

Non-Renewable Resource: Impact Sustainance and Alternatives

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ABSTRACT: *This paper attempts to examine the impact of imports of non-renewable sources of energy for generation of electricity on the trade deficit by using Trend analysis. India is heavily reliant on these non-renewable sources (Oil and Coal) for its electricity production. The paper further tries to establish the impact of these imports on how the trade deficit were to change if the government moves towards achieve its 2022 objectives i.e. by investing in renewable sources of energy. Our study considers how much Non-Renewable energy is imported by India and how much of the same is directed towards electricity.*

KEYWORDS: *Non-Renewable Energy, Balance of Trade, Electricity Production, Renewable Energy, Trend Analysis*

Date of Submission: 04-01-2019

Date of acceptance: 19-01-2019

I. INTRODUCTION

Energy is a vital source for developing economies and India being one of the world's largest and fastest growing economy has a very high energy consumption requirement which are currently met by Non-Renewable sources namely Oil, petroleum and coal. As the sixth largest crude oil consumer and the seventh largest oil importer, India today imports more than 70% of its crude oil requirements from Russia and OPEC countries. According to International Energy Agency (IEA) the demand for oil in India would increase by 2.9% per year, reaching 5.6 million barrels a day in 2030. This expected level of consumption will make India the world's third largest oil consumer (Amita Batra). Thus, this will result in a Deficit Balance of Trade (Net Imports more than Net Exports) thereby having a downward impact on the Gross Domestic Product of India. Further the non-renewable resources are depleting and excessive usage of them not only hinders sustainable development but also contributes to environmental depletion. Thus, it is vital for India to Diversify and Invest in Renewable energy sources.

By 2022, India is focusing on the establishment of 175GW of sustainable power source limit, which is an ambitious focus and will require a four-fold development in the sector. The nation has introduced limit over 50GW of sustainable limit as of December 2016, 57% of which is wind. The 2022 target incorporates 60GW of extensive and medium-scale network associated solar power ventures, 60GW of wind, 40GW of solar housetop ventures, 10GW of bio-power and 5GW of little hydro. Subsequently, sustainable power source in India has seen increasingly intense venture, limit building action and a more extreme fall in per unit vitality supply duty than some other vitality source in the nation, with the REWA delicate driving it to a new low of Rs 2.97 (4.4 pennies) as of late. This has outstandingly brought about a 157% expansion in solar power limit expansion amid FY2015 and FY2016, and the most elevated ever wind control limit expansion in FY2016, which totalled 3,300MW taking India to the fourth position in overall wind installation in the world. India has now accomplished 28.6% of its 2022 sustainable power source establishment focus of 175GW.

India, over the past 19 years, has seen a drastic increase in electricity production. This is a resultant of the increased electricity demand which is a sign of a healthy growth and development. The primary source of generation of electricity is coal which accounts to 69.4117% on an average, while the figure from 2016 showed that 74.773% of electricity was produced through consumption of coal, which is close to $\frac{3}{4}$ of the total requirement. On an average, only 3.0698% of electricity production was sourced through consumption of oil. The production sourced through oil has seen a decline in the recent years with only 1.5854% of electricity being produced using oil in 2016.

II. LITERATURE REVIEW

- a) It is crucial that India acquires vitality security without influencing the ever-booming economy, which infers that the nation must change from the non-renewable vitality - raw petroleum and coal - to sustainable power source. Sustainable power source is vitality from an asset that is replaceable by existing streams of vitality, for example, sunshine, wind, water, natural procedures and geothermal warmth streams. These vitality assets may be utilized straightforwardly or in a roundabout way as types of vitality. Petroleum products are relied upon to keep providing a significant part of the vitality utilized around the world.

