

A realistic glimpse into India's Energy Security in foreseeable future in view of renewable alternatives

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ABSTRACT

Energy Security plays a key role in the national security of any given country because without energy there is no economy, and without an economy there is no progress of society in general. In Indian context, electricity demand has grown at an average of 4 percent per annum over last 30 years. Currently, India is fulfilling their demand through domestic coal and oil and import of coal and oil playing a key role in India's energy security. In this context, India is looking for long-term solutions to increase energy security by reducing dependence on foreign oil & coal import, as coal reserves available in India is to be kept as reserve for future. Keeping in view this fact and considering the environmental issues, Government of India declares the development of renewable energy with the available potential and targeted 175GW installed capacity by the end of 2022. With this prediction, renewable energy will decide the future energy security of India. Further looking to the growth of renewable and predicted amount of development in future the role of renewable energy is not to be overlooked and it supports the reduction in import of coal and ultimately ensures the energy security in future.

1. Introduction

Just like each country, India must think about its future energy security because this is one of the main prerequisites for the future economic growth of the country. Our economy is traditionally based on fossil fuels (coal, oil and natural gas), and this fact leads to conclusion that only the adequate supply of fossil fuels can ensure future energy security.

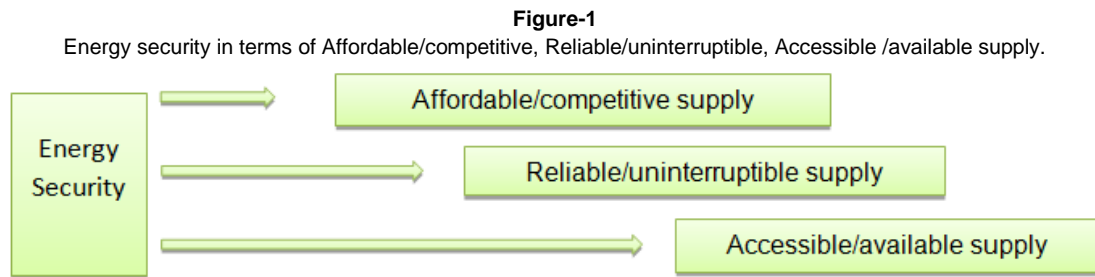
Energy security is term we often listen when the world running out of energy resources. In terms of this energy security refers to availability of natural resources for energy consumption in a given period of time in order to estimate future energy security.

Despite the present development of renewable energy sources such as solar power, wind power and biofuels, fossil fuels as a energy sources in India are still under development sage. Under such scenario fossil fuels like coal and oil will continue to satisfy most of the nation's energy demand which determine the destiny of future global energy security. However, the role of renewable alternatives in improving energy security is not to be overlooked because more renewable energy coming from domestic renewable energy sources which may likely to reduces the need for fossil fuels and expensive coal import. The transition to more domestic renewable alternatives energy resources instead of relying on expensive foreign coal import could change the scenario and attempt to push aside the coal to make India's Energy Security in foreseeable future, at least till the end of the century

1.1 Energy Security –Concept

Until the 1970s, the concept of energy security was mainly emphasized the physical availability of energy, especially oil, however after the oil crises the concept propagated terms of price level, in either "affordable" or "fair" contexts. Especially since 1990s, on recognition of global warming issues by governments, the more explicitly sustainability is mentioned in terms of energy security. More recently, availability of energy supply issues are predominantly discussed under the concept of energy security.

Today, a typical definition of energy security is "the continuous availability of energy in varied forms, in sufficient quantities, and at reasonable prices" (APERC, 2007)¹ The IEA defines energy security as "the uninterrupted availability of energy sources at an affordable price". Energy security has many dimensions: long-term energy security mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs. Short-term energy security focuses on the ability of the energy system to react promptly to sudden changes within the supply-demand balance². The extension of the IEA definition includes the environmental and sustainability issues that may introduce additional and sometimes disparate constraints. With further extensions to the original IEA definition, the Asia Pacific Energy Research Centre (APERC, 2007)¹ emphasizes the 'four A approach' - Availability, Accessibility, Affordability and Acceptability and defines energy security as "the ability of an economy to guarantee the availability of the energy supply resources in a sustainable and timely manner with the energy price being at an affordable level without affecting the economic performance of the economy".



