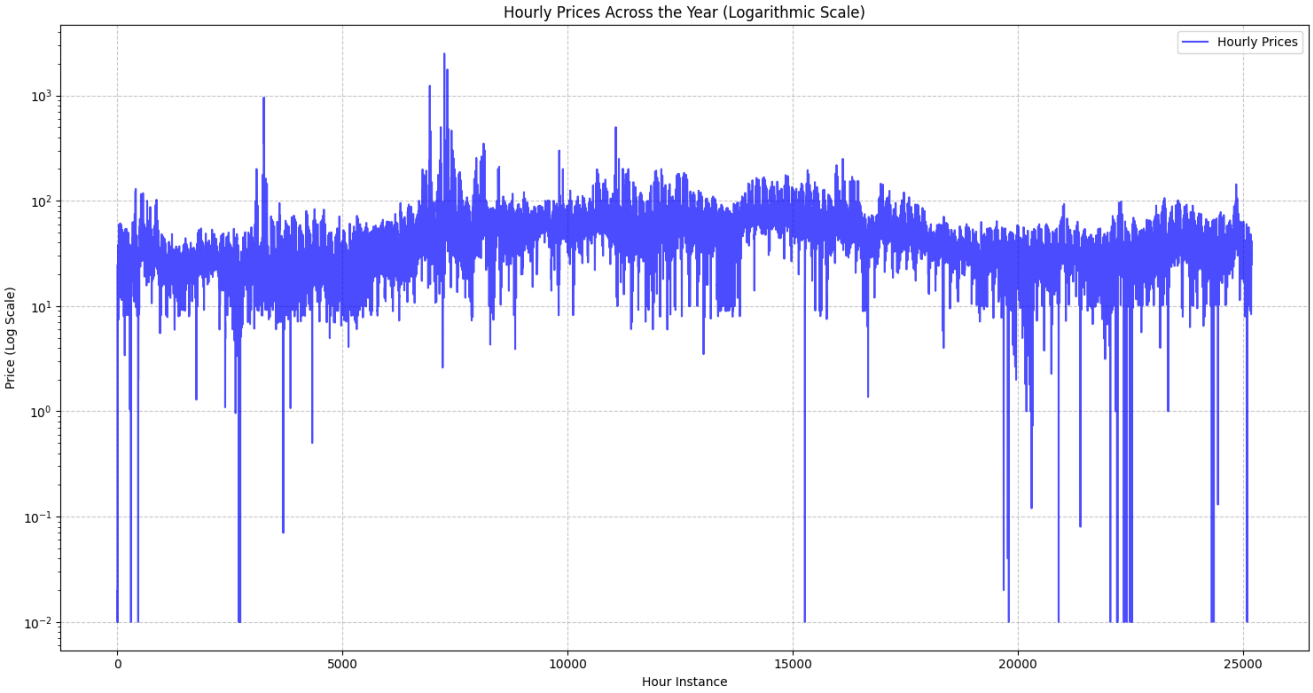
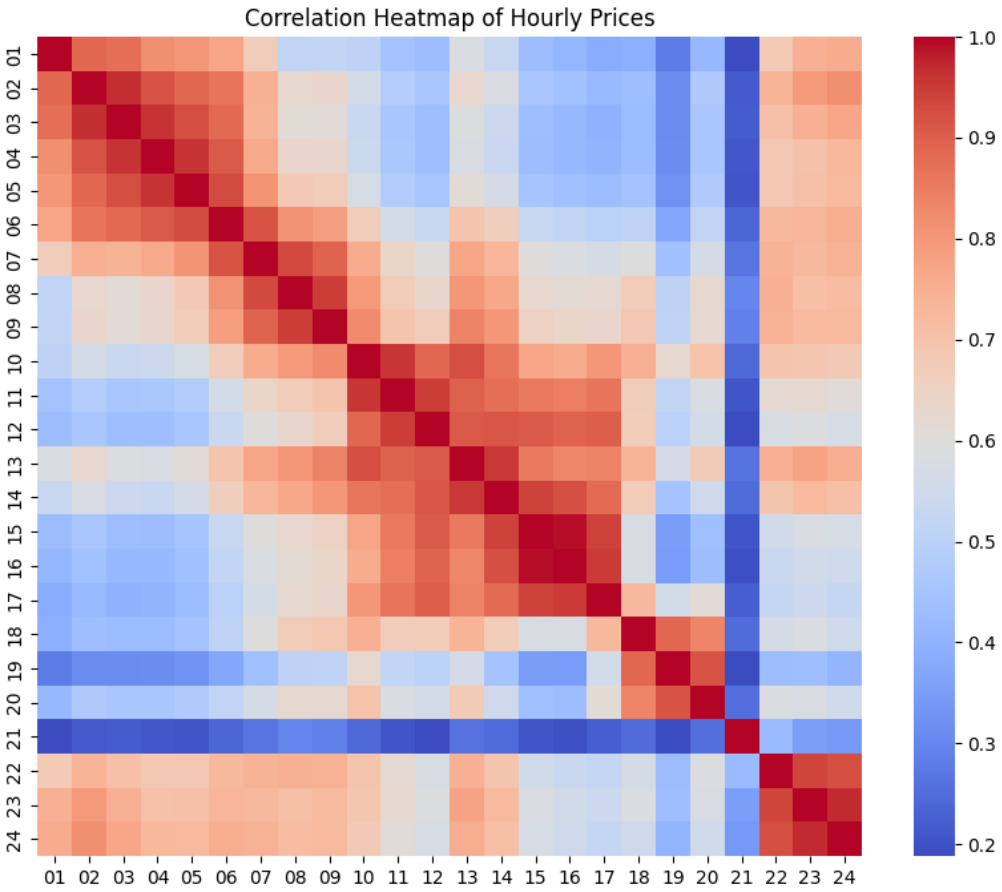
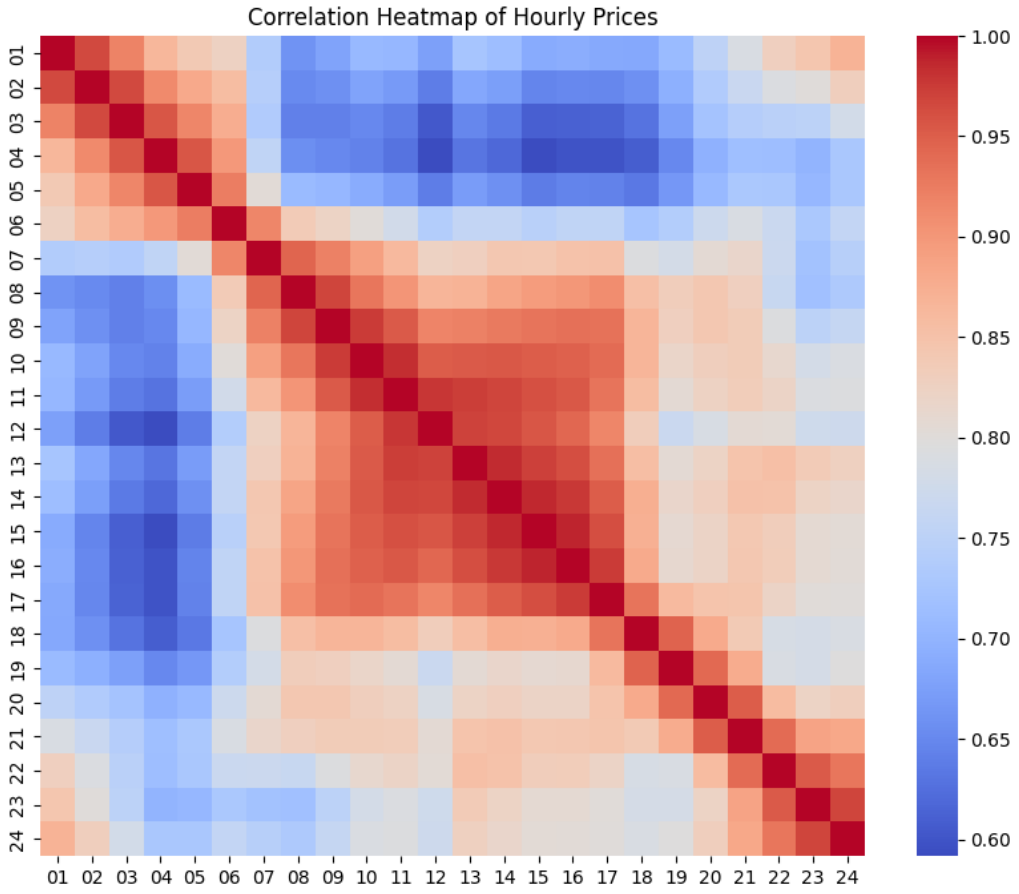
Train

