International Journal of Management Research and Social Science (IJMRSS)
Volume 7, Issue 4, October – December 2020
ISSN 2394-6407(Print)
ISSN 2394-6415(Online)

Energy Security in National and International Perspectives

Dr. B.S.K. Naidu

Chairman Emeritus, Great Lakes Institute of Management, Gurugram-122 413, NCR, Delhi
dr.bsknaidu@gmail.com

Abstract — Energy is one of the basic needs of human beings. Uninterrupted availability of energy sources therefore needs to be secured, both in the national and international domain. Electricity is becoming the first choice being environmentally benign at the users' end. Consequently, nations and the world at large are shifting towards its mass production. Globally, the trend is to shift from non-renewable energies to renewable for the long-term survival of humanity. Being left with just 200 years of fossil fuel, it is a compulsion to do so. Another persuasive factor is the unbearable carbon dioxide emissions leading to global warming. Carbon-free cheap renewable energies are going to drive the national economies. Being locally available they also eliminate transportation costs. Global and Indian scenarios have been laid out in time horizon of 2020-50. Examples from different continents are illustrating the economic benefits of tilting the resource-mix towards renewables. Indian perspective is crucial for the energy security of 1.38 billion population-second largest in the world. While becoming the world's fastest-growing energy market, India is lagging in conventional Hydro Power which is the highest efficiency, strongest source of dependable environment-friendly Renewable energy.

Keywords — *Energy Security; Electricity; Power Generating Capacity Mix; Renewable Energy; Energy-Environment Interface.*

1. Introduction

Energy is required to supply clean water, air conditioning, processing and cooking food, and creating shelter. Hence it becomes a basic need of human beings. Sources like Biomass, Coal, Oil, and Gas can be used as such or can be converted in the form of electricity which becomes environmentally benevolent at the users' end. Though electricity is environmentally benign at its utilization end, it is not necessarily so at the generating end in all the options of generation, because of the polluting nature of fossil fuels. Shifting to a non-fossil route of generation can only ensure energy production in a secure environment.

2. Energy Security in Global Perspective

Non-renewable energy dominates world consumption today at 81%. Renewable energy supplies 19% of global energy consumption counting traditional biomass, hydropower, and "new" renewables (wind, solar, geothermal, modern biomass, and biofuels). Of this traditional biomass, used primarily for cooking and heating, accounts for approximately 13%. Hydropower represents 3.2%. Other renewables account for 2.8%, all aggregating to 19%.

According to one estimate, with the present rate of consumption, the world is left with approx. 200 years of coal, 75 years of nuclear fuel, 50 years of natural gas, and 25 years of oil, respectively. World 'energy-related' carbon dioxide emissions are of the order of 33 billion metric tons. Fossil fuel power plants are largely accountable for carbon emissions contributing to nearly 60% of global warming. Sulphur content in coal causes 'acid rain' which spoils the crops. Carbon-free Nuclear energy has a risk of accidents causing radioactive hazards. Realizing this, several advanced nations like the US, Australia, New Zeeland, Japan, Sweden, and Germany are in the process of phasing out their nuclear plants in favor of natural gas and renewable energy.

Table 1: Global Scene (Resource Mix) of Electricity Component of Energy

No	Resource	Present Resource Mix		Expected Resource Mix by 2050 (%)
		TWh (BU)	(%)	
1	Coal	9,606	38.3%	43%
2	Natural Gas	5,794	23.1%	9%
3	Oil	928	3.7%	9%
4	Nuclear	2,609	10.4%	8%
5	Total Non-Renewable	18,937	75.5%	69%
6	Hydro	4,164	16.6%	12%
7	Other Renewables	1,981	7.9%	19%
8	Total Renewables	6,145	24.5%	31%
9	Grand Total	25,082	100%	100%
10	Non-RE: RE Mix	75.5: 24.5		69:31

While the sun is the infinite source of energy (reflected in several indirect forms also like the hydrological cycle, wind currents, biomass, etc.); its utilizable potential is finite owing to technical limitations. We have limited stocks of Fossil fuels on the other hand. Renewable sources are seasonal and intermittent in nature and therefore need energy storage complements like

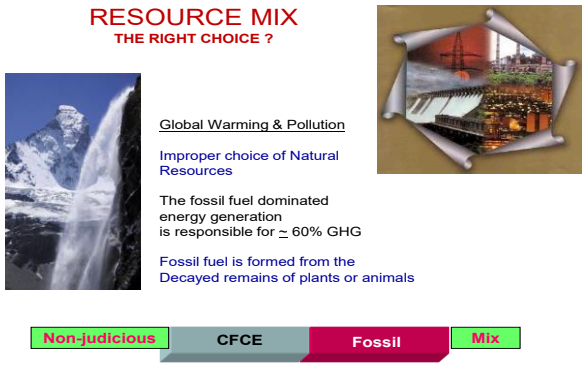
DOI: 10.30726/ijmrss/v7.i4.2020.74020

'pumped-storage' schemes. This throws a challenge for evolving a strategy on securing energy in a sustainable manner 24/7. For the electricity component of energy, the present and future global scene appears as in the table-1 above.

