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C02_Emissions_Interactive_ | C02_Emissions_Interactive_ | C:\Windows\System32\Win

Code | Notebook | Python 3 (ipykernel)

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CO_2 Emissions Interactive Dashboard

by Austin Jr. Mnthambala

Setup of Jupyter Lab Notebook and Python Interactive Dashboard Enviroment

The command terminal was used to navigate and create the directory that holds this dashboard. Python 3 is loaded into the project and enviroment, then the enviroment is activated to install hvplot and jupyter lab into it. Then it is deactivated so we can install panel into the project directory.

[1]:
```
import pandas as pd
import numpy as np
import panel as pn
pn.extension('tabulator')

import hvplot.pandas
```

Loading the Dataset into the Jupyter Lab Enviroment

[25]:
```
df = pd.read_csv("D:\Data\Datasets\Vu\owid-co2-data.csv")
```

[26]:
```
df
```

[26]:

	country	year	iso_code	population	gdp	cement_co2	cement_co2_per_capita	co2	co2_growth_abs	co2_growth_prct
0	Afghanistan	1850	AFG	3752993.0	NaN	NaN	NaN	NaN	NaN	NaN
1	Afghanistan	1851	AFG	3767956.0	NaN	NaN	NaN	NaN	NaN	NaN
2	Afghanistan	1852	AFG	3783940.0	NaN	NaN	NaN	NaN	NaN	NaN
3	Afghanistan	1853	AFG	3800954.0	NaN	NaN	NaN	NaN	NaN	NaN
4	Afghanistan	1854	AFG	3818038.0	NaN	NaN	NaN	NaN	NaN	NaN
...	...	...	...	...	...	...	...	...	...	...
48053	Zimbabwe	2018	ZWE	15052191.0	2.271535e+10	0.558	0.037	10.715	1.419	15.265
48054	Zimbabwe	2019	ZWE	15354606.0	NaN	0.473	0.031	9.775	-0.939	-8.765
48055	Zimbabwe	2020	ZWE	15669663.0	NaN	0.496	0.032	7.850	-1.926	-19.700
48056	Zimbabwe	2021	ZWE	15993525.0	NaN	0.531	0.033	8.396	0.547	6.962
48057	Zimbabwe	2022	ZWE	16320539.0	NaN	0.531	0.033	8.856	0.460	5.477

48058 rows × 79 columns

[27]:
```
df.columns
```

[27]:
```
Index(['country', 'year', 'iso_code', 'population', 'gdp', 'cement_co2',
       'cement_co2_per_capita', 'co2', 'co2_growth_abs', 'co2_growth_prct',
       'co2_including_luc', 'co2_including_luc_growth_abs',
       'co2_including_luc_growth_prct', 'co2_including_luc_per_capita',
       'co2_including_luc_per_gdp', 'co2_including_luc_per_unit_energy',
       'co2_per_capita', 'co2_per_gdp', 'co2_per_unit_energy', 'coal_co2',
       'coal_co2_per_capita', 'consumption_co2', 'consumption_co2_per_capita',
       'consumption_co2_per_gdp', 'cumulative_cement_co2', 'cumulative_co2',
       'cumulative_co2_including_luc', 'cumulative_coal_co2',
       'cumulative_flaring_co2', 'cumulative_gas_co2', 'cumulative_luc_co2',
       'cumulative_oil_co2', 'cumulative_other_co2', 'energy_per_capita',
       'energy_per_gdp', 'flaring_co2', 'flaring_co2_per_capita', 'gas_co2',
       'gas_co2_per_capita', 'ghg_excluding_lucf_per_capita', 'ghg_per_capita',
       'land_use_change_co2', 'land_use_change_co2_per_capita', 'methane',
       'methane_per_capita', 'nitrous_oxide', 'nitrous_oxide_per_capita',
       'oil_co2', 'oil_co2_per_capita', 'other_co2_per_capita',
       'other_industry_co2', 'primary_energy_consumption',
       'share_global_cement_co2', 'share_global_co2',
       'share_global_co2_including_luc', 'share_global_coal_co2',
       'share_global_cumulative_cement_co2', 'share_global_cumulative_co2',
       'share_global_cumulative_co2_including_luc',
       'share_global_cumulative_coal_co2',
       'share_global_cumulative_flaring_co2',
       'share_global_cumulative_gas_co2', 'share_global_cumulative_luc_co2',
       'share_global_cumulative_oil_co2', 'share_global_cumulative_other_co2',
       'share_global_flaring_co2', 'share_global_gas_co2',
       'share_global_luc_co2', 'share_global_oil_co2',
       'share_global_other_co2', 'share_of_temperature_change_from_ghg',
       'temperature_change_from_ch4', 'temperature_change_from_co2',
       'temperature_change_from_ghg', 'temperature_change_from_n2o',
       'total_ghg', 'total_ghg_excluding_lucf', 'trade_co2',
       'trade_co2_share'],
      dtype='object')
```