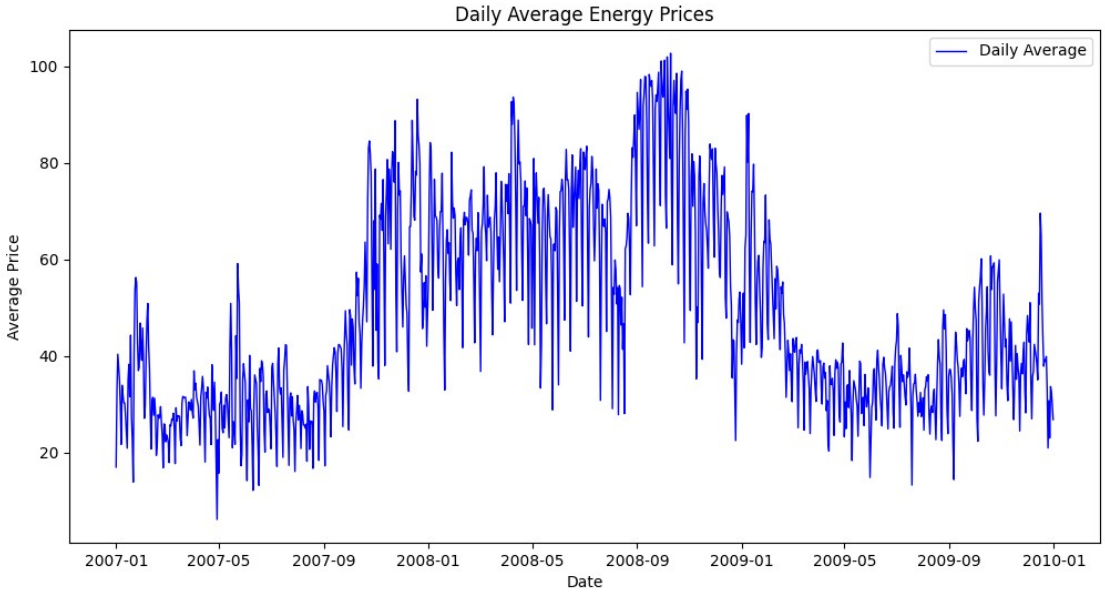

Hourly Prices Across the Year (Logarithmic Scale)
Hourly Prices
Price (Log Scale)
Hour Instance
0
5000
10000
15000
20000
25000

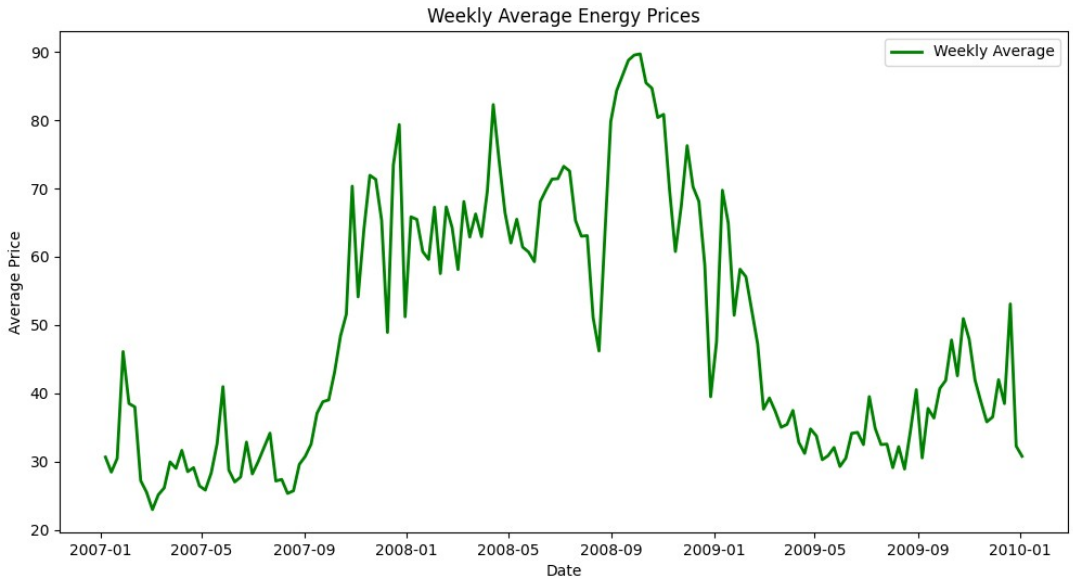

Correlation Heatmap of Hourly Prices
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2

