Cor :`-0.24`

Humidity Vs Efficiency(lb/kWh)

- Cor `-0.17`

The more increase the correlation of the variables of Heat and Humidity, the less efficient the production becomes.

Data Analysis

- How is the production correlated to the energy consumption?
  - TUNEL_3 and Product A: **0.747**
  - COMP_13 and Product A: **0.704**
  - COMP_2 and Product A: **0.692**
  - COMP_14 and Product A: **0.55**

Energy Consumption (TUNEL3) vs Product_A

- Energy consumption curve for each month of the year.
  - Most sundays, energy consumption decreases.
  - Gaps of maintenance. At least one per year.
    - A week to over two months
  - Tunel 3 worked almost all the year, meanwhile Tunel 1 & 2 stopped at least two times through a great period of time.

Energy Consumption (TUNEL1) in 7-2019

Energy Consumption (TUNEL1) in 8-2019

Energy Consumption (TUNEL1) in 9-2019
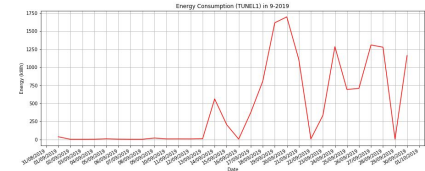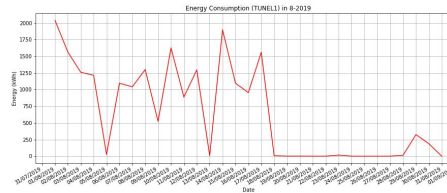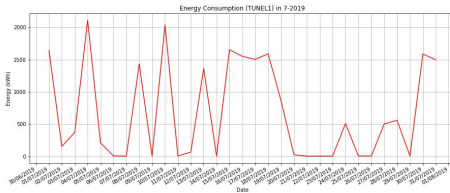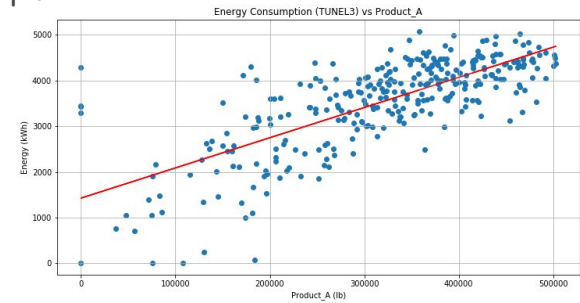
Data Analysis

- **Energy consumption curve for each season of the year.**
  - It is a clear reduction in the energy consumption in the months of February and March.
  - In September it is observed that there is no activity in any of the analyzed devices, this may be due to scheduled maintenance but there is not enough information to know the reason.

Energy Consumption

| Winter | Spring | Summer | Fall |
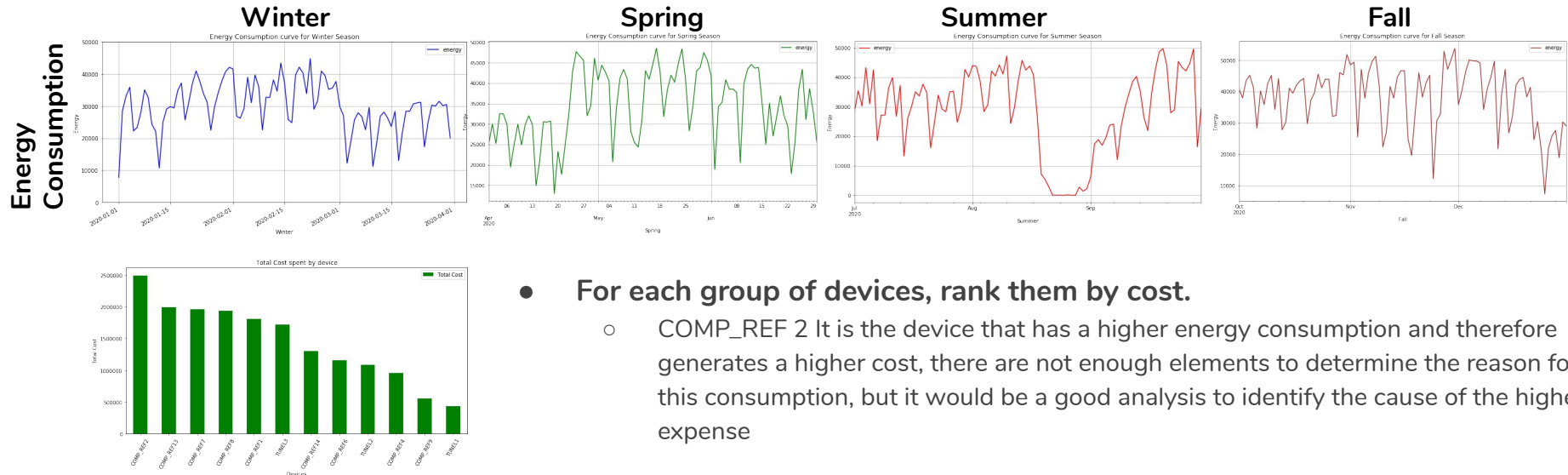
- **For each group of devices, rank them by cost.**
  - COMP_REF 2 It is the device that has a higher energy consumption and therefore generates a higher cost, there are not enough elements to determine the reason for this consumption, but it would be a good analysis to identify the cause of the higher expense

