JOURNAL OF LAW AND PUBLIC POLICY

SUSTAINABLE ENERGY: LAW AND POLICY IN INDIA

Vol - V Special Edition 2018

ISSN No : 2350-1200

ARTICLES

धर्मो रक्षति रक्षितः

NATIONAL LAW SCHOOL OF INDIA UNIVERSITY
BENGALURU

Journal of Law and Public Policy

Special Edition

SUSTAINABLE ENERGY: LAW AND POLICY IN INDIA

Vol - V 2018

V JLPP (2018)

धर्मो रक्षति रक्षितः

National Law School of India University
Nagarbhavi, Bengaluru-560 242
Karnataka, India

For Subscription
Contact
National Law School of India University,
P O Box 7201, Nagarbhavi,
Bengaluru - 560 242 (Old Pin: 560 072), Karnataka, India
Ph; 080-23160524/29
Email: ded@nls.ac.in

Price:	**India**	**₹ 500/-**
	Abroad	**$ 20 / £ 10**

ISSN No : 2350-1200

Mode of Citation: V JLPP [2018]

Disclaimer: The views expressed by the author/s in the journal are their personal and do not reflect the views of the National Law School of India University.

Printed at: National Printing Press, Bengaluru - 95

JOURNAL OF LAW AND PUBLIC POLICY

Special Edition

SUSTAINABLE ENERGY: LAW AND POLICY IN INDIA

Vol - V 2018

Contents

Foreword

On Public Policy, **Hon'ble Mr. Justice J Chelameswar,** Judge, Supreme Court of India observed that the Constituent Assembly of India was the greatest public policy centre of the country that has created a well researched policy called Constitution of India. Stating that the task of safeguarding the Constitution is the responsibility of the younger generation, he said that any policy research will have to essentially ensure implementation of goals elaborated in the Constitution though the Constitution itself is being amended from time to time.

It delights me to note that the Special Edition of the Journal of Law and Public Policy, 2018 on the theme of **"Future of Sustainable Energy in India"** is being released to mark the 69th Republic Day Celebrations. Republic Day is the day on which the Constitution of India came into force. This special edition is a humble and earnest effort on part of National Law School of India University to fulfill the Public Policy mandate as ordinated in the Constitution of India.

I congratulate Dr. Sairam Bhat, Chief Editor and his team for yet another stellar effort.

Prof. [Dr.] R. Venkata Rao
Vice-Chancellor

Editorial

We are once again delighted to publish the special edition of the Journal of Law and Public Policy, 2018 on the theme of "Future of Sustainable Energy in India."

This Journal is an earnest publication effort which is an outcome of the Two Days National Seminar organised at NLSIU on the same theme and of the papers presented, peer reviewed and selected thereof.

In the first article, Dr. Binu Mole has analysed the issue of "Integration of Energy Efficiency techniques in the Construction of Buildings". The author in her paper states that the regulatory framework for integrating energy efficiency techniques in the construction of buildings began with various initiatives such as the enactment of the Energy Conservation Act of 2001 and the Electricity Act of 2003, the establishment of the National Mission for Enhanced Energy Efficiency, the Bureau of Emergency Efficiency etc. Over the past decade, the Ministry for New and Renewable Energy, the Ministry of Environment and Forests and Climate Change, the Ministry of Power and the Ministry of Urban Development have introduced components which look at sustainability with overarching policy objectives to promote energy conservation in buildings. Despite these efforts, the pace of change towards energy efficiency appears to be very slow in our country. The message of Energy efficiency which led to the policy upsurge in this regard has unfortunately not reached the target groups. Rural areas are still struggling to achieve the desired energy goals. The infrastructure for small conservation projects in households has not been achieved and the need for correlation of climate change issues with energy efficiency policies has remained unheeded under the current scheme. In the backdrop of regulatory efforts and policy initiatives, the author in this article makes an effort to critically analyse the scheme in order to suggest improvements for useful interventions. The study tries to examine as to how far the mandate under Indian law to achieve "efficient and environmentally benign policies" has progressed.

In the next article, Chandralekha V. and Dr. T R Maruthi have analysed the legal framework of energy security and sustainable development In India. The development of a nation is dependent on adequate and continuous supply of energy sources. Energy is crucial for every human being and is considered to be the lifeline of economic development. India's attempt to shift from the agriculture sector to manufacturing and service sector has in the past resulted in an unexpected demand for energy sources. To achieve parity with the demand, India needs to generate and supply three times more of its current energy generation in the future. India is currently dependent on conventional non-renewable energy sources for its energy needs. But it is very difficult for the country to continue in the same manner and maintain balance with environmental issues, climatic change and use of non-renewable energy concurrently. Shifting towards renewable energy sources has the potential to provide solutions to long standing energy problems. No doubt India has taken important steps with regard to renewable energy by increasing the installed capacity, thereby attempting to reduce its dependence on fossil fuels, mainly on coal and diesel but there are many hurdles in achieving India's renewable energy targets. There is an urgent need to develop innovative technology and financial instruments to protect the renewable sector in India. There are several instruments that are currently available in the private market, especially relating to solar and wind energy. But their costs make them unreasonable for developers and inductors to utilize them effectively. Apart from the problems mentioned above, issues relating to location and storage of energy should also be considered by the government. The authors in this paper highlight the problems faced by the renewable energy sector of India, and also deal with how India can achieve energy security, economic development and environment sustainability simultaneously.

Pavithra R. and Sincy Williams in the next article talk about the issue of "Oil Exploration and Energy Security". The authors in their paper state that energy is of prime focus in our nation and receives wide importance in terms of environment and sustainable development. Oil, natural gas and its exploration are the main resources that are focused on for the purpose of ensuring energy security in the country. India stands fifth in overall energy consumption and the existing resources of energy production are proving to be insufficient to address the concerns of a large population. Approximately, only thirty percent of the nation's population has an LPG connection. Currently, India is a rapidly growing market for the energy sector, yet we see that even after the New Exploration Licensing Policy (NELP) was introduced, the required investment in the sector did not come to the country. Looking at the disappointing results of the existing policy, a new policy was brought about by the Ministry of Petroleum and Natural Gas and was coined as the Hydrocarbon Exploration Licensing Policy (HELP) which replaced the existing Exploration Licensing Policy. The new policy is supposed to place wide discretion in the hands of explorers and the production industry, which is an attempt to cure the defects of NELP. In the new policy, companies were given the power to choose areas they were interested to invest in and the government would further bid on the same area proposed by the companies, hence making companies proactive agents in the entire process. Given such a scenario, the investors are given the option to make an informed decision which is a desirable feature in such a policy. However, the new policy is not devoid of drawbacks. Hence, the authors in this paper focus on the lacunae of HELP, in particular on the preferences being given to certain companies and with respect to the issue of investment from countries across the world.

Next, Ritesh R contributes on the "Attempts to achieve energy security through Nuclear Energy". The aspiration of a growing population is to have a better quality of life for which energy sufficiency is crucial. Affordable and uninterrupted energy supply is critical to attain development goals. But the disparity in access to energy supply which translates into economic deprivation and an upsurge in poverty levels across the world, is a major concern among countries. Statistical figures and facts suggest that 25% of Indian population doesn't have access to electricity. In the next 20 years, energy is the major requirement to sustain economic growth which India has experienced for more than a decade now. If the percentage of India's economic growth (8% to 9%) continuous in the future, there will be change in power demand from 220Gwe to 800Gwe. This means that there will be Co2 production of about 3 to 4 billion ton managing which would become an extremely challenging task. Coal will continue to dominate India's energy mix for the next decade or so (given the low cost of production and abundance in India). But growing environmental pressures will require India to alter its energy mix, making nuclear energy an important fuel source in the future. India's Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) outlines its intent to scale up the country's clean-energy capacity and there lies a solution in the form of primary energy sources like solar, wind and nuclear. But to be able to economically exploit nuclear energy in the future, investments have to be made in the present so that a smooth transition could be made from a fossil fuel dominated energy mix, to an energy mix which would not wholly but substantially be dependent on nuclear energy. The author examines the future growth of nuclear power in India and also makes an attempt to explain the fact that nuclear power alone can bring about a feasible solution to the energy crisis in India and the world today. Nuclear energy has a very high capacity factor compared to other alternative sources and the technology is also proven. Government Policy to encourage use of Thorium fueled nuclear reactors also play a considerable role in the feasibility of Nuclear energy. Considering all the above factors, the author contends that energy security can be achieved through the development of nuclear energy.

Srividya Sastry in her paper evaluates the role of "Tidal and Geothermal Energy". With India's growing population and energy needs, it is estimated that the country's main source of energy i.e. conventional fossil fuels may run out in about next 40 years and even the natural gases may no longer be available in the future to meet the energy needs of the country. The fact that conventional sources of energy have led to severe environmental impacts and global warming has made the country look out for cleaner technology using renewable sources to meet its rising energy demands. Also, considering the fact that renewable sources of energy such as solar power projects, small hydro power projects etc. have benefitted millions of people across the Indian subcontinent, the author contends that it is time for India to explore other renewable sources of energy. Geothermal and Tidal energy are the renewable sources of energy vastly available across the Indian sub-continent. India having a large landmass and long coast line should make attempts in harnessing these sources energy to meet it's growing industrial and domestic energy requirements. These sectors have suffered mainly because of high costs and limited availability of sites with sufficient potential. India has the potential to contribute to the Energy industry positively through job creation, energy security, exports and economic growth in the Tidal and Geo Thermal sector. The author looks into the positive impact, feasibility of adopting these cleaner forms of energy and the regulatory framework of India wherein it provides opportunity for the growth of the industry in an economical and sustainable manner in order to achieve its target of 175GW of renewable energy by the year 2022.

Vani Kesari in the next paper has evaluated "The Role of MSMEs in the Energy Sector". Micro, Small and Medium Enterprises (MSME) have a significant role in India in terms of not only balanced growth but also its contribution towards employment generation, development of entrepreneur skills and enhancement of rural industrialisation. These industries contribute towards 8.9% of Gross Domestic Product of the country. However, MSMEs have fallen behind global benchmarks in terms of productivity, technology and end use energy efficiency. This may be due to the fact that MSMEs are vulnerable due to the limited resources within which they function as well as constrained operating margins. There have been various legal and policy interventions with regard to energy conservation in the operation of MSMEs. Apart from certain key legislations such as the Electricity Act, 2003, Energy Conservation Act, 2001, Electricity Regulatory Commissions Act, 1998 the government of India has in associations, bilateral/multilateral programmes, national agencies and financial institutions engaged in creating an energy efficiency transition in the MSME sector. The United Nations Industrial Development Organisation (UNIDO) has been working on MSME cluster Development as well as the policy initiatives to be undertaken under both Central and state governments. The principal question that is to be addressed is of what extent the existing laws and policy objectives can effectively intervene in making MSMEs maintain energy efficiency. In India, only very large companies have initiated the practice of sustainable reporting while the MSMEs that are doing so are very minimal. The major lacuna in the regulatory framework is the absence of sector specific regulations and institutional accountability. Investigations in this direction are thus essential to make green growth a reality. Moreover, the author evaluates the extent to which the legal and policy paradigm in India has attempted to incorporate the need to use renewable energy as an alternative source of energy by MSMEs and the stance of the regulatory policies and law in this regard.

In the next article, Vidya Ann Jacob examines the "Draft National Energy Policy and the question of whether renewable energy is a viable alternative." Renewable energy has become an important agenda of India's energy planning process, especially since climate change has taken centre stage in the domestic and international policy arena. The challenge of meeting energy demand is likely to get more complex since it has to keep pace with the population growth and expanding economy. In fact, experience has proved that access to modern energy is a prerequisite for achieving the Sustainable Development Goals. In the backdrop of the ever increasing demand for energy, there are also issues such as excessive dependence on oil imports and mounting deficits in balance of payments, volatility in oil prices, depleting fossil fuel reserves, the threat to energy security and climate change resulting from increasing emissions of greenhouse gases. The growth rate of energy consumption has now exceeded the growth rate of production of energy in the country. India also deals with a vast population and very limited natural resources, especially for meeting its energy requirements. Renewable energy is central from the twin perspectives of energy security and environmental sustainability. India today stands among the top five countries of the world in terms of renewable energy capacity. The author highlights importance and prospects of renewable energy in India and extrapolates the future developments keeping in view the demand, consumption, production and supply of power. She also examines the nature of India's energy problem, development of renewable energy, potential, investment in renewable energy, and the factors responsible for slow diffusion of renewable energy across the country.

Amit Kumar Akela's study is on the "Solar Panel case that was before the WTO in 2013" and its impact on Indian renewable energy sector and environment. The world is moving towards renewable energy with great pace and countries are incentivizing and encouraging them by several means as well. But the world has also witnessed quite a few disputes before the WTO Panel based on renewable energy issues. The Panel Reports and the Appellate Body ruling in the Indian Solar Panel case which concluded that the country's power purchase agreements with solar firms and domestic content requirements (DCR) were inconsistent with international norms generated a lot of hue and cry from academics, industries and non-governmental organizations. But there were also some scholars who asked India to abide by the decision, arguing that it went in India's favour as its renewable energy program was not prohibited and there was no restriction imposed on the import of cheaper solar cells and modules. Based on these lines of arguments, the paper tries to analyse from an Indian perspective, the defences our country advanced to justify its DCR measures. These measures adopted by India were not new, rather many developed and developing countries had used them to strengthen their domestic infant industries in the past. The author looks at the impact of the above on India's renewable energy program, the domestic renewable industry, job creation and achieving environmental goals.

Amongst the contributions from students, we have Aditya Sethi, who has written about conventional sources of energy and sustainable development. The energy requirement in India has been growing steadily which is being met both by conventional and non-conventional sources of energy. The non-availability of sufficient resources and emission of pollutants from conventional sources has therefore, increased the need for utilization of renewable energy to a great extent. Energy consumption rises with the increase in population and living standards. The need to expand access to energy in new ways is growing and so is the awareness of the environment costs. Economic development has been strongly correlated with increasing use and growth of greenhouse gas emissions.

The relationship between renewable energy and sustainable development can be viewed as a hierarchy of goals and constraints that involve both global, regional and local considerations. The three pillar concept of sustainable development- economy, ecology and society allows a schematic categorization of developmental goals. Renewable energy offers the opportunity to contribute to a number of important sustainable development goals like social and economic development, energy access, energy security, climate change mitigation and reduction of environment and health impacts. It is important to consider that for the development path to be sustainable over a long period, wealth, resources, and opportunity must be shared so that all citizens have access to minimum standards of security, human rights, and social benefits, such as food, health, education, shelter, and opportunity for self-development. The synergies with local sustainable development goals, conditions for their successful implementation, and trade-offs with the aspect of climatic mitigation have to be discussed. There are many different ways to classify indicators of sustainable development and identify where improvements need to be made. The author highlights the over exploitation and utilization of conventional energy resources in India and the strategy for sustainable utilization of energy resources for social and economic development of the nation.

Anand Jagmalani and Ambuj Tiwari in the next paper have examined issues in the "Growth and Utilisation of Tidal and Geothermal Energy." While in earlier days, wood and timber were the only sources of energy (biomass), the discovery of fossil fuel which includes coal and oil and natural gas have now replaced those conventional sources. Fossil fuel is an easily available source of energy and the technology for its use is well developed, due to which this particular source is extensively used by all the countries across the globe. Unfortunately, fossil fuel is also unsafe for continued usage since it produces large amounts of carbon dioxide which has led to environmental degradation and global warming. The concept of sustainable energy came up to help meet today's demand of energy without endangering the future needs. India is well gifted with natural resources and has the potential for alternative energy creation. Tidal energy and geothermal energy are the two forms of energy which can be looked at as viable alternative sources in India. Tidal power, also called tidal energy, is a form of hydropower that converts the energy of tides into useful forms of power. Tidal streams, barrages and tidal lagoons are the three sources from which such energy is created. The use of geothermal energy in India is at a nascent stage.. It has been identified that there are about 340 geothermal hot springs in the country. Both these sources of energy are inexhaustible in nature. They are supposed to be highly efficient and environmentally friendly. The authors while contending the benefits of these sources, emphasize the need for the government to take initiatives in advancing them.

Rhiti Chattopadhyay and Vaitasta Tickoo in the next article talk about "Renewable energy: Tidal and geothermal energy." The authors point out to research which states that if the trends in ratio of reserves to current rates of production are to be believed, the Earth might run out of traditional energy sources as soon as 2060. Even those who repudiate such speculation hold that the exhaustion of the Earth's capacity to withstand the harmful by-products of fossil fuel combustion will eventually limit its use. Today, reducing the fossil fuel contribution to the global energy system, and in particular doing so with renewable energy sources, is the greatest challenge for the world community. While the favourites, solar, wind and hydel dominate global renewable energy output, largely due to substantial capital investment in research and development in these sources and lower structural costs; geothermal and tidal energy have shown potential to surpass them in gross energy generation. As India gears up to implement the world's largest renewable energy expansion programme and reach 175 GW of energy production by 2022, it is now more imperative than ever to tap into these underutilized resources. The authors in their paper examine the quantum of energy output and cost effectiveness of methods of tidal and geothermal energy generation as against more conventional renewable energy sources, with special reference to the rapid scientific advancement in technology in recent years. Further, the article sheds light on the policy initiatives undertaken by the Ministry of New and Renewable Energy and the lack of legislation and implementation with regard to the aforesaid policies. Having studied the successes of the global giants in the field, the authors present a comprehensive review of the existing policy and legislative measures.