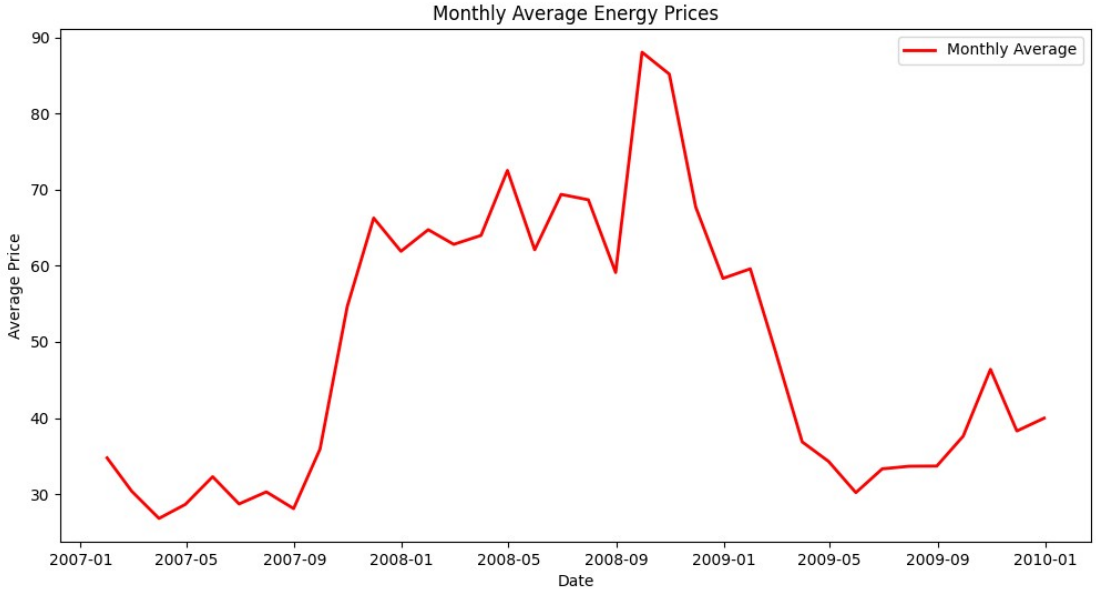
Outlier removal

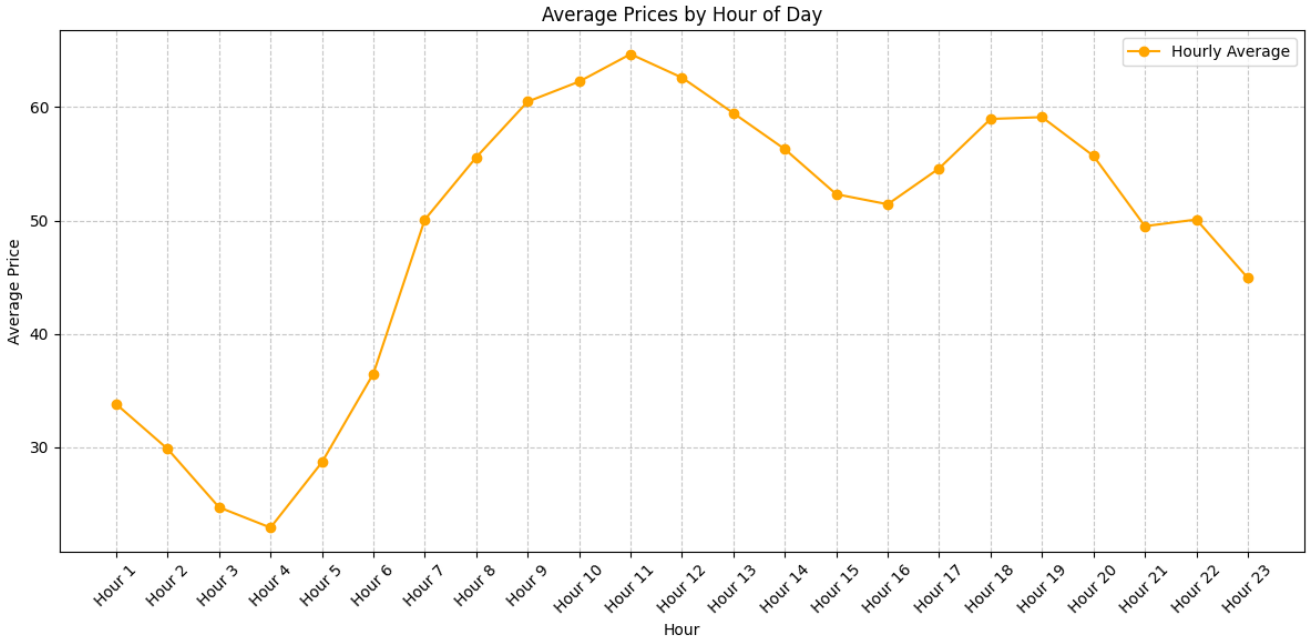
Q1 = df.quantile(0.25)
Q3 = df.quantile(0.75)
IQR = Q3 - Q1
df= df.where((df >= Q1 - 1.5 * IQR) & (df <= Q3 + 1.5 * IQR), np.nan)

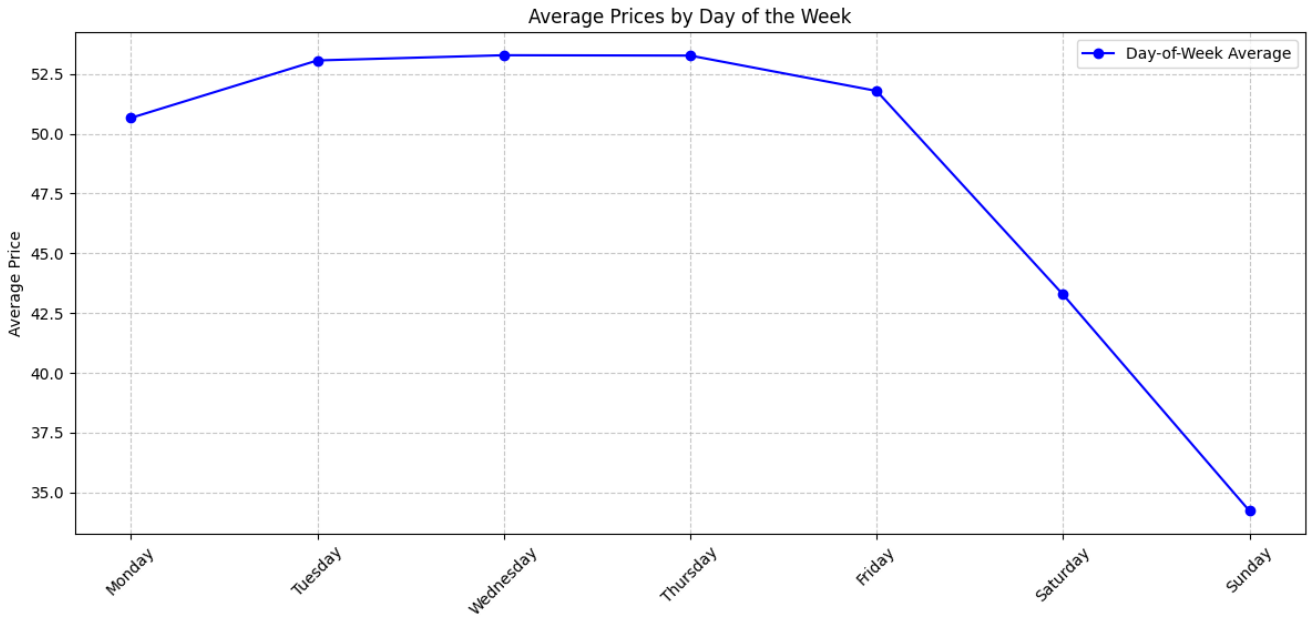


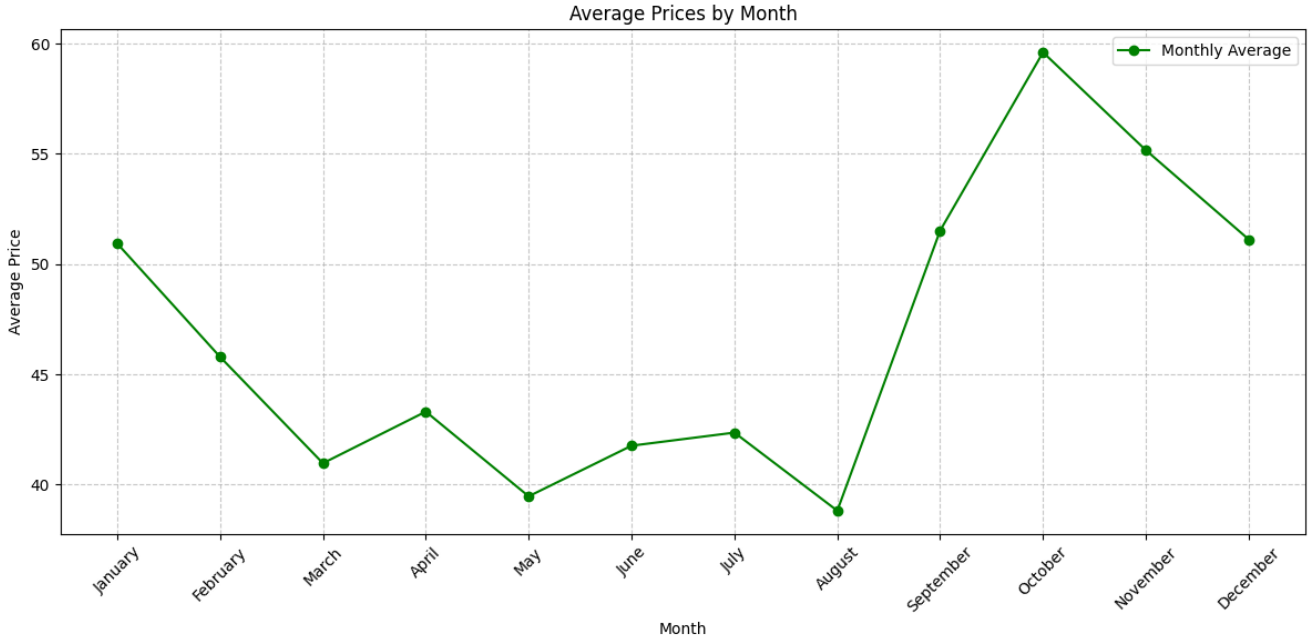

Daily Average Energy Prices
Daily Average
Average Price
Date
100
80
60
40
20
2007-01
2007-05
2007-09
2008-01
2008-05
2008-09
2009-01
2009-05
2009-09
2010-01


