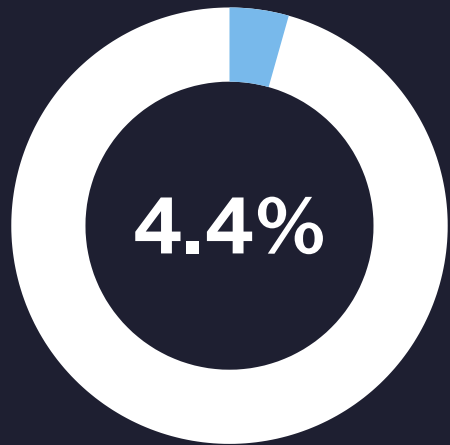


ENERGY CONSUMPTION & GENERATION IN SPAIN

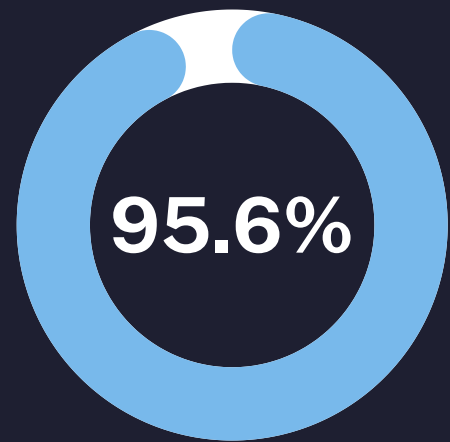
Using python and data analysis to understand and gain insights related to the consumption and generation energy in Spain.

ENERGY REPORT

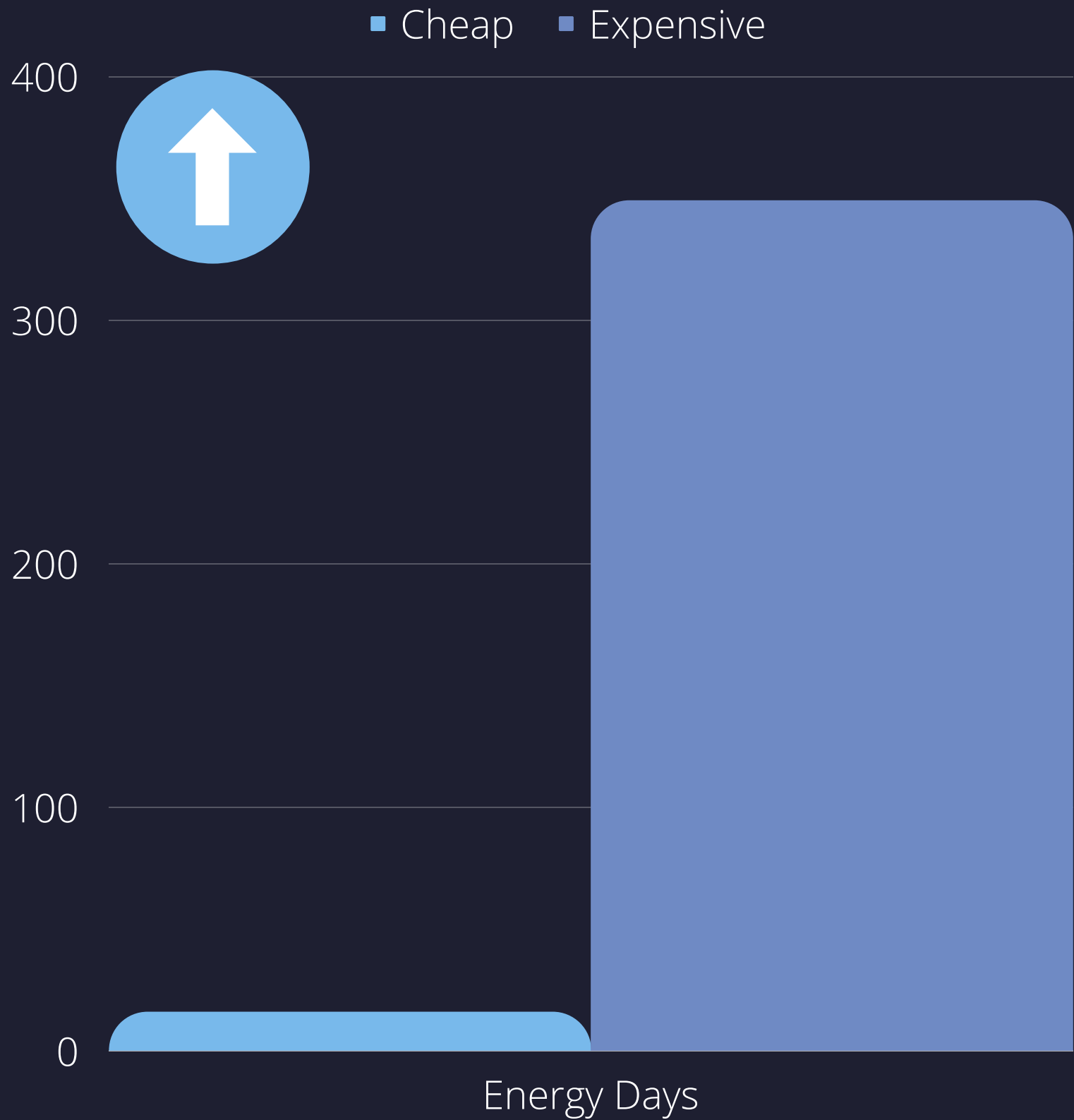


"CHEAP" ENERGY DAYS

- Days in 2019 where there was at least 1 hour where the price was < 10 Euros.
- 16 Days



"EXPENSIVE" ENERGY DAYS



AVERAGE HOURS ABOVE & BELOW MONTHLY MEAN PRICE

MONTHS WITH THE GREATEST % ABOVE THE MEAN

| month | H_Below_Avg | H_Above_avg | sum | perc_below | perc_above |
|-----------|-------------|-------------|-----|------------|------------|
| April | 251 | 469 | 720 | 34.861111 | 65.138889 |
| August | 343 | 401 | 744 | 46.102151 | 53.897849 |
| December | 306 | 415 | 721 | 42.441054 | 57.558946 |
| February | 288 | 384 | 672 | 42.857143 | 57.142857 |
| January | 280 | 464 | 744 | 37.634409 | 62.365591 |
| July | 324 | 420 | 744 | 43.548387 | 56.451613 |
| June | 353 | 367 | 720 | 49.027778 | 50.972222 |
| March | 254 | 490 | 744 | 34.139785 | 65.860215 |
| May | 306 | 438 | 744 | 41.129032 | 58.870968 |
| November | 338 | 382 | 720 | 46.944444 | 53.055556 |
| October | 351 | 393 | 744 | 47.177419 | 52.822581 |
| September | 362 | 358 | 720 | 50.277778 | 49.722222 |

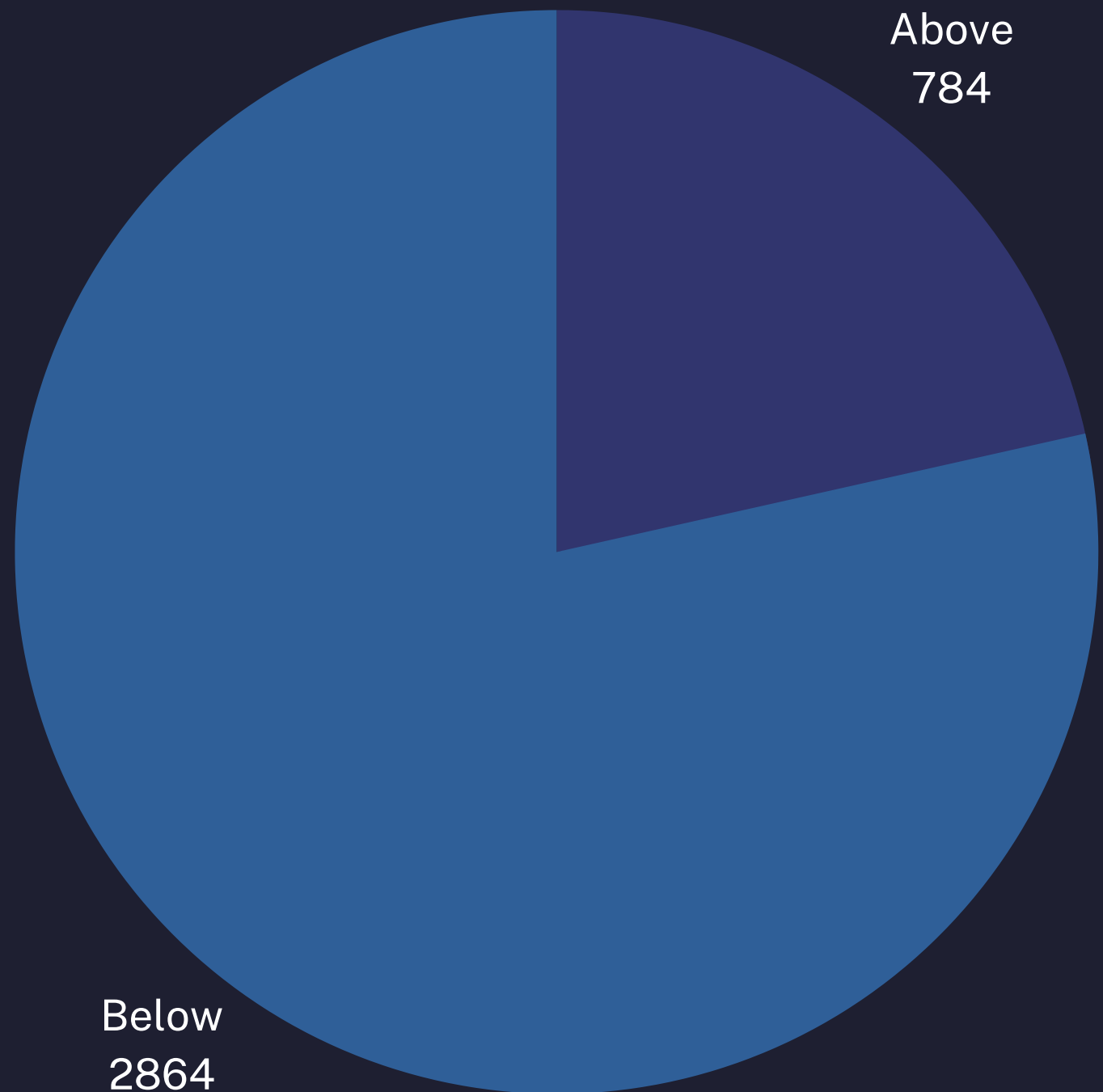
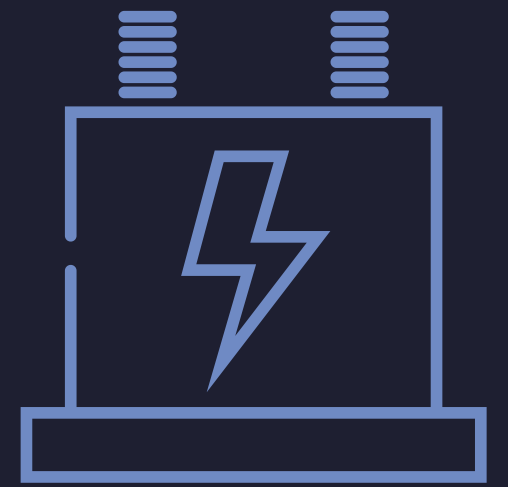
UNSTABLE
MONTHS

