Correlation between GDP and fossil fuel consumption in developing & developed countries

Research question

How does fossil fuel consumption change with GDP of developed and developing countries?

Introduction

Consumption of Fossil fuel is increasing day by day which also increases the greenhouse gasses in the atmosphere which affects the temperature of earth. The consumption of fossil fuel is increasing due to increase in the population and standard of living so their dependency on automobiles increases which uses petrol and diesel and emits Co2 in the atmosphere .An increase in the number of factories also affects the usage of fossil fuels in the country. This has become the global problem because Fossil fuels is decreasing day by day as it Non-renewable energy though creates pollution but it is also very important for various activities like petroleum use as a source of energy and coal which is used as a raw material for hard coke and it is used in the furnace of steel and iron factories. Although many developed countries like the USA and UK are able to decrease their consumption of fossil fuels by switching to clean energy like solar and wind energy[1]. However, many developed countries are trying to switch to renewable energy but lots needs to be done to reduce the usage of fossil fuels. So, all countries should join hands together to be able to save our "Earth"

Background information

Industry of developed and developing countries are heavily dependent on fossil fuel. Most of the vehicles and machineries are designed to use fossil fuels so it is very difficult to replace

[1] "Watch: Market Movers Europe, Nov 2-6: OPEC+ Faces New Lockdowns, Europe Talks Clean Energy." 02 Nov. 2020. Web. 02 Nov. 2020.

machineries by new machineries which run on renewable energy because it will be very expensive for the countries to replace all machineries. Hence it leads to an increase in the consumption of fossil fuels and it increases the concentration of greenhouse gas like Co2 in the atmosphere which increases the temperature because of which the Glacier of the polar region melts and increases in the leve sea water and causes flood. It changes the equilibrium of earth's ecosystem.

Hypothesis

The developing country will have higher fossil fuels consumption than the developed countries due to lack of infrastructure and finance. Hence the increase in the GDP of developing countries will increase the consumption of fossil fuels.

Table 1.1: Variables

Type of variable	component	reason
Independent	GDP of the developed and developing country	GDP of developed and developing countries vary a lot
Dependent	Use of fossil fuels and correlation with GDP in a developed and developing country	Usage of fossil fuels will depend upon the development of any country.

Controlled	Source of data method of establishing the correlation use of fossil fuel and GDP	Secondary research will be used for establishing the correlation of the use of fossil fuel and GDP of the country
Uncontrolled	Area of country and population size of the country	Population size and area of the country will vary

Method

- Raw Data for GDP and fossil fuel consumption is taken from the year 2000 to 2014 from www.macrotrends.com
- The data is segregated into Developed and developing
- Average fossil fuel consumption and GDP of developed and developing countries is calculated.
- Correlation between developing and the developed country will be established from the raw data of GDP and consumption of fossil fuels using Pearson correlation
- At last, the evaluation is done to show how the usage of fossil fuel is different from a developed and developing country.

Ethical Consideration:

- Data was collected from the website that is open for public usage
- No confidential data of any country has been taken or published.

Factories using fossil fuels and causing pollution

Automobile using fossil fuels and exerting harmful pollutants

Raw data collection

Table2.1: Fossil fuel consumption in % of total energy and GDP of developed countries

Developed Countries												
Countries	**USA**		**UK**		**Germany**		**Greece**		**Italy**		**Netherland**	
year	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**
1999	9,417.26	85.78	1,394.09	87.24	2,197.77	83.93	202.79	94.18	1,453.32	91.84	479.07	94.15
2000	10,002.86	85.88	1,561.78	88.41	2,249.97	83.62	205.20	94.59	1,576.00	91.73	491.56	93.85
2001	10,596.29	86.35	1,636.77	87.83	2,354.16	83.61	223.02	94.39	1,586.22	91.4	523.73	94.2
2002	10,992.05	86.28	1,726.20	88.53	2,440.51	83.28	239.29	94.07	1,658.58	91.04	548.95	93.99
2003	11,567.33	86.28	1,808.11	88.83	2,491.08	83.18	255.61	93.99	1,660.28	90.22	555.18	94.33
2004	12,303.34	86.12	1,917.52	88.62	2,593.45	82.57	276.20	93.78	1,660.28	90.41	570.87	94.02
2005	13,142.87	86.02	1,970.04	88.16	2,647.47	81.86	275.96	93.41	1,700.42	89.8	596.41	93.06
2006	13,867.47	85.63	2,118.41	88.61	2,853.46	81.27	306.73	92.89	1,898.90	89.19	647.42	92.75
2007	14,535.00	85.61	2,180.03	89.62	3,028.60	81.27	317.71	93.03	1,957.05	88.18	701.24	92.73

