Author: Amina Nsanza Class: 5550 Data Science and Climate Change. Project: Rising Temperature Impact on Energy Poverty Code Source: Cleaning and Tidying Datasets

```python
import pandas as pd
import polars as pl
import numpy as np
import matplotlib.pyplot as plt
```

Probelm Statement & Data Collection and Refinement.

The ongoing rise in global temperatures has led to significant environmental impacts, from severe weather events to energy surplus and poverty. One notable consequence is the increase in energy poverty– a lack of access to modern, reliable, and affordable energy services, including electricity and clean cooking facilities. This issue disproportionately affects low-income and rural communities and exacerbates existing inequalities. This project aims to establish the correlation between rising global temperatures and energy poverty while predicting future energy poverty indexes based on temperature projections. Understanding this relationship is crucial in anticipating how energy poverty may increase in response to global temperatures, thereby informing policy decisions and targeting interventions for vulnerable populations.

The data used in this project will be from various sources: The World Bank, The Intergovernmental Panel on Climate Change (IPCC), CEIC Data, the National Oceanic and Atmospheric Administration (NOAA), and Enerdata.

Energy Poverty Index Dataset

```python

path               =              'Raw_Data/World_Bank_Poverty_Indices/
API_EG.ELC.ACCS.ZS_DS2_en_csv_v2_62.csv'

#Initial dataset access to electricty % of population

access_elec_df = pd.read_csv(path, skiprows=4)  # Skipping metadata rows
print(access_elec_df.head())

access_elec_df.shape
```

```
                  Country Name Country Code  \
0                        Aruba          ABW
1  Africa Eastern and Southern          AFE
2                  Afghanistan          AFG
3   Africa Western and Central          AFW
4                       Angola          AGO

                            Indicator Name  Indicator Code  1960  1961  1962  \
0  Access to electricity (% of population)  EG.ELC.ACCS.ZS   NaN   NaN   NaN
```

```
1  Access to electricity (% of population)  EG.ELC.ACCS.ZS   NaN   NaN   NaN
2  Access to electricity (% of population)  EG.ELC.ACCS.ZS   NaN   NaN   NaN
3  Access to electricity (% of population)  EG.ELC.ACCS.ZS   NaN   NaN   NaN
4  Access to electricity (% of population)  EG.ELC.ACCS.ZS   NaN   NaN   NaN

   1963  1964  1965  ...        2015        2016        2017        2018  \
0   NaN   NaN   NaN  ...  100.000000  100.000000  100.000000  100.000000
1   NaN   NaN   NaN  ...   33.903800   38.854624   40.199898   43.017148
2   NaN   NaN   NaN  ...   71.500000   97.700000   97.700000   93.400000
3   NaN   NaN   NaN  ...   46.758739   50.906115   48.789457   51.211055
4   NaN   NaN   NaN  ...   42.000000   41.800000   42.900000   45.300000

         2019        2020        2021       2022  2023  Unnamed: 68
0  100.000000  100.000000  100.000000  99.900000   NaN          NaN
1   44.381259   46.264875   48.100862  48.711995   NaN          NaN
2   97.700000   97.700000   97.700000  85.300000   NaN          NaN
3   51.168083   51.730899   54.224724  55.437577   NaN          NaN
4   45.600000   47.000000   48.200000  48.500000   NaN          NaN

[5 rows x 69 columns]
```

```
(266, 69)
```

```
#Cleaning the data

#Dropping null years (1960 - 1989 & 2023 and last col)

columns_to_drop  =  [col  for  col  in  access_elec_df.columns  if
col.startswith(tuple(str(year) for year in range(1960, 1990)))]

access_elec_df = access_elec_df.drop(columns=columns_to_drop, axis=1)

access_elec_df = access_elec_df.drop(columns=['2023', 'Unnamed: 68'],
errors='ignore') #These cols are also empty
access_elec_df.columns.tolist()

#access_elec_df.shape
```

```
['Country Name',
 'Country Code',
 'Indicator Name',
 'Indicator Code',
 '1990',
 '1991',
 '1992',
 '1993',
 '1994',
 '1995',
 '1996',
 '1997',
 '1998',
 '1999',
 '2000',
 '2001',
 '2002',
 '2003',
 '2004',
 '2005',
 '2006',
 '2007',
 '2008',
 '2009',
 '2010',
 '2011',
 '2012',
 '2013',
 '2014',
 '2015',
 '2016',
 '2017',
 '2018',
 '2019',
 '2020',
 '2021',
 '2022']
```

```
#Checking for Nulls in Countries and countries with nulls 50% empty years will
be dropped.

year_columns = [col for col in access_elec_df.columns if col.isdigit()]

countries_na                                                                 =
access_elec_df[access_elec_df[year_columns].isnull().any(axis=1)]
countries_na['Null Count'] = countries_na[year_columns].isnull().sum(axis=1)

#Count of NAs per country
countries_na_summary  =  countries_na[['Country  Name',  'Country  Code',  'Null
Count']]

# Sort by the number of null values for better analysis
countries_na_summary   =   countries_na_summary.sort_values(by='Null   Count',
ascending=False)
```

```
countries_na_summary
```

```
/var/folders/19/lj7m40r97fj5_hs7nfmzyf880000gn/T/
ipykernel_8886/3541968494.py:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/
stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  countries_na['Null Count'] = countries_na[year_columns].isnull().sum(axis=1)
```

	Country Name	Country Code	Null Count
11	American Samoa	ASM	33
110	Not classified	INX	33
261	Kosovo	XKX	23
193	Korea, Dem. People's Rep.	PRK	19
216	South Sudan	SSD	17
…	…	…	…
106	Indonesia	IDN	1
33	Botswana	BWA	1
42	Cameroon	CMR	1
59	Dominican Republic	DOM	1
211	El Salvador	SLV	1

```
#Countries with more than 16 years of NAs

countries_NA = countries_na_summary[countries_na_summary['Null Count'] > 16]
print(countries_NA)


#Dropping these countries
countires_dropped = countries_NA['Country Code']  # List of country codes to
drop
access_elec_df           =           access_elec_df[~access_elec_df['Country
Code'].isin(countires_dropped)]

access_elec_df.shape
```

```

```

```
                   Country Name Country Code  Null Count
11               American Samoa          ASM          33
110              Not classified          INX          33
261                      Kosovo          XKX          23
193  Korea, Dem. People's Rep.          PRK          19
216                 South Sudan          SSD          17
131                     Liberia          LBR          17
```

```
(260, 37)
```

```
access_elec_df.head()

#Seems a lot of cols also have Nas in the earlier years deciding whether to drop
them or not

na_per_year = access_elec_df[year_columns].isnull().sum()

# Converting the result into a DataFrame for better readability
na_per_year_df = na_per_year.reset_index()
na_per_year_df.columns = ['Year', 'NA Count']

na_per_year_df


#1990 - 1992 Have a lot of NAs > 50% These
```

	Year	NA Count
0	1990	154
1	1991	143
2	1992	126
3	1993	111
4	1994	105
5	1995	98
6	1996	83
7	1997	76
8	1998	67
9	1999	58
10	2000	1
11	2001	1
12	2002	0
13	2003	0
14	2004	0
15	2005	0
16	2006	0
17	2007	0
18	2008	0
19	2009	0
20	2010	0
21	2011	0
22	2012	0
23	2013	0
24	2014	0
25	2015	0
26	2016	0
27	2017	0
28	2018	0
29	2019	0
30	2020	0
31	2021	0
32	2022	0

```
#Dropping the cols with 50%> NAs

years_to_drop = na_per_year[na_per_year > 125].index.tolist()

access_elec_df = access_elec_df.drop(columns=years_to_drop, axis=1)

remaining_years = [col for col in access_elec_df.columns if col.isdigit()]

remaining_years #Checks out
```

```
['1993',
 '1994',
 '1995',
 '1996',
 '1997',
 '1998',
 '1999',
 '2000',
 '2001',
 '2002',
 '2003',
 '2004',
 '2005',
 '2006',
 '2007',
 '2008',
 '2009',
 '2010',
 '2011',
 '2012',
 '2013',
 '2014',
 '2015',
 '2016',
 '2017',
 '2018',
 '2019',
 '2020',
 '2021',
 '2022']
```

```
#Saving the cleaned df prior to applying bootstrap

path = 'Cleaned_Data/cleaned_energy_poverty_index.csv'
access_elec_df.to_csv(path, index=False)
```

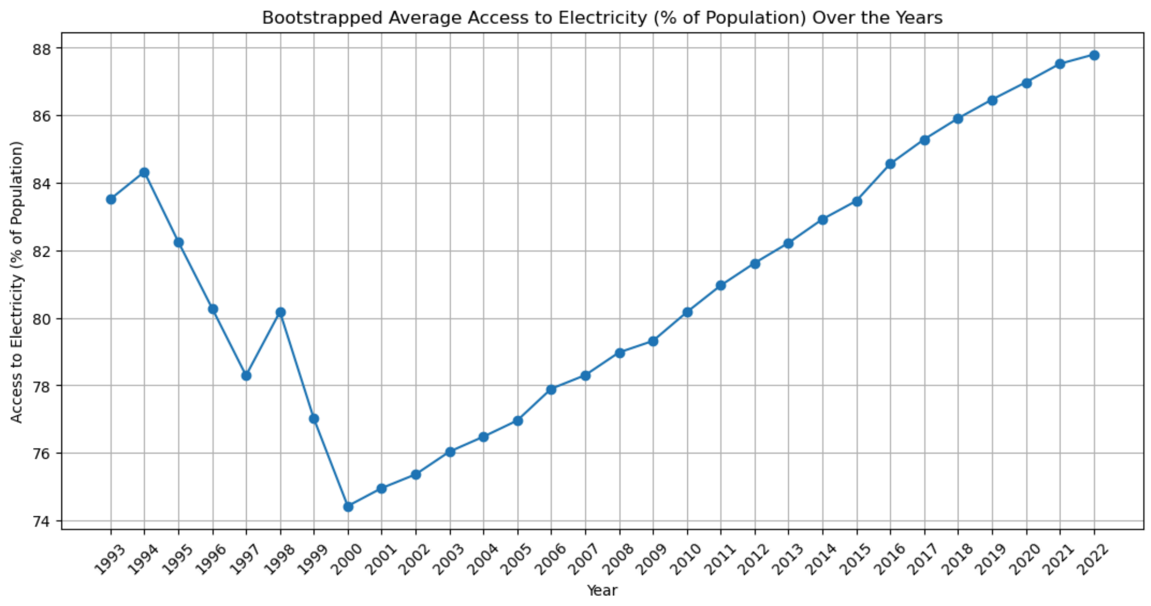
```
#For other NA values using bootsrapping to fill the NAs

#Countries with NAs
#access_elec_df.columns

#getting the year columns in the dataset
year_columns = [col for col in access_elec_df.columns if col.isdigit()]

# Applying bootstrapping to fill missing vals
def bootstrap_fill(df, year_columns):
    for col in year_columns:
        # Getting non NA values n
        non_na_values = df[col].dropna()
        # Using the non NAs to do random resampling for the values with NA
        df[col] = df[col].apply(lambda x: np.random.choice(non_na_values) if
pd.isnull(x) else x)
    return df

# Creating a bootstrapped version of the dataset
access_elec_bt_df = access_elec_df.copy()
access_elec_bt_df = bootstrap_fill(access_elec_bt_df, year_columns)

# Extracting og and bootstrapped values to compare
og_vals = access_elec_df[year_columns].stack()
bt_vals = access_elec_bt_df[year_columns].stack()
```

```
access_elec_bt_df.head()
```