- April
- March

STABLE
MONTHS

- Months besides April and march are relatively stable.

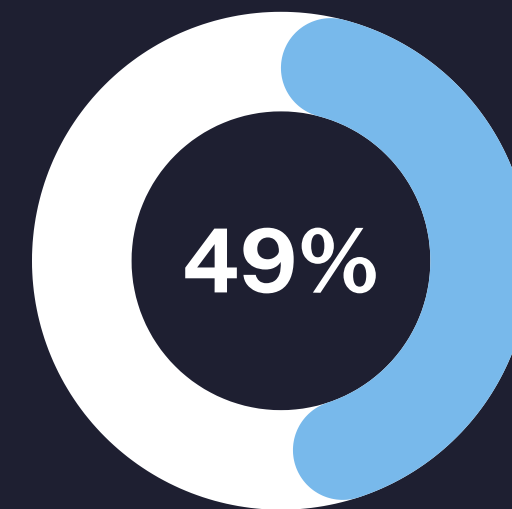
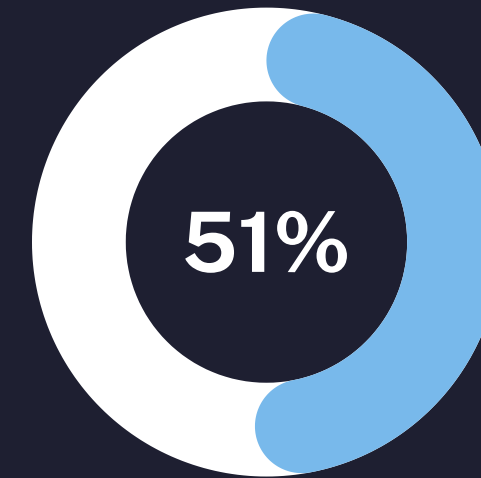
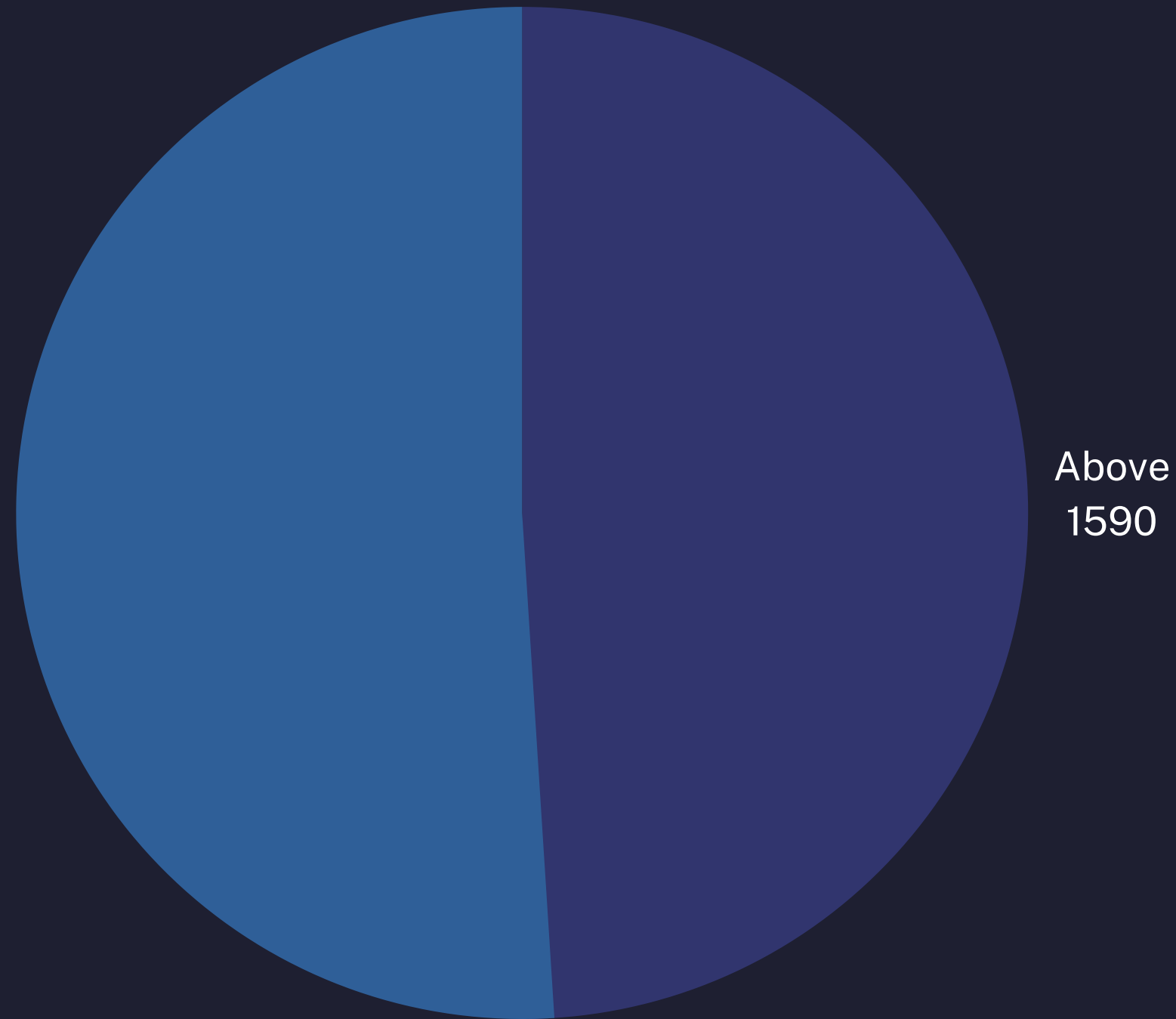
GAS VS WIND



Gas Generation When Wind Is Above Hourly Mean

- Gas generation tends to be lower when wind generation is high.
- Assumption - gas is used a substitute when energy cannot be produced from other sources like wind.

