

Economic Growth and Energy Resources for a Sustainable Future

(A Study Of The Growth Of The Indian Economy And Its Nexus With That Of The Energy Resources For A Sustainable Future)

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Abstract: The work studies the nexus of economic growth and energy resources, (coal in particular) for a Sustainable future of the Indian economy. The work makes use of a secondary data. In this regard, we use GDP as a measure of Economic Growth, Coal – (coal consumption, production, total availability and the amount of coal used for power generation) for Energy Resource. Looking into all the available data and studying the various aspects of the same, here we are going to go ahead with quantitative research followed by descriptive and analytical form of research and also the data would be put through the statistical test (Granger Causality Test) for the final analysis of the study.

A comprehensive study regarding the economic growth of Indian economy since Independence and the role of coal towards the same is dealt upon in the second chapter. Through the historical review and also based upon the statistical test done, we see that there is a nexus between economic growth and that of coal as an energy resource, thereby its impact on ecology is no longer on the path of Sustainable Development.

The work highlights the fact that over-dependence on coal and other non-renewable energy resources can cause long run damage to the economy. This brings in the need to shoulder upon other alternative renewable energy resources to meet our energy demands.

Indian government needs to change its development strategies as well as step up their policies and take strict actions for a sustainable future.

Keywords: Economic Growth, Energy resources and Sustainable Development.

“Coal in truth, stands not beside but entirely above all other commodities. It is the material energy of the country- the universal aid- the factor in everything that we do.” William Stanley Jevons, Economist, 1865.

1. INTRODUCTION

The study being done is to know about the nexus of economic growth and energy resources (coal) of the Indian economy and also to see, whether, if we continue on the same path of growth and development by depending upon coal to meet our energy demands, will we be able to maintain it in a sustainable way so that our future generations don't pay a price for it.

We know that this challenge of environmental degradation began with the industrial revolution, due to our dependence on coal to meet our energy demands. Coal is and was the cheapest form of non-renewable natural energy resource but we never cared about our environment from the start, we never gave a second thought to the ill-effects that coal mining and usage brought along with it. Indian economy too in their quest for growth and development by focusing more on the industrial growth with lacklustre policies started becoming over dependent on coal to meet our energy demands.

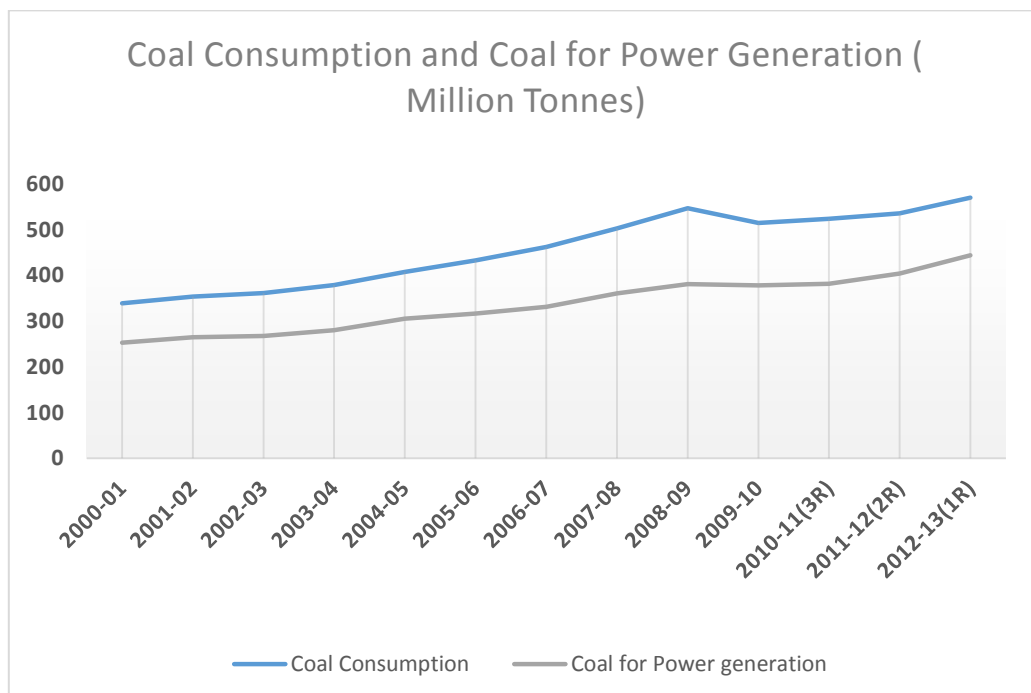
Ceteris Paribus; lets now appreciate the rudiments of these three important terms; Economic Growth, Energy Resources and Sustainable Development; in the context of the study done.

Economic Growth And Development: Development as we know is the primary objective of almost every Economy; raising of income, well-being and economic capabilities of the people in the Economy. This process of development is very much important; especially for the developing and the less developed countries; in which Economic Growth is the aspect through which the overall development of the economy is possible. Therefore we can say that Economic Growth is a part of Economic Development and Economic Development on a whole is a very broad concept and it also includes the overall well-being of the people in the economy. Now Economic Growth is nothing but an overall increase in the value of the goods and services produced in an economy; produced so as to meet the growing demands of the consumers. Some of the definitions of the term 'Economic Growth' are as follows –

