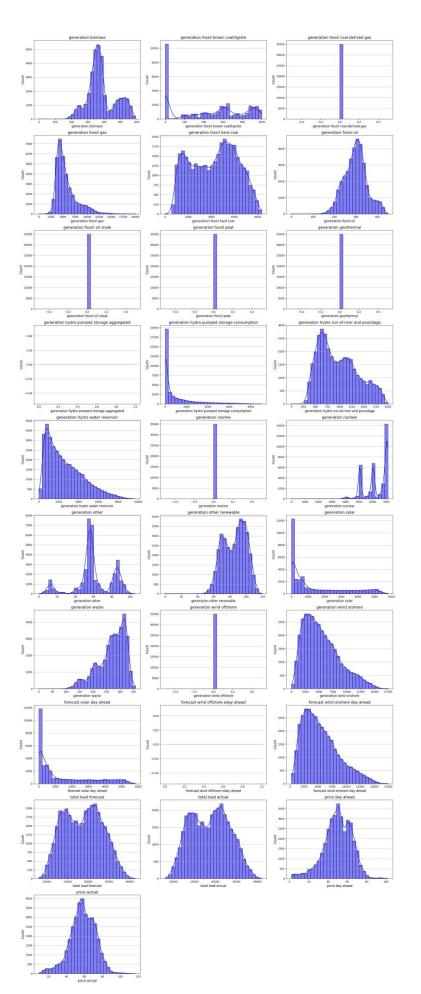# Electricity-demand-and-Price-forecasting

November 27, 2024
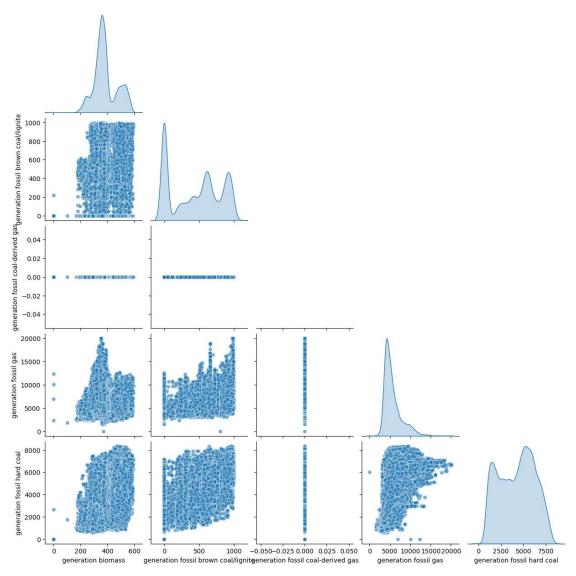
```python
[3]: import pandas as pd from google.colab import drive
     drive.mount('/content/drive') energy_data =
     pd.read_csv('/content/drive/MyDrive/energydataset.csv')
     weather_data =
     pd.read_csv('/content/drive/MyDrive/weaherdataset.csv')
     weather_df =
     pd.read_csv('/content/drive/MyDrive/weaherdataset.csv')
     energy_df =
     pd.read_csv('/content/drive/MyDrive/energydataset.csv')
```

Drive already mounted at /content/drive; to attempt to forcibly
remount, call drive.mount("/content/drive", force_remount=True).

```python
[4]: # Convert datetime columns to datetime type
     energy_df['time'] = pd.to_datetime(energy_df['time'],
     utc=True) weather_df['dt_iso'] =
     pd.to_datetime(weather_df['dt_iso'], utc=True)
```

```python
[5]: #Check for missing values and handle them
     print("Missing values in weather_df:")
     print(weather_df.isnull().sum())
     print("\nMissing values in energy_df:")
     print(energy_df.isnull().sum())
```

```
Missing values in
weather_df: dt_iso       0
city_name    0 temp        0
temp_min     0 temp_max 0
pressure     0 humidity 0
wind_speed 0 wind_deg 0
rain_1h      0 rain_3h   0
snow_3h      0 clouds_all
 0 weather_id       0
weather_main       0
weather_description    0

weather_icon          0
dtype: int64

Missing values in energy_df:
time                             0
generation biomass               19
```

```
generation fossil brown coal/lignite        18
generation fossil coal-derived gas          18
generation fossil gas                       18
generation fossil hard coal                 18
generation fossil oil                       19
generation fossil oil shale                 18
generation fossil peat                      18
generation geothermal                       18
generation hydro pumped storage          35064
aggregated
generation hydro pumped storage             19
consumption
generation hydro run-of-river and           19
poundage
generation hydro water reservoir            18
generation marine                           19
generation nuclear                          17
generation other                            18
generation other renewable                  18
generation solar                            18
generation waste                            19
generation wind offshore                    18
generation wind onshore                     18
forecast solar day ahead                     0
forecast wind offshore eday ahead        35064
forecast wind onshore day ahead              0
total load forecast                          0
total load actual                           36
price day ahead                              0
price actual                                 0
dtype: int64
```

