

A Study on Energy Import Dependency in India

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ABSTRACT-In today's globalized world, the interconnection between the economy and the environment is evident. A nation's prosperity and self-reliance hinge on adopting sustainable methods of energy production. Lack of energy security and self-sufficiency compels a country to import necessary energy resources, significantly impacting both sustainability and the foreign reserves. This paper addresses India's suboptimal utilization of energy resources, focusing on the import dependency in the energy sector due to the prevalent use of fossil fuel-based energy (conventional energy) from 2006 to 2020. Data analysis, incorporating graphical representations of conventional energy import and consumption, highlights the status, growth, and import dependency trends. The findings reveal that India heavily relies on imports for conventional energy resources, particularly crude oil. The paper concludes that the key solution for improving economic and environmental conditions lies in transitioning towards renewable energy resources.

KEYWORDS- Energy Import Dependency, Conventional Energy Consumption, Sustainability, Renewable Energy.

I. INTRODUCTION

In an epoch characterized by swift industrialization, burgeoning population growth and relentless technological progress, the global demand for energy has emerged as a pivotal catalyst for economic expansion. Positioned as one of the world's fastest-growing economies, India finds itself at a crucial juncture, navigating a burgeoning energy landscape fraught with challenges stemming from surging demand, limited resources, and pressing environmental concerns. Central to these challenges is the critical matter of energy import dependency—a multifaceted issue with profound implications for India's economic resilience, national security, and sustainable development. As the international community undergoes a transformative shift towards renewable and sustainable energy alternatives [1][2][3][4] the decisions India makes today regarding its energy portfolio are destined to shape its trajectory in the decades ahead. This research paper undertakes an in-depth exploration of the complex tapestry of India's energy import dynamics, dissecting the nuanced interplay of factors contributing to its growing reliance on external sources. By unravelling these intricacies, the study aims

to shed light on the multifaceted challenges posed by energy import dependency and its far-reaching consequences for India's future. The type of energy resource used by India has substantial implications for economic growth and sustainability. India mostly meets its energy demand by conventional energy sources i.e., coal and oil. In 1980s demand for coal was around 130.73 million tonnes which increased by 753% to 1115.02 million tonnes [5]. The most of the increased energy demand between 1980 to 2014 was met by coal (57%) followed by oil (28 %) [6]. The economic growth of India is making a boost in energy sector which is demanding more energy for fulfilling their needs. The energy production of India is inadequate to meet its demand so India has to rely on import of coal and crude oil to meet its energy demand. In our study we will explore the different aspects of conventional energy imports and its implications on India.

II. OBJECTIVES OF THE STUDY

The major objectives of the present study are the following

- To study the change of share of various types of conventional energy consumption in India during the period of 2006 to 2020.
- To study the energy import dependency of different conventional energy sources in India during the period of 2006 to 2020.

