



# SAS PROJECT

## WORLD ENERGY CONSUMPTION AND POPULATION

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# DATA SOURCE



WORLD ENERGY CONSUMPTION

<https://www.kaggle.com/datasets/nirmalprasad/world-energy-consumption>

WORLD POPULATION

<https://data.worldbank.org/indicator/SP.POP.TOTL>

## PROBLEM DEFINITION AND EXPLANATION



- To see if population and energy consumption are correlated.
- To understand energy consumed per person (renewable/non-renewable) by country.

## DATA CLEANING



- Imported the data in SAS.
- Checked and cleaned the data using proc sql codes.
- To correct typos.
- Selected top 20 most populated countries and created a table.
- Deleted unwanted columns and country names.
- Changed o to null.
- Used functions like CREATE, UPDATE AND DELETE.

# DATA VERIFICATION

- Summary Statistics (pre-cleaned)

Summary Statistics Of Population				
The MEANS Procedure				
Year=1995				
Analysis Variable : Total_Population Total Number of Population				
Country Name	Mean	Minimum	Maximum	N Miss
Bangladesh	117793338	117793338	117793338	0
Brazil	163515328	163515328	163515328	0
China	1204855000	1204855000	1204855000	0
Congo, Dem. Rep.	43285791.00	43285791.00	43285791.00	0
Egypt, Arab Rep.	64166908.00	64166908.00	64166908.00	0
Ethiopia	57476536.00	57476536.00	57476536.00	0
Germany	81678051.00	81678051.00	81678051.00	0
India	964279129	964279129	964279129	0
Indonesia	198140162	198140162	198140162	0
Iran, Islamic Rep.	60794809.00	60794809.00	60794809.00	0
Japan	125472000	125472000	125472000	0
Mexico	89969572.00	89969572.00	89969572.00	0
Nigeria	108187610	108187610	108187610	0
Pakistan	133117476	133117476	133117476	0
Philippines	69250468.00	69250468.00	69250468.00	0
Russian Federation	148375787	148375787	148375787	0
Thailand	59424834.00	59424834.00	59424834.00	0
Turkiye	59305490.00	59305490.00	59305490.00	0
United States	266278000	266278000	266278000	0
Viet Nam	73759110.00	73759110.00	73759110.00	0

- Summary Statistics (cleaned)

Summary Statistics of Population				
The MEANS Procedure				
Year=1995				
Analysis Variable : Total_Population Total Number of Population				
Country Name	Mean	Minimum	Maximum	N Miss
Bangladesh	117793338	117793338	117793338	0
Brazil	163515328	163515328	163515328	0
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Turkey	59305490.00	59305490.00	59305490.00	0
United States	266278000	266278000	266278000	0
Vietnam	73759110.00	73759110.00	73759110.00	0

- Summary Statistics (pre-cleaned)

Summary Statistics of Energy Consumption						
The MEANS Procedure						
Year=1965						
Analysis Variable : Energy Energy consumption (in Exajoules)						
Country	Mean	Std Dev	Minimum	Maximum	N Miss	Median
Algeria	0.0148403	0.0168426	0.0029308	0.0267498	0	0.0148403
Argentina	0.0894403	0.0834416	0.0304382	0.1484424	0	0.0894403
Australia	0.3637031	0.5142037	0.000106110	0.7273000	0	0.3637031
Austria	0.1379584	0.1058613	0.0631031	0.2128136	0	0.1379584
Azerbaijan				2		
Bangladesh				2		
Belarus				2		
Belgium	0.4026099	0.5655343	0.0026460	0.8025738	0	0.4026099
Brazil	0.0372446	0.0500580	0.0018483	0.0726410	0	0.0372446
Bulgaria	0.1265332	0.1760800	0.0020258	0.2510405	0	0.1265332
Canada	0.7140082	0.0934187	0.6479492	0.7800632	0	0.7140082
Central America	0.000013083		0.000013083	0.000013083	1	0.000013083
Chile	0.0355082	0.0187639	0.0222401	0.0487762	0	0.0355082
China	2.4152240	3.3591992	0.0399115	4.7905366	0	2.4152240
China Hong Kong SAR	0.0051498		0.0051498	0.0051498	1	0.0051498
Colombia	0.0582733	0.0368386	0.0322245	0.0843222	0	0.0582733
Croatia				2		
Cyprus				2		
Czech Republic	0.7472374	1.0349096	0.0154458	1.4790290	0	0.7472374
Denmark	0.1548321		0.1548321	0.1548321	1	0.1548321
Eastern Africa	0.0758912		0.0758912	0.0758912	1	0.0758912
Ecuador				2		
Egypt	0.0092853	0.0107303	0.0016979	0.0168728	0	0.0092853
Estonia				2		
Finland	0.0729354		0.0729354	0.0729354	1	0.0729354
France	0.9561284	1.0973720	0.1801692	1.7320876	0	0.9561284
Germany	3.4208140	4.6800591	0.1115124	6.7301155	0	3.4208140
Greece	0.0882159		0.0882159	0.0882159	1	0.0882159
Hungary	0.2528650	0.2883792	0.0489501	0.4567799	0	0.2528650
Iceland	0.000273675		0.000273675	0.000273675	1	0.000273675
India	0.7484038	1.0463239	0.0085411	1.4882665	0	0.7484038
Indonesia	0.0118355	0.0090998	0.0054010	0.0182700	0	0.0118355
Iran	0.0184810	0.0136427	0.0088341	0.0261278	0	0.0184810
Iraq	0.0170316		0.0170316	0.0170316	1	0.0170316
Ireland	0.1308794		0.1308794	0.1308794	1	0.1308794
Israel	0.0028510		0.0028510	0.0028510	1	0.0028510
Italy	0.3133213	0.0876448	0.2654892	0.3611534	0	0.3133213

