co2_dashboard

February 22, 2024

1 CO2 Dashboard

[ ]:
```
# Data processing packages
import numpy as np
import pandas as pd

# Dashboard packages
import panel as pn
pn.extension('tabulator')

# plot packages
import hvplot.pandas

from bokeh.server.server import Server
from bokeh.application import Application
from bokeh.application.handlers.function import FunctionHandler
```

[ ]:
```
# Load the dataset
df = pd.read_csv('owid-co2-data.csv')
```

[ ]:
```
# Display the first five rows of the dataset
df.head()
```

[ ]:
```
       country  year iso_code  population  gdp  cement_co2  \
0  Afghanistan  1850      AFG   3752993.0  NaN         NaN
1  Afghanistan  1851      AFG   3767956.0  NaN         NaN
2  Afghanistan  1852      AFG   3783940.0  NaN         NaN
3  Afghanistan  1853      AFG   3800954.0  NaN         NaN
4  Afghanistan  1854      AFG   3818038.0  NaN         NaN

   cement_co2_per_capita  co2  co2_growth_abs  co2_growth_prct  …  \
0                    NaN  NaN             NaN              NaN  …
1                    NaN  NaN             NaN              NaN  …
2                    NaN  NaN             NaN              NaN  …
3                    NaN  NaN             NaN              NaN  …
4                    NaN  NaN             NaN              NaN  …

   share_global_other_co2  share_of_temperature_change_from_ghg  \
```

```
0                     NaN                                  NaN
1                     NaN                                0.165
2                     NaN                                0.164
3                     NaN                                0.164
4                     NaN                                0.163

   temperature_change_from_ch4  temperature_change_from_co2  \
0                          NaN                          NaN
1                          0.0                          0.0
2                          0.0                          0.0
3                          0.0                          0.0
4                          0.0                          0.0

   temperature_change_from_ghg  temperature_change_from_n2o  total_ghg  \
0                          NaN                          NaN        NaN
1                          0.0                          0.0        NaN
2                          0.0                          0.0        NaN
3                          0.0                          0.0        NaN
4                          0.0                          0.0        NaN

   total_ghg_excluding_lucf  trade_co2  trade_co2_share
0                       NaN        NaN              NaN
1                       NaN        NaN              NaN
2                       NaN        NaN              NaN
3                       NaN        NaN              NaN
4                       NaN        NaN              NaN

[5 rows x 79 columns]
```

2 (1) Data Cleaning

- Data cleaning and processing is the process of preparing data for analysis by removing or correcting errors, handling missing values, This function is used to clean the data by removing any rows that have missing values in either column.

3 (2) Exploratory Data Analysis

- For this I will use numpy to find missing values and duplicate entries before starting dashboard prep.
- I will also try to understand the datatypes being used in each column using pandas describe() function.

4 (3) Engineering and Visulisation

- In the engineering and visualization phase of the project, the focus is on making the data interactive and creating engaging visualisations for the dashboard. This involves using pro-

gramming libraries such as ipywidgets to create widgets and sliders that allow users to interact with the data.

