

Causal Relationship between GDP, Electricity Generation & Environmental Degradation

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Abstract:

In India the thermal power plants play an important role in the supply of power that is electricity as 66% power is obtained from coal combustion. Consequently, Economic growth of any country, i.e. GDP is of primary concern. To achieve a reasonable rate of growth, adequate energy supply in the form of electricity is inevitable. All the developments are possible only by the use of energy, As a results of high dependence on energy sources. The total electricity generation in the country increased from 499.5 (BU_s) in (2000-01) to 1249.33 (BU_s) during (2018-19), Installed capacity of electric power station under utilities was 68323.32 (MW) in (2000-01) consisting of 63857.38 (MW) from thermal, which had increased to 226279.3 (MW) as on (2018-19) consisting of 194444.50 (MW) from thermal sources consequently, carbon emission is emanating from the burning of coal. As a results harmful gases are emitted for example sulfur dioxide (SO₂), Sulfur trioxide (SO₃), nitrogen oxides (NO_x), Carbon monoxide, carbon dioxide (CO₂), Nitric Oxide (NO), These gases are causing many health problems to the people, which is a big threat to the economy. Although, we see that there are many such energy alternative which can prove to be helpful in preventing carbon emission to a large extent, serious effort to shift from coal based power plant to alternative energy needs greater national attempt Alternative energy systems such as solar energy, wind energy, biomass energy, bio fuel, hydro energy could be harnessed so as to fight against the battle of climate change. India is blessed with huge potential of these alternative sources. If we tap the potential of these sources, this substantially will help the economy to reduce carbon emission, without compromising the growth of economy. Causal relationship between GDP, electricity generation & CO₂ emission.

Section 1 of the paper highlights the Power Scenario of India. Section 2 discusses the Data analysis and interpretation. Section 3 discusses the environmental degradation from Coal fired plants.

Lastly, Section 4 Provides measure to overcome environmental problems without compromising the growth.

Keywords: Thermal plants, GDP, Carbon emission, Solar Energy, Wind Energy, Bio Mass Energy.

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1. Introduction

Thermal power plants play an important role in the supply of power in India as more than 65% of power is obtained from coal combustion. Consequently, Economic growth of our economy has leads to continuous in the per capita electricity consumption which has also lead to drastic in the installed capacity of power. The total electricity generation in the country increased from 499.5 (BU_s) in (2000-01) to 1249.33 (BU_s) during (2018-19), Installed capacity of electric power station under utilities was 68323.32 (MW) in (2000-01) consisting of 63857.38 (MW) from thermal, which had increased to 2,26279.3(MW) as on (2018-19) consisting of 72,340 (MW) from thermal sources. (Ministry of power)

Indiacurrently lacks sufficed domestic coal energy resources and imports much of its growing energy requirements, according to the International Energy Agency (IEA). The total coal consumption for electricity in India was 150 (MT) in (2000-01) which has increased to 643.8(MT) in (2018-19) i.e. increase by more than 3 times. The Indian power sector is largely coal based with the total installed capacity comprising of 194444.50 (MW) in (2018-19).(Ministry of power) Coal fired power generation has under gone many ups and downs in the last 20 years, while coal based power generation was 63857.38 (MW) in (2000-01), it reached a peak of 194444.50 (MW) in (2018-19). However, the demand of electricity has always been combating the supply. From the annual report of ministry of coal, the coal production in all over India during the period (2000-01) had been 150 (MT) which has now increased 643.80 (MT) in (2018-19). India is now experiencing danger of exhausting coal reserve on one side and increasing demand for power on other hand.

Table 1 below shows that with increasing population and increasing GDP and increasing power generation, CO2 emissions are increasing, where CO2 emissions were 538 MT in 2000–01, they have increased by 1440 MT in (2018– 19).

Year	India's population (billions)	Total electricity from Thermal (MW)	GDP (billions)	Carbon emission from power industries (MT)
2000-01	1.057	68323.32	468.39	534
2001-02	1.075	72107.63	485.441	552

2002-03	1.093	75270.77	574.938	560
2003-04	1.112	76704.19	607.699	587
2004-05	1.130	79451.45	709.149	643
2005-06	1.148	82064.44	820.382	665
2006-07	1.165	62839.14	940.260	710
2007-08	1.183	90895.84	1217.00	776
2008-09	1.201	93725.24	1199.00	820
2009-10	1.218	100351.4	1342.00	900
2010-11	1.234	111034.4	1676.00	935
2011-12	1.250	120746.2	1823.00	979
2012-13	1.266	140615.9	1828.00	1068
2013-14	1.281	156547.7	1857.00	1105
2014-15	1.296	177741.8	2039.00	1205
2015-16	1.310	194154.9	2104.00	1246
2016-17	1.325	215168.9	2290.00	1310
2017-18	1.339	218959.5	2652.00	1390
2018-19	1.353	226279.3	2719.00	1440

