Evolution of renewable energy production in Spain

Alessandro Cosci

Dataset(s)

Which dataset did you use of the following:

- World Development Indicators Dataset

Motivation

Spain, the country I currently live in, has one of the highest amount of sunlight hours in Europe. Also, its continental climate grants strong winds and both factors combined give this country a great renewable energy production potential.

In this project, I would like to see if Spain is using this potential. This could be interesting especially for the general public living in Spain and cares about environmentally friendly production of energy.

Research Question(s)

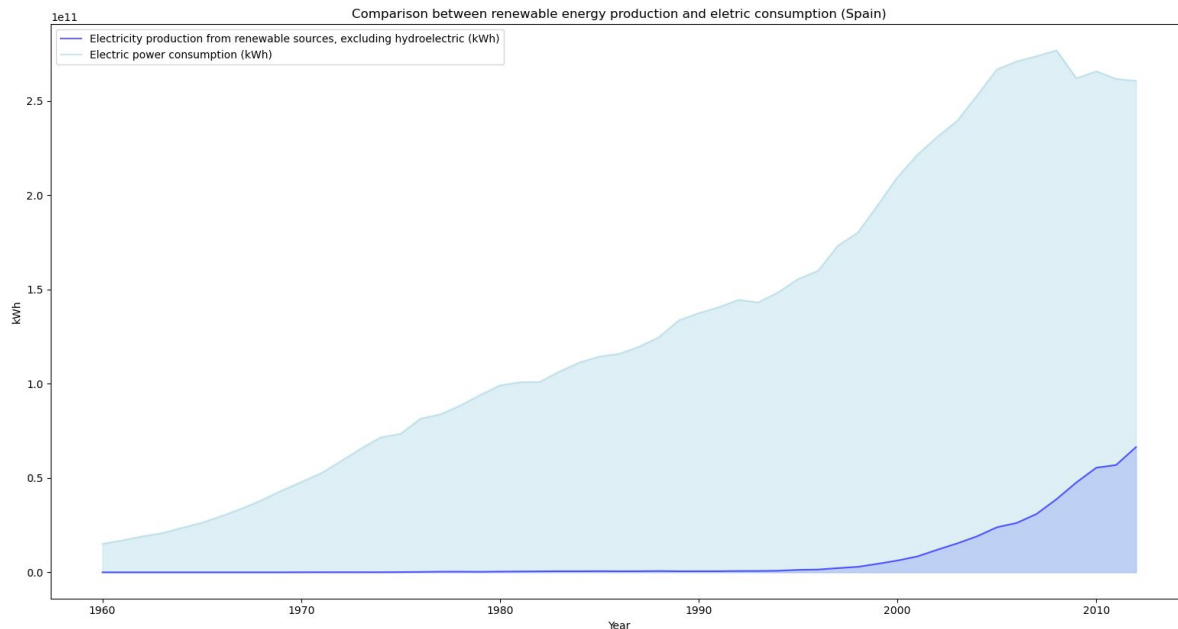How the renewable energy production has evolved in Spain?

Findings
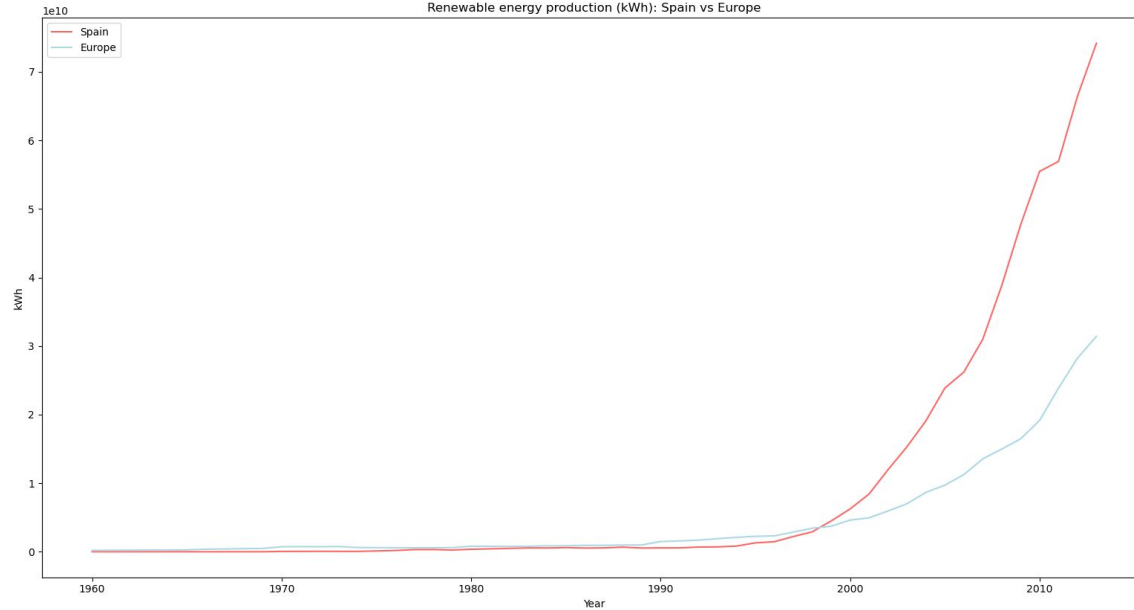
Renewable energy production (kWh): Spain vs Europe