Weekly Average Energy Prices
Weekly Average
Average Price
Date
90
80
70
60
50
40
30
20
2007-01
2007-05
2007-09
2008-01
2008-05
2008-09
2009-01
2009-05
2009-09
2010-01

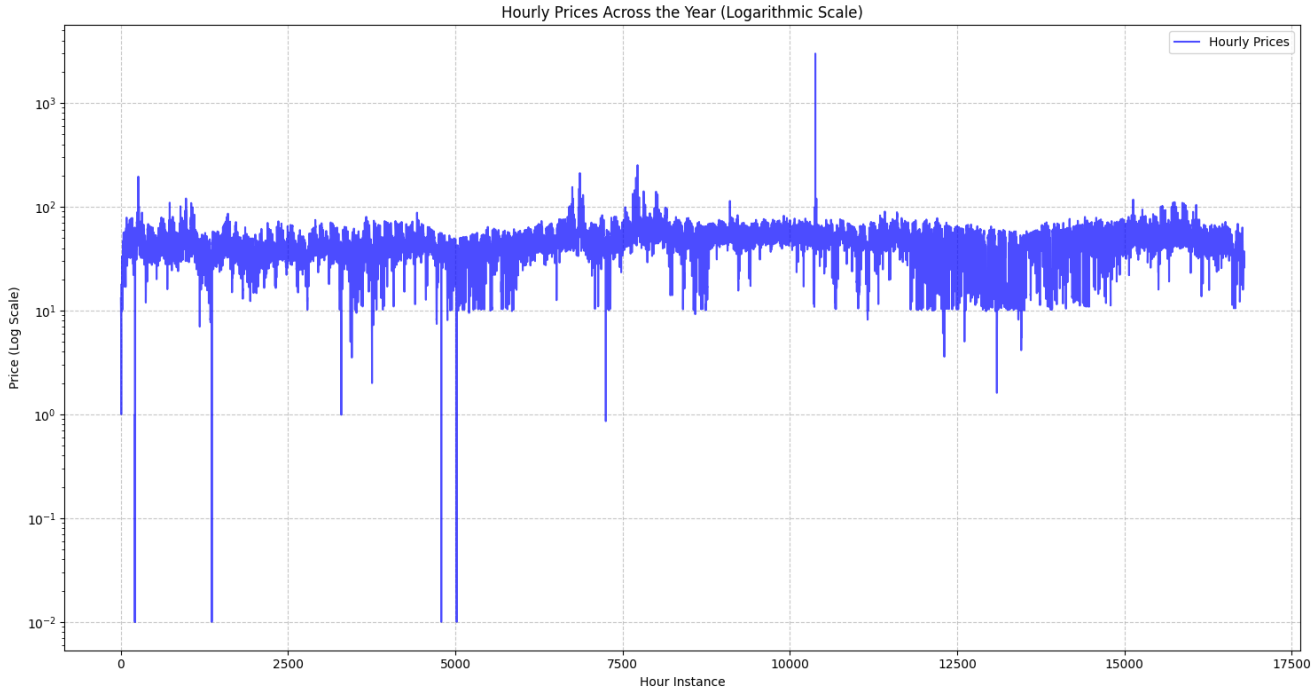

Monthly Average Energy Prices
Monthly Average
Average Price
Date
90
80
70
60
50
40
30
2007-01
2007-05
2007-09
2008-01
2008-05
2008-09
2009-01
2009-05
2009-09
2010-01

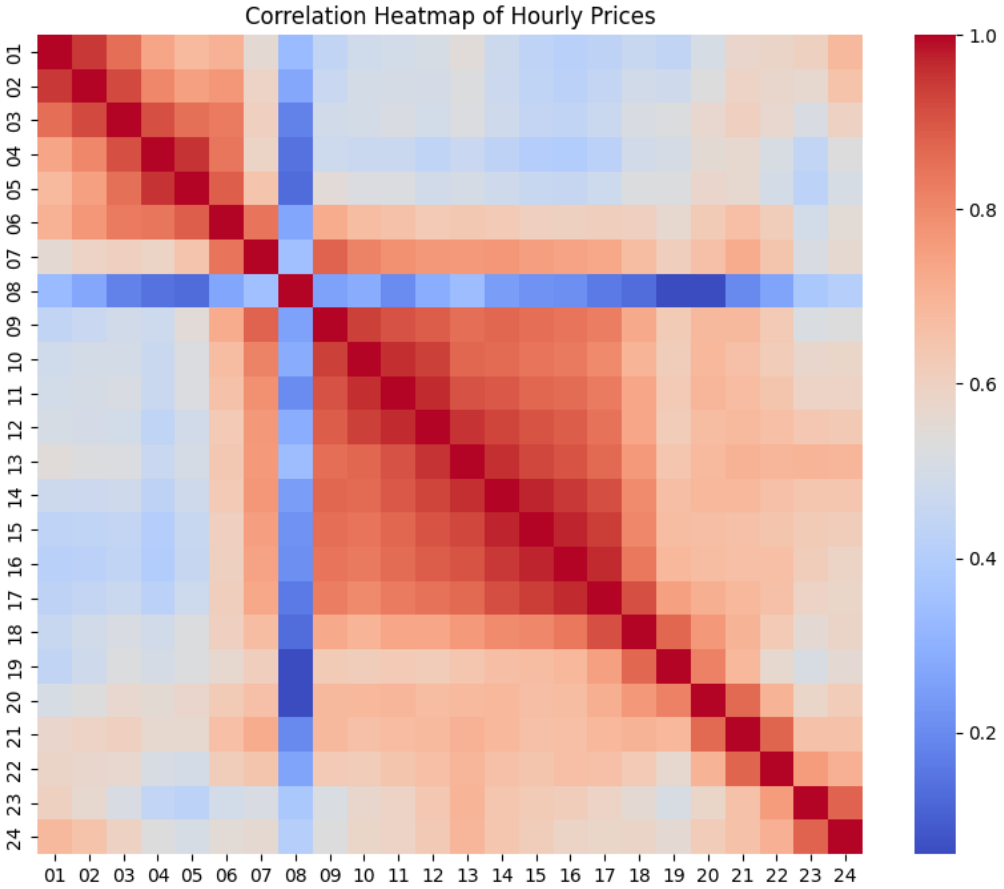

Average Prices by Hour of Day
Hourly Average
Average Price
60
50
40
30
Hour 1
Hour 2
Hour 3
Hour 4
Hour 5
Hour 6
Hour 7
Hour 8
Hour 9
Hour 10
Hour 11
Hour 12
Hour 13
Hour 14
Hour 15
Hour 16
Hour 17
Hour 18
Hour 19
Hour 20
Hour 21
Hour 22
Hour 23
Hour

