Fuel and Carbon Footprint: an Indian perspective

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ABSTRACT

Since the past three decades, India has advanced rapidly in terms of industrialization and productivity and economic stability. However, this has come at the cost of dramatically increased fuel consumption. Burning of fossil fuels, which is the mainstay of our power generation, has caused an ever increasing carbon footprint in the face of the earth. Also, with the increased buying power, the consumption of the average citizen factored in, this is contributing to rapid accured carbon debt. The increase in pollution cost India dearly in terms of money, productivity and mortality & morbidity. However, initiatives are being taken to mitigate these issues. In this article we report on the origin, effects and measures taken to mitigate the rising carbon footprint scenario in India.

KEY WORDS: Carbon footprint, fossil fuel, CO_2 emission, renewable energy,

INTRODUCTION

In the period between 1994 and 2017, India´s industrial production [1] has seen a steady growth of around 6.64%, reaching an all time high of 20% in november, 2006. Year on year, the industrial productivity increased by 2.7% in March 2017. Industrial production being a measure of the output of the businesses linked to industrial sector including manufacturing, mining, and utilities, is an indicator of the growing demand of commodities in this emerging nation. Since 1960, the GDP (Gross domestic product) has increased staggeringly from a record low of only USD 37.68 billion to USD 2088.80 billion in 2015. This represented 3.37% of the world economy [1]. In the future, substantive and sustained growth of both industry and living standard (hence economical) would entail an increase in power consumption, which could only be fulfilled (under current scenario) by increasing consumption of fossil fuels, since it is still the cheapest source of energy. With the rise of GDP had risen the purchasing power of average Indian. With more disposble income, the population is more likely to acquire and replace products more frequently. The domestic energy consumption had gone up substantially. The per capita electricity production in 2015-16 was provisionaly estimated to be 1075 KWh. Although, this is much less compared to say China (4000 KWh) or the developed nation (average 15000 KWh), however with the initiative taken by the Government for rapid penetration of electric supply in rural India, this is set to increase further [2]. Coal accounts for nearly 50% of the total energy supply, followed by oil and gas. Renewable energy accounts for only 15% of the total energy supply. With a compounded annual growth rate of 6.7%, the energy demand of India is all set to rise to 14500 TWh per year by 2050 [3]. This could lead to substantial carbon footprint.

FOSSIL FUEL CONSUMPTION AND CARBON FOOTPRINT OF INDIA

Carbon footprint refers to the amount of carbon dioxide released into the atmposphere as a result of the acitivities of a particular individual, organization, or community. According to the 2016 EDGAR (emission database for global atmospheric research) report compiled [4] by the European Commission and Netherland Environmental Assessment Agency; in 2015, India ranked 4th in the world for CO_2 emission. The estimated CO_2 emission was 2454968 Ktonne. This accounted for 6.81% of total CO_2 released to atmosphere. The top emitter in 2015 was China with 10,641,789 Ktonne CO_2 emission. This accounted for 29.51% of the global emission. For comparison, in 2010, India´s CO_2 emission was 1848710 Ktonne. In 1990, it was only 649205 Ktonne. This represents an almost 280% increase in CO_2 emission by India in 25 years period. Year-on year, whereas the CO_2 emission (in 2015) decreased for China and United States, it increased for India by 5.1% (still less than the average growth rate of 6.8% annually between 2006-2015). In 2015, whereas the global primary energy consumption increased by 1%, the global coal consumption decreased by 1.8%. However, the coal consumption in India increased in 2015. Globally, coal combustion accounted for 46% of CO_2 emission, with 31% emitted from coal fired power plants. Coal fired power plants accounted for 47% of CO_2 emission in India. Also its worth noting that global oil consumption in 2015 increased by 1.9% which was mainly due to the increase in oil consumption by China, United States and India. Since 2010, a total of 473.4 TW coal fires power plant had been added across 33 countries. Out of that, India account for 102 TW [5]. China figures higher at 208 TW. But, interestingly, India is still one of the lowest emitter of CO_2. The 2016 EDGAR report suggests that the per capita CO_2 emission in India was 1.9 tonne/cap per year whereas the global annual average was 4.9 tonne/cap.