Source: APERC 2017

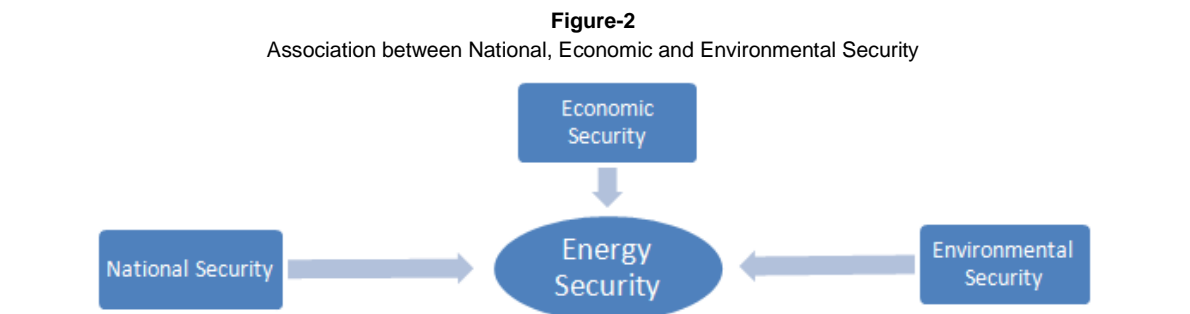
According to India's then president, A.P.J. Abdul Kalam, a scientist, demand for energy would be "a defining characteristic of our people's life in the 21st century" and defined energy security as "ensuring that our country can supply lifeline energy to all its citizens, at affordable costs at all times."

1.2 Significance of Energy Security

During World War I at the first decades of the 20th century, energy was first linked with national security, particularly with respect to security of oil supply for navy ships and vehicles and later in World War II² (2009) as well as by other papers (e.g. Sagan (1988)³). In the second half of the last

century, the scope of energy security concerns significantly changed and it was no longer about stable and cheap supplies of oil protected from unilateral embargoes as in the 1970s, but involved other energy systems like natural gas, nuclear energy, electricity and civil transportations⁴.

As per Wikipedia⁵, **Energy security** is the association between national security and the availability of natural resources for energy consumption. Access to relatively cheap energy has become essential to the functioning of modern economies. However, the uneven distribution of energy supplies among countries has led to significant vulnerabilities.



Source: Wikipedia Energy Security

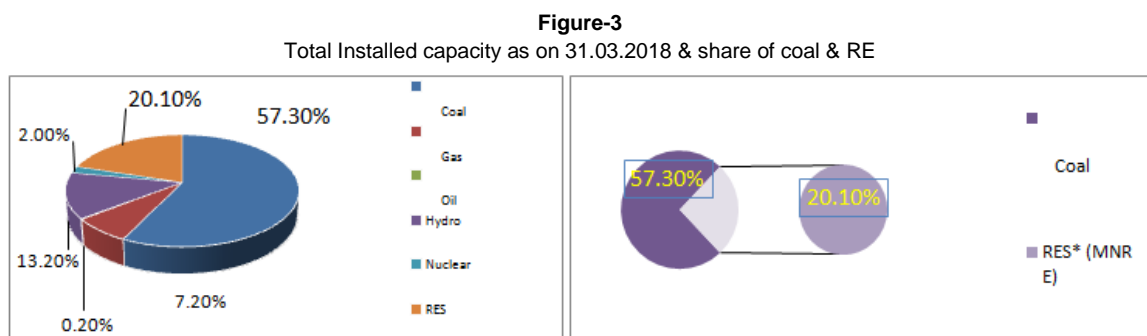
The APERC (2007)¹ report addressed four 'dimensions' of energy security (availability, adequacy, affordability, and sustainability) as 'multi-dimensional'. Such a multi-dimensional aspect of energy makes it a matter of national security.