year	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %
2008	14,835.19	84.97	2,258.19	90.18	3,144.66	80.8	335.44	92.78	2,071.88	86.84	767.25	92.32
2009	14,420.31	84.15	2,160.89	87.37	3,040.13	79.97	331.64	92.37	2,035.74	84.85	740.29	92.89
2010	15,079.92	84.15	2,278.07	88.17	3,224.11	79.56	328.94	90.39	2,060.18	84.63	743.34	93.67
2011	15,591.85	83.71	2,337.20	85.56	3,452.76	80.37	296.57	90.85	2,136.92	84.46	771.60	92.19
2012	16,257.15	83.44	2,438.92	85.14	3,522.03	80.63	280.36	90.15	2,157.16	82.2	788.79	91.23
2013	16,848.75	82.94	2,552.81	83.56	3,685.04	81.09	281.14	88	2,189.31	79.96	836.58	91.55
2014	17,719.84	83.09	2,657.15	82.72	3,838.30	79.71	290.92	86.05	2,190.93	78.59	826.00	90.92

Table 2.2: Fossil fuel consumption in % of total energy and GDP of developing countries

Developing countries												
Countries	**Brazil**		**India**		**Pakistan**		**Russia**		**Mexico**		**Argentina**	
year	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**	**GDP (in billion $)**	**Fossil fuel used in %**
1999	599.39	57.29	458.82	63.46	62.97	58.66	195.91	91.31	1,010.48	87.09	429.73	88.28
2000	655.42	58.23	468.39	63.73	82.02	58.57	259.71	91.13	1,069.23	87.25	440.59	88.39
2001	559.37	58.95	485.44	63.65	79.48	57.65	306.60	90.89	1,115.61	88.28	444.14	85.99
2002	507.96	57.15	514.94	64.33	79.90	57.65	345.47	90.75	1,113.80	88.52	383.31	85.80
2003	558.32	54.64	607.70	64.52	91.76	58.02	430.35	90.92	1,170.65	88.88	410.97	86.01
2004	669.32	54.7	709.15	65.58	107.76	59.83	591.02	90.69	1,227.68	88.76	467.11	89.33
2005	891.63	54.25	820.38	65.99	120.06	60.08	764.02	90.69	1,318.70	88.64	522.01	89.05
2006	1,107.64	53.42	940.26	66.81	137.26	60.93	989.93	90.62	1,482.46	89.11	579.16	88.65
2007	1,397.08	52.66	1,216.74	67.88	152.39	62.48	1,299.71	90.55	1,548.10	88.90	647.06	89.23
2008	1,695.82	52.57	1,198.90	69.01	170.08	61.64	1,660.85	90.95	1,605.52	89.70	712.02	90.65