Interest for Renewable Energy Sources represented 19% of worldwide vitality request, with customary biomass representing the main part of that request. The power division in India had an introduced limit of 233.929 GW as of December 2013. Captive power plants produce an extra 34.444 GW. Non-Renewable Power Plants comprise 87.55% of the introduced limit, and Renewable Power Plants establish the staying 12.45% of aggregate introduced Capacity. The aggregate yearly age of power from a wide range of sources was 1053.9 Terawatts-hours (TWh) in 2012. (Shaji)

- b) The carbon bubble has noteworthy ramifications for fund and venture, especially inside the petroleum product division. The Carbon Tracker Report conveyed to the consideration of the money related markets that the way the market was esteeming carbon resources overlooks the need to keep the petroleum derivatives underground, in this manner financial specialists base their ventures on the estimation of stores without thinking about the need to confine their utilization. The share trading system records roughly 1.500 oil and gas firms with resources over 4.5trn US dollars and around 275 coal firms worth over \$230bn. The non-renewable energy source organizations by and large would see their reasonable worth fall significantly (worth \$ 2 trillion) if they were compelled to expel 'stranded resources'. Fossil creation imperatives likely could be growing before long can be deduced from some political advancements. Profound cuts in greenhouse gas discharges are required and the worldwide economy ought to be decarbonised over the span of this century, with 70% of this decarbonisation by 2050. Such political proclamation is probably going to have repercussions in speculation choices in fossil and non-renewable energy source demand. (Jorge Nunez Ferrer)
- c) India's organizers have understood that fast financial development, which has started to be underestimated by general society, relies upon the accessibility of vitality. The outcome has been various endeavours to tie up provider connections around the world in an assortment of regions: oil, petroleum gas, atomic, and furthermore hydro-electric power from neighbours. In the medium term, despite everything it seems like India will be reliant on outer wellsprings of supply of hydrocarbons for its vitality needs. There is maybe an absence of vital goal. If there are no real oil and gas finds in Indian regional waters, India might be constrained down an unsafe way that incorporates a monstrous increment in the utilization of coal – with the orderly ecological issues – and additionally expanding reliance on atomic power. India is probably going to keep on being reliant on outside providers, regardless of whether in oil, gas, or atomic power. Except if new advances are ended up being financially practical sooner rather than later, India hopes to have generally little vitality security. The main option is coal, however the far-reaching utilization of that will draw in much analysis from around the world and will make contamination and a worldwide temperature alteration. In this way, it isn't sensible to rely upon coal alone. Until renewables tag along bigly, India will basically be vitality unreliable. (Rajeev, 2010)
- d) NTPC is ready to encourage India's drive toward national sustainable power source targets. At the bleeding edge of building India's vitality framework, NTPC stands to be one of the nation's key new vitality empowering influences. As a state-possessed utility in a creating nation, NTPC must make giving capacity to nationals and support for India's quickly creating economy its best needs. With the most recent new solar oriented tax results in 2017 NTPC's coal-let go control duty for its current armada offers a less expensive approach to give control. Significantly, solar based is presently less expensive than coal-let go control even before considering the externalities of coal (contamination, discharges and water use) that keep down the country's advancement. NTPC has huge commitment, it gives 25% of India's power supply, and in that capacity, it assumes a basic job in India's monetary movement. A developing extent of NTPC's speculation plan is being diverted into building present day age limit that has a much lower outflows profile and altogether diminished externalities. These changes are vital to continuing India's monetary development prospects. (Tim Buckley)
- e) Since the independence in 1947, India's Balance of trade was on a shortage except for two financial years, 1972-73 and 1976-77. This shortage has been expanding lately. Amid post liberalization period, exports have done well especially from 1992-93 to 1996-97; and from 2002-2003 to 2008-2009. The real segment of import was petroleum. The constant increment in oil price affected on the balance of trade adversely and the deficiency was satisfied by external capital borrowing that caused a raise in debt obligation. Accordingly, the higher trade deficit could be credited to an ascent in oil, oil and oils (POL) and in addition non-POL segments in imports. Proceeded with uptrend in costs in the worldwide markets and ascend in the cost were the real supporters of this procedure. (Ray)

III. RESEARCH METHODOLOGY

1. Scope

Our study focuses on Non-renewables (oil and coal) imported by India and how much imports of the same are directed towards electricity production for the period 2000-2016. The paper also tries to establish the

impact of these imports on the balance of trade and how the balance of trade is likely to be impacted by investments pertaining to establishment of renewable energy production plants, if the government tries to achieve the 2022 target of 175GW of electricity through solar and wind. The same is done by considering EXIM 2014-2018 data.