1.3 Indian's Energy Security Scenario

The sources of energy varies from age to age and since centuries the main sources of energy have been fossil fuels such as Coal, Oil and Natural Gas and these resources are now dominant in most of the developing countries of the World. India is the third largest coal producer in the World after China

and the USA and Coal will continue to constitute a major proportion of India's energy mix for many years to come.

As per Power sector at a glance –All India Gol, Ministry of Power⁶, the total installed capacity as on 31.03.2018 is 344GW, out of which the installed capacity based on coal constitute 199GW @ **57.3 %** and Renewable energy sources (MNRE) including solar, wind energy, biomass, small hydro, waste to energy etc constitutes 69GW @ **20.1%** as depicted in figure-3.



Source: Power sector at a glance –All India Gol, Ministry of Power

2. Coal reserve position of India

The total estimated coal resources of the country is 319020 million tonne as per "The inventory of Geological Resources of Indian Coal" (as on 01.04.2018)⁷, prepared by the Geological Survey of India. The total coal extracted from the various coalfields during 2017-18 is 680.46 million tonne and since 1950 upto 2017-18 is around 15122.28 million tonne. (As per Coal Controller, MoC, Government of India)⁷. Every year about 3 to 5 billion tonne of resources are being added through fresh exploration to the Coal Inventory of India⁸, which may create short fall over the period of time.

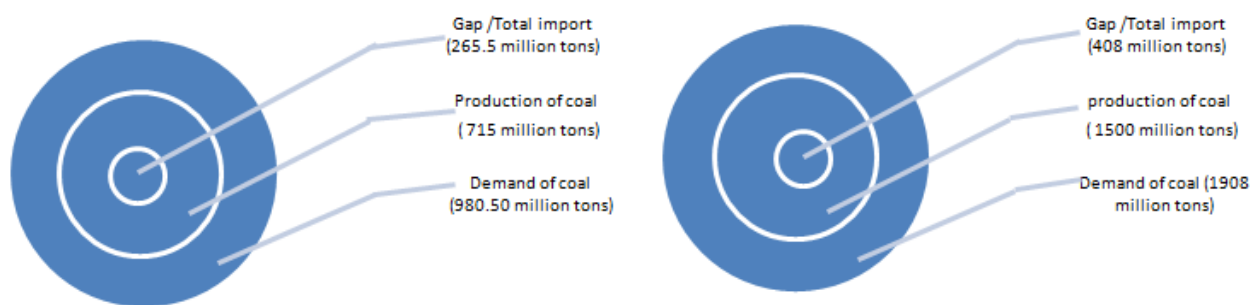
2.1 Coal Demand & Supply Scenario

As per the Report of the Working Group for coal & lignite in the terminal year of XII Plan (2016- 17)⁹, the total demand of coal both cooking & non-cooking in different projections was at 980.50 million tonne. As against these demands the production of both cooking & non cooking coal are projected at 715 million tonne in the terminal year of XIIth Plan, creates a gap of 265.50 million tonne between demand and indigenous availability of coal which has to be met through imports.

In source wise projected demand of coal in the terminal year of XIII Plan (2021-22), is 1373 million tonne and indigenous availability of coal is projected as 950 & 1100 million tonne in scenario 1 and 2 respectively, creating a sizeable shortfall of 423 & 273 respectively.⁹

Figure-4:

The demand and production of coal under XII plan (2016-17) & projected scenario of demand and production of coal (2030) coal vision 2030 report (2018)



Source: Working Group for Coal & Lignite for XIIth Plan & coal vision 2030 report (2018).

2.2 Foreseeable Future of Coal

As per the draft National Energy Policy (NEP), (version as on 27.06.2017) formulated by the Niti Aayog, India Vision 2040¹⁰ envisages demand-driven provision of energy at affordable prices, high per capita consumption of electricity, access to clean cooking energy & electricity with universal coverage, low emission and security of supply as criteria that would characterize the energy parameters of India in 2040. The installed coal-based electricity generation capacity is expected to grow to 330- 441 GW by 2040. This is likely to translate into a coal demand of 1.1- 1.4 billion tonnes. The known levels of proven coal reserves (138 billion tonne as of 31.03.2016) may only be able to support an annual peak production of 1.2-1.3 billion tonne till 2037, with a gradual decrease thereafter.