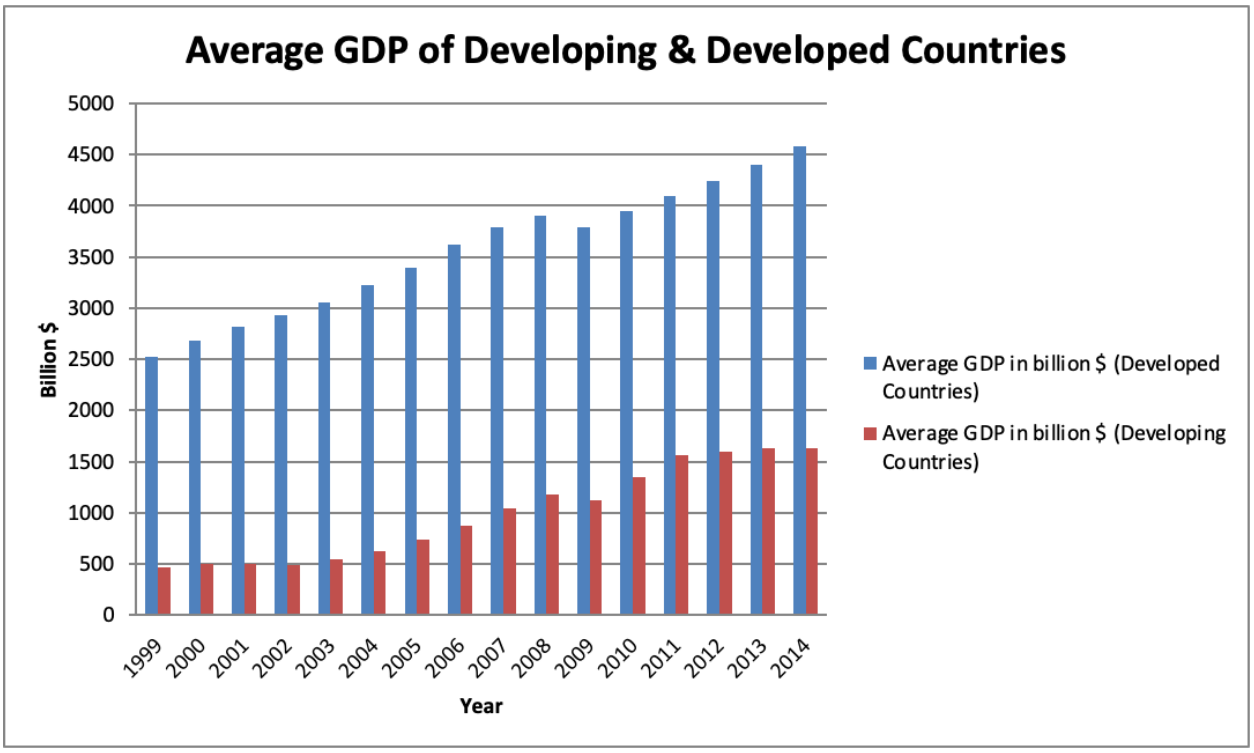
year	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %	GDP (in billion $)	Fossil fuel used in %
2009	1,667.02	51.32	1,341.89	71.14	168.15	61.03	1,222.64	90.16	1,686.47	90.58	672.24	89.61
2010	2,208.87	53.49	1,675.62	71.40	177.17	60.27	1,524.92	90.53	1,751.37	90.50	720.81	89.5
2011	2,616.20	54.57	1,823.05	71.47	213.59	59.69	2,045.93	90.91	1,886.84	90.46	801.24	88.85
2012	2,465.19	56.55	1,827.64	72.42	224.38	59.49	2,208.30	90.87	2,000.93	91.06	823.40	89.02
2013	2,472.81	58.02	1,856.72	72.29	231.22	59.28	2,292.47	89.51	2,049.89	90.57	847.87	88.97
2014	2,455.99	59.11	2,039.13	73.58	244.36	61.59	2,059.24	92.14	2,128.59	90.28	851.24	87.72