2. Objective

This paper attempts to establish a relationship between the imports of Non-Renewable sources of energy for electricity generation and the trade deficit. The paper also tries to establish the impact of these imports on the balance of trade or trade deficit specifically if the government moves towards achieve is 2022 objectives i.e. by investing in renewable sources of energy.

3. Tools Used

Trend Analysis: A technical analysis tool that endeavours to anticipate the future stock value developments dependent on past pattern information. Pattern examination depends on the possibility that what has occurred in the past gives dealers a thought of what will occur in the future

Coefficient of Determination: is a key output of regression analysis. It is interpreted as the proportion of the variance in the dependent variable that is predictable from the independent variable.

Mean: Also called Simple average is the sum of all observation divided by the total number of observations. Simple average is used to consolidate the monthly data in yearly terms.

4. SOURCES OF DATA

Secondary source of data was used for our paper.

- Dcgisanalytics
 - EXIM data 2014-2018
 - EXIM data quoted in INR th Cr
 - Non-Renewable Import Data 2014-2018
- IEA
 - Energy Data 2000-2016
 - Energy quoted in Ktoe
 - Electricity Data in GWh

5. LIMITATIONS

- Electricity production data available is up to 2016
- Sources of energy data available is up to 2016
- Accuracy of Future trends based on historical data
- Import of Non-Renewable data is given in totality. A clear bifurcation is not provided

6. HYPOTHESIS

H1: Investments in Renewable sources of energy for electricity generation has a significant impact on Trade Deficit

H0: Investments in Renewable sources of energy for electricity generation has no significant impact on Trade Deficit

IV. DATA ANALYSIS

In terms of Kilo Tonne Of Oil Equivalent (ktoe), an average of 68.108% of Total Primary Energy Supply (TPES) of coal and 5.527% of oil (primary and secondary) was diverted towards electricity production.

Based on the assumption of that the proportion of energy diverted from the TPES towards electricity requirements of each source being equivalent to the amount of imports utilized for the purpose of electricity generation, the average amount of oil and coal imports used was 43.8930% for the period 2000-2016. The 5-year average was 45.3303%. That is, the sum of energy of coal and oil used for electricity production by the TPES.

For the study, it has been assumed that the Mineral Fuels, Mineral Oils and Products, Bituminous Substances, Mineral Waxes data, which is inclusive of various oil and coal variants, on dgcisanalytics is in line with the coal and oil (primary and secondary) data on iea.

Year	2014	2015	2016	2017	2018
Import	2119.0700	2508.0900	2416.4100	2918.3200	3470.8560
Oil	788.5000	675.3000	597.3000	802.0400	1104.6533
Proportion	37.2097%	26.9249%	24.7185%	27.4829%	31.8265%

(Note: INR th Cr)

We see that an average of 29.510% of the imports is from oil and coal. That same is 31.827% in 2018 (upto September). Having approximately 30% of the imports from oil and coal leaves the imports or balance of trade subject to the high volatility in the prices affecting the prices and puts pressure on the deficit which may widen if price moves adversely.

Year	2014	2015	2016	2017	2018
Oil	788.5000	675.3000	597.3000	802.0400	1104.6533
Electricity	46.5280%	44.5687%	44.0968%	45.3303%	45.3303%
Import for Electricity	366.8733	300.9721	263.3900	363.5675	500.7431

(Note: INR th Cr)

Having ascertained the proportion of import of oil and coal that has been converted to electricity, we observe that an average of Rs 359.109th Cr of the total oil and coal imports has been spent for the production of electricity. This is assuming that the rate of utilization is constant at the 5-year average of 45.33%. And this average quantum amounts to 13.364% of the total imports on an average. Therefore, we see that over 10% of our imports constitutes of non-renewable resources (oil and coal) which have been channeled towards production of electricity to meet the growing energy requirements.

Year	2014	2015	2016	2017	2018
Electricity	366.8733	300.9721	263.3900	363.5675	500.7431
Deficit	678.6900	809.9900	652.0900	965.1000	1262.4600
Proportion	54.0561%	37.1575%	40.3917%	37.6715%	39.6641%

(Note: INR th Cr)

Comparing the above quantum directed towards acquiring the energy resources to the quantum of the deficit India maintains, we see that this acquisition on an average is equivalent to 41/7882% of the annual deficit.