- Summary Statistics (cleaned)

Summary Statistics For Energy Consumption						
The MEANS Procedure						
Year=1995						
Analysis Variable : Energy Energy consumption (in Exajoules)						
Country	Mean	Minimum	Maximum	N Miss	Median	
Bangladesh	0.0963978	0.0039600	0.2427240	4	0.0894535	
Brazil	0.9840704	0.0257317	3.1238782	2	0.2876153	
China	4.6586984	0.000074518	27.8526619	1	0.3873768	
Germany	1.5899180	0.000053226	5.8720663	0	0.2294671	
India	1.3334031	0.000010753	5.8738083	1	0.3842928	
Indonesia	0.6286045	0.0226043	1.76869534	4	0.2270789	
Iran	0.9521497	0.0432180	2.5295334	4	0.8179238	
Japan	2.6856779	0.000010215	11.8456271	0	1.5104987	
Mexico	0.6335185	0.000053226	3.3069275	1	0.1479883	
Pakistan	0.2956893	0.0053270	0.6695132	3	0.2421418	
Philippines	0.1815485	0.000183503	0.7193759	3	0.0826694	
Russian Federation	4.6212199	0.000639718	13.4080262	2	3.4371547	
Thailand	0.4430513	0.0016391	1.4822755	4	0.3006838	
Turkey	0.5116144	0.0034332	1.2497328	3	0.3783386	
United States	9.7363661	0.0054766	34.5510978	0	3.3129851	
Vietnam	0.1144374	0.0050547	0.2103976	4	0.1211488	

# MERGING ENERGY CONSUMPTION AND POPULATION

```
Proc Sql;
CREATE TABLE KINGG.MERGED_POPULATION_ENERGY AS
Select*
From KINGG.ENERGY_CONSUMPTION_TOP20 AS e
Inner Join KINGG.POPULATION AS p
On e.Country= p.Country_Name and e.Year = p.Year
GROUP BY COUNTRY
ORDER BY ENERGY DESC;
Quit;
```

- Inner join of Energy Consumption and Population was used for further analysis.
- Added a column named Energy\_Source and categorized type of energy by (Renewable/Non-Renewable)  
e.g Coal-NR and Wind-R

