



Global Energy Crisis and Its Impact on Indian Economy

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Abstract

India has the world's second largest population of 1.36 billion in 2022 (IEA, 2022) and the world's seventh largest landmass (IEA, 2011). India has achieved rapid and remarkable economic development in the past two decades and became the world's tenth largest economy in 2011. With its relatively young population with a median age of 26.2 years, India is expected to take over China as the world's most populous nation around 2025 (WEO 2011). However, India's nominal per-capita income of US\$ 1,489 remained much lower than other large economies. The Indian economy is moving towards a free market economy, albeit with remaining traces of a socialist economic model. The economy has increased at an average rate of approximately 7.0 per cent since 2000s. In the middle of the global economic recession in 2008, the Indian economy quickly rebounded and grew over 9.0 per cent between 2009 and 2010. However the nation, wide economic reforms in the 1990s and 2000s brought considerable changes to India's energy sector, but were left unfinished. Energy is the key to the material prosperity of a nation (Pachauri, 1977). It provides an important infrastructure to the all round balanced economic development of a country and furnishes a vital input for different sectors. It plays a crucial role in transforming a subsistence economy into an advanced one. Energy demand or consumption has also been increasing day by day and it reached the highest rate in all over the global. In economics, the prices of any product are primarily a function of demand, supply and other economic variables. In the past decade, oil prices were on a southward drive due to the rolling demand for oil particularly in China, India and other recently emerging and growing economies of the global. It is noticed that China (Second) and India (Fourth) are the largest consumer of oil in the global (Anandan and Ramaswamy, 2015). India has faced a formidable challenge in providing adequate energy supplies to users at a reasonable cost. In the last 67 years, India's energy use has increased 16 times and the installed electricity capacity by 84 times. In 2008, India's energy use was the fifth highest in the world. Nevertheless, India as a country suffers from significant energy poverty and pervasive electricity deficits. In recent years, India's energy consumption has been increasing at a relatively fast rate due to population growth and economic development (Garg, 2012). This paper attempts to look at the energy

production, consumption and price trends witnessed in the recent years along with the high level of volatility associated with it. The relationship between energy prices and market fundamentals, factors influencing global energy market, demand and supply gap to look at alternative opportunities, policies and strategies has been analyzed and elaborated in this paper.

Keyword: Crude Oil, Price, Energy consumption, Energy Production, Macro Scenario and Oil Market.

Introduction

Energy is one of the major inputs for the economic development of any country. In the case of the developing countries, the energy sector assumes a critical importance in view of the day to day increasing energy needs which require huge investments to meet them. Energy is a fundamental need ranging from, but not limited to the essential services of cooking, heating, cooling, lighting, mobility, and operation of appliances, to information and communications technology, and machines in every sector of every countries. The lack of access to reliable and clean energy supplies is now considered as a major barrier to improving human wellbeing around the globe (**Energy Statistics, 2021**). Energy can be classified into several types based on the following criteria: Primary and Secondary energy; Commercial and Non commercial energy; Renewable and Non-Renewable energy. The demand for commercial and non renewable energy like crude oil started to accelerate with the invention of the internal combustion engine in the late 21st century and thus it becomes one of the most important commercially traded and vulnerable commodities global wide. Modern civilization heavily depends on crude oil and it's by products. Oil is a most precious usable and important source of energy in the global. The human consume commodities and pay the price. Of these commodities, the oil is the one of much use all over the global and particularly in the developed-industrialized countries. The industrialized nations have completely taken for granted an uninterrupted supply of cheap hydrocarbon (**Ibrahim Sami Nashawi, 2010**). The vehicles, bikes, buses, trains, ships, planes, jets, factories, industries, manufacturing units and other economic, social, commercial, domestic and agricultural sectors have started consuming and using huge quantity oil for their development without considering the future consequences. As a result, economic development and economic growth has been taken place all around the global at the oil usage development of nations. The needs and consumption of oil has been increasing day by day and its demand has been increasing at highest rate in all over the global. At the sometime, oil prices have been showing exceptional instability during last 5 years. This kind of volatility was not even noticed and witnessed during the period of oil shocks (1973 and 1979). In fact, during the 1967 oil embargo in Arab, price of oil fell from \$40/b to \$15/b and thus a variance of \$25/b. Likewise, after five decades due to different incidents, the oil price came down from about \$36/b (1980) to \$15/b (1986 and 1988), \$13/b (1998) \$111.67/b (2013) and now \$55/b (April, 2015) and now reached to \$36/b in February, 2016 and \$48.91/b in October 2016;and The oil price averaged \$41.84/bbl in 2020. These changes were not drastic owing to the fact that huge Geo-political incidents had taken place in different time periods. Thus oil price fluctuations heavily affected consumers, producers and the overall investments in different sectors. It has been noticed that presently the price of oil does not seem to be amplified by traditional demand and supply relationships, but by dynamics of interlinked financial markets and changing Geo-political landscape