Riddhi Mundhra and Anwesha have examined the topic of "Bio-Diesel in the case of Jatropha". In an attempt to secure its energy supply, India has inclined towards development of bio-fuel production. The concept of bio-fuel has spurred the interest of policy makers and farmers alike because of "JATROPHA", an oil-crop which has the potential capacity to grow on degraded soil with fewer inputs. It is a drought resistant crop and grows round-the-year. For developing countries, bio-fuel production meant not only achieving economic growth, but also creating job opportunities/ livelihood for the farmers involved. Thus, a large-scale government programme was launched for promotion and implementation of Jatropha cultivation in South India in 2003. In 2010, an interview with 106 Jatropha farmers revealed that 85% of them have discontinued cultivation of Jatropha because of (a) ecological problems and economic losses, (b) failure to provide income to the farmer, (c) problems in the development and execution of the government Jatropha programme, (d) lack of support from authorities to farmers. As the Jatropha programme was not as successful as expected, the expected positive environmental and socio-economic impact has not been realized. In 2015, reports for replacements to petrol and diesel had generated much hope in Jatropha seeds, but, Jatropha proved to be commercially unviable. Surprisingly, Jatropha's viability has just begun to be explored in Botswana now.

Xavier in the next paper has contributed on the topic of "Nuclear Industry". The author in his article brings forward reports that state that India through its Uday Yojana seeks to connect over 18000 villages in the next 2 years which is approximately 300 million new electricity consumers. He states that the country not only has to account for its future energy needs but also has to provide solutions for current energy accessibility and availably issues. Also, issues such as that of carbon emissions are making countries over the world consider moving away from fossil fuels as a source of energy to alternative sources such as wind, solar, hydel or nuclear power. Finally, the author evaluates whether nuclear power is the best source of alternative energy. He also looks into matters such as privatization of the Indian nuclear industry and legal reforms needed to privatize the industry.

The fifth edition of JLPP extensively appreciates the support received from our University administration. As always, we would especially like to thank our respected Vice Chancellor, Prof. [Dr.] Venkata Rao for all the encouragement and support. I, on behalf of the editor Praveen Tripathi and myself , thank Ms. Raagya Zadu-Teaching Associate and PhD scholar, NLSIU and acknowledge her sincerity and dedicated work in bringing out this special issue. I also thank Ms. Archita Narayanan-Teaching Associate and Mrs. Susheela, for their respective coordinations with regard to this publication.

Dr. Sairam Bhat
Professor of Law, NLSIU
Chief Editor, JLPP

Integration of Energy Efficiency Techniques in Construction of Building: Regulatory Constraints and Policy Challenges in IndiA

*Dr. Binu Mole**

Introduction

Rapid urbanisation and better access to disposable incomes have driven the demand for better habitats in India. The demand from the hospitality sector, organised, retail and commercial spaces and Special Economic Zones is driving the surge in India's building market. On the other hand, the housing deficit in the nation at 27-28% indicates the urgent demand for residential spaces.[1] While buildings account for 40% of total national energy consumption, the building sector in India accounted for a third of the total electricity consumed in the nation.[2] The fast growing Indian economy is creating a huge increase in demand for building space. It is expected that more than 500 million people will live in cities by 2030 and around 80% of the buildings required by them are yet to be constructed. In 2010, the commercial floor space in India was estimated to be about 1 billion sq. m and about 30-70 million sq. m was projected to be added annually to the existing stock. This will amount to about 4 billion sq. m of commercial floor space by 2030.[3] With the increase of commercial building stock, electricity consumption of this sector has been growing rapidly at 11-12% annually. Between 1990 and 2005, commercial building energy consumption increased by 60%. The floor space distribution also is expected to witness a concentrated expansion in sectors like retail *establishments and large private* office occupancy. Besides this, the enhanced growth in the organised

* Assistant Professor, School of Legal Studies, Cochin University of Science & Technology, Kerala.

1 Reshmi Vasudevan, Dr. Koshy Cherail, Cdr. Ramesh Bhatia, & Nisha Jayaram, Alliance For an Energy Efficient Economy, Energy Efficiency in India : History and Overview. *Available At* http://www.indiaenvironmentportal.org.in/files/file/aeee%20energy%20efficiency%20final.pdf, (Last accessed on 20/08/2017).

2 BEE Report on Verified Energy Savings with the activities of 'Bureau of Energy Efficiency' for the year 2009-10, NPC, Sept 2010.

3 *Ibid.*

retail sector will drive the commercial floor space [4] This demand is reflected on the electricity consumption also. Electricity consumption showed an increase of 14% in 2009 alone. Since 2005, around 580 Special Economic Zones (SEZs) have been approved to be built on 0.11 million hectares which will also makes an addition on demand side of energy.[5]

Without energy efficient buildings, the growth in energy demand will fast outpace power generation, capacity addition and add to the country's chronic electricity shortages. This is because demand for energy in buildings exists for varied purposes that range between heating, cooling, ventilation, lighting, sanitation requirements etc. And both residential and commercial buildings need to meet these demands. Moreover, it is estimated that about 20- 40% energy savings potential exists across both residential and commercial buildings. As cautioned by the United Nations Environmental Programme, if energy efficiency of buildings is not addressed on a priority basis the total electricity related emissions from buildings could be high, 390 % higher than current levels.[6] Since most of the building stock is yet to be built, it is right time now to plan for energy efficient practices to adopt. This assumes importance because energy efficient buildings will lower operating costs, increase comfort and promote better environment.

By reducing energy consumption in buildings, a nation can reduce dependency on imported energy and strengthen its strategic position. In the 2000 Green Paper setting forth a strategy to secure energy supply,[7] the European Union named energy efficiency as the best way to establish energy security over a longer term. Reduction of energy consumption in buildings will also reduce greenhouse gas emissions and pollution produced by the combustion of fossil

4 Arijit Sengupta, & Saurabh Kumar, Bureau of Energy Efficiency, Roadmap for India in Energy Efficiency India. *Available At* http://environmentportal.in/files/file/India_Sengupta.pdf, (Last accessed on 26/08/2017).

5 *Ibid.*

6 United Nations Environment Programme, The 'State of Play' of Sustainable Buildings in India, *Available At* http://staging.unep.org/sbci/pdfs/State_of_play_India.pdf, (Last Accessed on 26/08/2017).

7 European Commission, "Towards a European strategy for the security of energy supply", (Sept. 4, 2017), *Available At* http://iet.jrc.ec.europa.eu/remea/sites/remea/files/green_paper_energy_supply_en.pdf, (Last Accessed on 26/8/2017).

fuels. Its environmental benefit appears on two scales, local and global. Because much of buildings' demand for energy requires local energy combustion in individual heating systems or district heating, reduced energy demand improves air quality at the local level. In particular, in developing countries a reduced demand for energy requires fewer power plants, thereby delaying or obviating the construction of new generation and grid capacity and enabling communities to devote public funds elsewhere. Given the potential scale of energy savings across the building sector, reduced demand for energy and fossil fuels can substantially contribute to a nation's compliance with domestic or supranational targets for the reduction of greenhouse gas emissions.

Energy efficient buildings equipped with proper ventilation will provide healthy and congenial environment for human habitation. Relative to traditional buildings, energy efficient buildings offer more stable indoor climate, with less draught from windows, walls, floors, and ceiling constructions. Because residents of energy efficient buildings must spend relatively less to heat and cool their homes to attain the margins of acceptable comfort, energy efficient construction reduces fuel poverty across society. As households demanding less energy for building-related uses burn less fuel locally, they double the potential to improve public health and otherwise benefit local communities.

Evolution of Regulatory Efforts for Conservation of Energy in Buildings in India

Globally, the oil crisis of 1973 had a significant impact on the regulatory surge for energy efficiency. This was the time many industrialised countries realised the urgent need for energy conservation. But the drive for energy conservation had struck the Indian intelligentsia even earlier in 1970, with efforts made to constitute Fuel Policy Committee by the Central Government.[8] The discussions made at the United Nations Conference on Human Environment held at Stockholm in 1972 on related issue of rapid degradation of global environment and unabated growth in material consumption and energy also created waves in

8 Paritosh Nandi & Sujay Babu, *A Review of Energy Conservation Initiatives by Government of India,* Renewable and Sustainable Energy Review, 518, 518-530 (2008).

India. Considering energy as the most polluting sector, the question of its proper management received due attention at international level. The decision of the Organization of Arab Petroleum Exporting Countries (OAPEC) to cut off oil export to USA, Japan and other countries of Western Europe, for supporting Israel during the Yom-Kippur War,1973 between Egypt and Israel also made world's nations to wake up to the chance of uncertainty in the restoration of oil supply. Conservation of energy finally started receiving serious attention as an extremely important item in national energy policy agenda.[9]

The Fuel Policy Committee in 1970 set up under the chairmanship Prof. Sukhamoy Chakraborty, then member of the Planning Commission suggested some important steps to be taken by the government in its march towards energy sufficiency. Despite emphasising the need for development of alternate energy sources and promoting research in this regard, Committee highlighted the need for a coherent energy policy for national development as energy availability was a necessity. The Advisory Board of Energy attached to the Planning Commission of India in 1980 and prepared a number of study reports[10]. With independence and unprecedented increase in use of oil to satisfy demands of transport industry, initiatives were made for conservation of petroleum. The most important one in this regard was the constitution of Petroleum Conservation Action Group which was later reconstituted as Petroleum Conservation Research Association (PCRA) in 1978 by the Ministry of Oil and Petroleum. Initiatives also followed after appointment of a committee under Mr. D V Kapur by government of India to target energy saving. But there was low awareness and initiative in the private sector for energy conservation. Realising this trend, the Government concluded that the only effective step for reducing consumption in the country was to go for enactment of an appropriate legislation. The Advisory Board on Energy commissioned the Indian Law Institute in 1987 to prepare a draft of the Energy Conservation Bill for adoption of an enactment by the Parliament. The main objective of the draft bill completed in 1988 was to empower the government to take such measures as deemed necessary and expedient for the

9 Basu S, Energy Technology and Policy Perspectives in Mapping Technovation through Multi-Goal Synthesis. First Indian Engineering Congress, (Jan. 9–13, 1987).

10 Ramesh J, Maggo JN. "*Towards a perspective on energy demand and supply in India in 2004/05*." Advisory Board on Energy, Government of India, 1985.

purpose of conserving energy in the country and making appropriate and rational use of energy resources[11]. The Bill addressed the establishment of a Nodal Energy Conservation Organization (NECO), whose observations and recommendations would be binding on governmental as well as the prescribed authorities, by drawing manpower and expertise from the government departments, public-private sectors and industries. The legislative measure of the government was considered strong, but the creation of the apex body as recommended earlier and envisaged in the Bill, could not be materialised. Thus in place of the NECO a more appropriately named Energy Management Centre (EMC) came into existence by a Government order in 1989 as a registered body under the general administration of the Department of Power, Government of India. Thereafter, notwithstanding the rise in fuel prices, the widening gap between demand and supply of electricity led to supply restrictions. The governmental efforts in creating awareness and providing technical and financial assistance, the response to the call for energy conservation from the consumers, large and small, remained characteristically lukewarm. Finally, in 1996, government again attempted to introduce a freshly drafted Energy Conservation Bill. After some delay, the Bill became law as Energy Conservation Act, 2001.[12] It was enacted with the goal of reducing energy intensity of Indian economy has among its initiatives to conserve energy, mandated formulation of energy conservation building codes for commercial buildings. In addition, the Act enjoins the Central Government and the Bureau to take steps to facilitate and promote energy efficiency regulatory mandate for: standards & labelling of equipment and appliances in buildings. The Act also directs states to designate agencies for the implementation of the Act and promotion of energy efficiency in the state. The Act underwent an amendment in 2010 to incorporate issuing of energy saving certificate and other allied aspects.[13]

11 Reshmi Vasudevan, Dr Koshi Cherail, Cdr Ramesh Bhatia & Nisha Jayaram, Energy Efficiency in India: History and Overview, *Available At* http://www.aeee.in/wp-content/uploads/2016/03/AEEE-EE-Book-Online-Version-.pdf, (Last accessed on 24/08/2017).

12 *Available At* http://lawmin.nic.in/ld/P-ACT/2001/The%20Energy%20Conservation%20Act,%202001.pdf, (Last accessed on 29/08/2017).

13 *Available At* http://www.mercindia.org.in/pdf/Order%2058%2042/The%20Energy%20Conservation%20(Amendment)%20Act,%202010.pdf, (Last accessed on 22/08/2017).

The concern for renewable energy began in 1981 with establishment of Commission on Additional Sources of Energy (CASE) in the Department of Science & Technology. Soon in 1982, Department of Non-Conventional Energy was created in the Ministry of Energy which became Ministry of Non-Conventional Energy Sources. The Ministry of Non-Conventional Energy Sources was rechristened as Ministry of New and Renewable Energy in 2006. It was also made a nodal agency for different new and renewable energies like wind, solar, hydropower and bio energies. Renewable Energy development in India has been aided by strong regulatory and policy backing. Electricity Act of 2003, specifically included promotion and cogeneration of electricity from renewable sources of energy and setting of Renewable Power Obligation targets.[14] In addition to the regulatory efforts, there have been several administrative and policy initiatives to satisfy energy efficiency drive for buildings.

Legal Strategy for Conservation and Energy Efficiency: an Introspection

Through the adoption of the Energy Conservation Act and the constitution of the Bureau of Energy Efficiency[15] (BEE), under it, the energy efficiency movement in India began to gain momentum. The Act in effect marked the shift in the focus of law from access to energy to one insisting for conservation of energy. Energy consumption by the built environment shall be on the rise if we continue to chart the current path. Government of India has developed the Energy Conservation Building Code of India in 2007 under the EC ACT 2001, which still remains a voluntary code with no mandates. Interestingly, the Energy Conservation Act, 2001 defines buildings as entities used for commercial purposes, which means that ECBC primarily applies to commercial buildings, while residential buildings account for nearly 24% out of 32% of building sector electricity consumption in India.

Bureau of Energy Efficiency appears to be an inventive step in the direction of governmental policy towards energy conservation in general and energy efficient

14 The Electricity Act, 2003, No-36, Acts of Parliament, 2003 (India).

15 Hereinafter referred to as "BEE".

buildings in particular.[16] The function of the BEE is to assist in developing policies and strategies with a thrust on self-regulation and market principles, within the overall framework of the Act to achieve energy efficiency goals[17]. This will be achieved with active participation of all stakeholders and co-ordinates with designated consumers, designated agencies and other organizations and recognize, identify and utilize the existing resources in performing the functions. BEE's main regulatory functions for gaining energy efficiency in buildings include developing minimum energy performance standards by adopting Energy Conservation Building Codes, focusing on designated Consumers, accredit and certify energy auditors and managers.

The government of India has developed the Energy Conservation Building Code of India in 2007 under the E.C. Act, 2001. The latest updated version was adopted in 2017. But till now the code retains its voluntary character. Interestingly, the Energy Conservation Act, 2001 by defining buildings as entities used for commercial purposes restricts the application of the code to commercial buildings, while residential buildings account for nearly 24% out of 32% of building sector electricity consumption in India.[18] The implementation of the code also suffers due to lack of integration of functions of urban local bodies like municipalities, and capacity enhancement of people responsible for its implementation. Creating awareness about ECBC remains a challenge despite designation of promotional functions on BEE to initiate programmes to create awareness and dissemination of information on energy efficiency and conservation in buildings, arranging and organizing training of personnel and specialists in the techniques for efficient use of energy and its conservation.

The Act identifies adoption of standards and labelling as a key activity for energy efficiency improvement to ensure that only energy efficient equipment and appliances are made available to the consumers. With this objective

16 BEE was set up on 1st March 2002. Available At http://www.bee-india.nic.in (Last Accessed on 24/8/2017).

17 Energy Conservation Act, 2001, No-52, Acts of Parliament, 2001 (India).

18 Mili Majumdar, Energy efficiency in Buildings: Implementation Challenges and Way Forward. *Available At* blogs.economictimes.indiatimes.com/IssuesonSustainableHabitats/energy-efficiency-in-buildings-implementation-challenges-and-way-forward, (Last accessed on 24/08/2017).

minimum energy, consumption and performance standards are insisted for notified equipment and appliances. The manufacture, sale and import of equipments, which does not conform to the standards, are thereby prohibited. Mandatory labelling scheme for notified equipment appliances to enable consumers to make informed choices also stands notified. India's policy on standards and labelling for buildings suffers due to policy constraints, lack of transparency and involvement of stakeholders, lack of testing centres and improper implementation.[19]

Therefore, India needs a robust implementation framework to holistically address energy efficiency requirements the building sector and its growing resource needs. Integration has to happen at policy level. It is a need of time make a re-look at building byelaws and expand its boundary to include energy efficiency, water efficiency, indoor environmental aspects, use of materials and construction techniques and renewable energy integration. Protecting consumer interest is also crucial.