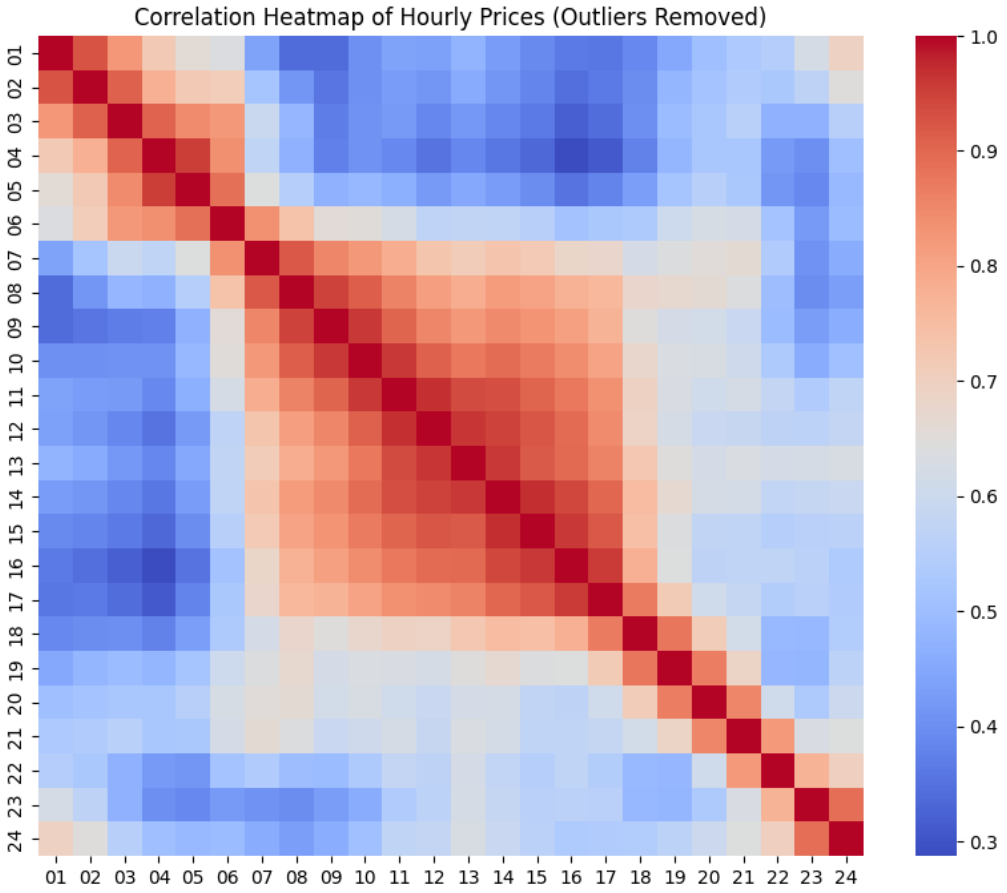

Average Prices by Day of the Week
Day-of-Week Average
Average Price
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

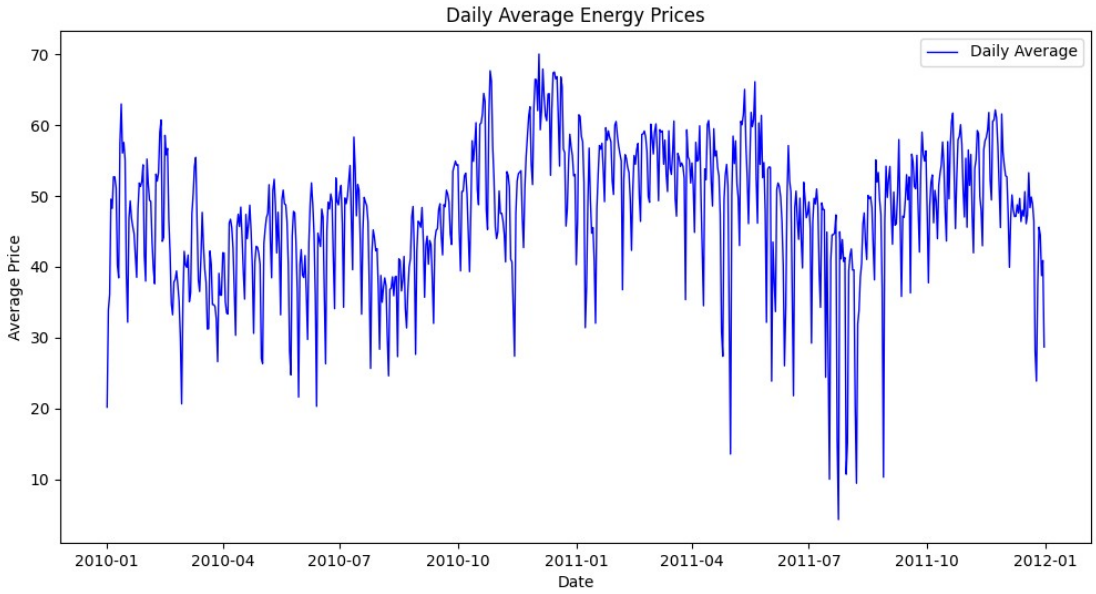

Average Prices by Month
Monthly Average
Average Price
60
55
50
45
40
January
February
March
April
May
June
July
August
September
October
November
December
Month