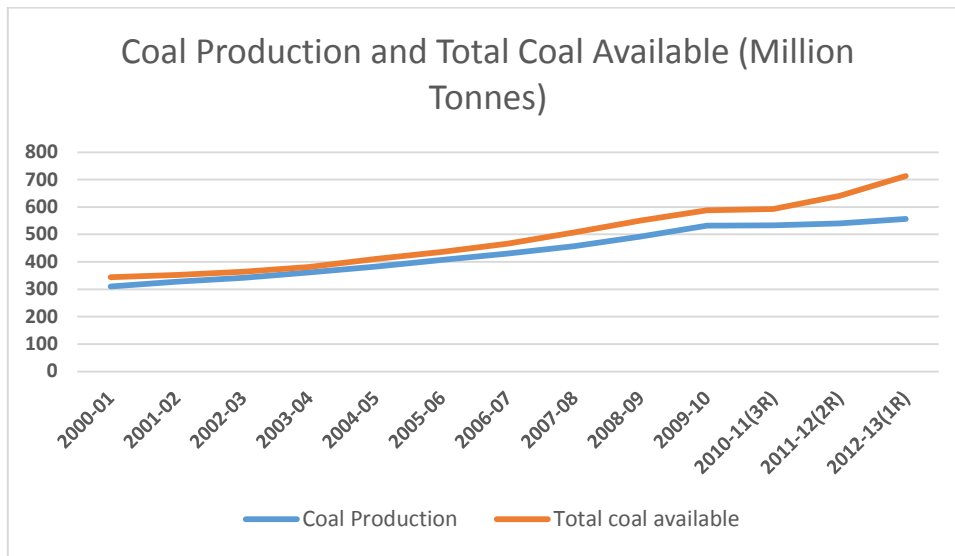
In the words of Schumpeter; “Economic Growth is a steady and gradual change in the long run, which comes through a general increase in the rate of savings and population in a dynamic economy.” Prof. Mehta says that “Growth has quantitative significance. It suggests an increase in the quantity of volume of something.”

Natural Resource: In favour for the growth of an Economy the nation require resources; human resource, capital resource and natural resource; out of which natural resources play an important role or we can say, the most important role for the growth of an economy. Under natural resources we have basically two types of resources; Renewable and Non-Renewable resources. Renewable resources are those resources which have the capacity for regeneration as well as growth; as long as the rate of use is less than the rate of its reequipping. On the other hand non-renewable resources are those resources whose rate of generation or production is not as fast as the rate at which they are utilized. At this time energy resources are those resources which give out power, or through which energy is generated for our requirements. We can divide the energy resources into; Renewable energy resource such as solar energy, wind energy, wave and tidal energy, biomass and geothermal energy; Nuclear energy resource such as the energy generated from nuclear fusion; and lastly fossil fuels such as coal, oil and natural gas. In this work I am looking into the aspect of fossil fuels (coal in particular); and its relationship with that of Economic Growth.

The chart given below tells us of the amount of coal consumption in India and also the amount of coal that is being used for power generation in India.

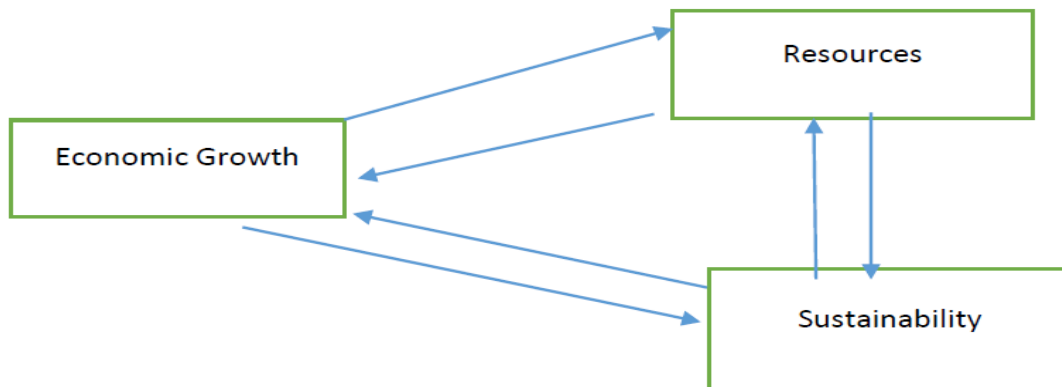


This is a chart showcasing the total amount of coal production happening in India and also the amount of total coal being made available to India, which includes imports of coal.



Sustainable Development: is nothing but the enhancement of the living conditions of the present generations without compensating the ability of the future generations to meet their own needs. The paper titled ‘Limits to Growth’ by the Club of Rome in 1972, was the first to talk about sustainable development in the context of population growth, impact of industrialisation and effects of pollution. The first definition on Sustainable Development appeared five years later in the report “Our Common Future” by the World Commission of Environment and Development in which it said that “Sustainable Development is the Development that meets the needs of the present generation without comprising the ability of the future generation to meet their own needs.” Since then various policies and strategies have been formulated for a Sustainable living. In the context of my study, I mean to say, preserving of the ecology and the resources for prosperity; that is, the natural resources should be used in such a way that it is available to us, for the present, sufficiently and also to see to it that it is available for the future generations too.

The diagrammatic representation of the study would be –



The objectives of the study done are –

- . To investigate the role of the energy resources and its importance for a sustained economic growth.
- . To infer the effect of economic growth on the natural resources and fossil fuels.
- . To examine the next best alternatives for the fossil fuels.

Research Questions:

- . How much of impact do the fossil fuels have on Economic Growth and vice versa?
- . What is the future of our resources; fossil fuels? What is the next best alternative?
- . Is growth all that necessary for an economy? At, what cost?

. Will there be an ecological collapse in the near future? Can we still do something to avoid it?

Hypothesis:

- . There does not exist a causal relationship between Economic Growth and Energy resources.
- . The rate of growth at which we are going, can be sustained for a long run.
- . There is next best alternative available to the two most important energy resources; oil and coal.
- . An ecological collapse in the near future is uncertain.