Other Policy Initiatives: Building Codes and Standards

National Building Code[20] is the model code formulated in India in 2005. Prior to1970, statutory control over construction of buildings was limited building norms adopted at local levels. The lack of uniformity among these norms was rectified by introduction of National Building Code in 1970. The code was revised in 1983 and 2005.[21] NBC was further revised by Bureau of Indian Standards in 1983 and 2005 respectively. It codifies administrative regulations, development control rules, general building requirements; fire safety requirements; conditions regarding materials, structural design, construction

19 Thanmay Thathagat, India Labeling Program Impacts: Case Study. *Available at* http://clasp.ngo/~/media/Files/SLDocuments/2006-2011/200705_IndiaLabelingProgramImpacts.pdf (Last accessed on 22/08/2017).

20 Bureau of Indian Standards (BIS).SP7: National Building Code (NBC)-2005. New Delhi; 2005 *Available At* https://law.resource.org/pub/in/bis/S03/is.sp.7. 2005.pdf (Last accessed on 31/08/2017).

21 Indian Standards Institution(ISI). National Building Code (NBC) – 1970. New Delhi;1974.

aspects including safety, and various building services. It covers diversified building industry which is mostly informal and provides basic information to the workforce. NBC regulates the building construction sector and is followed by building construction agencies, private developers, government departments, co-ordinates with designated consumers, designated agencies and other local bodies. NBC provides basic framework to develop local regulations for specific regions and covers basic guidelines but energy efficiency aspects are not covered clearly although some provisions may directly relate to energy efficiency improvements. Therefore to address energy efficiency issues in building sector, a separate energy code known as Energy Conservation Building Code (ECBC)[22] was enacted in 2006 and revised in 2007 by the BEE.

Energy Conservation Building Code (ECBC)

ECBC is a voluntary standard adopted by BEE for commercial buildings. While adopting the Code in to its legal system, states can make alterations to accommodate its peculiar local climatic conditions. As of now, majority of the states of Indian territory including states of Karnataka, Kerala and Tamil Nadu have given effect to the code. Its main purpose is to provide minimum requirements for the energy efficient design and construction of buildings. Energy efficiency parameters under the Code covers aspects like orientation of site to suit climatic conditions, building envelope, HVAC, sanitation, hot water, lighting controls and power requirements. A major drawback in this regard is lack of a similar energy conservation code for residential buildings in India.

Green Building Codes

India is one of the fastest growing economies in the world. The demand for construction and infrastructural development is also growing. In such a scenario even though importance of green buildings has been fairly understood, it is unfortunate that country does not have a comprehensive Green Building Code. Till date, India does not have an effective and comprehensive green building code. In the absence of such a national green code, internationally recognised green building norms that are unsuitable to Indian conditions occupy the field.

22 Bureau of Energy Efficiency. Energy Conservation Building Code (ECBC) *Available At* http://www.eco3.org/ ecbcl (Last accessed on 14/08/2017).

Today building certification systems for energy efficiency adopted by Leadership in Energy and Environmental Design (LEED) which was established by US Green Building Council is adopted as a standard for rating of buildings in India. Green rating of buildings adopted by Indian Green Building Council (IGBC) also follow a modified version of the LEED rating System that prevails in the US[23]. It rates individual and multi-dwelling residential units according to their compliance with energy efficiency parameters. Another notable effort in this regard is the Green Rating Integrated Habitat Assessment (GRIHA) developed by the Energy and Resources Institute (TERI) in 2005. It was later recognised by the Ministry of New and Renewable Energy, government of India in 2007, as the national rating system.[24] A specialised version of GRIHA was also adopted especially for residential buildings called SWAGRIHA has also been evolved. It recommends ECBC for the energy efficiency benchmarking and evaluates further improvements towards boosting energy efficiency in buildings.

Initiatives have also been made by institutions to issue guidelines on construction of energy efficient buildings. A Handbook on Energy Conscious Buildings was produced as a result of the project work undertaken by IIT, Bombay and Solar Energy Centre of MNRE to provide guidelines on energy conscious buildings. It provides guidelines on the use of eco-friendly and less energy intensive materials, passive solar techniques, day lighting features, integration of renewable energy technologies in building design, conservation of water and wastewater recycling, rainfall harvesting and use of energy efficient appliances.[25]

Action Plan for Promoting Energy Efficiency (2007-2012)

This plan is a multi-sectoral action plan to promote energy efficiency adopted by the Government of India and BEE. The focus of this plan for buildings is

23 Indian Green Building Council, IGBC green homes rating *Available At* http://igbc.in/site/mmbase/attachments/342261/IGBC_Green_Homes-_Abridged_, (Last accessed on 14/08/2017).

24 TERI, Green Rating for Integrated Habitat Assessment (GRIHA) Manuals. (Ed. (2010).

25 Ministry of New and Renewable Energy. Government of India; Hand book of energy conscious buildings of India, 2006, *Available At* http://mnre.gov.in/centers/about-sec-2/hand-book-on-energy-conscious- buildings (Last accessed on 14/07/17).

the demand side management efforts apart from Minimum Energy Performance Standards (MEPS) and comparative (pictorial) labels on end use appliances. The plan seeks to ensure energy efficiency in existing buildings by promotion of Energy Service Companies. Energy efficiency in new buildings is addressed under the plan by prescribing ECBC codes specific to particular climatic regions, developing pool of ECBC expert architects and engineers, developing training materials, initiating outreach activities and workshops and training programmes, providing technical assistance and developing curriculum for architectural and engineering colleges for capacity building etc. The Plan also promoted energy efficiency in household lighting through its various programmes. For managing the demand side, measures adopted under the plan were preparation of project reports, manuals, awareness to local and municipal authorities.

National Mission for Enhanced Energy Efficiency (NMEEE) (2010-2015)

The National Mission for Enhanced Energy Efficiency (NMEE) is one of the missions of the National Action Plan on Climate Change. The Ministry of Power (MOP) and BEE were tasked to prepare the implementation plan for the National Mission on Enhanced Energy Efficiency (NMEEE). The scheme of the mission for building sector was to accelerate the shift to energy efficient appliances through innovative measures to make them available at affordable prices, create financial mechanisms to finance demand side management etc. Minimum Energy Performance standards for appliances and Energy efficiency performance standards for existing and new buildings as mandated by the ECBC code are now being implemented for new and existing buildings.

Mandate for Renewable Energy in Residential and Commercial Buildings

The Electricity Act, 2003, is another milestone in India's march towards attaining energy efficiency. The Act which was enacted to harmonise and rationalise provisions of existing laws and to reform legislation by "promotion of efficient and environmentally benign policies", mandates efficiency in generation, transmission and distribution. While giving emphasis to higher efficiency levels of generating plants, stringent measures against electricity theft, it stands to boost use of renewable and nonconventional energy sources in residential and commercial buildings. It marked a paradigm shift within the power sector towards a globally competitive model, with an emphasis on renewable power. The Act specifically included promotion and cogeneration of electricity from renewable sources of energy and setting of RPO targets.[26] With the enactment of the Electricity Act, renewable energy found more mention in national level policy instruments such as the National Electricity Policy (NEP), formulated in 2005. The NEP stipulated a progressive shift from conventional sources to renewable energy. Apart from the larger framework of the Electricity Act, policies targeting specific renewable energy sources such as wind, solar, biomass and mini-hydro are operational at both the central and state level.[27]

Conclusion

Despite various regulatory efforts made by the Indian legislature, the pace of change for energy efficiency appears to be very slow. Certain hindrances continue to hamper attainment of market transformation in energy efficiency. Since earlier times, lack of awareness of energy efficient techniques has surfaced the penetration of governmental schemes in this regard. But the effective use of mass media has to a great extent, expanded the reach of the governmental policy. However, these changes have been limited in their reach to urban and semi urban areas. Rural areas still struggle with energy conservation issues in the agrarian sectors due to the prevalence of inefficient practices partially driven by an unreliable power supply. Use of energy efficient initiatives in industrial sectors also stands hit by issues related to lack of awareness, but on a different plane. Energy efficient techniques in industrial, building and other commercial sectors require huge investments. Considering the need for financial back up to support effective implementation of energy efficient techniques, both central

26 The Electricity Act, 2003, No-36, Acts of Parliament, 2003 (India).

27 Renewable Energy in India: An Analysis of the Regulatory Environment and Evolving Policy Trends, Centre for Policy Research, *Available At* http://www.cprindia.org/research/papers/renewable-energy-india-analysis-regulatory-environment-and-evolving-policy-trends (Last accessed on 20/08/2017).

and state government schemes have been formulated in this regard. But it is a concern that information on these are not easily available to the beneficiaries. Further, there is an impending need for increased awareness to be created about the co-relation of climate change issues and its impact on the national economy and society with an emphasis on energy efficiency.

*****

Legal Framework of Energy Security And Sustainable Development In India- A Critical Analysis

*Chandralekha V. and Dr. TR Maruthi**

Introduction

The demand for energy is increasing and supply of energy is lagging behind. Most of the countries in the world face same problem due to onerous environmental regulations and the lack of instrument in renewable energy sector. Supply of clean and renewable energy is essential for the development nation. India being a developing country is in need of continuous supply of energy to its industries and transport sector. On the other hand, India has got its own obligation to protect environment. So shifting towards renewable energy is inevitable.

Meaning and Definition of Energy Security

The concept of energy security can be defined in different way depending on the availability of energy sources in their respective country. In most of the developing countries Hundreds of Million people suffer from chronic power shortage due to unreliable supply of electricity. From the point of such developing countries energy security means access to energy to supply basic needs like clean water, cooking, lighting and public transportation. In more developed parts of the world where human needs are more complex, energy security is more about reliability of supply, access to the energy resources, in sufficient amounts, supply interpretations[1]

The definition of energy security is complicated and multi-dimensional. It not only means or denotes energy self- sufficiency or energy independence, but it also pertains to the sources of energy, cost, reliability, sustainability, and scale of energy use of any country.

---

* Assistant Professor, SDM Law College, Mangalore; Assistant Professor and Research Guide, Dept. of Studies in Law, University of Mysore

1 Gal Left and Anne Korin, Energy Security Challenges for the 21st Century; A Reference Hand Book, 5 (2009).

The European Commission defines energy security in its Green Paper 2000, as the 'uninterrupted physical availability of energy products on the market at a price which is affordable for all consumers (Private and Industrial).[2]

The Centre for Global Partnership, Japan, defines energy security as maintaining necessary access to energy resources without risking the states survival now and in future.[3]

Thus, energy security is very wide term which covers many concerns and holistic views linking energy supply and economic growth.

Historical Evolution of Energy Security

The concept of energy security has evolved during the time of First and Second World War. The liberalisation of energy markets, establishment and conclusion of various international trade treaties, increased demand on the part of developing nation development of Nuclear energy etc led to the development of the concept of Energy Security. Most of the countries, including developing nations, tried to use modern energy sources. The development of industries and technology also demanded the constant supply of energy. Most of the nations were dependent on the oil which was in abundance and cheap too until the oil price shocks of 1970's when OPEC imposed restriction on production. This increased price situation acted as a threat to the energy security and so many countries come together and established International Energy Agency with the condition that all member countries should hold oil stocks for sharing in an oil supply emergency[4]. During world war II, there was sudden development in the field of Nuclear Energy. Nearly 25 or more countries had stated and generated electricity from the nuclear means. Oil has become main fuel for transport and replaced coal as industries primary energy sources with the development

2 European Commission Green Paper 2000, *Available at* https://ec.europa.eu/energy/en/publications/green-paper (Last accessed on 20/08/2017).

3 Stephen Hall, J Foxon & Ronan Bolton, The New Civic Energy Sector: Implications for ownership, governance and financing of low carbon energy infrastructure, *Available At* www.biee.org/wpcms/wp-content.(Last accessed on 22/08/2017).

4 Lt. Col Dhall and Vivek Dhall, India's Energy Security, 10 (1st ed 2013).

and expansion of oil pipelines and tanker infrastructure[5]. The development in producing natural gas has also led to availability of natural gas at lower prices and wider popularity of this particular primary energy source which accounts for almost a quarter of the world energy consumption.[6]

Problems of Energy Security in India

India's energy needs continue to increase but inadequate energy infrastructure and energy shortage resulted in energy poverty in India. To meet this situation, more and more clean energy should be produced and as a result, India is the fourth largest consumer of oil and petroleum in the world. Apart from this, India is largely depending on coal as a source of energy. To meet this shortage of gas, India relies on import of gas from neighbouring countries. There is rapid growth in demand for electricity, and its shortage result in the loss of overall development of a nation. No doubt India is the 3rd largest country to produce energy but unfortunately it is depending upon non-renewable energy sources.

Energy Access: The term Energy Access means providing modern energy service to everyone. In other words it also means ability to consume a minimum level of energy by all individuals. In India the majority of population is in rural area. Transmission of energy to such rural area is challenging to the central government. On the other hand, urban poor households need energy for lighting, cooking, and cooling or heating and also income generation in the informal sector where activities are often home based[7]. India is striving to meet energy needs while being cognizant about climate change by advocating sustainable energy alternatives fossil fuels, adopting ambitious targets for reducing green house gas emissions through climate change policy[8]

5 *Ibid* at 10.

6 *Ibid* at 10.

7 Economic and Social Commission for Asia and the Pacific, Energy security and Sustainable Development in Asia and the Pacific p 13 (United Nations ESCAP).

8 Andrew JA Postoli and William A Gough *India's Energy climate dilemma; The pursuit for Renewable energy guided by existing climate change policies*, Journal of Earth science and climatic change, *Available At* https://www.omicsonline.org/earth-science-climatic-change.php (Last accessed on 05/11/2017).

The government of India slowly shifting from non renewable to renewable sources of energy and various inventive and promotional schemes are introduced. Recently India adopted an energy security policy or contingency plans to fall back on in case of crisis. The three cornerstone of this integrated energy policies are energy access, energy security and climatic change[9]. The central government passed an Integrated Energy Policy with the view to meet the energy demands of house hold, medical, agricultural and Industry sector. This policy aims at increasing the production as well as transferring of energy made cost effective with due consideration to environmental protection. Thus, IEP aims at producing sustainable energy by using resources from India.

Sustainable Energy Policy in India

It means energy production or generated by the use of renewable energy sources like solar, wind, geothermal, hydropower etc. It is a form of energy that meets demand of energy without exhausting and without any harm to the environment. Sustainable energy are not just a part of renewable energy sources, they are also the sources of energy that can best be used to power homes and industries without any harmful effect being experienced[10]. The new renewable energy policy of India gives a new direction to develop supply options and increased exploitation of renewable energy sources.

In the light of energy challenges faced by the country and the global energy related developments; the national energy policy proposes to set out the National Energy objectives and the strategy to meet them[11]. There are four main objectives of India's energy policy

a) ***Energy access at affordable prices;*** Being a developing country India's attempt to provide access to energy for all at affordable price is utmost importance. The government of India yet to provide electricity to nearly 304 million people and clean cooking fuel to nearly 500 million people,

9 *India's Energy Security Challenges,* Institute for the Analysis of Global Security, *Available At* www.iag.org (Last accessed on 22/08/2017).

10 What is energy? *Available At* www.conserve-energy-future.com, (Last accessed on 22/08/2017.)

11 Draft National energy policy, NITI Aayog, Government of India, version as on 27-06-2017, *Available At* www.niti.gov.in (Last accessed on 22/08/2017).

who still depend on biomass[12]. The policy aims at supply of electricity and clean cooking fuel to all within a reasonable time.

b) ***Improved Energy Security and independence;*** India's Energy scenario is heavily dependent on fossil fuel imports, if the imports are threatened or disturbed, it undermine energy security of India. In order to reduce this diversification, import source is inevitable to India. An energy security can be enhanced either through increase in the domestic protection or through reducing the requirement of energy i.e energy efficiency.

c) ***Greater sustainability;*** due to catastrophic effect of climate change and degradation in local air quality, India's energy policy tend to adopt, renewable source of energy. The twin measures of energy efficiency and renewable energy may reduce India's dependence on the importance of commercial energy.

d) ***Economic Growth;*** Supply of clean and continuous energy is the life blood of economic growth of a country. Developments of Industries are dependent on uninterrupted supply of energy. The current Energy Policy supports rapid economic growth by supplying energy to the industries.

But achieving these objectives is difficult task because these objectives are in conflict each other. For instance ,achieving energy security and sustainable energy is difficult for India. In order to eradicate energy poverty, more energy should be generated. There is no country in the world which produces 100% renewable energy. Government of India can reduce the dependence on fossil fuel by adopting sustainable energy sources. But the cost involved in providing renewable energy is more than the price of energy produced out of fossil fuel or coal. By using sustainable energy, accessibility at affordable prices is not possible.