However, with the current capacity for growth in emission, India could surpass the EU by 2020, thereby leaving a larger carbon footprint. An analysis of the emission data in the regards to India suggest that the increase in CO_2 emission is directly coupled with her GDP growth. Whereas the GDP grew at a rate of 7.4% (2006-2015), CO_2 emission also grew annualy by about 6.8%. This is directly linked with the growing domestic demand. In 2015, the total energy consumption in India went up by 5.1%. This was mitigated by an increase in supply of fossil fuel (coal by 4.8% and oil consumption by 8.1%). Between 1990 and first half of 2016, India added a total of about165 GW of coal power capacity. Currently, 64.7 GW is under constructiona and a further permitted capacity of 178.2 GW is in the pipeline. The coal production in India increased by 7%, however, this doesnot meet India´s gross coal demand. In 2015, India was the third largest energy consumer in the world. Oil and natural gas accounted for 37% of her total energy needs. India is among the largest consumer of petrol globally. In 2015, India was the 3rd largest consumer of crude oil and petroleum products in the world after USA and China. Although, the import of oil declined by 10% y-o-y (year on year) in the first quarter of 2017, the domestic oil consumption increased by 10.7%, which is a 16 year high of 196.48 MT in 2016. In the fiscal year 2016, oil production in India reached 36.942 MMT, whereas in 2015, it was 37.461 MMT. The net import of crude oil rose from 111.50 MT during 2006-07 to 202.85 MT during 2015-16. According to esmitates by OPEC, the demand for oil in 2017 would be 1.26 mb/d, the majority of which will be consumed by India followed by China. India´s oil demand is expected to grow at a CAGR (compound annual growth rate) of 3.6% to a staggering 458 MT of Oil Equivalent. India is the 4th largest consumer of LNG (liquified natural gas), and account for 5.8% of the total trade globally. The internal LNG demand in India is expected to grow at a CAGR of 16.89% to 306.54 MMSCMD by 2021. It was 64 MMSCMD in 2015. India´s domestic gas production in 2016-17 was 23.09 BCM, which is also expected to raise to 90 BCM by 2040 [6]. Due to various hurdles in procurement and deployment of other fossil fuels, promote clean energy for the nation and keeping in mind the cost factor, various core sectors including transport, power generation, petrochemical production and fertilizer are shifting rapidly towards natural gas (LNG). This is leading to exponentiated demand for natural gas. This huge increase in demand for fossil fuels in India for industrial, transportation and domestic purpose will lead to large increase in CO_2 emission in the atmosphere.

MITIGATION

In order to mitigate the growing crisis of fast depleting natural resources and degradation of the environment, the Government of India has taken various initiatives including introduction of nuclear power, encouraging increase of share of renewable energy in our energy mix and refinement of fuel standard (for oil and LNG) required for transportation and other industries.