[28]:
```
df[df['country']=='World']
```

[28]:

	country	year	iso_code	population	gdp	cement_co2	cement_co2_per_capita	co2	co2_growth_abs	co2_growth_prct
47266	World	1750	NaN	7.456641e+08	NaN	NaN	NaN	9.306	NaN	NaN
47267	World	1751	NaN	NaN	NaN	NaN	NaN	9.407	0.101	1.088
47268	World	1752	NaN	NaN	NaN	NaN	NaN	9.505	0.098	1.041
47269	World	1753	NaN	NaN	NaN	NaN	NaN	9.610	0.105	1.108
47270	World	1754	NaN	NaN	NaN	NaN	NaN	9.734	0.123	1.281
...	...	...	...	...	...	...	...	...	...	...
47534	World	2018	NaN	7.683790e+09	1.136302e+14	1565.803	0.204	36766.945	741.491	2.058
47535	World	2019	NaN	7.764951e+09	NaN	1615.776	0.208	37040.102	273.158	0.743
47536	World	2020	NaN	7.840953e+09	NaN	1633.047	0.208	35007.738	-2032.366	-5.487
47537	World	2021	NaN	7.909295e+09	NaN	1692.404	0.214	36816.543	1808.806	5.167
47538	World	2022	NaN	7.975105e+09	NaN	1605.474	0.201	37149.785	333.242	0.905

273 rows × 79 columns

Cleaning & Preprocessing Dataset

[29]:
```
# Replacing null records with 0 and create a calculated field (GDP per capita)
df = df.fillna(0)
df['gdp_per_capita'] = np.where(df['population']!= 0, df['gdp']/df['population'], 0)
```

[30]:
```
#Make Dataframe Interactive
idf = df.interactive()
```

Setting up Visualizations for the Dashboard

1st Viz Widgets

[31]:
```
# Creating Panel Slider
year_slider = pn.widgets.IntSlider(name='Year Slider', start=1750, end=2020, step=5,value=1850)
year_slider
```

[31]: Year Slider: 1850

[32]:
```
# Creating Panel Radio Buttons
yaxis_co2 = pn.widgets.RadioButtonGroup(
    name='Y axis',
    options=['co2', 'co2_per_capita',],
    button_type='success'
)
```

1st Viz: CO_2 Emissions by Continent

[33]:
```
continents = ['World', 'Asia', 'Oceania', 'Europe', 'Africa', 'North America', 'South America', 'Antarctica']

co2_pipelines = (
    idf[
        (idf.year <= year_slider) &
        (idf.country.isin(continents))
    ]
    .groupby(['country', 'year'])[yaxis_co2].mean()
    .to_frame()
    .reset_index()
    .sort_values(by='year')
    .reset_index(drop=True)
)
```

[34]:
```
co2_pipelines
```

[34]: Year Slider: 1850

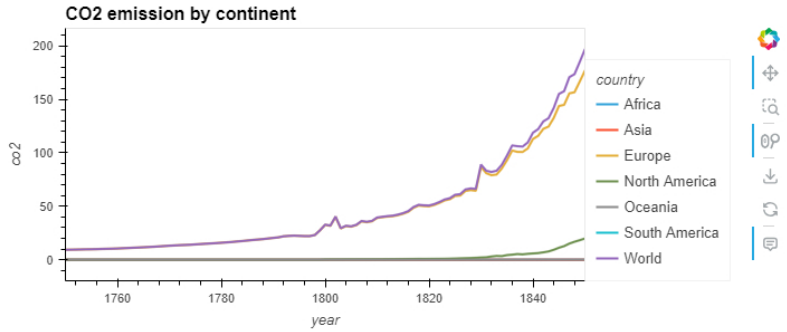
co2 | co2_per_capita

	country	year	co2
0	Africa	1750	0.000
1	World	1750	9.306
2	Oceania	1750	0.000
3	Europe	1750	9.306
4	Asia	1750	0.000
5	North America	1750	0.000