Considering the amount of input of the energy source in terms of ktoe and the final output as electricity in terms of GWh, we ascertained a simple average rate at which this conversion had taken place.

Year	2000	2001	2002	2003	2004	2005	2006	2007
Electricity	419396	435082	454630	472558	491274	503851	539786	563974
Non-Renewable Energy	112129	114878	116086	120562	131739	134597	143159	156838
Rate	3.7403	3.7873	3.9163	3.9196	3.7291	3.7434	3.7705	3.5959

(Note: Rate = GWh/ktoe)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Electricity	606208	638599	682348	741485	827394	887010	986557	1055157	1128254
NonRenewable	165138	179094	184643	196089	231216	237162	265439	261610	262972
Rate	3.6709	3.5657	3.6955	3.7814	3.5784	3.7401	3.7167	4.0333	4.2904

(Note: Rate = GWh/ktoe)

The above talks about the rate at which the Non-Renewable energy (ktoe) is converted into electricity (GWh).

Year	2000	2001	2002	2003	2004	2005	2006	2007
Energy	76148	75940	71109	84395	95005	114124	130138	139720
Sources	6548	6530	6114	7257	8169	9813	11190	12013
Rate	11.6292	11.6294	11.6305	11.6295	11.6299	11.6299	11.6298	11.6307

(Note: Rate = GWh/ktoe)

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016
Energy	132275	132130	143847	167019	158241	185056	187159	187750	196519
Sources	11374	11361	12369	14361	13606	15911	16007	16143	16898
Rate	11.6296	11.6301	11.6296	11.6300	11.6302	11.6307	11.6923	11.6304	11.6297

(Note: Rate = GWh/ktoe)

The above talks about the rate at which the Non-Renewable energy (ktoe) is converted into electricity (GWh).

Year	2017	2018	2019	2020	2021	2022
Production	1567069.2	1669317.3	1776418	1888371.3	2005177.2	2126835.7

(Note: GWh)

From the historical data of the Total Electricity Production (TEP), we produced a linear quadratic equation with $R^2 = 0.999$. This provides a superior predictability.

Using the above equation, we forecasted the probable TEP for the period 2017-2022.

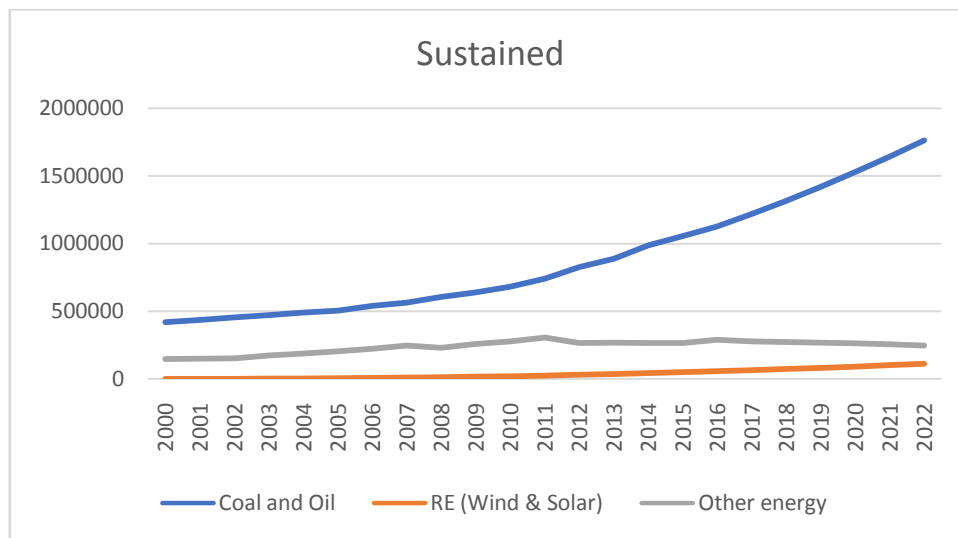
The Indian Government has set a target production of 175 GW or 15533000 GWh through the usage of renewable sources of energy – solar and wind. (100GW from solar and 75GW from wind). This target set is to be met by 2022. This comes from the drive to move towards sustainable and renewable sources of energy/electricity so as to combat the current issue regarding climate change and carbon emission.