	Country Name	Country Code	Indicator Name	Indicator Code	1993	1994	1995	1996	1997	1998	…	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
0	Aruba	ABW	Access to electricity (% of population)	EG.ELC.ACCS.ZS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Africa Eastern and Southern	AFE	Access to electricity (% of population)	EG.ELC.ACCS.ZS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Afghanistan	AFG	Access to electricity (% of population)	EG.ELC.ACCS.ZS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Africa Western and Central	AFW	Access to electricity	EG.ELC.ACCS.ZS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Angola	AGO	Access to electricity	EG.ELC.ACCS.ZS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

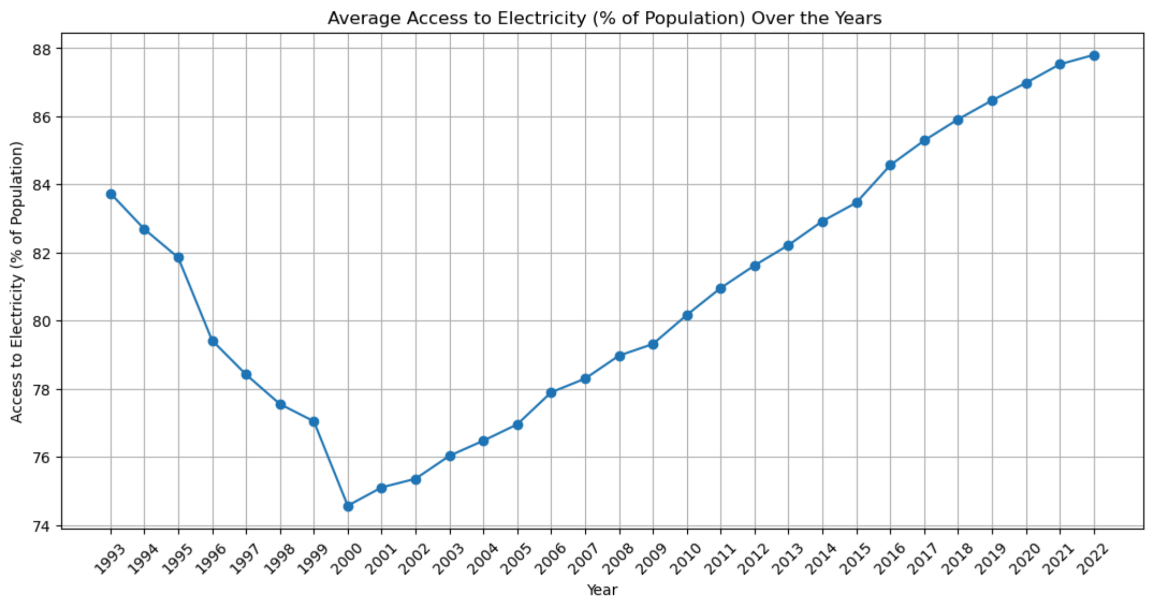
```
#Saving the boot_strapped

path = 'Cleaned_Data/cleaned_energy_poverty_index_bt.csv'
access_elec_bt_df.to_csv(path, index=False)
```

```
# Getting year columns
year_columns = [col for col in access_elec_bt_df.columns if col.isdigit()]

# Calculating the mean access to electricity for all countries per year
mean_access_per_year = access_elec_bt_df[year_columns].mean()


plt.figure(figsize=(13, 6))
plt.plot(mean_access_per_year.index,  mean_access_per_year.values,  marker='o',
linestyle='-')
plt.title('Bootstrapped Average Access to Electricity (% of Population) Over the
Years')
plt.xlabel('Year')
plt.ylabel('Access to Electricity (% of Population)')
plt.grid(True)
plt.xticks(ticks=mean_access_per_year.index,
labels=mean_access_per_year.index, rotation=45)

plt.show()
```



```
# Getting year columns
year_columns = [col for col in access_elec_df.columns if col.isdigit()]
```

```
# Calculating the mean access to electricity for all countries per year
mean_access_per_year = access_elec_df[year_columns].mean()


#The trend over the years
plt.figure(figsize=(13, 6))
plt.plot(mean_access_per_year.index, mean_access_per_year.values, marker='o',
linestyle='-')
plt.title(' Average Access to Electricity (% of Population) Over the Years')
plt.xlabel('Year')
plt.ylabel('Access to Electricity (% of Population)')
plt.grid(True)
plt.xticks(ticks=mean_access_per_year.index,
labels=mean_access_per_year.index, rotation=45)
plt.show()
```



Conclusion on this Dataset: This dataset showcased an increase in energy accessibility per % of population and this energy poverty index could not be used because factors like country develpoment contribute to the number of individuals that have access to energy. Instead another Energy Poverty Index was going to be created (Using Energy Prices & Global National Income)

Cleaning the Energy Price Data (2014 - 2019)

```
path = 'Raw_Data/P_Data_Extract_From_Doing_Business/36b3e48f-46ad-4de7-899c-
c8861482c822_Data.csv'
energy_price_df = pd.read_csv(path, encoding='ISO-8859-1')
```

```
energy_price_df.head()
```

	Series Name	Series Code	Country Name	Country Code	2010 [YR2010]	2011 [YR2011]	2012 [YR2012]	2013 [YR2013]	2014 [YR2014]	2015 [YR2015]	2016 [YR2016]	2017 [YR2017]	2018 [YR2018]	2019 [YR2019]
0	Getting electricity: Price of electricity (US …	IC.ELC.PRI.KH.DB1619	Beijing	CHN_BEI	..	..	..	..	14.1	14.3	13.9	18.7	17.4	16.7
1	Getting electricity: Price of electricity (US …	IC.ELC.PRI.KH.DB1619	Chittagong	BGD_CHI	..	..	..	..	9.3	9	9.3	9.2	9.3	10.9
2	Getting electricity: Price of electricity (US …	IC.ELC.PRI.KH.DB1619	Delhi	IND_DEL	..	..	..	..	20.3	19.8	16	15.2	14.9	16.3
3	Getting electricity: Price of electricity (US	IC.ELC.PRI.KH.DB1619	Dhaka	BGD_DHA	..	..	..	..	9.3	9	9.3	9.2	9.2	9.4
4	Getting electricity: Price of elec-	IC.ELC.PRI.KH.DB1619	Jakarta	IDN_JAK	..	..	..	..	14.2	13.7	11	11.1	10.7	10.7

```
# Cleaninng the cols so its only numerical years.
year_columns = [col for col in energy_price_df.columns if col.startswith('19')
or col.startswith('20')]
renamed_columns = {col: int(col.split(' ')[0]) for col in year_columns}
energy_price_df.rename(columns=renamed_columns, inplace=True)

# dropping years 2010 to 2013 as they are mostly empty
columns_to_drop = [col for col in energy_price_df.columns if isinstance(col,
int) and 2010 <= col <= 2013]
energy_price_df        =        energy_price_df.drop(columns=columns_to_drop,
errors='ignore')

# dropping series same and series code cols
energy_price_df = energy_price_df.drop(columns=['Series Name', 'Series Code'],
errors='ignore')

#dropping na values


energy_price_df.columns.tolist()
```

```
['Country Name', 'Country Code', 2014, 2015, 2016, 2017, 2018, 2019]
```

```
energy_price_df.head()

#Saving the cleaned df
path = 'Cleaned_Data/cleaned_energy_price.csv'
energy_price_df.to_csv(path, index=False)
```

```
NameError: name 'energy_price_df' is not defined
⍰[0;31m---------------------------------------------------------------------------⍰
[0m
⍰[0;31mNameError⍰[0m                                 Traceback (most recent
call last)
Cell ⍰[0;32mIn[3], line 1⍰[0m
⍰[0;32m----> 1⍰[0m ⍰[43menergy_price_df⍰[49m⍰[38;5;241m.⍰[39mhead()
⍰[1;32m      3⍰[0m ⍰[38;5;66;03m#Saving the cleaned df ⍰[39;00m
⍰[1;32m                                                                      4⍰[0m
path      ⍰[38;5;241m=⍰[39m      ⍰[38;5;124m'⍰[39m⍰[38;5;124mCleaned_Data/
cleaned_energy_price.csv⍰[39m⍰[38;5;124m'⍰[39m

⍰[0;31mNameError⍰[0m: name 'energy_price_df' is not defined
```

Further Cleaning and Combining Energy Prices.

```
path = 'Cleaned_Data/cleaned_energy_price.csv'
energy_price_df = pd.read_csv(path)

#Diving it by 100 -> USD Cents per Kwh
years = ['2014', '2015', '2016', '2017', '2018', '2019']
energy_price_df[years] = energy_price_df[years].apply(pd.to_numeric,
errors='coerce')

energy_price_df[years] = energy_price_df[years] / 100

energy_price_df.tail(7)
```

	Country Name	Country Code	2014	2015	2016	2017	2018	2019
211	Zambia	ZMB	0.045	0.048	0.038	0.047	0.047	0.046
212	Zimbabwe	ZWE	0.125	0.105	0.125	0.121	0.119	0.124
213	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
214	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
215	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
216	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
217	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN

```
#Energy Prices 2021
energy_price_2021_df       =       pd.read_excel('Raw_Data/Electricity_Prices/
Electricity_Prices2021.xlsx')

energy_price_2021_df.head()


#Drop rank col & Country code col
energy_price_2021_df   =   energy_price_2021_df.drop(columns=['Rank',   'Country
code'])

#Rename Coutry name -> Country Name  &  Changing Avg Price 1KW/h (USD) -> 2021

energy_price_2021_df = energy_price_2021_df.rename(columns={
    'Country name': 'Country Name',
    'Average price of 1KW/h (USD)': '2021'
})
```

```
#Saving the cleaned csv
path = 'Cleaned_Data/cleaned_electricity_prices2021.csv'
energy_price_2021_df.to_csv(path, index=False)
```

```
#Joining 2014 - 2019 + 2021  by Country
#energy_price_2021_df.shape 230 Countries
#energy_price_df.shape 218 Countries

#Join both datasets  left to keep most of the countries
energy_prices_2014_2021 = pd.merge(energy_price_df, energy_price_2021_df,
on='Country Name', how='left')


energy_prices_2014_2021.shape
```

```
(218, 10)
```

```
#Saving

energy_prices_2014_2021.sort_values(by='Country Name')
path = 'Cleaned_Data/energy_prices_2014_2021.csv'
energy_prices_2014_2021.to_csv(path, index=False)
```

```
#Drop rows 2 - 23 there cities not countries
energy_prices_2014_2021                                         =
energy_prices_2014_2021.drop(energy_prices_2014_2021.index[0:22])

energy_prices_2014_2021.head()
```