SOLAR IMPACT ON SPOT PRICE



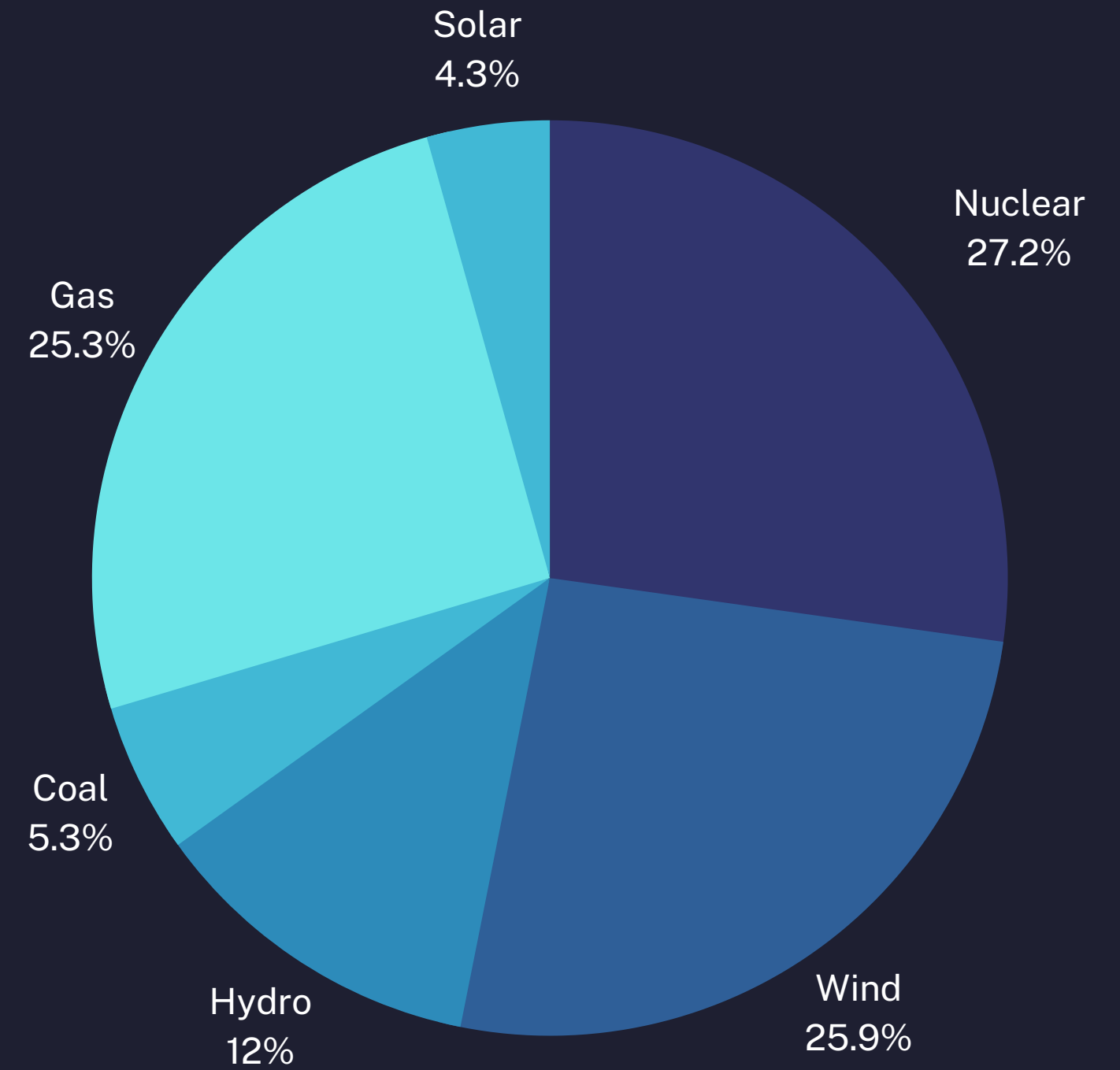
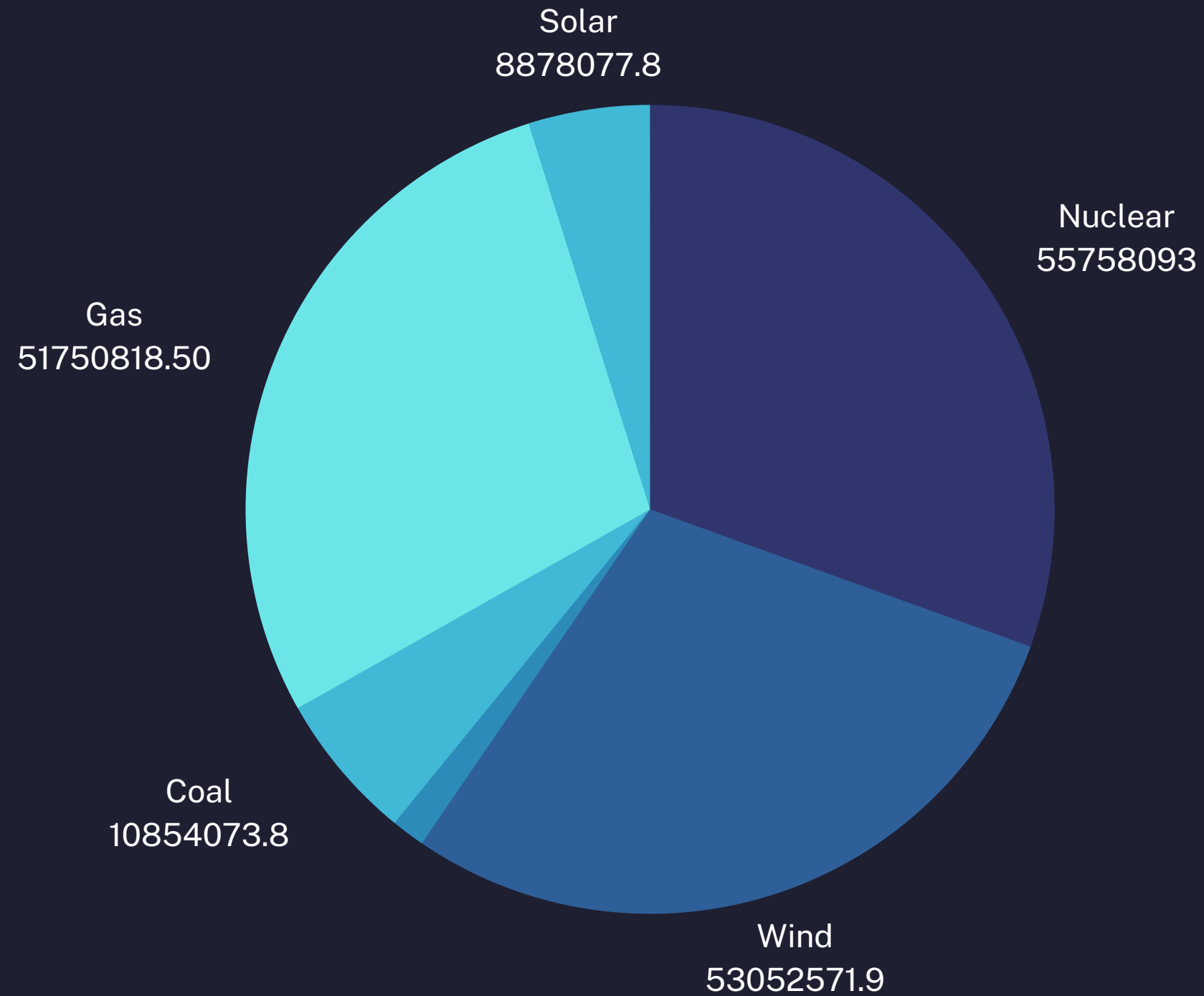
When solar generation is above its hourly mean , spot price is slightly below its hourly average price.

DEMAND IMPACT ON PRICE

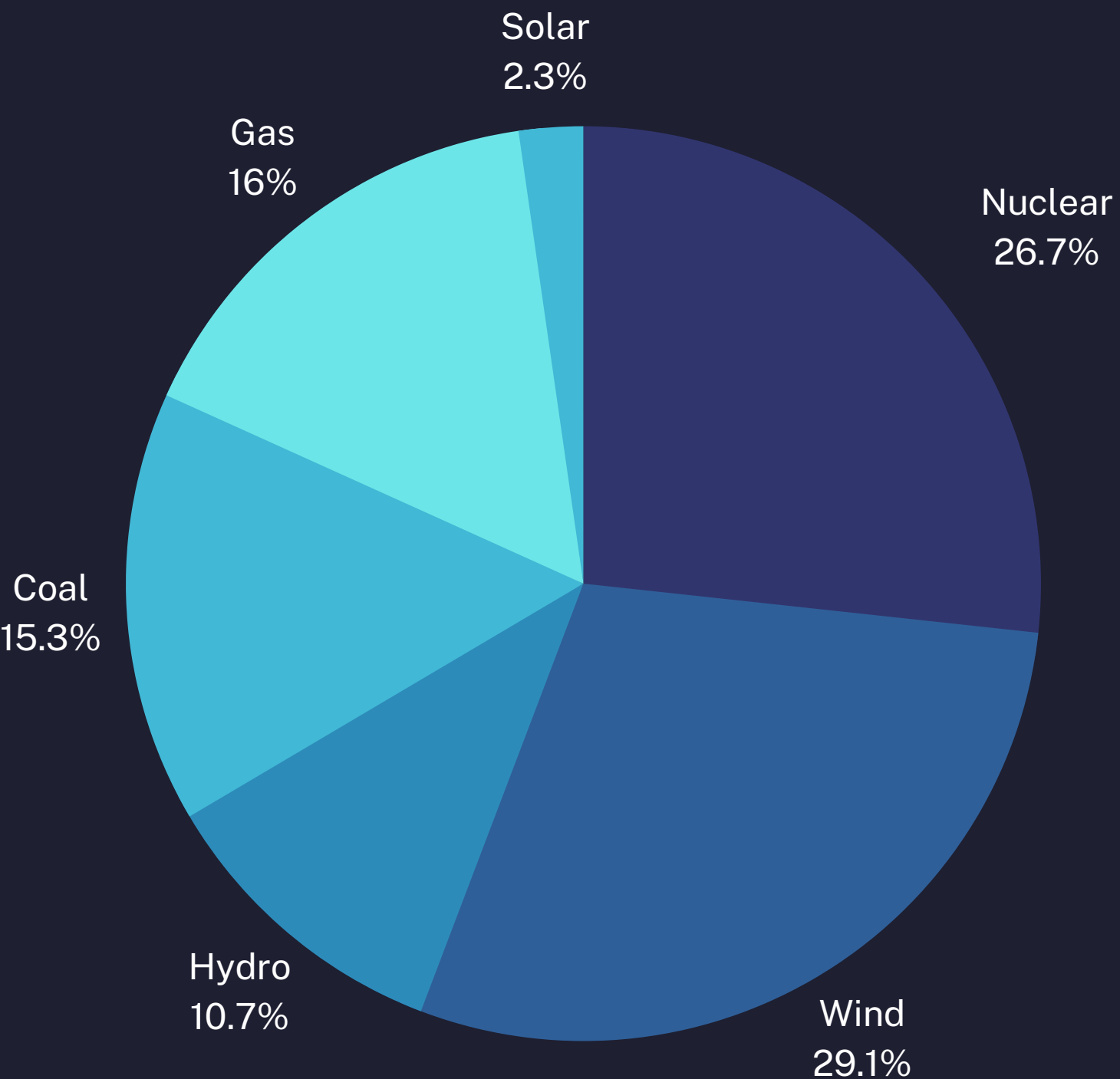
```
power_demand_generation
Above      4509
Name: month, dtype: int64
```

- Power demand is incredibly highly correlated with the price.
- 100% of the hours that the power demand is above its hourly average, the price is above its hourly average too.
- Higher demand = higher price.