(Syed Kaiser Mukhtar, 2011). Based on the discussion narrated above, this paper aims to analyze the oil production, consumption and price trends witnessed in different years along with the high level of volatility associated with it. The relationship between oil price and market fundamentals has been examined. The overall impact of rapidly changing oil price on global with respect to its inflation rate, external balances and overall growth has also been provided with authenticity of data support and data evidences. The empirical data from 1965-66 are used and projected upto 2034-35 in order to establish the driving forces behind the oil demand, supply and price. The outcome of this paper is purely based on the macro level secondary data available in the well established institute of international importance like IEA, OPEC, BP Statistics, WEO etc.

Energy and Economic Development

The modern Economist is highly dependent on reliable and adequate energy supply owing to the fact that it's the prerequisite for industrialization. All sectors of the economy- residential, commercial, transport, services and agriculture, demand energy in different forms. In turn, these sectors foster growth on economic and social front. Energy supply affects employment, productivity and development. Owing to the economic importance of energy it is important to develop the economic energy indicators and provide a profound basis for strategic changes and policy making. The economic indicators have two themes: Use & production patterns and Security. The first has the sub theme of Overall Use, Overall Productivity, Supply Efficiency, Production, End Use, Diversification (Fuel Mix) and Prices. The second has the sub themes of Imports and strategic Fuel stocks.

The COVID-19 pandemic had a dramatic impact on energy markets, with both primary energy and carbon emissions falling at their fastest rates since the Second World War. Nevertheless, renewable energy continued to grow, with solar power recording its largest ever increase. Economic growth is desirable for developing countries, and energy is essential for economic growth. However, the relationship between economic growth and increased energy demand is not always a straightforward linear one. For example, under present conditions, 6.0 percent increase in India's Gross Domestic Product (GDP) would impose an increased demand of 9.0 percent on its energy sector. Energy is a highly critical commodity and basically a natural resource without which the existence of human being is highly questionable. It functions as a factor of production, as a process feed stock, as a consumer good and as a producer good. The availability of energy determines the shape of the life style of individuals and that of the economy. The evidences all over the global show that there is a positive association between per capita income and per capita energy consumption. Economic development and growth are needed for any economies, for which, and energy serves as an essential input. However, the relationship between economic growth and increased energy demand is always a straight line. The per capita consumption of energy in India is one of the lowest in the global. India consumed 2081 Kwh in 2019 compared to other countries. For example 31223 Kwh by US, 5406 Kwh by China, 19953 Kwh by Norway, 23616 Kwh by Australia, and 12774 Kwh by UK. The Per-capita Energy Consumption increased from 19579 Mega Joules in 2011-12 to 22351 Mega Joules in 2016-17. The annual increase in PEC for 2015-16 over 2014-15 was 1.89 per cent (BP Statistics, 2019; Central Statistics Office, 2018). Crude Petroleum was second (35.05per cent), while Electricity (13.11per cent)

was third. The total consumption of energy from conventional sources increased from 28,337 petajoules during 2015-16 to 29,279 petajoules during 2016-17, showing an increase of 3.32 per cent. Per-capita Energy Consumption during a year is computed as the ratio of the estimate of total energy consumption during the year to the estimated mid-year population of that year. Per-capita Energy Consumption (PEC) increased from 19579 Mega Joules in 2011-12 to 22351 Mega Joules in 2016-17. The annual increase in PEC for 2015-16 over 2014-15 was 1.89 per cent. Average global energy consumption per capita decreased by 5.5% in 2020 to 71.4 GJ/head, driven by declines in North America (-8.6%) and Europe (-8%). Energy demand per head fell in all other regions. North America is the region with the highest consumption per capita (217 GJ/head), followed by CIS (150 GJ/head) and the Middle East (140 GJ/head). Africa remains the region with the lowest average consumption (14 GJ/head).