[6]:
```python
#Forward-fill missing values
weather_df.ffill(inplace=True)
energy_df.ffill(inplace=True)
```

[8]:
```python
!pip install scikit-learn
import pandas as pd
from sklearn.preprocessing import StandardScaler
#Normalize specific numerical columns
scaler = StandardScaler()
energy_df[['total load actual', 'price actual']] = scaler.fit_transform(
    energy_df[['total load actual', 'price actual']]
)
```

```
Requirement already satisfied: scikit-learn in
/usr/local/lib/python3.10/distpackages (1.5.2)
Requirement already satisfied: numpy>=1.19.5 in
/usr/local/lib/python3.10/distpackages (from scikit-learn) (1.26.4)
```

```
Requirement already satisfied: scipy>=1.6.0 in
/usr/local/lib/python3.10/distpackages (from scikit-learn) (1.13.1)
Requirement already satisfied: joblib>=1.2.0 in
/usr/local/lib/python3.10/distpackages (from scikit-learn) (1.4.2)
Requirement already satisfied: threadpoolctl>=3.1.0 in
/usr/local/lib/python3.10/dist-packages (from scikit-learn) (3.5.0)
```

[9]:
```python
# Add time-based features energy_df['hour'] =
energy_df['time'].dt.hour
energy_df['day_of_week'] =
energy_df['time'].dt.dayofweek energy_df['month']
= energy_df['time'].dt.month
```

[10]:
```python
# Add lag and rolling features energy_df['demand_lag_1'] =
energy_df['total load actual'].shift(1)
```

```python
energy_df['demand_lag_24'] = energy_df['total load
actual'].shift(24) energy_df['demand_rolling_24'] =
energy_df['total load actual']. ↪rolling(window=24).mean()
```

[11]:
```python
# Drop rows with NaNs generated by lagging and rolling
energy_df.dropna(inplace=True)
```

[12]:
```python
import matplotlib.pyplot
as plt import seaborn as
sns import numpy as np

# Calculate the number of rows and columns for subplots
num_cols =
energy_data.select_dtypes(include=np.number).shape[1] num_rows
= (num_cols + 2) // 3 # Adjust rows dynamically for all columns

# Adjust figure size dynamically
plt.figure(figsize=(20, num_rows * 5)) # Each row gets more space for
clarity

# Loop through numerical columns and plot histograms for i, col in
enumerate(energy_data.select_dtypes(include=np.number).columns):
    plt.subplot(num_rows, 3, i + 1)
    sns.histplot(energy_data[col], kde=True, color='blue',
    bins=30) plt.title(col, fontsize=14) plt.xlabel(col,
    fontsize=12) plt.ylabel('Count', fontsize=12)
    plt.grid(axis='y')

plt.tight_layout()
plt.show()
```

```
[13]: #Time-based train-test split
      train_size = int(len(energy_df) *
      0.8) train_data =
      energy_df[:train_size] test_data
      = energy_df[train_size:]

[15]: # Limit to first 5 numerical columns to avoid overcrowding
      selected_cols =
      energy_data.select_dtypes(include=np.number).columns[:5]

      # Pairplot with KDE for diagonal
      sns.pairplot(energy_data[selected_cols], diag_kind='kde',
      corner=True, ␣
      ↪plot_kws={'alpha': 0.6}) plt.suptitle("Pairplot of
      Selected Features", y=1.02, fontsize=16) plt.show()
```