	Country Name	Country Code	2014	2015	2016	2017	2018	2019	Continental region	2021
22	Afghanistan	AFG	0.233	0.220	0.209	0.186	0.176	0.180	ASIA (EX. NEAR EAST)	0.064969
23	Albania	ALB	0.095	0.102	0.096	0.091	0.087	0.094	EASTERN EUROPE	0.115875
24	Algeria	DZA	0.027	0.027	0.030	0.026	0.022	0.021	NORTHERN AFRICA	0.032792
25	Angola	AGO	0.047	0.046	0.088	0.060	0.046	0.037	SUB-SAHARAN AFRICA	0.012713
26	Antigua and Barbuda	ATG	0.507	0.445	0.442	0.432	0.437	0.449	CARIBBEAN	0.367061

```
energy_prices_2014_2021.shape
```

```
(196, 10)
```

```
#Add 2022 - 2023 Dataset Energy  Data Set
path = 'Cleaned_Data/cleaned_energy_price_2022_2023.csv'
energy_prices_2022_2023 = pd.read_csv(path)
energy_prices_2022_2023.head()
#energy_prices_2022_2023.shape -> 147 Countries.

#Combine it  with the other years of energy prices as final energy prices dataset
and save it

#Left Join to Perserve Countries from 2014 - 2023  Because 2014 - 2019 Had the
most prices.

energy_prices_2014_2023          =          pd.merge(energy_prices_2014_2021,
energy_prices_2022_2023, on='Country Name', how='left')
```

```
# Cleaning it further


#Re-arrainging the cols
columns = list(energy_prices_2014_2023.columns)
columns.insert(2, columns.pop(columns.index('Continental region')))
energy_prices_2014_2023 = energy_prices_2014_2023[columns]

#Ordering the years right

new_cols = ['Country Name', 'Country Code', 'Continental region'] + sorted(
    [col for col in energy_prices_2014_2023.columns if col.isnumeric()]
)
energy_prices_2014_2023 = energy_prices_2014_2023[new_cols]

#Dropping the empty 5 rows
energy_prices_2014_2023 = energy_prices_2014_2023[:-5]


energy_prices_2014_2023.head()
```

	Country Name	Country Code	Continental region	2014	2015	2016	2017	2018	2019	2021	2022	2023
0	Afghanistan	AFG	ASIA (EX. NEAR EAST)	0.233	0.220	0.209	0.186	0.176	0.180	0.064969	0.043	0.0421
1	Albania	ALB	EASTERN EUROPE	0.095	0.102	0.096	0.091	0.087	0.094	0.115875	0.116	0.1051
2	Algeria	DZA	NORTHERN AFRICA	0.027	0.027	0.030	0.026	0.022	0.021	0.032792	0.039	0.0391
3	Angola	AGO	SUB-SAHARAN AFRICA	0.047	0.046	0.088	0.060	0.046	0.037	0.012713	0.016	0.0231
4	Antigua and Barbuda	ATG	CARIBBEAN	0.507	0.445	0.442	0.432	0.437	0.449	0.367061	NaN	NaN

```
energy_prices_2014_2023.shape

# Assingning Continental Region for the countries that did not have them  ->
this will help to connect weather temperatures.
#How many dont have region assigned
countries_no_region              =           energy_prices_2014_2023['Continental
region'].isna().sum()
countries_no_region

#list of the countries
countries_no_region_list                                                    =
energy_prices_2014_2023[energy_prices_2014_2023['Continental   region'].isna()]
['Country Name'].tolist()
countries_no_region_list

#Assigning them regions based the the 2021 dataset
#Reggion mapping

region_mapping = {
    'Bahamas, The': 'Caribbean',
    'Cabo Verde': 'Sub-Saharan Africa',
    'Congo, Dem. Rep.': 'Sub-Saharan Africa',
    'Congo, Rep.': 'Sub-Saharan Africa',
    'Egypt, Arab Rep.': 'Northern Africa',
    'Eritrea': 'Sub-Saharan Africa',
    'Gambia, The': 'Sub-Saharan Africa',
    'Hong Kong, China': 'Asia (Ex. Near East)',
    'Iran, Islamic Rep.': 'Asia (Ex. Near East)',
    'Korea, Rep.': 'Asia (Ex. Near East)',
    'Kosovo': 'Eastern Europe',
    'Kyrgyz Republic': 'Asia (Ex. Near East)',
    'Lao PDR': 'Asia (Ex. Near East)',
    'Micronesia, Fed. Sts.': 'Oceania',
    'Netherlands': 'Western Europe',
    'North Macedonia': 'Eastern Europe',
    'São Tomé and Principe': 'Sub-Saharan Africa',
    'Slovak Republic': 'Eastern Europe',
    'South Sudan': 'Sub-Saharan Africa',
    'St. Kitts and Nevis': 'Caribbean',
    'St. Lucia': 'Caribbean',
    'St. Vincent and the Grenadines': 'Caribbean',
    'Syrian Arab Republic': 'Near East',
    'Taiwan, China': 'Asia (Ex. Near East)',
    'Venezuela, RB': 'South America',
    'West Bank and Gaza': 'Near East',
    'Yemen, Rep.': 'Near East'

}

# assigning the regions to the coresponding countrydataset

energy_prices_2014_2023['Continental                 region']                 =
energy_prices_2014_2023['Country Name'].map(
lambda             country:             region_mapping[country]             if
pd.isna(energy_prices_2014_2023.loc[energy_prices_2014_2023['Country     Name']
==         country,         'Continental         region']).all()         else
energy_prices_2014_2023.loc[energy_prices_2014_2023['Country Name'] == country,
'Continental region'].values[0]

)
energy_prices_2014_2023.head()
```

	Country Name	Country Code	Continental region	2014	2015	2016	2017	2018	2019	2021	2022	2023
0	Afghanistan	AFG	ASIA (EX. NEAR EAST)	0.233	0.220	0.209	0.186	0.176	0.180	0.064969	0.043	0.0421
1	Albania	ALB	EASTERN EUROPE	0.095	0.102	0.096	0.091	0.087	0.094	0.115875	0.116	0.1051
2	Algeria	DZA	NORTHERN AFRICA	0.027	0.027	0.030	0.026	0.022	0.021	0.032792	0.039	0.0391
3	Angola	AGO	SUB-SAHARAN AFRICA	0.047	0.046	0.088	0.060	0.046	0.037	0.012713	0.016	0.0231
4	Antigua and Barbuda	ATG	CARIBBEAN	0.507	0.445	0.442	0.432	0.437	0.449	0.367061	NaN	NaN

```
#Checking if they all got assigned
countries_no_region = energy_prices_2014_2023['Continental
region'].isna().sum()
countries_no_region #Checks out

#Saving the cleaned energy_prices_2014_2023

path = 'Cleaned_Data/cleaned_energy_prices_2014_2023.csv'
energy_prices_2014_2023.to_csv(path, index=False)
```

```
#Dealing with NAs for Different Years Using Boot strapping and interpolation as
fall back for countries with insuficient data to preserve the trend.

energy_prices_2014_2023              =              pd.read_csv('Cleaned_Data/
cleaned_energy_prices_2014_2023.csv')

# bootsrapping  function to fill na values with bootstrapping
def bootstrap(energy_prices_2014_2023, group_col, year_cols):
    """
    Fill missing values using bootstrapping.
    Args: Country Cols
    Returns:
    - DataFrame with missing values filled.
    """
    bt_data = energy_prices_2014_2023.copy()

    for col in year_cols:
        for name, group in bt_data.groupby(group_col):
            # values with numbers in years
            valid_values = group[col].dropna()

            # Filling NAs with bt samples from the same country
            if not valid_values.empty:
                bt_vals = group[col].apply(
                    lambda x: np.random.choice(valid_values) if pd.isna(x) else
x
                )
                bt_data.loc[group.index, col] = bt_vals

        # Interpolating any remaining missing values in the columns if some were
addded
                    bt_data[col]  =  bt_data[col].interpolate(method='linear',
limit_direction='both')  #This allows us to make sure we get all NAs but we
preserve the trend of the data.

    return bt_data

# Make sure the years are cols just incase
year_columns  =  [col  for  col  in  energy_prices_2014_2023.columns  if
col.isnumeric()]

# Applying the bootstrap samples to the dataset for missin vals
bt_energy_prices_2014_2023        =        bootstrap(energy_prices_2014_2023,
group_col="Country Name", year_cols=year_columns)


# making sure all NA are filled
NA_vals = bt_energy_prices_2014_2023.isna().sum()  #Checks out.
NA_vals
```

```
Country Name          0
Country Code          0
Continental region    0
```

```
2014                    0
2015                    0
2016                    0
2017                    0
2018                    0
2019                    0
2021                    0
2022                    0
2023                    0
dtype: int64
```

```
bt_energy_prices_2014_2023.head()

#Saving the bootstapped data

path = 'Cleaned_Data/bt_energy_prices_2014_2023.csv'
bt_energy_prices_2014_2023.to_csv(path, index=False)
```

Cleaning Energy Consumption Data and Creating total Energy Consumption Price per Region / Country $/Kwh

```
bt_energy_prices_2014_2023 = pd.read_csv('Cleaned_Data/
bt_energy_prices_2014_2023.csv')
```

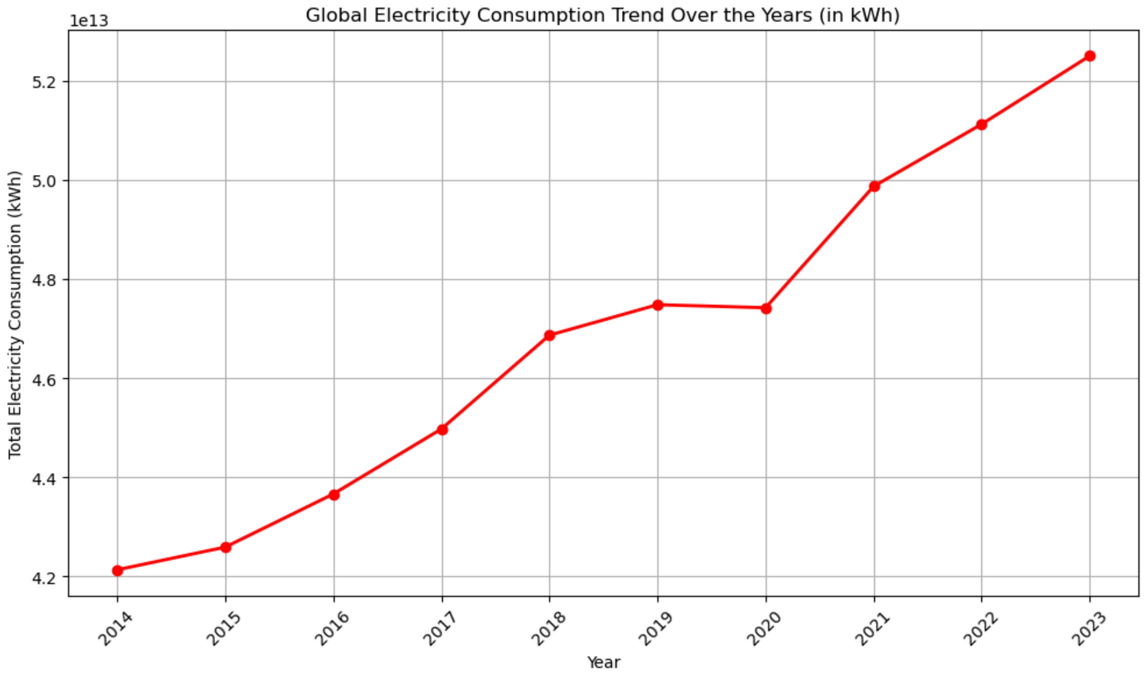
```
energy_consumption  =  pd.read_excel('Raw_Data/Electricity_Prices/electricity-
domestic-consumption-data.xlsx')

energy_consumption.head()

energy_consumption_kwh = energy_consumption.copy()

#Converting to Kwh Energy Consuption  / Year from Twh Terrawatt hour -> Kilowatt
hw conversion is 1000000000
energy_consumption_kwh.iloc[:,  1:]  =  energy_consumption_kwh.iloc[:,  1:]  *
1000000000

#Renaming cols later for combining with pricce
energy_consumption_kwh.rename(
    columns={col: f"energy_consumption_kwh_{col}" if isinstance(col, int) else
col for col in energy_consumption_kwh.columns},
    inplace=True

)
energy_consumption_kwh.rename(columns={"Country":       "Country       Name"},
inplace=True)
```

```python
energy_consumption_kwh.head()

path = 'Cleaned_Data/energy_consuption.csv'
energy_consumption_kwh.to_csv(path, index=False)

energy_consumption_kwh.head()
```