We have assumed that the shift in dependence from non-renewable sources to renewable sources is from the year 2019.

Hence, we have assumed that this target is likely to be met and what would be the impact of meeting this target on our balance of trade and trade deficit in that period.

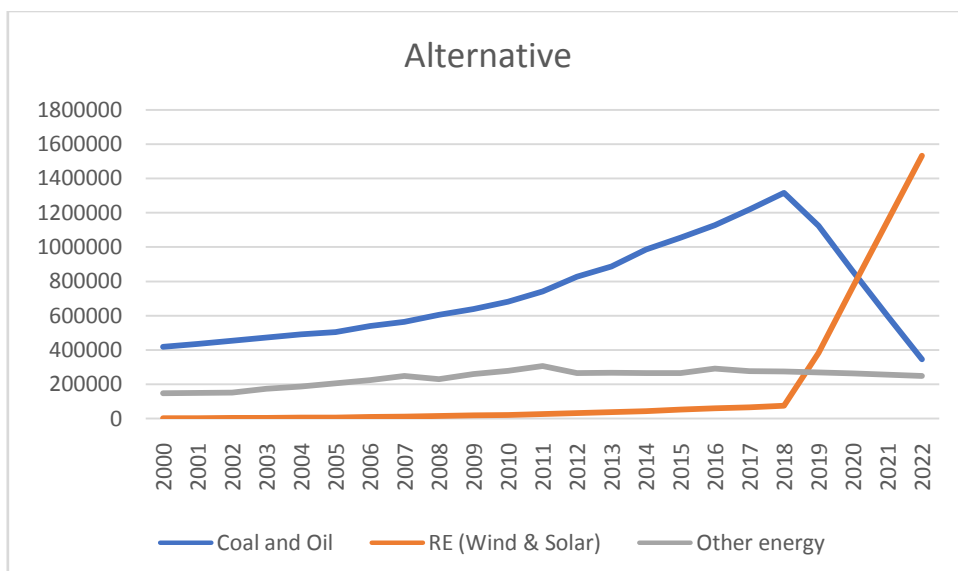
(GWh)

Year	2017	2018	2019	2020	2021	2022
Coal and Oil	1219063.4	1316654.8	1419932	1528895	1643543.8	1763878.4
RE (Wind & Solar)	66025.46	74338.74	83161.9	92494.94	102337.86	112690.66
Other energy	276934.76	273744.14	269237	263413.34	256273.16	247816.46
Total EGF	1567069.2	1669317.3	1776418	1888371.3	2005177.2	2126835.7



Electricity Generation If Dependence on Non-Renewable Continues.

Year	2017	2018	2019	2020	2021	2022
Total Req	1567069.2	1669317.3	1776418	1888371.3	2005177.2	2126835.7
Coal and Oil	1219063.4	1316654.8	1123931	858457.96	599154.04	346019.24
RE (Wind & Solar)	66025.46	74338.74	383250	766500	1149750	1533000
Other energy	276934.76	273744.14	269237	263413.34	256273.16	247816.46



Electricity Generation If Dependence on Non-Renewable Reduces.

To ascertain the probable electricity production from the various sources, three categories of sources were made.

- 1) Non-renewable sources – Oil and Coal
- 2) Renewable sources – Solar and Wind
- 3) Other sources – The remaining sources

Trends were made based on the historical data available to ascertain the probable rate at which these sources' consumption is likely to increase.

We have made the assumption that non-renewable sources of energy is replaced by renewable sources and the other sources remain unaffected and grow at the rates based on historical data. We also assume that the movement towards achieving the goal of 2022 is linear (2019-2022 = 0.25, 0.5, 0.75, 1).

Values	2018	2019	2020	2021	2022
Deficit	1262460	1262460	1262460	1262460	1262460
Increase in Deficit	0	39277.83204	80718.05711	124320.6752	170085.6863
Sustain	1262460	1301737.832	1343178.057	1386780.675	1432545.686

(Note: INR Cr)

The increase in the deficit value if the current rate of electricity were to sustain.