Pairplot of Selected Features


```
[17]: print("Initial Shape of Energy Data:", energy_df.shape)
      print("\nMissing values in Energy Data before filling:")
      print(energy_df.isnull().sum())
      energy_df.ffill(inplace=True) print("\nMissing
      values in Energy Data after filling:")
      print(energy_df.isnull().sum()) energy_df['hour'] =
      energy_df['time'].dt.hour energy_df['day_of_week'] =
      energy_df['time'].dt.dayofweek energy_df['month'] =
      energy_df['time'].dt.month energy_df['demand_lag_1'] =
      energy_df['total load actual'].shift(1)
      energy_df['demand_lag_24'] = energy_df['total load
      actual'].shift(24) energy_df['demand_rolling_24'] =
      energy_df['total load actual'].
```

```
↪rolling(window=24).mean() print("\nShape after
feature engineering:", energy_df.shape)
energy_df.dropna(inplace=True) print("\nShape after
dropping NaNs:", energy_df.shape) train_size =
int(len(energy_df) * 0.8) train_data =
energy_df[:train_size] test_data =
energy_df[train_size:] print("\nCleaned Energy
Data:") print(energy_df.head())
```

```
Initial Shape of Energy Data: (0, 35)
Missing values in Energy Data before
filling:
time                                         0
generation biomass                           0
generation fossil brown coal/lignite         0
generation fossil coal-derived gas           0
generation fossil gas                        0
generation fossil hard coal                  0
generation fossil oil                        0
generation fossil oil shale                  0
generation fossil peat                       0
generation geothermal                        0
generation hydro pumped storage              0
aggregated
generation hydro pumped storage              0
consumption
generation hydro run-of-river and            0
poundage
generation hydro water reservoir             0
generation marine                            0
generation nuclear                           0
generation other                             0
generation other renewable                   0
generation solar                             0
generation waste                             0
generation wind offshore                     0
generation wind onshore                      0
forecast solar day ahead                     0
forecast wind offshore eday ahead            0
forecast wind onshore day ahead              0
total load forecast                          0
total load actual                            0
price day ahead                              0
price actual                                 0
hour                                         0
day_of_week                                  0
month                                        0
demand_lag_1                                 0
```

```
demand_lag_24                        0
demand_rolling_24                    0
dtype: int64

Missing values in Energy Data after
filling:
time                                 0
generation biomass                   0
generation fossil brown coal/lignite 0
generation fossil coal-derived gas   0
generation fossil gas                0
generation fossil hard coal          0
generation fossil oil                0
generation fossil oil shale          0
generation fossil peat               0
generation geothermal                0
generation hydro pumped storage      0
aggregated
generation hydro pumped storage      0
consumption
generation hydro run-of-river and    0
poundage
generation hydro water reservoir     0
generation marine                    0
generation nuclear                   0
generation other                     0
generation other renewable           0
generation solar                     0
generation waste                     0
generation wind offshore             0
generation wind onshore              0
forecast solar day ahead             0
forecast wind offshore eday ahead    0
forecast wind onshore day ahead      0
total load forecast                  0
total load actual                    0
price day ahead                      0
price actual                         0
hour                                 0
day_of_week                          0
month                                0
demand_lag_1                         0
demand_lag_24                        0
demand_rolling_24                    0
dtype: int64
Shape after feature engineering: (0, 35)

Shape after dropping NaNs: (0, 35)
```

Cleaned Energy Data:
Empty DataFrame
Columns: [time, generation biomass, generation fossil brown
coal/lignite, generation fossil coal-derived gas, generation fossil
gas, generation fossil hard coal, generation fossil oil, generation
fossil oil shale, generation fossil peat, generation geothermal,
generation hydro pumped storage aggregated, generation hydro pumped
storage consumption, generation hydro run-of-river and poundage,
generation hydro water reservoir, generation marine, generation
nuclear, generation other, generation other renewable, generation
solar, generation waste, generation wind offshore, generation wind
onshore, forecast solar day ahead, forecast wind offshore eday ahead,
forecast wind onshore day ahead, total load forecast, total load
actual, price day ahead, price actual, hour, day_of_week, month,
demand_lag_1, demand_lag_24, demand_rolling_24] Index: []