	Country Name	energy_consumption_kwh_2014	energy_consumption_kwh_2015	energy_consumption_kwh_2016	energy_consumption_kwh_2017	energy_consumption_kwh_2018	energy_consumption_kwh_2019	energy_consumption_kwh_2020	energy_consumption_kwh_2021	energy_consumption_kwh_2022	energy_consumption_kwh_2023
0	Belgium	8.263350e+10	8.305660e+10	8.358120e+10	8.374510e+10	8.441140e+10	8.351800e+10	8.053800e+10	8.306870e+10	7.812930e+10	7.326844e+10
1	Czechia	5.509928e+10	5.639808e+10	5.714214e+10	5.915109e+10	5.986537e+10	6.005744e+10	5.859066e+10	6.133582e+10	5.992518e+10	5.615308e+10
2	Denmark	3.168196e+10	3.204767e+10	3.224809e+10	3.258358e+10	3.221332e+10	3.261211e+10	3.226121e+10	3.481474e+10	3.350485e+10	3.390188e+10
3	France	4.335326e+11	4.431028e+11	4.511150e+11	4.475050e+11	4.458387e+11	4.405567e+11	4.204749e+11	4.421444e+11	4.256846e+11	4.107675e+11
4	Germany	5.248260e+11	5.283500e+11	5.305510e+11	5.311180e+11	5.218090e+11	5.075430e+11	4.928220e+11	5.101020e+11	4.891310e+11	4.634868e+11

Global Energy Consumption Visualization

```python
# numeric columns related to energy consumption for visualization

energy_consumption_columns = [col for col in energy_consumption_kwh.columns if
col.startswith("energy_consumption_kwh_")]

years = [col.split('_')[-1] for col in energy_consumption_columns]

energy = energy_consumption_kwh[energy_consumption_columns].sum()

#  energy consumption trend over the years

plt.figure(figsize=(10, 6))
plt.plot(years, energy, marker='o', linestyle='-', color = 'red' ,linewidth=2)
plt.title("Global Electricity Consumption Trend Over the Years (in kWh)")
plt.xlabel("Year")
plt.ylabel("Total Electricity Consumption (kWh)")
plt.grid(True)
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



Obtaining $ per Energy Consumption.

```
# Combining energy Consumption with energy Price by Country keeping those that
appear in both using country name
energy_consumption_kwh.shape

# keeping only countries that appear in both
energy_consuption_price           =           pd.merge(energy_consumption_kwh,
bt_energy_prices_2014_2023, on="Country Name", how="inner")

# Countries analyzing.
n_countries = energy_consuption_price["Country Name"].nunique()
n_countries


energy_consuption_price.head()
```

	Country Name	energy_consumption_kwh_2014	energy_consumption_kwh_2015	energy_consumption_kwh_2016	energy_consumption_kwh_2017	energy_consumption_kwh_2018	energy_consumption_kwh_2019	energy_consumption_kwh_2020	energy_consumption_kwh_2021	energy_consumption_kwh_2022	...	Continental region	2014	2015	2016	2017	2018	2019	2021	2022	2023
0	Belgium	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	WESTERN EUROPE	0.195	0.192	0.169	0.167	0.158	[illegible]	[illegible]	[illegible]	[illegible]
1	Denmark	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	WESTERN EUROPE	0.147	0.145	0.225	0.214	0.203	[illegible]	[illegible]	[illegible]	[illegible]
2	France	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	WESTERN EUROPE	0.142	0.143	0.145	0.136	0.130	[illegible]	[illegible]	[illegible]	[illegible]
3	Germany	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	WESTERN EUROPE	0.292	0.285	0.266	0.338	0.322	[illegible]	[illegible]	[illegible]	[illegible]
4	Italy	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	WESTERN EUROPE	0.255	0.238	0.216	0.202	0.193	[illegible]	[illegible]	[illegible]	[illegible]

```
#Adding price of total consuption of electricity

# new columns for consumption price by matching years and multiplying consuption
with Kwh / $ cent
#Diving it by 12 for monthly price. -> Not doing this will use yearly because
we switch to  using gdp instead.
for year in years:
    consumption_col = f"energy_consumption_kwh_{year}"
    price_col = year  # Matching year column in the energy prices dataset
    new_col_name = f"consumption_price_{year}"
      if consumption_col in energy_consuption_price.columns and price_col in
energy_consuption_price.columns:
                                    energy_consuption_price[new_col_name]     =
(energy_consuption_price[consumption_col] * energy_consuption_price[price_col])
```

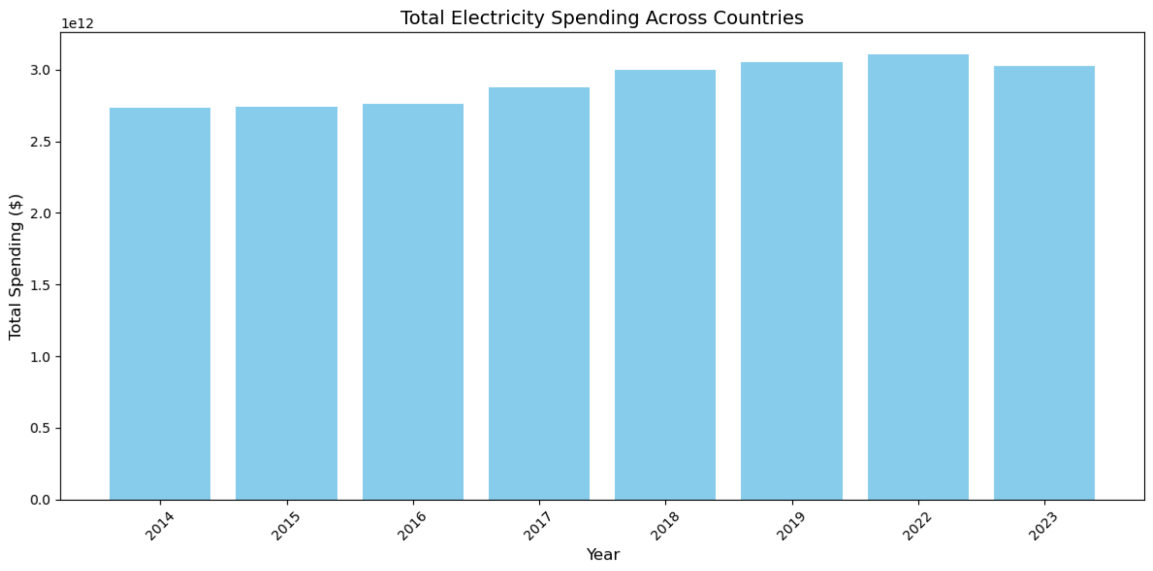
```
#Monthly Consuption price that will be ablyzed with monthly income -> Switched
back to yearly due to use of GDP instead.

energy_consuption_price.head()
```

	Country Name	energy_consumption_kwh_2014	energy_consumption_kwh_2015	energy_consumption_kwh_2016	energy_consumption_kwh_2017	energy_consumption_kwh_2018	energy_consumption_kwh_2019	energy_consumption_kwh_2020	energy_consumption_kwh_2021	energy_consumption_kwh_2022	…	2023	consumption_price_2014	consumption_price_2015	consumption_price_2016	consumption_price_2017	consumption_price_2018	consumption_price_2019	consumption_price_2020	consumption_price_2021	consumption_price_2022	consumption_price_2023
0	Belgium	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	…	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Denmark	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	…	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	France	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	…	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Germany	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	…	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Italy	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	…	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```
#Cleaning it to keep monthly consumption price alone to analyze with monthly
income  -> Analyzing yearly consumption to Yearly GDP Instead.

# Retain only "Country Name", "Continental region", and columns starting with
consumption_price

cols_to_keep = ["Country Name", "Continental region"] + [col for col in
energy_consuption_price.columns if col.startswith("consumption_price")]
#monthly_consuption_price = energy_consuption_price[cols_to_keep]

#monthly_consuption_price.head() -> removing bc we switched to GDP


yearly_consumption_price = energy_consuption_price[cols_to_keep]

yearly_consumption_price.head()
```

	Country Name	Continental region	consumption_price_2014	consumption_price_2015	consumption_price_2016	consumption_price_2017	consumption_price_2018	consumption_price_2019	consumption_price_2021	consumption_price_2022	consumption_price_2023
0	Belgium	WESTERN EUROPE	1.611353e+10	1.594687e+10	1.412522e+10	1.398543e+10	1.334174e+10	1.394751e+10	2.023628e+10	4.093975e+10	3.253851e+10
1	Denmark	WESTERN EUROPE	4.657248e+09	4.646912e+09	7.255821e+09	6.972885e+09	6.539304e+09	7.892131e+09	1.218516e+10	1.930931e+10	1.798510e+10
2	France	WESTERN EUROPE	6.156163e+10	6.315303e+10	6.514067e+10	6.086068e+10	5.795903e+10	5.991571e+10	7.612318e+10	9.270924e+10	8.794533e+10
3	Germany	WESTERN EUROPE	1.532492e+11	1.505798e+11	1.411266e+11	1.795855e+11	1.680225e+11	1.299310e+11	1.646105e+11	2.725574e+11	2.410595e+11
4	Italy	WESTERN EUROPE	7.422668e+10	7.012884e+10	6.382994e+10	6.097986e+10	5.856449e+10	5.070300e+10	6.045383e+10	1.712991e+11	1.317949e+11

```
#Number list of countries in the dataset

#monthly_consuption_price                                              =
monthly_consuption_price.drop(columns=["consumption_price_2021"],
errors="ignore")
yearly_consumption_price  =  yearly_consumption_price.drop(columns  =
["consumption_price_2021"], errors="ignore")


# Aggregate total spending per year for all countries
total_spending_per_year = yearly_consumption_price.iloc[:, 2:].sum()

# Extracting years and their corresponding total spend values
years = [col.split('_')[-1] for col in total_spending_per_year.index]
spending_values = total_spending_per_year.values


# Plot the total spend per year
plt.figure(figsize=(12, 6))
plt.bar(years, spending_values, color='skyblue')
plt.title("Total Electricity Spending Across Countries", fontsize=14)
plt.xlabel("Year", fontsize=12)
plt.ylabel("Total Spending ($)", fontsize=12)
plt.xticks(rotation=45)
plt.tight_layout()
plt.show()
```



```
#Adding GDP of  the 39 countries.

n_countries = yearly_consumption_price["Country Name"].unique().tolist()


yearly_consumption_price.shape
n_countries
```

```
['Belgium',
 'Denmark',
 'France',
 'Germany',
 'Italy',
 'Netherlands',
 'Poland',
 'Portugal',
 'Romania',
 'Spain',
 'Sweden',
 'United Kingdom',
 'Norway',
 'Azerbaijan',
 'Kazakhstan',
 'Uzbekistan',
 'Canada',
 'United States',
 'Argentina',
 'Brazil',
 'Chile',
 'Colombia',
 'Mexico',
 'China',
 'India',
 'Indonesia',
 'Japan',
 'Malaysia',
 'Singapore',
 'Thailand',
 'Vietnam',
 'Australia',
 'New Zealand',
 'Algeria',
 'Nigeria',
 'South Africa',
 'Kuwait',
 'Saudi Arabia',
 'United Arab Emirates']
```

```
#path = 'Cleaned_Data/monthly_consuption_price.csv'

path = 'Cleaned_Data/yearly_consumption_price.csv'

yearly_consumption_price.to_csv(path, index=False)
```