<https://powermin.nic.in/en/content/annual-reports-year-wise-ministry>

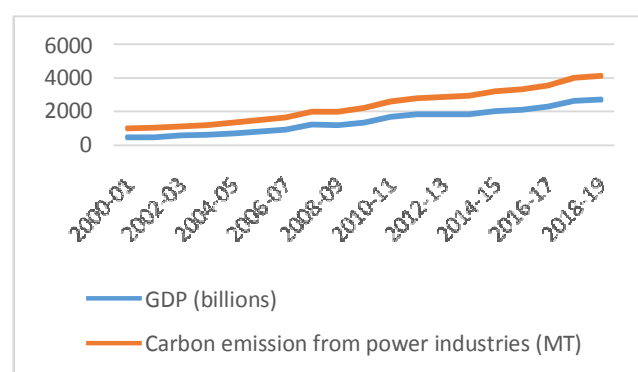


Figure 1- Growth of GDP and carbon emission from power industries

In Fig 1 the last 70 years, GDP has increased. If we look at the details of the last 20 years, where GDP was (468.39) billion in (2000-01), the same increased to (2719) billion in (2018-19) (World bank data).

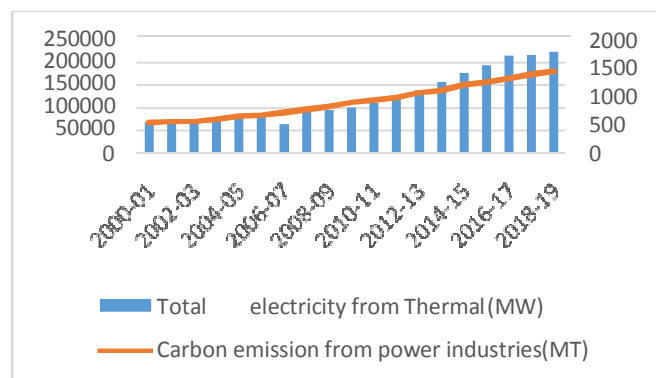


Figure 2-Growth of the total electricity from thermal and carbon emission from power industries since.

In Fig 2 Due to the increase in thermal electricity demand

where the power generation is continuously increasing. The production of electricity has also increased continuously, where electricity production was 68323.32 (MW) in (2000-01), the same increased to 226279.3 (MW) in (2018-19).

There are a number of studies the assessment of addition of variable. Industrial sectors are major contributors of CO₂ emissions, and GDP are related to industrial area(Hussain, Javaid, & Drake, 2012). Upcoming Coal in India, there will be more in 10 years, which is the harm factor for environment and human health(Guttikunda & Jawahar, 2014). Coal is abundance in India so for sustainable development solar energy is utmost option for India(Ahmed, Mahmood, Hasan, Sidhu, & Butt, 2016). Indian government is focusing on renewable energy sources for sustainable development(Kumar, Kumar, Baredar, & Shukla, 2015). Thermal power is the only cause of carbon emission(Mittal, Sharma, & Singh, 2014). Economic growth, electricity production and CO₂ emissions are interrelated (Smith, 2018). Renewable energy is necessary to improve the quality of the environment and to pave the way for development(Oum Kumari & Ojha, 2019).

Data analysis and Interpretation-

Table 2 brings out clearly the fact that CO₂ is result of GDP & total electricity production

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin - Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.991 ^a	.983	.982	40.6643	.983	970.234	1	17	.000	
2	.996 ^a	.993	.992	27.1260	.010	22.204	1	16	.000	1.790

Predictors: (Constant), GDP billion

Predictors: (Constant), GDP billion, Total electricity production from power industries environmental degradation from Coal Fired Plant

Dependent Variable: Carbon emission from power industries MT The R value shows a very strong positive correlation existing between the 3 variable and Durbin –Watson is above 1.5 which shows that there is no auto correlation

3 Coefficients

a. Dependent Variable: Carbon emission from power industries MT

3 Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	332.553	20.957		15.868	.000
	GDP billion	.406	.013	.991	31.149	.000
	(Constant)	299.919	15.602		19.224	.000
	GDP billion	.286	.027	.697	10.587	.000
2	Total electricity production from power industries MW	.002	.000	.310	4.712	.000

a. Dependent Variable: Carbon emission from power industries MT

Interpretation-

The relationship between GDP and carbon emission was mediated by electricity production. regression analysis was used to investigate the hypothesis that electricity production mediates the effect of GDP on carbon emission. Illustrates, the standardized regression coefficient between GDP and electricity production was statistical significant as was the standardized regression coefficient between electricity production and carbon emission the standardized indirect effect was (.991) (.697). We tested the significance of this procedure unstandardized indirect effects were computed for each 19 samples and the indirect effect statistically significant.

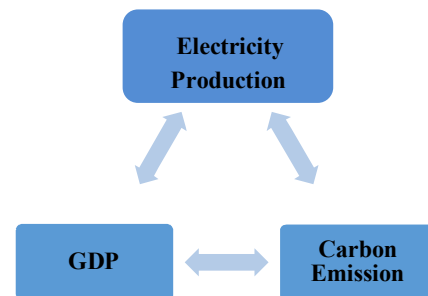


Figure 3. Standardized regression coefficients for the relationship between electricity production and carbon emission as mediated by GDP.