CONTRIBUTION OF EACH ENERGY TYPE



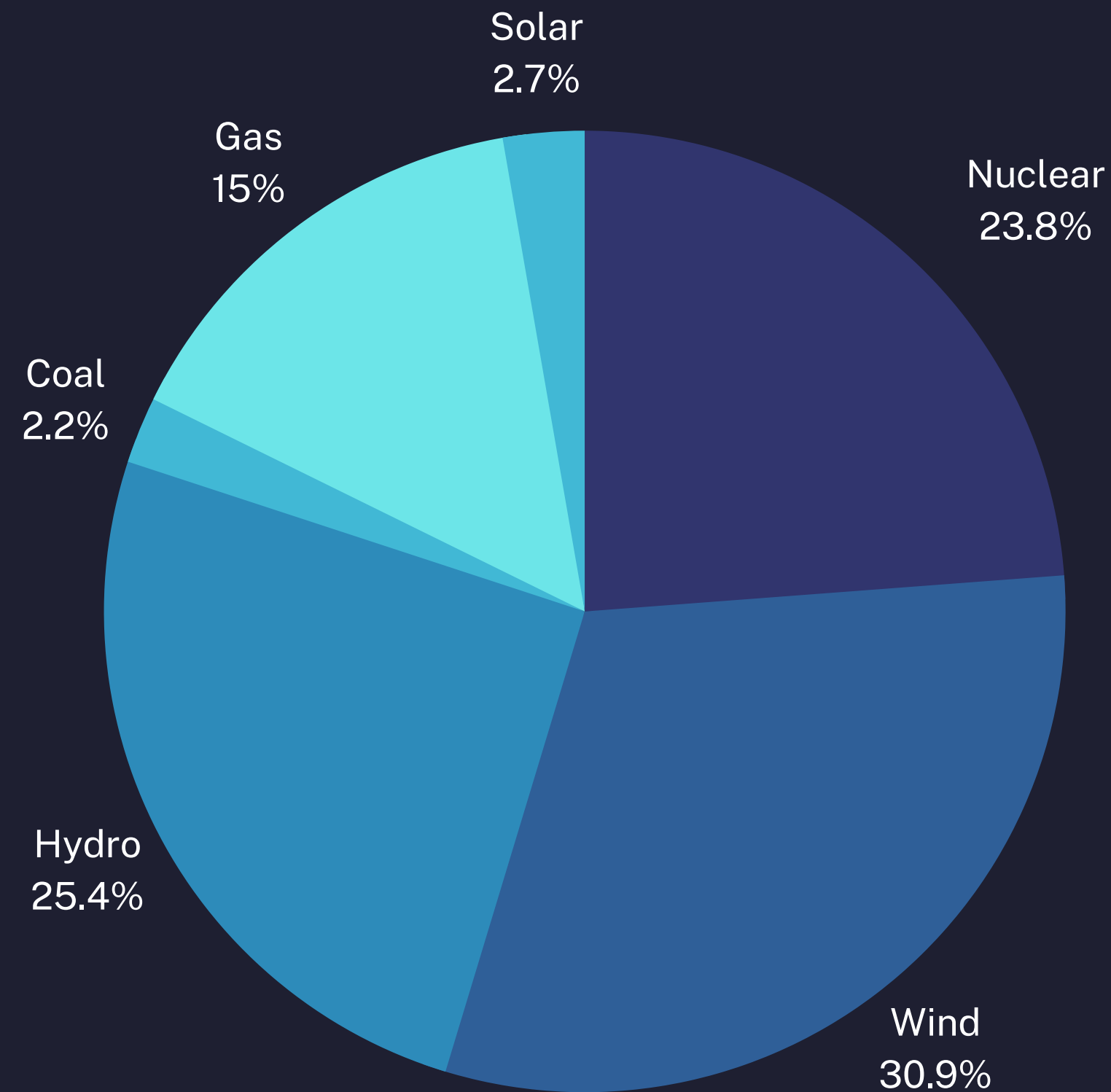
CONTRIBUTION OF THE MOST EXPENSIVE MONTH



January Data

- Wind and especially coal contributed more than average.
- January is the most expensive month - we ask whether this means that coal is expensive as it is the highest contributor for January.
- Nuclear, hydro, gas, solar contributed less than average.
- Are these energy types affecting the price or are they cheaper to produce ?

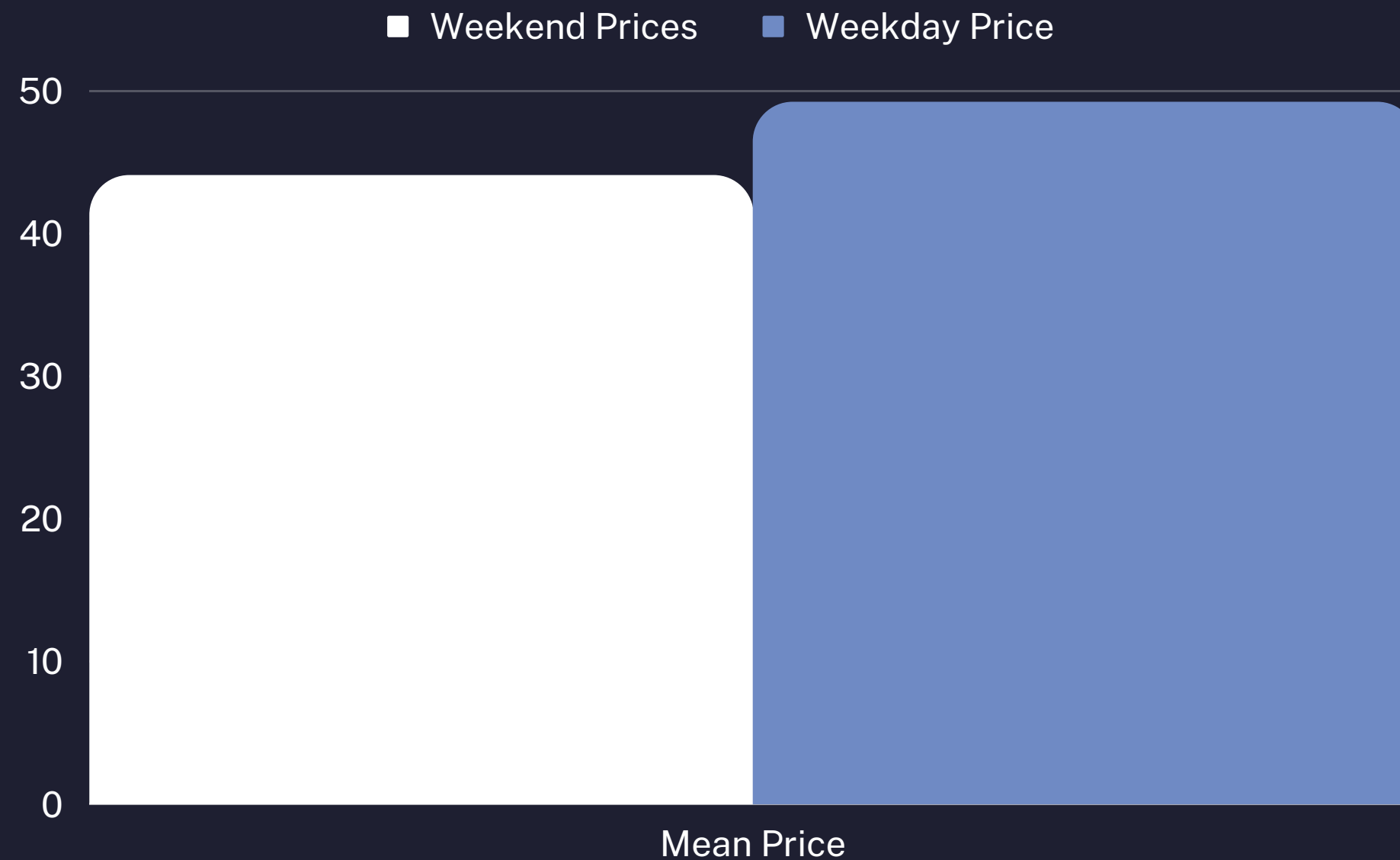
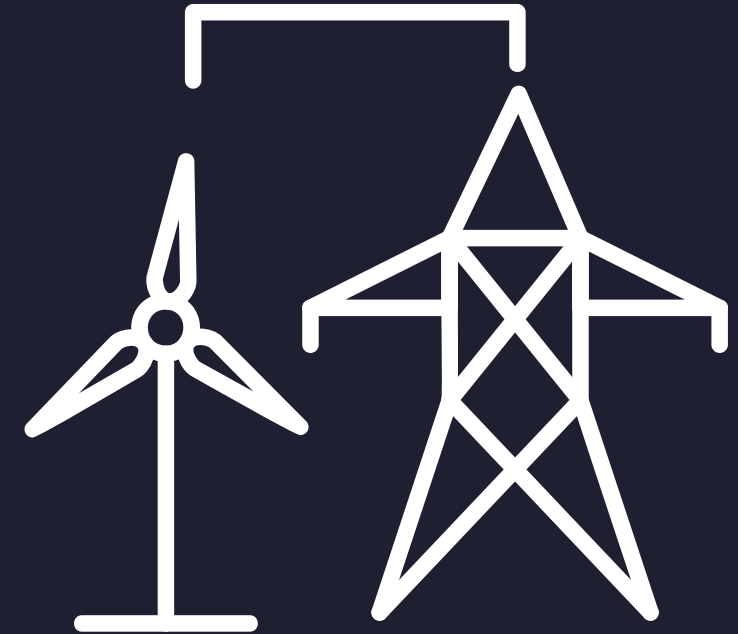
CONTRIBUTION THE CHEAPEST MONTH



December Data

- Wind and especially hydro contributed more than average.
- Clean energies seem to lower the prices again.
- Nuclear, gas, solar and especially coal contributed less than average.
- Coal energy may seem costly again.