Income Data Cleaning This Analysis will not be included in final rsults.

```
"""#Assigning the right dollar amount depending on low or high income
income_data = pd.read_csv('Cleaned_Data/clean_household_income.csv')

income_data.tail()

#Drop 2021 & renaming cols to include income for differentiation

income_data = income_data.drop(columns=["2021"], errors="ignore")
income_data.rename(columns=lambda col: f"income_{col}" if col.isdigit() else
col, inplace=True)

#Joining with Energy Prices Data by the countries
```

```
energy_income = pd.merge(income_data, monthly_consuption_price, on="Country
Name", how="inner")

#Create % of Income Goes to Electricty
energy_income.head() """  #Code Removed -> Using GDP
```

```
'#Assigning the right dollar amount depending on low
or high income \nincome_data = pd.read_csv(\'Cleaned_Data/
clean_household_income.csv\')\n\nincome_data.tail()\n\n#Drop 2021 &
renaming cols to include income for
differentiation\n\nincome_data = income_data.drop(columns=["2021"],
errors="ignore")\nincome_data.rename(columns=lambda col: f"income_{col}" if
col.isdigit() else col, inplace=True)\n\n#Joining with Energy Prices Data by
the countries \nenergy_income = pd.merge(income_data, monthly_consuption_price,
on="Country Name", how="inner")\n\n#Create % of Income Goes to
Electricty\nenergy_income.head() '
```

```
"""#Visual of country income per grouped income
#Converting the income into approximations  income for analysis
# Low = 1,000, Lower Middle = 3,000, Upper Middle = 8,000, High = 13,000
income_value_mapping = {
    "1,046-4,125": 3000,
    "1,026-4,035": 3000,
    "1,006-3,955": 3000,
    "996-3,895": 3000,
    "1,026-3,995": 3000,
    "1,036 - 4,045": 3000,
    "1,046 - 4,095": 3000,
    "1,086 - 4,255": 3000,
    "1,136 - 4,465": 3000,
    "4,046-12,735": 8000,
    "4,036-12,475": 8000,
    "3,956-12,235": 8000,
    "3,896-12,055": 8000,
    "3,996-12,375": 8000,
    "4,046 - 12,535": 8000,
    "4,096 - 12,695": 8000,
    "4,256 - 13,205": 8000,
    "4,466 - 13,845": 8000,
    "> 12,735": 13000,
    "> 12,475": 13000,
    "> 12,235": 13000,
    "> 12,055": 13000,
    "> 12,375": 13000,
    "> 13,205": 13000,
    "> 13,845": 13000,
    "1,000-4,125": 3000,
    "1,026 - 4,095": 3000,
    "4,256-13,205": 8000
}


numeric_energy_income = energy_income.replace(income_value_mapping)
numeric_energy_income.head()"""
```

```
'#Visual of country income per grouped income \n#Converting the income into approximations  income for analysis \n# Low = 1,000, Lower Middle = 3,000, Upper Middle = 8,000, High = 13,000\nincome_value_mapping = {\n    "1,046-4,125": 3000,\n    "1,026-4,035": 3000,\n    "1,006-3,955": 3000,\n    "996-3,895": 3000,\n    "1,026-3,995": 3000,\n    "1,036 - 4,045": 3000,\n    "1,046 - 4,095": 3000,\n    "1,086 - 4,255": 3000,\n    "1,136 - 4,465": 3000,\n    "4,046-12,735": 8000,\n    "4,036-12,475": 8000,\n    "3,956-12,235": 8000,\n    "3,896-12,055": 8000,\n    "3,996-12,375": 8000,\n    "4,046 - 12,535": 8000,\n    "4,096 - 12,695": 8000,\n    "4,256 - 13,205": 8000,\n    "4,466 - 13,845": 8000,\n    "> 12,735": 13000,\n    "> 12,475": 13000,\n    "> 12,235": 13000,\n    "> 12,055": 13000,\n    "> 12,375": 13000,\n    "> 13,205": 13000,\n    "> 13,845": 13000,\n    "1,000-4,125": 3000,\n    "1,026 - 4,095": 3000,\n    "4,256-13,205": 8000\n}\n\n\nnumeric_energy_income = energy_income.replace(income_value_mapping)\nnumeric_energy_income.head()'
```

```
"""#Creating an avg income using the income columns alone
#income_columns = [col for col in numeric_energy_income.columns if col.startswith("income_")]
#average_income_trend = numeric_energy_income[income_columns].mean()

#average_income_trend #Why are the constant?

#2nd attempt at avgs. Cols (2- 9)

income_columns2 = numeric_energy_income.columns[1:9]
average_income_trend2 = numeric_energy_income[income_columns2].mean()

# Display the updated results
#average_income_trend
average_income_trend2 #Same ocnstant value.
""" #Gave me inconsintencies and showed no difference in monthly income in different years.
```

```
'#Creating an avg income using the income columns alone \n#income_columns = [col for col in numeric_energy_income.columns if col.startswith("income_")]\n#average_income_trend = numeric_energy_income[income_columns].mean()\n\n#average_income_trend #Why are the constant? \n\n#2nd attempt at avgs. Cols (2- 9)\n\nincome_columns2 = numeric_energy_income.columns[1:9] \naverage_income_trend2 =
numeric_energy_income[income_columns2].mean()\n\n#    Display    the    updated
results\n#average_income_trend\naverage_income_trend2 #Same ocnstant value. \n'
```

Switching to Consider GDP Prices Instead of Montly Income

```
yearly_consumption_price               =              pd.read_csv('Cleaned_Data/
yearly_consumption_price.csv')
yearly_gdp = pd.read_csv('Raw_Data/Income_Price/WITS_Country_Timeseries.csv')


yearly_gdp.head()

#Combining GDP with the yearly consumption of  energy

energy_consumtion_gdp    =    pd.merge(yearly_gdp,    yearly_consumption_price,
on='Country Name', how='inner')

print(energy_consumtion_gdp.shape)
energy_consumtion_gdp.head()
```

```
(39, 20)
```

	Country Name	Indicator Name	2014	2015	2016	2017	2018	2019	2020	2021	2022	Continental region	consumption_2015	consumption_2016	consumption_2017	consumption_2018	consumption_2019	consumption_2020	consumption_2021	consumption_2022	consumption_2023
0	Algeria	GDP (current US$)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	NORTHERN AFRICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Argentina	GDP (current US$)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	SOUTH AMERICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Australia	GDP (current US$)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	OCEANIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Azerbaijan	GDP (current US$)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	C.W. OF IND. STATES (FORMER USSR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Belgium	GDP (current US$)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	WESTERN EUROPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```python
#Cleaning the combined data

#Dropping the 2nd col and move continental region as second col

energy_consumtion_gdp = energy_consumtion_gdp.drop(columns=['Indicator Name'])

cols = list(energy_consumtion_gdp.columns)
cols.remove('Continental region')
cols.insert(1, 'Continental region')
energy_consumtion_gdp = energy_consumtion_gdp[cols]

energy_consumtion_gdp.head()
```

	Country Name	Continental region	2014	2015	2016	2017	2018	2019	2020	2021	2022	consumption_price_2014	consumption_price_[illegible]	consumption_price_[illegible]	consumption_price_[illegible]	consumption_price_[illegible]	consumption_price_[illegible]	consumption_price_2022	consumption_price_2023
0	Algeria	NORTHERN AFRICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Argentina	SOUTH AMERICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Australia	OCEANIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Azerbaijan	C.W. OF IND. STATES (FORMER USSR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Belgium	WESTERN EUROPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```python
#creating a new % of gdp -> electriciy

#Dropping the 2020 & 2021 cols of gdp to keep consistent  since the yearly
consuption price also did not have them.

energy_consumtion_gdp = energy_consumtion_gdp.drop(columns=['2020'])
energy_consumtion_gdp = energy_consumtion_gdp.drop(columns=['2021'])

energy_consumtion_gdp.head()
```

	Country Name	Continental region	2014	2015	2016	2017	2018	2019	2022	consumption_price_2014	consumption_price_2015	consumption_price_2016	consumption_price_2017	consumption_price_2018	consumption_price_2019	consumption_price_2022	consumption_price_2023
0	Algeria	NORTHERN AFRICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Argentina	SOUTH AMERICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Australia	OCEANIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Azerbaijan	C.W. OF IND. STATES (FORMER USSR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Belgium	WESTERN EUROPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```
#Dropping the 2023

energy_consumtion_gdp                                        =
energy_consumtion_gdp.drop(columns=['consumption_price_2023'])


energy_consumtion_gdp.head()
```

	Country Name	Continental region	2014	2015	2016	2017	2018	2019	2022	consumption_price_2014	consumption_price_2015	consumption_price_2016	consumption_price_2017	consumption_price_2018	consumption_price_2019	consumption_price_2022
0	Algeria	NORTHERN AFRICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Argentina	SOUTH AMERICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Australia	OCEANIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Azerbaijan	C.I.S. (FORMER USSR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Belgium	WESTERN EUROPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

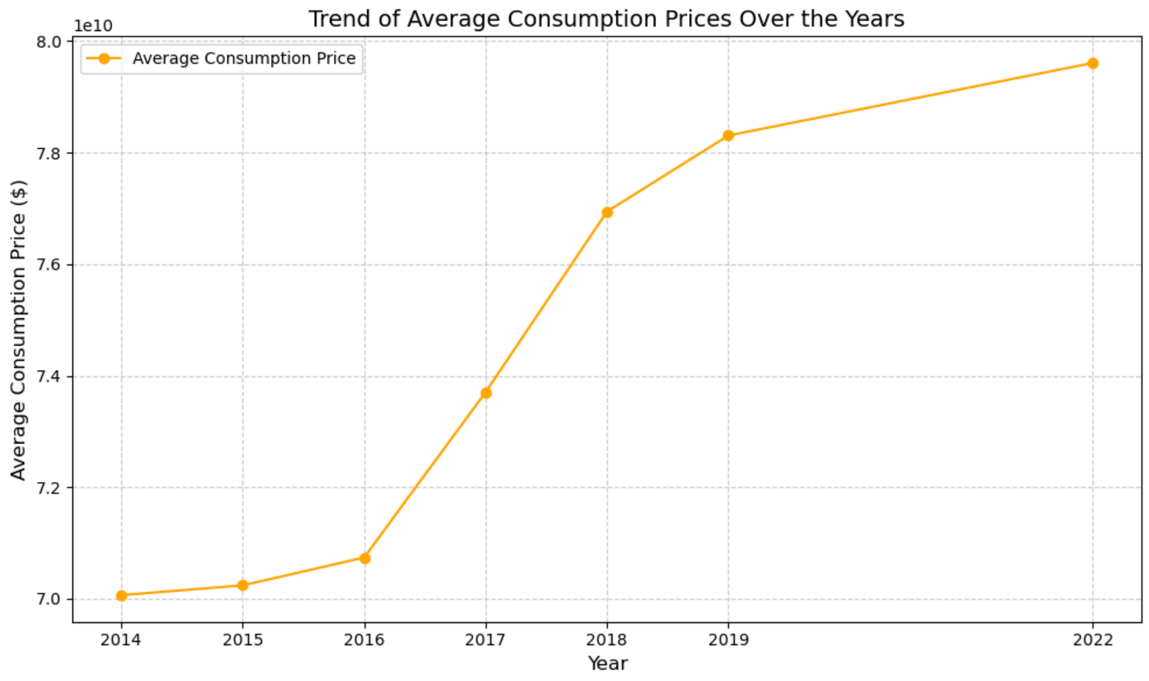
```python
#Renaming the 2014 - 2022 to add GDP to it