The plot shows how Spain is actually quite above the main european countries average renewable energy production.
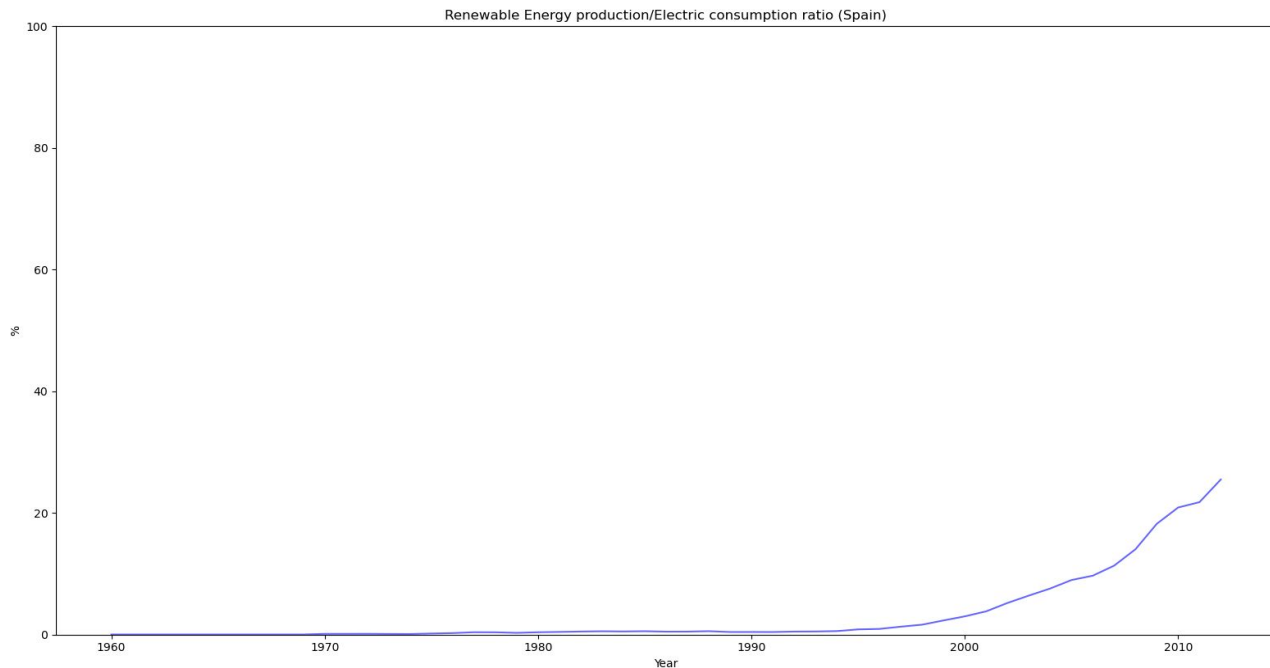Now the question is: how this compares with its electric power consumption?

Findings

Although Spain has notably increased its renewable electric production, it is still quite far from satisfying the country's energy needs. Still, it is worth checking the yearly evolution of the percentage of electric consumption covered by renewable energy.

Findings

Renewable Energy production/Electric consumption ratio (Spain)

We can see that the electric consumption in Spain is growing at a slower rate than the renewable energy production, which can be defined as a positive trend.