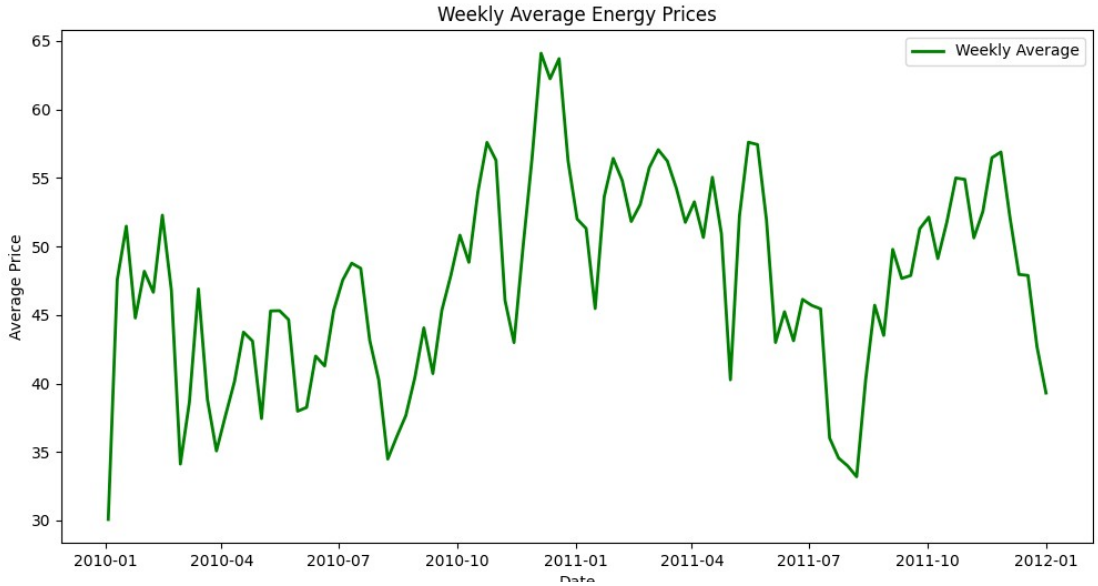
Validation set

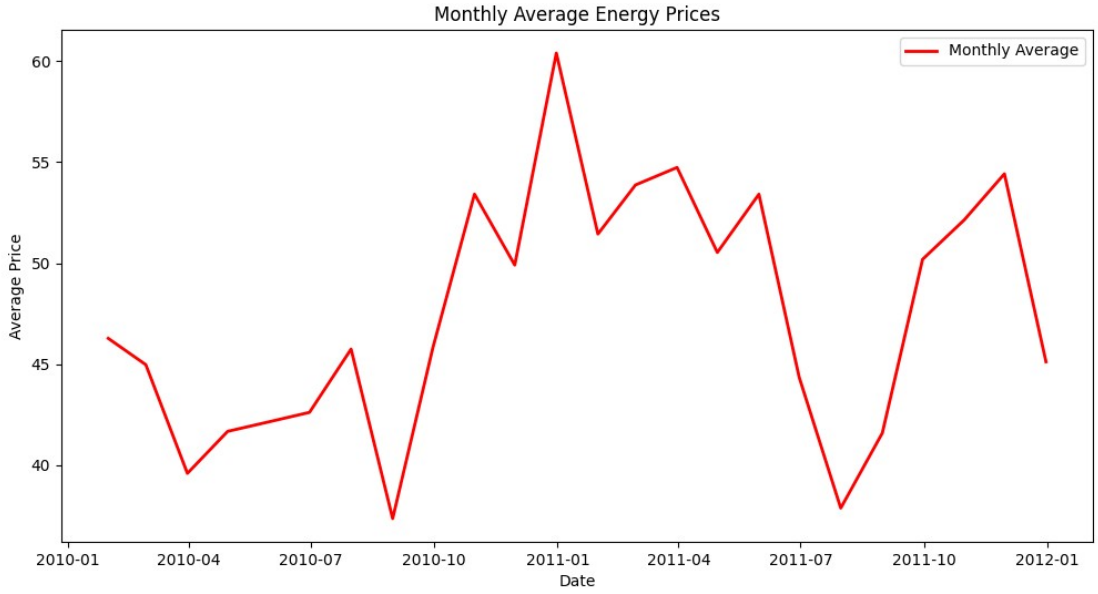


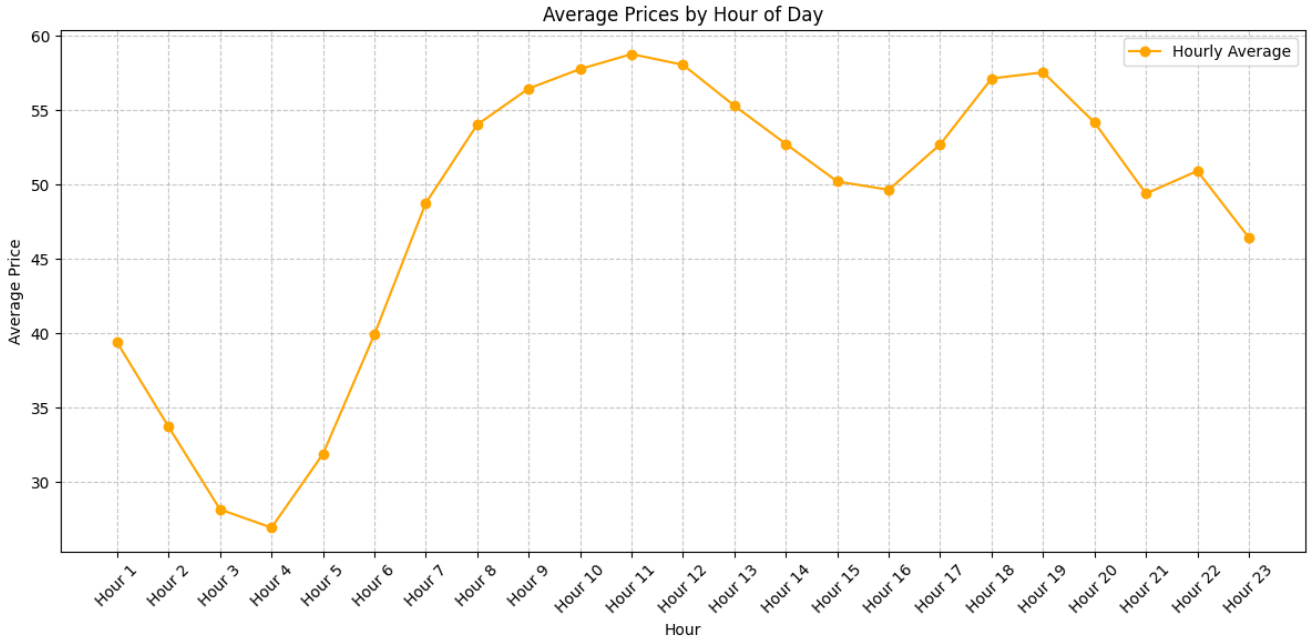

Correlation Heatmap of Hourly Prices
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1.0
0.8
0.6
0.4
0.2

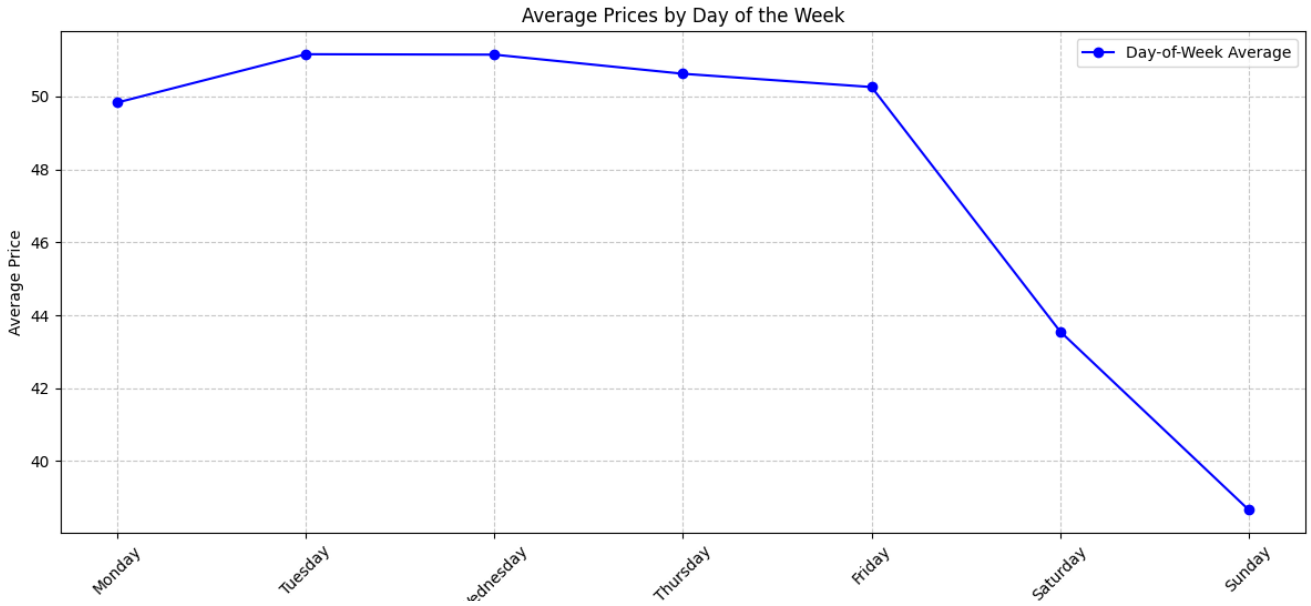

Correlation Heatmap of Hourly Prices (Outliers Removed)
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3

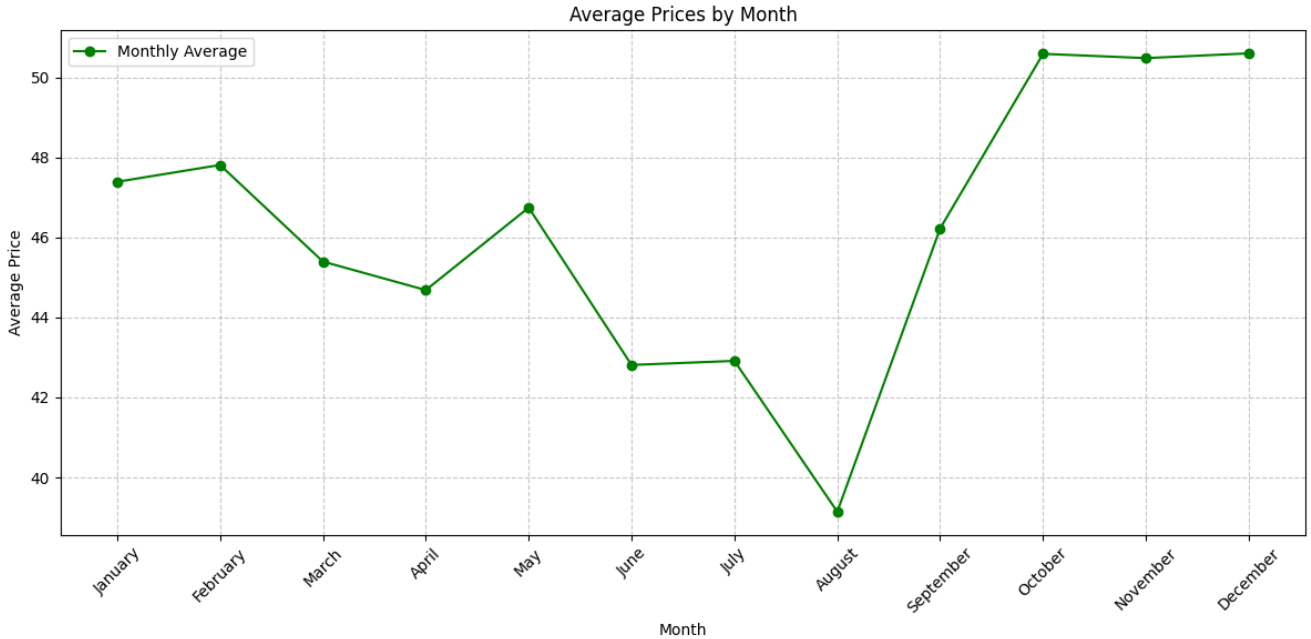

Daily Average Energy Prices
Daily Average
Average Price
Date
70
60
50
40
30
20
10
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01