gdp_columns = [col for col in ["2014", "2015", "2016", "2017", "2018", "2019",
"2022"] if col in energy_consumtion_gdp.columns]
energy_consumtion_gdp.rename(columns={col: f"gdp_{col}" for col in gdp_columns},
inplace=True)


path = 'Cleaned_Data/energy_consumtion_gdp.csv'
energy_consumtion_gdp.to_csv(path, index=False)
```

Creating a energy poverty index per % of how much the enrgy price is compared to the GDP.

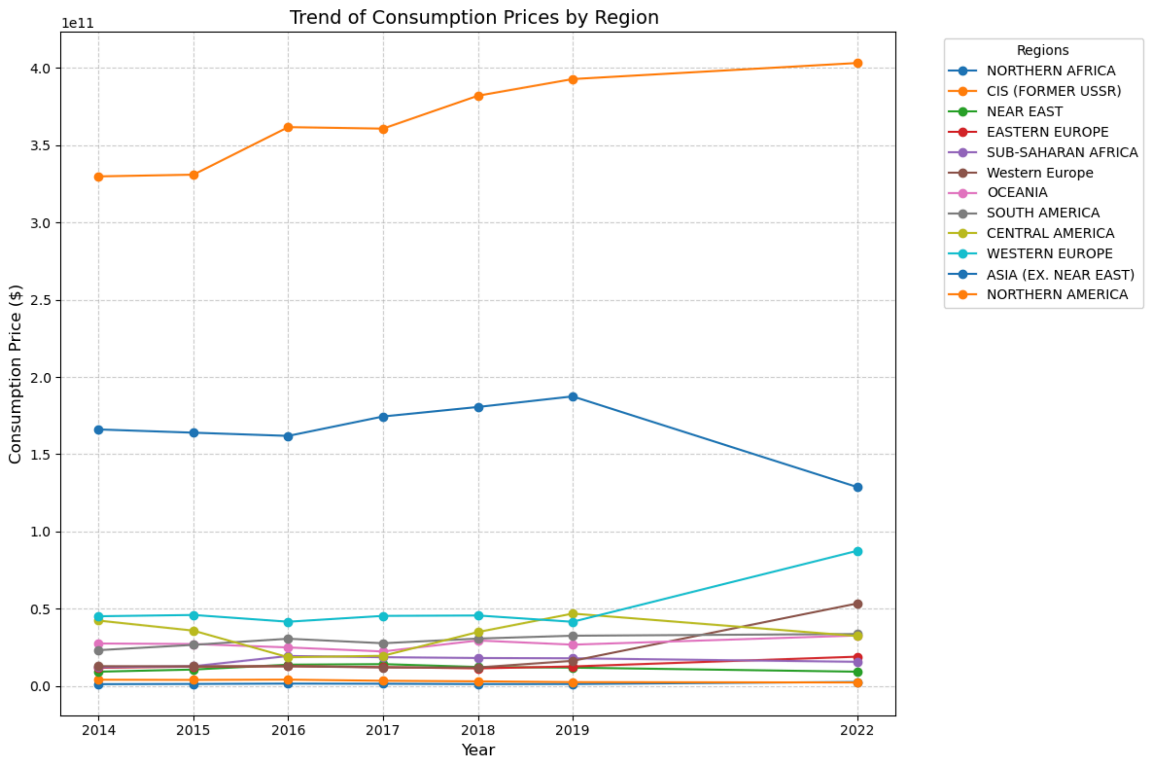
```python
energy_consumtion_gdp = pd.read_csv('Cleaned_Data/energy_consumtion_gdp.csv')
energy_consumtion_gdp.head()
```

	Country Name	Continental region	gdp_2014	gdp_2015	gdp_2016	gdp_2017	gdp_2018	gdp_2019	gdp_2022	consumption_price_2014	consumption_price_2015	consumption_price_2016	consumption_price_2017	consumption_price_2018	consumption_price_2019	consumption_price_2022
0	Algeria	NORTHERN AFRICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Argentina	SOUTH AMERICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Australia	OCEANIA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Azerbaijan	C.W. OF IND. STATES (FORMER USSR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Belgium	WESTERN EUROPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```python
#Rechecking the trend of consumption price

years = [2014, 2015, 2016, 2017, 2018, 2019, 2022]
consumption_columns = [f"consumption_price_{year}" for year in years]

avg_consumption_prices= energy_consumtion_gdp[consumption_columns].mean()

plt.figure(figsize=(10, 6))
plt.plot(years, avg_consumption_prices, marker='o', label="Average Consumption
Price", color = 'orange')
plt.title("Trend of Average Consumption Prices Over the Years", fontsize=14)
plt.xlabel("Year", fontsize=12)
plt.ylabel("Average Consumption Price ($)", fontsize=12)
plt.xticks(years)
plt.grid(True, linestyle='--', alpha=0.6)
plt.legend()
plt.tight_layout()
plt.show()
```



```
# Trend per Regions.

regions = energy_consumtion_gdp['Continental region'].unique()
region_trends = {}

for region in regions:
    region_data = energy_consumtion_gdp[energy_consumtion_gdp['Continental
region'] == region]
    region_trends[region] = region_data[consumption_columns].mean().values

# Sorting the regions by total avg consumption price across  years
sorted_regions    =    sorted(region_trends.keys(),    key=lambda    x:
sum(region_trends[x]))

sorted_region_trends  =  {region:  region_trends[region]  for  region  in
sorted_regions}

plt.figure(figsize=(12, 8))
for region, prices in sorted_region_trends.items():
    plt.plot(years, prices, marker='o', label=region)

plt.title("Trend of Consumption Prices by Region ", fontsize=14)
plt.xlabel("Year", fontsize=12)
plt.ylabel("Consumption Price ($)", fontsize=12)
plt.xticks(years)
plt.grid(True, linestyle='--', alpha=0.6)
plt.legend(title="Regions", bbox_to_anchor=(1.05, 1), loc='upper left')
plt.tight_layout()
plt.show()
```

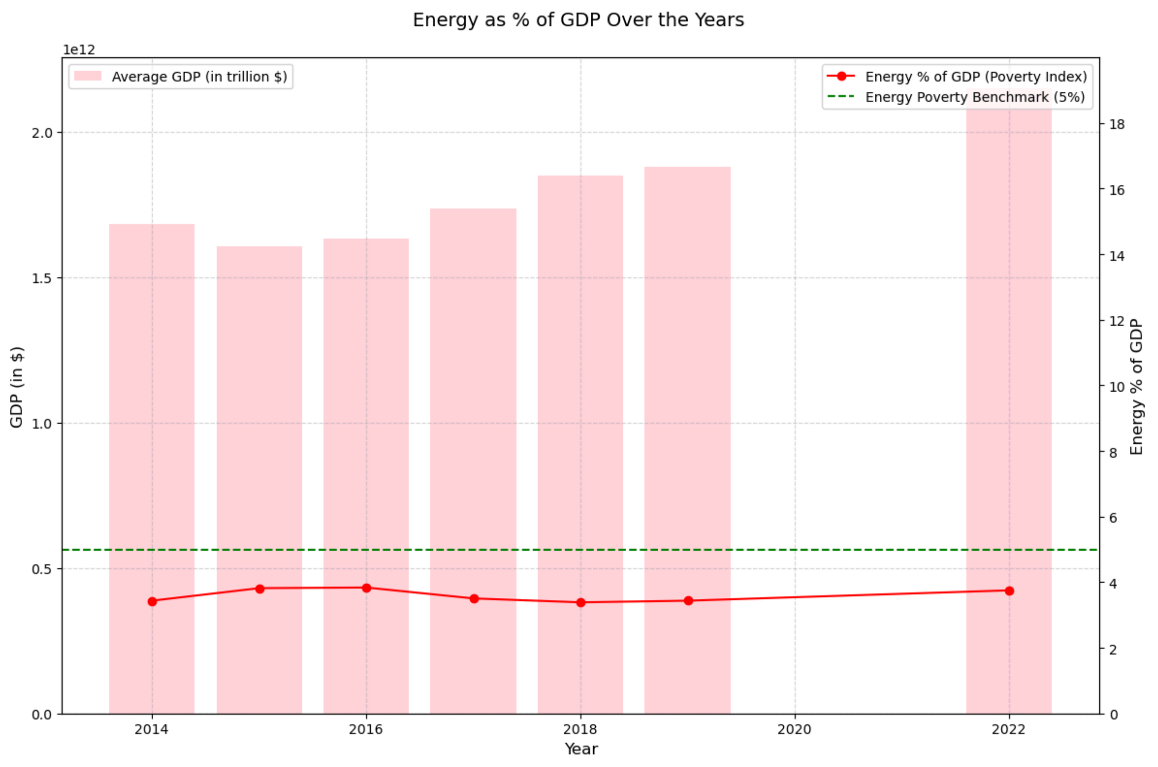


```
# Creating the index which is a % of GDP that goes towards energy

#  new columns for the poverty index for each year
for year in years:
    gdp_column = f"gdp_{year}"
    consumption_column = f"consumption_price_{year}"
    poverty_index_column = f"poverty_index_{year}"

    #  the poverty index as the percentage of GDP spent on energy
                            energy_consumtion_gdp[poverty_index_column]       =
(energy_consumtion_gdp[consumption_column] / energy_consumtion_gdp[gdp_column])
* 100
```

	Country Name	Continental region	gdp_2014	gdp_2015	gdp_2016	gdp_2017	gdp_2018	gdp_2019	gdp_2022	consumption_price_2014	...	consumption_price_2018	consumption_price_2019	consumption_price_2022	poverty_index_2014	poverty_index_2015	poverty_index_2016	poverty_index_2017	poverty_index_2018	poverty_index_2019	poverty_index_2022
34	United Arab Emirates	NEAR EAST	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
35	United Kingdom	WESTERN EUROPE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
36	United States	NORTHERN AMERICA	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
37	Uzbekistan	C.W. OF IND. STATES (FORMER USSR)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
38	Vietnam	ASIA (EX. NEAR EAST)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```python
#saving this data.

path = 'Cleaned_Data/gdp_energy_price_poverty_index.csv'

energy_consumtion_gdp.to_csv(path, index=False)

gdp_energy_price_poverty_index = pd.read_csv(path)
```

```python
#Visual of gdp & the % that goes towards energy per Year.



avg_gdp = gdp_energy_price_poverty_index[[f"gdp_{year}" for year in
years]].mean()
avg_poverty_index = gdp_energy_price_poverty_index[[f"poverty_index_{year}" for
year in years]].mean()
avg_consumption  =  gdp_energy_price_poverty_index[[f"consumption_price_{year}"
for year in years]].mean()



# benchmark line at 5% visualization
fig, ax1 = plt.subplots(figsize=(12, 8))

#  Y-axis for GDP
ax1.bar(years,  avg_gdp,  alpha=0.7,  label="Average  GDP  (in  trillion  $)",
color='pink')
ax1.set_ylabel("GDP (in $)", fontsize=12)
ax1.set_xlabel("Year", fontsize=12)
ax1.legend(loc="upper left")
ax1.grid(alpha=0.5, linestyle='--')