Global Energy Production and Consumption

Production: Energy is one of the most important building blocks in human development, and as such, acts as a key factor in determining the economic development of all the countries. In an effort to meet the demands of a developing nation, the energy sector has witnessed a rapid growth. It is important to note that non-renewable resources are significantly depleted by human use, whereas renewable resources are produced by ongoing processes that can sustain indefinite human exploitation.

Table - 1
Production of Energy Sources in India

Year	Coal (Mt)	Lignite (Mt)	Crude Petroleum (Mt)	Natural Gas (Bcm)	Electricity* (GWh)
2007-08	457.08	33.98	34.12	32.42	162,553.72
2008-09	492.76	32.42	33.51	32.85	152,886.00
2009-10	532.04	34.07	33.69	47.50	159,642.84
2010-11	532.69	37.73	37.68	52.22	179,926.46
2011-12	539.95	42.33	38.09	47.56	214,024.08
2012-13	556.40	46.45	37.86	40.68	204,035.31
2013-14	565.77	44.27	37.79	35.41	234,595.01
2014-15	609.18	48.27	37.46	33.66	238,908.43
2015-16	639.23	43.84	36.94	32.25	224,571.11
2016-17	657.87	45.23	36.01	31.90	241,841.64
2017-18	675.40	46.64	35.68	32.65	266,308.30
2018-19	728.72	44.28	34.20	32.87	299,465.00
2019-20	730.87	42.10	32.17	31.18	340,578.57
Growth rate of 2019-20 over 2018-19 (per cent)	0.30	3.17	-2.53	-1.10	7.69
CAGR 2007-08 to 2016-17(per cent)	3.79	2.90	0.54	-0.16	4.05
CAGR 2010-11 to 2019-20 (per cent)	3.58	1.23	-1.74	-5.57	7.35

* Electricity from Hydro, Nuclear and other Renewable energy sources.

Sources: Ministry of Coal, Ministry of Petroleum & Natural Gas, Central Electricity Authority and Central Statistics Office, 2021.