According to the coal vision 2030 report (2018)¹¹ Coal to continue enjoying demand for some more time in India, even in the most adverse low sentiment scenario, as of 2017, it appears that the demand for coal in India, shall expand until 2030 and perhaps beyond to some extent.

Overall coal demand scenario is estimated to be 900–1,000MTPA by 2020 and 1,300–1,900MTPA by 2030 corresponds to a GDP growth rate of 8 per cent, as shown in Figure-4, which is influenced by economic growth, energy efficiency and emergence of alternate coal uses. By 2030, of the overall coal demand, thermal coal demand is estimated to be 1,150–1,750MTPA and the balance is coking coal demand.

The total production capacity of coal mines as on 2018 is about 1,500MTPA at the current rated capacity which is adequate upto 2020 as per current scenario. However, in the scenario where actual demand is higher, there is limited new mines in the immediate future, say 2022–25 horizons.

India is currently facing a number of energy security challenges, the gravity of which will increase in future as the demand for energy outstrips supply. As limited indigenous resources will not be sufficient to meet India's accelerated energy demands, in this context its dependence on the importing of oil, gas and coal will continue into the foreseeable future

2.3 Changing Scenario

During the 2017-18, the consumption of coal by the thermal power stations is almost stagnated, as the net capacity addition is negligible after accounting the retired thermal power capacity and the existing capacity operating at lower plant load factor (PLF) due to the fact that most of the incremental electricity demand is catered by the must run solar, wind, etc. as a part of energy security and to preserve the coal. Hence, utilization of available natural resources for energy generation is used to demonstrate energy security in a given short or long-term period by preserving domestic coal thereby reducing import of coal, in order to estimate future energy security

2.4 Role of Renewable Energy in Energy Security

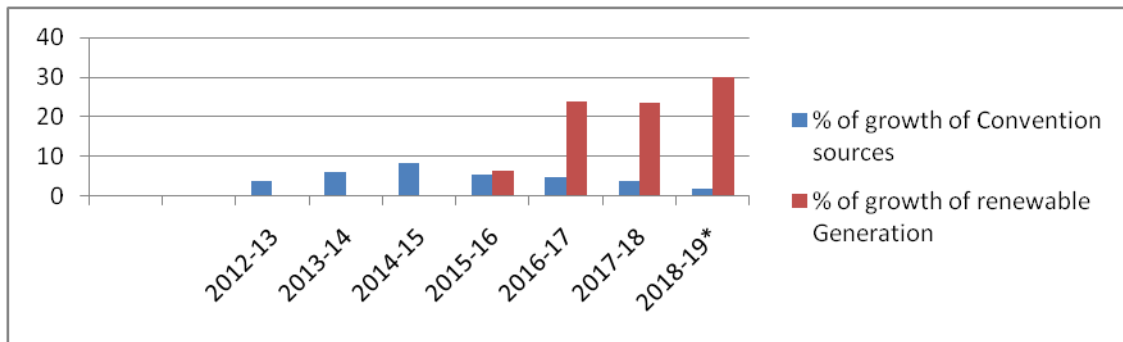
In the changing scenario with growing concern on energy security, Government emphasized on Renewable Energy

projects development. Accordingly, the Government has up-scaled the target of Renewable Energy capacity to 175 GW by the year March 2022¹³, which includes 100 GW from solar, 60 GW from wind, 10 GW from Bio-power and 5 GW from Small Hydro power and so far a total of 69 GW capacity has been installed through the implementation of various renewable energy schemes & programme upto 31st March 2018 and further installation continue.

The effect of schemes/policies envisaged the transition in electricity sector of India. The recent scenario witnessed that

the accelerated renewable capacity addition of generation over the past few years lead to a situation wherein the electricity supply potential over reached the economic demand that had never happened before in the history of the Indian electricity sector. Accordingly witnessing changes in the energy mix due to enhanced policy focus on energy security concerns, climate change etc. due to which the penetration of renewable electricity, especially from wind and solar energy, has been increasing steadily during recent years⁶ and is projected to grow much faster in the coming years as depicted in Figure-5 for the years 2026-27.