#  Y-axis for poverty index
ax2 = ax1.twinx()
ax2.plot(years, avg_poverty_index, marker='o', color='red', label="Energy % of
GDP (Poverty Index)")
ax2.axhline(y=5,  color='green',  linestyle='--',  linewidth=1.5,  label="Energy
Poverty Benchmark (5%)")  # benchmark line of 5%
ax2.set_ylabel("Energy % of GDP", fontsize=12, color='black')
ax2.tick_params(axis='y', labelcolor='black')
ax2.set_ylim(1, 20)
ax2.set_yticks(range(0, 20, 2))  #increment of 2%
ax2.legend(loc="upper right")

fig.suptitle("Energy as % of GDP Over the Years", fontsize=14)
fig.tight_layout()
plt.show()
```

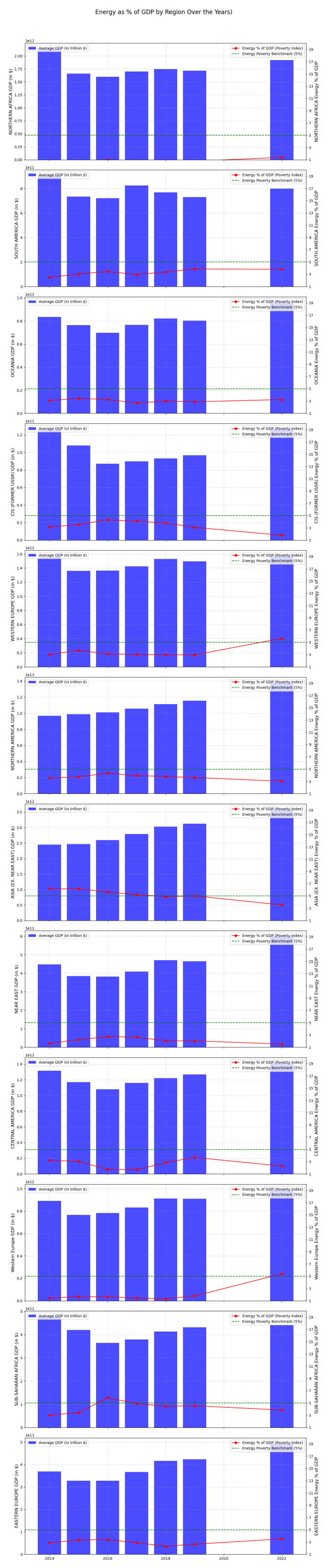


Energy Poverty Index: This represents the percentage of GDP that goes toward energy consumption for every country.

5%Threshold: There is 10% rule that suggests households should spend no more than 10% of their income on energy, exceeding this threshold could hinder their ability to afford other necessities, placing them in energy poverty (Lu, 2023). Applying this principle to GDP, a 5% threshold was established as the benchmark for energy poverty. This is based on household income typically representing 50-70% of GDP, with 10% of that being 5-7%. The lower end (5%) was chosen to account for developing countries. In this dataset, countries / regions spending more than 5% of their GDP on energy are classified as energy poverty regions.

```
#Visual of Energy Poverty per Region to see the ones that did surpass the
threshold.
#  the regional averages for GDP and poverty index per year
regions = gdp_energy_price_poverty_index['Continental region'].unique()

regional_gdp = {}
regional_poverty_index = {}

for region in regions:
                                                      region_data          =
gdp_energy_price_poverty_index[gdp_energy_price_poverty_index['Continental
region'] == region]
```

```
    regional_gdp[region] = region_data[[f"gdp_{year}" for year in years]].mean()
     regional_poverty_index[region]  =  region_data[[f"poverty_index_{year}"  for
year in years]].mean()

#  regional data
fig,  ax  =  plt.subplots(len(regions),  1,  figsize=(12,  len(regions)  *  5),
sharex=True)

for i, region in enumerate(regions):
    # subplots for each region
    ax1 = ax[i]
   ax1.bar(years, regional_gdp[region], alpha=0.7, color='blue', label="Average
GDP (in trillion $)")
    ax1.set_ylabel(f"{region} GDP (in $)", fontsize=12)
    ax1.legend(loc="upper left")
    ax1.grid(alpha=0.5, linestyle='--')

    # re-stating the  for poverty index as before
    ax2 = ax1.twinx()
     ax2.plot(years,  regional_poverty_index[region],  marker='o',  color='red',
label="Energy % of GDP (Poverty Index)")
   ax2.axhline(y=5, color='green', linestyle='--', linewidth=1.5, label="Energy
Poverty Benchmark (5%)")
    ax2.set_ylabel(f"{region} Energy % of GDP", fontsize=12, color='black')
    ax2.tick_params(axis='y', labelcolor='black')
    ax2.set_ylim(2, 20)
    ax2.set_yticks(range(1, 21, 2))
    ax2.legend(loc="upper right")

fig.suptitle("Energy as % of GDP by Region Over the Years)", fontsize=16)
fig.tight_layout(rect=[0, 0, 1, 0.97])
plt.show()
```


Energy as % of GDP by Region Over the Years)
Average GDP (in trillion $)
Energy % of GDP (Poverty Index)
Energy Poverty Benchmark (5%)
NORTHERN AFRICA GDP (in $)
NORTHERN AFRICA Energy % of GDP
SOUTH AMERICA GDP (in $)
SOUTH AMERICA Energy % of GDP
OCEANIA GDP (in $)
OCEANIA Energy % of GDP
CIS (FORMER USSR) GDP (in $)
CIS (FORMER USSR) Energy % of GDP
WESTERN EUROPE GDP (in $)
WESTERN EUROPE Energy % of GDP
NORTHERN AMERICA GDP (in $)
NORTHERN AMERICA Energy % of GDP
ASIA (EX. NEAR EAST) GDP (in $)
ASIA (EX. NEAR EAST) Energy % of GDP
NEAR EAST GDP (in $)
NEAR EAST Energy % of GDP
CENTRAL AMERICA GDP (in $)
CENTRAL AMERICA Energy % of GDP
Western Europe GDP (in $)
Western Europe Energy % of GDP
SUB-SAHARAN AFRICA GDP (in $)
SUB-SAHARAN AFRICA Energy % of GDP
EASTERN EUROPE GDP (in $)
EASTERN EUROPE Energy % of GDP
2014
2016
2018
2020
2022

Cleaning Weather Data and Seeing if there Correlation Between the energy poverty and weather anomalies.

```
#Past Weather data and finding correlation among energy prices.

past_weather_data = [
    ('Raw_Data/Weather_Data/Africa.csv', 'Africa'),
    ('Raw_Data/Weather_Data/Asia.csv', 'Asia'),
    ('Raw_Data/Weather_Data/Atlantic_MDR.csv', 'Atlantic MDR'),
    ('Raw_Data/Weather_Data/Carribean.csv', 'Caribbean'),
    ('Raw_Data/Weather_Data/East_Pacifc.csv', 'East Pacific'),
    ('Raw_Data/Weather_Data/Europe.csv', 'Europe'),
    ('Raw_Data/Weather_Data/North_America.csv', 'North America'),
    ('Raw_Data/Weather_Data/Northern_Hemisphere.csv', 'Northern Hemisphere'),
    ('Raw_Data/Weather_Data/Oceania.csv', 'Oceania'),
    ('Raw_Data/Weather_Data/South_America.csv', 'South America')
]

# Cleaning all the files  the data and change the cols
def clean_data(file_path, region, start_row=4):
    try:

        df = pd.read_csv(file_path, skiprows=start_row, header=None)
        # renaming the cols based on year and anomaly
        df.columns = ["Year", "Anomaly"]
        # adding the continental Region column so we can join wih energy prices
later.
        df["Continental Region"] = region
        return df
    except Exception as e:
        print(f"Error processing file {file_path}: {e}")
        return None
```

```

# processing all files using the function
cleaned_files = []
for file_path, region in past_weather_data:
    cleaned_df = clean_data(file_path, region)
    if cleaned_df is not None:
        cleaned_files.append(cleaned_df)

# combining all files in a df
combined_weather_data = pd.concat(cleaned_files, ignore_index=True)

# restructuring the and dropping anomaly col so that every year is a col like
the energy price dataset.
cleaned_weather_data_past = combined_weather_data.pivot(
    index="Continental Region", columns="Year", values="Anomaly"
).reset_index()
cleaned_weather_data_past
```

Year	Continental Region	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Year
0	Africa	0.55	0.56	0.67	0.72	0.65	0.66	0.72	0.63	0.57	0.59	Anomaly
1	Asia	0.55	0.56	0.67	0.72	0.65	0.66	0.72	0.63	0.57	0.59	Anomaly
2	Atlantic MDR	0.52	0.50	0.83	0.83	0.61	0.40	0.79	0.74	0.68	0.81	Anomaly
3	Caribbean	0.62	0.65	0.92	0.91	0.77	0.55	0.93	0.83	0.74	0.70	Anomaly
4	East Pacific	0.61	1.19	1.42	0.84	0.85	0.82	0.76	0.59	0.56	0.40	Anomaly
5	Europe	1.10	1.75	1.55	1.40	1.54	1.68	1.96	1.94	1.29	1.98	Anomaly
6	North America	0.50	1.03	1.89	1.68	1.19	0.86	1.15	1.41	1.18	1.42	Anomaly
7	Northern Hemisphere	0.82	0.97	1.22	1.32	1.19	1.09	1.28	1.34	1.17	1.20	Anomaly
8	Oceania	1.10	0.91	1.32	0.78	1.12	1.06	1.03	0.83	1.00	0.53	Anomaly
9	South America	0.78	1.22	1.44	1.18	1.11	1.16	1.29	1.13	1.01	1.19	Anomaly

```
#Further clean dropping first and last col of year anomaly data and save
```

```
cleaned_weather_data_past = cleaned_weather_data_past.iloc[:, -13:-1]
#Dropping the 2020, 2021 amd 2023
col = ["2020", "2021", "2023"]
cleaned_weather_data_past  =  cleaned_weather_data_past.drop(columns=col,
errors='ignore')


path = 'Cleaned_Data/cleaned_weather_data_past.csv'
cleaned_weather_data_past.to_csv(path, index=False)
```

```
cleaned_weather_data_past.head()

#Dropping the 2020, 2021 amd 2023
```

Year	Continental Region	2014	2015	2016	2017	2018	2019	2022
0	Africa	0.55	0.56	0.67	0.72	0.65	0.66	0.57
1	Asia	0.55	0.56	0.67	0.72	0.65	0.66	0.57
2	Atlantic MDR	0.52	0.50	0.83	0.83	0.61	0.40	0.68
3	Caribbean	0.62	0.65	0.92	0.91	0.77	0.55	0.74
4	East Pacific	0.61	1.19	1.42	0.84	0.85	0.82	0.56

Combining the past weather anomalies and energy poverty index & renaming according to the regions in past weather regions.