[ ]:
```
# Find the datatypes
df.describe()
```

[ ]:
```
                year    population           gdp    cement_co2  \
count  48058.000000  3.949500e+04  1.456400e+04  23764.000000
mean    1926.842565  6.083223e+07  2.677586e+11      9.109400
std       59.414846  3.285867e+08  2.103151e+12     66.463548
min     1750.000000  2.220000e+02  4.998000e+07      0.000000
25%     1883.000000  3.464375e+05  7.516679e+09      0.000000
50%     1930.000000  2.456362e+06  2.597999e+10      0.029000
75%     1976.000000  1.008038e+07  1.132942e+11      0.834000
max     2022.000000  7.975105e+09  1.136302e+14   1692.404000

       cement_co2_per_capita           co2  co2_growth_abs  co2_growth_prct  \
count           22017.000000  30308.000000    28157.000000     25136.000000
mean                0.066798    391.272161        5.868310        20.055703
std                 0.125367   1855.824655       59.845871       687.366449
min                 0.000000      0.000000    -2032.366000      -100.000000
25%                 0.000000      0.183000        0.000000        -0.733500
50%                 0.008000      3.856000        0.026000         3.749500
75%                 0.093000     47.277250        0.873000        10.593500
max                 2.574000  37149.785000     1813.064000    102318.508000

       co2_including_luc  co2_including_luc_growth_abs  …  \
count       23320.000000                  23030.000000  …
mean          534.225708                      7.445587  …
std          2164.644277                     97.593192  …
min          -187.847000                  -2334.695000  …
25%             5.950750                     -0.752750  …
50%            27.777000                      0.071000  …
75%           124.373750                      2.568500  …
max         41637.617000                   2340.859000  …

       share_global_other_co2  share_of_temperature_change_from_ghg  \
count             2593.000000                          41724.000000
mean                19.199870                              2.190116
std                 33.432368                              9.012474
min                  0.000000                             -0.899000
25%                  0.249000                              0.003000
50%                  1.431000                              0.071000
75%                 19.405000                              0.329000
max                100.000000                            100.000000

       temperature_change_from_ch4  temperature_change_from_co2  \
```

```
count                  37620.000000                  41724.000000
mean                       0.002956                      0.006886
std                        0.016068                      0.039698
min                       -0.001000                     -0.000000
25%                        0.000000                      0.000000
50%                        0.000000                      0.000000
75%                        0.001000                      0.001000
max                        0.415000                      1.113000

       temperature_change_from_ghg  temperature_change_from_n2o     total_ghg  \
count                  41724.000000                  37620.000000   6354.000000
mean                       0.010069                      0.000497    790.430981
std                        0.057196                      0.002943   3610.534250
min                       -0.001000                      0.000000   -186.660000
25%                        0.000000                      0.000000      8.450000
50%                        0.000000                      0.000000     38.285000
75%                        0.001000                      0.000000    153.595000
max                        1.611000                      0.083000  49880.602000

       total_ghg_excluding_lucf    trade_co2  trade_co2_share
count               6354.000000  4398.000000      4397.000000
mean                 759.384745    -7.157874        20.368010
std                 3531.641287   269.156220        52.720717
min                    0.010000 -2367.758000       -99.795000
25%                    7.042500    -3.024750        -6.287000
50%                   30.830000     1.478500         8.741000
75%                  131.512500     9.124000        32.512000
max                48089.621000  2187.777000       576.482000

[8 rows x 77 columns]
```

[ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 48058 entries, 0 to 48057
Data columns (total 79 columns):
 #   Column                                Non-Null Count  Dtype
---  ------                                --------------  -----
 0   country                               48058 non-null  object
 1   year                                  48058 non-null  int64
 2   iso_code                              39717 non-null  object
 3   population                            39495 non-null  float64
 4   gdp                                   14564 non-null  float64
 5   cement_co2                            23764 non-null  float64
 6   cement_co2_per_capita                 22017 non-null  float64
 7   co2                                   30308 non-null  float64
 8   co2_growth_abs                        28157 non-null  float64
 9   co2_growth_prct                       25136 non-null  float64
```