Data processing and Presentation

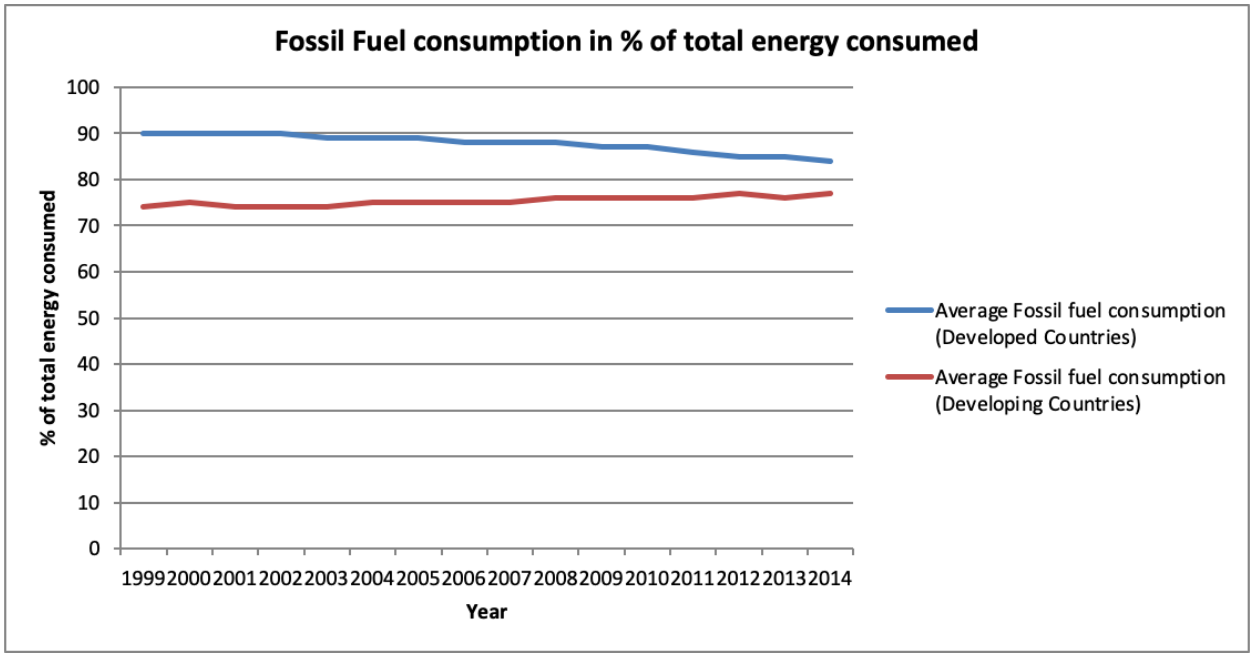
Table 3.1: Fossil fuel consumption in % of total energy and GDP developing and developed country

	Developed Countries		Developing Countries	
Year	**Average GDP in billion $**	**Average Fossil fuel consumption**	**Average GDP in billion $**	**Average Fossil fuel consumption**
1999	2524	90	460	74
2000	2681	90	496	75
2001	2820	90	498	74
2002	2934	90	491	74
2003	3056	89	545	74
2004	3220	89	629	75
2005	3389	89	739	75
2006	3615	88	873	75
2007	3787	88	1044	75
2008	3902	88	1174	76
2009	3788	87	1126	76
2010	3952	87	1343	76
2011	4098	86	1564	76
2012	4241	85	1592	77
2013	4399	85	1625	76
2014	4587	84	1630	77

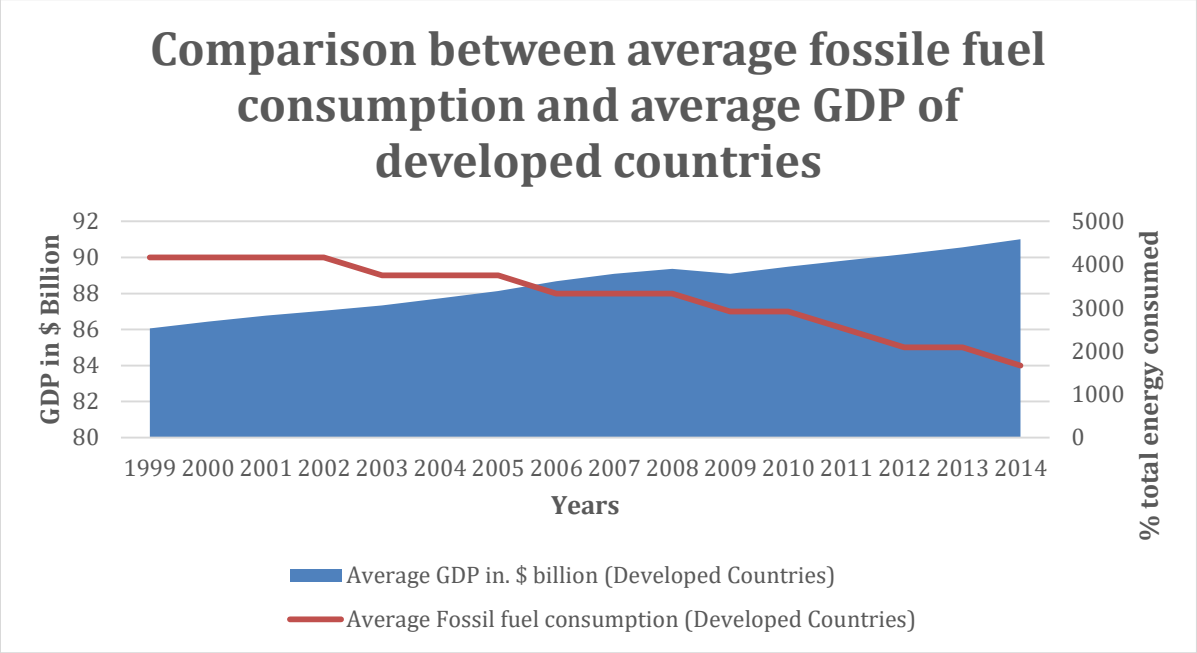
Graph 1.1: Average GDP of developing & Developed countries from 1999-2014



