Notebook relevant version changes

- V11 (CV 1-fold: 90.76 / LB: 97.66)
  - Create feature processing per dataset inside the class FeatureProcessorClass
  - Renaming of the features per dataset
  - Remove latitude/longitude columns for model
  - Add mean_price_per_mwh_gas as feature
- V21 (CV 1-fold: 78.99 / LB: 86.43)
  - Add revealed_target lags from 2 to 7 days ago - inspired from [Enefit] Baseline + cross-validation ⚙️
  - Use custom N_days_lags to specify the max number of revealed_target day lags
- V23 (CV 1-fold: 72.96 / LB: 83.79)
  - Map latitude & longitude for each county, using code from mapping locations and county codes
  - *historical_weather* and *forecast_weather* group by county too, and specify aggegate statistics

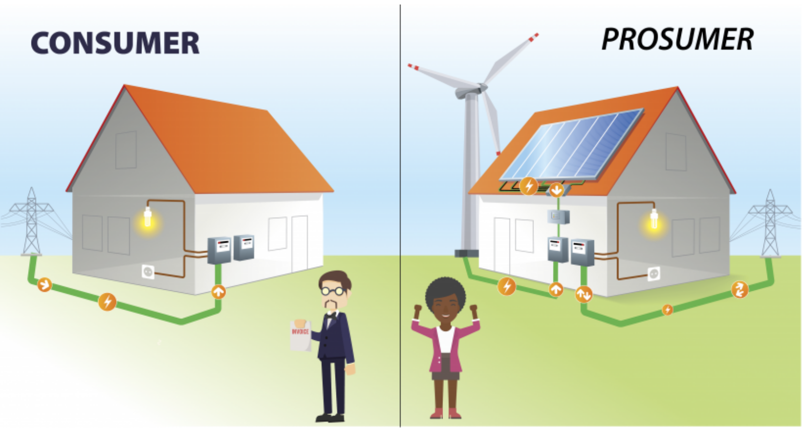
Introduction

> 📌**Note**: If you liked or forked this notebook, please consider upvoting ⬆️⬆️ It encourages to keep posting relevant content

This notebook covers the following:

- Pre-processing of the different datasets
- Basic merging of the datasets
- Simple feature engineering
- XGBoost starter model
- Next steps

Competition Description



> 📌**Note**: Energy prosumers are individuals, businesses, or organizations that both consume and produce energy. This concept represents a shift from the traditional model where consumers simply purchase energy from utilities and rely on centralized power generation sources. Energy prosumers are actively involved in the energy ecosystem by generating their own electricity, typically through renewable energy sources like solar panels (or wind turbines, small-scale hydropower etc.). They also consume energy from the grid when their own generation is insufficient to meet their needs

- The number of prosumers is rapidly increasing, associated with higher energy imbalance - increased operational costs, potential grid instability, and inefficient use of energy resources.
- The goal of the competition is to create an energy prediction model of prosumers to reduce energy imbalance costs
- If solved, it would reduce the imbalance costs, improve the reliability of the grid, and make the integration of prosumers into the energy system more efficient and sustainable.
- Moreover, it could potentially incentivize more consumers to become prosumers and thus promote renewable energy production and use.

Data Description

> 📌**Note**: Your challenge in this competition is to predict the amount of electricity produced and consumed by Estonian energy customers who have installed solar panels. You'll have access to weather data, the relevant energy prices, and records of the installed photovoltaic capacity.
>
> This is a forecasting competition using the time series API. The private leaderboard will be determined using real data gathered after the submission period closes.

Files

train.csv

- `county` - An ID code for the county.
- `is_business` - Boolean for whether or not the prosumer is a business.
- `product_type` - ID code with the following mapping of codes to contract types: `{0: "Combined", 1: "Fixed", 2: "General service", 3: "Spot"}`.
- `target` - The consumption or production amount for the relevant segment for the hour. The segments are defined by the `county`, `is_business`, and `product_type`.
- `is_consumption` - Boolean for whether or not this row's target is consumption or production.
- `datetime` - The Estonian time in EET (UTC+2) / EEST (UTC+3).
- `data_block_id` - All rows sharing the same `data_block_id` will be available at the same forecast time. This is a function of what information is available when forecasts are actually made, at 11 AM each morning. For example, if the forecast weather `data_block_id` for predictions made on October 31st is 100 then the historic weather `data_block_id` for October 31st will be 101 as the historic weather data is only actually available the next day.
- `row_id` - A unique identifier for the row.
- `prediction_unit_id` - A unique identifier for the `county`, `is_business`, and `product_type` combination. *New prediction units can appear or dissappear in the test set*.

gas_prices.csv

- `origin_date` - The date when the day-ahead prices became available.
- `forecast_date` - The date when the forecast prices should be relevant.
- `[lowest/highest]_price_per_mwh` - The lowest/highest price of natural gas that on the day ahead market that trading day, in Euros per megawatt hour equivalent.
- `data_block_id`

client.csv

- `product_type`
- `county` - An ID code for the county. See `county_id_to_name_map.json` for the mapping of ID codes to county names.
- `eic_count` - The aggregated number of consumption points (EICs - European Identifier Code).
- `installed_capacity` - Installed photovoltaic solar panel capacity in kilowatts.
- `is_business` - Boolean for whether or not the prosumer is a business.
- `date`
- `data_block_id`

electricity_prices.csv

- `origin_date`
- `forecast_date`
- `euros_per_mwh` - The price of electricity on the day ahead markets in euros per megawatt hour.
- `data_block_id`

forecast_weather.csv Weather forecasts that would have been available at prediction time. Sourced from the European Centre for Medium-Range Weather Forecasts.

- `[latitude/longitude]` - The coordinates of the weather forecast.
- `origin_datetime` - The timestamp of when the forecast was generated.
- `hours_ahead` - The number of hours between the forecast generation and the forecast weather. Each forecast covers 48 hours in total.
- `temperature` - The air temperature at 2 meters above ground in degrees Celsius.
- `dewpoint` - The dew point temperature at 2 meters above ground in degrees Celsius.
- `cloudcover_[low/mid/high/total]` - The percentage of the sky covered by clouds in the following altitude bands: 0-2 km, 2-6, 6+, and total.
- `10_metre_[u/v]_wind_component` - The [eastward/northward] component of wind speed measured 10 meters above surface in meters per second.
- `data_block_id`
- `forecast_datetime` - The timestamp of the predicted weather. Generated from `origin_datetime` plus `hours_ahead`.
- `direct_solar_radiation` - The direct solar radiation reaching the surface on a plane perpendicular to the direction of the Sun accumulated during the preceding hour, in watt-hours per square meter.
- `surface_solar_radiation_downwards` - The solar radiation, both direct and diffuse, that reaches a horizontal plane at the surface of the Earth, in watt-hours per square meter.
- `snowfall` - Snowfall over the previous hour in units of meters of water equivalent.
- `total_precipitation` - The accumulated liquid, comprising rain and snow that falls on Earth's surface over the preceding hour, in units of meters.

historical_weather.csv Historic weather data.