Concluding remarks:

‘As per the 12th plan projections, the total amount of energy production will reach roughly around 669.6 million tonnes of oil equivalent (MTOE) by 2016-17 and 375.6 MTOE by 2021-22 to meet our energy requirements around 71% and 69% of energy consumption and the balance of the energy requirements would be with imports. Our dependence on coal and oil imports are only going to increase in the near future and for coal the import is going to increase from 18.8% in 2011-12 to around 22.4% by the end of the 12th plan. The demand and supply gap has always been increasing for coal and at the end of the 11th plan the demand and supply gap was about 100MT and now it is around 145-150MT. Seeing all this we can only say that the coal demand is only going to increase in the future. And now with the projected growth rate of the economy at 7% the demand for coal and other energy resources is only going to increase and in case of coal the demand is going to reach around 1373MT by 2021-22. In India the main end users of coal are 60% for thermal power generation, 7% for iron and steel industries and 5% for cement and also there are some irregular demand from the unorganised small scale sectors.’

– Teri Energy and Environment Data Diary and Yearbook (2014-15)

2. HISTORY

Introduction:

Since Indian Independence, the central government has gone in a big way for the extraction of all types of minerals but has never paid much attention to the environmental problems that are created by the mining activities to the land, air, water and forest. The major atmospheric pollutants are carbon dioxide, carbon monoxide, sulphur dioxide and oxides of nitrogen to name a few.

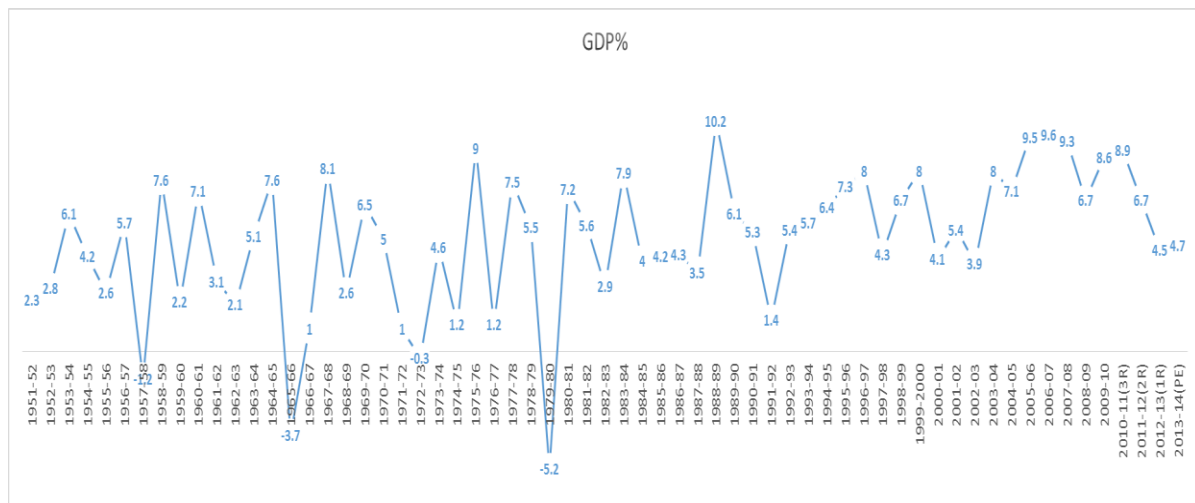
Recently both the Prime Minister and the president of India emphasized the need for sustainability and announced the launch of “Swachh Bharat Mission.” While addressing parliament after the formation of the new government the President emphasized that the government strongly believes that environmental conservation can go hand in hand with development, and the 12th five year plan 2012-17 along with other national policies too aim at addressing the same issues.

The latest Union Budget of India 2015/16 forecasts that India would be the fastest growing economy all over the world with the projected growth rate of around 7.5% real GDP. This form of growth rate to be accomplished as well sustained for a long run is not an easy task. Many resources come into play for the future prospect of the growth of the economy, out of which the most important resources are the energy resources. The various source to meet the energy requirements of India are, Coal and Lignite, Natural Gas and Petroleum, Nuclear power, Hydropower, Solar power and Wind energy. To name a few and the various sources of demand for these resources are Agriculture, Transport, Household, Industries and various other commercial sectors. To get to know the future and well- being of the country both the past and the current patterns of energy consumption and generation should be deliberated. One of the major forms of meeting our energy demands is through that of electricity (power) without which we would have not reached, where we are today. To meet the requirements of power generation we make the most of Coal that amounts to 78%, followed by Gas amounting to 16%., amongst all the sources of energy.

The most important resource for our energy requirements from the inspectional years of planning has always been Coal followed by Crude Oil. Coal and Crude are non-renewable forms of energy resources and abundant studies advocate that the resources have reached Saturation in their respective cycles. These two key resources are one of the main reasons for the current challenge of climate change that we are facing.

The table below gives a brief look into the history of the Indian economy as to how we have reached where we are today.

Table: 2.1 Gross Domestic Product (GDP) at factor cost in percentage for the year 1950 through 2013



There has always been discussions deliberated and enormous research carried in the study the growth path of the Indian economy. After Indian Independence until 1980's the average GDP growth rate was around 3.6%. There was some acceleration in the rate of growth seen during later 1980's followed by the balance of payment crisis which hit us during the 1990. This was followed by the era of economic reforms of in the Post 1991 era which Gave us a tremendous boost up in the growth from 1996-2007. During the period 2003-2014, there was as unprecedented average growth rate of around 8.5%. Today Indian economy is well thought-out as one of the fastest growing economies worldwide.

