



Section 4: Visualization

Project 3 **CO2 Emissions Around the World**

Presented by:
Paola Yunes
Rafael Orihuela
Emilio Aristegui
Adrian Fraile

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Part 1: Proposal

- **Analyze contribution to global pollution by continents.**
- **Identify the countries with the highest pollution rates**
- **Determine the industries that cause the most pollution, and discover the specific segments responsible for significant pollution levels.**



Proposal - What we Will Evaluate

01

Continents

- Asia/Pacific
- Central and South America
- Europe
- Middle East
- North America
- Russia & Caspian

02

Countries

- 89 countries

03

Industries

- Energy
- Agriculture
- Waste
- Other

Part 2:

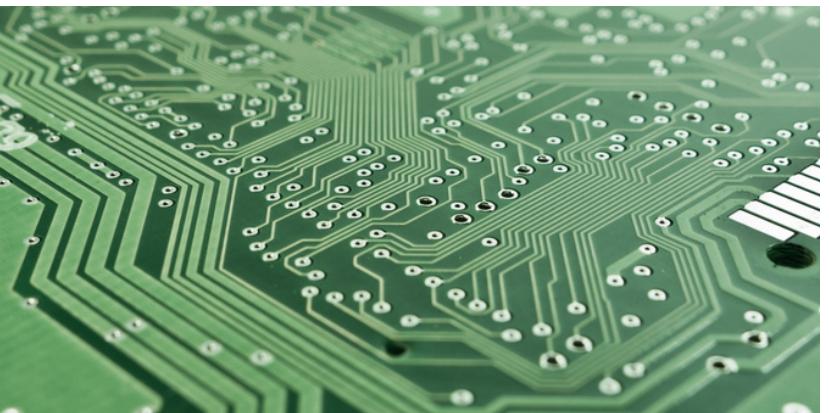
Data and Delivery



Data and Delivery

Original Dataset

- Obtained from Kaggle
 - International Energy Agency
 - Emissions Around the World
 - License: Attribution 4.0 International (CC BY 4.0)



Merging

- Merge coordinates csv with kaggle csv to provide location for countries.
 - Merge with perimeter of country.
 - Created final dataset with Jupyter Notebook.



Final Dataset

- Contains 1,600 unique records.
 - PostgreSQL houses the data.
 - Powered by Python Flask API, VSCode
 - Includes HTML/CSS, JavaScript, JupyterNotebook



An aerial photograph of an industrial facility, likely a power plant or chemical processing plant. Several large, circular cooling towers are visible, each with a large fan at the top. A massive plume of white steam or smoke is rising from one of the towers. The facility is surrounded by a mix of paved roads, green lawns, and clusters of trees with autumn-colored leaves. In the foreground, there's a large, dark, rectangular area that appears to be a pond or a large storage tank. The overall scene suggests a heavy industrial presence in a semi-rural or suburban setting.

Part 3: Back End

Project 3

06



Jupyter Notebook

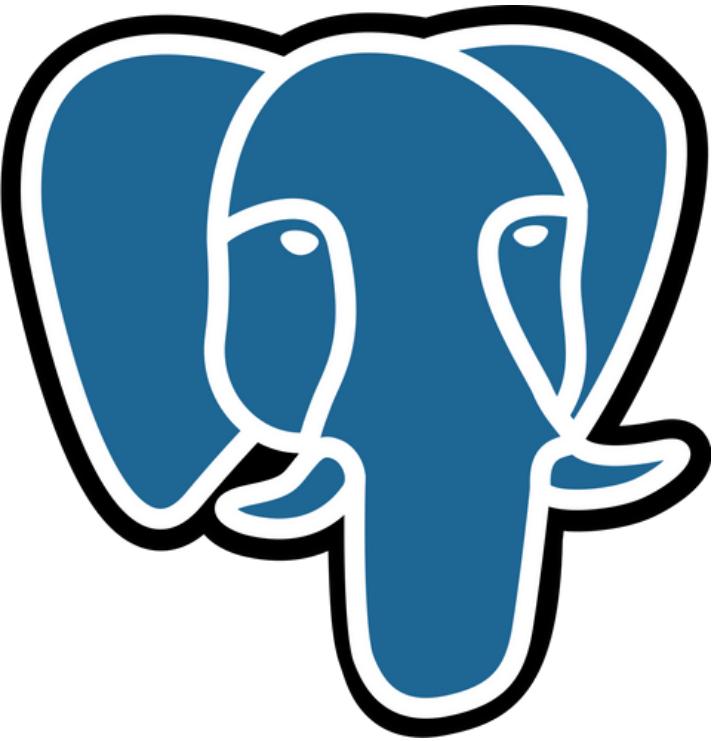
- Used to load three datasets
- Used to merge the datasets to create the final
- Cleaned the final dataset
- Created engine for PostgreSQL

1]:

```
methane_df = pd.read_csv("data/Methane_final.csv")
coordinates_df = pd.read_csv("data/average-latitude-longitude-countries.csv")
merged_df = methane_df.merge(coordinates_df, on="Country")
merged_df.head(5)
```

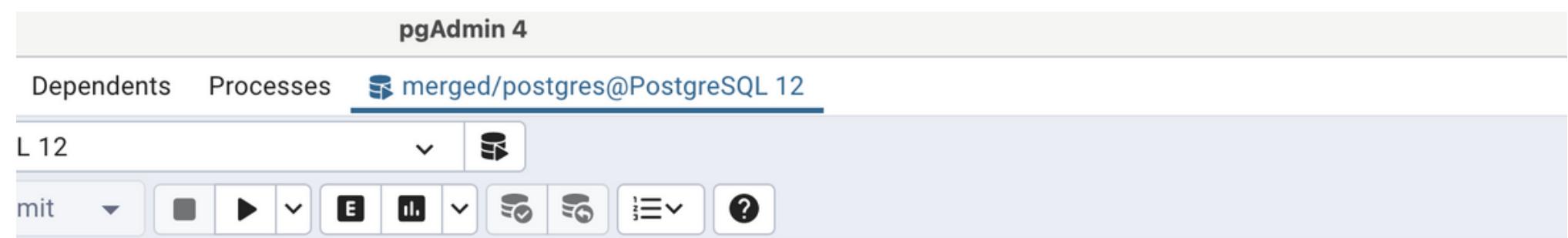
1]:

	Unnamed: 0	region	Country	emissions	type	segment	reason	baseYear	notes	ISO 3166 Country Code	Latitude	Longitu
0	0	Africa	Algeria	257.611206	Agriculture	Total	All	2019-2021	Average based on United Nations Framework Conv...	DZ	28.0	
1	1	Africa	Algeria	0.052000	Energy	Bioenergy	All	2022	Estimates from end-uses are for 2020 or 2021 (...)	DZ	28.0	
2	2	Africa	Algeria	130.798996	Energy	Gas pipelines and LNG facilities	Fugitive	2022	Not available	DZ	28.0	
3	3	Africa	Algeria	69.741898	Energy	Gas pipelines and LNG facilities	Vented	2022	Not available	DZ	28.0	
4	4	Africa	Algeria	213.986999	Energy	Onshore gas	Fugitive	2022	Not available	DZ	28.0	



PostgreSQL

- Hosted final dataset
- Created single table
- Connects with FlaskAPI



pgAdmin 4

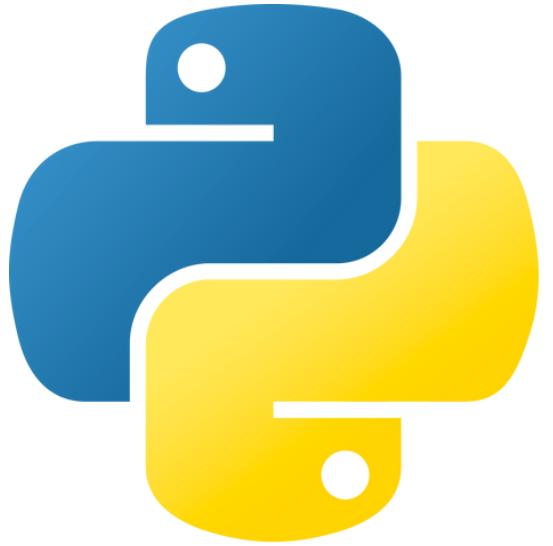
Dependents Processes merged/postgres@PostgreSQL 12

L 12 mit

pgAdmin? Remove Remove All

[https://www.quickdatabasediagrams.com/ ...](https://www.quickdatabasediagrams.com/)

```
CREATE TABLE merged (
    region varchar(15) NOT NULL,
    Country varchar(30) NOT NULL,
    emissions integer NOT NULL,
    industry varchar(30) NOT NULL,
    segment varchar(30) NOT NULL,
    reason varchar(25) NOT NULL,
    base_year varchar(20) NOT NULL,
    notes varchar(200) NOT NULL,
    ISO_3166_country_code varchar(10) NOT NULL,
    latitude float NOT NULL,
    longitude float NOT NULL
);
```



Python (app.py)

- Used to create our database setup and connection
- Used to create our flask setup and routes
- Created 4 app routes

```
36     # welcome route
37     @app.route('/')
38     def welcome():
39         return render_template('index.html')
40
41     # pd.readsql route
42     @app.route('/data_emissions')
43     def return_data():
44
45         #reading SQL database, creating a pandas df for easier manipulation
46         results = pd.read_sql('select * from merged', engine)
47         results = {
48             'country': results['country'].to_list(),
49             'region': results['region'].to_list(),
50             'emissions': results['emissions'].to_list(),
51             'industry': results['industry'].to_list(),
52             'segment': results['segment'].to_list(),
53             'reason': results['reason'].to_list(),
54             'baseYear': results['base_year'].to_list(),
55             'ISO': results['iso_3166_country_code'].to_list(),
56             'Lat': results['latitude'].to_list(),
57             'Lon': results['longitude'].to_list(),
58         }
59         df = pd.DataFrame(results, columns = ['region', 'country','emissions','industry'],
60                           #pandas df converted into json file
61                           df = df.groupby("region")["emissions"].sum()
62                           df = df.to_json(orient="split")
63                           return df
64
65
```

HTML

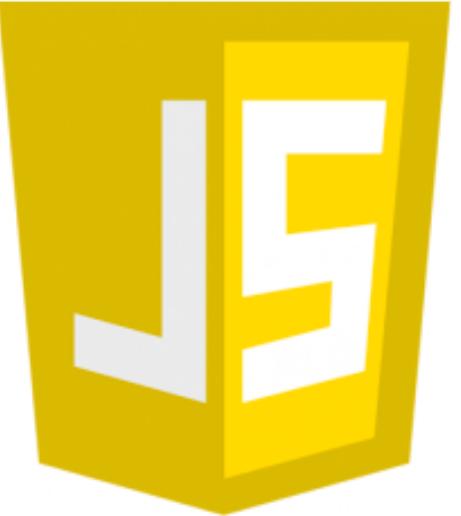


HTML

(index.html)

- Created page body
- Created dropdown menus
- Connection

```
10      <!-- D3 library -->
11      <script src="https://d3js.org/d3.v5.min.js"></script>
12      
13      <base href="/">
14  </head>
15  <body>
16      <h1>Global CO2 Emissions</h1>
17      <p>A distribution of CO2 emissions around the world!</p>
18      <select id="selectregion">
19          <option value="global">Global</option>
20      </select>
21      <div id="plot1"></div>
22  </div>
23  <hr>
24      <select id="selectcountry">
25          <option value="global">Global</option>
26      </select>
27      <div id="plot2"></div>
28  </div>
29  <hr>
30      <select id="selectindustry">
31          <option value="global">Global</option>
32      </select>
33      <div id="plot3"></div>
34  </div>
35      <script src="static/logic.js"></script>
36  </body>
37  </html>
```



JavaScript

JavaScript (logic.js)

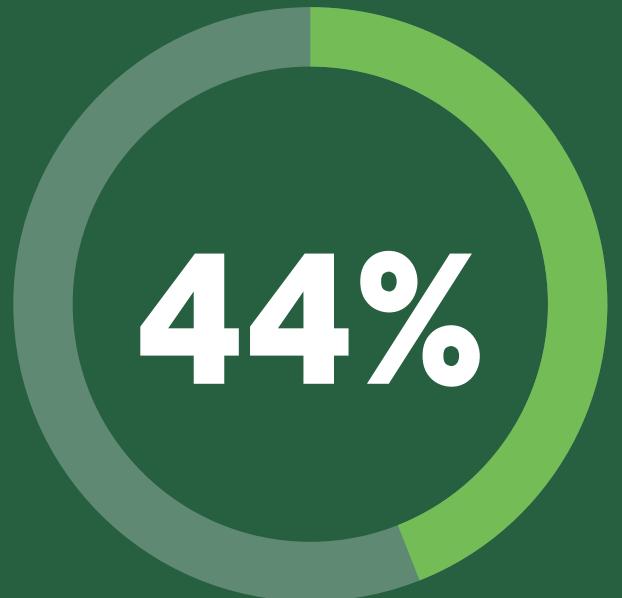
- Connected with database
- Created plots
- Used plotly to show graphs

```
5    // First plot
6    d3.json('http://127.0.0.1:5000/data_emissions').then(d=>{
7      d3.selectAll("#selectregion")
8        .selectAll("option")
9          .data(d.index)
10         .enter()
11         .append("option")
12         .attr("value", d=>d)
13         .text(d=>d)
14       let trace1={
15         x:d.index,
16         y:d.data,
17         type:'bar'
18       }
19       let data = [trace1]
20
21       var layout = {
22         title: "CO2 Emissions by Region",
23         yaxis: {title: "CO2 Emissions", showgrid: false},
24         font: {
25           color: "white",
26           family: "'Courier New', Courier, monospace",
27           size: 12
28         },
29         paper_bgcolor:"rgba(0,0,0,0)",
30         plot_bgcolor:"rgba(234,247,161,0.8)",
31         marker: {
32           color: 'rgba(0,0,0,1)',
33         }
34       };
35
36       Plotly.newPlot('plot1', data, layout)
37       d3.selectAll("#selectregion").on("change", updatePlotly);
38     }
39
40     function updatePlotly() {
41       // Use D3 to select the dropdown menu
42       let dropdownMenu = d3.select("#selectregion");
43       // Assign the value of the dropdown menu option to a variable
44       let dataset = dropdownMenu.property("value");
45       if (dataset == "global"){
46         Plotly.restyle("plot1", "x", [d.index]);
47         Plotly.restyle("plot1", "y", [d.data]);
48       }else{let index = d.index.indexOf(dataset)
49         let x = [d.index[index]];
50         let y = [d.data[index]];
51
52         // Note the extra brackets around 'x' and 'y'
53         Plotly.restyle("plot1", "x", [x]);
54         Plotly.restyle("plot1", "y", [y]);}
55     }
56
57   )
58 }
```



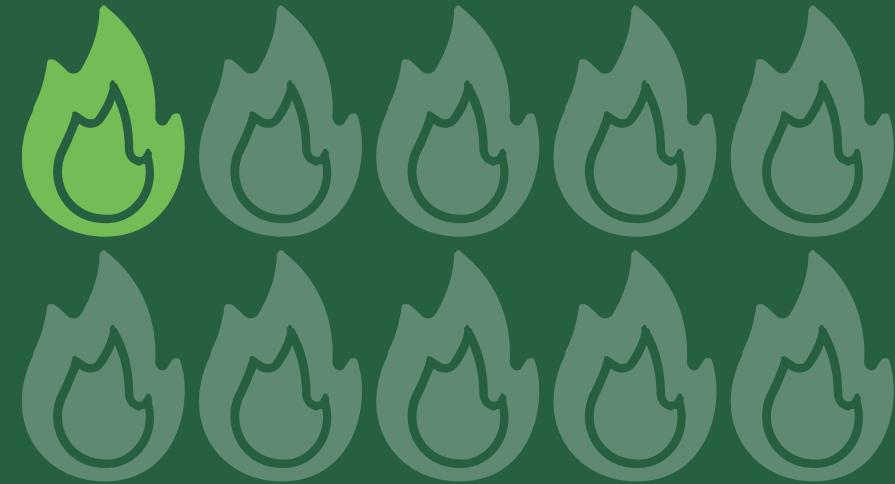
Part 4:

Visualizations



Asia-Pacific's share in
global pollution

1 in 10

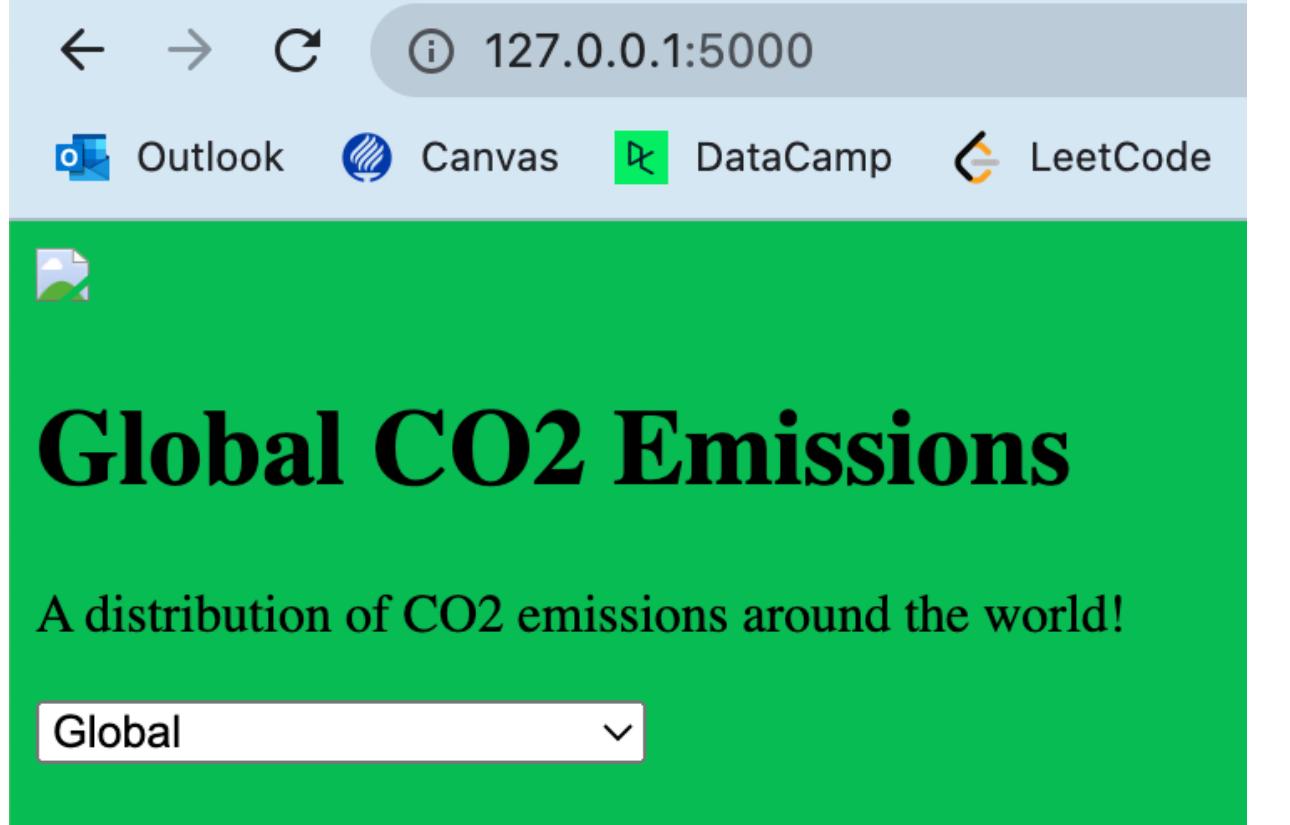


Mexico's share in North
American emissions



Energy Industry Emissions

Our Data Story





Project 3

Thank you!

Questions?

Website

<http://127.0.0.1:5000/>

Github

<https://github.com/emilioaristegui/project-3>

Kaggle Dataset

<https://www.kaggle.com/datasets/ulrikthygepedersen/co2-emissions-by-country>