Ministry of New and Renewable Energy adopted several renewable power policies in relation to solar energy, wind energy, hydro electricity power etc. The benefits of renewable energy sources are breathtaking but Government of India is not in the position to fully switch over to the renewable sources because of uncertainty in generation of power with the help of these sources.[13] Herein, the drawbacks of different renewable energy sources are discussed.

12 *Ibid* at p.4.

13 *Conserve energy future; Available At* www.conserve-energy-future.com (Last accessed on 22/08/2017).

Drawbacks of Solar Energy

Ministry of New Renewable Energy (MNRE) of Govt. of India is taking following major steps to promote solar energy in India:[14]

- National solar mission is being implemented to give a boost to utilisation of solar energy for power generation with long term goal.
- Fiscal and financial inventions in the form of accelerated depreciation, concessional/ nil customs and exercise duties, preferential tariffs and generation based inventive are being provided to improve the viability of the solar power generation units. Capital subsidy is being provided for off-grid decentralised solar power generation system.

Solar energy has , however, number of adverse impact on the environment, some toxic materials, chemicals, solvents and alcohols are required in manufacturing photovoltaic cells[15] the waste materials from this process can have adverse impact on the environment.[16] Besides these, high initial costs of installing solar photovoltaic modules is another drawback of the system. However solar photovoltaic panels require virtually nothing to run and once installed provide energy for years and years together.[17] In India, poor people from rural area who are struggling to afford the price of electricity supplied out of conventional sources of energy, cannot think of investing money to install solar panels at the initial stage. Industries in India are investing huge amount of capital for other infrastructure than the solar energy because if the solar photovoltaic panels are installed to store the electricity, they are compelled to invest money on batteries and other devises to store the energy. Lack of space is another drawback of solar energy. For the purpose of installing solar panels, significant space with proper sunshine is required. Industries or households from urban areas are not able to get such space and so they are deprived from using solar energy.

14 Press Information Bureau, Govt. of India, Ministry of New and Renewable Energy *Available At* www.pib.nic.in.

15 Solar photovoltaic modules can connect solar energy in to electricity. A large number of these modules are arranged on a panel which is called solar panel which can either be directly connected to the energy – using device or indirectly to batteries so that the electricity generated could be used later when there is no sunshine.

16 Bala Bhaskar, Energy Security and Economic Development in India p. 148, 1st ed 2013).

17 D.K Asthana & Meera Asthana, Environment-Problems and Solutions, 100 (1st.ed 1998).

- Another major drawback of the solar photovoltaic system is the non-availability of adequate energy, efficient hardware required by the system.[18] For example invertors, batteries, lamps, electronic equipments, etc., thaat can work efficiently with solar energy are not developed or invented in India. Solar beams emanating from large solar power plants can kill birds and insects, thereby altering ecosystem. Any energy development has some impact on habitats and wildlife, and in the big picture, the threat of climate change poses a greater risk to entire species than renewable energy installations generally pose to individual birds.

Drawbacks of Wind Energy

Like all other energy sources, wind power has some drawbacks. Areas with the greatest wind power potential are often fully populated, and located far from energy thirsty cities[19]

After generating power, transmission cost is involved in order to store and supply the energy to the people. Sometimes the location with prime wind power and proper transmission lines are installed, in residential area but even though people support wind energy in general, they do not want turbines in their own neighbourhood.[20] The people are disturbed from the shadow of rotating wind turbine blades. The most serious environmental impact from wind energy may be its effect on bird and bird mortality.[21] So placement of wind turbines can be avoided if they conflict with bird's migration patterns or critical to birds' habitat.

The wind turbines are suited to the coastal regions which receive wind throughout the year to generate power.[22] Therefore, countries that do not have any coastal or hilly areas may not be able to take any advantage of wind power[23].

---

18 *Ibid* at 10.

19 G.Tyler Miller & Scoott Spoolman, Living in The Environment; Principles, Connections and Solutions, 420, (1st ed 2011).

20 Minnesota Higgins, Wind Energy, 52 (1st ed 2013).

21 Bala Bhaskar, *Supra note* 18

22 What is wind energy, *Available At* www.conserve-energy-future.com (Last accessed on 29/08/2017).

23 *Ibid.*

From a technical perspective, the fixed speed wind energy has some more drawbacks. Wind energy system may be fixed speed wind energy or variables speed wind energy. A fixed speed wind energy system is simpler and more cost effective. It is directly committed to the grid without the need of a full capacity power converter system. But the system has low power conversion efficiency. the power that can be captured by the wind turbines for a given wind speed varies with the rotational speed of the turbine[24] In order to capture maximum power, the wind turbine and generator must adjusted according to different speed of the wind and if it is distinct grid connection it is not possible to change frequently. This reduces the capacity of wind energy generation.

Drawbacks of Hydroelectricity Power

It was used since early days as one of the resources. Hydroelectricity Power was considered as most ecofriendly until ecologists found the draw backs. Hydropower is also not free from its potential negative effects upon environment. The biggest drawback is the construction of an impoundment of dam for storing water. The flood of water from these dams effect on ecosystem. This can displace people and wildlife and it also removes land from possible agricultural productivity.[25] When hydroelectric projects are constructed, ecological impacts occur on the fish and other organisms' dependant on the river.[26]

Drawbacks of Biomass Energy

There is no doubt that biomass energy could replace some fossil fuel that are used in generation of electricity. But the greater use of biomass adversely affects environment and may cause drought and thereby indirectly affects agricultural crop and human being. Biomass fuel is used in bulk and is very difficult to transport. Generating electricity from biomass make sense if fuel is used near

24 Bin Wu, Yongqang Lang, Navid Zargari & Samir Kouro, Power Conversion and Control of Wind Energy System, 177, (1st ed, 2011).

25 Stephan D. Butz, Energy and Agriculture; Sciences, Environment Solutions, 137 (1st ed, 2014).

26 R.N. Bhargava. V. Rajaram, Keith Olson & Lynn Tiede, Ecology and Environment, 38 (2012).

to where it is produced.[27] The biomass combustion devises used in rural areas are most traditional and inefficient which results in incomplete combustion, excessive production of Green House gases and negative impact on health of human beings. It can have a neutral or positive effect on the environment if they are managed in a sustainable fashion and the technologies used to convert them to energy, are efficient.[28]

Legal Framework of Renewable Energy in India

Indian Renewable Energy Development Agency Limited (IREDA) is established under the administrative control of Ministry of New and Renewable Energy (MNRE). It is a public limited government company in 1987 with the objective of promoting, developing and extending financial assistance for setting up projects relating to new and renewable sources of energy and energy efficiency/ conservation.[29] To meet the rural energy requirements, National Projects on Biogas Development (NPBD), the Integrated Rural Energy Programme (IREP), power generation through wind, small hydro, biomass, solar energy, etc are promoted. But India needs a comprehensive renewable energy law to meet the various requirements in connection with sustainable energy development. Legislation is necessary to frame a policy with a necessary regulatory mechanism to buy back the power generated by new and renewable source and deliver the energy to the end user.[30]Another aim is to bring down the cost of energy, especially from solar and other such renewable sources, through suitable research and development and enhanced manufacturing capacity.[31]

27 David T Hatchat, Energy Alternatives, 33 (2005).

28 Jane Carter Ingram, Fabrice Declerk & Cristina Rumbaities Del Rio, Integrating Ecology and Poverty Reduction: Ecological Dimention, 285 (2012).

29 Indian Renewable Energy Development Agency Limited (IREDA) *Available At* http://www.ireda.gov.in (Last accessed on 01/09/2017).

30 Muhammad Naseem, Energy Law in India, 39 (1st ed 2011).

31 *Ibid* at 39.

Energy Efficiency as A Method of Energy Conservation

It is commonly understood that efficient use of energy will reduce energy use and therefore emissions. But despite of significant increase in energy efficiency energy use in most sectors has continued to increase.[32] The Government of India Enacted Energy Conservation Act (EC Act) in 2001 which provides regulatory mandate for: standards & labelling of equipment and appliances; energy conservation building codes for commercial buildings; and energy consumption norms for energy intensive industries.[33] Bureau of Energy Efficiency (BEE), established as a statutory body under Energy Conservation Act, has initiated a number of energy efficiency initiatives in the areas of household lighting, commercial buildings, demand side management in agriculture/municipalities, SMEs and large industries including the initiation of the process for development of energy consumption norms for industrial sub sectors, capacity building of SDA's etc.[34] Adoption of energy efficient technology is one of the methods to reduce energy Consumption in many instances.

Energy efficiency method if used properly can be a best method of energy conservation. But the government policies discourage adoption of energy efficient technologies. For example: the energy efficiency of agricultural pump sets in India is extremely low, which coincides with policies that heavily subsidize electricity use for farmers.[35] The heavy subsidies on electricity prevented the farmers from replacement of their pump set in to energy efficient set.

32 Effect H Herring & S Sorrel, Energy Efficiency and Sustainable Consumption: The Rebound 11 (1st ed 2009).

33 Government of India, Ministry of Power, *Available At* http://powermin.nic.in/en/content/energy-efficiency (Last accessed on 05/11/2017).

34 *Ibid.*

35 Soma Bhattacharya and Maureen L. Cropper, *Options for Energy Efficiency in India and Barriers to Their Adoption: A Scoping Study*, *Available At* http://www.rff.org/files/sharepoint/WorkImages/Download (Last accessed on 03/09/2017).

Conclusion and Suggestions

Sustainable energy policies and energy efficient methods are two primary methods of achieving energy security and environmental protection. But anything available free of cost will never be conserved by the people. In India electricity prices are fixed and collected by the state government and to attract new industries state government will provide various incentives like free supply of electricity for infant industries etc. These incentives may not encourage them to adopt energy efficient machineries in their production system. So to achieve energy security through energy efficiency policy, following measures can be adopted.

1. Instead of supplying subsidized energy to the industries, the government should provide subsidies to purchase and install energy efficient machineries and technologies.
2. The government must encourage industries to adopt self-sufficient energy policy that is generating renewable energy by the industries. It is true that 100% energy required for an industry cannot be produced or generated through renewable sources. But government can provide subsidies to those industries which are generating sustainable energy and thereby reduced the consumption of non-renewable energy.
3. Instead of supplying subsidized or free electricity for the agriculture purpose, government can supply energy efficient pump sets or incentives to purchase such pump sets.
4. Encourage the development of energy efficient technologies and machineries, and also cost effective technologies to store and transmit energy produced through renewable energy source.
5. Educating the future citizens about the conservation of energy from their school level is one of important method of creating awareness about new policies.

Through adoption of these methods, India can achieve energy security, economic development and environment sustainability simultaneously. Renewable sources are sustainable, abundant and environment friendly. But there are challenges that hinder the sustainability of renewable energy sources towards climate change mitigation. They are highly dependent on weather and less efficient in comparison to the renewable source. It can never replace the non-renewable source of energy. Thus renewable energy sources are also not free from the drawbacks. To achieve energy security along with renewable energy source, energy efficiency is also a suitable method to the country like India. The Government of India adopted policies regarding sustainable energy as well as energy efficiency, but awareness relating to energy efficiencies are yet to be created. To achieve energy efficiency, suitable technological development is required in every field, which is lagging in India.

*****

Help – Replacing Nelp for Oil Exploration and Energy Security

*Pavithra R. and Sincy Wilson**

Introduction

Energy is a prime focus in our nation and receives wide importance in terms of environment and sustainable development. Oil, natural gas and its exploration occupies the central place for the purposes of ensuring energy security in the nation. The nation stands fifth in overall energy consumption, hence the existing resources prove insufficient to address the concerns of the large population where the ground reality is set that the LPG connection being provided for not more than thirty percent of the nation's population. Initially, through the Oilfield Act, 1948 there was a centralized monopoly in the petroleum exploration and production activities making it viable only for the government owned company to participate in the exploration through nomination basis. However through rapid liberalization and the Hydrocarbon Mission, 2025 to achieve a prescribed target, to explore unconventional oil and gas resources, to encourage technology transfer and to attract major oil companies both at national and international level, there was a need for change in the policy. Currently, India is a rapidly growing market for energy sector. However, with the New Exploration Licensing Policy, 1999 ('NELP') there were not many bids and investments that were brought about to the country. Having concerns, a new policy replacing the old policy was brought about by the Ministry of Petroleum and Natural Gas and was titled as Hydrocarbon Exploration Licensing Policy, 2017 ('HELP'). The new policy is supposed to place wide discretion in the hands of explorers and the production industry ,which in turn is an attempt to cure the defects of NELP. With the government taking fresh approach and progressive route, the new policy HELP, companies are given the power to choose their interested and attractive areas to exploration and the Government would further tender

* Assistant Professors, School of Law, Christ University, Bengaluru.

bids on the same area proposed by the companies, hence making companies the proactive agents of the entire process. Given such scenario, the investors are given an option to make informed decisions which is a further point of attraction to the investors. Though, the new policy tries to attract more investments, it has its own drawbacks. Hence, the researchers of this paper would focus on the lacunas of HELP in particular to preferences being given to companies and with respect to the issue of investment from countries worldwide and marking its step in the new era.

Legal Framework Governing Oil Exploration

Oil and gas have been in constant demand from the times of its monopoly till the coming up of HELP. For the demands to be fulfilled at the right time in oil and natural gas supply, there primarily involves actions including the upstream, midstream and downstream activities. It is through the upstream activities, that the nation achieves proper oil exploration and thereby assigns the licenses for exploration. For such exploration and for further accessibility of oil fields, legislative action plays a critical role in the upbringing and stabilising of the industry, thereby constantly monitoring the same. From the legislative perspective in India, the law making power with respect to oilfields, natural gas, mineral oil resources, petroleum and petroleum products and liquids and substances that are declared by Parliament to be dangerously inflammable are provided exclusively to the Central Government in accordance to Entry 53 of List 1 of Schedule VII to the Constitution of India. In order to tap the domestic potential and to reduce the import level in this particular field, Parliament has passed different laws and the policies are still evolving to compete with the global market. The primary legislations that were brought for regulation of oil and natural gas include The Petroleum Act of 1934 and The Petroleum and Natural Gas Rules of 1959 whereas numerous rules and regulations were brought including the Oilfields (Regulation and Development) Act of 1948, NELP and the recent HELP.

The Petroleum Act, 1934

The Act came into operation from the year 1934 and is one of the pre-constitutional legislation that still governs wide range of petroleum related activities such as the import into India, transfers within, storage, production, refining and blending petroleum. It was this legislation that consolidated and codified the earlier wide spread rules and thereby became umbrella legislation for the whole of India. This Act plays in regulation of activities in relation to petroleum and petroleum products. Further, the Act has placed a wide priority in dealing with midstream activities with the rules framed under this Act provides framework for grant of exploration licenses and mining leases. Since all the petroleum products that the Act seeks to regulate are being listed as essential commodity under the Essential Commodities Act, 1955, the Petroleum Act has laid a clear prohibition to all mining activities that could be carried out without obtaining a valid license from the Central Government.

Oilfields (Regulation and Development) Act, 1948

The Act that came later in this field was the Oilfields Act of 1948 which formed the basic statute for licensing and leasing of petroleum and gas blocks by the Central Government.[1] This Act was specifically enforced to deal with upstream activities and to empower the Central Government to draft rules and regulations for the development of mineral oil resources. The Act also provided for certain other aspects including the qualifications for the applicants, the place where applications are to be submitted and the authorised person who would scrutinize the applications in order to provide mining lease. The terms that would be added to the license when being granted, the maximum time period for lease can be made also formed an integral part of the Act. Further, the Oilfields Act prescribed that royalties in respect of petroleum and natural gas are to be paid by the holder of a mining lease. In addition, there was a clear guideline where it was laid that the Union Government may exempt petroleum or natural gas produced from offshore areas from any royalty under the circumstances that are prescribed for such exemption. This exemption thereby allowed the Union Government to encourage exploration in these less accessible frontiers.

1 The Oilfields (Regulation and Development) Act, 1948, Sec. 53.

Petroleum and Natural Gas regulatory Board Act, 2006

The Regulatory Act of 2006 primarily aimed at the setting up of the regulatory board with main function to be to regulate the refining, processing, storage, transportation. It is to ensure that there is proper distribution, marketing and sale of petroleum products and natural gas excluding production of crude oil and natural gas so as to protect the interest of consumers and entities engaged in specific activities. Moreover, it became essentially important to ensure that such petroleum products and natural gas are ensured to have an uninterrupted and adequate supply of these products in all parts of the country and to promote competitive markets and for matters connected therewith. This Act also provides for a legal framework for downstream gas sector regulation and development of natural gas pipelines and city and local gas distribution networks. In order to achieve the main objectives of the Act, the Regulatory Board had been conferred with certain powers as well, such as adjudication of disputes between entities engaged in activities set out in the Act and to conduct inquiry in to such entities.[2] The idea behind conferring these entities with such functions and powers were to protect the interests of the consumers and entities engaged in the specified activities relating to these products and to ensure proper supply throughout the country and to engender competition. Further, the Board is also having power to fix tariff in the gas market. Hence, the legislators had taken a proactive role in establishing a proper oil base in India through a sanctioned legislative action that would impact on the larger public.

New Exploration Licencing Policy- A Guideline

With economic liberalization in the year 1991, thrive for economic independence in varied sectors grew in India. Being a nation that was dependent on imports to a large extent on other countries for petroleum, crude oil and other natural resources, there was an immense need to bring about a supportive policy framework to increase exploration and production of the same by India and their companies. The Governments around the world look for companies who can

2 The Petroleum and Natural Gas regulatory Board Act, 2006, Sec.12.

invest and the companies fear due to high risk profile involved in the business of oil exploration.[3] Hence, there came an immense need to bring harmonize the risks and the requirement of capital investments, through regulations and policies. It was during this time that the Government of India formulated a policy called New Exploration Licensing Policy in 1997[4] in addition to the laws, rules and regulations that already had existed. The NELP ended the monopoly that was attached to Oil and Natural Gas Corporation of India thereby letting the private players in the show and brought in an objective to attracted more companies to invest in technologies, exploration and production of oil and gas.[5]

Aiming to provide equal footing to both the Indian and foreign companies, the licences under the policy are granted by rounds of open international competitive bidding. These rounds of bidding ended in production sharing contracts. With the open international competitive bidding, it was preferred to award only blocks and licences for the blocks are to be awarded to all the players equally on the competitive bidding basis and not on the basis of nomination. Hence, an equal footing and freedom was ensured in terms of both fiscal and contract terms in the marketing of oil and natural gas in India. The policy allowed hundred percent foreign direct investments to be made in the petroleum sector and let the companies acquire the petroleum licensing without the interference of government. From 1999 to 2010, tenders offered through NELP announced nine rounds of bidding and had successfully offered two hundred and fifty exploration blocks.[6]

NELP was appreciated for the efforts taken to maintain the transparent and level playing field among the participating investors. A new bid evaluation system was introduced which had four effective criteria to be followed. The criterion included the technical capability of the bidder, their financial capacity, the work scheme offered, fiscal package including the royalties and the tax returns to the

3 Silvana Tardo, *Fiscal Systems of Hydrocarbons*, World Bank Working Paper (2014)

4 The New Hydrocarbon Exploration Policy.

5 *Ibid.*

6 Mohammed Azhar, *New Exploration Policy in India* Opec Energy Review (June 2011) *Available At* http://onlinelibrary.wiley.com/wol1/doi/10.1111/j.1753-0237.2011.00187.x/full, (Last accessed on 05/09/2017).

nation.[7] Further, on successful bidding, the investors are allowed to amortize the bidding and exploration costs when they start the actual production activities.[8] Moreover, the investors are given seven years tax holiday along with varied tax incentives thereby encouraging the international players to enter the India Petroleum Sector.[9] However, these have been amended and improved from time to time to make it clear and transparent. Thus the new policy resulted in attracting substantial investment in exploration activities for oil and gas and also a substantial discovery of oil and gas in the blocks awarded under various rounds of NELP. After nine rounds of NELP, in and around 2009, due to global crisis, the government and policy makers considered yet another promising policy called the Open Acreage Licensing Policy ("OALP"). However, there were procedural complexes in obtaining permission and no proper facilitation for the same has been assured to the investors. Further, NELP and sharing contracts therein had possibilities of it being misused to seek extensions and to cause delays. Understanding the inherent complexities of NELP, the government brought in HELP to remedy the defects.

Hydrocarbon Exploration Licencing Policy- A Path Breaker

The Union Cabinet, chaired by the Prime Minister Mr. Narendra Modi approved the Hydrocarbon Exploration and Licensing Policy in March, 2016. HELP replaced the then existing policy regime titled NELP which, which governed the exploration and production of oil and natural gas. This object of HELP is to enhance domestic oil and gas production, attract substantial investment, generate considerable employment, enhancing transparency and to scale down administrative discretion. HELP comprehends four main facets.

1. Uniform license for exploration and production of all forms of hydrocarbon.

7 Economic Survey of Budget *Available At* http://indiabudget.nic.in/es2008-09/chapt2009/chap95.pdf (Last accessed on 07/09/2017).

8 Report on Union Performance Civil Hydrocarbon Production and Sharing Contracts *Available At* http://www.cag.gov.in/sites/default/files/audit_report_files/Union_Performance_Civil_Hydrocarbon_Production_Sharing_Contracts_Ministry_of_Petroleum_19_2011_chapter_1.pdf (Last accessed on 07/09/2017).

9 *Supra 6.*

2. An open acreage policy.
3. Easy to administer revenue sharing model.
4. Marketing and pricing freedom for the crude oil and natural gas produced.[10]

HELP has put into effect a new uniform licensing system which will felicitate the contractor to explore both unconventional and conventional oil and gas resources by acquiring a single license. The new policy by providing for uniform licensing system covers all hydrocarbons such as oil, gas, coal, methane etc., under a single licensing framework, while the old exploration policy requires separate and individual licenses for each type of hydrocarbon. For instance, while exploring for a particular type of hydrocarbon, a different one is found, then it requires a separate license under the old policy.[11] So the new uniform licensing policy by sorting this out will lure more contractors and explorers to make investments.

The OALP is introduced under HELP and will capacitate the Exploration and Production companies to choose the block for exploration from the designated areas. OALP hands the option to choose the exploration blocks for exploring hydrocarbons to the exploration and production companies. This takes away the procedure, which makes the companies wait for the formal bid round to be conducted by the government. Under OALP the bidder who intends to explore hydrocarbons shall apply to the government entreating for the exploration of any new block. However, this will not be applicable in case of blocks already covered for exploration. When such an application is received, the government shall examine the expression of interest and justification. If the government finds the application suitable it can call for competitive bids after obtaining environmental and other required clearances. The biggest benefit of OALP over NELP is that under OALP is that the potential investors shall not wait for cyclic bidding rounds instead the oil and gas acreages will be available

10 Hydrocarbon Exploration Licensing Policy *Available At* http://pib.nic.in/newsite/PrintRelease.aspx?relid=137638 (Last accessed on 08/09/2017).

11 Directorate General of Hydrocarbons, India's New Hydrocarbon Exploration Licensing Policy- A Prelude *Available At* http://dghindia.gov.in/assets/downloads/58be45eab40a4Presentation_on_HELP_-_DG,_DGH_India_06.03_.17_.pdf (Last accessed on 08/09/2017).

all-round the year. Revenue Sharing Contract ('RSC') is a term used in the Hydrocarbon industry and it refers to an agreement between Government and contractor.[12] This model of agreement obliges the contractor to bear all risks of exploration, development and production cost for which in return he is entitled to a stipulated share of revenue arising from his efforts. RSC is a fiscal regime that exists in hydrocarbons exploration and production. These contracts are based on a sharing method called 'biddable revenue sharing'.[13] Under this method the bidders are required to quote in their bids the amount of revenue share and this will be a deciding parameter for choosing the winning bid.

HELP opts for RSCs to determine the share of revenue between the government and the contractors. Earlier the contracts were based on profit sharing method in which the profit is to be shared between the government and the contractor after recovery of cost. Under the old methodology it makes it mandatory for the government to scrutinize the details of cost of private participants which paved way for disputes and delays, while under the current regime the government have not to concern about cost incurred and still will receive a share of the gross revenue acquired from the sale of gas, oil etc. This method of revenue sharing under the new policy regime reduces the burden of government as it has to audit only the production and the revenue earned by the company.[14] Under the new regime, the government need not micromanage which puts minimum regulatory burden on the government which falls in line with the government's policy of 'ease of doing business'. Further by this new revenue sharing method there will be tremendous reduction in administrative discretion.

HELP further grants marketing and pricing freedom for new gas production from High Pressure- High Temperature Areas, Deepwater and Ultra Deepwater while subjecting it to a ceiling in the price limit. There are several imperfections in the gas market in India. Having regard to the imperfections in gas markets

12 Ministry of Petroleum and National Gas, *Resolution Available At* http://petroleum.nic.in/sites/default/files/HELP.pdf (Last accessed on 09/09/2017).

13 *Ibid.*

14 Sarah Ladislaw, *India's Hydrocarbon Exploration and Licensing Policy (HELP): Will it Help India's Upstream Oil and Gas?* (Centre for Strategic and International Studies) *Available At* https://www.csis.org/analysis/indias-hydrocarbon-exploration-and-licensing-policy (Last accessed on 10/09/2017).

in India and in order to protect the consuming sector's interest a ceiling based on landed cost of the alternate fuels has been imposed. The lowest of the fuel oil import landed price shall be the Ceiling price. The ceiling under the policy shall be calculated once in six months. This policy while safeguarding the revenue of the Government, has fixed that the profit share of the government will be calculated based on the higher of current international crude price or actual price.[15]

Therefore, HELP has been a real path breaker as it has effectuated practices and rules which are very much relevant to the current hydrocarbon extraction industry. It is an initiative to modernize the oil and gas exploration policy. HELP is expected to boost the oil and gas exploration activities in India thereby reducing import dependence. It has provided the contractors with an option to choose new blocks for exploration. The new policy has eased up licensing procedure by introducing Uniform Licensing system and it will embolden the contractors to explore both conventional as well as unconventional sources of hydrocarbons vide a single license. Further, the new policy safeguards government's revenue share by introducing an easy to administer revenue sharing model. The shifting of the revenue sharing model is based on the policy of 'minimum government maximum governance' and will expedite '*ease of doing business*.' The new model of revenue sharing will bring immediate revenue to government on production which is in contrast to the NELP model where in the Government receives its share of profit only after contractors claim their cost incurred. HELP leaves less room for disputes, corruption and delays caused to complex administrative procedures thereby reducing litigations and arbitrations which in-turn will boost investments and production. This in-turn will lead to increase in employment opportunities. The interests of consuming sector are also taken into account as the policy fixes a ceiling for the price limit. While taking into account the interests of all stakeholders, HELP has effectuated current hydrocarbon industry oriented policies and procedures.

15 The Oxford Institute for Energy Studies, *India's Upstream Revival- HELP or Hurdle?* (Nov. 2016) *Available At* https://www.oxfordenergy.org/wpcms/wp-content/uploads/2016/11/Indias-Upstream-Revival-HELP-or-Hurdle.pdf (Last accessed on 09/09/2017).

Conclusion

India is the third largest consumer of oil and petroleum products in the world, out of which gas and oil contributes to thirty four percent of consumption. The NELP policy introduced in 1997 was aimed at ending the dominance of the state in oil and gas exploration and to creating a competitive environment by liberalization of the industry. However, the policy failed to keep up the momentum of growth in production and it also did not attract foreign investment. In 2016, the dependence of India on import of crude oil from foreign nations rose to eighty percent. Hence, to make amends to this and boost up the growth HELP was introduced and aimed to attract major global investors to strengthen the industry both technologically and financially. The government have introduced this policy with a vision to create 'Energy Security' for India and to reduce by ten percent, the imports of oil by 2022. The new policy that was created has a provision to link the available data with the National Data Repository where all the data would be stored for the purposes of accession for the companies thereby further liberalizing and encouraging the web-access. The web-access in both online and offline mode ensures that the nation is in tune with the acclaimed digitalization. With reduced burden in terms of administration and regulatory set-up, nation is also in accordance with the improvement for ease of doing business. Through HELP, promotion of investor friendly environment is ensured thereby abiding minimum government and maximum governance. In addition, with HELP, there would not be micromanaging by the government, hence would result in ensuring sustainability and efficiency by attracting investors both onshore and offshore. HELP is right step taken by the government and it is certainly in the right direction but the only issue surrounding the new policy is the question whether the policy has been implemented at the opportune time as the global crude oil prices are plunging down to all-time lows. Further, the ease in increasing or reducing the production of unconventional resources of energy have led to a change in the outlook of the capital investment in the global level and the situation in India is no different. However, HELP as a single licensing framework is expected to reduce the pressure and cost of compliance to regulations. Nonetheless, the actual success of HELP and increased productivity in the oil and gas exploration industry remains to be a hope and hypothesis. Hence, the actual success depends on implementation and effective streamlining of the new policy for a best outcome.

*****

Achieving Energy Security Through Development of Nuclear Energy

*Ritesh R.**

Introduction of Power Sector in India:

Perhaps the most challenging task humanity has in its front is providing energy for the humanity particularly for the developing countries where there is a large scale growth potential and at the same time maintain balance in the environment, mitigating any possibility of climate change. And this is now accepted by entire community of India, be it politicians, scientists, environmentalists and citizens. Prediction of scientists is that the impact of climate change will be worse on India. Advancing the deployment of thorium (the fuel which is most abundantly available in India) based reactors might be the most effective step towards curtailing carbon emissions.

The total installed electrical capacity of India (utilities) was just over 329 gigawatts (GW) as of June, 2017. Of this, 220 GW (67 %) constituted thermal power such as coal, gas and diesel. India is thus highly reliant on fossil fuels to meet its energy demands[1]. Hydroelectric power too contributes a significant percentage with a total installed capacity of just over 44 GW. The total installed capacity of grid-interactive renewable power—which consists of wind, solar, biomass and small hydro is just under 57 GW. The installed capacity of nuclear power is 6.78 GW, a mere 2.1% of the total capacity.

Globally India is the world's third largest producer & fourth largest consumer of electricity. In April, 2017, In an attempt to provide a clear view of the governments overall policy roadmap, the apex government think tank, Niti Aayog presented a three year action agenda, recommending ambitious targets to various ministries and departments to be achieved during the period 2017-18 to 2019-2020. One of the key issue that the report emphasizes is nuclear

---

* Manager, Bharat Heavy Electricals Limited, Bengaluru.

1 *Available At* http://powermin.nic.in/en/content/power-sector-glance-all-india as on 23-10-2017.

energy. 'India is betting on nuclear energy' it states. In order to meet the targets of 63GW of nuclear capacity by 2032 Niti Aayog states that the segment must achieve a capacity addition of 2.8GW by 2019[2].Although India is the fourth largest energy consumer in the world, behind only the US, China and Russia, it continues to remain energy-poor[3].

At the same time, India's total carbon emissions are on the rise, with an estimated 2.3 billion tonnes in 2014, or an increase of 7.8 percent over 2013 levels.[4] Averaged over the last decade, emissions from fossil fuels and industry account for 91% of human-caused CO_2 emissions, with 9% coming from land use change. Of the 9.9bn tonnes of carbon in the form of CO_2 emitted from fossil fuels in 2016, 41% came from coal, 34% from oil, 19% from gas, 5.6% from cement production and 0.7% from flaring. In contrast, emissions are rising across the developing world. India, which contributes 6.3% of global emissions, saw its emissions rise by 5.2% in 2016. Since 1990, India's GHG emissions have risen by nearly 200 percent.

On 2 October 2016, India ratified the Paris Agreement. In India's Intended Nationally Determined Contributions (INDCs), the Indian government said it would reduce carbon emissions relative to its GDP by 33% to 35% from 2005 levels by 2030 and increase clean energy capacity to 40 percent of the total installed capacity by 2030. Nuclear energy with its massive potential will have to play a key role in the country's future sustainable energy mix[5].

2 Target 2020 of NITI Aayog draws up a three-year action agenda available at *Available At* https://powerline.net.in/2017/05/19/niti-aayog-draws-up-a-three-year-action-agenda/ May 2017 (Last Accessed on 27/08/2017).

3 India's per capita electricity consumption, computed as the ratio of the estimated total electricity consumption during the year to the estimated mid-year population of that year, stood at just over 1,075 kilowatt hours (kWh) in 2015-16. In comparison, developed countries average is around 15,000 kWh and world average is around 2800kwh. China has a per capita consumption of around 4,000 kWh.

4 Trends In Global Co2 Emissions 2015 Report, p.4.

5 When looking at sustainable electricity resources, we commonly identify four: solar, wind, hydro and biomass. Each of them is renewable, but that doesn't necessarily make them sustainable. Sustainability is determined by different parameters like environmental sustainability and economic sustainability. Sustainable energy is a form of energy that meet our today's demand of energy without putting them in danger of getting expired or depleted and can be used over and over again.

NDCs and Human Development Index:

International climate targets as it suggests countries are on track to meet their national commitments under the Paris Agreement (dashed line in the graph below (Fig. 1)). But as the blue line shows, emissions reductions will need to pick up momentum everywhere to meet the goal of limiting warming to the internationally agreed goal of staying "well below" 2°C above pre-industrial levels.