	Country	Year	Region	Type	Energy	Energy_source	Country_Name	Total_Population
1	China	2021	Asia Pacific	Coal	86.169817291	Non-Renewable	China	1412360000
2	China	2014	Asia Pacific	Coal	82.480215395	Non-Renewable	China	1371860000
3	China	2013	Asia Pacific	Coal	82.43068181	Non-Renewable	China	1363240000
4	China	2020	Asia Pacific	Coal	82.376123089	Non-Renewable	China	1411100000
5	China	2019	Asia Pacific	Coal	81.698552898	Non-Renewable	China	1407745000
6	China	2018	Asia Pacific	Coal	81.053223201	Non-Renewable	China	1402760000
7	China	2015	Asia Pacific	Coal	80.91794045	Non-Renewable	China	1379860000
8	China	2012	Asia Pacific	Coal	80.706561022	Non-Renewable	China	1354190000
9	China	2017	Asia Pacific	Coal	80.560382036	Non-Renewable	China	1396215000
10	China	2016	Asia Pacific	Coal	80.185852512	Non-Renewable	China	1387790000
11	China	2011	Asia Pacific	Coal	79.706312393	Non-Renewable	China	1345035000
12	China	2010	Asia Pacific	Coal	73.220806404	Non-Renewable	China	1337705000
13	China	2009	Asia Pacific	Coal	70.578071174	Non-Renewable	China	1331260000
14	China	2008	Asia Pacific	Coal	67.377314245	Non-Renewable	China	1324655000
15	China	2007	Asia Pacific	Coal	66.326086566	Non-Renewable	China	1317885000
16	China	2006	Asia Pacific	Coal	60.90617426	Non-Renewable	China	1311020000
17	China	2005	Asia Pacific	Coal	55.45828066	Non-Renewable	China	1302320000

# TOTAL ENERGY CONSUMED BY COUNTRY

```
PROC SQL;
  SELECT Country, total_energy
  FROM (
    SELECT Country, SUM(Energy) AS total_energy
    FROM KINGG.ENERGY_CONSUMPTION_TOP20
    GROUP BY Country
  )
  GROUP BY Country
  ORDER BY total_energy DESC;
QUIT;
```

- United States tops the chart for the usage of overall energy resources.
- Used subquery to get this output.

Country	total_energy
United States	4683.622
China	2992.6
Russian Federation	1100.144
Japan	1000.803
Germany	797.3196
India	725.6019
Brazil	383.3546
Mexico	272.4627
Iran	264.8482
Indonesia	191.7098
Turkey	155.109
Thailand	127.3925
Pakistan	87.18834
Vietnam	60.20968
Philippines	50.27736
Bangladesh	28.25428

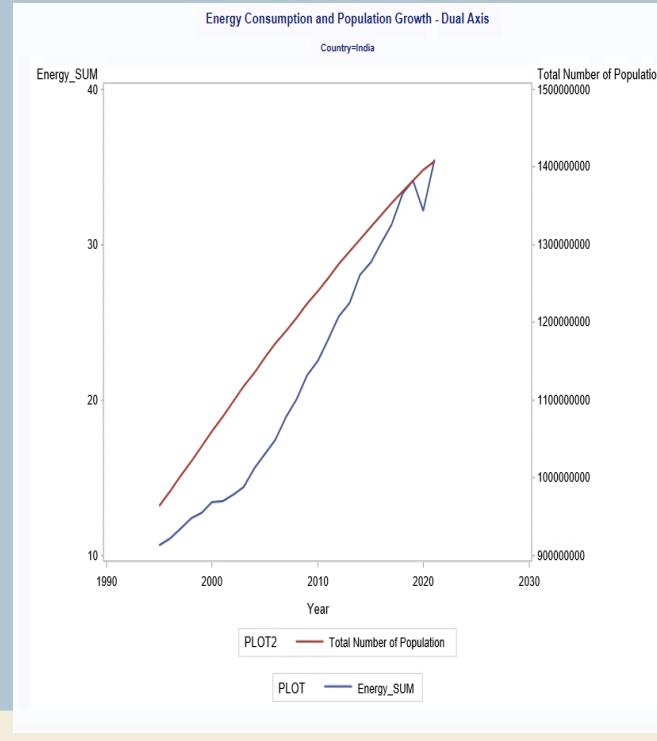
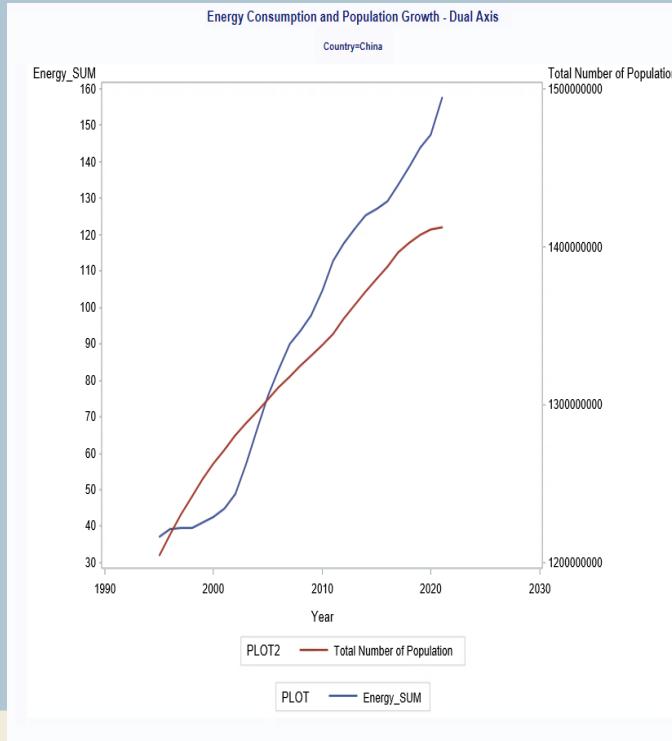
## Total Energy Consumption by Country and Type

	Biofuel	Coal	Hydro-electric	Natural gas	Nuclear energy	Oil	Other renewables	Solar	Wind	Energy Consumption per Country
Bangladesh		1.28	0.21	17.01		5.83	0.00	0.03	0.00	24.35
Brazil	13.17	15.98	94.07	23.07	3.08	113.35	8.52	0.37	3.47	275.08
China	1.52	1617.91	174.45	119.18	28.77	461.27	10.99	11.90	30.71	2456.70
Germany	2.09	88.38	5.54	83.03	34.25	138.10	8.36	4.25	12.50	376.50
India	0.98	314.40	29.71	39.82	6.39	172.26	4.15	2.48	5.73	575.92
Indonesia	1.33	40.82	3.65	37.32		70.92	2.75	0.01	0.02	156.81
Iran		1.59	3.27	123.81	0.46	85.67	0.00	0.02	0.06	214.89
Japan		122.34	22.21	91.91	51.48	260.13	6.70	4.72	0.83	560.32
Mexico	0.12	11.37	8.16	58.47	2.63	98.35	1.91	0.32	1.14	182.45
Pakistan		5.95	7.46	29.65	0.96	23.11	0.11	0.07	0.15	67.46
Philippines		8.87	2.26	2.45		19.33	2.67	0.07	0.08	35.73
Russian Federation		108.90	47.34	394.95	41.91	159.67	0.10	0.07	0.05	752.98
Thailand	0.86	15.19	1.67	34.58		53.56	1.33	0.33	0.14	107.66
Turkey		32.91	12.88	30.16		40.69	0.94	0.43	1.68	119.69
United States	20.71	510.06	76.27	652.38	211.50	991.31	22.11	7.13	28.68	2520.14
Vietnam		18.98	9.97	5.79		17.68	0.02	0.40	0.05	52.88
Energy Consumption per Type	40.78	2914.93	499.10	1743.58	381.42	2711.22	70.66	32.58	85.29	8479.55

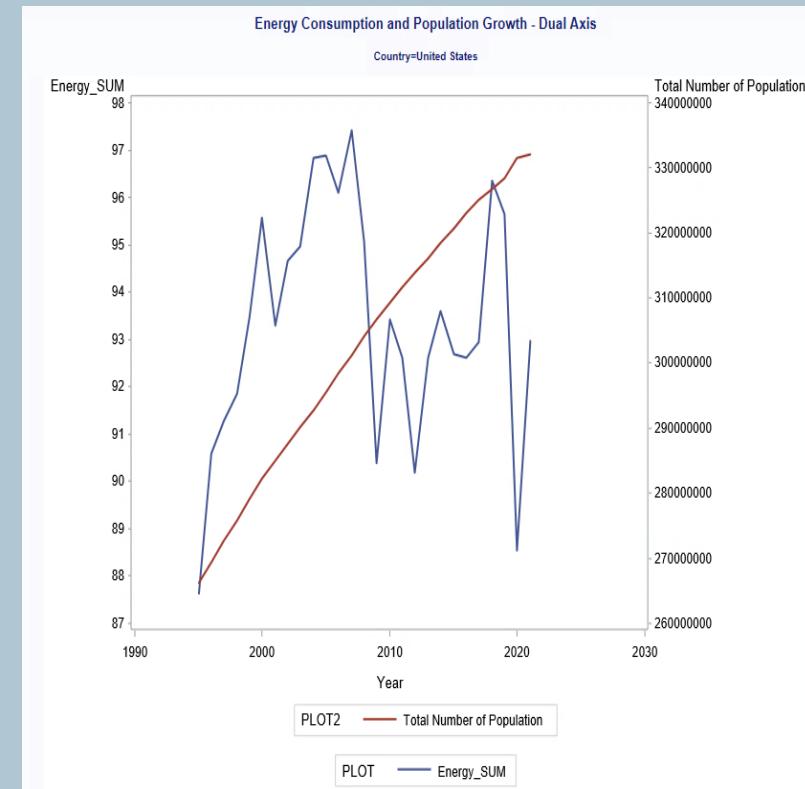
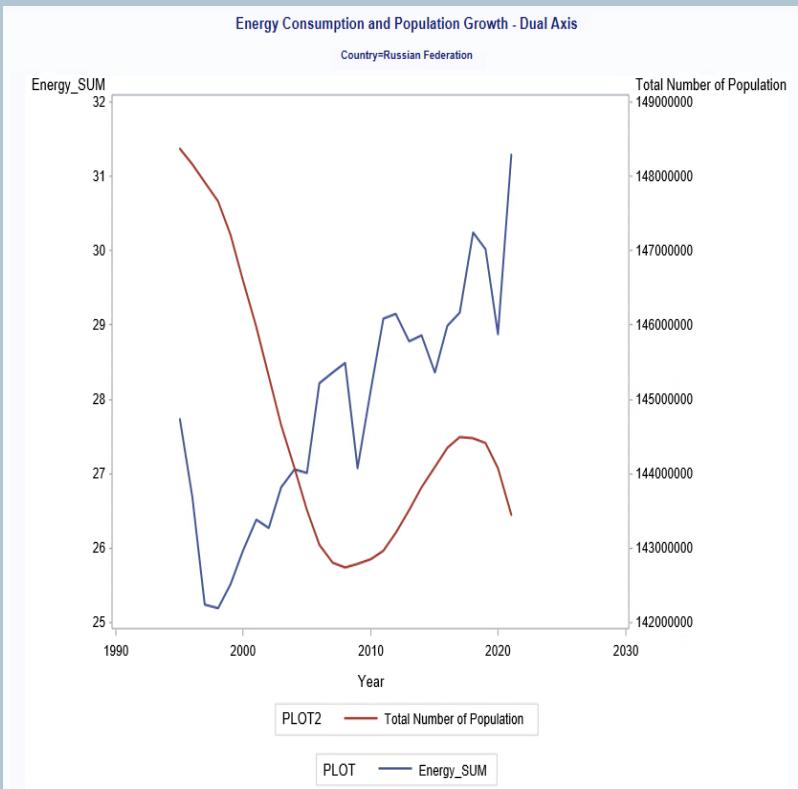
# CORRELATION OF ENERGY CONSUMPTION AND POPULATION

Analysis for 1<sup>st</sup> problem definition:

- Population and energy consumption were correlated for 13 countries i.e., 76.47% of the data.
- Timeseries graphs indicate the same.



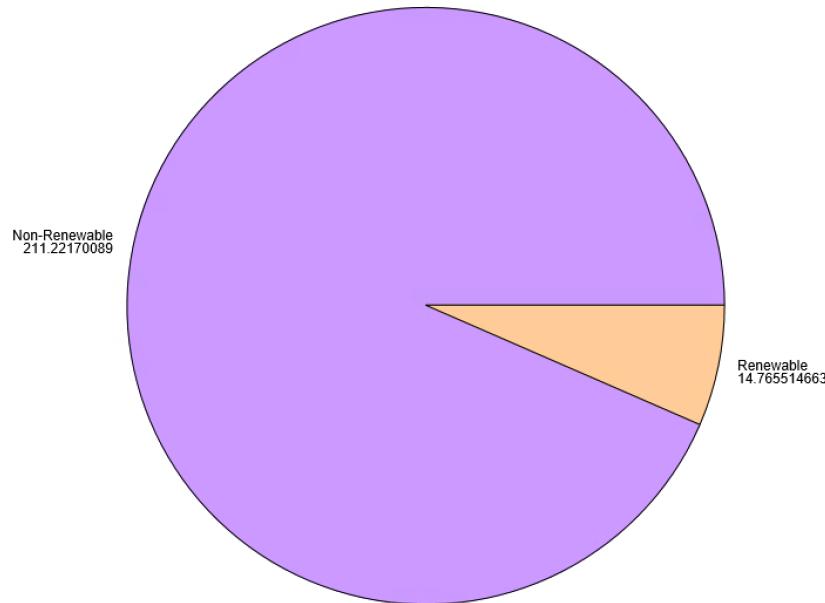
No correlation found between population and energy consumption for 4 countries i.e., 23.5% of the data.



## GRADUAL INCREASE OF RENEWABLE ENERGY CONSUMPTION FROM 1995 - 2021

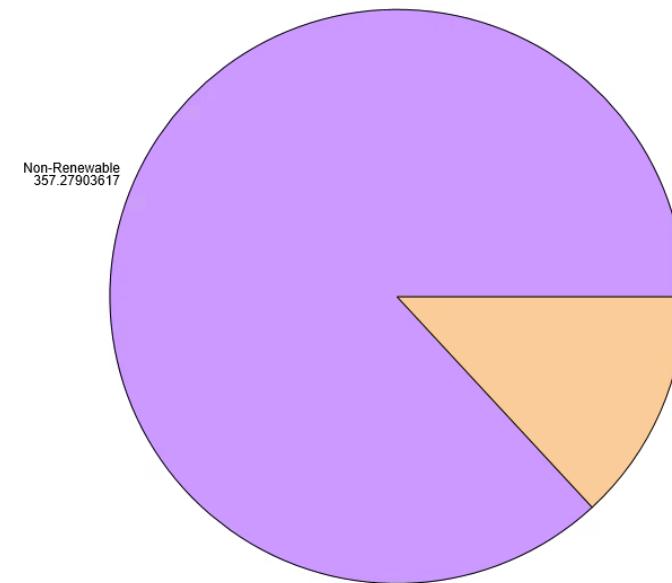
Energy Source Pie Chart

Year=1995



Energy Source Pie Chart

Year=2021



# COUNTRIES ABOVE TOTAL TEMPORAL AVERAGE ENERGY CONSUMPTION

Country	Year	Type	Energy consumption (in Exajoules)
China	2020	Hydro-electric	12.496284381
China	2021	Hydro-electric	12.246048092
China	2019	Hydro-electric	12.075750116
China	2018	Hydro-electric	11.418840696
China	2017	Hydro-electric	11.162074355
China	2016	Hydro-electric	11.114425688
China	2015	Hydro-electric	10.804893059
China	2014	Hydro-electric	10.334910647
China	2013	Hydro-electric	8.9246645324
China	2012	Hydro-electric	8.5166128277
China	2010	Hydro-electric	7.1082000274
China	2011	Hydro-electric	6.833082622
China	2008	Hydro-electric	6.4436205971
China	2009	Hydro-electric	6.1895391398
China	2021	Wind	6.1757762531
China	2007	Hydro-electric	4.9397135806
China	2006	Hydro-electric	4.4639551917
China	2020	Wind	4.4105901251
Brazil	2011	Hydro-electric	4.2538412912
Brazil	2012	Hydro-electric	4.0998292158
China	2005	Hydro-electric	4.0925660127
Brazil	2010	Hydro-electric	4.0297056544
Brazil	2009	Hydro-electric	3.9309015137

- Output shows countries with years that surpass average energy usage (renewable and nonrenewable)
- Used inline view.

Country	Year	Type	Energy consumption (in Exajoules)
China	2021	Coal	86.160817201
China	2014	Coal	82.480215395
China	2013	Coal	82.43068181
China	2020	Coal	82.376123089
China	2019	Coal	81.698552898
China	2018	Coal	81.053223201
China	2015	Coal	80.91794045
China	2012	Coal	80.706561022
China	2017	Coal	80.580382036
China	2016	Coal	80.185852512
China	2011	Coal	79.706312393
China	2010	Coal	73.220806404
China	2009	Coal	70.578071174
China	2008	Coal	67.377314245
China	2007	Coal	66.326088566
China	2006	Coal	60.90817426
China	2005	Coal	56.45838066
China	2004	Coal	47.359006934
China	2003	Coal	40.619010882
United States	2005	Oil	40.370681647

```

PROC SQL;
SELECT Country, Year, type, Energy
from KINGG.ENERGY_CONSUMPTION_TOP20
where Energy_source='Renewable' and Energy > (select avg(Energy)
      from KINGG.ENERGY_CONSUMPTION_TOP20
      where Energy_source='Renewable')
order by Energy Desc;
quit;

```

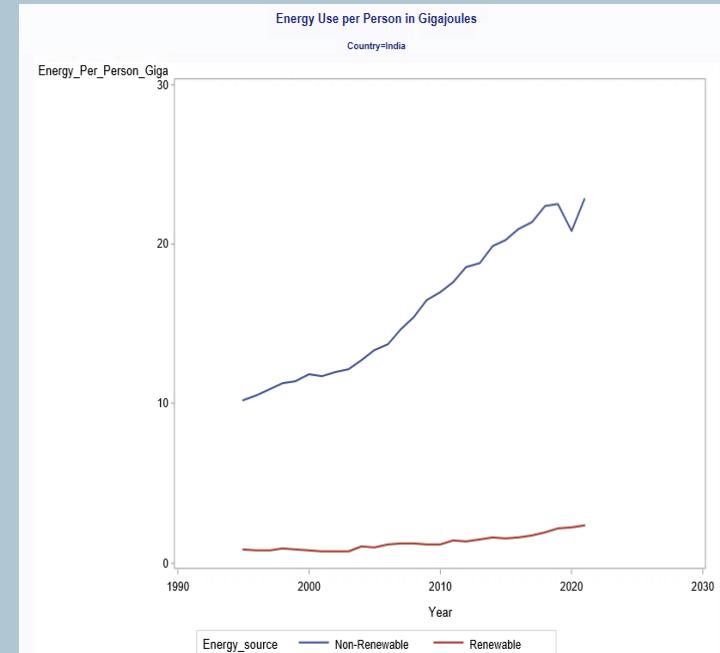
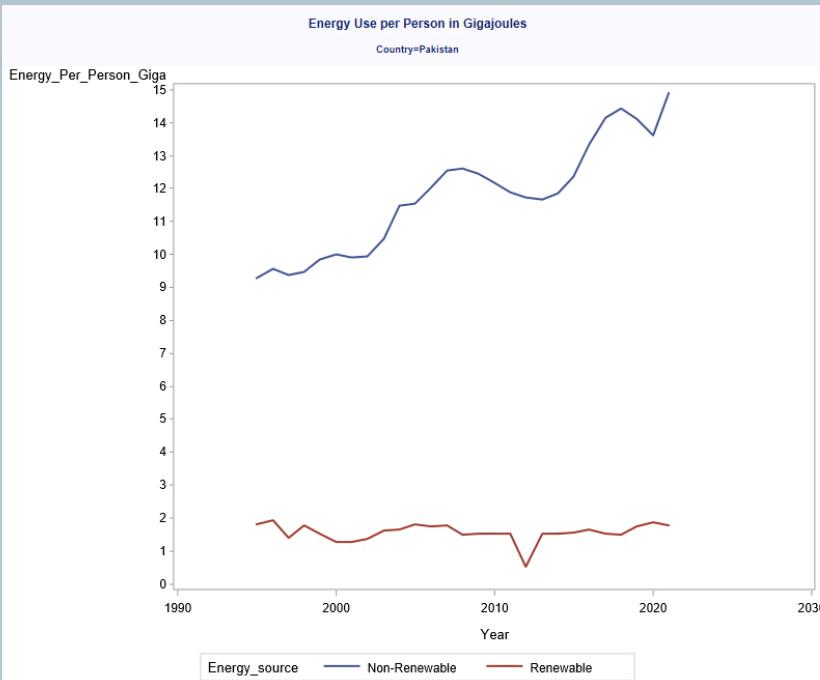
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PROC SQL;
SELECT Country, Year, type, Energy
from KINGG.ENERGY_CONSUMPTION_TOP20
where Energy_source='Non-Renewable' and Energy > (select avg(Energy)
      from KINGG.ENERGY_CONSUMPTION_TOP20
      where Energy_source='Non-Renewable')
order by Energy Desc;
quit;