III. METHODOLOGY

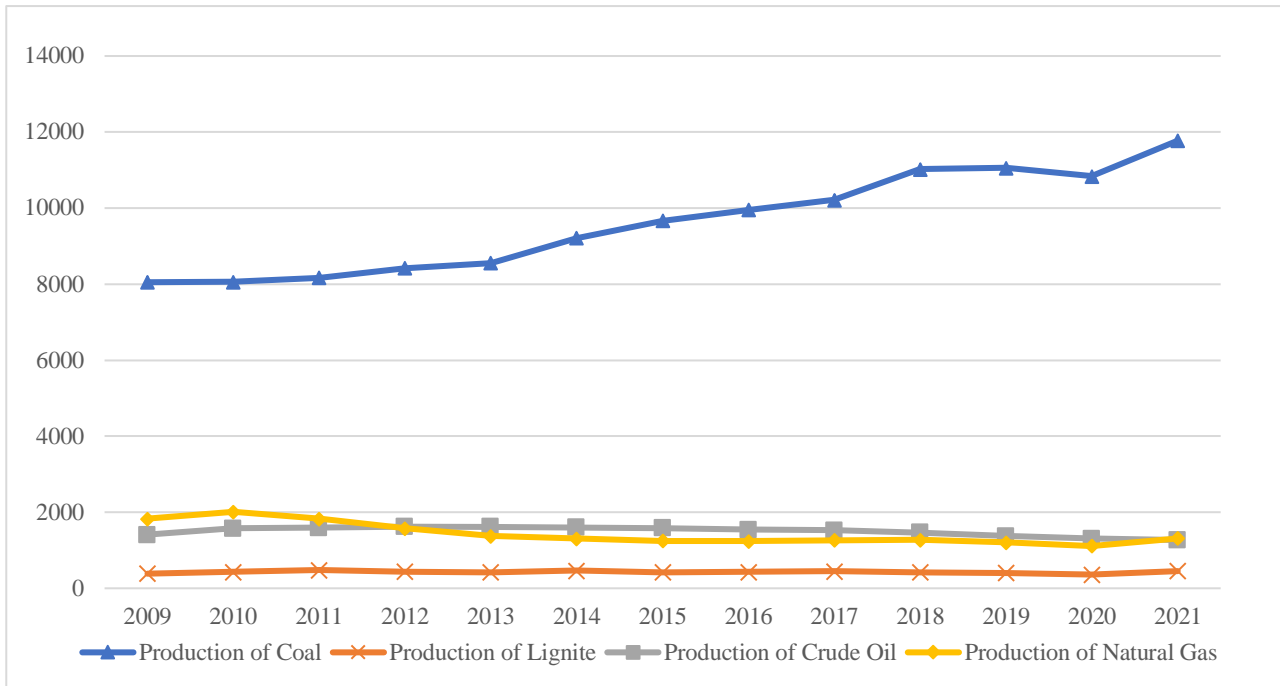
Diagrammatical representation, tables and percentage share of different conventional energy sources have been used to represent the different aspects of conventional energy sources. Ratio of import of conventional energy sources to its consumption has been used to see the import dependency of different conventional energy sources in India.

IV. RESULTS AND DISCUSSION

We know, there are two types of energy sources: conventional energy and non-conventional energy. We are dependent upon the conventional energy sources like coal and crude oil as a driving force for all economical activities either directly or indirectly. However, conventional energy sources are limited in nature and some of them are a major threat to the environment. In 2009 total conventional energy share in capacity generation of electricity was 61.37 % and 60.82 % in 2020 [7][8]. The total energy production from

conventional energy sources have been increased from 11677.49 petajoule in 2009 to 13611.53 petajoule in 2020. This increased production of energy is mainly due to increase in coal production. Figure 1 illustrates energy production in petajoule from different conventional energy

sources. In 2009 energy production from coal was 8049.80 petajoule and in 2020 it was 11774.01 petajoule. From other conventional energy sources, it was almost stagnant throughout the period.



(Source: Government of India, Energy Statistics, Various Years)

Figure 1: Energy production (Petajoule) trend from different conventional energy sources in India from 2009 to 2020

To meet country’s energy demand, there has been a huge amount of import of conventional energy sources from other countries. Conventional energy import drains out our foreign reserve. Energy consumption has increased manifold for different sources. Energy demand is obvious with the flow of growth rate but country should be energy

sustain. Table 1 edifies that how much energy consumption of conventional energy has been increased with time. We can see that the major part of energy consumption has been met by coal (approx. 50%) followed by crude oil and others.

Table 1: Energy Consumption (Petajoule) from different conventional energy sources for 2000 and 2020

Conventional Energy Sources	2000		2020	
	Amount	% contribution in consumption	Amount	% contribution in consumption
Coal	5120.28	47.41	13713.00	52.89
Crude Oil	4331.00	40.10	9489.00	36.60
Natural Gas	1073.00	9.94	2356.00	9.09
Lignite	275.72	2.55	367.00	1.42
Total	10800.00	100	25925.00	100

(Source: Government of India (2010) and Government of India (2021))

Conventional energy consumption pattern indicates that the consumption of crude oil gets 2nd place (36.60%) after coal (52.89 %) in India in 2020 [8]. Primary energy consumption of India increases by 140% from 2000 to 2020. Growth rate of aggregate production of conventional energy is lower than the growth rate of aggregate consumption of

conventional energy. So, share of gross import of energy in aggregate consumption is increasing overtime. Table 2 shows the energy import is required to fill the gap between consumption and production of conventional energy. There is very strong and positive relation between electricity price and crude oil import. As electricity is a perfect substitute for

crude oil, the electricity price reduction decreases the amount of import of crude oil [9]. So, it is a good idea to

reduce our electricity price by using other non-conventional energy resources.