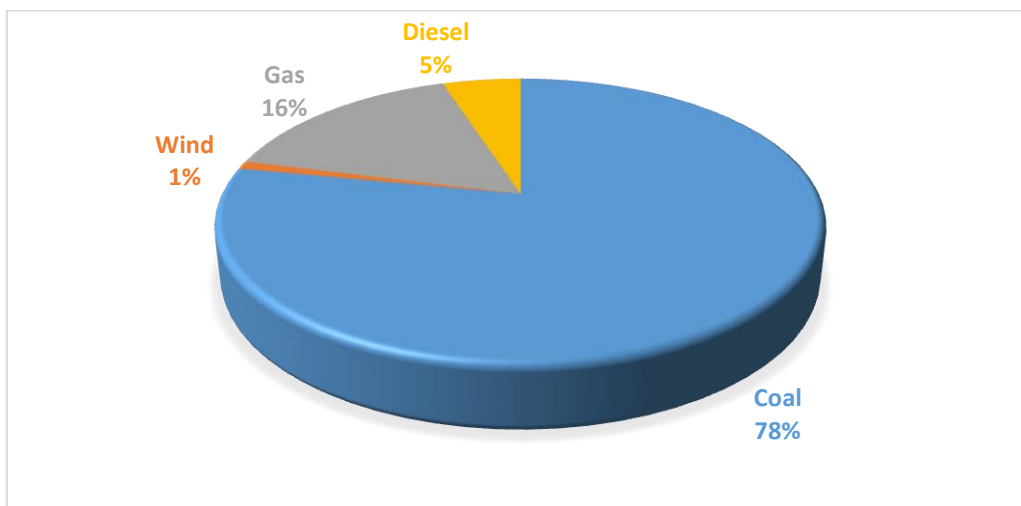
ENERGY RESOURCES, MINERAL POLICY AND ENERGY CRISIS:

In the Tenth five year plan it has been rightly said that – “The development and management of the mineral resources plays a major role in the industrial growth of a nation.”

Coal and Iron for instance are the basic minerals needed for the growth of the iron and steel industry, which in turn is very much necessary for the development of the economy of the country. There are other minerals too, such as, mica, manganese, lead, copper and zinc which are of economic importance. We also have thorium, uranium, petroleum and coal which are of national importance.

Coal has been and will be the primary source of energy, which roughly amounts to 67% of the total energy consumption in the country. The principle centres of coal are Bengal, Bihar region, Maharashtra, Orissa, Madhya Pradesh and Andhra Pradesh. But most amount of coal production in bulk comes from Bengal and Bihar region which roughly amounts to 60-65% of the total production.

Energy usage for power generation using captive units 2011/12.



One of the main problems of coal in India is that, nearly two-thirds of the coal resources lie too deep due to which their extraction is not always profitable. And secondly the good quality of coal which is required for the industries is very much limited. Indian coal has around 25-40% of ash content which is very high, due to which the coal available is of very low quality. The government nationalised coal mines and Coal India Ltd. was set up in 1975.

The worldwide growth of renewable energy resources began in the 1990's and later accelerated by 2000's. The total investments worldwide in 2013 was around 214\$ billion for renewable energy which is much less from the previous year's owing to reduction in the costs and also policy uncertainty for the same. India has announced plans for attracting funds of around 100\$ billion into the renewable energy sector. The central government has also announced the target to increase the installed wind power capacity to 40 GW by 2019 through the National Wind energy mission. India has around 32GW of renewable energy capacity installed which amounts to around 15% of the power generation capacity. Some of the main renewable energy technologies in India are onshore wind, biomass power, solar photovoltaic, concentrated solar power and hydropower. So far wind power is the largest renewable energy system in India which is around 21996 MW of energy, which makes India ranked 4th globally for installed generation of wind energy.

Rapid industrialisation and mining activities have caused severe environmental problems for the economy, following which various measures have been taken for the management and control of pollution in the various five year plans. The central pollution control board (CPCB) has been set up to check and maintain the air and water quality standards – water prevention and control of pollution act 1974, the environmental protection act 1986 and National water pollution act 1987. The government has also launched the National River Conservation Plan (NRCP) in 1995 to clean all the major rivers of the country and also the National Lake Conservation Plan (NLCP) to clean and restore major lakes of the country. For the management of solid wastes, the Municipal Solid waste management and handling rules (2000) has been set up. Finally, let's briefly look at the Energy crisis that was faced by the Indian Economy.

Industrial development worldwide was based on coal as the leading source of energy in the 18th and 19th century. Towards the end of the 19th century, coal was replaced by oil as a leading source of energy. Industrial development everywhere in the 20th century was mainly based on the low cost oil. After Independence, India too followed the same example and started importing Arab oil to accelerate the development of the Industries. In 1973 the OPEC had hiked the oil prices for the first time ever, following which the prices of petroleum crude was regularly hiked up from 2.1\$ per barrel in 1973 to 27.3\$ per barrel in 1980. The prices of crude hovered around 50\$ to 60\$ per barrel in the last two decades, after which the prices of crude hiked again upto 100\$ per barrel in 2007-08.

Due to this regular hike in the prices of crude India's trade gap widened, thereby creating a challenge of adverse balance of trade and balance of payments. However India has been saved every now and then from the BOP crisis because of large inward remittances of foreign currencies by the Indian's working abroad. In short the nature of the energy crisis would be as –the demand and supply gap kept on widening not only in oil but other commercial fuels too and with the higher projected growth rate the demand for commercial energy would rise. The coal industry which was expected to meet the growing demands for energy has also been failing badly. The demand and supply gap for electricity too is widening.

Global measures taken to tackle the challenge of climate change:

No single source of global financing will be sufficient to meet the needs of sustainable development, given the enormous number of resources that would be required. All options have been debated and have to be seen in the context of their impacts on the developing countries. Global emissions have increased despite various efforts by the multilateral institutions as well as several national policies and the use of energy is by far the biggest driver of emissions. India's per capita CO₂ emissions increased from 0.8 to 1.7 metric tons from 1990 to 2010, which was well below the levels of the major economies like that of USA, China or Canada.