[0 rows x 35 columns]

```python
import pandas as pd from sklearn.preprocessing import
StandardScaler energy_df =
pd.read_csv('/content/drive/MyDrive/energydataset.csv')
print("First few rows of Energy Data:")
print(energy_df.head()) print("\nShape of
Energy Data:", energy_df.shape)
print("\nColumns in Energy Data:")
print(energy_df.columns) print("\nData
Types of Columns:")
print(energy_df.dtypes) print("\nMissing values
in Energy Data before filling:")
print(energy_df.isnull().sum()) energy_df['generation hydro pumped
storage aggregated'].fillna(0, inplace=True)
energy_df.drop(columns=['forecast wind offshore eday ahead'],
inplace=True) energy_df.ffill(inplace=True) print("\nMissing values
in Energy Data after filling:") print(energy_df.isnull().sum())

#Ensure 'time' column is in datetime format (if
applicable) if 'time' in energy_df.columns:
    energy_df['time'] = pd.to_datetime(energy_df['time'],
    errors='coerce',
 utc=True) # 'coerce' to handle invalid formats

# Feature Engineering
# Adding time-based features (hour, day of the week,
month) if 'time' in energy_df.columns:
    energy_df['hour'] = energy_df['time'].dt.hour
    energy_df['day_of_week'] = energy_df['time'].dt.dayofweek
    energy_df['month'] = energy_df['time'].dt.month
```

```python
# Lag features - e.g., demand 1 hour ago, 24 hours ago
energy_df['demand_lag_1'] = energy_df['total load
actual'].shift(1) energy_df['demand_lag_24'] =
energy_df['total load actual'].shift(24)

# Rolling averages - e.g., 24-hour moving average for demand
energy_df['demand_rolling_24'] = energy_df['total load actual'].
↪rolling(window=24).mean()

# Drop any resulting NaN rows from lagging and rolling operations
energy_df.dropna(inplace=True)

# Step 8: Normalize the data (if needed)
scaler = StandardScaler() if 'total load actual' in
energy_df.columns and 'price actual' in energy_df.
 ↪columns: energy_df[['total load actual', 'price
   actual']] = scaler.
 ↪fit_transform(energy_df[['total load actual', 'price
 actual']])

# Step 9: Time-based train-test split
train_size = int(len(energy_df) * 0.8)
train_data, test_data = energy_df[:train_size],
energy_df[train_size:]

# Print the cleaned and feature-engineered dataset preview
print("\nCleaned Energy Data:")
print(energy_df.head())

# Verify the shape after cleaning and feature engineering
print("\nShape after cleaning and feature engineering:")
print(energy_df.shape)

# Verify train-test split shape
print("\nTrain Data Shape:",
train_data.shape) print("Test Data
Shape:", test_data.shape)
```

```
First few rows of Energy Data: time
                  generation biomass \
0 2015-01-01 00:00:00+01:00          447.0
1 2015-01-01 01:00:00+01:00          449.0
2 2015-01-01 02:00:00+01:00          448.0
3 2015-01-01 03:00:00+01:00          438.0
4 2015-01-01 04:00:00+01:00          428.0
 generation fossil brown coal/lignite generation fossil coal-derived gas
                                                                       \
0                                  329.0                            0.0
```

```
1                            328.0                             0.0
2                            323.0                             0.0
3                            254.0                             0.0
4                            187.0                             0.0
   generation fossil gas  generation fossil hard coal  generation fossil
   oil \
0                 4844.0                       4821.0                162.0
1                 5196.0                       4755.0                158.0
2                 4857.0                       4581.0                157.0
3                 4314.0                       4131.0                160.0
4                 4130.0                       3840.0                156.0
 generation fossil oil shale  generation fossil peat  generation geothermal \
0                         0.0                     0.0                    0.0
1                         0.0                     0.0                    0.0
2                         0.0                     0.0                    0.0
3                         0.0                     0.0                    0.0
4                         0.0                     0.0                    0.0
   … generation waste  generation wind offshore  generation wind onshore
   \
0 …            196.0                       0.0                   6378.0
1 …            195.0                       0.0                   5890.0
2 …            196.0                       0.0                   5461.0
3 …            191.0                       0.0                   5238.0
4 …            189.0                       0.0                   4935.0

   forecast solar day ahead  forecast wind offshore eday
                      ahead \
0                        17  NaN
1                        16  NaN
2                         8  NaN
3                         2  NaN
4                         9  NaN
 forecast wind onshore day ahead  total load forecast  total load actual
                              \
0                           6436                26118             25385.0
1                           5856                24934             24382.0
2                           5454                23515             22734.0
3                           5151                22642             21286.0
4                           4861                21785             20264.0

   price day ahead  price actual
0          50.10      65.41
1          48.10      64.92
2          47.33      64.48
3          42.27      59.32
4          38.41      56.04
[5 rows x 29 columns]
```

```
Shape of Energy Data: (35064, 29)

Columns in Energy Data:
Index(['time', 'generation biomass', 'generation fossil brown
coal/lignite', 'generation fossil coal-derived gas', 'generation
fossil gas',
       'generation fossil hard coal', 'generation fossil oil',
       'generation fossil oil shale', 'generation fossil peat',
       'generation geothermal', 'generation hydro pumped storage
       aggregated',
       'generation hydro pumped storage consumption',
       'generation hydro run-of-river and poundage',
       'generation hydro water reservoir', 'generation marine',
       'generation nuclear', 'generation other', 'generation other
       renewable',
       'generation solar', 'generation waste', 'generation wind
       offshore',
       'generation wind onshore', 'forecast solar day ahead',
       'forecast wind offshore eday ahead', 'forecast wind onshore day
       ahead',
       'total load forecast', 'total load actual', 'price day ahead',
       'price actual'],
      dtype='object')
Data Types of Columns:

time                                        object
generation biomass                          float64
generation fossil brown coal/lignite        float64
generation fossil coal-derived gas          float64
generation fossil gas                       float64
generation fossil hard coal                 float64
generation fossil oil                       float64
generation fossil oil shale                 float64
generation fossil peat                      float64
generation geothermal                       float64
generation hydro pumped storage             float64
aggregated
generation hydro pumped storage             float64
consumption
generation hydro run-of-river and           float64
poundage
generation hydro water reservoir            float64
generation marine                           float64
generation nuclear                          float64
generation other                            float64
generation other renewable                  float64
generation solar                            float64
generation waste                            float64
```