- `datetime`
- `temperature`
- `dewpoint`
- `rain` - Different from the forecast conventions. The rain from large scale weather systems of the preceding hour in millimeters.
- `snowfall` - Different from the forecast conventions. Snowfall over the preceding hour in centimeters.
- `surface_pressure` - The air pressure at surface in hectopascals.
- `cloudcover_[low/mid/high/total]` - Different from the forecast conventions. Cloud cover at 0-3 km, 3-8, 8+, and total.
- `windspeed_10m` - Different from the forecast conventions. The wind speed at 10 meters above ground in meters per second.

- `winddirection_10m` - Different from the forecast conventions. The wind direction at 10 meters above ground in degrees.
- `shortwave_radiation` - Different from the forecast conventions. The global horizontal irradiation in watt-hours per square meter.
- `direct_solar_radiation`
- `diffuse_radiation` - Different from the forecast conventions. The diffuse solar irradiation in watt-hours per square meter.
- `[latitude/longitude]` - The coordinates of the weather station.
- `data_block_id`

public_timeseries_testing_util.py An optional file intended to make it easier to run custom offline API tests. See the script's docstring for details. You will need to edit this file before using it.

example_test_files/ Data intended to illustrate how the API functions. Includes the same files and columns delivered by the API. The first three `data_block_ids` are repeats of the last three `data_block_ids` in the train set.

example_test_files/sample_submission.csv A valid sample submission, delivered by the API. See this notebook for a very simple example of how to use the sample submission.

example_test_files/revealed_targets.csv The actual target values, served with a lag of one day.

enefit/ Files that enable the API. Expect the API to deliver all rows in under 15 minutes and to reserve less than 0.5 GB of memory. The copy of the API that you can download serves the data from **example_test_files/**. You must make predictions for those dates in order to advance the API but those predictions are not scored. Expect to see roughly three months of data delivered initially and up to ten months of data by the end of the forecasting period.

Install & imports

```
!pip install -U xgboost -f /kaggle/input/xgboost-python-package/ --no-index
```

```
Looking in links: /kaggle/input/xgboost-python-package/
Requirement already satisfied: xgboost in /opt/conda/lib/python3.10/site-packages (1.7.6)
Processing /kaggle/input/xgboost-python-package/xgboost-2.0.1-py3-none-manylinux2014_x86_64.whl
Requirement already satisfied: numpy in /opt/conda/lib/python3.10/site-packages (from xgboost) (1.23.5)
Requirement already satisfied: scipy in /opt/conda/lib/python3.10/site-packages (from xgboost) (1.11.2)
Installing collected packages: xgboost
  Attempting uninstall: xgboost
    Found existing installation: xgboost 1.7.6
    Uninstalling xgboost-1.7.6:
      Successfully uninstalled xgboost-1.7.6
Successfully installed xgboost-2.0.1
```

```
import pandas as pd
import numpy as np
import json
```

```
#General
import pandas as pd
import numpy as np
import json

# Visualization
import seaborn as sns
import matplotlib.pyplot as plt
from colorama import Fore, Style, init;

# Modeling
import xgboost as xgb
import lightgbm as lgb
import torch

# Geolocation
from geopy.geocoders import Nominatim

# Options
pd.set_option('display.max_columns', 100)
```

```
DEBUG = False # False/True
```

```
# GPU or CPU use for model
if torch.cuda.is_available():
    device = 'cuda'
else:
    device = 'cpu'
```

```
# Helper functions
def display_df(df, name):
    '''Display df shape and first row '''
    PrintColor(text = f'{name} data has {df.shape[0]} rows and {df.shape[1]} columns. \n ===> First row:')
    display(df.head(1))

# Color printing
def PrintColor(text:str, color = Fore.BLUE, style = Style.BRIGHT):
    '''Prints color outputs using colorama of a text string'''
    print(style + color + text + Style.RESET_ALL);
```

```
DATA_DIR = "/kaggle/input/predict-energy-behavior-of-prosumers/"

# Read CSVs and parse relevant date columns
train = pd.read_csv(DATA_DIR + "train.csv")
client = pd.read_csv(DATA_DIR + "client.csv")
historical_weather = pd.read_csv(DATA_DIR + "historical_weather.csv")
forecast_weather = pd.read_csv(DATA_DIR + "forecast_weather.csv")
electricity = pd.read_csv(DATA_DIR + "electricity_prices.csv")
gas = pd.read_csv(DATA_DIR + "gas_prices.csv")
```

```
# Location from https://www.kaggle.com/datasets/michaelo/fabiendaniels-mapping-locations-and-county-codes/data
location = (pd.read_csv("/kaggle/input/fabiendaniels-mapping-locations-and-county-codes/county_lon_lats.csv")
            .drop(columns = ["Unnamed: 0"])
           )
```

```
•[1m•[34mtrain data has 2018352 rows and 9 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	county	is_business	product_type	target	is_consumption	datetime	data_block_id	row_id	prediction_unit_id
0	0	0	1	0.713	0	2021-09-01 00:00:00	0	0	0

```
•[1m•[34mclient data has 41919 rows and 7 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	product_type	county	eic_count	installed_capacity	is_business	date	data_block_id
0	1	0	108	952.89	0	2021-09-01	2

```
•[1m•[34mhistorical weather data has 1710800 rows and 18 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	datetime	temperature	dewpoint	rain	snowfall	surface_pressure	cloudcover_total	cloudcover_low	cloudcover_mid	cloudc
0	2021-09-01 00:00:00	14.4	12.0	0.0	0.0	1015.8	4	4	0	0

```
•[1m•[34mforecast weather data has 3424512 rows and 18 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	latitude	longitude	origin_datetime	hours_ahead	temperature	dewpoint	cloudcover_high	cloudcover_low	cloudcover_mid
0	57.6	21.7	2021-09-01 00:00:00+00:00	1	15.655786	11.553613	0.904816	0.019714	0.0

```
•[1m•[34melectricity prices data has 15286 rows and 4 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	forecast_date	euros_per_mwh	origin_date	data_block_id
0	2021-09-01 00:00:00	92.51	2021-08-31 00:00:00	1

```
•[1m•[34mgas prices data has 637 rows and 5 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	forecast_date	lowest_price_per_mwh	highest_price_per_mwh	origin_date	data_block_id
0	2021-09-01	45.23	46.32	2021-08-31	1

```
•[1m•[34mlocation data data has 75 rows and 3 columns.
 ===> First row:•[0m
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	county	longitude	latitude
0	0	24.2	59.1