Mainstreaming climate change in the development process has costs for the developing countries. This process would require international co-operation based on which the 19th conference parties (COP) to the UNFCCC and 9th meeting of the parties to the Kyoto Protocol took place in Warsaw, Poland in November 2013. There is still a negotiation going on for finalizing the emissions cuts for pre and post 2020 periods. Another issue for many countries is on high priority is the capitalization of the Green Climate Fund (GCF). The world has to prepare itself for two very important roles – one, the issue of how the developed and the developing countries will be treated under the new framework and two, Kyoto Protocol bought only the historical polluters to pay (Developed economies), however the new framework would apply to all. It is very much important that any further agreement taking place should keep and take the picture of India's development concerns and requirements into account. The challenge of checking the pace of environmental degradation in India is very much necessary due to the necessity of maintaining high economic growth for the rapidly growing population.

Concluding remarks:

Gandhi once said that “Earth provides enough to satisfy every man's need, but not for every man's greed.” The saying is so true, it is nothing but our greed for a better world, with better growth prospects and to meet the growing demands of the ever growing population that we negate the fact of the importance of ecology. We have still not realised that growth and materialism have no limit, while the environment in which it is placed is strictly limited. Infinite growth in a finite environment is not at all possible. Our focus is more on development of industries and infrastructure, from the very beginning. We never gave a thought for the development towards small scale and tertiary industries. Small scale operations no matter how numerous have lesser impact on the environment.

3. REVIEW OF LITERATURE

Pirlogea et.al. (2011) make a survey of last sixty years and elucidate that the world energy consumption has increased six times more than before. This is a very serious issue and it needs to be looked into with great importance, because at the rate of this consumption our conventional sources of energy i.e. oil, coal, natural gas etc.... are facing a severe shortage these days. The researchers use time series data from 1965-2007 for all the different macro variables used in the investigation of the country Romania and the long simulated results show that there exists a long run causal relationship between GDP and energy consumption where hydro power plays a key role in determining, when compared to oil and coal resource which makes its impact in the short run. From this they also imply that Romania is not dependant on energy derived from natural gas to achieve economic growth.

Adjaye (2000) examines the relationship between energy and the income of four different energy dependant Asian Developing countries – India, Indonesia, Philippines and Thailand. The empirical results shows a unidirectional Granger causality which runs from energy to income for India and Indonesia. On the other side there exists bidirectional Granger causality between energy and income for Thailand and Philippines. To conclude the results do not support the view that energy and income are neutral, with the exception of India and Indonesia where neutrality is observed in the short-run. Therefore, the situation adversely affects the economic growth, and there by energy conservation policies which aims at curtailing energy usage.

Tiwari (2011) reviews the responsiveness of renewable energy consumption on the economic growth of India and found that an increase in the RES increases the GDP and also decreases CO₂, as also the study shows an increase in GDP has a positive impact on the CO₂ emissions. Therefore the work implies that an increase in the RES share may initially increase CO₂ emissions, therefore Indian government should complement RES with other supporting policies.

Wang et.al.(2011) estimate the main driving forces affecting CO₂ emission patterns and the relationship between economic development and CO₂ emissions. They make use of Convergence, absolute convergence and Conditional

convergence models to analyse and understand the inner characteristics of the CO₂ emissions and the income levels of 128 countries in the world for the year 1965 through 2004. The result projects a convergence, which was found in most of the countries. And a cross country differences in absolute emission levels tend to decline over a period of time. The lower middle income countries, showed diversity through some years but later on they started converging after 1987. Both the absolute and conditional convergence were consistent.

To different countries, the main factors affecting their emission patterns were quite different –

- . Oil and coal consumption for high income OECD countries
- . Population for high income Non-OECD.
- . Neither GDP nor population for the middle income countries.
- . GDP was the main driving force for both lower middle income and low income countries.

E. Nanaji et.al. (2013) investigate the relationship between electricity supply, fossil fuel consumption, CO₂ emissions and Economic Growth in Nigeria from 1971-2009. Using the 'bound test approach' and Granger Causality test the researchers found that in the short and long run there is a relationship among the variables; and there is also a significant relationship between that of CO₂ emissions and the consumption of fossil fuel. And they also found that the Economic Growth is associated with the CO₂ emissions. There is a positive relationship between electricity supply and CO₂ emissions, which reveals the poor nature of electricity supply in Nigeria. And the Granger Causality test indicate that the supply of electricity has not impacted on the Economic growth of Nigeria significantly.

Abaidoo tries to look into the causal relationship and also the magnitude of the impact between the Economic growth and energy consumption in an Emerging economy; i.e. energy consumption form the context of electric energy consumption, since it is the dominant source of energy in Ghana. For this the researcher has used the quarterly data spanning a period of 39 years and using the Granger causality test the researcher found that there exists a unidirectional causal relationship between economic growth and energy consumption in an emerging economy; with the direction running from economic growth to energy consumption and the magnitude of impact is found to be 2% on the growth in electricity induced a percentage growth in the GDP; other things being equal.

Mukherjee et.al. (2006) try to examine the relationship between environmental quality and per capita NSDP (Environmental Kuznets Curve) of 14 major states in the light of their high economic growth in the post liberalisation period. By ranking the states on the basis of their environmental quality and then checking the relationship by analysing and capturing both temporal and spatial aspects of environmental quality by ranking the states in two time periods – I – 1990-1996 and II- 1997-2001, the researchers found that there is a relationship between environmental quality and per-capita NSDP in slanting S-shaped curve. And except Bihar, all other states are on the upward sloping curve of the Environmental Kuznets Curve. Therefore the findings of the researchers suggest that economic growth is mostly at the cost of environmental quality.