3. Energy Environment Interface

The energy environment interface has a celestial dimension. While Nature's Solar energy can be directly tapped, it has a couple of consequential manifestations which are also harnessable. Solar radiation reaching the rotating earth drives the atmospheric engine causing global convective circulation of wind due to temperature and pressure differentials.It alsodrives the hydrological cycle facilitating gravitating waterfalls at select topographical locations.

Fig.1: Envirinment Energy



Fossil fuel (formed in the geological past from the remains of living organisms) dominated energy generation is contributing to a substantial part of the greenhouse gas emissions responsible for pollution &global warming. A change in the mindset of society will trigger the development process of a safe and prosperous future. Deep insights on intellectual, psychological, and spiritual approaches for the well-being of mankind are essential at this point of time in history. However, the knowledge of science and technology without a spiritual foundation is a cause of imbalance evident in the self, the society, the nation, and the world; so also the 'energy-world' and the ecosphere.

4. Energy and Resource Base

The philosophical and resource-oriented sentimental relationship between mankind and the environment depicts the impact of the improper choice of '*resource mix'* for power generation and also its reflection on national economies (please see illustration below and Table 2 that follows). It would be intriguing to note that India's average cost of power generation (of any nation for that matter) can be significantly reduced by a higher proportion of Nature's Carbon-free cheap energy (CFCE) comprising Hydro, Wind, and Solar), besides huge reduction in carbon footprint.

5. CFCE: A Key Factor in National Economies

Current research indicates that a 1% increase in electricity consumption leads to a 1.72% increase in economic growth. Though there may be several factors driving the national economies of different countries, Carbon-free Cheap energy (CFCE) seems to be one of the key factors. A few examples from different continents are cited below:

Table 2: Comparision of GDP and Power Generating Capacity Mix of Select Countries

No	Country	2019 GDP Trillion $	Total Power Gen. Capacity (MW)	Hydro Power Gen. Capacity (MW)	Wind Power Gen. Capacity (MW)	Solar Power Gen. Capacity (MW)	Percentage CFCE Capacity (%)	Remarks
1	USA	21.44	1100,546	102,750 (09.34%)	105,466 (09.58%)	75,900 (06.89%)	25.81or 26%	
2	China	14.14	2010,660 #	356,400 # (17.73%)	236,402 # (11.75%)	204,700 # (10.18%)	39.66% or 40%	# World's highest
3	Germany	3.86	211,310	11,260 (05.33%)	61,357 (29.03%)	49,200 (23.28%)	57.64% or 58%	
4	India	2.94	368,789	50,070 (13.58%)	37,506 (10.17%)	42,800 (11.60%)	35.35% or 35%	
5	Brazil	1.85	170,071	109,060 (64.13%)	15,452 (9.09%)	2,847 (01.67%)	74.89% or 75%	
6	Canada	1.73	147,600	81,390 (55.14%)	13,413 (09.08%)	3,310 (02.24%)	66.46% 66%	

DOI: 10.30726/ijmrss/v7.i4.2020.74020

- China has become the second-largest economy in the world, next only to the USA with :
  1. World's largest power generating installed capacity
  2. World's largest Hydro installed capacity
  3. World's largest Wind Power installed capacity
  4. World's largest Solar Power installed capacity
  5. China's CFCE capacity has reached 40% of the total installed power generating capacity against 26% that of the USA.
- Germany (a country of <11% size of India) has surpassed India's GDP by reaching its CFCE capacity to 58% of total power generating capacity against 35% in the case of India.

- Brazil has surpassed the GDP of an advanced country like Canada by building 64% Hydro *(including the world's second-largest Hydro Power Station- Itaipu 14,000 MW)* out of its total capacity against 55% Hydro in Canada. It has also surpassed CFCE capacity reaching approx. 75% against 66% that of Canada.

Man-made threatening Green House is a clear example where human mindset has to integrate internationally for a safer common future, going beyond the mere arithmetic's of carbon credits, not depending on technological solutions alone, but resorting to the right choices of carbon-free renewable energy sources.

6. Energy Security in Indian National Perspective

In Indian context, the utilizable potentials are Solar-$5x10^{15}$ kWh/yr., Hydro-300,000 (150,000 Conventional + 90,000 Pumped Storage + 10,000 Tidal + 20,000 Small Hydro + 30,000 Interlinking of Rivers) MW, Wind-302,000 MW including offshore, Biomass-20,000 MW, as regards the Renewable Energies. When it comes to a national strategy, dependence on imports will have to be minimized in favor of indigenous sources. Rest is techno-economic feasibility. India is responsible for 5.3% of world CO_2 emissions. She is importing coal from Indonesia, South Africa, Russia, and Australia. For India's energy security, dependence on the import of technology and nuclear fuel (uranium) adds another negative dimension. Possessing the world's highest thorium reserves, India needs to develop thorium reactors that can work on the Thorium-Uranium fuel cycle.

7. Indian Electricity Sector

India generates 2,060 BU of electricity in a year out of 27,645 BU in the world, being 3rd largest producer after China and the United States. However, Annual Per capita consumption in India is 1,181 kWhagainst a worldwide average of 2,674 kWh. Resource wise Power Generation Capacity and Expected Growth by 2050 are shown in Table 3alongside.

Table 3: Indian Scene of Electricity Generation Capacity

No	Resource	ResourceMix 2000		Resource Mix by 2050	
		MW	Percentage	MW	Percentage
1	Thermal(Coal, Lignite, Gas, Diesel)	231,633	62.81%	694,000	50%
2	Nuclear	6,780	1.84%	208,200	15%
3	Total Non-renewables	**238,413**	**64.65%**	**902,200**	**65%**
4	Hydro	50,070	13.58%	138,800	10%
5	Other Renewables	80,306	21.77%	347,000	25%
6	Total Renewables	130,376	35.35%	485,800	35%
7	Grand Total	368,789	100%	1388,000 100%	
8	Non-RE: RE Mix	65:35 approx.		65:35	

8. India – Fastest Growing Energy Market in the World

India is the fastest growing energy market. The country's investment in the energy sector is growing most rapidly at a rate of 12% - the highest growth rate as compared to any other country, according to the International Energy Agency (IEA) in its latest World Energy Investment (WEI) 2019 report. This report is among the most credible publications in the energy space globally.

Renewable spending continues to exceed that for fossil fuel-based power, amid the uncertain financial attractiveness of coal power and India's commitment to environmentally benign options. India's investment in industrial energy efficiency is growing by 5%.Modernization of industrial facilities coupled with strong mandatory government policies is driving greater levels of attention and investment. In India, solar PV spending is exceeding that of coal power. Total renewable power is topped fossil fuel-based power for the third year in a row. The IEA also says that India is the largest market for coal-fired power, which is now mostly oriented towards super-critical technology. Coal supply investment in India is growing by 5 %, underpinned by policy favouring domestic production while reducing imports as much as

DOI: 10.30726/ijmrss/v7.i4.2020.74020

possible amid a substantial growth of coal consumption driven by economic growth and implicit higher power demand.

The only area that seems to be lagging is conventional Hydro Power which is the highest efficiency, the strongest source of dependable environment-friendly naturally recycled Renewable energy.

9. Renewable Energy for National "Energy Security"

Nuclear, thermal, oil, and gas power plants fairly depend on imports for their fuel. Indigenous and perennial sources like Hydro, Wind, and Solar can alone ensure the Energy Security of nations like India. Hydro is always cheaper than others. Ignoring natural, indigenous, least cost, highest density, highest efficiency, renewable hydropower goes against the national economy and environment, be it any country in the world. It would therefore be desirable to change the Non-RE:RE Mix in favour of renewable energy, particularly hydro in a foreseeable future.

10. Conclusion

Energy security of a nation does not merely mean fulfilling the needs of all by imports of non-renewable sources like coal, oil, gas, and uranium but to consistently reducing dependence on such fuels and their imports, and developing indigenous renewable resources such as hydro, wind, and solar which provide Carbon-free cheap energy becoming prime movers of national economies. This is the key to global energy security also. Low carbon pathways will moreover mitigate global warming and climate change.

Acknowledgment

The author is grateful to Govt. of India and its Public Sector undertakings devoted to Energy & Power, where he had an opportunity to work at different levels and get exposure to the national and international perspectives of energy security and appreciate the role of the electricity sector in influencing the same, during his association of nearly five decades.

References

[1] C Winzer "Conceptualizing energy security" Energy Policy, Elsevier, 2012.
[2] B Kruyt, DP van Vuuren, HJM de Vries, H Groenenberg "Indicators for energy security" EnergyPolicy, Elsevier, 2009.
[3] Ferdinand E Banks "Energy and Economic Theory (World Scientific Environmental and Energy Economics and Policy)" 2015.
[4] Ashok Sharma "India's Pursuit of Energy Security: Domestic Measures, Foreign Policy and Geopolitics"2019.
[5] Ajay Kumar Chaturvedi "Nuclear Energy in India's Energy Security Matrix: An Appraisal" 2014.
[6] Bala Bhaskar "Energy Security and Economic Development in India: a holistic approach", 2012.
[7] Prashant Agrawal "China and India: A Comparative Analysis of Approaches to Energy Security" 2009.
[8] Journal of Energy Security, Singapore International Energy Week, 29 Oct-1 Nov'2019.
[9] "World Energy Investment (WEI) Report of the International Energy Agency (IEA)" 2019.
[10] BW Ang, WL Choong, TS Ng "Energy security: Definitions, dimensions, and indexes, Renewable and sustainable energy reviews, Elsevier, 2015.

DOI: 10.30726/ijmrss/v7.i4.2020.74020