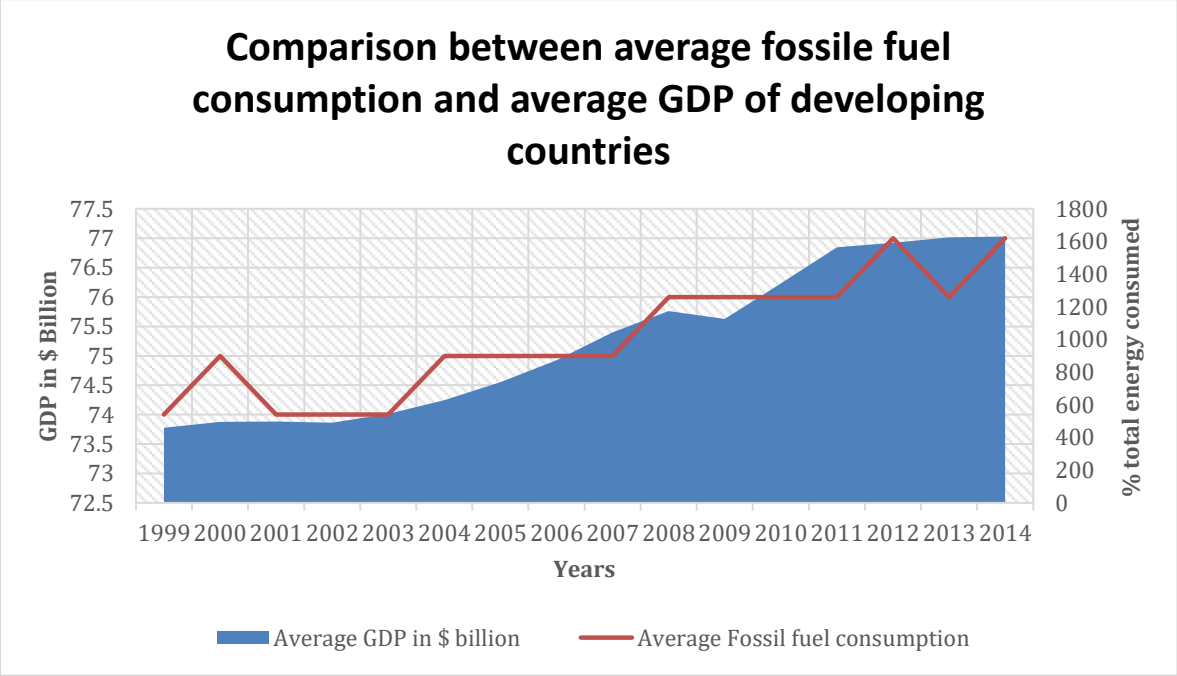
Graph 1.2: Fossil fuel consumption in% of total energy consumed from 1999-2014



Graph 1.3: Comparison between average fossil fuel consumption and Average GDP of Developed countries



Graph 1.4: Comparison between average fossil fuel consumption and Average GDP of Developing countries



Result and discussion

As per above graph 1.1 which shows that the average GDP of both developed and developing countries have risen dramatically from 1999 to 2014 due to many factors like increase in the availability of natural resources, increase in the availability of employment and increase in the technology used in the production process has pulled the GDP of both countries upwards.