Sahu (2009) By referring to data from 1980-2005 and using the general trend analysis technique along with the double log regression model and by calculating the growth rate using the least squares growth rate equation the researcher found that the consumption of the total primary energy resources has been increasing since 1980, and 1980-85 has seen the highest growth rate in the consumption of energy in India and the next from 1991-96, after which the total primary energy consumption has increased but at a decreasing rate. Therefore the researcher concludes that there is a positive relationship between total primary energy consumption to GDP, population and per capita energy consumption, however there is a negative relationship between energy use and the production of energy resources in case of India. The total primary energy use is one of the key components of GDP; population is an important factor for the demand and consumption of the total primary energy resource. More the nation develops economically, the demand for energy resources also increases.

Munir et.al. try to empirically examine the relationship and the impact of fossil fuel energy consumption on CO₂ emissions for Pakistan and found that, the industrial value added and trade openness positively impact the CO₂ emissions, while the financial development reduces the amount of CO₂ emissions. And the results of the energy consumption

$$X_t = c_0 + c_1 X_{t-1} + \dots + c_p X_{t-p} + U_t$$

$$\text{Testing } H_0 = a_1 = a_2 = \dots = a_p = 0$$

Against H_1 : Not H_0 is a test that Y_t does not Granger-cause X_p

Similarly, testing $H_0: c_1 = c_2 = \dots = c_p = 0$ against

H_1 : Not H_0 is a test that X_t does not Granger causes X_p .

In each case, a rejection of the null hypothesis implies there is Granger causality between the variables. In testing for Granger causality, two variables are usually analyzed together, while testing for their interaction. All the possible results of the analyses are four:

- Unidirectional Granger causality from variable Y_t to variable X_t .
- Unidirectional Granger causality from variable X_t to Y_t
- Bi-directional causality and
- No causality

Here, we present the main results obtained from the Pairwise Granger-causality analysis done in the study. Twelve pairs of variables (economic indicators) were modeled as seen in table 5.4 and 5.5 below. The seven economic indicators considered are represented as follows:

Table 5.4 Pairwise Granger Causality test with Coal Production and Coal Usage

Lags 2: Sample: 2002 through 2014

Pairwise Hypothesis	Obs	F- Stat	Probability	Decision	Type of Casualty
$A \Rightarrow B$	13	1.51574	0.2766	DNR H0	No causality
$A \Leftarrow B$	13	12.4090	0.0035	Reject H0	Uni-directional causality
$A \Rightarrow C$	13	0.01132	0.9888	DNR H0	No causality
$A \Leftarrow C$	13	11.3518	0.0046	Reject H0	Uni-directional causality
$A \Rightarrow D$	13	1.95156	0.2040	DNR H0	No causality
$A \Leftarrow D$	13	2.22205	0.1708	DNR H0	No causality
$A \Rightarrow E$	13	1.64056	0.2529	DNR H0	No causality
$A \Leftarrow E$	13	1.21473	0.3462	DNR H0	No causality
$A \Rightarrow F$	13	40.5093	7.E-05	Reject H0	Uni-directional causality
$A \Leftarrow F$	13	0.13205	0.8782	DNR H0	No causality

Alpha (α) = 0.05

Decision rule: reject H_0 if P-value < 0.05.

Key: DNR = Do not reject;

\nrightarrow = does not Granger cause.

No causality exists between Coal production and Coal consumption for cement but a Unidirectional causality exists between Coal consumption for cement and Coal usage in fertilizers and chemicals which infers that India survives with Import of coal for its various usage and there by its GDP an indirect function of Government Expenditure. Similarly there exists uni-direct causality between Inflation Rate and Government Expenditure, No causality exists between coal production and Steel manufacturing and causality exists between steel manufacturing and Coal production which proves an uni directional causality exists between resource supply of coal to iron refineries. More specifically, we can see that the following uni-directional causality exists between GDP and coal usage in cement industry.

Table 5.6 Pairwise Granger Causality Tests with GDP and Coal Usage

Lags 2: Sample: 2002 through 2014

Pairwise Hypothesis	Obs	F- Stat	Probability	Decision	Type of Casualty
$G \Rightarrow A$	13	3.41980	0.0845	DNR H0	No causality
$G \Leftarrow A$	13	1.80410	0.2256	DNR H0	No causality

$G \Rightarrow B$	13	4.77281	0.0432	Reject H0	Uni-directional causality
$G \Leftarrow B$	13	1.81860	0.2233	DNR H0	No causality
$G \Rightarrow C$	13	2.00923	0.1963	DNR H0	No causality
$G \Leftarrow C$	13	0.66494	0.5406	DNR H0	No causality
$G \Rightarrow D$	13	0.46579	0.6436	DNR H0	No causality
$G \Leftarrow D$	13	0.56424	0.5899	DNR H0	No causality
$G \Rightarrow E$	13	1.47989	9.20E-03	Reject H0	Bi-directional causality
$G \Leftarrow E$	13	1.35731	2.90E-03	Reject H0	Bi-directional causality
$G \Rightarrow F$	13	0.12375	0.8853	DNR H0	No causality
$G \Leftarrow F$	13	1.66874	0.2479	DNR H0	No causality

Alpha (α) = 0.05

Decision rule: reject H0 if P-value < 0.05.

Key: DNR = Do not reject;

\nearrow = does not Granger cause.

The goal of this analysis was to examine the interrelationships among certain economic indicators using National output GDP and coal consumption and production as an engine of growth, by using the concept of Granger causality tests developed by Granger (1969). We used 22 VAR models to test for Pairwise Granger (non) causality among the selected economic indicators and the following results were obtained.

Bi-directional causality exists between GDP and Power generation and vice versa which proves that the energy factor plays a very important role in driving the economy.

5. CONCLUSION

We can clearly see that globally as well as in India, we are more dependent on the non-renewable energy resources to meet our energy requirements. This has been from the very start of Industrial revolution, seeing which India too has gotten into this mad rush for quantitative growth with focus more on coal to meet our energy requirements. And as we are progressing towards more growth focused economies, which are materialistic in nature we would surely require a lot of resources to meet our requirements.