Year	2018	2019	2020	2021	2022
Deficit	1262460	1262460	1262460	1262460	1262460
Decrease in Deficit	0	73295.6843	174258.9703	272876.0495	369146.9221
Alternative	1262460	1189164.316	1088201.03	989583.9505	893313.0779

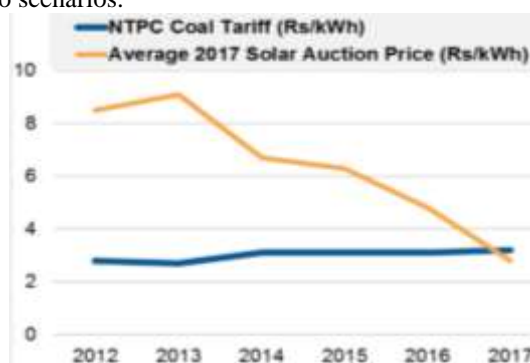
(Note: INR Cr)

The decrease in the deficit value if the alternative measures, that is, Non-Renewable sources were substituted by Renewable sources.

Values	2018	2019	2020	2021	2022
Sustain	1262460	1301737.832	1343178.057	1386780.675	1432545.686
Alternative	1262460	1189164.316	1088201.03	989583.9505	893313.0779
Difference	0	112573.5163	254977.0274	397196.7247	539232.6084

(Note: INR Cr)

The difference between the two scenarios.



(Source: NTPC as a Force in Indian Electricity Transition)

The historical data regarding the pertaining to generation of one unit (KWh) of electricity.

V. FINDINGS AND SUGGESTIONS

If the current growth rate were to persist, we see that the proportion of electricity from oil and coal imports will probably cause an increase in the imports value by 17.6301%. If we were to assume that the trade deficit remains constant at the 2018 level of Rs 1262.46 th Cr, it would increase by 13.472% by 2022. If the renewable energy sources were to meet the target set by the government, we see that the proportion of electricity from oil and coal imports will probable cause a decline in the imports value by 38.2637%. As a result, the trade deficit may fall by 29.2402% by 2022. If we compare the difference in the quantum of deficit in both the scenarios, we see a difference of Rs 539232.6084 Cr (Rs 539.232th Cr).

Coal and oil, for the period 2000-2016, was converted at an average rate of 3.7808, while it was constant between the range of 3.5657-4.290. Whereas, the rate at which Renewable sources of energy was being

converted into electricity was far efficient at 11.6336 and was constant between the range of 11.6291-11.6923. (GWh/ktoe).

Hence, based on the above findings, the alternative hypothesis H1: Investments in Renewable sources of energy for electricity generation has a significant impact on Trade Deficit holds true

VI. CONCLUSION

Lesser reliance on external resources will not only safe guard our economy from external threats and economic factors, but also increase the velocity and liquidity of the money rotation within the economy. The excess money can be utilized in public welfare or infrastructure development and prevent money to leave India's economic premise.

In the recent years, we have seen that the cost of production of one unit of electricity by the means of Renewable sources of energy has become lesser than that of Non-Renewable sources of energy.

This shows that investing in the Renewable energy sources attracts various benefits to the economy such as,

- Efficiency in production or conversion from energy to electricity.
- Significant decrease in the Trade deficit, which helps increasing the liquidity and prevents investments to stay and circulate internally thus increasing the velocity of transactions.
- It also has become a cheaper source of electricity generation hence requiring lesser investments per unit cost.
- Renewable sources, as compared to Non-Renewable, doesn't attract much variable cost as the major cost is the fixed cost of setting it up.
- The energy output would also minimise carbon emission thus tackling the climate change issue and at the same time helping to achieve the Paris Agreement.

Based on the above findings, we conclude that the government should take up further initiatives and provide incentives to the electricity production companies and majorly to companies importing Non-Renewable to diversify their operations and invest in areas pertaining to electricity generation using Renewable energy sources. It would help the government to meet its 2022 target.

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Vaibhav H Shah" Non-Renewable Resource: Impact Sustainance and Alternatives"
International Journal of Business and Management Invention (IJBMI), vol. 08, no. 01, 2019, pp
16-22