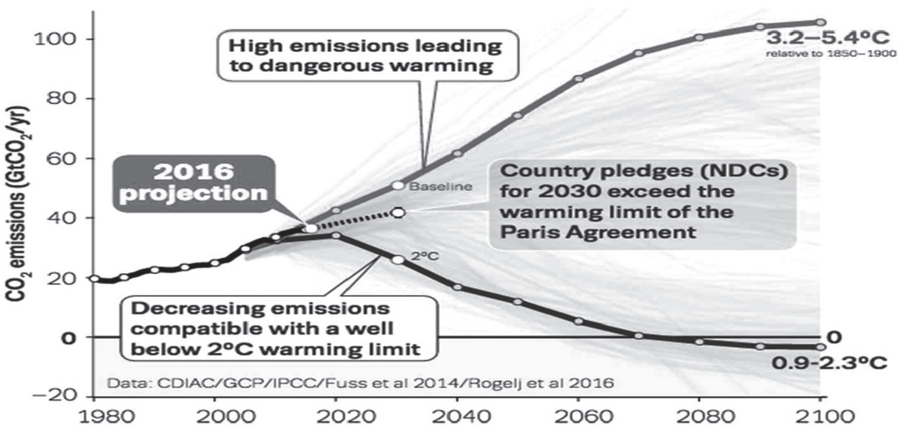

FIG 1: National Commitments under the Paris Agreement

Global CO_2 emissions since 1980 (solid black) and country pledges under the Paris Agreement (dashed) compared to a high emissions scenario (orange) and a scenario compatible with limiting warming to 2°C above pre-industrial levels (blue).

If the world pursues the Paris Agreement's more ambitious limit of 1.5°C, the timescales over which global emissions need to peak and start falling rapidly are much shorter. At the end of 2016, total global emissions since the start of the industrial era has a total of 565bn tonnes of carbon – or 92% of the carbon budget for 1.5°C.

The graphical representation shown in Fig.2 is the relationship between per capita primary power consumption and human development indices for

181 countries. Data on the human development indices are from the UN HDRO and per capita primary energy consumption are from the US Energy Information Administration [6].

Improvement in macro-economic indicators as an expected result of increased installed capacity. Expected increase in Per-Capita Electricity Consumption, leading to increase in:

- Human Development Index
- Gross Development Product
- Life Expectancy at Birth

The aspiration of growing population in India is to have better quality of life, and to have better quality of life it would require more energy. The solution for energy sustainability comes from primary energy sources. Primary energy sources are divided into following two types 1) Intermittent & Distributed 2) Concentrated and Continuous.

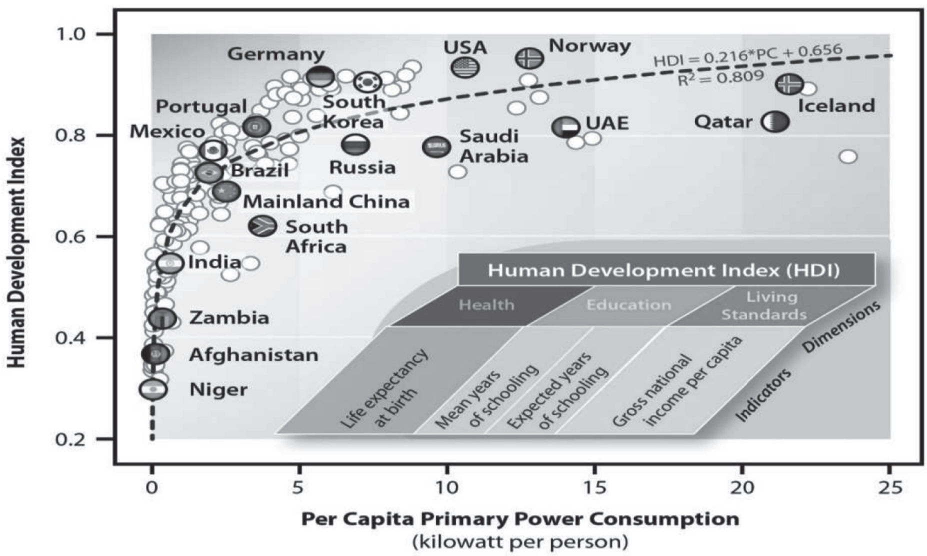

FIG. 2: Relationship between per capita primary power consumption and human development indices

6 The figure concept is based on a figure by Martinez and Ebenhack and the inset is based on a figure from the Human Development Report Office (HDRO) of the United Nations (UN).

Intermittent & Distributed Sources of Energy:

A clean energy future is on top of every country's sustainability agenda today, which is evidenced by the large-scale expansion of sustainable power projects worldwide. European nations, for example, seem to be in a race to outdo one another in their renewable energy accomplishments[7].

One concept over the last few months that seems to have become more prevalent is the idea of base load power. When the wind isn't blowing and the sun isn't shining, renewables like solar and wind aren't producing electricity. What happens during that time when we need energy? We need something more reliable, something that produces electricity all the time and that we can rely on. Base load power can be provided by reliable sources such as nuclear and coal fire power plants. Traditionally, base load is often covered by so-called "base load power plants", like nuclear or coal power plants. These plants are characterized by high capital costs and low variable costs and, as such, prefer running at a constant output.

Wind power is currently the cheapest source of renewable energy, but presents the challenge of dealing with the intermittency of wind speed. Both solar power and wind power require a large area to produce a significant amounts of energy. As space is limited in many industrial countries, this could become a limit to its use close to the consumption. There remain large amount of unused space available far away from where most of the population live, but building wind or solar power installations at such locations require large investment in transmission system.

7 In 2015, Denmark generated 140 percent of its electricity requirements on one particularly windy day from wind turbines alone, the excess of which was exported to Germany, Norway and Sweden. And last May, Germany came remarkably close to being completely run by clean energy for a day due to a surge in wind and solar power. That same month, Portugal was powered solely by renewable sources for 107 hours, which is roughly four-and-a-half days, setting the bar higher. But the Central American nation of Costa Rica beat all the European countries with its landmark achievement in green energy in 2016. For more than 250 days last year, the country used zero fossil fuels and drew its electricity from hydropower plants, wind turbines and geothermal plants. *Available At* www.theguardian.com/environment/2016/may/18/portugal-runs-for-four-days-straight-on-renewable-energy-alone.

A 1,000-MW wind farm would require approximately 260 to 360 square miles, accounting for a range of capacity factors (32-47 percent). The land needed for solar power to produce the same amount of electricity in a year is between 45 to 75 square miles accounting for a capacity factor of around 17 to 28%. A 1,000-MW nuclear power plant would require approximately 1 square miles, accounting for a range of capacity factor of around 90%.

Solar and wind sector needs better power storage, grid infrastructure and government support to meet the growth predictions and to be sustainable. The main is grid infrastructure, which was built to carry fairly consistent levels of generation and will struggle to cope with the variability of solar and wind energy. Nearly 600 million Indians do not have access to electricity grid. Ours is a country of 600,000 villages and 1/3rd of which does not have access to grid. Government policy allows 100% FDI (foreign direct investment) in all these segments.

Concentrated & Continuous Sources of Energy:

The huge potential of the atom had been envisioned in India in the ancient times and references to the same can be found in some of the ancient scriptures[8]. Such references provide us a tantalizing glimpse into the ancient Indian history and, indeed, into the level of advanced thinking that these civilizations had reached in those times. In the modern times, it was Dr. Homi Bhabha[9], who foresaw, as early as in 1944, the potential of harnessing nuclear power in improving the quality of life of the millions of people stated: "Any substantial rise in the standard of living in this region – that can be sustained in the long term – will only be possible on the basis of very large imports of fuel or on the basis of atomic energy." The issues of energy sustainability and inevitability of nuclear power, which are only now receiving global attention, was foreseen by him over half a century ago. When the rest of the world was working on the military applications of atomic energy, he focused on harnessing atomic energy

8 Ancient scriptures Vaisesika treatises source: Crises in Modern Thought: The Crises of Reason - By Swami Kriyananda (J. Donald Walters) Vol. 1 p – 95.

9 Details Related To Homi Jehangir Bhabha *Available At* nuclearweaponarchive.org/India/Bhabha.html (Last Accessed on 27/08/2017).

for the improving the quality of life. In the 1950s, nuclear power in the world was still in its infancy and India had just gained independence. The nascent near future [10]. Energy system planning and development involves the effective utilization of energy resources and technologies for meeting energy demand in a nation was essential a rural economy, with practically no technology or industrial base. Therefore, realizing such a technology-intensive vision, which involved complex reactor and fuel cycle technologies must have seemed like a fantasy. However, with his clear vision, Dr Bhabha went ahead, building institutions – R&D facilities, research reactors, industrial units – to develop technologies and to deploy them.

The atomic energy commission envisages a target of 500GW of nuclear energy generation by 2060[11]. Dr. Chidambaram[12], former Chairman, AEC said "India is the only developing country that has demonstrated its capability to design, build, operate and maintain nuclear power plants, manufacture all associated equipment and components, and produce the required nuclear fuel and special materials." Indeed India can claim to have experience in construction, operation and maintenance of varied range of nuclear power plants. India has accumulated vast experience in operating pressurized heavy water reactor (PHWR), India's first prototype fast breeder reactor is going to be ready for synchronization in sustainable manner. Integrated energy systems comprise multiple energy carriers and energy distribution networks. The planning of

---

10 India Nearing Completion of 500 MW Commercial Fast Breeder Reactor *Available At* https://www.nextbigfuture.com/2017/07/india-nearing-completion-of-500-mw-commercial-fast-breeder-reactor.html, July 3, 2017, (Last accessed on 28/08/2017).

11 Beyond 2052 the growth of the installed capacity will continue to rapidly reach at least 50% of total electricity supply, and thereafter at a moderate rate. Thorium will be brought in FBRs and molten salt reactors (MSRs) as necessary to support the growth. The high temperature reactors (HTRs) will be added to progressively enhance the contribution of hydrogen to meet the need arising from deficiency of fluid fossil fuels. IAEA Nuclear Energy Series Publications, Nuclear Energy Development In The 21st Century: Global Scenarios And Regional Trends p.69.

12 Dr. R. Chidambaram is one of India's distinguished experimental physicists and he has made outstanding contributions to many aspects of basic science and nuclear technology. He received his Ph.D. degree from the Indian Institute of Science, Bangalore in 1962 and joined the Bhabha Atomic Research Centre in 1962 and became its Director in 1990. He was Chairman, Indian Atomic Energy Commission from 1993-2000. He was Chairperson of the Board of Governors of the International Atomic Energy Agency (IAEA) during 1994-95. He was a member of the Commission of Eminent Persons appointed by IAEA in 2008 to prepare a report on the 'Role of the IAEA to 2020 and beyond'.

such a system is a complex process of evaluating the use of competing energy carriers to meet energy demand under economic, environmental and energy network and security constraints.

NUCLEAR POWER GENERATION IN INDIA:

India has consciously proceeded to explore the possibility of tapping nuclear energy for the purpose of power generation and the Atomic Energy Act, 1962 was framed and implemented with the set objectives of using two naturally occurring elements Uranium and Thorium having good potential to be utilized as nuclear fuel in Indian Nuclear Power Reactors. The estimated natural deposits of these elements in India [13] are:

- Natural Uranium deposits - ~70,000 tonnes
- Thorium deposits - ~ 3,60,000 tonnes

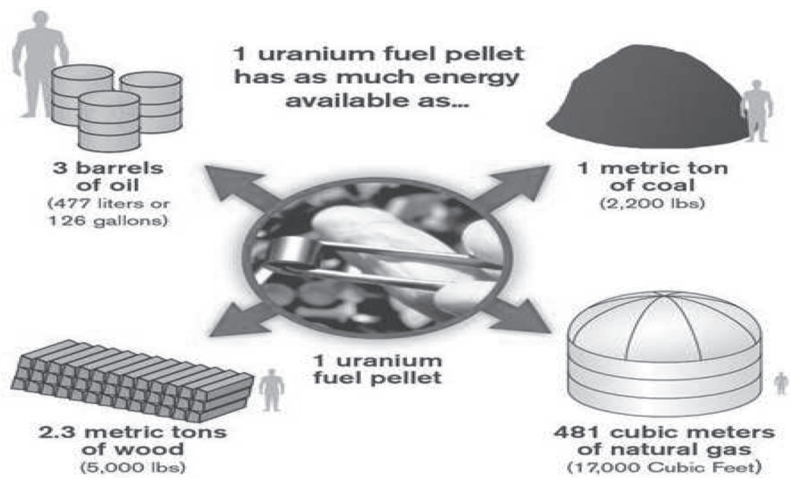

FIG.3: Uranium in comparison with coal, Crude oil, Natural Gas & Wood

Figure 3 shows the Energy Equivalents Fuels have different energy content. Some sources produce the same amount of electricity from less fuel. One uranium fuel pellet(approximately 7 grams), about the size of the tip of your little finger, has the equivalent energy potential of 481 cubic meters of natural gas, 2,200

13 Strategy for Nuclear Energy, *Available At* http://www.barc.gov.in/about/anushakti_sne.html.

pounds of coal, or 477 liters of oil or 2.3 metric tons of wood. Less uranium is required to produce electricity than other fuel sources[14].

Abundance of Nuclear Fuel in India:

The capabilities for providing the technology resources for India's nuclear Programme have been mainly derived from India's strong R & D Programme, in the 15-year old Fast Breeder Test Reactor (FBTR) at Kalpakkam, the performance of the unique and indigenously developed mixed Uranium-Plutonium Carbide fuel has been extremely good and so far it has reached a maximum burn-up of 53,830 MWd/t without any fuel failure. Preparations for the commencement of construction of a 500 MWe Prototype Fast Breeder Reactor (PFBR) is underway. The U-233 fuelled Kamini research reactor is also being operated successfully. A closed fuel cycle is also important for the safe management of the environment as it brings down the quantity of high level wastes to very low levels.

The XII plan [2012-17] proposals envisage start of work on eight indigenous[15] 700M we pressurised heavy water reactors (PHWRS), two 500 MW fast breeder reactors (FBRS), one 300 mw advanced heavy water reactor (AHWR) and eight light water reactors of 1000 mw or higher capacity with foreign technical cooperation. India has a flourishing and largely indigenous nuclear power program and expects to have 20 GWe nuclear capacity on line by 2020 and 63 GWe by 2032. Meanwhile it's important to note that with the betterment of three stage programme[16] and with the nuclear research interested government, the amount of nuclear fuel reserves may increase rapidly. And nuclear capacity additions will also scale up eradicating the danger of nuclear proliferation and spent fuel storage. The following discussion is on different kinds of reactors namely:

14 Nuclear Fuel Processes, Report By Center For Nuclear Science And Technology Information By American Nuclear Society *Available At* http://www.ans.org/pi/usafestival/docs/Table4_V3.pdf, (Last Accessed on 28/8/27).

15 "Development of Nuclear Energy based on a closed fuel cycle enabling fuller use of Uranium & Thorium is the only way to meet the development aspirations of over a billion people while meeting the low emission norms."

16 Kalpakkam has the unique distinction of being the only place in the world, where all the three fissile isotopes viz., U-235 [MAPS], Pu-239 [FBTR] & U-233 [KAMINI] are used as fuel in reactors.

STAGE 1 » Pressurized Heavy Water Reactor

STAGE 2 » Fast Breeder Reactor

STAGE 3 » Breeder Reactor

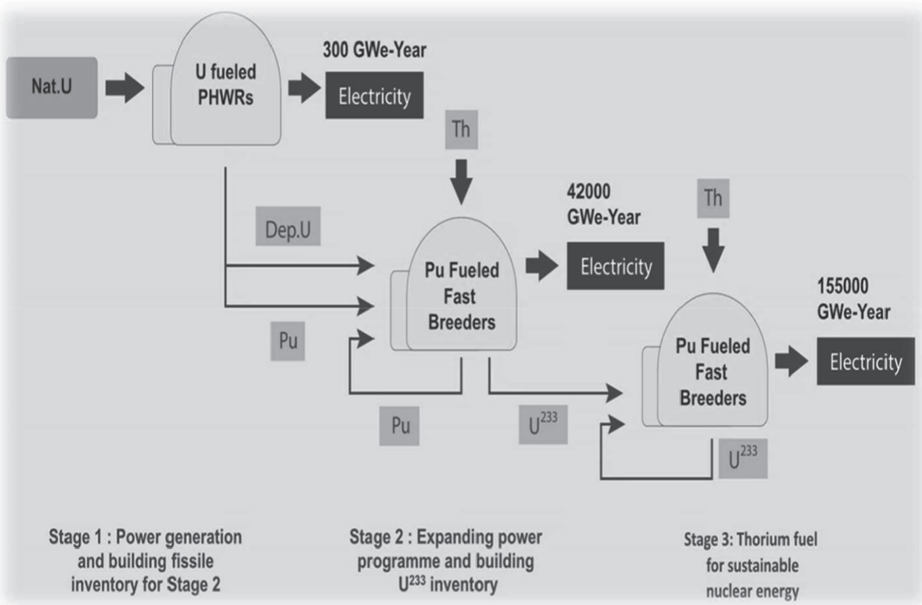

FIG.4: Three Stage Nuclear Program

Stage 1» Pressurized Heavy Water Reactor Using

- Natural UO_2 as fuel matrix
- Heavy water as moderator and coolant
- Natural U isotopic composition is 0.7 % fissile U-235 and the rest is U-238.