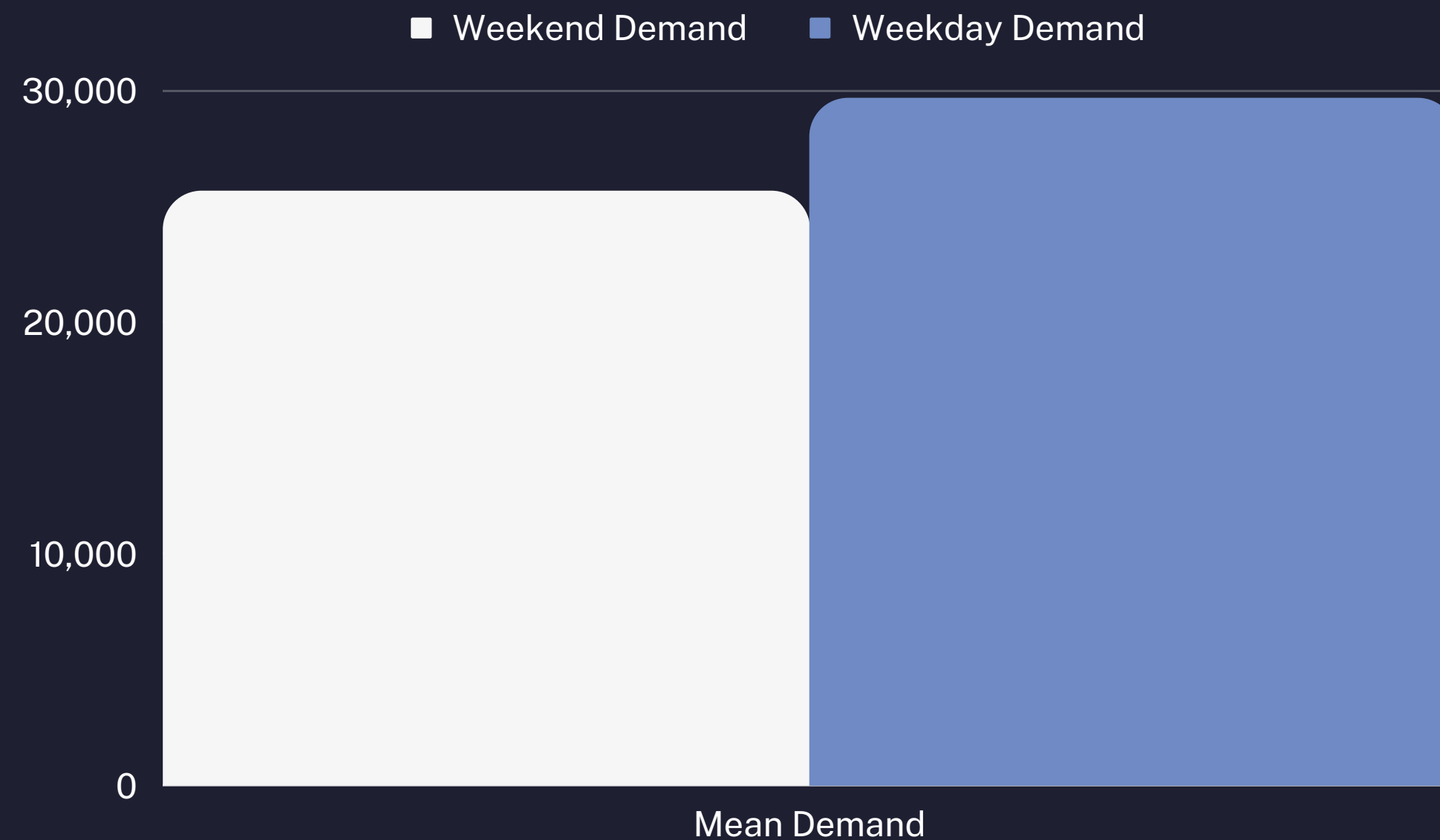
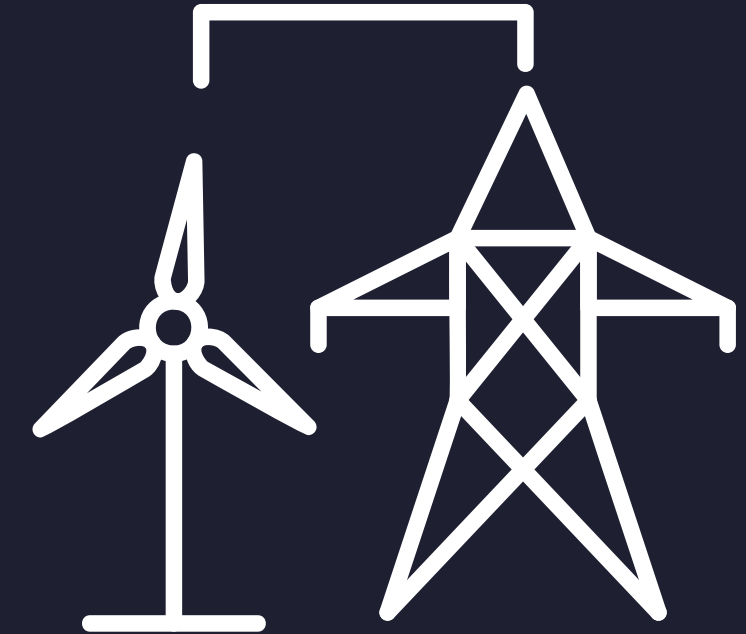
WEEKEND VS WEEKDAYS



Weekend - 44€
Weekday - 49€

- - 10.43% energy spot price difference between weekends and weekdays.
- Weekends are cheaper.

WEEKEND VS WEEKDAYS



Weekend -25652
Weekday - 29657

- -13.5% difference in power demand between weekends and weekdays.
- Potential reasons - business are closed, people travel, weekly remote work etc.