Acknowledgements

I did not get any feedback on my work.

References

In the first comparison between Spain and Europe, the european countries selection is based on the data provided by the International Renewable ENergy Agency (irena.org).

How the renewable energy production has evolved in Spain?

Spain, the country I currently live in, has one of the highest amount of sunlight hours in Europe. Also, its continental climate grants strong winds and both factors combined give this country a great renewable energy production potential. In this project, I would like to see if Spain is using this potential.

First things first: let's call the necessary Python modules

```
In [1]: import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
```

Let's read the indicators csv file and print the columns

```
In [2]: df = pd.read_csv('/home/lorque/UCSanDiegoX: DSE200x/Python for Data Science/
        week 6 mini project/databases/World Development Indicators/Indicators.csv')
        df.columns
```

```
Out[2]: Index(['CountryName', 'CountryCode', 'IndicatorName', 'IndicatorCode', 'Year
        ',
                'Value'],
               dtype='object')
```

Now let's extract the Electricity porduction from renewable sources

```
In [3]: df_energy_production = df[df['IndicatorName']=='Electricity production from
        renewable sources, excluding hydroelectric (kWh)']
```

Creating the Spain and Europe dataframes in order to compare the Spanish renewable energy production with the rest of Europe

```
In [4]: df_spain = df_energy_production.loc[df_energy_production['CountryName']=='Sp
        ain',['Year','Value']]
        Europe = ['Italy','United Kingdom','Greece','Turkey','Germany','France','Por
        tugal','Denmark','Finland','Sweden','Iceland']
        df_avg = df_energy_production.groupby(['Year']).mean()
        df_europe_avg = df_energy_production[df_energy_production['CountryName'].isi
        n(Europe)].groupby(['Year']).mean()

        df_to_plot = pd.merge(df_spain, df_europe_avg, on='Year',how='outer')

        df_to_plot.columns = ['Year','Spain','Europe']
```

Generating the plot for graphical comparison

```
In [5]: plt.plot('Year','Spain',data=df_to_plot,color='red',alpha=0.6)
        plt.plot('Year','Europe',data=df_to_plot,color='lightblue')
        plt.xlabel('Year')
        plt.ylabel('kWh')
        plt.title('Renewable energy production (kWh): Spain vs Europe')
        plt.legend()
        plt.show()
```
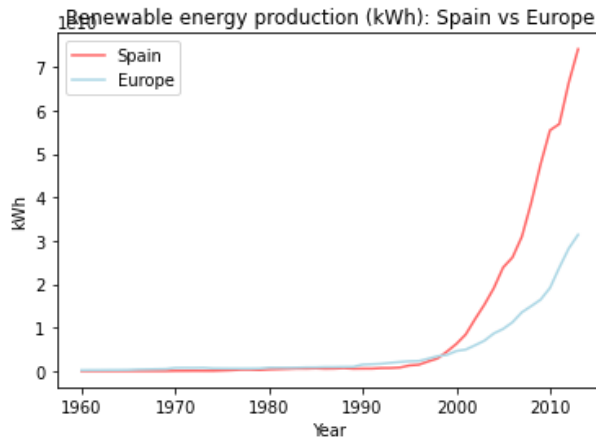

The plot shows how Spain is actually quite above the main european countries average renewable energy production. Now the question is: how this compares with its electric power consumption?

Since the electric power consumption is shown in kWh per capita, we have to multiply it by the population to make the energy consumption and renewable energy prodution comparable

```
In [6]: df_spain_new = df[df['CountryName']=='Spain']
        indicators_spain = ['Electric power consumption (kWh per capita)','Populatio
        n, total']
        df_spain_new = df_spain_new[df_spain_new['IndicatorName'].isin(indicators_sp
        ain)]
        df_spain_electric_consumption = df_spain_new[df_spain_new['IndicatorName']==
        'Electric power consumption (kWh per capita)']
        df_spain_population = df_spain_new[df_spain_new['IndicatorName']=='Populatio
        n, total']
        df_spain_new = pd.merge(df_spain_electric_consumption,df_spain_population,on
        ='Year',how='outer')
        df_spain_new = df_spain_new[['Year','Value_x','Value_y']]
        df_spain_new.columns = ['Year','Electric power consumption (kWh per capit
        a)','Population, total']
        df_spain_new['Electric power consumption (kWh)'] = df_spain_new['Electric po
        wer consumption (kWh per capita)']*df_spain_new['Population, total']

        df_spain_to_plot = pd.merge(df_spain,df_spain_new[['Year','Electric power co
        nsumption (kWh)']],on='Year',how='outer')
        df_spain_to_plot.columns = ['Year','Electricity production from renewable so
        urces, excluding hydroelectric (kWh)','Electric power consumption (kWh)']
        df_spain_to_plot = df_spain_to_plot.dropna()
```