The production of crude oil the United States, China and India are the top largest consumers of oil in the world, totaling 17.2 million, 14.2 million and 4.7 Million barrels per day, respectively during the last decade 2021. The Worldwide oil consumption reached approximately 88.5 million barrels per day in 2020. This was a decrease of nine million barrels compared to the previous year and resulted from pandemic-enforced mobility restrictions leading to a decline in transportation fuel demand. Apart from the years of the financial crisis and the 2020 coronavirus pandemic, oil consumption consecutively increased in every year since 1998. The share of global oil consumption from Europe and North America have begun to decline, whereas consumption levels from Asia Pacific and other regions have risen. As other sources of energy become more cost effective and due to the prominence of new transportation technologies, oil consumption worldwide is expected to reach a peak in the near future. Further the Distribution of total world production according to countries shows that United States and Saudi Arabia were the first and second highest producers with 20.0 per cent and 12.0 respectively. They were followed by Russia (11.0 per cent), Canada (6.0 per cent), China (5.0 per cent), Iraq (4.0 per cent), UAE (4.0 per cent) Brazil (4.0 per cent), Iran (3.0 per cent), Kuwait (3.0 per cent), Venezuela (2.8 per cent), Mexico (2.77 per cent), Nigeria (2.25 per cent), Norway (2.06 per cent) and Angola (2.0 per cent). India has accounted for only 0.92 per cent of the world production. The above table Coal production in the country during the year 2016-17 was 662.79 million tone (MTs) as compared to 639.23 MTs during 2015-16, registering a growth of 3.69 per cent. Further the Coal production in the country during the year 2019-20(P) was 730.87 million tonne as compared to 728.72 million tonnes during 2018-19, growing at the rate of 0.30 per cent. The overall trend of production in the last ten years i.e. 2010-11 to 2019-20 has shown a steady increase with a CAGR of 3.58 percent. The Lignite production during 2016-17 was 45.23 Mts which is 3.17 per cent higher than the production during 2015-16 (43.84 Mts). The Lignite production during 2019-20 reduced to 42.10 Mts from the figure of 44.28 Mts in 2018-19 which is 4.92 percent lower than the production in 2018-19. However, the CAGR of Lignite was about 1.23 percent with production increasing from 37.73 Mts in 2010-11 to 42.10 Mts in 2019-20. Considering the trend of production from 2007-08 to 2016-17, it is observed that coal production in India was about 457.08 MTs during 2007-08, which has increased to 662.79 MTs during 2016-17; 730.87 Mts during 2019-20 with a CAGR of 3.58 per cent. During the same period, the CAGR of Lignite was about 1.23 per cent with production increasing from 33.98 MTs in 2007-08 to 45.23 MTs in 2016-17; and 42.10 Mts in 2019-20. Production of crude petroleum increased from 34.12 MTs during 2007-08 to 36.01 MTs during 2016-17; and 32.17 Mts during 2019-20, a CAGR of about 0.54 per cent and further decline CAGR of about -1.74 percent. The CAGRs for natural gas and electricity were (-) 5.57 per cent and 7.35 per cent respectively for the period 2010-11 to 2019-20; Electricity has experienced the highest CAGR i.e. 7.35 per cent among all the commercial sources of energy since 2010-11 to 2019-20. The production of energy in peta joules by commercial sources shows that Coal was the major source of energy, accounting for about 72.22 per cent of the total production during 2019-20. Crude Petroleum was the second (8.79 per cent), while Natural Gas (8.68 per cent) was the third major source. Electricity and lignite contributed 6.15 per cent and 3.63 per cent respectively. Out of the total coking coal production of 61.66 MT in the country, 89.76 per cent is produced by public sector, whereas for the private sector, the share of production is 10.24 per cent. A similar pattern is observed

for the production of non-coking coal in the country, where the public sector contributes a significant 95.38 per cent (573.37 MTs) of the total production (601.13) and the private sector producing only 4.62 per cent of non-coking coal in the country (27.76 MTs). In the year 2016-17, the production of Petroleum Products in the country was 243.55 MTs as against 231.92 during 2015-16, an increase of 5.02 per cent (**Ministry of Petroleum & Natural Gas and Ministry of Coal 2018**). The all India gross electricity generation from utilities, excluding that from the captive generating plants, was 162,553.72 Giga Watt-Hours (GWh) during 2007-08. It rose to 12,35,358 GWh during 2016-17; 340,578.57 GWh during 2019-20. The production of electricity from utilities has increased from 11,67,584 GWh during 2015-16 to 340,578.57 GWh during 2019-20, registering an annual growth rate of about 5.80 per cent. Total Electricity generation in the country, from utilities and non-utilities taken together during 2016-17 was 14,32,358 GWh. Out of the total electricity generated through utilities, 9,93,516 GWh was generated from thermal and 1,22,378 GWh was from hydro and 37,916 GWh was generated from nuclear sources. Total output from non-utilities was 1,97,000 GWh (**Central Electricity Authority, 2018**).

Global Energy Consumption: Region-wise consumption that Asia Pacific accounted for the highest share (35.25 per cent) of total world consumption, followed by North America (23.69 per cent), and Europe & Eurasia (20.02 per cent). African countries accounted for the lowest share in the globe consumption (4.20 per cent). Primary energy consumption fell by 4.5 per cent in 2020 - the largest decline since 1945. The drop in energy consumption was driven mainly by oil, which contributed almost three-quarters of the net decline, although natural gas and coal also saw significant declines. Wind, solar and hydroelectricity all grew despite the fall in overall energy demand. By country, the US, India and Russia contributed the largest declines in energy consumption. China posted the largest increase (2.1 per cent), one of only a handful of countries where energy demand grew last year (**Bp Statistics-2021**). Consumption for all fuels decreased, apart from renewables (+9.7 per cent) and hydro (+1.0 per cent). Consumption fell across all the regions, with the largest declines in North America (-8.0 per cent) and Europe (-7.8 per cent). The lowest decrease was in Asia-Pacific (-1.6 per cent) due to the growth in China (+2.1 per cent), the only major country where energy consumption increased in 2020. In the other regions, the decline in consumption ranged between -7.8 per cent in South and Central America to -3.1 per cent in the Middle East. Country-wise distribution of consumption reveals that the United States was the largest consumer of crude oil, consuming 20.00 per cent of the world consumption during 2019-20. China was the second largest consumer (14.00 per cent), followed by India (5.0 per cent), Japan (4.17 per cent), Saudi Arabia (3.80 per cent), Russian federation (3.35 per cent) and Brazil (3.14 per cent). India was the third largest consumer of crude oil in the world and the second largest crude oil consumer in the Asia-Pacific region after China (**Central Statistics Office, 2021**).

Table - 2

Consumption of Energy Sources in India

Year	Coal	Lignite	Crude Oil (Mts)	Natural Gas (BCM)	Electricity (GWh)
	(Million Tonnes)				
2007-08	502.82	34.65	156.10	39.80	501,977.00
2008-09	549.57	31.85	160.77	39.81	553,994.71
2009-10	585.30	34.41	186.55	48.34	612,644.99
2010-11	589.87	37.69	196.99	64.16	694,392.00
2011-12	642.64	41.89	204.12	64.45	785,194.00
2012-13	688.75	46.01	219.21	57.36	824,300.99
2013-14	724.18	43.90	222.50	52.37	874,208.57
2014-15	821.85	46.94	223.24	51.30	948,521.82
2015-16	836.73	42.21	232.86	52.51	10,01,190.68
2016-17	837.22	43.16	245.36	55.70	10,61,182.64
2017-18	898.50	46.32	251.93	59.17	11,23,426.86
2018-19	968.36	45.81	257.20	60.79	12,09,971.63
2019-20	942.63	42.27	254.39	64.14	12,91,493.75
Growth rate of 2019-20 over 2018-19 (per cent)	-2.66	-7.73	-1.10	5.51	6.74
CAGR 2010-11 to 2019-20 (per cent)	5.28	1.28	2.88	-0.003	7.14

Sources: Ministry of Coal, Ministry of Petroleum & Natural Gas, Central Electricity Authority and Central Statistics Office.

The consumption energy sources the coal consumption by industry has increased from 502.82 Mt during 2007-08 to 841.56 Mt during 2016-17; 942.63Mt during 2019-20 with a CAGR of 5.28 per cent during 2010-11 to 2019-20 (Table-2). The annual growth rate from 2018-19 to 2019-20 is -2.66 per cent. Consumption of Lignite increased from 34.65 Mt in 2007-08; 43.16 Mt in 2016-17 to 42.27 Mt in 2019-20 registering a compound growth of 1.28 per cent during 2010-11 to 2019-20. The electricity generating units consumed 527.26 Mt of coal, followed by steel & washer industries (54.15 Mt), cement industries (6.43 Mt) and sponge iron industries (5.68 Mt). Consumption of Lignite in Electricity Generation sector is the highest, accounting for about 89.96 per cent of the total lignite consumption. The estimated consumption of crude oil has a steady increase, from 156.10 Mt during 2007-08; 245.36 Mt during 2016-17 and 254.39 Mt during 2019-20 with CAGR of 2.88 per cent. It increased from 232.86 Mt in 2015-16 to 254.39 Mt in 2019-20 registering a growth rate of 2.88 per cent (Table-2). The maximum use of Natural Gas is in fertilizers industry (25.12 per cent) followed by power generation (17.19 per cent) and 14.47 per cent natural gas was used for domestic fuel. Further Industry wise off-take of natural gas shows that while 55.08 percent of natural gas has been used for Energy purposes, 32.91 percent is used for Non-energy purposes (**Central Statistics Office 2020 and Energy Statistics 2021**). The estimated electricity consumption increased from 501,977.00 GWh during 2007-08 to 12,91,493.75 GWh during 2019-20, showing a CAGR of 7.14 per cent. The percentage increase in electricity consumption from 2015-16 (12,09,971.63 GWh) to 2019-20 (12,91,493.75 GWh) is 6.74 per cent. Of the total consumption of electricity in 2019-20, industry sector accounted for the largest share (42.69 per cent), followed by domestic (24.01 per cent), agriculture (17.67 per cent) and commercial sectors (8.04 per cent). The electricity consumption in Industry sector and domestic sector has increased at a