Whereas, the fossil fuel consumption of developed countries has decreased overtime and of developing countries it has increased as seen in graph 1.2.

Graph 1.3 and graph 1.4 shows comparison between the GDP and Fossil fuel consumption of developed countries and developing countries respectively. Further, **Pearson correlation** will be done see the correlation between GDP and Fossil Fuel consumption.

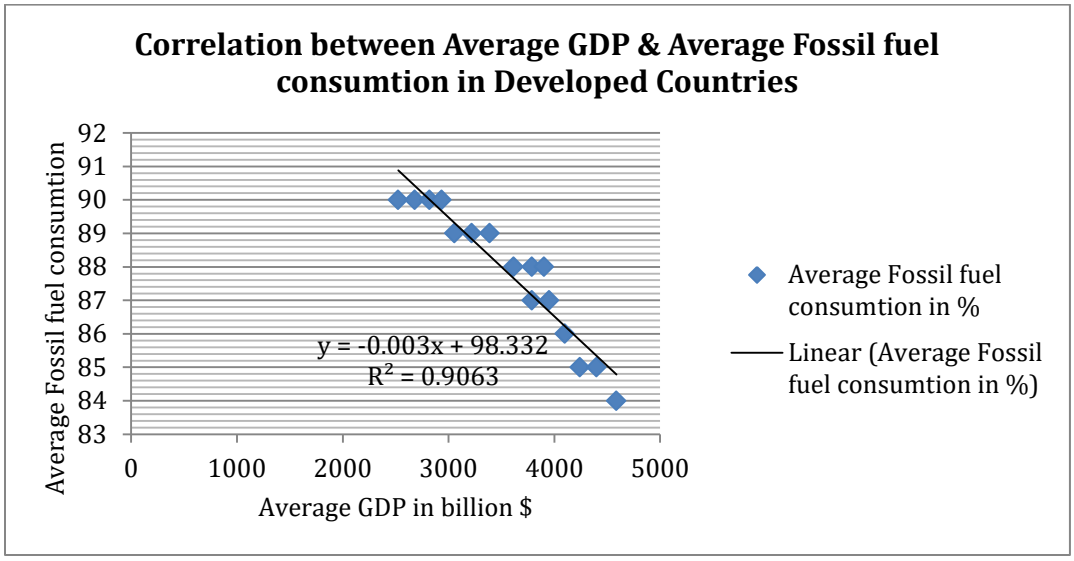
This contrast relationship between both countries has happened because people of the developed countries are more educated than the developing countries so they have higher job opportunities of high salary which makes there spending power better than people of developed countries.

Therefore in developed countries, fossil fuel has decreased as the GDP increase because of altering the source of energy to a renewable source of energy and also in some developed countries people have switched from the vehicle which runs on gasoline and diesel to an electric vehicle. These steps have reduced the carbon emission in the atmosphere drastically.