India, as well as globally, all of us are mainly dependent on coal to meet our respective energy requirements because as we saw that it is one of the cheapest form of energy resource and it is easily available compared to the other energy resources. In India, as we saw, most of our energy requirements is met with coal and in the near future the situation is only going to worsen, unless and until we don't act now and the government doesn't form stricter policies for the same we would be heading for a downturn in our development process as well as that of the growth of the economy.

Therefore from all that has been gone through and mentioned above, we can say that, yes, there is nexus between that of the growth of the economy and that of coal requirements to meet our energy demands. The more the growth and need for development of the economy the more would be the requirement of the energy resources, and as seen from all the data above mentioned and the texts, we can only say that to meet all our energy requirements readily we would require coal, for the same. Because even if we start more on the green path of using the renewable energy resources, it can in no way meet our growing demands and replace coal in the long run.

Seeing this we need to look into the other best alternatives to meet our energy demands. Yes, we do have the renewable energy resources, natural gas and nuclear energy so as to meet our energy demands, but as per the present data and the current scenario of the economies worldwide it is really hard to say that these energy resources would suffice our energy demands in any big way.

Looking into the history of our evolution and our civilizations which have in fact collapsed due to, depletion of the resources and ecology as a whole and climate change being the second, third being the ever growing population and finally the humans impact on the environment, all of these factors together have collapsed our precious civilizations before. They too have done the same mistakes of over exploiting of the natural resources and the growth of population thereby increase in demands, which have had severe impacts on them, leading to their collapse.

We being more dependent on coal to meet our energy demands would surely deplete these precious non-renewable resources and with the ever growing population and demands of the same there would be depletion of our ecology in the long run, and also the effect of climate would be really catastrophic.

The mining activities of coal or for that matter even natural gas or oil are all harmful for the ecology and with the combustion of coal and oil to meet our energy demands, there is huge amount of harmful gases; such as, CO₂ and methane, which are released into the atmosphere, which are also one of the main causes of climate change. And with the increase in the population and their respective demands, and as per history goes, we can only hope for the best, because at the speed in which we are going and our demands are increasing and for the blind form of growth of industries, an ecological collapse would be certain in the near future.

What is history for? Is it just some account of events and data to read and leave it alone or is there something to learn from the same.

The government needs to step in and take serious measures on the management of the exhaustible resources and also form stricter laws for the polluting industries and also provide subsidies who are meeting their energy requirements through a majority use of renewable energy resources. The government also needs to encourage the need of using biogas for generation, with this 'Clean India Campaign' we can have dual effects, with the waste all being cleaned up and being utilised for generating biogas to meet our growing energy needs. The governments needs to provide subsidies and encourage every household to set up micro biogas plant units, wherein the day to day wastes which are collected can be put in process into the plant, thereby creation of energy which would at least meet the daily requirements of kitchen gas, therefore leading to less consumption of LPG's. Plantation of trees too needs to be encouraged whose by-products can be used for the generation of electricity by putting into these biogas pants, thereby having a dual effect of a greener and cleaner India, to meet the energy requirements of a locality.

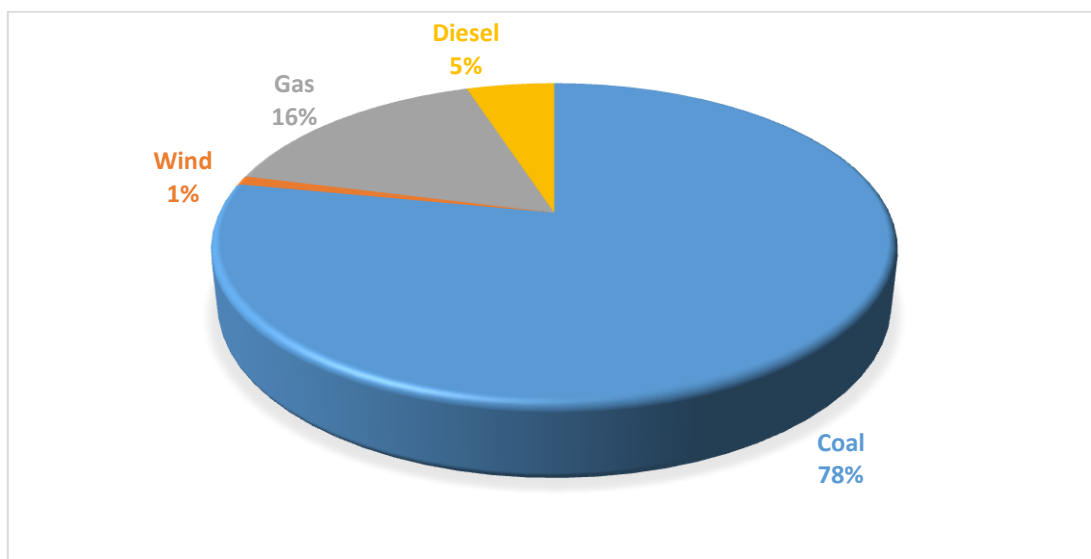
Green accounting needs to be done in the economy, and also for the calculation of the growth rate of economy we should also start considering the type of ecology or environment in which the economy is running and also the amount of natural resources available for the future generations, with all these considerations, even if we are late, its better we get on with these changes and start leaving a brighter and a better future.

The neoclassical assumption that energy is neutral for growth is false and it is rejected.

I would like to end this study done, with a beautiful quote by Victor Hugo.