much faster pace compared to other sectors during 2010-11 to 2019-20 with CAGRs of 6.74 per cent respectively. Loss of electricity due to transmission has decreased from 23.97 per cent during 2010-11 to 20.33 per cent during 2019-20 (**Central Electricity Authority, 2019; Central Statistics Office, 2020; and Energy Statistics, 2020**). Oil continues to hold the largest share of the energy mix (31.2 per cent). Coal is the second largest fuel in 2020, accounting for 27.2 per cent of total primary energy consumption, a slight increase from 27.1 per cent in the previous year. The share of both natural gas and renewables rose to record highs of 24.7 per cent and 5.7 per cent respectively. Renewables has now overtaken nuclear which makes up only 4.3 per cent of the energy mix. Hydro's share of energy increased by 0.4 percentage points last year to 6.9 per cent, the first increase since 2014 (Bp Statistics, 2021).

Factors Determine the Global Energy Demand and Supply

Energy is one of the important strategic commodity which guarantees the development of modern industry and economy. It is also an important resource, which is scrambled by each interest group in the global oil market. Oil price fluctuation is always regarded as the barometer in changing globalwide economy and each change in oil price would be the hot issues which are and discussed generally in political and economic circle in every country (**Lingyu Yan, 2012**). The Long-term growth in demand for petroleum (oil) products depends upon a number of factors such as economic growth (GDP), elasticity of demand for petroleum (oil) products with respect to GDP growth, relative price levels of substitute products particularly LNG/CNG, saturation of LPG demand, and the impact of energy conservation measures. The demand for petrol and diesel is dependent on the growth of road infrastructure, the price of oil, the future efficiency of vehicles, the growth of alternate modes of transport and the emergence of substitutes like bio-fuels and/or technologies such as hybrids. Naphtha demand is dependent on the growth plans for fertilizer and petro-chemicals and its price relative to the price and availability of natural gas. In this paper, the authors hand systematically reviewed the historical path of international oil price fluctuation, analyzed comprehensively all factors, which effect the oil production, consumption and price fluctuation and finally proposed the countermeasures and suggested to respond the international oil price fluctuation. Through the indepth analysis, the researchers have identified the various factors influencing the price of oil. Such factors are oil demand and oil intensity. Global oil demand are subject to many factors such as growth factors uncertainty in supply and demand for oil, changes in macroeconomic and geo-political situations, population growth, urbanization, growing costs of exploration and production, Changes OPEC policy, Dollar depreciation, taxes subsidies, the dynamics of the US dollar exchange rate and conditions of the global financial markets, including the cynical demand, prices of substitutes, changes in climate and market speculation.

Suggestion and Recommendations

The various policies have been adopted by the Government of India for reducing the consumption of energy, but researchers observe from the present study that success has not been achieved. India's energy consumption pattern is at the crossroads of development, and the evaluation suggests a major policy reorientation to mitigate the emerging problems. India has to adopt a energy policy that promotes the growth of less-energy-intensive components of final demand; India has to encourage those industries which are using more energy efficient technologies such as renewable energy technologies, and further more introduce new technology at a more rapid rate than in the past. This is only possible by the proper enhancement of expenditure on research and development projects. However, the priority has to be given to the conservation of energy, which will be important in alleviating the shortage of energy and in reducing environment pollution. The considerable efforts have to be made to speed up the exploitation of oil and natural gas, and the development of hydro and nuclear power. Last, but not the least, a suitable energy price policy has to be adopted. **(Mukhopadhyay and Chakraborty 1999)**. Strengthen the finance ecosystem for utility scale renewable energy, with focus on long-term debt, interest rate subsidies, loan guarantees, and risk insurance; Use generation based incentives and penalties in combination with any form of viability gap or tax related capital subsidies; Pilot green bonds and a green bank via leading municipalities or state governments; Invest in energy storage technologies and infrastructure for grid stability in the long-term; Build synergies between ministries (water, health, agriculture, etc.) to leverage potential of decentralized energy; for example, integrating clean energy into national clean drinking water programmes; Support opportunities to create value at home by being part of a global supply chain of renewable energy products and services; Introduce government accredited standardized curricula for decentralized energy skills development in training institutes.