[35]:
```
co2_plot = co2_pipelines.hvplot(x='year', by='country', y=yaxis_co2, line_width=2, title="CO2 emission by continent")
co2_plot
```

[35]: Year Slider: 1850

co2 | co2_per_capita



2nd Viz: Table of CO2 emissions over time by continent

[36]:
```
co2_table = co2_pipelines.pipe(pn.widgets.Tabulator, pagination='remote', page_size=10, sizing_mode='stretch_width')
co2_table
```

[36]: Year Slider: **1850**

co2 | co2_per_capita

index	country	year	co2
0	Africa	1,750	0.0
1	World	1,750	9.306
2	Oceania	1,750	0.0
3	Europe	1,750	9.306
4	Asia	1,750	0.0
5	North America	1,750	0.0
6	Europe	1,751	9.407
7	Asia	1,751	0.0
8	Oceania	1,751	0.0
9	World	1,751	9.407

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3rd Viz: C02 vs GDP Scatterplot

[37]:
```
co2_vs_gdp_scatterplot_pipeline = (
    idf[
        (idf.year == year_slider) &
        (~ (idf.country.isin(continents)))
    ]
    .groupby(['country', 'year', 'gdp_per_capita'])['co2'].mean()
    .to_frame()
    .reset_index()
    .sort_values(by='year')
    .reset_index(drop=True)
)
```

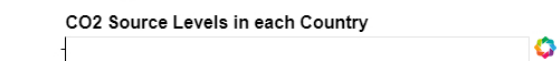
[38]:
```
co2_vs_gdp_scatterplot_pipeline
```

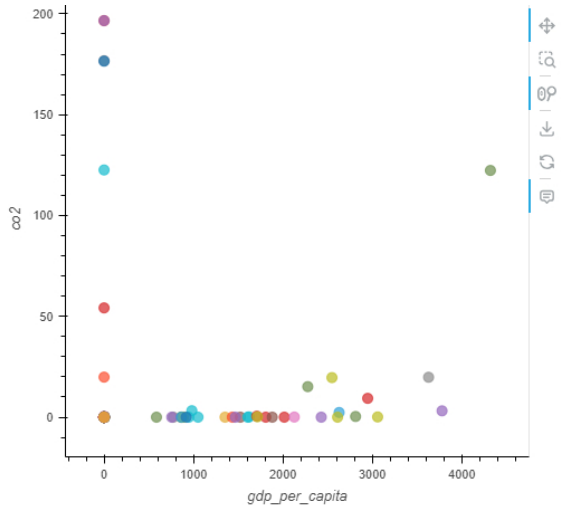
[38]: Year Slider: **1850**

	country	year	gdp_per_capita	co2
0	Afghanistan	1850	0.000000	0.000
1	New Zealand	1850	1807.790148	0.000
2	Nicaragua	1850	0.000000	0.000
3	Niger	1850	0.000000	0.000
4	Nigeria	1850	0.000000	0.000
5	Niue	1850	0.000000	0.000
6	Non-OECD (GCP)	1850	0.000000	0.111
7	North America (GCP)	1850	0.000000	19.852

[39]:
```
co2_vs_gdp_scatterplot = co2_vs_gdp_scatterplot_pipeline.hvplot(x='gdp_per_capita', y='co2', by='country', size=80, kind="scatter'
                                                                alpha=0.7, legend=False, height=500, width=500)
co2_vs_gdp_scatterplot
```

[39]: Year Slider: **1850**





4th Viz Widget

[40]:
```
yaxis_co2_source = pn.widgets.RadioButtonGroup(
    name='Y axis',
    options=['coal_co2', 'oil_co2', 'gas_co2'],
    button_type='success'
)

continents_excl_world = ['Asia', 'Oceania', 'Europe', 'Africa', 'North America', 'South America', 'Antarctica']
```

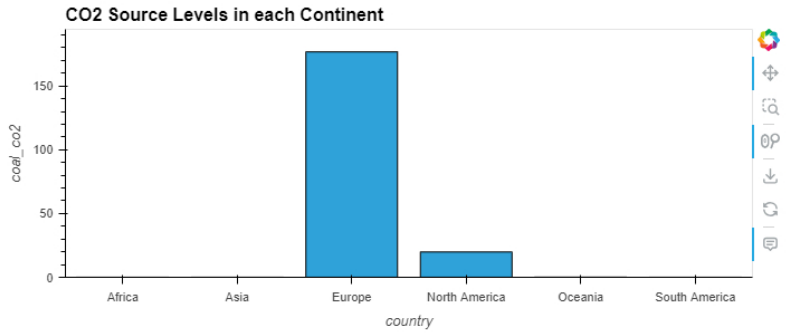
[41]:
```
co2_source_bar_pipeline = (
    idf[
        (idf.year == year_slider) &
        (idf.country.isin(continents_excl_world))
    ]
    .groupby(['year', 'country'])[yaxis_co2_source].sum()
    .to_frame()
    .reset_index()
    .sort_values(by='year')
    .reset_index(drop=True)
)
```