```
#adding weather to weather cols
cleaned_weather_data_past.rename(columns=lambda   col:   f"weather_{col}"   if
col.isdigit() else col, inplace=True)

cleaned_weather_data_past.head()
# Renaming regional cols of poverty index so they match that of per past weather
region. This will also be done for the future weather prdictions. #10 regions.
cleaned_weather_data_past.shape

gdp_energy_price_poverty_index.shape #39 countries should stay the same after
merge. -> 2 countries were dropped.
```

```
(39, 23)
```

```
# region mapping to align better with weather regions
refined_region_mapping = {
    'NORTHERN AFRICA': 'Africa',
    'SOUTH AMERICA': 'South America',
    'OCEANIA': 'Oceania',
    'CIS (FORMER USSR)': 'Asia',
    'WESTERN EUROPE': 'Europe',
    'NORTHERN AMERICA': 'North America',
    'ASIA (EX. NEAR EAST)': 'Asia',
    'NEAR EAST': 'Asia',
    'CENTRAL AMERICA': 'Central America',
    'SUB-SAHARAN AFRICA': 'Africa',
    'EASTERN EUROPE': 'Europe'
}

gdp_energy_price_poverty_index['Mapped       Region']
=         gdp_energy_price_poverty_index['Continental
region'].map(refined_region_mapping)

# merging both datasets.
energy_index_past_weather = pd.merge(
    cleaned_weather_data_past,
    gdp_energy_price_poverty_index,
    left_on='Continental Region',
    right_on='Mapped Region',
    how='inner'
)

print(energy_index_past_weather.head())
print(energy_index_past_weather.shape)
```

```
  Continental Region weather_2014 weather_2015 weather_2016 weather_2017  \
0             Africa         0.55         0.56         0.67         0.72
1             Africa         0.55         0.56         0.67         0.72
2             Africa         0.55         0.56         0.67         0.72
3               Asia         0.55         0.56         0.67         0.72
4               Asia         0.55         0.56         0.67         0.72

  weather_2018 weather_2019 weather_2022  Country Name    Continental region  \
0         0.65         0.66         0.57       Algeria       NORTHERN AFRICA
1         0.65         0.66         0.57       Nigeria    SUB-SAHARAN AFRICA
2         0.65         0.66         0.57  South Africa    SUB-SAHARAN AFRICA
3         0.65         0.66         0.57    Azerbaijan     CIS (FORMER USSR)
4         0.65         0.66         0.57         China  ASIA (EX. NEAR EAST)

   ...  consumption_price_2019  consumption_price_2022  poverty_index_2014  \
0  ...            1.329216e+09            2.665089e+09            0.587191
1  ...            3.261033e+09            8.078539e+08            0.677614
2  ...            3.270208e+10            3.059550e+10            5.390580
3  ...            1.039147e+09            1.089051e+09            2.011522
```

```
4  ...            9.611643e+11           6.124248e+11           6.872319

   poverty_index_2015  poverty_index_2016  poverty_index_2017  \
0            0.829379            0.995413            0.876373
1            1.314681            1.271323            1.169959
2            5.525253           10.441043            8.642432
3            2.945881            3.219049            2.983395
4            6.631112            6.775796            7.208289

   poverty_index_2018  poverty_index_2019  poverty_index_2022  Mapped Region
0            0.741677            0.773880            1.388697         Africa
1            0.864181            0.687232            0.169224         Africa
2            8.083663            8.416853            7.538250         Africa
3            2.384563            2.157060            1.383430           Asia
4            6.985615            6.730842            3.409330           Asia

[5 rows x 32 columns]
(37, 32)
```

```python
#Dropping the Index Regions
energy_index_past_weather.drop(columns=['Continental region'], inplace=True)
#Mapped Region
energy_index_past_weather.drop(columns=['Mapped Region'], inplace=True)

 #Moving Country up
columns_order = ['Continental Region', 'Country Name'] + [col for col in
energy_index_past_weather.columns if col not in ['Continental Region', 'Country
Name']]

#Saving the combined df
energy_index_past_weather = energy_index_past_weather[columns_order]

path = 'Cleaned_Data/energy_index_past_weather.csv'
energy_index_past_weather.to_csv(path, index=False)




energy_index_past_weather.head()
```

	Continental Region	Country Name	weather_2014	weather_2015	weather_2016	weather_2017	weather_2018	weather_2019	weather_2022	gdp_2014	...	consumption_price_2018	consumption_price_2019	consumption_price_2022	poverty_index_2014	poverty_index_2015	poverty_index_2016	poverty_index_2017	poverty_index_2018	poverty_index_2019	poverty_index_2022
0	Africa	Algeria	0.55	0.56	0.67	0.72	0.65	0.66	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	Africa	Nigeria	0.55	0.56	0.67	0.72	0.65	0.66	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	Africa	South Africa	0.55	0.56	0.67	0.72	0.65	0.66	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3	Asia	Azerbaijan	0.55	0.56	0.67	0.72	0.65	0.66	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
4	Asia	China	0.55	0.56	0.67	0.72	0.65	0.66	[illegible]	[illegible]	...	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

```python
# later Drop all cols except poverty_index and region and Year

#Tidy the combined data make years one col and gdp one col, weather_anomalie one
col, consumption_price one col and poverty index.
# Melt the dataset to make it tidy
tidy_data = pd.melt(
    energy_index_past_weather,
    id_vars=['Continental Region', 'Country Name'],
    value_vars=[
              'weather_2014',  'weather_2015',  'weather_2016',  'weather_2017',
'weather_2018', 'weather_2019', 'weather_2022',
        'gdp_2014', 'gdp_2015', 'gdp_2016', 'gdp_2017', 'gdp_2018', 'gdp_2019',
'gdp_2022',
                          'consumption_price_2014',    'consumption_price_2015',
'consumption_price_2016',
                          'consumption_price_2017',    'consumption_price_2018',
'consumption_price_2019', 'consumption_price_2022',
             'poverty_index_2014',  'poverty_index_2015',  'poverty_index_2016',
'poverty_index_2017',
        'poverty_index_2018', 'poverty_index_2019', 'poverty_index_2022'
    ],
    var_name='Metric',
    value_name='Value'
)
```

```
tidy_data['Year'] = tidy_data['Metric'].str.extract(r'(\d{4})').astype(int)
tidy_data['Metric'] = tidy_data['Metric'].str.extract(r'([a-zA-Z_]+)')

# Pivoting it to  have one column per metric
tidy_energy_index_past_weather = tidy_data.pivot_table(
    index=['Continental Region', 'Country Name', 'Year'],
    columns='Metric',
    values='Value',
    aggfunc='first'
).reset_index()

# Renaming cols
tidy_energy_index_past_weather.columns = ['Continental Region', 'Country Name',
'Year', 'Consumption Price', 'GDP', 'Poverty Index', 'Weather Anomaly']

#tidy_energy_index_past_weather.head() checked out

#Save it
path = 'Cleaned_Data/tidy_energy_index_past_weather.csv'
tidy_energy_index_past_weather.to_csv(path, index=False)
tidy_energy_index_past_weather.shape

#Drop all cols except poverty_index and region and Year  to have index and
weather data only to move forward.


tidy_index_past_weather = tidy_energy_index_past_weather[['Continental Region',
'Year', 'Poverty Index', 'Weather Anomaly']]



#Save it this is the one to continue with in Analysis and model training and
predicting.

path = 'Cleaned_Data/tidy_index_past_weather.csv'
tidy_index_past_weather.to_csv(path, index=False)


tidy_index_past_weather.shape#checksout

tidy_index_past_weather.head()#checksout
```

```
(259, 4)
```

Cleaning future weather anomalies to make sure its the same region as the past data

```
weather_temp    =    pd.read_csv('Raw_Data/Weather_Data/Weather_Extremes.csv',
skiprows=1 )
weather_temp.head()

# Drop the last column this was empty
weather_temp.drop(weather_temp.columns[-1], axis=1, inplace=True)

#Droping irrelevant cols to fit the past weather dataset (scenarion, mask, region
label, season, everything but Year and Median (this is going to be th temo
anamoly in C), Region, Year  )
weather_temp.head()

col_keep = [' Region', ' Year', ' median'] #They all had spaces why it gave me
an error ->come back and rename.

# Filter the DataFrame to keep only the specified columns
weather_temp = weather_temp[col_keep]

#weather_temp.shape (999 rows of regions before drop) -> Now its =

weather_temp.head()

#weather_temp.columns
```

	Region	Year	median
0	Africa: Sahara	2035	0.9
1	Africa: Sahara	2065	1.2
2	Africa: Sahara	2100	1.1
3	Africa: Sahara	2035	0.9
4	Africa: Sahara	2065	1.3

```
weather_temp.columns
```

```
Index([' Region', ' Year', ' median'], dtype='object')
```

```
#Change the region names into the same ones as the old past weather and convert
year rows into cols for the different regions.  And drop the sea temperatures
becaue the past weather data had land

# Mapping for regions to exhast them all
region_mapping = {
    'Africa: Sahara': 'Africa',
    'West Africa': 'Africa',
    'East Africa': 'Africa',
    'Southern Africa': 'Africa',
    'West Asia': 'Asia',
    'Central Asia': 'Asia',
    'Eastern Asia': 'Asia',
    'South Asia': 'Asia',
    'Southeast Asia (land)': 'Asia',
    'Tibetan Plateau': 'Asia',
    'North Asia': 'Asia',
    'North Indian Ocean': 'Atlantic MDR',
    'Caribbean (land and sea)': 'Caribbean',
    'Equatorial Pacific': 'East Pacific',
    'Southern Pacific': 'East Pacific',
    'Northern Tropical Pacific': 'East Pacific',
    'Central Europe': 'Europe',
    'Northern Europe': 'Europe',
    'Southern Europe/Mediterranean': 'Europe',
    'Central North America': 'North America',
    'Eastern North America': 'North America',
    'West North America': 'North America',
    'Alaska/NW Canada': 'North America',
    'Arctic (land)': 'Northern Hemisphere',
    'Arctic (sea)': 'Northern Hemisphere',
    'Australia/North Australia': 'Oceania',
    'South Australia/New Zealand': 'Oceania',
    'Central America': 'South America',
    'South America: Amazon': 'South America',
    'Northeast Brazil': 'South America',
    'West Coast South America': 'South America',
    'Southeastern South America': 'South America'
}

# dropping sea temp rows
weather_temp   =   weather_temp[~weather_temp['   Region'].str.contains('sea',
case=False, na=False)]

# switch teh region names & only keeping the re-named ones
weather_temp[' Region'] = weather_temp[' Region'].replace(region_mapping)
weather_temp                   =                   weather_temp[weather_temp['
Region'].isin(region_mapping.values())]

# renaming to make sure is the same as past data
weather_temp.rename(columns={' Region': 'Continental Region'}, inplace=True)
weather_temp.rename(columns={' median': 'Weather Anomaly'}, inplace=True)


cleaned_regions = weather_temp['Continental Region'].unique()
```

```
weather_temp.head(), cleaned_regions
```

```
(  Continental Region   Year  Weather Anomaly
 0             Africa   2035              0.9
 1             Africa   2065              1.2
 2             Africa   2100              1.1
 3             Africa   2035              0.9
 4             Africa   2065              1.3,
 array(['Africa', 'Northern Hemisphere', 'Asia', 'Oceania',
        'South America', 'Europe', 'North America', 'East Pacific',
        'Atlantic MDR'], dtype=object))
```

```
#weather_temp. shape

path = 'Cleaned_Data/tidy_future_weather.csv'
weather_temp.to_csv(path, index=False)
```

Initial Analysis: At first glance, the dataset reveals that while energy prices have decreased, energy consumption continues to rise, indicating a potential ongoing risk of energy poverty. However, the data shows that energy poverty doesn't steadily increase but instead fluctuates across different regions and years. The second source code will explore whether there is a connection between energy poverty and temperature trends adn then predict future energy poverty indexes.

```
```

```
(810, 3)
```