```
10  co2_including_luc                          23320 non-null  float64
11  co2_including_luc_growth_abs               23030 non-null  float64
12  co2_including_luc_growth_prct              23313 non-null  float64
13  co2_including_luc_per_capita               23320 non-null  float64
14  co2_including_luc_per_gdp                  15608 non-null  float64
15  co2_including_luc_per_unit_energy          9608 non-null   float64
16  co2_per_capita                             26600 non-null  float64
17  co2_per_gdp                                16290 non-null  float64
18  co2_per_unit_energy                        10241 non-null  float64
19  coal_co2                                   25075 non-null  float64
20  coal_co2_per_capita                        24389 non-null  float64
21  consumption_co2                            4718 non-null   float64
22  consumption_co2_per_capita                 4365 non-null   float64
23  consumption_co2_per_gdp                    3899 non-null   float64
24  cumulative_cement_co2                      23681 non-null  float64
25  cumulative_co2                             28495 non-null  float64
26  cumulative_co2_including_luc               23320 non-null  float64
27  cumulative_coal_co2                        24992 non-null  float64
28  cumulative_flaring_co2                     24909 non-null  float64
29  cumulative_gas_co2                         25000 non-null  float64
30  cumulative_luc_co2                         37022 non-null  float64
31  cumulative_oil_co2                         25028 non-null  float64
32  cumulative_other_co2                       2593 non-null   float64
33  energy_per_capita                          10061 non-null  float64
34  energy_per_gdp                             7159 non-null   float64
35  flaring_co2                                24992 non-null  float64
36  flaring_co2_per_capita                     24261 non-null  float64
37  gas_co2                                    25083 non-null  float64
38  gas_co2_per_capita                         24352 non-null  float64
39  ghg_excluding_lucf_per_capita              6354 non-null   float64
40  ghg_per_capita                             6354 non-null   float64
41  land_use_change_co2                        37022 non-null  float64
42  land_use_change_co2_per_capita             36313 non-null  float64
43  methane                                    6355 non-null   float64
44  methane_per_capita                         6355 non-null   float64
45  nitrous_oxide                              6355 non-null   float64
46  nitrous_oxide_per_capita                   6355 non-null   float64
47  oil_co2                                    25111 non-null  float64
48  oil_co2_per_capita                         24380 non-null  float64
49  other_co2_per_capita                       2447 non-null   float64
50  other_industry_co2                         2593 non-null   float64
51  primary_energy_consumption                 10103 non-null  float64
52  share_global_cement_co2                    20208 non-null  float64
53  share_global_co2                           28495 non-null  float64
54  share_global_co2_including_luc             23320 non-null  float64
55  share_global_coal_co2                      24992 non-null  float64
56  share_global_cumulative_cement_co2         20208 non-null  float64
57  share_global_cumulative_co2                28495 non-null  float64
```

```
 58  share_global_cumulative_co2_including_luc  23320 non-null  float64
 59  share_global_cumulative_coal_co2           24992 non-null  float64
 60  share_global_cumulative_flaring_co2        16129 non-null  float64
 61  share_global_cumulative_gas_co2            22156 non-null  float64
 62  share_global_cumulative_luc_co2            37022 non-null  float64
 63  share_global_cumulative_oil_co2            23513 non-null  float64
 64  share_global_cumulative_other_co2          2593 non-null   float64
 65  share_global_flaring_co2                   16129 non-null  float64
 66  share_global_gas_co2                       22156 non-null  float64
 67  share_global_luc_co2                       37022 non-null  float64
 68  share_global_oil_co2                       23513 non-null  float64
 69  share_global_other_co2                     2593 non-null   float64
 70  share_of_temperature_change_from_ghg       41724 non-null  float64
 71  temperature_change_from_ch4                37620 non-null  float64
 72  temperature_change_from_co2                41724 non-null  float64
 73  temperature_change_from_ghg                41724 non-null  float64
 74  temperature_change_from_n2o                37620 non-null  float64
 75  total_ghg                                  6354 non-null   float64
 76  total_ghg_excluding_lucf                   6354 non-null   float64
 77  trade_co2                                  4398 non-null   float64
 78  trade_co2_share                            4397 non-null   float64
dtypes: float64(76), int64(1), object(2)
memory usage: 29.0+ MB
```

[ ]:
```
column_entries = df['country'].unique()
print(column_entries)
```

```
['Afghanistan' 'Africa' 'Africa (GCP)' 'Albania' 'Algeria' 'Andorra'
 'Angola' 'Anguilla' 'Antarctica' 'Antigua and Barbuda' 'Argentina'
 'Armenia' 'Aruba' 'Asia' 'Asia (GCP)' 'Asia (excl. China and India)'
 'Australia' 'Austria' 'Azerbaijan' 'Bahamas' 'Bahrain' 'Bangladesh'
 'Barbados' 'Belarus' 'Belgium' 'Belize' 'Benin' 'Bermuda' 'Bhutan'
 'Bolivia' 'Bonaire Sint Eustatius and Saba' 'Bosnia and Herzegovina'
 'Botswana' 'Brazil' 'British Virgin Islands' 'Brunei' 'Bulgaria'
 'Burkina Faso' 'Burundi' 'Cambodia' 'Cameroon' 'Canada' 'Cape Verde'
 'Central African Republic' 'Central America (GCP)' 'Chad' 'Chile' 'China'
 'Christmas Island' 'Colombia' 'Comoros' 'Congo' 'Cook Islands'
 'Costa Rica' "Cote d'Ivoire" 'Croatia' 'Cuba' 'Curacao' 'Cyprus'
 'Czechia' 'Democratic Republic of Congo' 'Denmark' 'Djibouti' 'Dominica'
 'Dominican Republic' 'East Timor' 'Ecuador' 'Egypt' 'El Salvador'
 'Equatorial Guinea' 'Eritrea' 'Estonia' 'Eswatini' 'Ethiopia' 'Europe'
 'Europe (GCP)' 'Europe (excl. EU-27)' 'Europe (excl. EU-28)'
 'European Union (27)' 'European Union (28)' 'Faroe Islands' 'Fiji'
 'Finland' 'France' 'French Equatorial Africa (Jones et al. 2023)'
 'French Polynesia' 'French West Africa (Jones et al. 2023)' 'Gabon'
 'Gambia' 'Georgia' 'Germany' 'Ghana' 'Greece' 'Greenland' 'Grenada'
 'Guatemala' 'Guinea' 'Guinea-Bissau' 'Guyana' 'Haiti'
 'High-income countries' 'Honduras' 'Hong Kong' 'Hungary' 'Iceland'
```