4th Viz: CO_2 Source Levels in each continent

[42]:
```
co2_source_bar_plot = co2_source_bar_pipeline.hvplot(kind='bar', x='country', y=yaxis_co2_source, title='CO2 Source Levels in eac
co2_source_bar_plot
```

[42]:
Year Slider: 1850

coal_co2 | oil_co2 | gas_co2



Building Dashboard from Vizzes

[43]:
```
template = pn.template.FastListTemplate(
    title='World CO2 Emissions Dashboard',
    sidebar=[
        pn.pane.Markdown("# CO2 Emissions and Climate Change"),
        pn.pane.Markdown("#### Carbon dioxide emissions are the primary driver of global climate change. It's widely recongised th
        pn.pane.JPG('orb.jpeg', sizing_mode='scale_both'),
        pn.pane.Markdown("## Settings"),
        year_slider
    ],
    main=[
        pn.Row(
            pn.Column(yaxis_co2, co2_plot.panel(width=700), margin=(0, 25)),
            co2_table.panel(width=500)
        ),
        pn.Row(
```

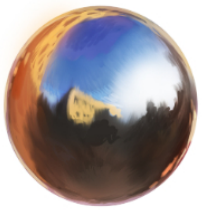
```
            pn.Column(co2_vs_gdp_scatterplot.panel(width=600), margin=(0, 25)),
            pn.Column(yaxis_co2_source, co2_source_bar_plot.panel(width=600))
        )
    ],
    accent_base_color="#88d8b0",
    header_background="#88d8b0",
)

# Display template
template.servable()
```

[43]:

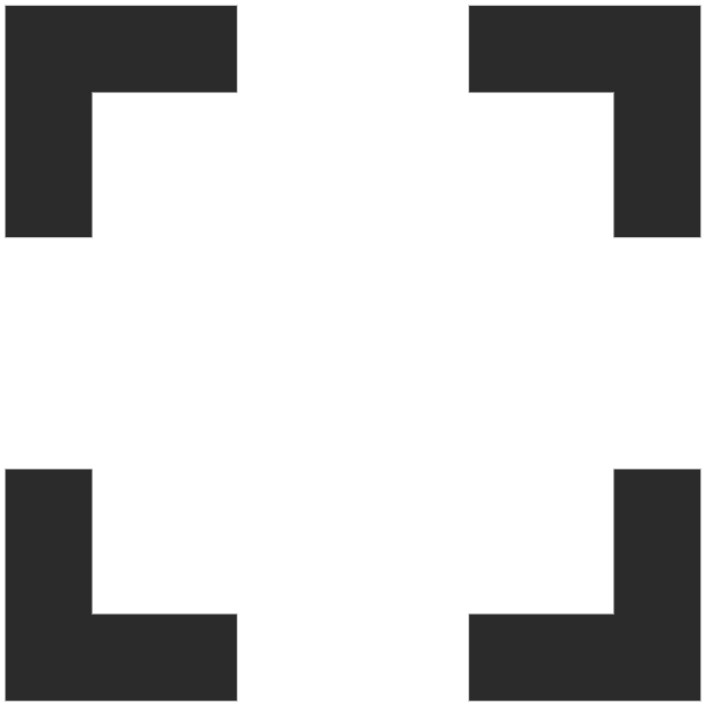
CO2 Emissions and Climate Change

Carbon dioxide emissions are the primary driver of global climate change. It's widely recongised that to avoid global warming, we must find ways to reduce our carbon footprint.