Weekly Average Energy Prices
Weekly Average
Average Price
65
60
55
50
45
40
35
30
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01


Monthly Average Energy Prices
Monthly Average
Average Price
Date
60
55
50
45
40
2010-01
2010-04
2010-07
2010-10
2011-01
2011-04
2011-07
2011-10
2012-01


Average Prices by Hour of Day
Hourly Average
Average Price
Hour
Hour 1
Hour 2
Hour 3
Hour 4
Hour 5
Hour 6
Hour 7
Hour 8
Hour 9
Hour 10
Hour 11
Hour 12
Hour 13
Hour 14
Hour 15
Hour 16
Hour 17
Hour 18
Hour 19
Hour 20
Hour 21
Hour 22
Hour 23


Average Prices by Day of the Week
Day-of-Week Average
Average Price
Monday
Tuesday
Thursday
Friday
Saturday
Sunday


Average Prices by Month
Monthly Average
Average Price
Month
January
February
March
April
May
June
July
August
September
October
November
December

Conclusion

Notably:

- A lot of variation in prices across all time scales
- The data has extreme outliers
  - Likely do not generalize and should be removed

There clearly are trends observable, generally:

- Prices are lower at night, higher during day
- Prices decline towards the weekends, sharp rise on Monday
- Prices decline during spring, rise during autumn

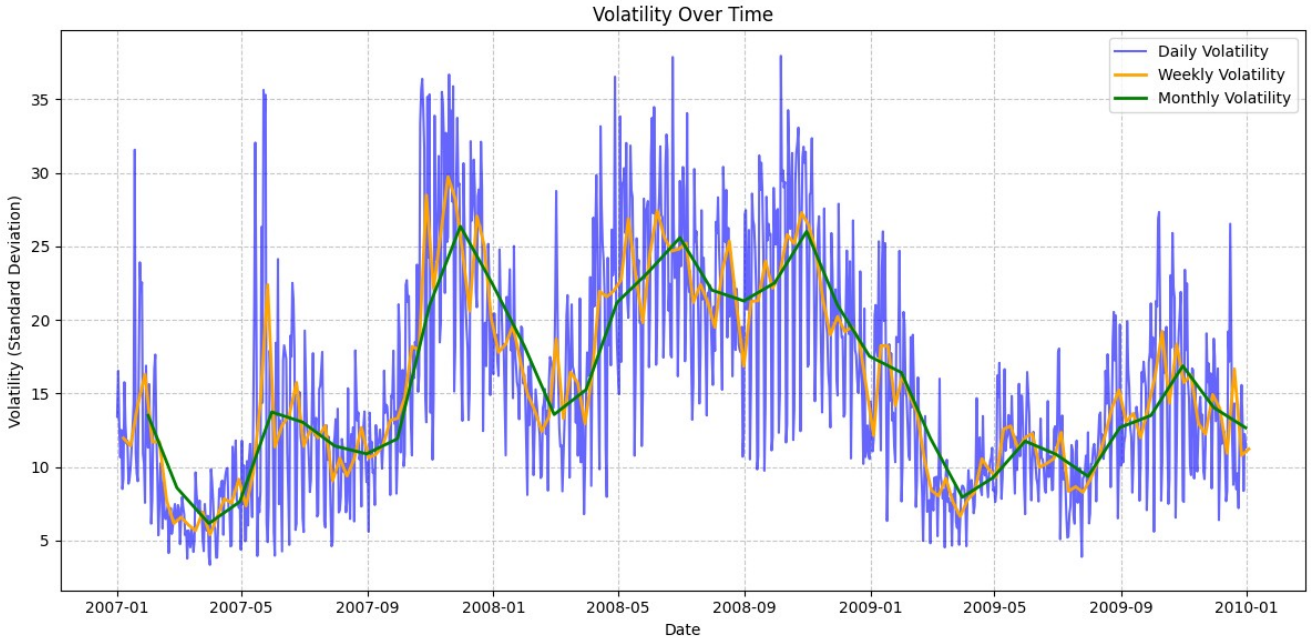
From this a few strategic insights arise:

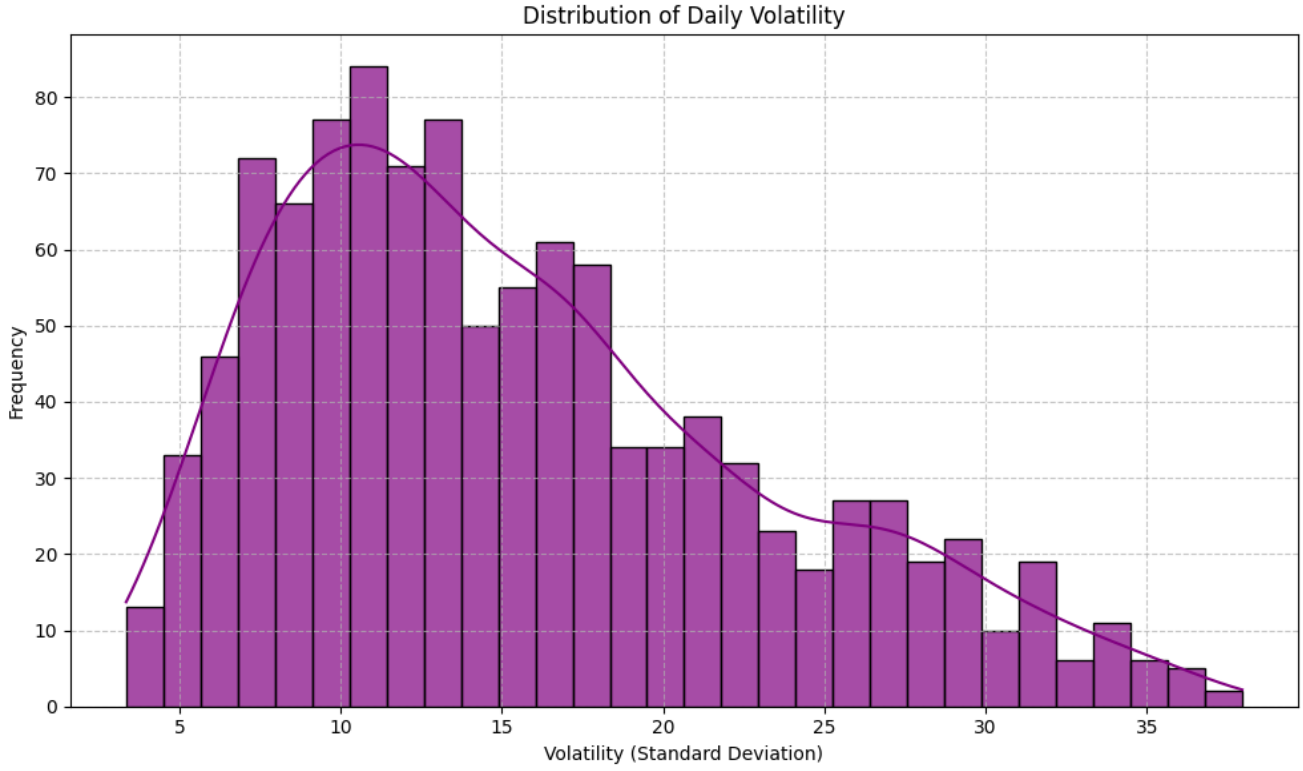
- Buy during night
- During uptrend, storing energy is less risky
- During downtrend, storing energy is more risky
- Include measure of price volatility to let agent adjust risk profile