Analytical Insights



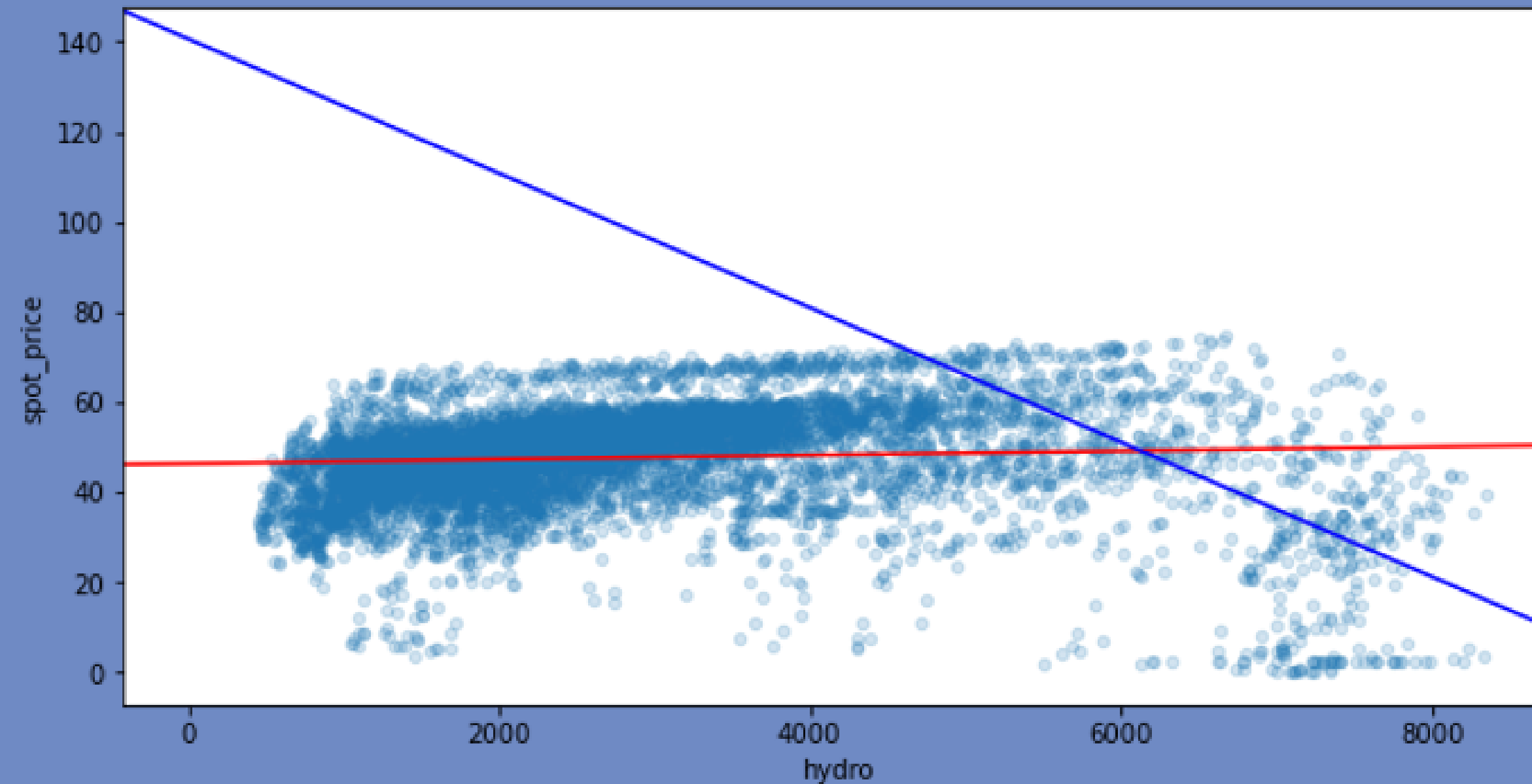
PEARSON CORRELATION HEATMAP

| | gas | solar | nuclear | hydro | coal | wind | spot_price | power_demand |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|------------|--------------|
| gas | 1.000000 | 0.247081 | 0.043591 | -0.114536 | -0.089383 | -0.539931 | 0.359471 | 0.465950 |
| solar | 0.247081 | 1.000000 | 0.047449 | -0.040042 | -0.056729 | -0.179670 | 0.053682 | 0.425638 |
| nuclear | 0.043591 | 0.047449 | 1.000000 | -0.203778 | 0.252089 | -0.292254 | 0.191179 | 0.092873 |
| hydro | -0.114536 | -0.040042 | -0.203778 | 1.000000 | 0.177159 | 0.085666 | 0.070018 | 0.382848 |
| coal | -0.089383 | -0.056729 | 0.252089 | 0.177159 | 1.000000 | -0.032942 | 0.591425 | 0.375170 |
| wind | -0.539931 | -0.179670 | -0.292254 | 0.085666 | -0.032942 | 1.000000 | -0.354866 | 0.060931 |
| spot_price | 0.359471 | 0.053682 | 0.191179 | 0.070018 | 0.591425 | -0.354866 | 1.000000 | 0.533324 |
| power_demand | 0.465950 | 0.425638 | 0.092873 | 0.382848 | 0.375170 | 0.060931 | 0.533324 | 1.000000 |

HYDRO

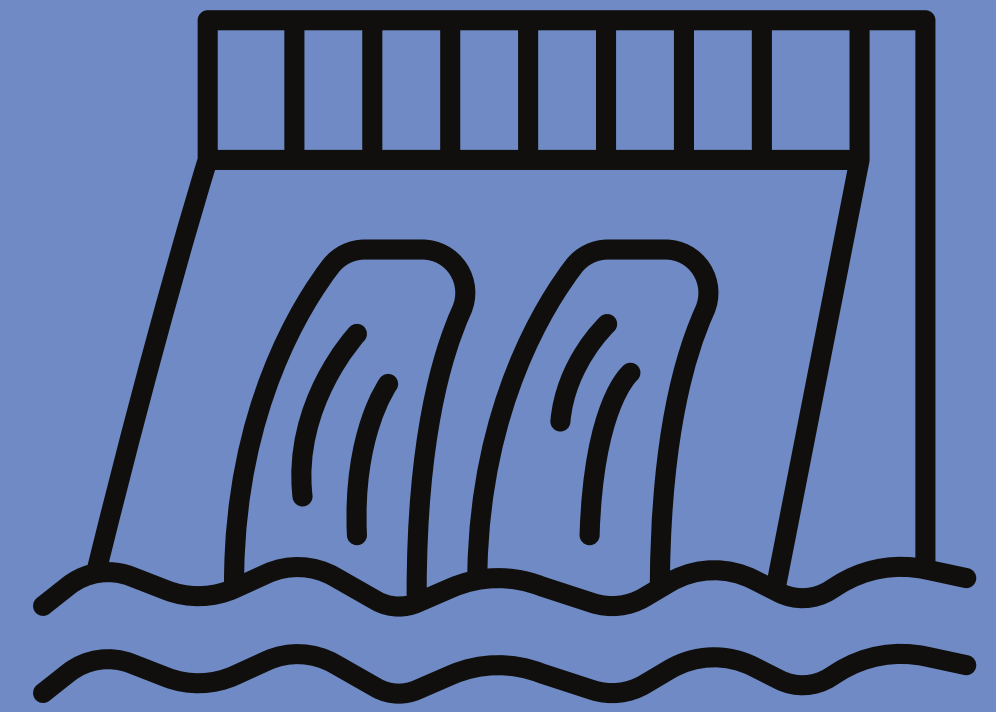
Mixed Effect

Correlation with the price = 7%



Red line slope = 0.0004

Blue line slope = -0.0149

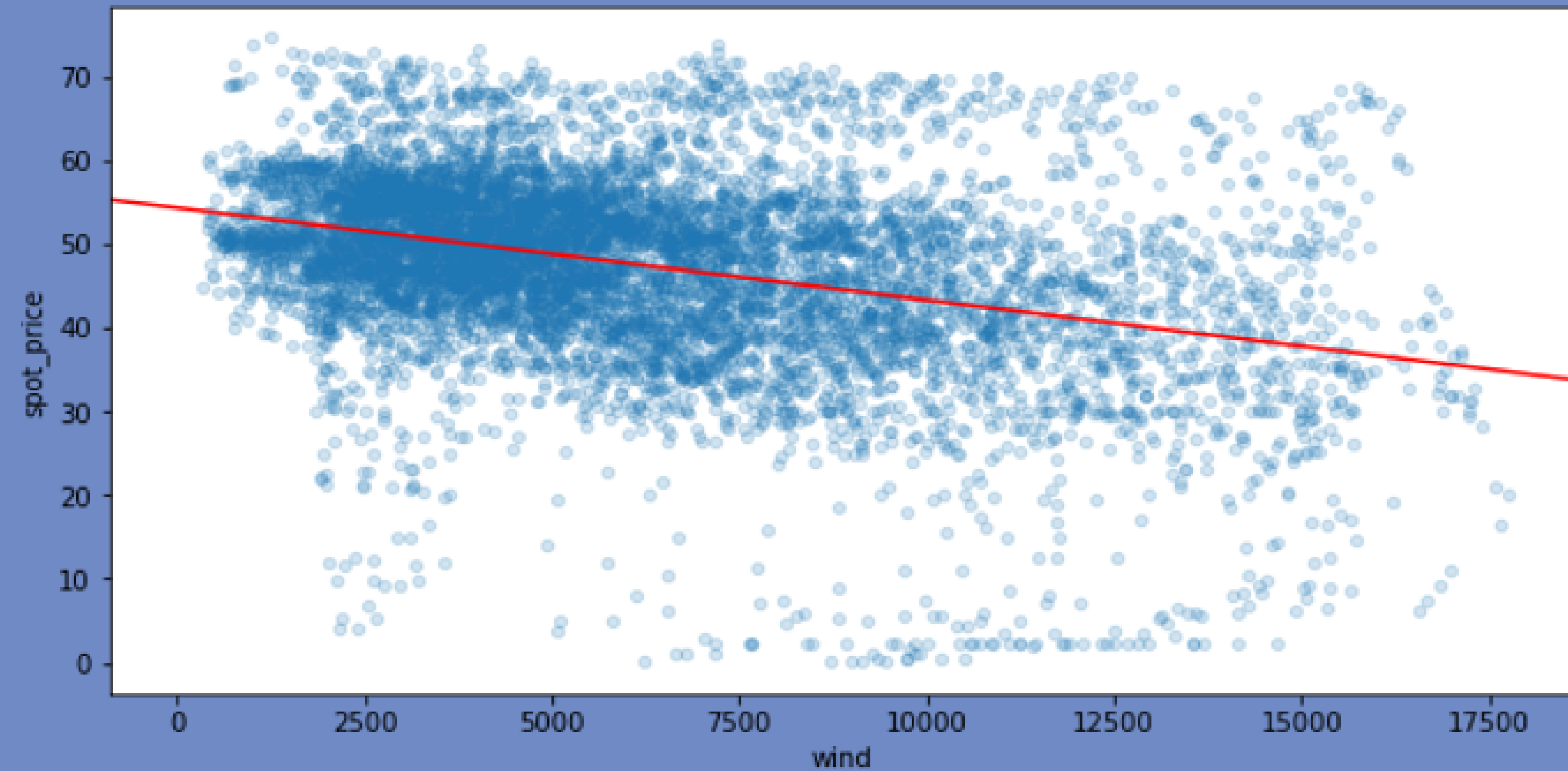


- Slightly positively correlated in the whole data.
- Negatively correlated when hydro energy production is high (>6000)