```
'India' 'Indonesia' 'International aviation' 'International shipping'
'International transport' 'Iran' 'Iraq' 'Ireland' 'Israel' 'Italy'
'Jamaica' 'Japan' 'Jordan' 'Kazakhstan' 'Kenya' 'Kiribati' 'Kosovo'
'Kuwait' 'Kuwaiti Oil Fires (GCP)'
'Kuwaiti Oil Fires (Jones et al. 2023)' 'Kyrgyzstan' 'Laos' 'Latvia'
'Least developed countries (Jones et al. 2023)' 'Lebanon'
'Leeward Islands (GCP)' 'Leeward Islands (Jones et al. 2023)' 'Lesotho'
'Liberia' 'Libya' 'Liechtenstein' 'Lithuania' 'Low-income countries'
'Lower-middle-income countries' 'Luxembourg' 'Macao' 'Madagascar'
'Malawi' 'Malaysia' 'Maldives' 'Mali' 'Malta' 'Marshall Islands'
'Mauritania' 'Mauritius' 'Mexico' 'Micronesia (country)'
'Middle East (GCP)' 'Moldova' 'Monaco' 'Mongolia' 'Montenegro'
'Montserrat' 'Morocco' 'Mozambique' 'Myanmar' 'Namibia' 'Nauru' 'Nepal'
'Netherlands' 'New Caledonia' 'New Zealand' 'Nicaragua' 'Niger' 'Nigeria'
'Niue' 'Non-OECD (GCP)' 'North America' 'North America (GCP)'
'North America (excl. USA)' 'North Korea' 'North Macedonia' 'Norway'
'OECD (GCP)' 'OECD (Jones et al. 2023)' 'Oceania' 'Oceania (GCP)' 'Oman'
'Pakistan' 'Palau' 'Palestine' 'Panama' 'Panama Canal Zone (GCP)'
'Panama Canal Zone (Jones et al. 2023)' 'Papua New Guinea' 'Paraguay'
'Peru' 'Philippines' 'Poland' 'Portugal' 'Puerto Rico' 'Qatar' 'Romania'
'Russia' 'Rwanda' 'Ryukyu Islands (GCP)'
'Ryukyu Islands (Jones et al. 2023)' 'Saint Helena'
'Saint Kitts and Nevis' 'Saint Lucia' 'Saint Pierre and Miquelon'
'Saint Vincent and the Grenadines' 'Samoa' 'San Marino'
'Sao Tome and Principe' 'Saudi Arabia' 'Senegal' 'Serbia' 'Seychelles'
'Sierra Leone' 'Singapore' 'Sint Maarten (Dutch part)' 'Slovakia'
'Slovenia' 'Solomon Islands' 'Somalia' 'South Africa' 'South America'
'South America (GCP)' 'South Korea' 'South Sudan' 'Spain' 'Sri Lanka'
'St. Kitts-Nevis-Anguilla (GCP)'
'St. Kitts-Nevis-Anguilla (Jones et al. 2023)' 'Sudan' 'Suriname'
'Sweden' 'Switzerland' 'Syria' 'Taiwan' 'Tajikistan' 'Tanzania'
'Thailand' 'Togo' 'Tonga' 'Trinidad and Tobago' 'Tunisia' 'Turkey'
'Turkmenistan' 'Turks and Caicos Islands' 'Tuvalu' 'Uganda' 'Ukraine'
'United Arab Emirates' 'United Kingdom' 'United States'
'Upper-middle-income countries' 'Uruguay' 'Uzbekistan' 'Vanuatu'
'Vatican' 'Venezuela' 'Vietnam' 'Wallis and Futuna' 'World' 'Yemen'
'Zambia' 'Zimbabwe']
```

5 What does this tell us?

- There are no missing values
- The majority of data types are floats
- There are continent names in the 'country' column, many of which are the same with but with minor differences or specific exclusions.

[ ]:
```
# Select a Series of True/False values indicating whether~
# each row's 'country' value is equal to 'World'.
df[df['country'] == 'World']
```

[ ]:

	country	year	iso_code	population	gdp	cement_co2	\
47266	World	1750	NaN	7.456641e+08	NaN	NaN	
47267	World	1751	NaN	NaN	NaN	NaN	
47268	World	1752	NaN	NaN	NaN	NaN	
47269	World	1753	NaN	NaN	NaN	NaN	
47270	World	1754	NaN	NaN	NaN	NaN	
…	…	…	…	…	…	…	
47534	World	2018	NaN	7.683790e+09	1.136302e+14	1565.803	
47535	World	2019	NaN	7.764951e+09	NaN	1615.776	
47536	World	2020	NaN	7.840953e+09	NaN	1633.047	
47537	World	2021	NaN	7.909295e+09	NaN	1692.404	
47538	World	2022	NaN	7.975105e+09	NaN	1605.474	

	cement_co2_per_capita	co2	co2_growth_abs	co2_growth_prct	…	\
47266	NaN	9.306	NaN	NaN	…	
47267	NaN	9.407	0.101	1.088	…	
47268	NaN	9.505	0.098	1.041	…	
47269	NaN	9.610	0.105	1.108	…	
47270	NaN	9.734	0.123	1.281	…	
…	…	…	…	…	…	
47534	0.204	36766.945	741.491	2.058	…	
47535	0.208	37040.102	273.158	0.743	…	
47536	0.208	35007.738	-2032.366	-5.487	…	
47537	0.214	36816.543	1808.806	5.167	…	
47538	0.201	37149.785	333.242	0.905	…	

	share_global_other_co2	share_of_temperature_change_from_ghg	\
47266	NaN	NaN	
47267	NaN	NaN	
47268	NaN	NaN	
47269	NaN	NaN	
47270	NaN	NaN	
…	…	…	
47534	100.0	100.0	
47535	100.0	100.0	
47536	100.0	100.0	
47537	100.0	100.0	
47538	100.0	NaN	

	temperature_change_from_ch4	temperature_change_from_co2	\
47266	NaN	NaN	
47267	NaN	NaN	
47268	NaN	NaN	

```
47269                          NaN                          NaN
47270                          NaN                          NaN
…                              …                            …
47534                        0.399                        1.058
47535                        0.404                        1.076
47536                        0.410                        1.094
47537                        0.415                        1.113
47538                          NaN                          NaN

       temperature_change_from_ghg  temperature_change_from_n2o  total_ghg  \
47266                          NaN                          NaN        NaN
47267                          NaN                          NaN        NaN
47268                          NaN                          NaN        NaN
47269                          NaN                          NaN        NaN
47270                          NaN                          NaN        NaN
…                              …                            …          …
47534                        1.536                        0.079  49585.910
47535                        1.561                        0.081  49880.602
47536                        1.585                        0.082  47513.148
47537                        1.611                        0.083        NaN
47538                          NaN                          NaN        NaN

       total_ghg_excluding_lucf  trade_co2  trade_co2_share
47266                       NaN        NaN              NaN
47267                       NaN        NaN              NaN
47268                       NaN        NaN              NaN
47269                       NaN        NaN              NaN
47270                       NaN        NaN              NaN
…                           …          …                …
47534                 48069.809      0.000              0.0
47535                 48089.621      0.000              0.0
47536                 46120.922      0.000              0.0
47537                       NaN     -0.004             -0.0
47538                       NaN      0.000              0.0