Data Analysis

Cost per Month

Consume per Month

- Annual base line for each device.
  - The Consumption of energy is increasing in order to Production
  - We can look that the trend of the consumption fall twice in a year on fifth and the eighth month
  - Component 2 is the element that demand more energy, as a consequence the cost operation are increasing of all the production process
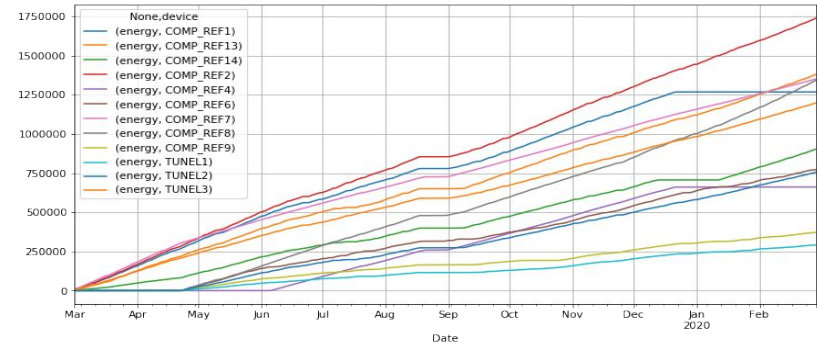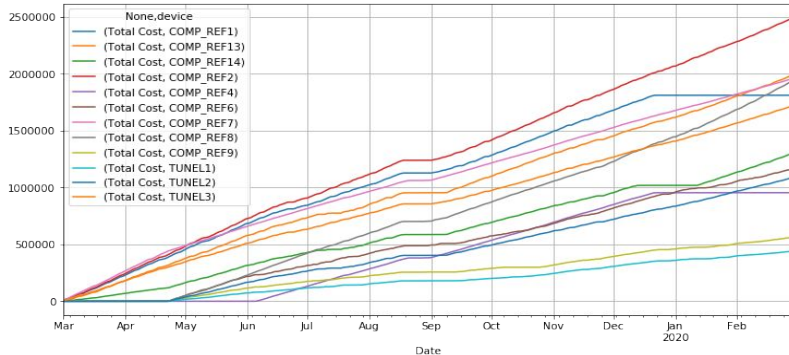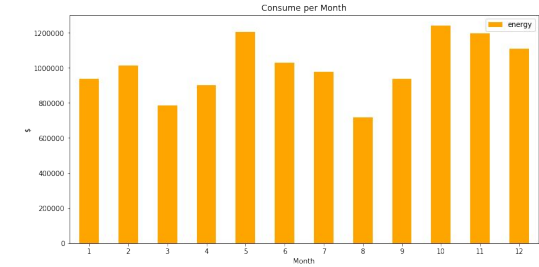
Discussion

- There's almost no correlation between the energy consumption of the devices and the climate variables.
- There's almost no correlation between the energy consumption of the devices and production.
- Production efficiency is lightly correlated to climate variables.
- There might be no way to predict the energy consumption of the devices with the given data.

Post Mortem

- Get the climate forecast from the API (15 days) and predict the energy consumption from the devices.
- Production Efficiency VS Climate Data
  - Predict the cost