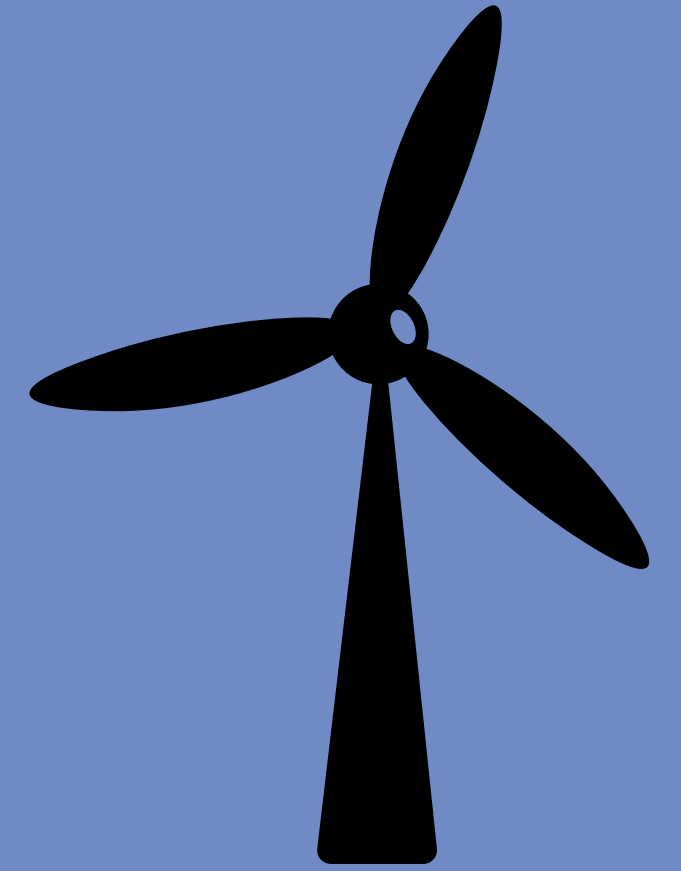
WIND

Strong Negative Effect

Correlation with price = **-35%**



Red line slope = **-0.0011**

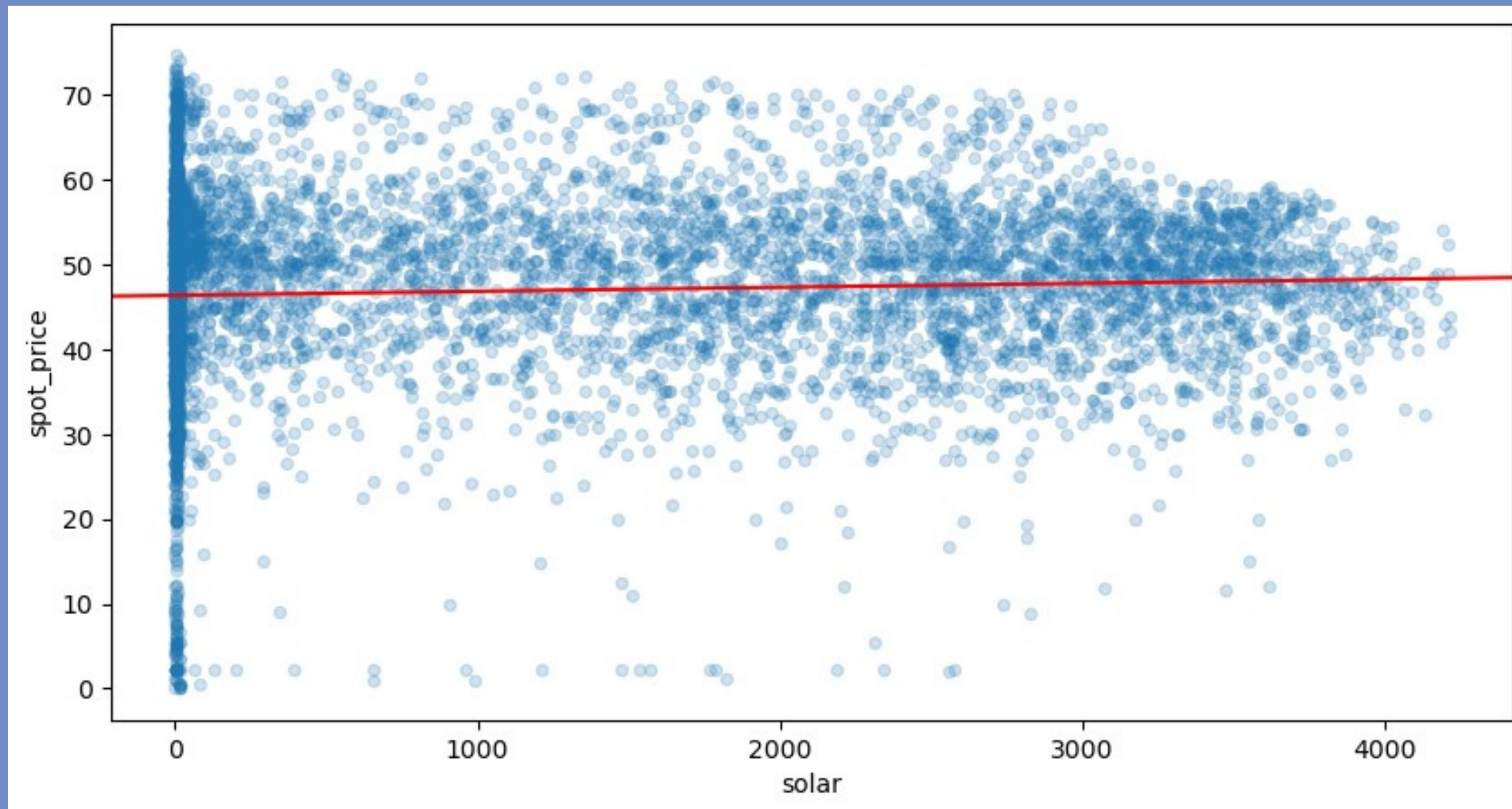
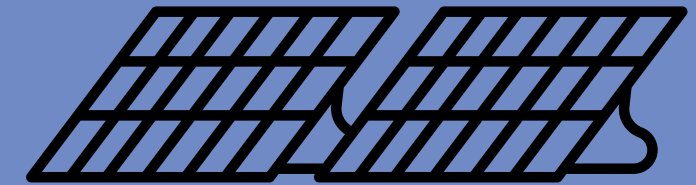
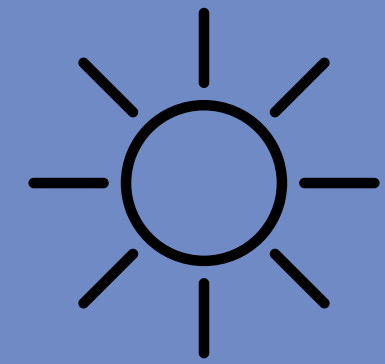


- **Negatively correlated in the whole data.**

SOLAR

Positive Effect

Correlation with price = 5%



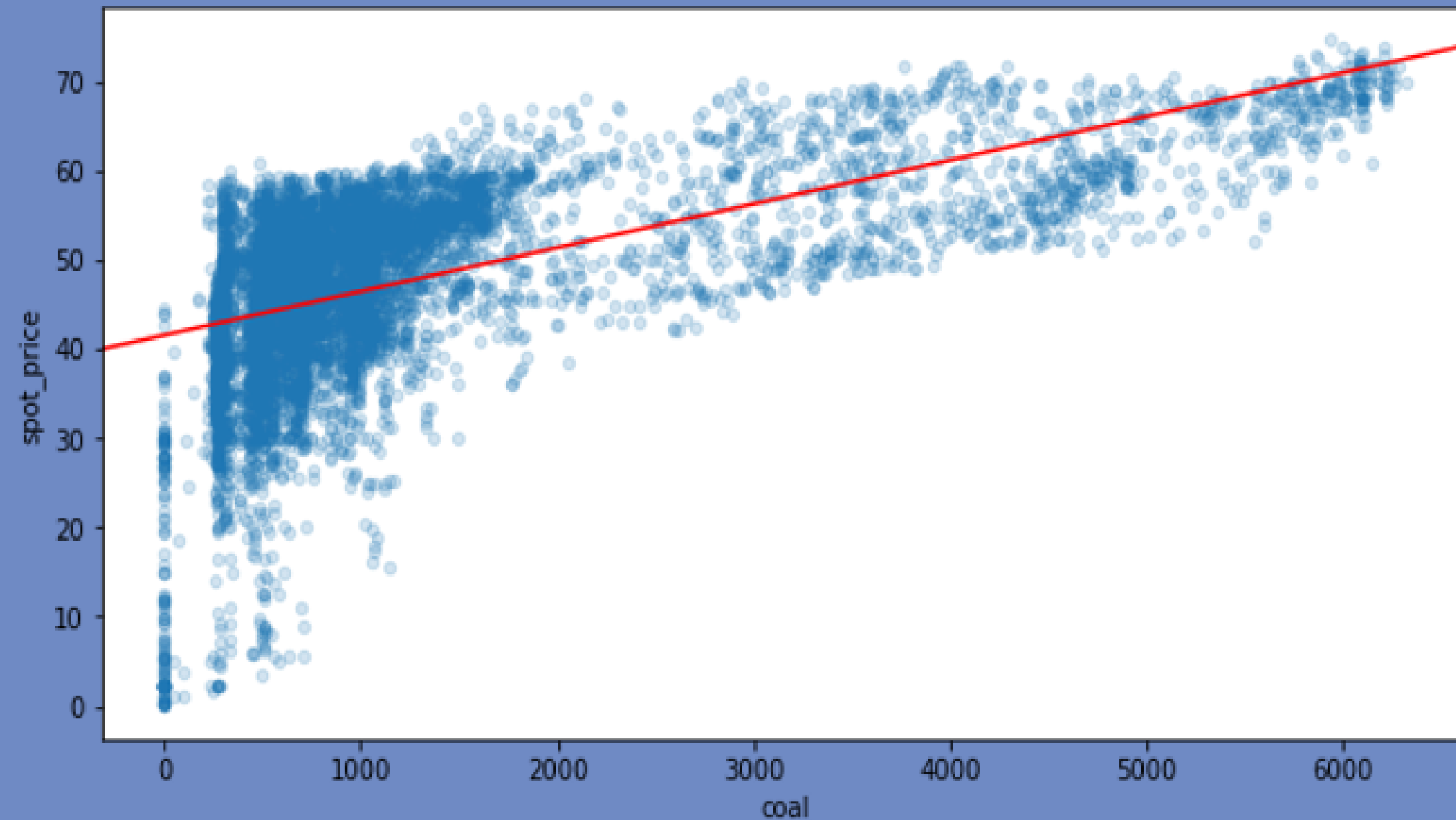
- Slightly positively correlated in the whole data.