Figure-5: The %age annual growth in conventional & RE generation



Source: Power sector at a glance –All India GoI, Ministry of Power

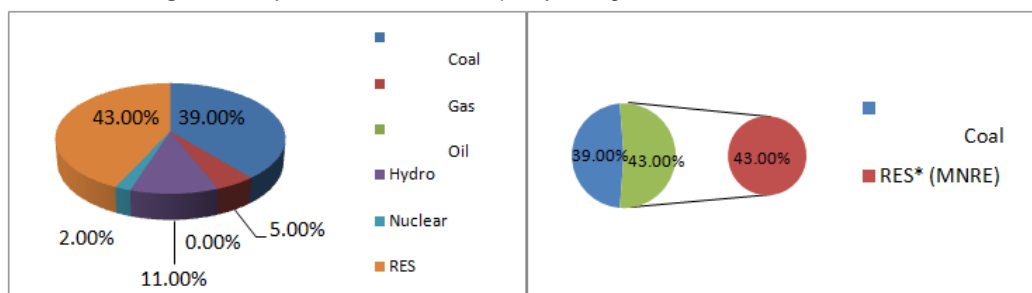
3. Projected Renewable Scenario

The Energy and Resources Institute (TERI) in their report 'Transitions in Indian Electricity Sector report 2030'¹² studied and bring out possible transitions to address the changing demand and supply scenarios and made an assessment of electricity demand till 2030. The electricity demand scenario is built on the basis of extrapolating past demand to the future, taking into account the current year consumption and future economic growth and adjusting it to account for future end-use energy efficiency improvements, additional requirement for the households, industries and transportation.

As per the draft National Electricity Plan (December 2016) 13, the supply side studied upto 2029-30, planned capacity additions of non-RE power i.e. coal, nuclear, hydro, and gas-based capacities of 50,025 MW, 7600 MW, 27,330 MW, and 4,340 MW, respectively. In case of coal-based power stations,

the study has accounted for retirement of approximately 5.2 GW up to 2021–22 (as envisaged in draft NEP) and approximately 30 GW of capacity during the subsequent five years based on plant age, obsolescence of technology and environmental considerations. The likely installed capacity by end of 2026-27 works out to 640GW among which coal base capacity constitutes 248.5GW @ 39% including 50GW coal base addition currently under construction likely to yield benefit in 2017-22 and no coal base addition during 2022-27 and renewable energy constitutes 275GW @ 43%. India needs no extra coal power stations until at least 2027 as running and under construction coal plants meet demand until 2026-27, according to the government's latest draft National Electricity Plan. By that point, renewables and energy storage could be cheaper enough to provide all new capacity as per 'The Energy and Resources Institute' (TERI) 201812.

Figure-6: Projected Total Installed capacity during 2026-27 & share of coal - RE

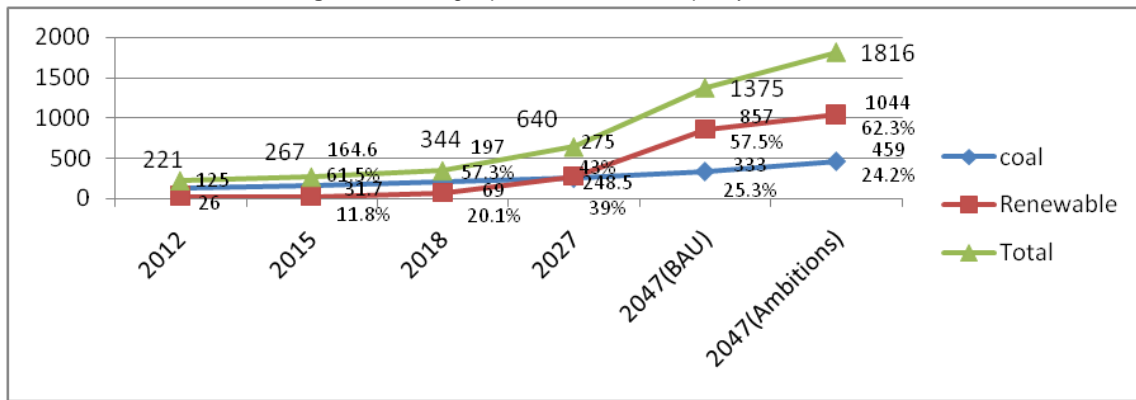


Source: Draft NEP-2016

Now, for the better understanding, it is preferable to consider another study by NITI Ayog 2017 'energizing India'¹⁴ projected data for 2047 indicates that India's energy

consumption grows fastest among all major economies by 2047, depicted under figure 7 for better comparisons.