The natural resource coal is available in abundance in India. It is used in large quantity in thermal power plants. India has 334,400 (MW) power generation capacity. India pays a very high price interns of environment. Coal fired plants emit more than just CO₂, which supply to global warming said researchers from [ETH ZURICH in Switzerland. \(2019\).](#)

It is also seen that China and the US both are biggest producers of thermal power but they have been working rigorously on renewable to meet out their energy demand in last few years. High dependence of coal causes air pollution which intern has resulted in health problems. Which is a big threat to the economy as the productivity of people deteriorates with health.

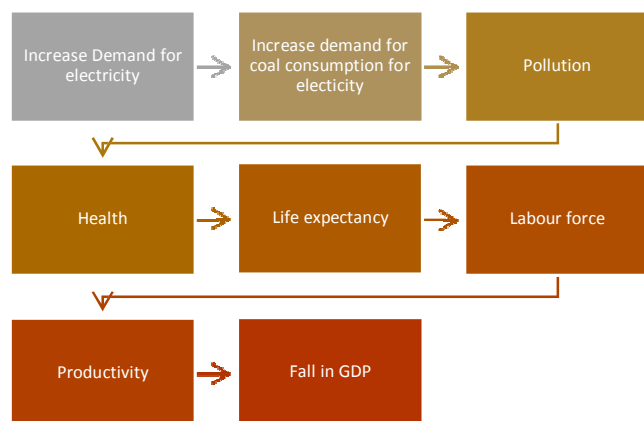


Figure 4 Negative effects of CO₂ emission

Air pollution can cause health problems like cancer, asthma, heart disease Decreased lung capacity etc. These health problems are seriously affected quality of life. Which has decreased significantly over the years. This change in the quality of life has the resulted in disproportionate labor force and has a direct impact on the production capacity of our country.

4. Measures to overcome the environmental problems-

Section 4 of this article suggest some measures that could go a long way in combating the problems of environment without compromising energy needs and growth.

India is a tropical country and the rays of the sun and winds are in India's lap. India needs to make good use of this invaluable gifts of nature for sustainable developments. so there are some sources of alternative energy which can prove to be highly helpful in preventing carbon emission to a large extent. The [figure 5](#) shows the sources of renewable resource

Sources of Renewable Energy

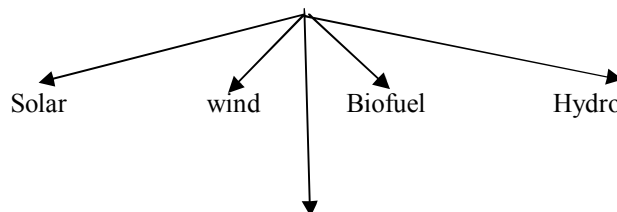


Figure 5

Solar energy- solar energy is the one type of renewable energy. Solar energy can be accumulating as a heat for thermal process such as water and earth heating in India. Solar radiation is obtained throughout the year in India, which remains on earth for about 3000 hours. This is similar to more 5000 trillion kwh. In many places in India receive 4-7 kwh of solar radiation per sq. meters. This is parallel to 2300-3200 sunlight hours per year. State such as Rajasthan, Gujrat, Punjab, Madhya Pradesh, Maharashtra, has a huge potential for tapping solar energy.

There are many advantages to using solar energy, it is an environment friendly energy. Solar energy is the great replacement to thermal power energy. India's solar power project is estimated at 700-2100 (GW) by Thar. So therefor it is a great alternative for India.

Wind energy- Wind energy a form of solar energy. wind energy is generating by the wind. In the last few years, the capacity to produce wind power energy has been increasing. India has the 4th place in the World due to its ability to generate wind power energy. The total installed capacity of wind power energy was 36.625 (GW) till 31 march (2019). Which is close to 4% of total electricity generation in India. Wind power capacity is range across north, south, east and west regions. Therefor it has a good potential in India.

Wind energy dose not pollute the environment just like a thermal power plants. it's a very clean fuel source. Wind is a sustainable and domestic source of energy.

Biomass energy- Biomass energy is biological material it

comes from animals and plants. In India total installed electricity generation capacity is 200,000(MG). Biomass energy is remains 12.83% total electricity generation in India. India is agricultural country so there is a lots of potential for biomass energy. there is a lots of sources such as forest and organic waste, water based vegetation, municipal waste etc.

Biomass energy is renewable energy. it is a carbon neutral energy. it reduces garbage in landfill. It is less expensive from fossil fuel. This is a very good alternative to reduce carbon emission.

Although we see that there are many such alternatives which proves to be helpful in preventing carbon emission to a large extent, serious effort to shift from coal based power plants to alternative energy needs greater national attempt.

Conclusion- By adopting renewable energy sources in the long run We can not only overcome energy issues. But the GHG emission will also decrease, and our life expectancy will increase and at the same time. No doubt such strategies would improve the productivity without affecting the growth of our economy.

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