The first two plants were of boiling water reactors based on imported technology. Subsequent plants are of PHWR type through indigenous R&D efforts. India achieved complete self- reliance in this technology and this stage of the Programme is in the industrial domain.

The future plan includes Setting up of VVER type plants based on Russian Technology is under progress to augment power generation and MOX fuel

(Mixed oxide) is developed and introduced at Tarapur to conserve fuel and to develop new fuel technology [17].

REPROCESSING OF SPENT FUEL:

"Open cycle" refers to disposal of the entire waste after subjecting to proper waste treatment. This Results in huge underutilization of the energy potential of Uranium (~ 2 % is exploited) (Fig.5)

FIG.5: Open Fuel Cycle

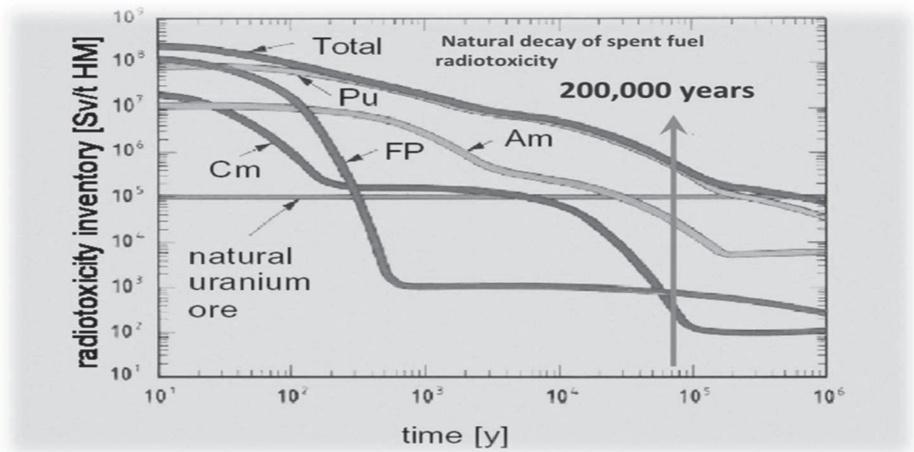

FIG.6: Radiotoxicity of spent fuel in open fuel cycle

Nuclear waste of very high radioactive life is generated with open cycle. Radiotoxicity [18] is plotted as a function of time in figure 6. The natural level of radiotoxicity of natural uranium which is indicated by a green horizontal line.

17 Nuclear India, Department of Atomic Energy Government of India Vol. 34/NO. 5-6/Nov-Dec 2000.

18 To be able to deal with issues of spent fuel or transmutation of radioactive waste, it is imperative to know which radioactive nuclides are produced and how radiotoxic they are. It is also necessary to know which radioactive nuclides need to be removed in order to considerably reduce radiotoxicity in short term (up to 400 years), medium term (up to 20 000 years) and long term (up to 300 000 years) storage.

The total radiation level of spent fuel from open fuel cycle comes down to the natural level only after 200,000 years.

"Closed cycle" refers to chemical separation of U-238 and Pu-239 and further recycled while the other radioactive fission products were separated, sorted out according to their half-lives & activity and appropriately disposed off with minimum environmental disturbance (Figure 7).

- Both the options are in practice.
- India should go ahead with closed cycle mode in view of its phased expansion of nuclear power generation extending through the second and third stages.

Indigenous technology for the reprocessing of the spent fuel as well as waste management programme has been developed by India through its own comprehensive R&D efforts and reprocessing plants were set up and are in operation thereby attaining self - reliance in this domain.

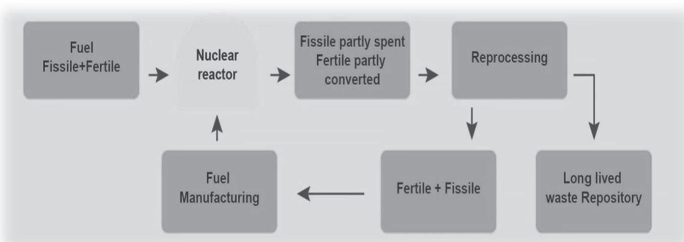

FIG.7: Closed Fuel Cycle

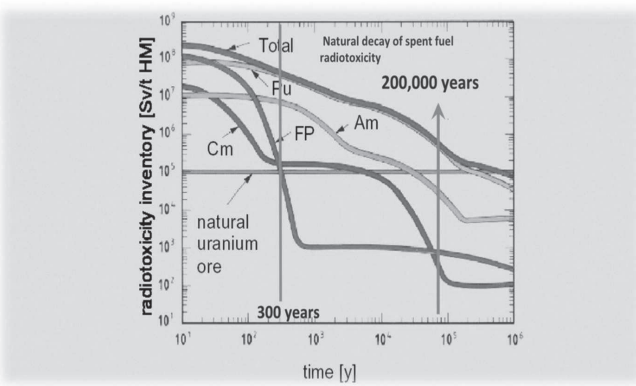

FIG.8: Radiotoxicity of spent fuel in closed fuel cycle

Closed fuel cycle handles yet another a major issue i.e. nuclear waste (Figure 7). If you take out Plutonium, Amnesium, Currium and burn them out in another reactor. The closed cycle reactor not only provides you more of energy supplied but will also takes care of waste. The total radiation level of spent fuel from closed fuel cycle comes down to natural level after 300 years (Figure 8). As of today, France, Russia, Japan, India and China reprocess most of their spent fuel, while the USA, Canada, Finland and Sweden have currently opted for direct disposal [19].

Opting for a closed nuclear fuel cycle, a significant fraction of the energy output could come from the materials recycled from reprocessing. From Indian stand-point, under given limited resources of natural Uranium, this option is not only superior but also an inevitable one. Closed fuel cycle with Plutonium (Pu) recovery on a 'reprocess to recycle mode' can lead to a viable, safe and eco-friendly reprocessing and waste management strategy. Development of flow-sheets for co-processing of Pu together with Uranium (U), without their individual separation by Purex process for conversion to MOX in integrated facilities, appears attractive. Advancements in reactor research have spawned several new alternatives for the better utilization of Pu and U. These systems are yet to be perfected prior to commercial exploitation and public acceptability. Meanwhile, the available fissile inventory can be redeployed on an interim basis in the existing reactor systems which can lead to an enhanced energy profile. The emerging reactor concepts such as the AHWR, which integrates both U/Pu and Th/U233 fuel cycles can yield valuable information and can lead India closer to its ultimate goal, ie. The Th-U233 fuel cycle. From environmental safety considerations, the separation of long-lived isotopes and minor actinides (MA) from reprocessing high level waste would enhance the acceptability of reprocessing and recycle option. However, the advanced fuel cycles with such recycling of uranium and transuranium elements call for additional sophisticated fuel cycle activities which are yet to be mastered. Any strategy for sustained nuclear power generation that involves recycling of reprocessed U and Pu will have to face these challenges.

19 In February, 2006 the USA announced a Global Nuclear Energy Partnership, which includes the development of advanced recycling technologies for use in the USA.

The principal reason for reprocessing used fuel has been to recover unused plutonium[20], along with less immediately useful unused uranium, in the used fuel elements and thereby close the fuel cycle, gaining some 25% to 30% more energy from the original uranium in the process. This contributes to national energy security. A secondary reason is to reduce the volume of material to be disposed of as high-level waste to about one-fifth. In addition, the level of radioactivity in the waste from reprocessing is much smaller and after about 100 years falls much more rapidly than in used fuel itself.

Stage 2 » Fast Breeder Reactor

India's second stage of nuclear power generation envisages the use of Pu-239 obtained from the first stage reactor operation, as the fuel core in fast breeder reactors (FBR).

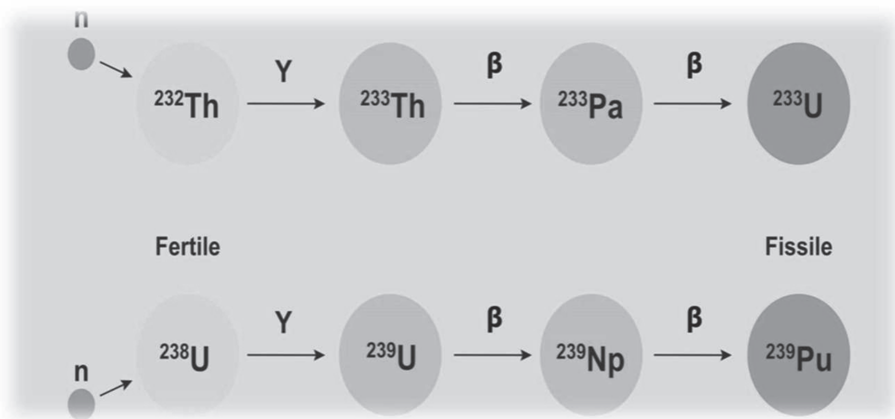

Fig 9: Conversion from fertile to fissile material

- Pu-239 serves as the main fissile element in the FBR.A blanket of U-238 surrounding the fuel core will undergo nuclear transmutation to produce fresh Pu-239 as more and more Pu-239 is consumed during the operation.
- Besides a blanket of Th-232 around the FBR core also undergoes neutron

20 A significant amount of plutonium recovered from used fuel is currently recycled into MOX fuel; a small amount of recovered uranium is recycled so far. Processing of Used Nuclear Fuel, (Updated November 2016) *Available At* http://www.world-nuclear.org (Last Accessed on 27/8/2017).

capture reactions leading to the formation of U-233. U-233 is the nuclear reactor fuel for the third stage of India's Nuclear Power Programme.

- It is technically feasible to produce sustained energy output of 420 GWe from FBR.Setting up Pu-239 fuelled fast Breeder Reactor of 500 MWe power generation is in advanced stage of completion.

India plans to commission its first fast breeder reactor (FBR) by the end of this year at Kalpakkam in the southern state of Tamil Nadu. India's Prototype Fast Breed Reactor will produce 500MW of power. India would be the second country worldwide to have a commercial reactor currently produce power through a fast-breeder reactor. Russia owns the other commercially run FBR, the Beloyarsk Nuclear Plant. Countries such as the US, France, and Japan have also experimented with fast breeder technology programmes. France had a commercial fast breeder (Superphenix reactor) from 1985 to 1998. This novel nuclear reactor is a kind of an 'akshaya patra', the mythical goblet with a never-ending supply of food. China is more than a decade behind India in trying to master this complex beast

Experts say to make nuclear energy sustainable, one sure shot way is to make fast-breeder reactors mainstream. Yukiya Amano, Director General of International Atomic Energy Agency (IAEA), Vienna, says "fast reactors can help extract up to 70 per cent more energy than traditional reactors and are safer than traditional reactors while reducing long lived radioactive waste by several fold."

India has been running an experimental facility called a Fast-Breeder Test Reactor (FBTR) now for 27 years. This is a small nuclear reactor a forerunner for the monster that India has constructed at Kalpakkam called the Prototype Fast Breeder Reactor (PFBR). This will generate electricity commercially using the fast breeder route. M Chudakov, now with the IAEA and well-known Russian fast breeder expert, calls "these reactors a bridge to the future as they can supply an almost unlimited supply of electricity". All eyes are now on southern India where another global nuclear milestone is likely to be crossed this year. Arun Kumar Bhaduri, Director of the Indira Gandhi Centre for Atomic Research(IGCAR), Kalpakkam says, "fast breeder reactors are far safer than the current generation of nuclear plants and that all efforts are being made to kick start within this year India's first commercial fast breeder reactor at Kalpakkam[21]"

Electricity generated by FBR would be a source of green energy as the waste from the first stage nuclear programme is reprocessed and used as fuel in FBR. The spent fuel from this reactor can be fed back into the reactor core several times, till the spent fuel contains only shortlived fission products. This is the concept of FBR with closed fuel cycle. Hence, there is no need of large quantity of fuel materials for the annual external feed and thus eliminates the need for large capacity waste storage spaces with complex construction features

India's fast breeder reactor is even more unique as within it the country also deploys special rods of thorium which when they get exposed to or irradiated by fast neutrons they generate U-233 and a normally thorium turns into a valuable atomic material. It is well known that India is very energy hungry and as economic growth takes place mega quantities of electricity will be required. Unfortunately, nature has not been bountiful on India as the Indian land mass is not endowed with enough uranium but on the other hand the country has the world's second largest store of thorium. Today the country in a well thought out strategy is mastering fast breeder reactors that can be an effective via media for utilizing the vast thorium reserves.

With the PFBR, India is pioneering a kind of nuclear technology that could potentially be the country's greatest renewable energy source. That's a big step, especially since nuclear fission remains the only kind of nuclear reaction we've managed to sustain, though efforts to make nuclear fusion viable are still in the works.

Stage 3*»A Solution to Nuclear Waste and Stockpiles of Plutonium*

Breeder Reactor

The third phase of India's Nuclear Power Generation programme is, breeder reactors using U-233 fuel. India's vast thorium deposits permit design and operation of U-233 fuelled breeder reactors.

21 Nuclear reactor at Kalpakkam: World's envy, India's pride *Available At* economictimes. indiatimes.com (Last Accessed on 2/7/2017).

- U-233 is obtained from the nuclear transmutation[22] of Th-232 used as a blanket in the second phase Pu-239 fuelled FBR.
- Besides, U-233 fuelled breeder reactors will have a Th-232 blanket around the U-233 reactor core which will generate more U-233 as the reactor goes operational thus resulting in the production of more and more U-233 fuel from the Th-232 blanket as more of the U-233 in the fuel core is consumed helping to sustain the long term power generation fuel requirement.
- These U-233/Th-232 based breeder reactors are under development and would serve as the mainstay of the final thorium utilization stage of the Indian nuclear programme. The currently known Indian thorium reserves amount to 358,000 GWe-yr of electrical energy and can easily meet the energy requirements during the next century and beyond.

KAMINI (Kalpakkam Mini reactor) is a research reactor at Indira Gandhi Center for Atomic research in Kalpakkam, India. It achieved criticality on October 29, 1996. Designed and built jointly by the Bhabha Atomic Research Centre (BARC) and Indira Gandhi Centre for Atomic Research (IGCAR) it produces 30 KW of thermal energy at full power. KAMINI is cooled and moderated by light water, and fueled with uranium-233 metal produced by the thorium fuel cycle harnessed by the neighboring FBTR reactor. It is the world's only thorium-based experimental reactor, as of 2006. KAMINI was the first reactor in the world designed specifically to use uranium-233 fuel. Use of the large thorium reserves to produce nuclear fuel is a key strategy of India's nuclear energy program.

Thorium, from which U-233 is bred, is roughly three to four times more abundant in the earth's crust than uranium. The radioisotope bismuth-213 is a decay product of uranium-233; it has promise for the treatment of certain types of cancer, including acute myeloid leukemia and cancers of the pancreas, kidneys and other organs.

---

22 Transmutation, conversion of one chemical element into another. A transmutation entails a change in the structure of atomic nuclei and hence may be induced by a nuclear reaction, such as neutron capture, or occur spontaneously by radioactive decay, such as alpha decay and beta decay. Uranium-235 absorbs a neutron becomes Uranium-236 which is very unstable and quickly breaks down into Strontium and Xeon. This is one of several possible fission reacts, all Uranium fission uses U-235 to create U-236, however the products are not always the same.

AHWR has alternate fuel options, given it has diverse fuel cycles. It can do closed types and once-through types of fuel cycles. The overall aspect of the AHWR is primed for high burn up with thorium-based fuel. Recycled thorium that is recovered from the reactor is then sent back, and plutonium is stored to be later used for a fast breeder reactor. The fuel for AHWR would be manufactured by advanced fuel fabrication facility, which is under the direction of BARC Tarapur. AFFF is currently working on PFBR fuel rod production.AFFF has been associated with fuel rod fabrication for other research purposes in the past.AFFF is the only nuclear fuel production facility in the world which has dealt with Uranium, plutonium and thorium.

Indian Government announced in 2013 it would build an AHWR of 300 MW with its location to be decided. As of 2017, the design is in the final stages of validation. One of the essential elements of the Indian strategy is to enhance the fuel utilization using a closed fuel cycle. This entails reprocessing of the spent fuel to recover fissile and fertile materials and its recycle back into the system[23]. The AWHR is an innovation in renewable energy safety as it will limit the use of fissile uranium-235 to breeding fissile uranium-233 from fertile thorium-232. The extraction of nuclear energy from the 90th element Thorium[24] is said to have more energy than the world's oil, coal, and uranium combined. The AHWR has safety features that distinguish it from conventional light water nuclear reactors. Some of these features consist of: strong safety systems, reduction of heat from core through a built in cooling system, multiple shutdown systems, and a fail-safe procedure that consist of a poison that shuts down the system in the case of a technical failure (FBR). The potential threat scientists try to avoid in reactors is the buildup of heat because nuclear energy escalates when it reacts with, high temperatures, high pressures, and chemical reactions.