Figure-7: Existing & predicted Installed capacity 2012-2047



Source: Projected installed capacity data 2047 & 2012 NITI Ayog, Data of 2027 from NEP 2016, Data of 2015 & 2018 from CEA Report.

From the above Figure-7, it is predicted that since 2027 renewable energy begins to sideline coal, with the pace of renewable energy capacity additions more than doubling from the 2027 to 2047.

Outlook News¹⁵ in their report Bloomberg new energy finance's (BNEF) predict that batteries and new sources of flexibility bolster the reach of renewables, the renewable energy will be reaching 49 percent in India as compared with just 17 percent upto 2017 by 2040. The long-term forecast suggests that the addition of renewable energy in the energy mix of the India's electricity system is unstoppable perhaps due to rapidly falling costs for solar and wind power. Considering such predictions, it is expected that the renewables will undercut the majority of fossil based generation by 2030. Alongside the growth of renewable sources generation capacities, supporting technologies such as storage will also continue their impressive growth. Besides this the electric vehicles also account for scale up of electricity generation which further slide down the cost proportionately for battery storage by 2030.

In such increased percentage potential for renewable energy sources in a country's energy portfolio means improved national energy security ultimately contribute towards reduction in dependency on imported fossil fuels but all current estimates concludes that the India's economy will continue its dependence on fossil fuels until at the end of the century. Under such scenario, fossil fuels will continue to determine the destiny of future India's energy security.

However, the contribution of renewable energy in improving energy security is not to be overlooked because more renewable energy is being obtained from domestic renewable energy sources leads to reduced need for fossil fuels as well as expensive foreign fuel import, which is positive sign for a country's future energy security¹⁶.

Though India having both conventional and renewable resources of energy, yet for such a large country, no single energy resource or technology constitutes a remedial cure to address all issues pertaining to the availability of fuel supplies, environmental impact and energy security as well. Therefore, it is need of the hour to integrate all diversified resources to be a

part of an energy mix to ensure energy security to a country like India during the present century.

Renewable energy thus, has been an important component of India's energy security planning but renewable energy as an 'alternate energy' will remains as alternate source, however will attempt to push aside coal from its high energy pedestal to some extent.

4. Conclusion

Each country must think about its future energy security because this is one of the main prerequisites for the future economic growth. Energy security will remain the core of India's security and of all renewable energy sources will remain on the top agenda of India to meet the challenges in energy security for 21st century through the availability of electricity at affordable rate. While taking into account current rate of economic growth, the demand will grow much faster. India is one of the world's largest growing economies needs bulk of energy sources to fulfill requirements of its industries as well as expanding population. Currently, India is attempting to fulfill their demands based on fossil fuels (oil, coal and natural gas) and heavily relying on imported coal, petroleum and oil to meet its energy demands concluded that the supply of fossil fuel though limited available resources cannot guarantee future energy security. In such a critical situation, energy security for a state like India is undoubtedly a source of serious concern.

To meet these challenges, India has embarked on a 175GW renewable project to expand its available renewable energy potential. For India renewable energy is highly significant in context to energy security. Renewable energy is the most eco-efficient, cheaper and inexhaustible of all energy sources because of its free natural resources. In light of the abandon availability of natural resources in India, renewable energy is viable option for India to mitigate the issue of energy security. Despite the rapid growth in renewable energy, the literature review implied that the legacy coal plants will continue to generate thermal energy. However, most additional capacity in the country will come from renewable sources.

The role of renewable energy in improving energy security is not to be overlooked because more renewable energy coming from domestic renewable energy sources means less need for fossil fuels and expensive foreign fuel import.

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