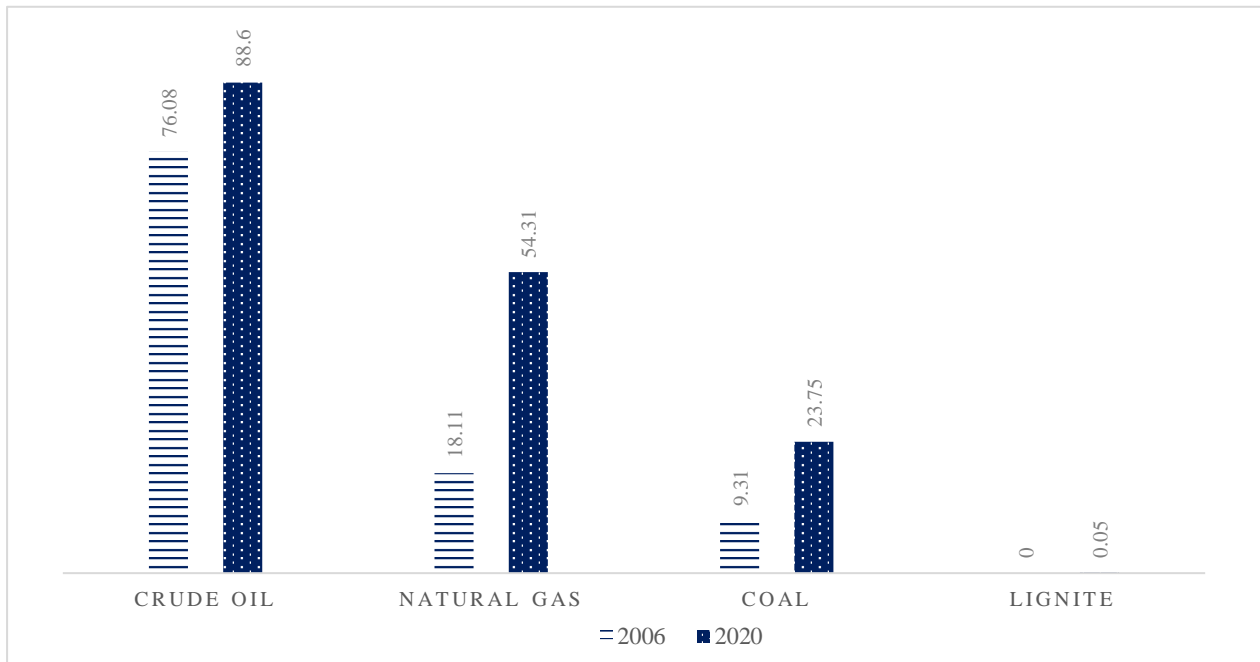
Table 2: Aggregate consumption, production and gross import of conventional energy (In Petajoule)

Year	Aggregate consumption of conventional energy	Aggregate production of conventional energy	Aggregate gross import of energy	Share of gross import energy in aggregate consumption (%)
2006	14929.00	9520.17	5582.34	37.39
2010	20119.00	12077.85	8390.76	41.70
2014	24426.00	12584.31	12121.55	49.62
2017	27108.00	13455.63	13646.93	50.34
2020	25925.00	13611.53	12943.91	49.92

(Source: Government of India, Energy Statistics, Various Years)

Now we will discuss imports of different energy sources with respect to their consumption and aggregate gross import. These specify the energy import dependency for particular sources. Energy import dependency for all conventional energy sources increases in 2020 with compare to 2006. From Figure 2 we can see energy import dependency for crude oil, natural gas, coal and lignite are 88.6%, 54.31%, 23.75% and 0.05% respectively in 2020.

Energy import dependency has been increased for all sources. Maximum increment has been seen in natural gas, signifies that for natural gas energy import dependency increases from 18.11% to 54.31% from 2006 to 2020 respectively. Maximum energy import dependency has been observed for crude oil. This signifies that 88.60% crude oil has been imported to meet the demand for consumption of crude oil.

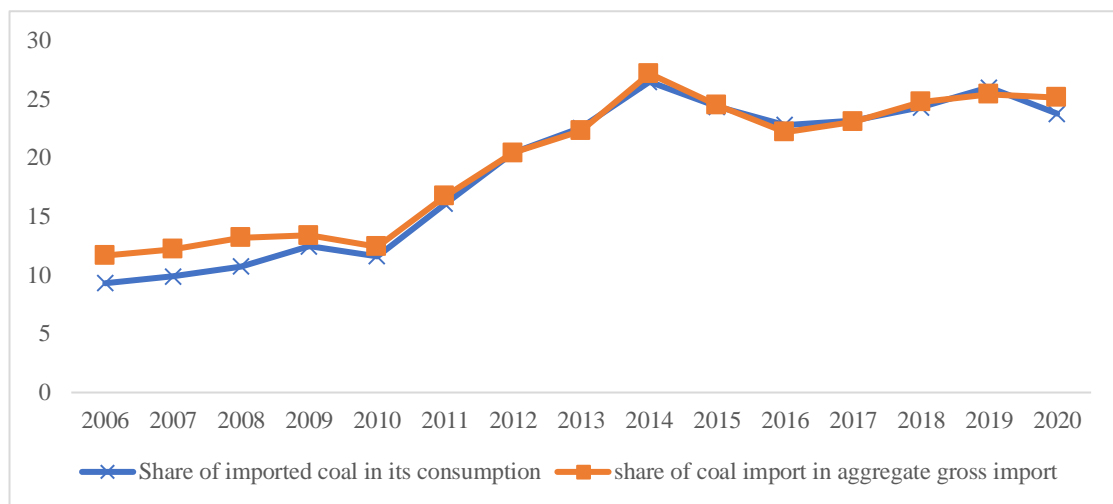


(Source: Government of India (2010) and Government of India (2021))

Figure 2: Comparison of energy import dependency of different energy resources between 2006 and 2020.

Coal import condition can be understood from Figure 3 where we can see the share of coal import with respect to its consumption and aggregate import of energy. Although coal is highly used in conventional energy source in India but its share of import in its consumption as well in aggregate

gross import is lower than crude oil, it is only due to easy availability of coal in India. Import dependency of coal has been found to increase from 9.32% in 2006 to 23.75% in 2020. Contribution of coal in aggregate gross import has been also increased from 11.67% (2006) to 25.16% (2020).

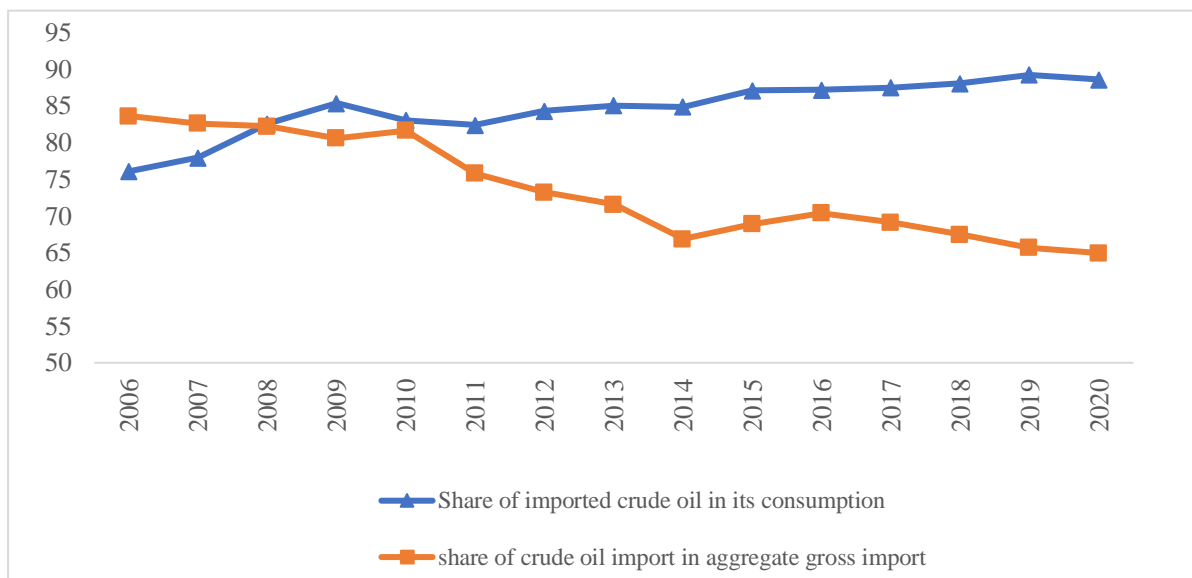


(Source: Government of India, Energy Statistics, Various Years)

Figure 3: Share of coal import with respect to its consumption and aggregate import of energy

Crude oil import condition has been seen in Figure 4 where its import demand is very high from early period. Its import share in consumption and import share in aggregate gross import is always near to 75%-85%. In conventional energy sources crude oil is the 2nd largest consumed energy source after coal. Energy import dependency of India is highest in crude oil from very early period and its dependency

increases with time. In 2006 energy import dependency for crude oil was 76.08% and in 2020 it increased to 88.60%. Share of imported crude oil in aggregate gross import decreases from 83.63% to 64.95%, from 2006 to 2020 respectively. This share of imported crude oil decreases due to increase in shares of other conventional sources like coal and natural gas.

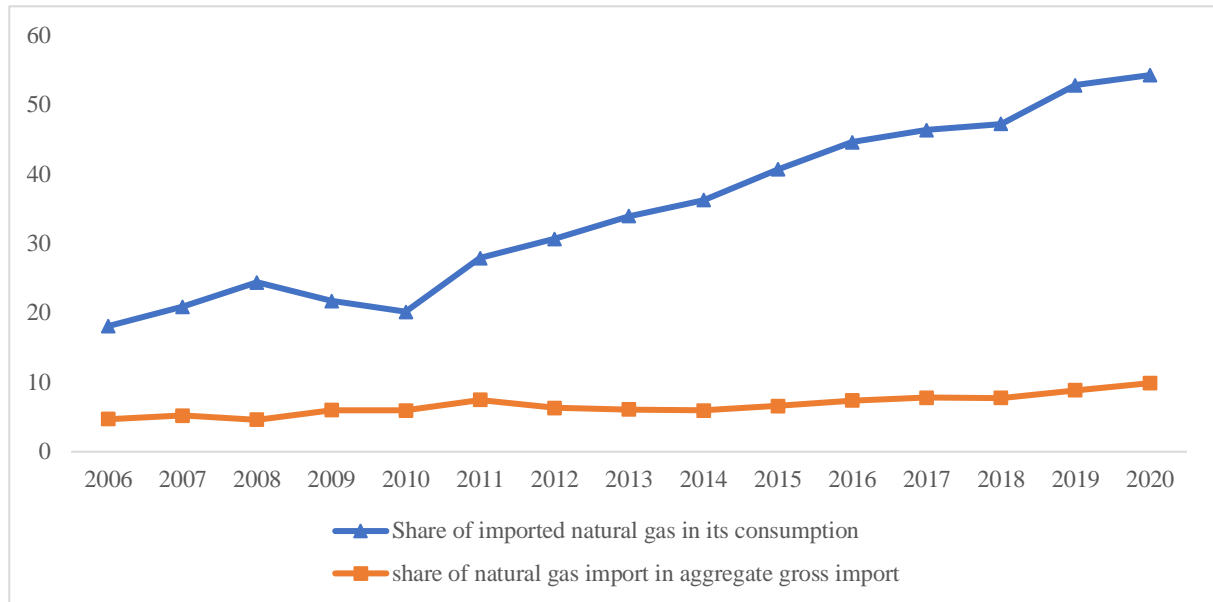


(Source: Government of India, Energy Statistics, Various Years)

Figure 4: Share of crude oil import with respect to its consumption and aggregate import of energy

Imported natural gas share in aggregate gross import is always very less but now a days with the increase in demand of natural gas its energy import dependency has also been increased with time. In Figure 5 slope of curve (share of imported natural gas in its consumption) depicts the increment of growth of energy dependency upon natural

gas in India. Share of Natural gas in aggregate gross energy import is not so high but its import dependency increases with time. In 2020 its import dependency increased to 54.30% from 18.11% in 2006, which is a matter of concern. Share of natural gas import in aggregate gross import increases from 4.7% in 2006 to 9.89% in 2020.

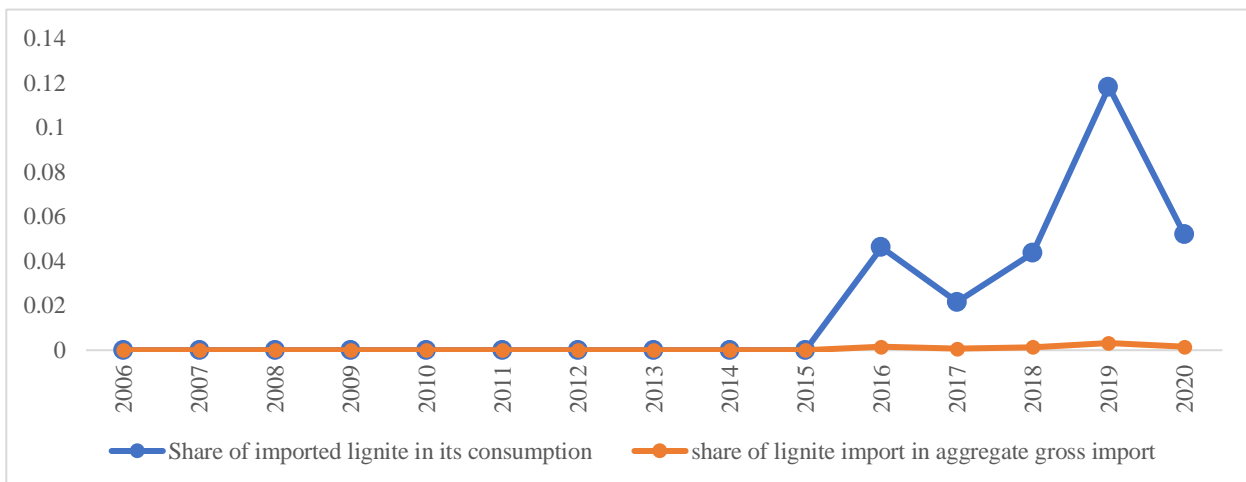


(Source: Government of India, Energy Statistics, Various Years)

Figure 5: Share of Natural Gas import with respect to its consumption and aggregate import of energy

Lignite is comparatively less used and less import conventional energy sources. We can understand its import condition from Figure 6. Import for lignite is 0 before 2016 so share of imported lignite in its consumption curve has been started from 2015. From very early period lignite consumption is very less and till 2015 there is no need to import it. After 2015 there is negligible increase in amount

of imported lignite. Energy import dependency for lignite increases from 0 to 0.05 till 2020 which is insignificant. Share of imported lignite in aggregate gross import is near to 0, which means India is self-efficient in lignite consumption.

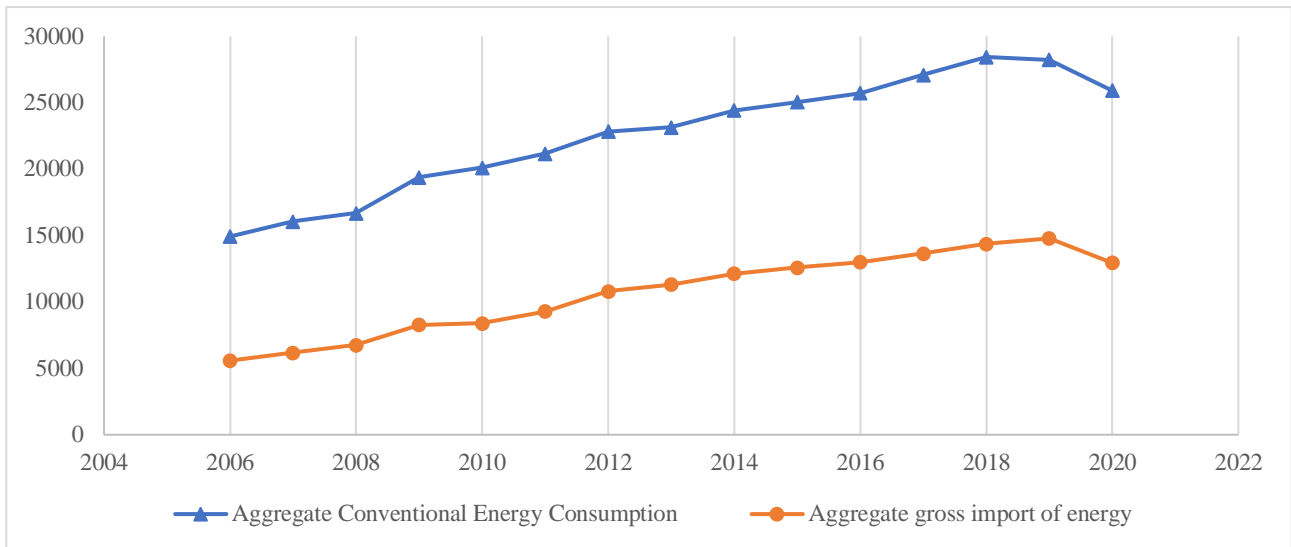


(Source: Government of India, Energy Statistics, Various Years)

Figure 6: Share of Lignite import with respect to its consumption and aggregate import of energy

Import of any commodity increases due to increase in its demand for consumption. Although there is introduction of different modern technology for renewable energy production but there is very rare change has been seen in use pattern of conventional energy sources. That's why India still dependent upon import energy to meet its energy demand. Among different type of imported conventional energy sources, India is largely dependent upon crude oil

(64.95%) in 2020. In 2006 there was mainly two components of imported conventional energy sources i.e., crude oil and coal. In 2006 crude oil share in import was 83.62% and share of coal was 11.67%. In 2020 natural gas share in aggregate gross import was 9.89%, share of coal in aggregate gross import was 25.16% and share of crude oil was high as compare to other i.e., 64.95%.

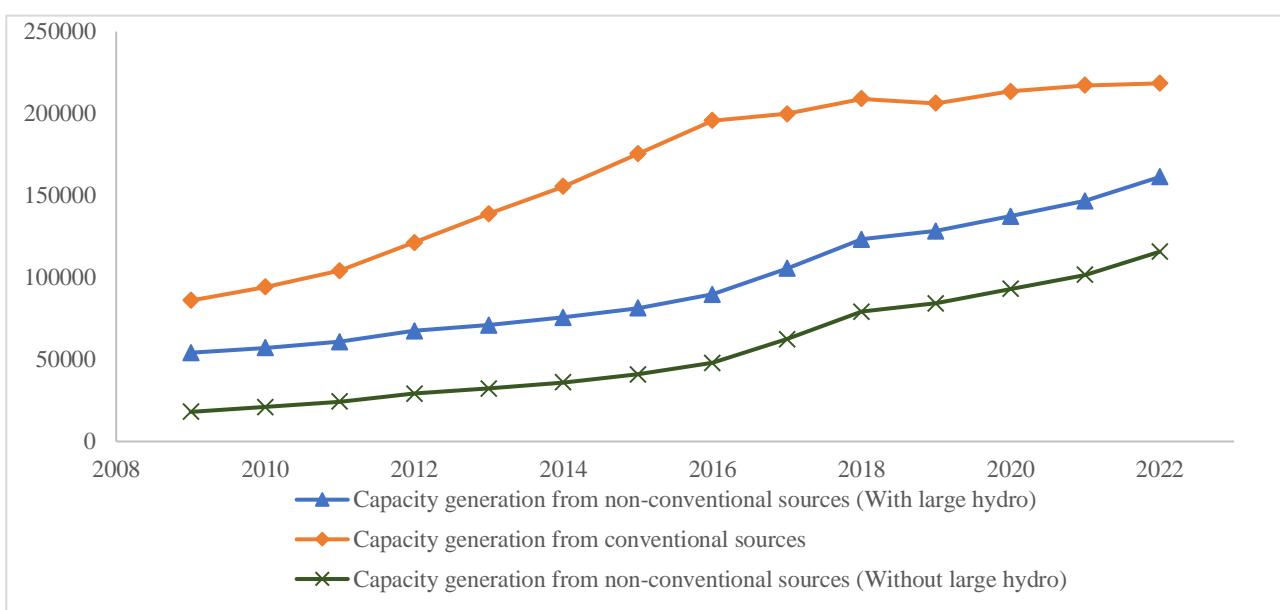


(Source: Government of India, Energy Statistics, Various Years)