Now that we have the electric power consumption and renewable energy production for each year in the same dataframe, we can visualize the yearly evolution of both indicators.
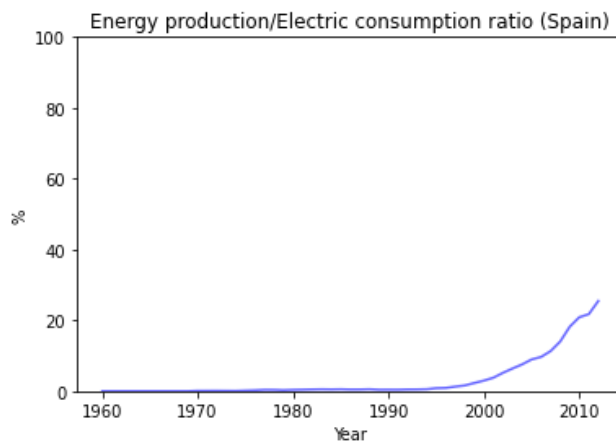
In [7]:
```python
plt.fill_between('Year',df_spain_to_plot.columns[1],data=df_spain_to_plot,co
lor='blue',alpha=0.2)
plt.plot('Year',df_spain_to_plot.columns[1],data=df_spain_to_plot,color='blu
e',alpha=0.6)
plt.fill_between('Year',df_spain_to_plot.columns[2],data=df_spain_to_plot,co
lor='lightblue',alpha=0.4)
plt.plot('Year',df_spain_to_plot.columns[2],data=df_spain_to_plot,color='lig
htblue',alpha=0.6)
plt.xlabel('Year')
plt.ylabel('kWh')
plt.title('Comparison between renewable energy production and eletric consum
ption (Spain)')
plt.legend()
plt.show()
```
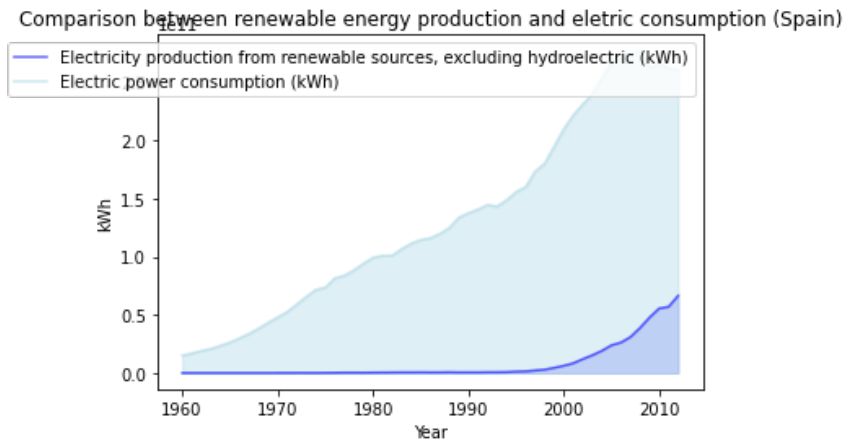

Although Spain has notably increased its renewable electric production, it is still quite far from satisfying the country's energy needs. Still, it is worth checking the yearly evolution of the percentage of electric consumption covered by renewable energy.

In [8]:
```python
df_spain_to_plot['production_consumption_ratio'] = df_spain_to_plot['Electri
city production from renewable sources, excluding hydroelectric (kWh)']/df_s
pain_to_plot['Electric power consumption (kWh)']*100

plt.plot('Year','production_consumption_ratio',data=df_spain_to_plot,color='
blue',alpha=0.6)
plt.xlabel('Year')
plt.ylabel('%')
plt.ylim(0,100)
plt.title('Energy production/Electric consumption ratio (Spain)')
plt.show()
```

We can see that the electric consumption in Spain is growing at a slower rate than the renewable energy production, which can be defined as a positive trend.

In [ ]: