The Correlation Between Renewable Energy, Energy Production

and Greenhouse Gas Emissions

Project Team

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Summary

In this project, our goal is to analyze the relationship between the increase in energy production and the corresponding greenhouse gas emissions. This investigation is motivated by the significant rise in energy derived from renewable sources, with data sourced from the Turkish Statistical Institute (TÜİK), Organisation for Economic Co-operation and Development (OECD) and U.S Energy Information Administration (EIA).

Problem Definition

Because technology is advancing in a rapid speed while more households get their hands on electric products, there is a constantly increasing need for energy. In order to satisfy this need, more and more energy was generated using non renewable energy sources and this caused significant increases in greenhouse gas emissions. With the growing popularity of renewable energy sources, countries increased their usage of renewable energy sources and this caused an increase in generated energy while not emitting greenhouse gasses. In this project, we will be inspecting how the increase in the usage of renewable energy sources effect the generated energy - greenhouse gas emission ratio.

Dataset(s) Sources

Türkiye Electric Generation by Source in Percentage Through Years

	Year	Total	Coal	Liquid fuels	Natural Gas	Hydro	Renewable Energy and wastes(1)
0	1990	57543.000000	35.100000	6.800000	17.700000	40.200000	0.200000
1	1991	60246.000000	35.800000	5.600000	20.800000	37.600000	0.200000
2	1992	67342.000000	36.500000	7.800000	16.000000	39.500000	0.200000
3	1993	73808.000000	32.100000	7.000000	14.600000	46.100000	0.200000
4	1994	78322.000000	36.000000	7.100000	17.600000	39.100000	0.200000
5	1995	86247.000000	32.500000	6.700000	19.200000	41.200000	0.400000
6	1996	94862.000000	32.000000	6.900000	18.100000	42.700000	0.300000
7	1997	103296.000000	32.800000	6.900000	21.400000	38.500000	0.400000
8	1998	111022.000000	32.200000	7.200000	22.400000	38.000000	0.300000
9	1999	116440.000000	31.800000	6.900000	31.200000	29.800000	0.300000
10	2000	124922.000000	30.600000	7.500000	37.000000	24.700000	0.300000
11	2001	122725.000000	31.300000	8.400000	40.400000	19.600000	0.300000
12	2002	129400.000000	24.800000	8.300000	40.600000	26.000000	0.300000
13	2003	140581.000000	22.900000	6.600000	45.200000	25.100000	0.200000
14	2004	150698.000000	22.800000	5.000000	41.300000	30.600000	0.300000

Our first dataset is about the yearly electric generation percentage by source and the total amount of electric generated in terms of gigawatt-hours (GWh) in Turkiye. The dataset includes data from the year 1990 to 2021. On the left you can see the first 15 rows of the dataset (TUIK).

Türkiye Greenhouse Gas emissions (Million Tons of CO2)

	Yıl\nYear	Toplam\nTotal	CO2	CH4	N2O	F-gazlar\nF-gases
0	1990	219.526151	151.614981	42.487543	24.950823	0.472804
1	1991	226.794721	158.126315	43.377429	24.733992	0.556985
2	1992	233.132483	164.064876	43.288202	25.259650	0.519754
3	1993	240.771746	171.138875	43.065540	26.048287	0.519045
4	1994	234.387830	167.565647	42.787878	23.570421	0.463884
5	1995	248.248909	181.355257	42.613471	23.870854	0.409326
6	1996	267.581386	199.646693	42.968946	24.542460	0.423287
7	1997	278.813841	212.108198	42.231314	24.050525	0.423804
8	1998	280.318959	212.135043	42.421875	25.338883	0.423158
9	1999	277.776799	207.927912	43.789483	25.636443	0.422961
10	2000	298.916755	229.936660	43.667289	24.774565	0.538241
11	2001	279.740138	213.581229	42.902486	22.600494	0.655929
12	2002	285.623365	221.225642	40.956329	22.594353	0.847041
13	2003	304.794788	236.765649	42.958062	24.006964	1.064113
14	2004	314.423570	244.768581	43.501239	24.802051	1.351699

This dataset includes the yearly amount of greenhouse gas emissions throughout the years 1990-2021 in terms of million tons of CO2 (TUIK).

USA Electric Generation by Source in Years

	NaN	coal	natural gas	nuclear	renewables	petroleum and other	total
0	1990.0	1594	373	577	357	137	3038
1	1991.0	1591	382	613	358	131	3075
2	1992.0	1621	404	619	327	113	3084
3	1993.0	1690	415	610	357	125	3197
4	1994.0	1691	460	640	337	120	3248
5	1995.0	1709	496	673	385	90	3353
6	1996.0	1795	455	675	423	96	3444
7	1997.0	1845	479	629	434	105	3492
8	1998.0	1874	531	674	400	141	3620
9	1999.0	1881	556	728	399	130	3694
10	2000.0	1966	601	754	356	124	3801

This dataset includes the yearly amount of electric generated in terms of billion kilowatt-hours (KWh) by the major sources in the United States throughout the years 1990-2021 (EIA).

USA and TR Greenhouse Gas Emissions (Tons of CO2)

	Country	Pollutant	Year	Unit	PowerCode	Value
0	Türkiye	Greenhouse gases	1990	Tonnes of CO2 equivalent	Thousands	219526.15
1	Türkiye	Greenhouse gases	1991	Tonnes of CO2 equivalent	Thousands	226794.72
2	Türkiye	Greenhouse gases	1992	Tonnes of CO2 equivalent	Thousands	233132.48
3	Türkiye	Greenhouse gases	1993	Tonnes of CO2 equivalent	Thousands	240771.75
4	Türkiye	Greenhouse gases	1994	Tonnes of CO2 equivalent	Thousands	234387.83
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59	United States	Greenhouse gases	2017	Tonnes of CO2 equivalent	Thousands	6561824.44
60	United States	Greenhouse gases	2018	Tonnes of CO2 equivalent	Thousands	6754831.65
61	United States	Greenhouse gases	2019	Tonnes of CO2 equivalent	Thousands	6617916.88
62	United States	Greenhouse gases	2020	Tonnes of CO2 equivalent	Thousands	6025973.61
63	United States	Greenhouse gases	2021	Tonnes of CO2 equivalent	Thousands	6340228.29

This dataset includes the amount of greenhouse gas emissions of both the USA and Türkiye in terms of thousand tons of CO2 through the years 1990-2021 (OECD).

Possible Research Questions

- How does increasing the percentage of renewable energy sources affect the greenhouse gas emission and the total energy produced?

- What would the future of energy production look like and how are these values expected to change?

- What are the differences in electric generation sources between USA and Turkiye?

- Which country between Turkiye and USA is adapting to renewable energy sources quicker than the other country?