```
display_df(train, 'train')
display_df(client, 'client')
display_df(historical_weather, 'historical weather')
display_df(forecast_weather, 'forecast weather')
display_df(electricity, 'electricity prices')
display_df(gas, 'gas prices')
display_df(location, 'location data')
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	0	1	2	3	4	5	6	7	8	9	10
0	HARJUMAA	HIIUMAA	IDA-VIRUMAA	JÄRVAMAA	JÕGEVAMAA	LÄÄNE-VIRUMAA	LÄÄNEMAA	PÄRNUMAA	PÕLVAMAA	RAPLAMAA	SAAREMAA

```
# See county codes
with open(DATA_DIR + 'county_id_to_name_map.json') as f:
    county_codes = json.load(f)
pd.DataFrame(county_codes, index=[0])
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	count	mean	std	min	0%	0.1%	1%	5%	10%	25%	50%	75%	90%	95%	99%
target	1008912.0	460.71	1198.95	0.0	0.0	0.28	1.86	6.42	12.0	34.51	108.9	386.97	972.05	1567.52	7141.02

```
# pd.DataFrame(train[train['is_consumption']==0].target.describe(percentiles = [0, 0.001, 0.01, 0.05, 0.1, 0.25, 0.5, 0.75, 0.9, 0.95, 0.99, 0.999])).round(2).T
# pd.DataFrame(train[train['is_consumption']==1].target.describe(percentiles = [0, 0.001, 0.01, 0.05, 0.1, 0.25, 0.5, 0.75, 0.9, 0.95, 0.99, 0.999])).round(2).T
```

Data processing

```
class FeatureProcessorClass():
    def __init__(self):
        # Columns to join on for the different datasets
        self.weather_join = ['datetime', 'county', 'data_block_id']
        self.gas_join = ['data_block_id']
        self.electricity_join = ['datetime', 'data_block_id']
        self.client_join = ['county', 'is_business', 'product_type', 'data_block_id']

        # Columns of latitude & longitude
        self.lat_lon_columns = ['latitude', 'longitude']

        # Aggregate stats
        self.agg_stats = ['mean'] #, 'min', 'max', 'std', 'median']

        # Categorical columns (specify for XGBoost)
        self.category_columns = ['county', 'is_business', 'product_type', 'is_consumption', 'data_block_id']

    def create_new_column_names(self, df, suffix, columns_no_change):
        '''Change column names by given suffix, keep columns_no_change, and return back the data'''
        df.columns = [col + suffix
                      if col not in columns_no_change
                      else col
                      for col in df.columns
                      ]
        return df

    def flatten_multi_index_columns(self, df):
        df.columns = ['_'.join([col for col in multi_col if len(col)>0])
                      for multi_col in df.columns]
        return df

    def create_data_features(self, data):
        '''📊Create features for main data (test or train) set📊'''
        # To datetime
        data['datetime'] = pd.to_datetime(data['datetime'])

        # Time period features
        data['date'] = data['datetime'].dt.normalize()
        data['year'] = data['datetime'].dt.year
        data['quarter'] = data['datetime'].dt.quarter
        data['month'] = data['datetime'].dt.month
        data['week'] = data['datetime'].dt.isocalendar().week
        data['hour'] = data['datetime'].dt.hour

        # Day features
        data['day_of_year'] = data['datetime'].dt.day_of_year
        data['day_of_month']  = data['datetime'].dt.day
        data['day_of_week'] = data['datetime'].dt.day_of_week
        return data

    def create_client_features(self, client):
        '''💼 Create client features 💼'''
        # Modify column names - specify suffix
        client = self.create_new_column_names(client,
                                           suffix='_client',
                                           columns_no_change = self.client_join
                                          )
        return client

    def create_historical_weather_features(self, historical_weather):
        '''⏳🌤 Create historical weather features 🌤⏳'''

        # To datetime
        historical_weather['datetime'] = pd.to_datetime(historical_weather['datetime'])

        # Add county
        historical_weather[self.lat_lon_columns] = historical_weather[self.lat_lon_columns].astype(float).round(1)
        historical_weather = historical_weather.merge(location, how = 'left', on = self.lat_lon_columns)

        # Modify column names - specify suffix
        historical_weather = self.create_new_column_names(historical_weather,
                                                          suffix='_h',
                                                          columns_no_change = self.lat_lon_columns + self.weather_join
                                                          )

        # Group by & calculate aggregate stats
        agg_columns = [col for col in historical_weather.columns if col not in self.lat_lon_columns + self.weather_join]
        agg_dict = {agg_col: self.agg_stats for agg_col in agg_columns}
        historical_weather = historical_weather.groupby(self.weather_join).agg(agg_dict).reset_index()

        # Flatten the multi column aggregates
        historical_weather = self.flatten_multi_index_columns(historical_weather)

        # Test set has 1 day offset for hour<11 and 2 day offset for hour>11
        historical_weather['hour_h'] = historical_weather['datetime'].dt.hour
        historical_weather['datetime'] = (historical_weather
                                               .apply(lambda x:
                                                      x['datetime'] + pd.DateOffset(1)
                                                      if x['hour_h']< 11
                                                      else x['datetime'] + pd.DateOffset(2),
                                                      axis=1)
                                              )

        return historical_weather

    def create_forecast_weather_features(self, forecast_weather):
        '''🔮🌤 Create forecast weather features 🌤🔮'''

        # Rename column and drop
        forecast_weather = (forecast_weather
                            .rename(columns = {'forecast_datetime': 'datetime'})
                            .drop(columns = 'origin_datetime') # not needed
                           )

        # To datetime
        forecast_weather['datetime'] = (pd.to_datetime(forecast_weather['datetime'])
                                        .dt
                                        .tz_convert('Europe/Brussels') # change to different time zone?
                                        .dt
                                        .tz_localize(None)
                                       )

        # Add county
        forecast_weather[self.lat_lon_columns] = forecast_weather[self.lat_lon_columns].astype(float).round(1)
        forecast_weather = forecast_weather.merge(location, how = 'left', on = self.lat_lon_columns)

        # Modify column names - specify suffix
        forecast_weather = self.create_new_column_names(forecast_weather,
                                                        suffix='_f',
                                                        columns_no_change = self.lat_lon_columns + self.weather_join
                                                        )

        # Group by & calculate aggregate stats
        agg_columns = [col for col in forecast_weather.columns if col not in self.lat_lon_columns + self.weather_join]
        agg_dict = {agg_col: self.agg_stats for agg_col in agg_columns}
        forecast_weather = forecast_weather.groupby(self.weather_join).agg(agg_dict).reset_index()

        # Flatten the multi column aggregates
        forecast_weather = self.flatten_multi_index_columns(forecast_weather)
        return forecast_weather

    def create_electricity_features(self, electricity):
        '''⚡ Create electricity prices features ⚡'''
        # To datetime
        electricity['forecast_date'] = pd.to_datetime(electricity['forecast_date'])