Figure 7: Trend of aggregate conventional energy consumption (Petajoule) and aggregate gross energy import (Petajoule) of India from 2006 to 2020

Curves of Figure 7 are looking-alike that means consumption of conventional energy is mostly dependent upon import of energy. In 2006 energy import dependency of India was 37.39% and it is increased to 49.93% in 2020. If we do not work upon the problems generated from conventional energy uses, then we will leave nothing behind for our next generation and it will create unsustainable exhaustion of sources. The consumption of conventional energy is consistently in same trend in India. From above explanation we can see that the import dependency of coal and natural gas are comparatively lower than crude oil and for lignite it is negligible. For crude oil import dependency is almost 80% from very early period. In 2006 import dependency for crude oil in India was

76.08%. It increases with time and it has reached to 88.60% in 2020, which is very high. This means that maximum crude oil demand of India is fulfilled by its import. This retards India's economy and negatively affects foreign exchange. From this paper we can say that India is highly import dependent on crude petroleum. As we know reserves of conventional energy is decreasing with time as it is conventional in nature so it can't be replaced by new. Potential of renewable energy resources in India is enough to meet its energy demand, so we should give more attention to harness energy from those energy resources rather than uses of conventional energy sources. India's situation of capacity generation from non-conventional energy sources is a beacon of hope for future sustainability.



(Source: Government of India, Energy Statistics, Various Years)

Figure 8: Trend for capacity generation (MW) from different energy sources in India from 2009 to 2020.

Figure 8 shows that capacity generation from non-conventional sources improves in growing period and one day it will surpass the capacity generation from conventional sources. In 2019 large hydro power has been taken as renewable energy [10][11][12] so we have used two figures to show capacity generation from non-conventional sources. In 2009 capacity generation from conventional energy sources was 85936.28 MW and in 2022 it is increased to 218409.56 MW. It means capacity generation from conventional energy sources has been increased 2.5 times of 2009 generation. The capacity generation from non-conventional energy resources (with large hydro power) was 54118.64 MW in 2009 and it has increased to 161260.93 MW in 2022 which is 2.9 times of 2009 generation. The capacity generation from non-conventional energy resources (without large hydro power) was 18043.58 MW in 2009 and it has increased to 115701.07 MW in 2022 which is 6.4 times of 2009 generation. This is due to high increment in generation in wind energy, biomass power, waste to energy and solar energy in India. More uses of conventional energy resources creates so many problems like creation of greenhouse gases that increases global warming, exhaustion of resources because they are scarce in nature, though we have limited stocks of conventional energy sources so country import it to meet its energy demand, huge import badly affects foreign reserve which retard country growth etc. On the other hand, non-conventional energy resources are beneficial for environment, economic condition of country etc. Although non-conventional energy resources have their limitation like financial problem, technological problem, wastage problem for future etc. but its benefits are more important. Government of India has taken many policies regarding improvement of renewable energy sector and to make country self-sustain and efficient. People of the country should also adopt these policies and help to make it implemented.

V. CONCLUSION

Energy plays both a direct and indirect role in the process of transforming into a developed nation. Upon analysis, it becomes apparent that a significant portion of India's energy needs is met through conventional sources, posing a considerable challenge to the country's energy security as most of these sources are imported. Realistically, an immediate transition from conventional to non-conventional energy sources is challenging due to technological and economic constraints. India, however, possesses certain advantages, such as its tropical climate providing abundant sunlight throughout the year, being surrounded by seas on three sides, having mighty rivers, and some regions consistently experiencing air flow suitable for harnessing wind power. In summary, to achieve development and ensure energy security, India must leverage the potential of renewable energy sources, including solar energy, tidal energy, hydropower, and wind energy.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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