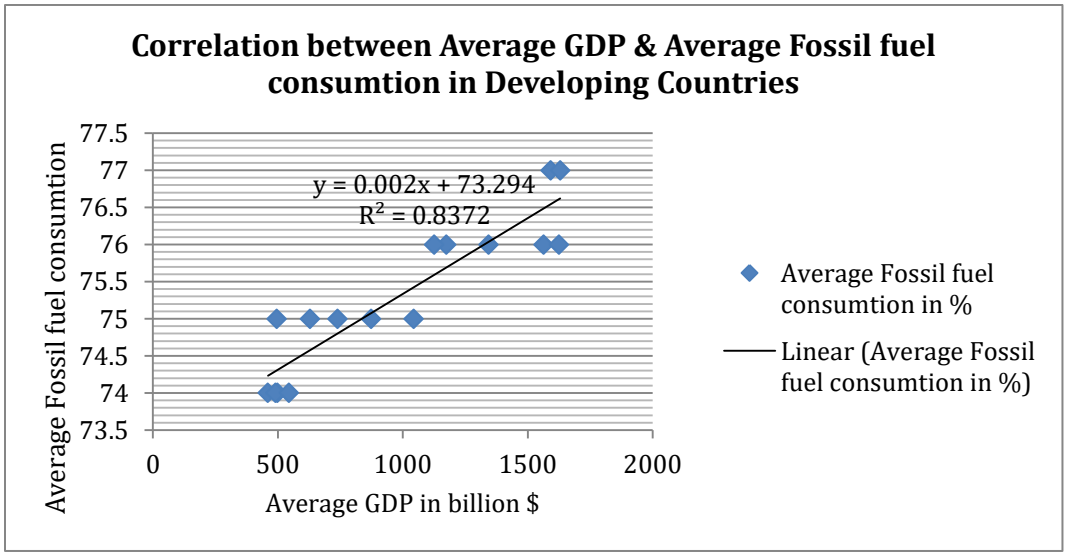
Statistical Analysis

Pearson correlation has been done to establish correlation between the GDP and Fossil fuel consumption of developing countries and Developed countries.

Graph 2.1: Correlation between GDP & Fossil fuel consumption of Developed countries



Graph 2.2: Correlation between GDP & Fossil fuel consumption of Developing countries



In the above graph 2.1, the R^2 value of 0.9063 shows strong negative correlation between average GDP and fossil fuel consumption of developed countries, whereas, graph 2.2 shows a strong positive correlation between average GDP and fossil fuel consumption of developing countries

Conclusion

As graphs 2.1 and 2.2 clearly shows the correlation between the GDP and usage of fossil fuel in both developed and developing countries. In developed countries, there is a negative correlation between fossil fuel consumption and GDP of the country whereas there is a positive correlation between fossil fuel consumption and GDP of the developing countries. There is higher carbon emission in the developing countries than developed countries which also lead to higher pollution in future if they won't reduce the using fossil fuels. However, correlation does not mean causation.

Developing countries can reduce the usage of fossil fuels by altering human activities like the government should give benefit to people in the use of the renewable source of energy such as solar energy or hydroelectric so that people are willing to switch from fossil fuels to renewable energy. In 2019 Indian government has reduced the taxes on electric vehicle which will encourage people to buy more electric vehicle in the country than a regular vehicle which runs on diesel or gasoline and they are also giving subsidy to automobile companies on producing the electric vehicle which will help them to reduce the usage fossil fuel. Countries can also regulate and reduce pollution at the point of emission like recently in India government has banned the usage of diesel cars which are older than 10 year[2]s and they have also banned the registration of BS-IV vehicles from 2020[3] so that the existing automobile companies produce vehicles with BS-VI emission which does not produce much carbon monoxide.

[2] Pti. *SC Prohibits Plying of 15-Year-Old Petrol, 10-Year-Old Diesel Vehicles in NCR*. 29 Oct. 2018, economictimes.indiatimes.com/news/politics-and-nation/sc-prohibits-plying-of-15-yr-old-petrol-10-yr-old-diesel-vehicles-in-ncr/articleshow/66414941.cms?from=mdr.

[3] Amit Anand Choudhary | TNN | Updated: Oct 24, 2018. *BS 4 Vehicles Ban: Supreme Court Bans Sale and Registration of BS IV Vehicles after March 31, 2020: - Times of India*. timesofindia.indiatimes.com/auto/cars/sc-bans-sale-and-registration-of-bs-iv-vehicles-after-march-31-2020/articleshow/66342929.cms.

Many European countries using renewable energy like Germany's 80% energy comes from solar energy, Denmark is focusing on wind energy, etc

However, above solution will reduce the usage of fossil fuels but renewable energy can't take the place of fossil fuels at this initial stage so it will take time for the countries to switch to totally to clean energy and for that they need to spend lot of capital in developing new technology and giving subsidies to industries to encourage them to switch to renewable energy.

Evaluation

Strength:

I have taken the good amount of data for developed and developing countries which makes my report precise and reliable. My report shows clear evidence of how people are exploiting natural resources in the name of development which will impact humanity very soon if resources are being used unsustainably.

Weakness:

All data which I have taken is from one source from www.macrotrends.com. Which might have decreased the reliabilty of data, and various other calamities like income and availability of resources haven't been taken into account while making the report. Also there is a strong positive correlation between GDP and fossil fuel usage that doesn't mean high GDP is causing increased use of fossil fuel.

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