        # Test set has 1 day offset
        electricity['datetime'] = electricity['forecast_date'] + pd.DateOffset(1)

        # Modify column names - specify suffix
        electricity = self.create_new_column_names(electricity,
                                                   suffix='_electricity',
                                                   columns_no_change = self.electricity_join
                                                  )
        return electricity

    def create_gas_features(self, gas):
        '''⛽ Create gas prices features ⛽'''
        # Mean gas price
        gas['mean_price_per_mwh'] = (gas['lowest_price_per_mwh'] + gas['highest_price_per_mwh'])/2

        # Modify column names - specify suffix
        gas = self.create_new_column_names(gas,
                                           suffix='_gas',
                                           columns_no_change = self.gas_join
                                          )
        return gas

    def __call__(self, data, client, historical_weather, forecast_weather, electricity, gas):
        '''Processing of features from all datasets, merge together and return features for dataframe df '''
        # Create features for relevant dataset
        data = self.create_data_features(data)
        client = self.create_client_features(client)
        historical_weather = self.create_historical_weather_features(historical_weather)
        forecast_weather = self.create_forecast_weather_features(forecast_weather)
        electricity = self.create_electricity_features(electricity)
        gas = self.create_gas_features(gas)

        # 🔗 Merge all datasets into one df 🔗
        df = data.merge(client, how='left', on = self.client_join)
        df = df.merge(historical_weather, how='left', on = self.weather_join)
        df = df.merge(forecast_weather, how='left', on = self.weather_join)
        df = df.merge(electricity, how='left', on = self.electricity_join)
        df = df.merge(gas, how='left', on = self.gas_join)

        # Change columns to categorical for XGBoost
        df[self.category_columns] = df[self.category_columns].astype('category')
        return df
```

```
def create_revealed_targets_train(data, N_day_lags):
    '''🎯 Create past revealed_targets for train set based on number of day lags N_day_lags 🎯 '''
    original_datetime = data['datetime']
    revealed_targets = data[['datetime', 'prediction_unit_id', 'is_consumption', 'target']].copy()

    # Create revealed targets for all day lags
    for day_lag in range(2, N_day_lags+1):
        revealed_targets['datetime'] = original_datetime + pd.DateOffset(day_lag)
        data = data.merge(revealed_targets,
                          how='left',
                          on = ['datetime', 'prediction_unit_id', 'is_consumption'],
                          suffixes = ('', f'_{day_lag}_days_ago')
                         )
    return data
```

```
---------------------------------------------------------------------------

NameError                                 Traceback (most recent call last)

File <timed exec>:4
```

```
NameError: name 'FeatureProcessorClass' is not defined
```

```
%%time
# Create all features
N_day_lags = 15 # Specify how many days we want to go back (at least 2)

FeatureProcessor = FeatureProcessorClass()

data = FeatureProcessor(data = train.copy(),
                      client = client.copy(),
                      historical_weather = historical_weather.copy(),
                      forecast_weather = forecast_weather.copy(),
                      electricity = electricity.copy(),
                      gas = gas.copy(),
                     )

df = create_revealed_targets_train(data.copy(),
                                  N_day_lags = N_day_lags)
```

```
CPU times: user 31.7 s, sys: 3.63 s, total: 35.3 s
Wall time: 35.4 s
```

```
df
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	county	is_business	product_type	target	is_consumption	datetime	data_block_id	row_id	prediction_unit_id	date
0	0	0	1	0.713	0	2021-09-01 00:00:00	0	0	0	2021-09-01
1	0	0	1	96.590	1	2021-09-01 00:00:00	0	1	0	2021-09-01
2	0	0	2	0.000	0	2021-09-01 00:00:00	0	2	1	2021-09-01
3	0	0	2	17.314	1	2021-09-01 00:00:00	0	3	1	2021-09-01
4	0	0	3	2.904	0	2021-09-01 00:00:00	0	4	2	2021-09-01
...	...	...	...	...	...	...	...	...	...	...
2018347	15	1	0	197.233	1	2023-05-31 23:00:00	637	2018347	64	2023-05-31
2018348	15	1	1	0.000	0	2023-05-31 23:00:00	637	2018348	59	2023-05-31
2018349	15	1	1	28.404	1	2023-05-31 23:00:00	637	2018349	59	2023-05-31
2018350	15	1	3	0.000	0	2023-05-31 23:00:00	637	2018350	60	2023-05-31
2018351	15	1	3	196.240	1	2023-05-31 23:00:00	637	2018351	60	2023-05-31