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```
generation wind offshore                  float64
generation wind onshore                   float64
forecast solar day ahead                    int64
forecast wind offshore eday ahead         float64
forecast wind onshore day ahead             int64
total load forecast                         int64
total load actual                         float64
price day ahead                           float64
price actual                              float64
dtype: object
Missing values in Energy Data before filling:

time                                          0
generation biomass                           19
generation fossil brown coal/lignite         18
generation fossil coal-derived gas           18
generation fossil gas                        18
generation fossil hard coal                  18
generation fossil oil                        19
generation fossil oil shale                  18
generation fossil peat                       18
generation geothermal                        18
generation hydro pumped storage           35064
aggregated
generation hydro pumped storage              19
consumption
generation hydro run-of-river and            19
poundage
generation hydro water reservoir             18
generation marine                            19
generation nuclear                           17
generation other                             18
generation other renewable                   18
generation solar                             18
generation waste                             19
generation wind offshore                     18
generation wind onshore                      18
forecast solar day ahead                      0
forecast wind offshore eday ahead         35064
forecast wind onshore day ahead               0

total load forecast                           0

total load actual                            36

price day ahead                               0
```

```
price actual                               0
dtype: int64

Missing values in Energy Data after
filling:
time                                   0

generation biomass                     0

generation fossil brown coal/lignite   0

generation fossil coal-derived gas     0

generation fossil gas                  0

generation fossil hard coal            0

generation fossil oil                  0

generation fossil oil shale            0

generation fossil peat                 0

generation geothermal                  0

generation hydro pumped storage        0
aggregated
generation hydro pumped storage        0
consumption
generation hydro run-of-river and      0
poundage
generation hydro water reservoir       0

generation marine                      0

generation nuclear                     0

generation other                       0
generation other renewable             0
generation solar                       0
generation waste                       0
generation wind offshore               0
generation wind onshore                0
forecast solar day ahead               0
forecast wind onshore day ahead        0
total load forecast                    0
total load actual                      0
price day ahead                        0
price actual                           0
dtype: int64
<ipython-input-18-bc595b8680fa>:28: FutureWarning: A value is trying
to be set on a copy of a DataFrame or Series through chained
assignment using an inplace method.
```

The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or df[col] = df[col].method(value) instead, to perform the operation inplace on the original object.