[273 rows x 79 columns]
```

5.1 Some minor data processing

- To be safe and for good working practices I will fill in missing NaN values,
- In real world scenarios or in a professional environment, this may not be necessary as this will taking more time for the code to run if we know that there are no missing values.

[ ]:
```
# Fill in the NaN values and create gdp per capita column
df = df.fillna(0)
df['gdp_per_capita'] = np.where(df['population'] != 0, df['gdp']/␣
 ↪df['population'],0)
```

[ ]:
```
# Make DataFrame pipeline interactive
idf = df.interactive()
```

5.2 CO2 Emission Over Time by Continent

- Now its time to create the interactive parts of the dashboard such as:
  - The slider
  - The widgets

  Note: This will be used to create the pipeline.

[ ]:
```
# Define panel widgets
year_slider = pn.widgets.IntSlider(name='Year Slider', start=1750, end=2020,␣
 ↪step=5, value=1850)
year_slider
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'1cd2793d-edf6-4056-b79f-39a8dd00c93f': {'version…
```

[ ]:
```
# Radio buttons for CO2 measure
yaxis_co2 = pn.widgets.RadioButtonGroup(
    name='Y axis',
    options=['co2', 'co2_per_capita',],
    button_type='success'
)
```

[ ]:
```
# continents for which CO2 data will be displayed
continents = ['World', 'Asia', 'Oceania', 'Europe', 'Africa', 'North America',␣
 ↪'South America', 'Antartica']

# Create a pipeline to calculate the average CO2 emissions for each continent␣
 ↪and year
co2_pipeline = (
    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)
)
```

[ ]:
```
co2_pipeline
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'58a0b333-7108-474c-8509-f77c7b875c03': {'version…
```

[ ]:
```
# Create the plot
co2_plot = co2_pipeline.hvplot(x = 'year', by='country', y=yaxis_co2,␣
↪line_width=2, title='CO2 Emission by Continent')
co2_plot
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'8bbe90cd-459d-4b41-a19f-dd9c75a5a249': {'version…
```

5.3 Table - CO2 Emission Over Time by Continent

- The 'co2_table' variable is a table widget that displays the CO2 emissions data for each continent and year.
- The table is paginated, with 10 rows per page.
- The table's width is automatically adjusted to fill the available space.

[ ]:
```
# Create a table widget to display the CO2 emissions data
co2_table = co2_pipeline.pipe(pn.widgets.Tabulator, pagination='remote',␣
↪page_size=10, sizing_mode='stretch_width')
co2_table # Display the table widget
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'a2e34479-f5d1-41e6-b641-5d5881ee5663': {'version…
```

5.4 CO2 vs gdp scatterplot

[ ]:
```
# Create a pipeline to calculate the average CO2 emissions
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)
)
```

[ ]:
```
co2_vs_gdp_scatterplot_pipeline
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'4f396402-a918-4e96-b3a8-87548f27cb2e': {'version…
```

[ ]:
```
# Scatter plot creation for dashboard using hvplot
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
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'a64eff11-d8bd-447e-a98a-ea7ac612e2eb': {'version…
```

5.5 Bar Chart with CO2 Sources by Continent

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

continents_excl_world = ['World', 'Asia', 'Oceania', 'Europe', 'Africa', 'North␣
 ↪America', 'South America', 'Antartica']
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)
)
```

[ ]:
```
co2_source_bar_plot = co2_source_bar_pipeline.hvplot(kind='bar',
                                                     x='country',
                                                     y=yaxis_co2_source,
                                                     title='CO2 Source by␣
 ↪Continent')
co2_source_bar_plot
```

[ ]:
```
BokehModel(combine_events=True, render_bundle={'docs_json':
{'5dafd0ea-2291-42b5-bc6e-902c63b027b7': {'version…
```

5.6 Creating The Dashboard

- Use of FastListTemplate from the documentation provided by panel.

[ ]:
```
# Layout via Template
template = pn.template.FastListTemplate(
    title='World CO2 Emission Dashboard',
    sidebar=[pn.pane.Markdown('# CO2 Emissions and Climate Change'),
             pn.pane.Markdown('### CO2 emissions are the primary driver of␣
 ↪climate change. It iss widely recognised that to combat this issue we need␣
 ↪to understand which contries/ continents drive this issue furthest, we can␣
 ↪use complex data analysis to find solutions'),
             pn.pane.PNG('climate.change.png',
             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',
)
#template.show()
template.servable();
```