2018352 rows × 71 columns

XGBoost single fold

```
#### Create single fold split ######
# Remove empty target row
target = 'target'
df = df[df[target].notnull()].reset_index(drop=True)

train_block_id = list(range(0, 600))

tr = df[df['data_block_id'].isin(train_block_id)] # first 600 data_block_ids used for training
val = df[~df['data_block_id'].isin(train_block_id)] # rest data_block_ids used for validation
```

```
# Remove columns for features
no_features = ['date',
                'latitude',
                'longitude',
                'data_block_id',
                'row_id',
                'hours_ahead',
                'hour_h',
               ]

remove_columns = [col for col in df.columns for no_feature in no_features if no_feature in col]
remove_columns.append(target)
features = [col for col in df.columns if col not in remove_columns]
PrintColor(f'There are {len(features)} features: {features}')
```

```
•[1m•[34mThere are 59 features: ['county', 'is_business', 'product_type', 'is_consumption', 'prediction_unit_id', 'year', 'quarter',
'month', 'week', 'hour', 'day_of_year', 'day_of_month', 'day_of_week', 'eic_count_client', 'installed_capacity_client',
'temperature_h_mean', 'dewpoint_h_mean', 'rain_h_mean', 'snowfall_h_mean', 'surface_pressure_h_mean', 'cloudcover_total_h_mean',
'cloudcover_low_h_mean', 'cloudcover_mid_h_mean', 'cloudcover_high_h_mean', 'windspeed_10m_h_mean', 'winddirection_10m_h_mean',
'shortwave_radiation_h_mean', 'direct_solar_radiation_h_mean', 'diffuse_radiation_h_mean', 'temperature_f_mean', 'dewpoint_f_mean',
'cloudcover_high_f_mean', 'cloudcover_low_f_mean', 'cloudcover_mid_f_mean', 'cloudcover_total_f_mean', '10_metre_u_wind_component_f_mean',
'10_metre_v_wind_component_f_mean', 'direct_solar_radiation_f_mean', 'surface_solar_radiation_downwards_f_mean', 'snowfall_f_mean',
'total_precipitation_f_mean', 'euros_per_mwh_electricity', 'lowest_price_per_mwh_gas', 'highest_price_per_mwh_gas',
'mean_price_per_mwh_gas', 'target_2_days_ago', 'target_3_days_ago', 'target_4_days_ago', 'target_5_days_ago', 'target_6_days_ago',
'target_7_days_ago', 'target_8_days_ago', 'target_9_days_ago', 'target_10_days_ago', 'target_11_days_ago', 'target_12_days_ago',
'target_13_days_ago', 'target_14_days_ago', 'target_15_days_ago']•[0m
```

```
clf = xgb.XGBRegressor(
                        device = device,
                        enable_categorical=True,
                        objective = 'reg:absoluteerror',
                        n_estimators = 2 if DEBUG else 1500,
                        early_stopping_rounds=100
                       )
```

```
clf.fit(X = tr[features],
        y = tr[target],
        eval_set = [(tr[features], tr[target]), (val[features], val[target])],
        verbose=True #False #True
       )
```

```
[0] validation_0-mae:241.34721  validation_1-mae:313.59462
[1] validation_0-mae:215.42586  validation_1-mae:280.99203
[2] validation_0-mae:190.86725  validation_1-mae:251.45951
[3] validation_0-mae:170.40260  validation_1-mae:225.99166
[4] validation_0-mae:154.06729  validation_1-mae:206.62102
[5] validation_0-mae:140.95136  validation_1-mae:191.85803
[6] validation_0-mae:125.98240  validation_1-mae:173.54080
[7] validation_0-mae:104.74360  validation_1-mae:149.22355
[8] validation_0-mae:90.29161   validation_1-mae:130.83786
[9] validation_0-mae:79.63454   validation_1-mae:118.34117
[10]    validation_0-mae:72.73513   validation_1-mae:110.68650
[11]    validation_0-mae:67.91961   validation_1-mae:105.49589
[12]    validation_0-mae:63.86090   validation_1-mae:102.48943
[13]    validation_0-mae:61.27159   validation_1-mae:100.79835
[14]    validation_0-mae:59.58509   validation_1-mae:99.21592
[15]    validation_0-mae:58.43125   validation_1-mae:98.35090
[16]    validation_0-mae:57.70675   validation_1-mae:97.24712
[17]    validation_0-mae:57.58207   validation_1-mae:97.17726
[18]    validation_0-mae:57.45992   validation_1-mae:97.12659
[19]    validation_0-mae:57.10950   validation_1-mae:96.66838
[20]    validation_0-mae:57.02720   validation_1-mae:96.63234
[21]    validation_0-mae:56.73053   validation_1-mae:96.31508
[22]    validation_0-mae:56.64142   validation_1-mae:96.27841
[23]    validation_0-mae:56.60987   validation_1-mae:96.27897
[24]    validation_0-mae:56.51125   validation_1-mae:96.17523
[25]    validation_0-mae:56.49119   validation_1-mae:96.17494
[26]    validation_0-mae:56.44668   validation_1-mae:96.15047
[27]    validation_0-mae:55.71773   validation_1-mae:95.47065
[28]    validation_0-mae:55.64144   validation_1-mae:95.45888
[29]    validation_0-mae:55.54472   validation_1-mae:95.33269
[30]    validation_0-mae:55.30892   validation_1-mae:95.14519
[31]    validation_0-mae:55.13800   validation_1-mae:95.10340
[32]    validation_0-mae:54.34211   validation_1-mae:92.27292
[33]    validation_0-mae:54.13944   validation_1-mae:92.13361
[34]    validation_0-mae:54.08822   validation_1-mae:92.13123
[35]    validation_0-mae:54.00945   validation_1-mae:92.02850
[36]    validation_0-mae:53.91672   validation_1-mae:91.98403
[37]    validation_0-mae:53.81292   validation_1-mae:91.97371
[38]    validation_0-mae:53.77167   validation_1-mae:91.97043
[39]    validation_0-mae:53.27585   validation_1-mae:91.35711
[40]    validation_0-mae:52.66954   validation_1-mae:90.48650
[41]    validation_0-mae:52.60527   validation_1-mae:90.43138
[42]    validation_0-mae:52.19321   validation_1-mae:90.38414
[43]    validation_0-mae:52.10671   validation_1-mae:90.30494
[44]    validation_0-mae:52.10104   validation_1-mae:90.30380
[45]    validation_0-mae:52.07043   validation_1-mae:90.26735
[46]    validation_0-mae:52.03017   validation_1-mae:90.20380
[47]    validation_0-mae:51.68873   validation_1-mae:89.60882
[48]    validation_0-mae:51.58029   validation_1-mae:89.51276
[49]    validation_0-mae:51.05095   validation_1-mae:88.77510
[50]    validation_0-mae:50.26902   validation_1-mae:88.36140
[51]    validation_0-mae:49.70186   validation_1-mae:86.07584
[52]    validation_0-mae:49.63804   validation_1-mae:85.98791
[53]    validation_0-mae:49.59058   validation_1-mae:85.97256
[54]    validation_0-mae:49.49412   validation_1-mae:85.85553
[55]    validation_0-mae:49.44461   validation_1-mae:85.84631
```

```
[56]    validation_0-mae:49.40024   validation_1-mae:85.81806
[57]    validation_0-mae:49.38706   validation_1-mae:85.80490
[58]    validation_0-mae:49.36791   validation_1-mae:85.79694
[59]    validation_0-mae:49.30003   validation_1-mae:85.78800
[60]    validation_0-mae:49.12381   validation_1-mae:85.64225
[61]    validation_0-mae:48.98335   validation_1-mae:85.52265
[62]    validation_0-mae:48.97579   validation_1-mae:85.51833
[63]    validation_0-mae:48.93175   validation_1-mae:85.49262
[64]    validation_0-mae:48.74839   validation_1-mae:85.30307
[65]    validation_0-mae:48.41075   validation_1-mae:84.89825
[66]    validation_0-mae:48.09019   validation_1-mae:84.53928
[67]    validation_0-mae:48.08323   validation_1-mae:84.53435
[68]    validation_0-mae:48.05237   validation_1-mae:84.49849
[69]    validation_0-mae:48.03206   validation_1-mae:84.50571
[70]    validation_0-mae:47.96101   validation_1-mae:84.44547
[71]    validation_0-mae:47.90092   validation_1-mae:84.39536
[72]    validation_0-mae:47.29120   validation_1-mae:84.07351
[73]    validation_0-mae:47.21455   validation_1-mae:83.95200
[74]    validation_0-mae:47.01989   validation_1-mae:83.69855
[75]    validation_0-mae:46.94186   validation_1-mae:83.61440
[76]    validation_0-mae:46.86568   validation_1-mae:83.60936
[77]    validation_0-mae:46.63500   validation_1-mae:83.35545
[78]    validation_0-mae:46.54098   validation_1-mae:83.33399
[79]    validation_0-mae:46.52873   validation_1-mae:83.33538
[80]    validation_0-mae:46.45950   validation_1-mae:83.29527
[81]    validation_0-mae:46.44614   validation_1-mae:83.29022
[82]    validation_0-mae:46.37544   validation_1-mae:83.24646
[83]    validation_0-mae:46.17560   validation_1-mae:82.99274
[84]    validation_0-mae:46.05692   validation_1-mae:82.89495
[85]    validation_0-mae:45.69188   validation_1-mae:82.63792
[86]    validation_0-mae:45.40070   validation_1-mae:82.20865
[87]    validation_0-mae:45.27809   validation_1-mae:82.10219
[88]    validation_0-mae:45.23533   validation_1-mae:82.07927
[89]    validation_0-mae:45.04454   validation_1-mae:81.41379
[90]    validation_0-mae:45.03000   validation_1-mae:81.36624
[91]    validation_0-mae:45.00327   validation_1-mae:81.32480
[92]    validation_0-mae:44.97829   validation_1-mae:81.28484
[93]    validation_0-mae:44.91376   validation_1-mae:81.20590
[94]    validation_0-mae:44.85950   validation_1-mae:81.13431
[95]    validation_0-mae:44.79079   validation_1-mae:81.01057
[96]    validation_0-mae:44.74278   validation_1-mae:80.95125
[97]    validation_0-mae:44.61347   validation_1-mae:80.76770
[98]    validation_0-mae:44.55458   validation_1-mae:80.68544
[99]    validation_0-mae:44.41335   validation_1-mae:80.53338
[100]   validation_0-mae:44.34341   validation_1-mae:80.48621
[101]   validation_0-mae:44.32076   validation_1-mae:80.45152
[102]   validation_0-mae:44.30986   validation_1-mae:80.45073
[103]   validation_0-mae:44.19915   validation_1-mae:80.37231
[104]   validation_0-mae:43.92723   validation_1-mae:80.22435
[105]   validation_0-mae:43.83492   validation_1-mae:80.11962
[106]   validation_0-mae:43.78134   validation_1-mae:80.07397
[107]   validation_0-mae:43.68554   validation_1-mae:80.02998
[108]   validation_0-mae:43.50173   validation_1-mae:79.58102
[109]   validation_0-mae:43.46996   validation_1-mae:79.57399
[110]   validation_0-mae:43.46702   validation_1-mae:79.58189
[111]   validation_0-mae:43.43123   validation_1-mae:79.57947
[112]   validation_0-mae:43.37678   validation_1-mae:79.57926
[113]   validation_0-mae:43.28527   validation_1-mae:79.42417
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[115]   validation_0-mae:43.22801   validation_1-mae:79.25131
[116]   validation_0-mae:43.18895   validation_1-mae:79.24136
[117]   validation_0-mae:43.12090   validation_1-mae:79.12599
[118]   validation_0-mae:43.04558   validation_1-mae:79.06094
[119]   validation_0-mae:42.99986   validation_1-mae:79.03418
[120]   validation_0-mae:42.98772   validation_1-mae:79.00577
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[122]   validation_0-mae:42.66125   validation_1-mae:78.64187
[123]   validation_0-mae:42.63997   validation_1-mae:78.85746
[124]   validation_0-mae:42.55864   validation_1-mae:78.95272
[125]   validation_0-mae:42.47354   validation_1-mae:78.87363
[126]   validation_0-mae:42.41527   validation_1-mae:78.81177
[127]   validation_0-mae:42.39506   validation_1-mae:78.77688
[128]   validation_0-mae:42.36823   validation_1-mae:78.81546
[129]   validation_0-mae:42.30408   validation_1-mae:78.78874
[130]   validation_0-mae:42.18954   validation_1-mae:78.41514
[131]   validation_0-mae:42.00767   validation_1-mae:78.19895
[132]   validation_0-mae:41.97221   validation_1-mae:78.18885
[133]   validation_0-mae:41.94240   validation_1-mae:78.07361
[134]   validation_0-mae:41.88868   validation_1-mae:77.93633
[135]   validation_0-mae:41.87088   validation_1-mae:77.86320
[136]   validation_0-mae:41.86614   validation_1-mae:77.84953
[137]   validation_0-mae:41.79489   validation_1-mae:77.87915
[138]   validation_0-mae:41.48586   validation_1-mae:77.58578
[139]   validation_0-mae:41.39748   validation_1-mae:77.57802
[140]   validation_0-mae:41.37674   validation_1-mae:77.57208
[141]   validation_0-mae:41.32238   validation_1-mae:77.54507
[142]   validation_0-mae:41.29873   validation_1-mae:77.51609
```

```
[143]	validation_0-mae:41.28246	validation_1-mae:77.50369
[144]	validation_0-mae:41.27464	validation_1-mae:77.50277
[145]	validation_0-mae:41.26760	validation_1-mae:77.48860
[146]	validation_0-mae:41.17406	validation_1-mae:77.36742
[147]	validation_0-mae:41.15402	validation_1-mae:77.35406
[148]	validation_0-mae:41.12971	validation_1-mae:77.36048
[149]	validation_0-mae:41.10978	validation_1-mae:77.31123
[150]	validation_0-mae:41.10822	validation_1-mae:77.30963
[151]	validation_0-mae:41.10187	validation_1-mae:77.30694
[152]	validation_0-mae:41.09901	validation_1-mae:77.30869
[153]	validation_0-mae:41.03727	validation_1-mae:77.25469
[154]	validation_0-mae:41.00350	validation_1-mae:77.23024
[155]	validation_0-mae:40.98282	validation_1-mae:77.24651
[156]	validation_0-mae:40.78624	validation_1-mae:76.93693
[157]	validation_0-mae:40.71075	validation_1-mae:76.76264
[158]	validation_0-mae:40.65457	validation_1-mae:76.70269
[159]	validation_0-mae:40.58190	validation_1-mae:76.58029
[160]	validation_0-mae:40.57342	validation_1-mae:76.58390
[161]	validation_0-mae:40.54335	validation_1-mae:76.56733
[162]	validation_0-mae:40.48590	validation_1-mae:76.53407
[163]	validation_0-mae:40.47333	validation_1-mae:76.48980
[164]	validation_0-mae:40.46767	validation_1-mae:76.48863
[165]	validation_0-mae:40.44640	validation_1-mae:76.47871
[166]	validation_0-mae:40.43746	validation_1-mae:76.47438
[167]	validation_0-mae:40.37245	validation_1-mae:76.44083
[168]	validation_0-mae:40.31191	validation_1-mae:76.41591
[169]	validation_0-mae:40.30475	validation_1-mae:76.41757
[170]	validation_0-mae:40.27335	validation_1-mae:76.42117
[171]	validation_0-mae:40.21178	validation_1-mae:76.39561
[172]	validation_0-mae:40.12003	validation_1-mae:76.37913
[173]	validation_0-mae:40.05273	validation_1-mae:76.11590
[174]	validation_0-mae:39.91388	validation_1-mae:75.94656
[175]	validation_0-mae:39.91253	validation_1-mae:75.95107
[176]	validation_0-mae:39.78610	validation_1-mae:75.72109
[177]	validation_0-mae:39.73083	validation_1-mae:75.67458
[178]	validation_0-mae:39.67020	validation_1-mae:75.59377
[179]	validation_0-mae:39.66490	validation_1-mae:75.59393
[180]	validation_0-mae:39.65213	validation_1-mae:75.57957
[181]	validation_0-mae:39.63645	validation_1-mae:75.57247
[182]	validation_0-mae:39.62455	validation_1-mae:75.57695
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[185]	validation_0-mae:39.55615	validation_1-mae:75.38605
[186]	validation_0-mae:39.54796	validation_1-mae:75.38602
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[189]	validation_0-mae:39.48240	validation_1-mae:75.37029
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[191]	validation_0-mae:39.46813	validation_1-mae:75.36578
[192]	validation_0-mae:39.44029	validation_1-mae:75.34571
[193]	validation_0-mae:39.43417	validation_1-mae:75.34728
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[196]	validation_0-mae:39.34678	validation_1-mae:75.23441
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[204]	validation_0-mae:39.14237	validation_1-mae:74.99497
[205]	validation_0-mae:39.14075	validation_1-mae:74.99431
[206]	validation_0-mae:39.13613	validation_1-mae:74.97404
[207]	validation_0-mae:39.12762	validation_1-mae:74.96613
[208]	validation_0-mae:39.12702	validation_1-mae:74.96630
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[217]	validation_0-mae:38.85130	validation_1-mae:75.46205
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[220]	validation_0-mae:38.79530	validation_1-mae:75.42470
[221]	validation_0-mae:38.74722	validation_1-mae:75.33332
[222]	validation_0-mae:38.74536	validation_1-mae:75.33425
[223]	validation_0-mae:38.60496	validation_1-mae:75.11513
[224]	validation_0-mae:38.46282	validation_1-mae:75.10530
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[227]	validation_0-mae:38.35860	validation_1-mae:75.02694
[228]	validation_0-mae:38.35446	validation_1-mae:75.03226
[229]	validation_0-mae:38.35248	validation_1-mae:75.03357
```

```
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[530]	validation_0-mae:33.92303	validation_1-mae:73.03324
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[577]	validation_0-mae:33.48128	validation_1-mae:73.22623
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[664]	validation_0-mae:32.65653	validation_1-mae:72.97862
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[747]	validation_0-mae:32.19961	validation_1-mae:73.02433
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```

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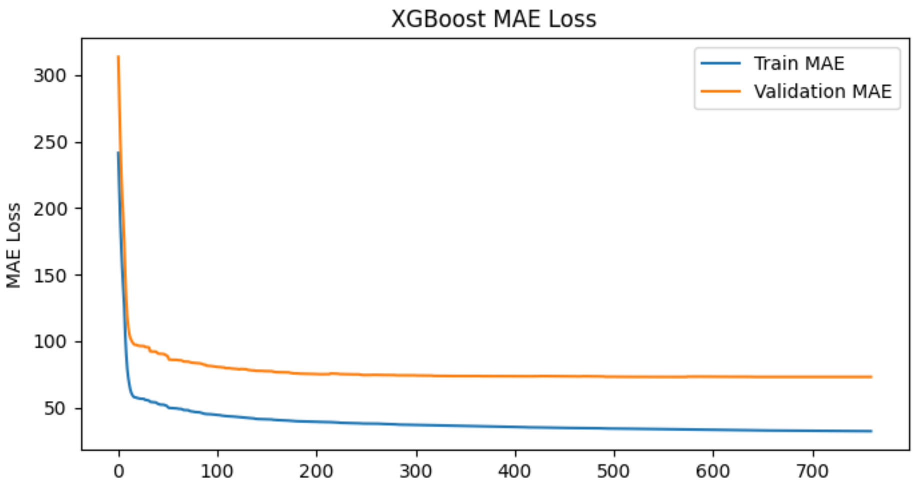
[754]	validation_0-mae:32.17463	validation_1-mae:73.01117
[755]	validation_0-mae:32.16938	validation_1-mae:73.01076
[756]	validation_0-mae:32.16868	validation_1-mae:73.01035
[757]	validation_0-mae:32.16852	validation_1-mae:73.01081
[758]	validation_0-mae:32.16766	validation_1-mae:73.01479
```

```
         colsample_bylevel=None, colsample_bynode=None,
         colsample_bytree=None, device=&#x27;cuda&#x27;, early_stopping_rounds=100,
         enable_categorical=True, eval_metric=None, feature_types=None,
         gamma=None, grow_policy=None, importance_type=None,
         interaction_constraints=None, learning_rate=None, max_bin=None,
         max_cat_threshold=None, max_cat_to_onehot=None,
         max_delta_step=None, max_depth=None, max_leaves=None,
         min_child_weight=None, missing=nan, monotone_constraints=None,
         multi_strategy=None, n_estimators=1500, n_jobs=None,
         num_parallel_tree=None, objective=&#x27;reg:absoluteerror&#x27;, ...)</pre><b>In a Jupyter environment, please rerun this cell to
show the HTML representation or trust the notebook. <br />On GitHub, the HTML representation is unable to render, please try loading this
page with nbviewer.org.</b></div><div class="sk-container" hidden><div class="sk-item"><div class="sk-estimator sk-toggleable"><input
class="sk-toggleable__control sk-hidden--visually" id="sk-estimator-id-1" type="checkbox" checked><label for="sk-estimator-id-1" class="sk-
toggleable__label sk-toggleable__label-arrow">XGBRegressor</label><div class="sk-toggleable__content"><pre>XGBRegressor(base_score=None,
booster=None, callbacks=None,
         colsample_bylevel=None, colsample_bynode=None,
         colsample_bytree=None, device=&#x27;cuda&#x27;, early_stopping_rounds=100,
         enable_categorical=True, eval_metric=None, feature_types=None,
         gamma=None, grow_policy=None, importance_type=None,
         interaction_constraints=None, learning_rate=None, max_bin=None,
         max_cat_threshold=None, max_cat_to_onehot=None,
         max_delta_step=None, max_depth=None, max_leaves=None,
         min_child_weight=None, missing=nan, monotone_constraints=None,
         multi_strategy=None, n_estimators=1500, n_jobs=None,
         num_parallel_tree=None, objective=&#x27;reg:absoluteerror&#x27;, ...)</pre></div></div></div></div></div>
```

```
PrintColor(f'Early stopping on best iteration #{clf.best_iteration} with MAE error on validation set of {clf.best_score:.2f}')
```

```
•[1m•[34mEarly stopping on best iteration #659 with MAE error on validation set of 72.96•[0m
```