```
  energy_df['generation hydro pumped storage aggregated'].fillna(0,
inplace=True)
```

Cleaned Energy Data: time generation biomass \
24 2015-01-01 23:00:00+00:00   368.0
25 2015-01-02 00:00:00+00:00   368.0
26 2015-01-02 01:00:00+00:00   358.0
27 2015-01-02 02:00:00+00:00   353.0
28 2015-01-02 03:00:00+00:00   354.0
    generation fossil brown coal/lignite generation fossil coal-
    derived gas \
24   0.0   0.0
25   0.0   0.0
26   0.0   0.0
27   0.0   0.0
28   0.0   0.0

generation fossil gas generation fossil hard coal generation fossil oil \
24   3189.0   1291.0   193.0
25   2902.0   1190.0   192.0
26   2772.0   1023.0   189.0
27   2936.0   1016.0   188.0
28   2893.0   1103.0   189.0

    generation fossil oil shale generation fossil peat \
24   0.0   0.0
25   0.0   0.0
26   0.0   0.0
27   0.0   0.0
28   0.0   0.0
 generation geothermal … total load forecast total load actual \
24   0.0 …   27309   -
                                                          0.356482
25   0.0 …   25397   -
                                                          0.823150

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```
26                  0.0 …             23640          -
                                                1.199327
27                  0.0 …             22638          -
                                                1.346650
28                  0.0 …             22238          -
                                                1.443699
    price day ahead price actual hour day_of_week month demand_lag_1 \
24          10.0      0.432104   23          3     1      26798.0
25           7.0      0.040747    0          4     1      27070.0
26           5.0     -0.223911    1          4     1      24935.0
27           4.0     -0.209130    2          4     1      23214.0
28           4.0     -0.338644    3          4     1      22540.0

             demand_lag_24
           demand_rolling_24
24      25385.0 23966.958333
25      24382.0 23990.000000
26      22734.0 24010.000000
27      21286.0 24062.250000
28      20264.0 24138.583333


[5 rows x 34 columns]
Shape after cleaning and feature
engineering:
(35040, 34)

Train Data Shape: (28032, 34)
Test Data Shape: (7008, 34)
```

```python
# Step 1: Define features (X) and target variable (y)
# Let's predict 'total load actual' as an example
X_train = train_data.drop(['time', 'total load actual', 'price
actual'], axis=1) y_train = train_data['total load actual']
X_test = test_data.drop(['time', 'total load actual', 'price

actual'], axis=1) y_test = test_data['total load actual'] # Step 2:

Train the Random Forest model
```

```python
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score

# Initialize the Random Forest model
rf_model = RandomForestRegressor(n_estimators=100, random_state=42)

# Train the model
rf_model.fit(X_train, y_train)

# Step 3: Make predictions on the test set
y_pred = rf_model.predict(X_test)

# Step 4: Evaluate the model
mae = mean_absolute_error(y_test, y_pred)
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

# Output the evaluation metrics
print(f"Mean Absolute Error (MAE): {mae}")
print(f"Mean Squared Error (MSE): {mse}")
print(f"R-squared (R2): {r2}")
```

```
Mean Absolute Error (MAE): 0.05117966337905116
Mean Squared Error (MSE): 0.005580688290006658
R-squared (R2): 0.9942780029263171
```

```python
[20]:  import matplotlib.pyplot as plt
       import seaborn as sns
       from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score

       # Make predictions on the test set
       y_pred = rf_model.predict(X_test)

       # Calculate evaluation metrics
       mae = mean_absolute_error(y_test, y_pred)
       mse = mean_squared_error(y_test, y_pred)
       r2 = r2_score(y_test, y_pred)

       # Print the evaluation metrics
       print(f"Mean Absolute Error (MAE): {mae}")
       print(f"Mean Squared Error (MSE): {mse}")
       print(f"R-squared (R2): {r2}")

       # Plot of Actual vs Predicted values
       plt.figure(figsize=(10, 6))

       # Plot actual values
```

```python
plt.plot(y_test.index, y_test, label='Actual Values', color='blue', alpha=0.7)

# Plot predicted values
plt.plot(y_test.index, y_pred, label='Predicted Values', color='red', alpha=0.7)

# Add title and labels
plt.title('Actual vs Predicted Values (Overlapping Lines) ', fontsize=14)
plt.xlabel('Time', fontsize=12)
plt.ylabel('Price', fontsize=12)

# Add a legend
plt.legend()

# Show the plot
plt.grid(True)
plt.show()
```

Mean Absolute Error (MAE): 0.05117966337905116
Mean Squared Error (MSE): 0.005580688290006658
R-squared (R2): 0.9942780029263171

Actual vs Predicted Values (Overlapping Lines)

[21]:
```python
from sklearn.metrics import r2_score

# Calculate R² score for the model
```

```python
r2 = r2_score(y_test, y_pred)

# Print the R² score
print(f'R-squared (R²) Score: {r2}')
```