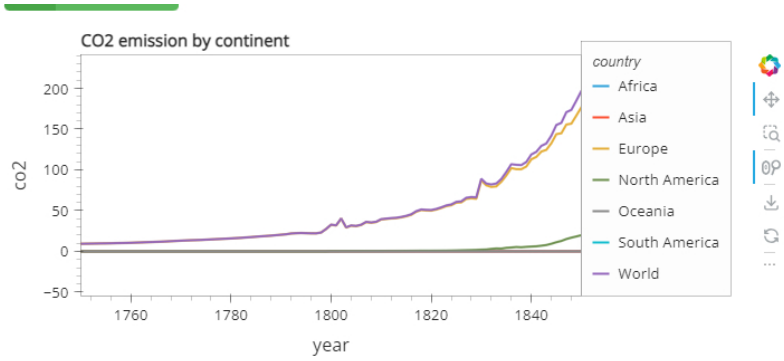
Settings

Year Slider: 1850



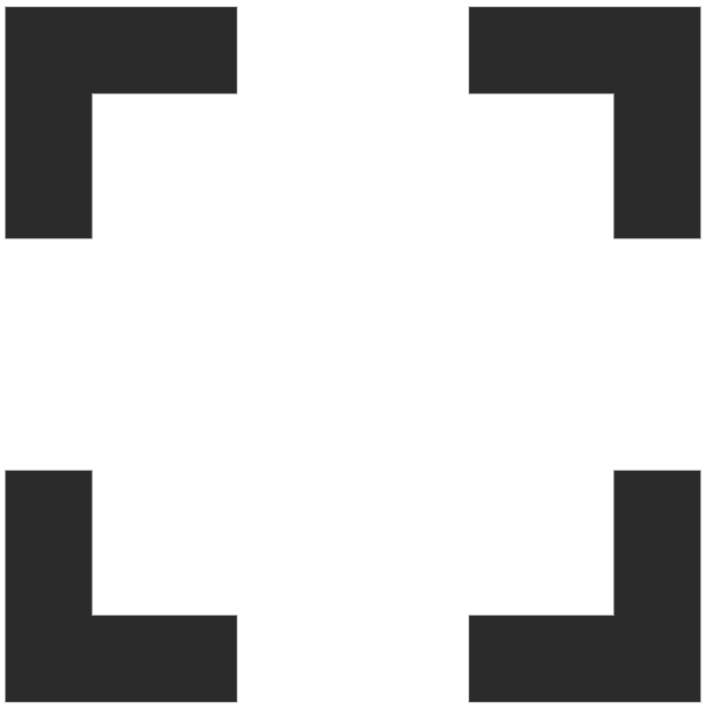
co2 co2_per_capita

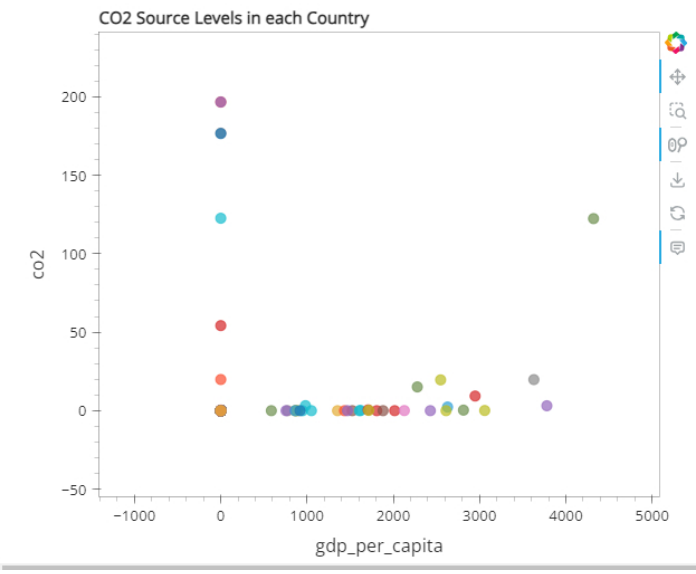
index ▲ country ▲



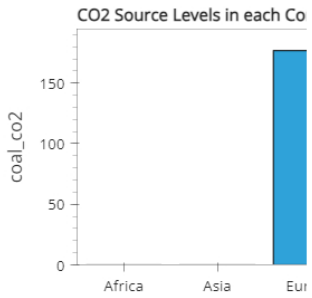
0	Africa
1	World
2	Oceania
3	Europe
4	Asia
5	North America
6	Europe
7	Asia
8	Oceania
9	World

First Prev **Next** La





coal_co2 oil_co2 gas_co2



To Load the Interactive Dashboard, access your Jupyter Terminal and use this command to load the dashboard.

> *panel serve C02_Emissions_Interactive_Python_Dashboard.ipynb*

[44]:
```
from subprocess import call
call(['python', '-m', 'nbconvert', 'C02_Emissions_Interactive_Python_Dashboard.ipynb'])
```

[44]:
```
1
```

[ ]: