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# Global Carbon Emission Comparisons

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# Topic Description

- Alarming rates of carbon emissions
  - Study major factors affecting climate conditions
  - Analyze correlations between energy usage and GHG emissions through transportation
  - Determine the recent impact of alternative energy sources
  - Predict future impact of higher alternative energy adoption
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# Group Roles

- X - Avneesh
  - Triangle - Tarini
  - Circle - Mikhail
  - Square - Ruchita & Kobe
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# Data Description

- Annual worldwide vehicle mix by different energy types (Diesel, Electric, Hybrid, etc.)
  - Overall GHG emissions by sector
  - Market demand of all vehicles types
  - Energy production
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# Database

- Downloaded datasets related to co2 emissions and GHG emissions
  - Source - <https://ourworldindata.org/>
- Tried to find the unique key to merge the data in this case it is the country name and year
- Collected the datasets for Transport Vehicle demand country wise and year wise, merged it with the GHG emissions database

# Database Sample

The screenshot displays a database management interface. On the left is a sidebar with a tree view of the database structure, including Extensions, Foreign Data Wrappers, Languages, Publications, Schemas (1), and the 'public' schema. Under 'public', various database objects are listed, with 'merged' selected under 'Tables (1)'. The main area is divided into a 'Query Editor' and a 'Query History' tab. The 'Query Editor' contains a single SQL query: `select * from public.merged`. Below the query editor is a 'Data Output' section showing a table with 8 columns and 7 rows of data. The columns are: 'num' (integer, primary key), 'Entity' (character varying), 'Year' (integer), 'Fossil fuels (% electricity)' (double precision), 'Renewables (% electricity)' (double precision), 'Per capita electricity (kWh)' (double precision), and 'Fossil fuels (%)' (double precision). The data rows show values for Africa from the year 2000 to 2006.

	num [PK] integer	Entity character varying	Year integer	Fossil fuels (% electricity) double precision	Renewables (% electricity) double precision	Per capita electricity (kWh) double precision	Fossil fuels (%) double precision
1	0	Africa	2000	78.74517059	17.65452576	542.7769165	
2	1	Africa	2001	79.02587128	18.2166481	552.5474243	
3	2	Africa	2002	79.12548065	18.00189972	572.7458496	
4	3	Africa	2003	80.06246948	16.8457756	583.6015625	
5	4	Africa	2004	80.04415894	16.82542038	605.0234375	
6	5	Africa	2005	80.85244751	16.53281784	611.7351685	
7	6	Africa	2006	81.17703247	16.49860191	624.1119995	

# Machine Learning Model Summary

## OLS Regression Results

Dep. Variable:	ev_savings	R-squared (uncentered):	0.507			
Model:	OLS	Adj. R-squared (uncentered):	0.493			
Method:	Least Squares	F-statistic:	36.02			
Date:	Thu, 01 Sep 2022	Prob (F-statistic):	2.36e-75			
Time:	03:50:38	Log-Likelihood:	-8982.0			
No. Observations:	576	AIC:	1.800e+04			
Df Residuals:	560	BIC:	1.807e+04			
Df Model:	16					
Covariance Type: nonrobust						
	coef	std err	t	P> t	[0.025	0.975]
Fossil fuels (% equivalent primary energy)	7950.8993	5231.081	1.520	0.129	-2324.038	1.82e+04
Transport_x	0.1986	0.161	1.234	0.218	-0.118	0.515
Agriculture	0.0011	0.001	1.013	0.312	-0.001	0.003
Land-use change and forestry	0.0015	0.001	2.731	0.007	0.000	0.003
Waste	0.0082	0.005	1.731	0.084	-0.001	0.018
Industry	0.0584	0.005	10.943	0.000	0.048	0.069
Manufacturing and construction	-0.0240	0.002	-11.381	0.000	-0.028	-0.020
Transport_y	-0.1989	0.155	-1.280	0.201	-0.504	0.106
Electricity and heat	0.0080	0.001	7.096	0.000	0.006	0.010
Buildings	-0.0098	0.003	-3.043	0.002	-0.016	-0.003
Fugitive emissions	-0.0062	0.002	-3.892	0.000	-0.009	-0.003
Other fuel combustion	0.0040	0.016	0.246	0.805	-0.028	0.036
Aviation and shipping	-0.0209	0.006	-3.501	0.001	-0.033	-0.009
Renewables (% equivalent primary energy)	5839.8990	1.32e+04	0.444	0.657	-2e+04	3.17e+04
Fossil fuels (% electricity)	-1.103e+04	5700.997	-1.935	0.054	-2.22e+04	168.776
Renewables (% electricity)	-4951.9647	9257.701	-0.535	0.593	-2.31e+04	1.32e+04

Renewables (% equivalent primary energy)	5839.8990	1.32e+04	0.444	0.657	-2e+04	3.17e+04
Fossil fuels (% electricity)	-1.103e+04	5700.997	-1.935	0.054	-2.22e+04	168.776
Renewables (% electricity)	-4951.9647	9257.701	-0.535	0.593	-2.31e+04	1.32e+04
Omnibus:	416.999	Durbin-Watson:	1.018			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	21995.226			
Skew:	2.579	Prob(JB):	0.00			
Kurtosis:	32.831	Cond. No.	2.41e+08			

## Notes:

- [1]  $R^2$  is computed without centering (uncentered) since the model does not contain a constant.
- [2] Standard Errors assume that the covariance matrix of the errors is correctly specified.
- [3] The condition number is large, 2.41e+08. This might indicate that there are strong multicollinearity or other numerical problems.

# Machine Learning Model - Data columns

```
Index([
    ('Petrol', 'Econ'),
    ('Petrol', 'Mid'),
    ('Petrol', 'Lux'),
    ('Adv Petrol', 'Econ'),
    ('Adv Petrol', 'Mid'),
    ('Adv Petrol', 'Lux'),
    ('Diesel', 'Econ'),
    ('Diesel', 'Mid'),
    ('Diesel', 'Lux'),
    ('Adv Diesel', 'Econ'),
    ('Adv Diesel', 'Mid'),
    ('Adv Diesel', 'Lux'),
    ('CNG', 'Econ'),
    ('CNG', 'Mid'),
    ('CNG', 'Lux'),
    ('Hybrid', 'Econ'),
    ('Hybrid', 'Mid'),
    ('Hybrid', 'Lux'),
    ('Electric', 'Econ'),
    ('Electric', 'Mid'),
    ('Electric', 'Lux'),
    ('Bikes', 'Econ'),
    ('Bikes', 'Lux'),
    ('Electric Bikes', 'Adv Econ'),
    ('Electric Bikes', 'Adv Lux'),
    'Fossil fuels (% equivalent primary energy)',
    'Transport_x',
    'Agriculture',
    'Land-use change and forestry',
    'Waste',
    'Industry',
    'Manufacturing and construction',
    'Transport_y',
    'Electricity and heat',
    'Buildings',
    'Fugitive emissions',
    'Other fuel combustion',
    'Aviation and shipping',
    'Renewables (% equivalent primary energy)',
    'Fossil fuels (% electricity)',
    'Renewables (% electricity)',
    'fossil_demand',
    'ev_demand',
```

- To calculate CO2 emissions saved by electric vehicles year by year
- Features given in the screenshot are taken into consideration



# Machine Learning Model Output

```
[121] X = df_ev_ghg_merged[[
    'Fossil fuels (% equivalent primary energy)',
    'Transport_x',
    'Agriculture',
    'Land-use change and forestry',
    'Waste', 'Industry', 'Manufacturing and construction', 'Transport_y',
    'Electricity and heat',
    'Buildings', 'Fugitive emissions', 'Other fuel combustion', 'Aviation and shipping', 'Renewables (% equivalent primary energy)', 'Fossil fuels (% electricity)',
    'Renewables (% electricity)']]
```

```
[122] X
```

```
▶ y = df_ev_ghg_merged[['ev_savings']]
```

```
[124] lm = linear_model.LinearRegression()
      model = lm.fit(X,y)
```

```
▶ y_predictions = lm.predict(X)
```

```
[126] lm.score(X,y)
```

```
0.4954363469172296
```

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# Next Steps...

- Explore and analyze data to study the impact of various vehicles by energy type on carbon emission
  - Determine if there is a significant correlation between each factor
  - Reveal possible outcomes of alternate energy consumption on carbon & GHG emissions
  - Summarize each step taken in the machine learning preprocess
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