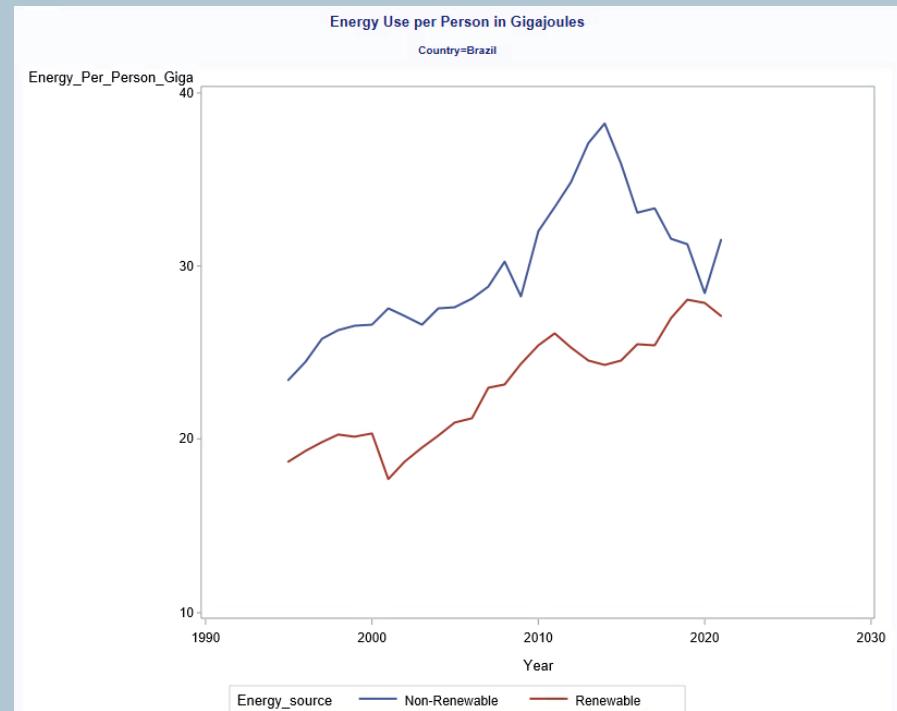
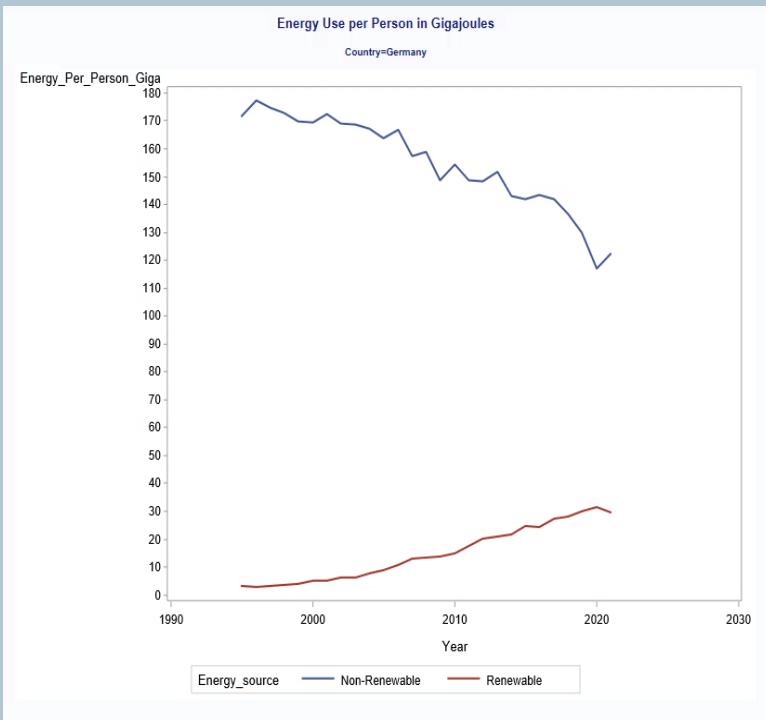
```

# PER PERSON USAGE OF NON-RENEWABLE AND RENEWABLE ENERGY

- An increase in non-renewable energy is seen but very slow to no growth in renewable per-person energy usage.
- This trend is observed for 13 countries i.e; 76.47% of overall data.



- A gradual decrease in non-renewable resource usage while renewable resource usage is increasing. This trend is observed for 4 countries i.e; 23.53% of overall data.



# CONCLUSION

- **To see if population and energy consumption are correlated.**
- 76.47% indicates correlation
- 23.53% indicates lack of correlation
  
- **To understand energy consumed per person (renewable/non-renewable) by country.**
- 76.47% indicates increasing non-renewable energy usage while renewable energy usage runs constant
- 23.53% indicates declining non-renewable energy usage while renewable energy usage increases

## RECOMMENDATIONS

- For more in-depth research, all countries can be considered from both datasets instead of just 17 countries
- New variable for clean energy can be added (renewable energy does not always mean clean energy)

# THANK YOU