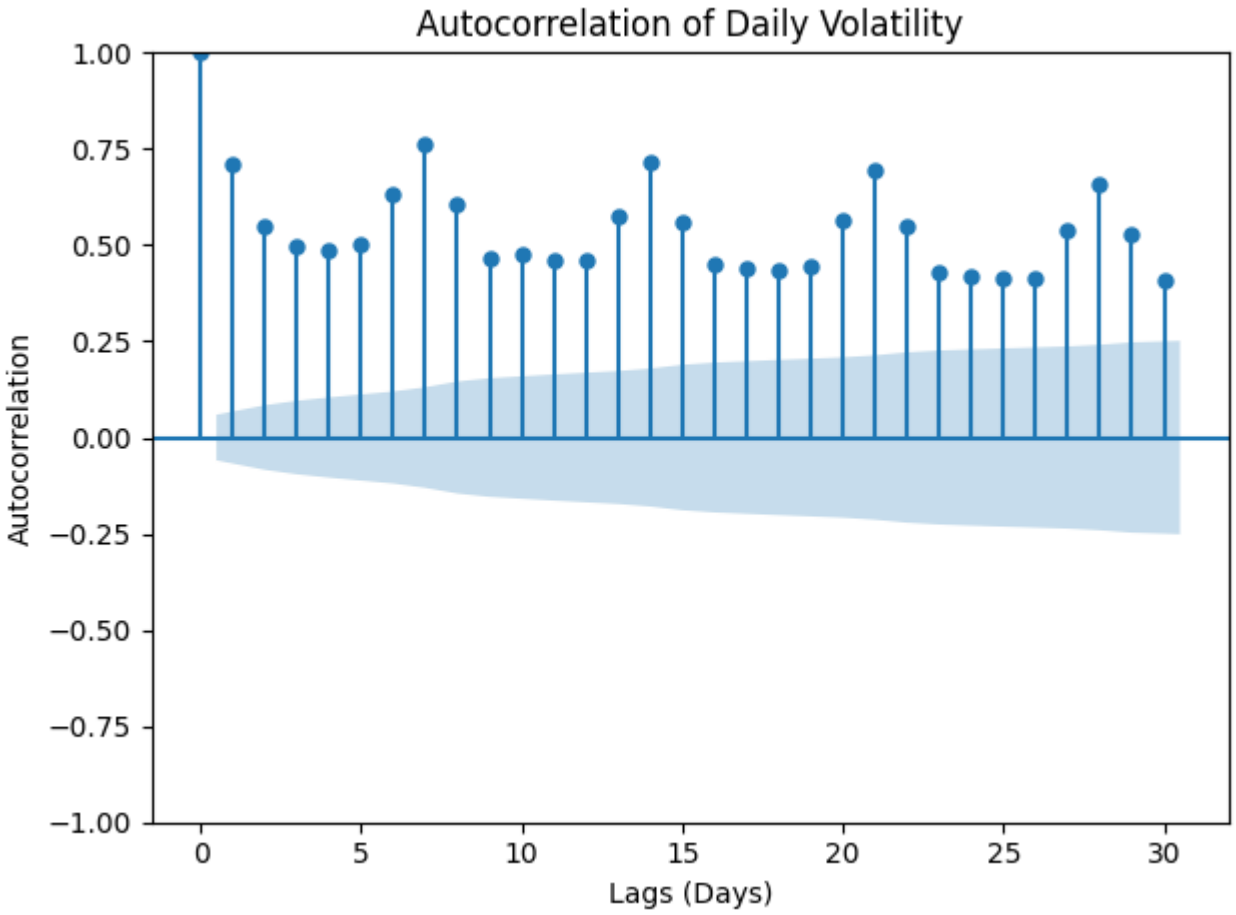
Possible volatility based storage strategy:

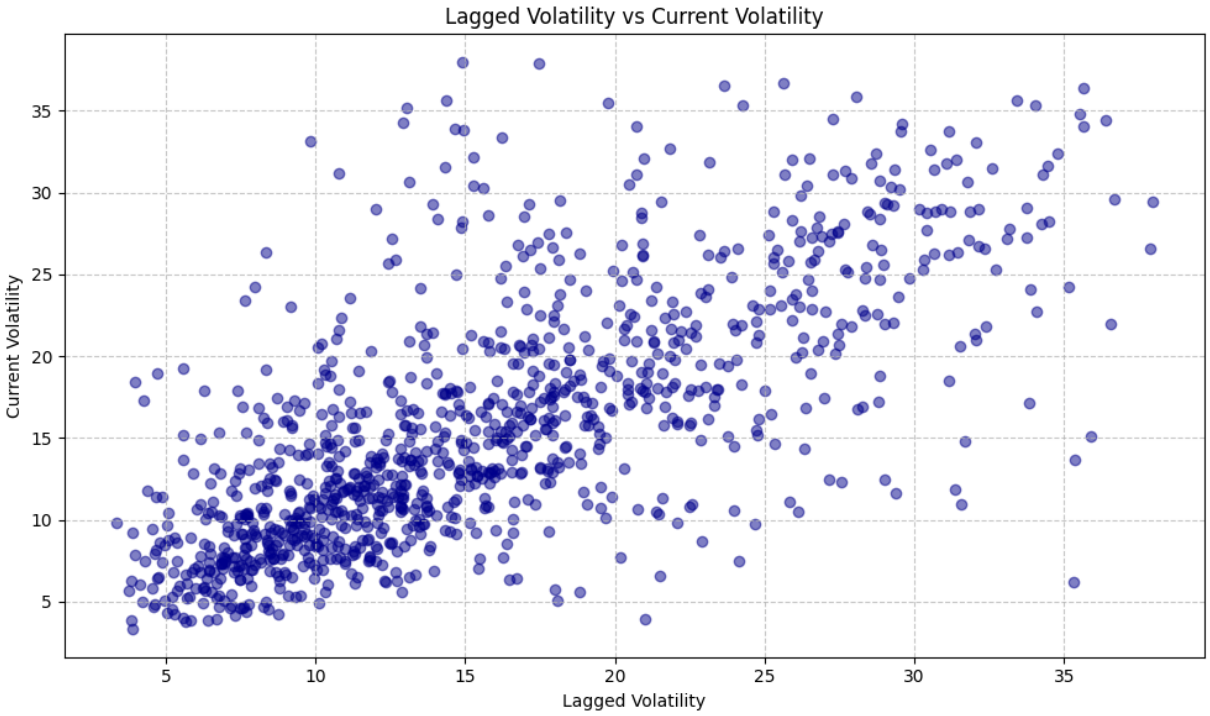
Factor	Autumn	Spring
Price Trend	Rising	Falling
Storage Risk	Lower	Higher
Volatility Impact	Amplifies potential savings	Amplifies potential losses
Best Strategy	Store during dips for later spikes	Delay storage until prices stabilize

Volatility analysis






Autocorrelation of Daily Volatility
Autocorrelation
Lags (Days)
1.00
0.75
0.50
0.25
0.00
−0.25
−0.50
−0.75
−1.00
0
5
10
15
20
25
30


Lagged Volatility vs Current Volatility
Current Volatility
Lagged Volatility
5
10
15
20
25
30
35