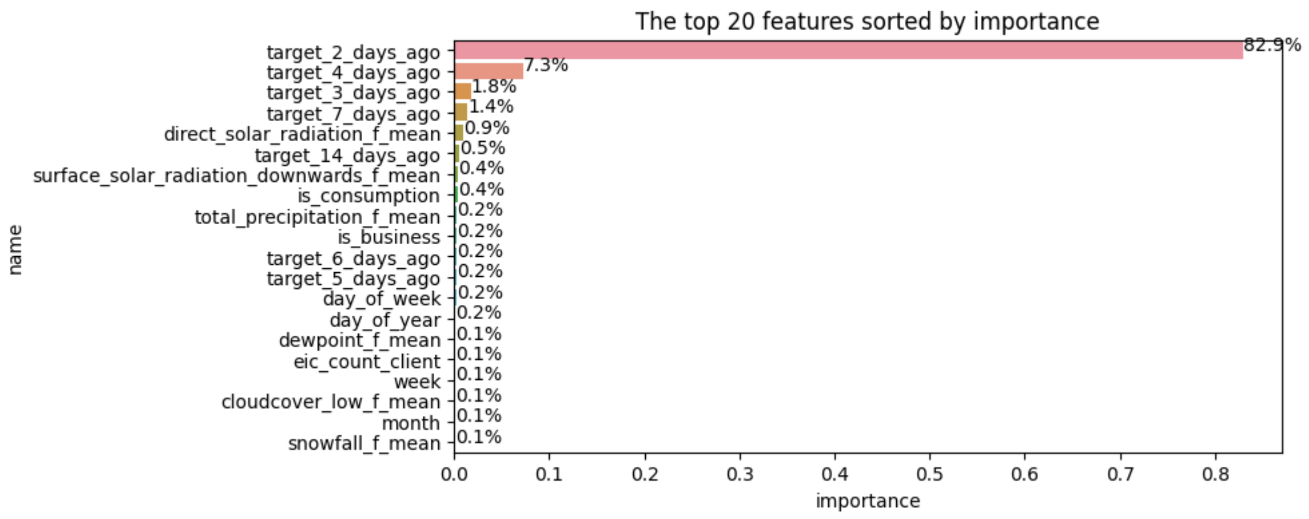
```
# Plot RMSE
results = clf.evals_result()
train_mae, val_mae = results["validation_0"]["mae"], results["validation_1"]["mae"]
x_values = range(0, len(train_mae))
fig, ax = plt.subplots(figsize=(8,4))
ax.plot(x_values, train_mae, label="Train MAE")
ax.plot(x_values, val_mae, label="Validation MAE")
ax.legend()
plt.ylabel("MAE Loss")
plt.title("XGBoost MAE Loss")
plt.show()
```



```
TOP = 20
importance_data = pd.DataFrame({'name': clf.feature_names_in_, 'importance': clf.feature_importances_})
importance_data = importance_data.sort_values(by='importance', ascending=False)

fig, ax = plt.subplots(figsize=(8,4))
sns.barplot(data=importance_data[:TOP],
            x = 'importance',
            y = 'name'
        )
patches = ax.patches
count = 0
for patch in patches:
    height = patch.get_height()
    width = patch.get_width()
    perc = 100*importance_data['importance'].iloc[count]#100*width/len(importance_data)
    ax.text(width, patch.get_y() + height/2, f'{perc:.1f}%')
    count+=1

plt.title(f'The top {TOP} features sorted by importance')
plt.show()
```



```
importance_data[importance_data['importance']<0.0005].name.values
```

```
array(['dewpoint_h_mean', 'target_11_days_ago', 'cloudcover_mid_f_mean',
       'winddirection_10m_h_mean', 'euros_per_mwh_electricity',
       'surface_pressure_h_mean', 'target_10_days_ago',
       'cloudcover_total_h_mean', 'cloudcover_mid_h_mean', 'rain_h_mean',
       'cloudcover_high_h_mean', 'snowfall_h_mean',
       'windspeed_10m_h_mean', 'cloudcover_high_f_mean'], dtype=object)
```