R-squared (R²) Score: 0.9942780029263171

```python
[22]: # Check available variables
globals().keys()
```

```
[22]: dict_keys(['__name__', '__doc__', '__package__', '__loader__',
'__spec__',
    '__builtin__', '__builtins__', '_ih', '_oh', '_dh', 'In', 'Out',
    'get_ipython',
    'exit', 'quit', '_', '__', '___', '_i', '_ii', '_iii', '_i1',
    'XGBRegressor',
    'mean_absolute_error', 'mean_squared_error', 'r2_score', 'xgb_model',
    '_i2',
    '_i3', 'pd', 'drive', 'energy_data', 'weather_data', 'weather_df',
    'energy_df',
    '_i4', '_i5', '_i6', '_i7', '_i8', '_exit_code', 'StandardScaler',
    'scaler',
    '_i9', '_i10', '_i11', '_i12', 'plt', 'sns', 'np', 'num_cols',
    'num_rows', 'i',
    'col', '_i13', 'train_size', 'train_data', 'test_data', '_i14',
    '_i15',
    'selected_cols', '_i16', '_i17', '_i18', '_i19', 'X_train',
    'y_train', 'X_test',
    'y_test', 'RandomForestRegressor', 'rf_model', 'y_pred', 'mae',
    'mse', 'r2', '_i20', '_i21', '_i22'])
```

```python
[24]: # Assuming 'rf_model', 'scaler', and 'energy_df' are already defined
    from↵previous code

# Create a copy of the last row of the training data
last_row = energy_df.iloc[-1].copy()

# Create an empty list to store the next month's predictions
next_month_predictions = []

# Loop to simulate predictions for each hour of the next month
for i in range(1, 721): # Assuming 30 days in a month, 24
hours per day
    # Update time-based features for the next hour
    last_row['time'] = last_row['time'] +
    pd.Timedelta(hours=1) last_row['hour'] =
    last_row['time'].hour last_row['day_of_week'] =
```

```python
    last_row['time'].dayofweek last_row['month'] =
    last_row['time'].month

    # Update lag features using the previous predicted values
    last_row['demand_lag_1'] = last_row['total load actual']
    # Fix: Check if the list has enough elements before accessing
    index -24 last_row['demand_lag_24'] = last_row['total load
    actual'] if i < 24 else
    next_month_predictions[-24] if len(next_month_predictions) >= 24
                              else
    last_row['total load actual']
    # ... (update other lag features similarly)
    # Update rolling average if necessary (more complex)
    # ...

    # Prepare the input features for the model
    input_features = last_row.drop(['time', 'total load actual', 'price
    actual']).values.reshape(1, -1)

    # Make prediction
    predicted_demand = rf_model.predict(input_features)[0]

    # Inverse scaling
    predicted_demand = scaler.inverse_transform([[predicted_demand, 0]])[0, 0]

    # Store the prediction and update the last_row values with this prediction
    next_month_predictions.append(predicted_demand)
    last_row['total load actual'] = predicted_demand  # Update last_row


# Create a DataFrame for next month's predictions
next_month_df = pd.DataFrame({'predicted_demand': next_month_predictions})


# Output the next month's predictions (or store it in a file)
next_month_df
```

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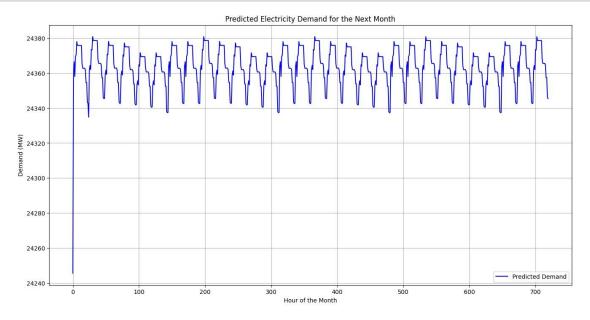RandomForestRegressor was fitted with feature names
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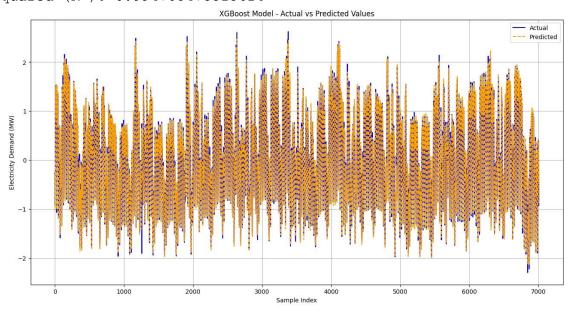
```
[24]:    predicted_demand
     0            24245.56
     1            24357.33
     2            24366.51
     3            24358.03
     4            24369.50
     ..                 …
     715          24364.54
     716          24357.39
     717          24357.39
     718          24346.07
     719          24345.38

     [720 rows x 1 columns]
```

```python
[25]: import matplotlib.pyplot as plt

      # Create a DataFrame for next month's predictions (this part is from
      your code) next_month_df = pd.DataFrame({'predicted_demand':
      next_month_predictions})
```

```python
# Increase the figure size for better visibility
plt.figure(figsize=(16, 8))   # Adjust the width and height as needed

# Plot the predicted demand for the next month
plt.plot(next_month_df['predicted_demand'], label='Predicted Demand',
    color='blue')

# Add labels and title
plt.title('Predicted Electricity Demand for the Next Month ')
plt.xlabel('Hour of the Month')
plt.ylabel('Demand (MW)')

# Show the grid for better readability
plt.grid(True)

# Display the plot
plt.legend()
plt.show()
```



```python
[ ]:
```

```python
[26]: from xgboost import XGBRegressor
      from sklearn.metrics import mean_absolute_error, mean_squared_error, r2_score

      # Initialize the XGBoost regressor
      xgb_model = XGBRegressor(
          n_estimators=100,        # Number of trees
```

```python
    learning_rate=0.1,        # Step size shrinkage
    max_depth=6,              # Maximum tree depth
    subsample=0.8,            # Subsampling ratio for training
    colsample_bytree=0.8,     # Subsampling ratio of columns per tree
    random_state=42           # For reproducibility
)

# Train the model
xgb_model.fit(X_train, y_train)

# Predict on the test set
y_pred_xgb = xgb_model.predict(X_test)

# Evaluate the model
mae_xgb = mean_absolute_error(y_test, y_pred_xgb)
mse_xgb = mean_squared_error(y_test, y_pred_xgb)
r2_xgb = r2_score(y_test, y_pred_xgb)

# Display the results
print(f"XGBoost Model Performance:")
print(f"Mean Absolute Error (MAE): {mae_xgb}")
print(f"Mean Squared Error (MSE): {mse_xgb}")
print(f"R-squared (R²): {r2_xgb}")
```

```
XGBoost Model Performance:
Mean Absolute Error (MAE): 0.051302981863773606
Mean Squared Error (MSE): 0.005160846527187979
R-squared (R²): 0.994708475515614
```

```python
[27]: print(f"XGBoost Model Performance:")
print(f"Mean Absolute Error (MAE):
{mae_xgb}") print(f"Mean Squared Error
(MSE): {mse_xgb}") print(f"R-squared
(R²): {r2_xgb}")

# Plot actual vs. predicted values for the test set
plt.figure(figsize=(16, 8))
plt.plot(y_test.values, label='Actual', color='blue')
plt.plot(y_pred_xgb, label='Predicted', color='orange',
linestyle='dashed')
plt.title('XGBoost Model - Actual vs Predicted Values')
plt.xlabel('Sample Index')
plt.ylabel('Electricity Demand
(MW)') plt.legend()
plt.grid(True) plt.show()
```

```
XGBoost Model Performance:
```

```
Mean Absolute Error (MAE): 0.051302981863773606
Mean Squared Error (MSE): 0.00516084652718797
R-squared (R²): 0.994708475515614
```