Red line slope = 0.0004

COAL

Strong Positive Effect

Correlation with price = 60%



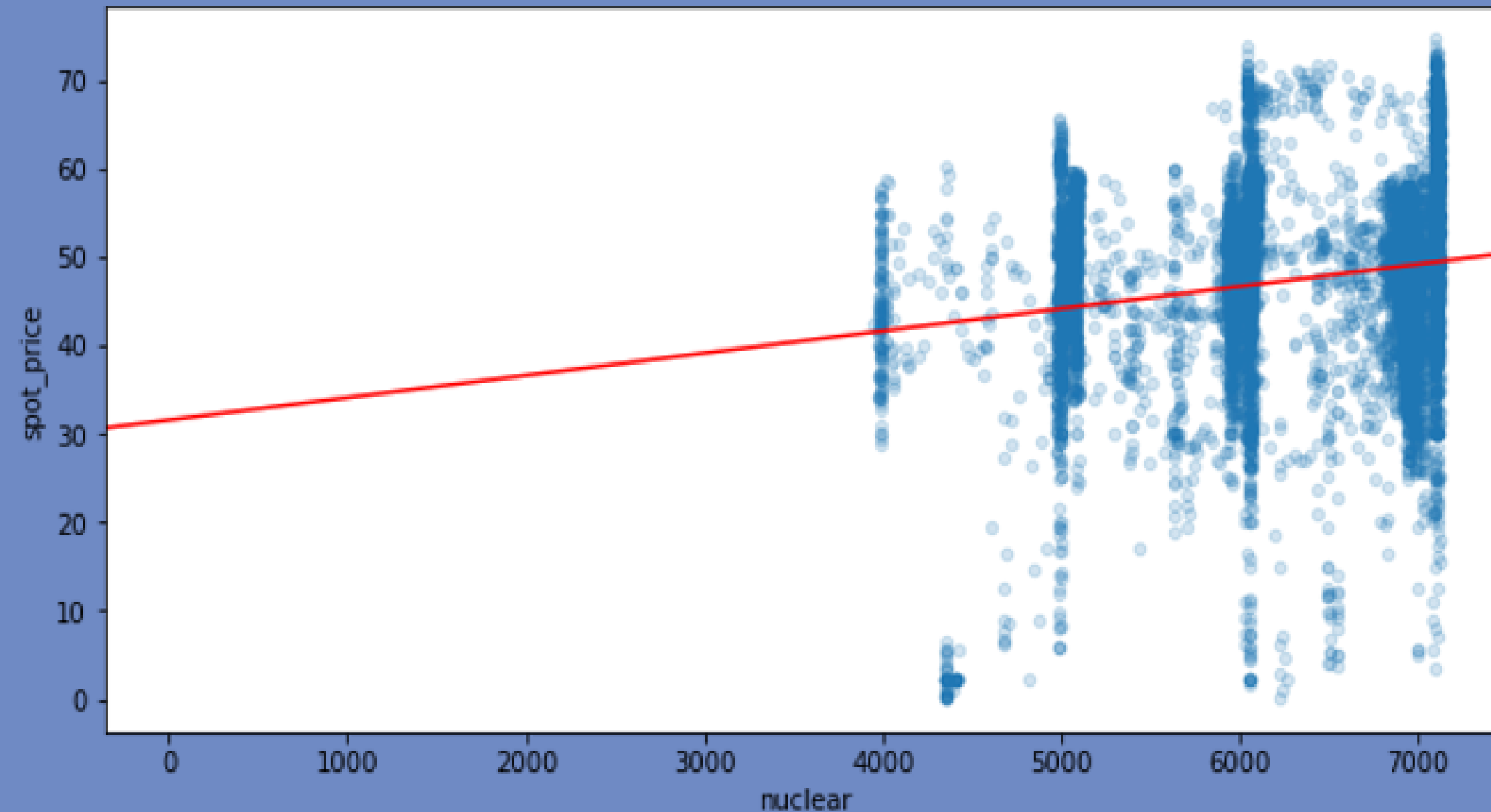
- Positively correlated in the whole data

Red line slope = 0.0049

NUCLEAR

Positive Effect

Correlation with price = 20%



Red line slope = 0.0025

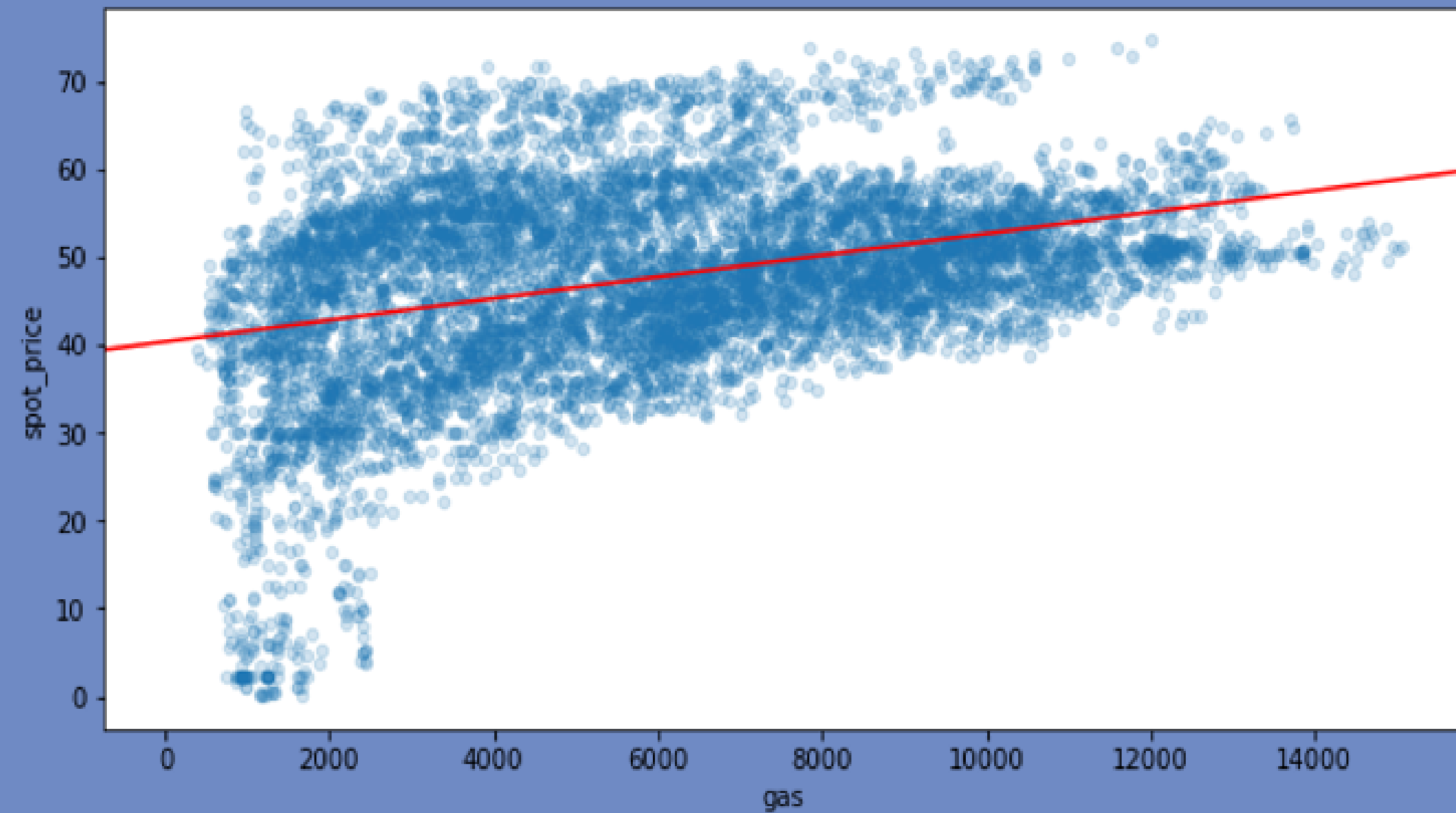


- Slightly positively correlated in the whole data.

GAS

Strong Positive Effect

Correlation with price = 36%



Red line slope = 0.0012



- Slightly positively correlated in the whole data.

The Team



Fabio Venturini



Sumayah Alduhaim



Moritz Zoepffel



Yash Singh



Lucas Trenzado



Lutho Dabula



Johnny Naime