The demand for electricity in India is rising at a very fast pace, both for domestic purpose and industrial sector. Currently, India is the worlds 3rd largest producer and 4th largest consumer of electricity. At 1287 TWh, the electricity produced in 2014 was triple of what was produced back in 1990. With about 19.4% transmission loss, this amounted to a consumption of about 947 TWh in 2014. In the fiscal year 2015-16, the total electricity generation was 1352 TWh or 1075.64 kWh/ capita. From the available statistics, the gross electricity generation in 2014 comprised of 850 TWh from black coal, 36 TWh from brown coal, 63 TWh from gas, 23 TWh from oil. These are all fossil fuel generated power. Renewable energy resources accounted for about 199 TWh of electricity generation. More than three quarter of the power in the recent years is being generated from coal, which is leading to lot of pollution. The per capita electricity consumption figures are estimated to double by 2020 and reach 5000-6000 KWh/year by 2050. Hence there is an urgent demand for reliable and viable energy source to meet this increasing power load. The nuclear power roadmap was envisioned to fulfill this goal. Since its inception in 1987, NPCIL (Nuclear Power Corporation of India Limited) has been making slow but steady progress in fulfilling the energy gap, given its sever constraint in procurement of nuclear fuel. As of March 01, 2017, the total installed nuclear electricity generation capacity is 6.78 GW. This accounts for only 1.91% of the total installed capacity. NPCIL aims to produce 20 GW energy by 2020 and then more than triple (63 GW) its load capacity by 2032. The nuclear power generation in India has received the ISO-14001 accreditation for environmental management system and peer review by World Association of Nuclear Operators. As of 2016, India has 22 nuclear reactors in operation in 8 nuclear power plants across India. The total installed capacity is 6780 MW and the producing a total of 30,292.91 GWh of electricity. 6 more reactors are under construction and is expected to be operational with an added 4,300 MW capacity. India is taking active initiative in funding cold fusion research and is also a part of the ITER megaproject. Indian Government is also developing upto 62 thorium based reactors, which is expected to be operational by 2025. The advances in the field of working, designing and prototyping of the thorium and low enricher uranium -based fuel reactors are all part of India´s three stage nuclear power programme [7]. Currently, the renewable energy resources in India contribute around 30% of the primary energy. India was the first country in the world to set up a ministry of non-conventional energy in early 1980s [8]. As of September 2016, the grid connected renewable energy capacity was about 50.2 GW. Of this, 61% contribution came from wind energy whereas solar energy contributed around 19%. Third came biogas with about 16% contribution, small hydro around 8.5% and waste to power about 0.2%. As of February 2017, the total installed

large hydropower capacity is around 44.41 GW. It is worth mentioning here that India has the fourth largest installed wind power capacity in the world. As of February 28, 2017, the total installed wind power capacity in India is 29151.29 MW. In the case of solar power, the main impetus at the beginning had been to apply it for water pumping in remote places and off-grid lighting. However, with the advent of better technology and through various government projects, solar power in India has been growing at a fast pace of 113% yoy and the current unit cost of solar power has dropped to 4.34 INR (Indian Rupees). India also ranks seventh in the world for hydroelectricity generation. As of March 2016, the total grid utility installed capacity of hydroelectricity is 42,783 MW. India has set a goal to more than double the wind power capacity and increase the solar power capacity by fifteen times of the April 2016 level by 2022. India is a part of the International Solar Alliance, and achievement of such ambitious projection would put her firmly in a leading position across the world. India intends to generate as much as 40% of the total installed capacity from non-fossil based fuel by 2030. By 2021, the Ministry for Energy aims to increase the total renewable energy capacity by 175 GW, with 100 GW of solar power and 60 GW of wind power, and also reduce the grid transmission losses to 15% by 2019 [8]. These initiatives would greatly reduce the emission of green house gases in the future. Since 1991, the government has been setting progressively stricter norms of fuel emission starting from BS-I (Bharat Stage I) and BS-II introduced in April 1999. Following the Auto Emission Policy 2003, the BS-III was introduced in April 2005 in 13 major cities. Keeping ahead of schedule, BS-IV has also been implemented as of April 2016. Keeping in lieu with the developments, the oil firms in India are also gearing up to embrace the refined oil to keep in check auto emission. Also introduction of CNG for running of public and private vehicles have also cut down the emission by a large amount [9].

CONCLUSION

With the sustained effort of the government in implementing protocols for transition to low carbon economy and through active participation of the top listed companies in reducing emission, India can seriously assert her role in reducing the carbon footprint and embarking upon an era of responsible, sustainable development. However, the challenge lie in implementing (with utmost transparency) these initiatives through active participation of all stakeholders.

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