Submit

```
def create_revealed_targets_test(data, previous_revealed_targets, N_day_lags):
    '''🎯 Create new test data based on previous_revealed_targets and N_day_lags 🎯 '''
    for count, revealed_targets in enumerate(previous_revealed_targets) :
        day_lag = count + 2

        # Get hour
        revealed_targets['hour'] = pd.to_datetime(revealed_targets['datetime']).dt.hour

        # Select columns and rename target
        revealed_targets = revealed_targets[['hour', 'prediction_unit_id', 'is_consumption', 'target']]
        revealed_targets = revealed_targets.rename(columns = {"target" : f"target_{day_lag}_days_ago"})


        # Add past revealed targets
        data = pd.merge(data,
                        revealed_targets,
                        how = 'left',
                        on = ['hour', 'prediction_unit_id', 'is_consumption'],
                       )

    # If revealed_target_columns not available, replace by nan
    all_revealed_columns = [f"target_{day_lag}_days_ago" for day_lag in range(2, N_day_lags+1)]
    missing_columns = list(set(all_revealed_columns) - set(data.columns))
    data[missing_columns] = np.nan

    return data
```

```
import enefit
env = enefit.make_env()
iter_test = env.iter_test()
```

```
# Reload enefit environment (only in debug mode, otherwise the submission will fail)
if DEBUG:
    enefit.make_env.__called__ = False
    type(env)._state = type(type(env)._state).__dict__['INIT']
    iter_test = env.iter_test()
```

```
# List of target_revealed dataframes
previous_revealed_targets = []

for (test,
     revealed_targets,
     client_test,
     historical_weather_test,
     forecast_weather_test,
     electricity_test,
     gas_test,
     sample_prediction) in iter_test:

    # Rename test set to make consistent with train
    test = test.rename(columns = {'prediction_datetime': 'datetime'})

    # Initiate column data_block_id with default value to join on
    id_column = 'data_block_id'

    test[id_column] = 0
    gas_test[id_column] = 0
    electricity_test[id_column] = 0
    historical_weather_test[id_column] = 0
    forecast_weather_test[id_column] = 0
    client_test[id_column] = 0
    revealed_targets[id_column] = 0

    data_test = FeatureProcessor(
                               data = test,
                               client = client_test,
                               historical_weather = historical_weather_test,
                               forecast_weather = forecast_weather_test,
                               electricity = electricity_test,
                               gas = gas_test
                               )

    # Store revealed_targets
    previous_revealed_targets.insert(0, revealed_targets)

    if len(previous_revealed_targets) == N_day_lags:
        previous_revealed_targets.pop()

    # Add previous revealed targets
    df_test = create_revealed_targets_test(data = data_test.copy(),
                                           previous_revealed_targets = previous_revealed_targets.copy(),
                                           N_day_lags = N_day_lags
                                          )

    # Make prediction
    X_test = df_test[features]
    sample_prediction['target'] = clf.predict(X_test)
    env.predict(sample_prediction)
```

Next steps

> 📌**Note**: If you liked or forked this notebook, please consider upvoting ⬆ ⬆ It encourages to keep posting relevant content. Feedback is always welcome!!

- Create more rolling / lag features and make sure they are robust on the test set
- Be creative with new feature engineering
- Cross validation and hyperparameter tuning
- Choose other models e.g. CatBoost, LGBM, Neural Networks (Transformers?) and ensemble
- Alternative merging, not sure the merging I used is the most correct!