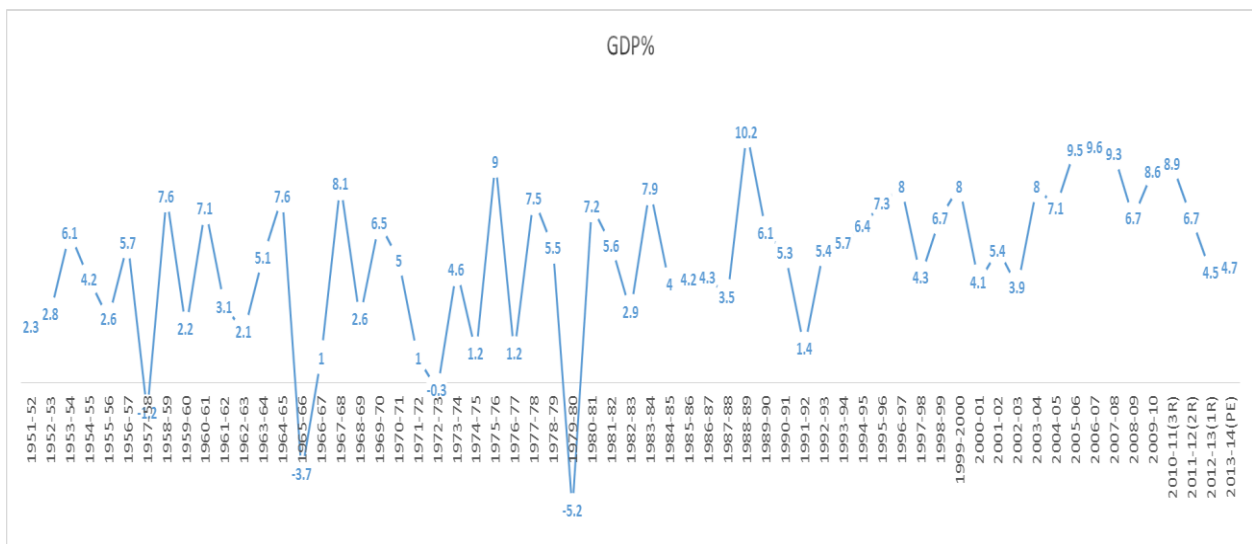
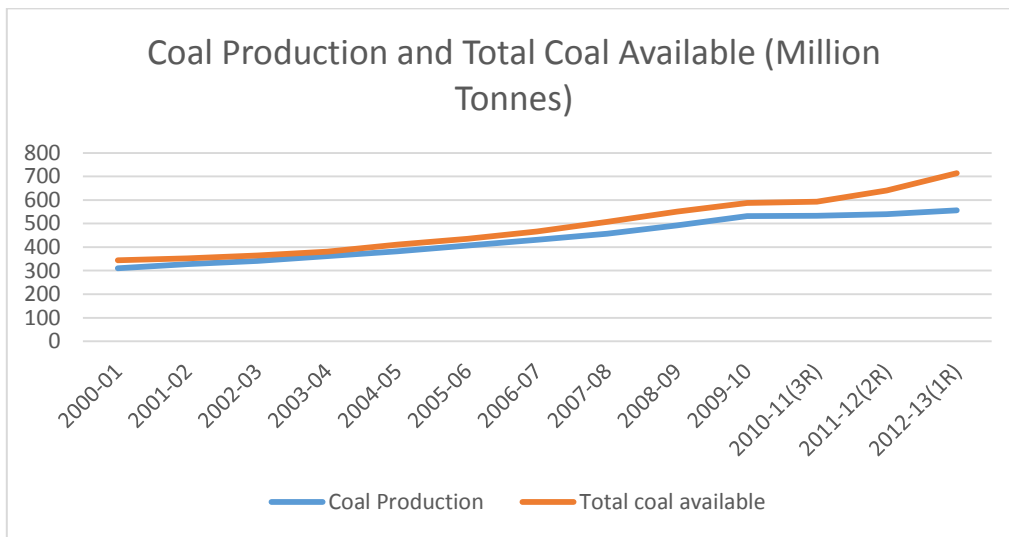
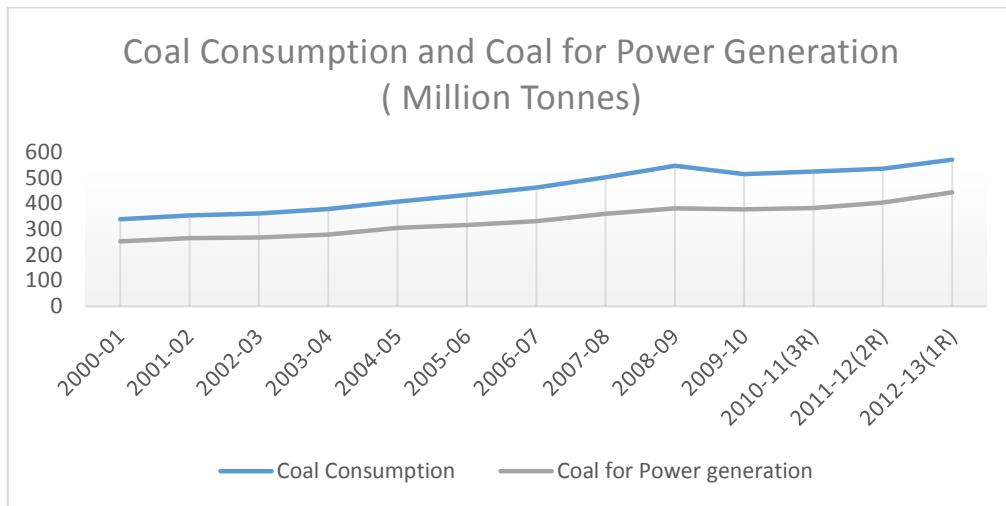
"How sad to think that nature speaks and mankind never listens" Victor Hugo, 1840

Annexure:



Electricity generation from captive units during 2011/12

Source CEA 2013b



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