The National Institute of Solar Energy has assessed the Country's solar potential of about 748 GW assuming 3.0 percent of the waste land area to be covered by Solar PV modules. Solar energy has taken a central place in India's National Action Plan on Climate Change with National Solar Mission as one of the key Missions. National Solar Mission (NSM) was launched on 11th January, 2010. National Solar Mission is a major initiative of the Government of India with active participation from States to promote ecological sustainable growth while addressing India's energy security challenges. It will also constitute a major contribution by India to the global effort to meet the challenges of climate change. Government of India have launched various schemes to encourage generation of solar power in the country like Solar Park Scheme, VGF Schemes, CPSU Scheme, Defence Scheme, Canal bank & Canal top Scheme, Bundling Scheme, Grid Connected Solar Rooftop Scheme etc.

Various policy measures undertaken included declaration of trajectory for Renewable Purchase Obligation (RPO) including Solar, Waiver of Inter State Transmission System (ISTS) charges and losses for inter-state sale of solar and wind power for projects to be commissioned up to March 2022, Must run status, Guidelines for procurement of solar power through tariff based competitive bidding process, Standards for deployment of Solar Photovoltaic systems and devices, Provision of roof top solar and Guidelines for development of smart cities, Amendments in building bye-laws for mandatory provision of roof top solar for new construction or higher Floor Area Ratio, Infrastructure status for solar

projects, Raising tax free solar bonds, Providing long tenor loans from multi-lateral agencies, etc. The Gol India achieved 5th global position in solar power deployment by surpassing Italy. Solar power capacity has increased by more than 11 times in the last five years from 2.6 GW in March, 2014 to 30 GW in July, 2019. Presently, solar tariff in India is very competitive and has achieved grid parity (MNRE, 2022). Further Out of the total installed generation capacity of renewable sources of power in 2020, installed capacity of Wind power accounted for about 43.3 percent, followed by Solar power including roof tops (39.8 percent) and Biomass power (11.2 percent). However, in terms of growth rates year on year, Solar power installed capacity raced at a growth rate of almost 23.0 percent just over the last year from 2019 to 2020.

Conclusion

Energy is one of the most important commodities in the global. Oil is greatest in importance because of its significance of being a far easier to use than any alternative fossil fuel. Oil price has the capability to move the whole range of the market because of its demand and supply. Energy exploration and exploitation, capacity additions, clean energy alternatives, conservation, and energy sector reforms will, therefore, be critical for energy security. Energy conservation has also emerged as one of the major issues in recent years. Conservation and efficient utilization of energy resources play a vital role in narrowing the gap between demand and supply of energy. Improving energy efficiency is one of the most desirable options for bridging the gap in the short term. The developed and developing countries like India, with its vast population and limited natural resources for meeting its energy requirements needs to maintain its momentum of growth and this can be made possible only with a clear strategy for use of best possible and available energy options. There is high potential for generation of renewable energy from various sources- wind, solar, biomass, small hydro and cogeneration, bagasse, biogas, geothermal, ocean thermal, etc. The use of renewable resources of energy is rapidly increasing worldwide. Solar power, one of the potential energy sources, is a fast developing industry in India. The country's solar installed capacity has reached 12.28 GW in year 2016-17 as compared to 6.76 GW during the year 2015-16. India has expanded its solar generation capacity by 5.52 GW during last one year which has led to downward trend in the cost and has increased usage. It clearly signifies that proper integration of policy interventions holds the key to achieve the sustainable development goals (**Central Statistics Office, 2018**). Renewable sources of energy or the alternative forms of energy which can save us from the energy crises and become the major sources of energy in future sustainable development.

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