XGBoost Model - Actual vs Predicted Values

[36]:
```python
from sklearn.metrics import mean_absolute_error, mean_squared_error,
r2_score import xgboost as xgb

# Remove or transform the 'time' column in the training and testing
datasets
X_train_price['hour'] = X_train_price['time'].dt.hour
X_train_price['day_of_week'] = X_train_price['time'].dt.dayofweek
X_train_price['month'] = X_train_price['time'].dt.month
X_train_price = X_train_price.drop(columns=['time'],
errors='ignore')

X_test_price['hour'] = X_test_price['time'].dt.hour
X_test_price['day_of_week'] = X_test_price['time'].dt.dayofweek
X_test_price['month'] = X_test_price['time'].dt.month
X_test_price = X_test_price.drop(columns=['time'], errors='ignore')

# Initialize and train the XGBoost model xgb_model_price =
xgb.XGBRegressor(random_state=42, n_estimators=100,
 ↪learning_rate=0.1)
xgb_model_price.fit(X_train_price,
y_train_price)

# Make predictions
y_pred_price_xgb = xgb_model_price.predict(X_test_price)
```

```python
# Evaluate the model
mae_price_xgb = mean_absolute_error(y_test_price, y_pred_price_xgb)
mse_price_xgb = mean_squared_error(y_test_price, y_pred_price_xgb)
r2_price_xgb = r2_score(y_test_price, y_pred_price_xgb)

# Print the performance metrics print(f"XGBoost
Model Performance for Price Forecasting:")
print(f"Mean Absolute Error (MAE):
{mae_price_xgb}") print(f"Mean Squared Error
(MSE): {mse_price_xgb}") print(f"R-squared (R²):
{r2_price_xgb}")
```

```
XGBoost Model Performance for Price Forecasting:
Mean Absolute Error (MAE): 0.5640587135799863
Mean Squared Error (MSE): 0.5400858317781766
R-squared (R²): 0.18641775400886207
```

[37]:
```python
# Plot the actual vs. predicted values
plt.figure(figsize=(16, 8))
plt.plot(y_test_price.values, label='Actual Price', color='blue')
plt.plot(y_pred_price_xgb, label='Predicted Price', color='orange',⏎
  ⏎linestyle='dashed')
plt.title('XGBoost Model - Actual vs Predicted Electricity Price ')
plt.xlabel('Sample Index')
plt.ylabel('Electricity Price')
plt.legend()
plt.grid(True)
plt.show()
```