Threat of climate change and importance of sustainable development has brought nuclear power in sharper focus in recent times. Growth of nuclear

23 Design and development of the AHWR—the Indian thorium fuelled innovative nuclear reactor R.K. Sinha, A. Kakodkar Nuclear Engineering and Design 236 (2006) 683–700.

24 Anantharaman, K., Kamath, H.S., Majumdar, S., Ramanujam, A., Venkatramani, M., 2000. Thorium Based Fuel Reprocessing & Refabrication Technologies and Strategies, INSAC-2000, Mumbai, 1–2 June.

power worldwide, however, requires satisfactory technological response to challenges of very high level of safety and security assurance, ability to perform with lower level of technological infrastructure as it prevails in several developing countries, high degree of fuel use efficiency and superior waste disposal options. Development of Advanced Heavy Water Reactor, AHWR300-LEU, is an effort to realize these futuristic objectives through innovative configuration of present day technologies.

Using Liquid Fuel in Molten Salt Reactors:

A molten salt reactor (MSR) is a type of nuclear reactor that uses liquid fuel instead of the solid fuel rods used in conventional nuclear reactors. Using liquid fuel provides many advantages in safety and simplicity of design.

Conventional reactors use solid ceramic fuel rods containing enriched uranium. The fission of uranium in the fuel rod releases gases, such as xenon, which causes the fuel rods to crack. This cracking, in turn, makes it necessary to remove and replace the fuel rods well before most of the actinides (elements that remain radioactive for thousands of years) such as uranium have fissioned. This is why nuclear waste is radioactive for a very long time. However, the actinides that remain in the cracked fuel rods is still an excellent source of fuel for reactors. France, for example, recycles the waste instead of burying it so that these actinides can be placed in new fuel rods and used to make more electricity.

Because Molten Salt Reactors (MSRs) use liquid fuel, the release of gases simply bubbles up, typically to an off-gas unit in the coolant loop where it can be removed. Since the liquid fuel is unaffected by the releases of gas, the fuel can be left in the reactor until almost all the actinides are fissioned, leaving only elements that are radioactive for a relatively short time (300 years or less). The result is that MSRs have no long-term issue with regard to nuclear waste.

Not only do MSRs not have a long-term waste issue, they can be used to dispose of current stockpiles of nuclear waste by using those stockpiles as fuel. Even stockpiles of plutonium can be disposed of this way. In fact, conventional reactors typically use only 3-to-5% of the available energy in their fuel rods before the fuel rods must be replaced because of cracking. MSRs can use up most of the rest of the available fuel in these rods to make electricity.

Conclusion

The Indian experience with operation of nuclear power plants (NPP) has been quite successful and incident-free. This has been partly due to the technology used as well as the strict control over NPP operations, primarily as a result of such operations being strictly in the public domain with the operating personnel being trained under a strict regime.

Unlike uranium, thorium alone cannot be directly used as nuclear fuel in a reactor. Utilization of Thorium with either uranium or plutonium, without going through the second stage of Fast Breeder Reactors, to build sufficient inventory of plutonium first, will be counter-productive by limiting thorium utilization to a very small fraction of the total available resources in the country. Utilization of Thorium in the third stage makes it available as a sustainable energy resource for centuries. Thorium offers not only a sustainable energy resource, but also excellent fuel performance characteristic in a reactor, better than Uranium with respect to lower inventory of long lived nuclear waste. With more trust on thorium use, certainly India can have sustainable energy for centuries with the amount of thorium reserves it processes.

With India's abundance in thorium, its Advanced Heavy Water Reactors (AWHR) would use low enriched uranium (LEU) to convert thorium into uranium for energy production. The use of low enriched uranium in these reactors is an important advantage because it carries a much lower risk for proliferation than HEU. This strengthens India's non-proliferation credentials and aligns India with the global movement away from HEU, in accordance with the recent 2016 Nuclear Security Summit [25.]

25 The Nuclear Security Summit 2016 will continue to provide a forum for leaders to engage with each other and reinforce our commitment at the highest levels to securing nuclear materials. *Available At* www.nss2016.org (Last Accessed on 27/08/2017).

India today is recognized as a country with advanced nuclear technologies. Comprehensive indigenous capabilities have been developed in all aspects of nuclear power and associated fuel cycles. It has a large R&D base, qualified human resource and facilities for continual development of human resource, industrial capability and capacity as well as robust regulatory framework. The performance of Indian nuclear power stations and implementation of projects have been comparable to international benchmarks. India should join hands and cooperate with few countries in order to make mutually beneficial advances in MSR technology although in India, a few technologies for several complex in-core operations have been developed and deployed successfully. With the available industry base, engineering base and R&D base India will be a country which can produce sustainable power by using fissile materials, in particular thorium.

The bill was the last hurdle for the government in opening up India's nuclear power industry to private investors in the USA, and proposed that financial liability for foreign suppliers. Bill includes supplier liability in addition to the operator liability. India's liability regime is currently unique in that it also holds suppliers accountable. All the provisions of this bill should benefit the one who has suffered from the accidents and there should be responsibilities fixed with respect to each operations of nuclear establishments.

The Land Acquisition (Amendment) Act, 2009 called for a mandatory social impact assessment (SIA) study in case of large-scale "physical displacements" in the process of land acquisition. The act ensured the eligibility of tribals, forest-dwellers and persons having tenancy rights under the relevant state laws. Mandatory impact assessments of all kinds for all types of power plant should happen irrespective of the project being renewables or Non-renewables. Proper compensation should be given to those who sacrifice land for the construction of power plants.

*****

The Need for Harnessing Nature Through Tidal and Geo Thermal Energy in India

*Srividya R. Sastry**

Introduction

India is the second largest populated country in the world and fourth largest consumer of energy[1] in the world. The country's needs presently are mainly satisfied by the conventional, non-renewable sources of energy such as coal, petroleum and natural gases. The usage of these resources have shown to have caused environmental degradation by generating greenhouse gases, have altered the biodiversity and has led to extinction of many ecosystems around the world. With the prediction that these resources will get extinguished in about 40 years and India's ambitious target to reduce greenhouse gas emissions , it is imperative to look at how the country shall achieve its objective to produce 175GW energy through renewable sources by 2022[2] and fulfil the growing demand of the energy in industrial and domestic sector which are mainly met by non-renewable sources of energy.

India luckily has an abundant variety of renewable resources which are readily available at its disposal. Solar radiations, wind, tides, waves, geothermal are the various forms of renewable sources of energy available in India. The renewable energy sector in India has mainly suffered because of high costs, limited availability of sites and nonexistence of policies for the regulation of this sector. Even though it is seen that the country has made progress in the solar energy and wind energy sectors to some extent, it is seen that this progress is not at all sufficient to achieve its objective by 2022 and has to look the others form as early as possible.

* Asst. Professor of Law, Keshav Memorial College of Law, Hyderabad.

1 *Available At* http://www.thehindubusinessline.com/economy/india-is-fourth-largest-energy-consumer-in-the-world-report/article4525172.ece (Last Accessed on 28/08/2017).

2 Press Information Bureau Government of India Ministry of New and Renewable Energy *Available At* http://pib.nic.in/newsite/PrintRelease.aspx?relid=155612. (Last Accessed on 27/08/2017).

For the first time after a decade, states in the country recorded a fall in the energy disparity among states to 2% and energy surplus-ness up to 2.6 % in the year 2016-2017[3]. Yet it is predicted that few states may still face energy deficiency because of non-availability of energy for small durations and non-accessibility of electricity to remote places in various states. The renewable energy sector in India is capable of supplementing the present and future energy security issues, at the same time addressing the country's environmental. Renewable energy sector in India a great potential and has made considerable progress especially in solar and wind energy. Presently India is mainly concentrating solar and wind energy but it is important for the country to look at the other forms such as tidal and geothermal energy at the earliest. This sector in India being in its punitive form requires proper attention to promote the technology and policies which shall help in managing future energy needs.

Renewable Energy Policy Framework in India

The importance of renewable energy in transition to a sustainable energy base was recognised as early as 1970s. This commitment to renewable energy led to the establishment of Department of Non-Conventional Energy Sources in 1982 which further was upgraded as the Ministry of Non-Conventional Energy Sources renamed as the Ministry of New and Renewable Energy (MNRE) in 2006. The Ministry of New and Renewable Energy is the nodal Ministry of the Government of India at the national level for the matters relating to renewable energy. The ministry is responsible for implementation of wide range of programmes like harnessing renewable energy, usage of renewable energy in domestic and industrial applications, research and development of the renewable energy technologies[4].

The Electricity Act, 2003 along with National Electricity policy recognised the importance of renewable energy sector in India. It has assigned responsibilities to the State Electricity Regulatory Commissions (SERCs) to set up tariffs for

3 *Available At* http://economictimes.indiatimes.com/industry/energy/power/power-deficit-disparity-among-indian-states/articleshow/52790487.cms (Last Accessed on 27/08/2017).

4 Lakshmi Priya Vinjamuri & Amal. V. Narasimhan, Imperative For Renewable Energy Sources –An Insight Into The Regulatory and Policy Framework, IPCBEE Vol.21 (2011).

renewable energy based electricity generation. It has also been mandated to set quotas for renewable energy as a percentage of total consumption of electricity in the area of distribution licensee. The National Tariff Policy notified by the Ministry of Power in continuation with the EA 03 and the National Electricity Policy also emphasizes the importance of setting renewable energy quotas and preferential tariffs for renewable energy procurement by the respective SERCs.

An Overview of Tidal and Geo Thermal Energy

Tidal Energy:

Our earth is covered 2/3rd by water bodies and they form a source of energy in the form tides, waves, marine current and thermal gradient. The usage of tidal power has a long history it can be traced back to Roman Empire who built the tide mills and which later became a feature to be found on the North Atlantic coast, particularly in France and Canada[5]. Tidal movements are generated from the gravitational and centrifugal forces between the earth, moon and sun. This results in regular rise and fall of the surface of the ocean[6]. From this movement Tidal energy is harnessed. There are only four countries around the world which have made the use of this technology. The first tidal energy project built was La Rance Tidal Plant in France as early as 1966 followed by South Korea, Canada, China and Russia.

Features of Tidal Energy:

1. Renewable Source of Energy and Clean Technology: Since this form of energy is generated using the tidal movements of water there is no harmful effect on environmental by the generation green house gases.
2. Predictable: Our country is well equipped with the weather detective technology and hence, will be able predict the variations in the tides.
3. Long Lasting Technology: The technology used to generate tidal energy has proved to last for a long time with little maintenance compared to other renewable energy technology. e.g La Rance Project.

---

5 Eugene D. Coyle et al, Harnessing Nature: Wind, Hydro, Wave, Tidal, and Geothermal Energy, Purdue University Press. (2014), pg nos 91-124, (102.)

6 *Supra note 6.*

4. Effective at Low Speeds: Since the density of water is much denser than wind the energy can be used even when the tides are a very low speed.
5. Development in areas around the coastal areas by boosting tourism and creation of jobs.

Tidal Energy in India

India having a 7500 km long coastal line[7] has a great potential in tapping this source of energy. The following sites are considered for the project;

1. In the west: Coast Gulf of Kambhat and Gulf of Kutch
2. In the east Coast: the Ganges Delta in the Sunderbans in West Bengal.

The tidal energy project in India is currently limited but is considered to fuel economic growth, reduce carbon foot print and create jobs. Thus, making it important to understand the features of tidal energy

Policy Framework

To carryout tidal energy projects in India there doesn't exist any framework within which it can be carried out. It is high time India would formulate a policy for the commencement and development of this technology

Below are few suggestions that could be incorporated in the policy would be the following:

a. Proper guidelines relating exploration and utilization of this technology.
b. Guidelines as to the kind of agencies, academia and governmental authorities to be involved in the tidal energy project.
c. Need for encouraging collaboration of industry with the small and micro industries since most of them are spin off of the educational institutions.
d. There is requirement to formulate a finance mechanism in order to fund these projects especially to carry out research in the area.

7 Rakhee Iyer, Tidal Energy In India -7500 Km Coastline, Hidden Potential, March 29, 2017. *Available At* http://www.marketexpress.in/2017/03/tidal-energy-in-india-7500-km-coastline-hidden-potential.html (Last Accessed on 28/8/2017).

e. Should aim to attract investments through provision of tax rewards, feed in tariffs which would make costly, precommercial installations more attractive. Provision for risk management and reduction in insurance risks would also reduce overall project costs.
f. To spread awareness and conduct capacity building programmes.
g. Regulation of marine activities since they are usually involved in traditional marine activities which tend to be critical of the impact of the new technology. Thus, if any licensing procedure is to be adopted it should be in a position to take these concerns into account.
h. Further, it should aim at integrating economic and societal concerns. The policy must be able address the environmental impact of these technologies like habitat preservation, water management and maintaining quality of the basin in order to enhance the environment around the basin.

Geothermal Energy

Several countries have established geo-thermal electric power projects, they are; USA, Philippines, Indonesia, Mexico and New Zealand. It was first used as early as 20th century, the electric power generation in Prince

Piero Ginori Conti in 1904; geothermal steam at Larderello, Tuscany in 1913; and the first large scale municipal district heating service in Iceland in 1930.

The word Geo thermal originates from the Greek words Geo meaning 'Earth' and Thermos meaning 'heat'. Thus, geothermal energy is the energy that is stored in the form of heat in the earth. The inner core of the earth reaches a maximum temperature of 4000^{o}C. Usually, the heat is transferred from depth to sub-surface regions mainly through the solid submarine and land surface mainly by conduction occasionally by active convective currents of geothermal fluids such as molten magma or heated water. The water gets heated through contact with hot rocks, and accumulates in aquifers. These aquifers form the essential parts of most geothermal fields. The geothermal heat flow is generally not noticeable; this is because the rocks temperature increases with depth upto 30^{o}C/Km. Geothermal energy can be commercially exploited if it is within 5km at fluxes of 10-20W/m^{2}.[8]

8 *Supra 6,* at Pg 115.

Managing supply and demand:

Geothermal means of generation of electricity is preferable in area close to the point of generation, not more than 30 kilometres. This form of energy can be utilised to meet the demand in cold climates, domestic or industrial colonies or districts.

Establishing cost:

It is seen that the cost of establishing a geothermal unit is very less compared to other forms of generation of electricity. The problem acquiring land and establishing a generating unit does not existing since it is extracted from the surface of the land. The only cost that is required to be borne would be for the identification and drilling of the geothermal site for the extraction of heat for generating electricity.

Environmental impact:

Geothermal energy is considered to be reliable. The main drawback of extraction of the energy is it effects the land stability due to the removal of hot water from the ground but this problem can be addressed by re-injection of the output water flow into the area. Even though the geothermal units generate carbon dioxide it is very minimal compared to conventional sources of energy.

Geothermal Energy in India

India has reasonably good potential for geothermal. The Ministry of New and Renewable Energy is targeting for deployment of Geo-thermal capacity of 1000 MW_{th} in the initial phase till 2022.[9]

Currently in India these places have been indentified:

- Puga Valley (J&K)
- Tatapani (Chhattisgarh)

9 *Available At* Government of India Ministry of New & Renewable Energy, http://mnre.gov.in/mnre-2010/new-technologies/geothermal/ (Last Accessed on 28/8/2017).

- Godavari Basin Manikaran (Himachal Pradesh)
- Bakreshwar (West Bengal)
- Cambay Graben (Gujarat)
- Surajkund in Jharkhand
- Chhumathang in Jammu & Kashmir

Draft National Policy on Geo-Thermal Energy

Main features of the said policy:[10]

a. Providing soft loan, help in procurement of equipments, creating awareness and capacity building programmes.
b. The states are entrusted with the planning and implementation of the programmes.
c. State Electricity Boards are allowed to buy power from the producers as per MNRE guidelines for renewable energy sources.
d. According to the policy minimum 25% of the power generated should be sold to the State Electricity Board at mutually agreed rates. Remaining power can be sold at the liberty of the producer to any suitable customer at prevalent rates recommended by the competent authority.
e. Applicants should apply to MNRE which evaluates and is approved by a committee of at least three members comprising representatives of MNRE, State Government and Industry/Academia.

This policy once approved shall provide to some extent a framework for establishing this technology in India. Even though it is in its prenatal stage it has carved road towards the future of geothermal energy in India but how far it will take is the question unanswered.

10 Government of India Ministry of New & Renewable Energy, Draft National Policy on Geo-Thermal Energy *Available At* http://mnre.gov.in/file-manager/UserFiles/Draft-National-Policy-on-Geothermal-Energy.pdf (Last Accessed on 28/8/2017).

Conclusion

Considering the various factors it is clear that India's response to tidal and geothermal energy through the years have been slow and indifferent. It is time for India to harness these energies in view of its objective set by it for 2022. We need to understand the fact that the main requirement, if a policy is to be formulated to regulate these technologies it should be with an aim to slow down the process of climate change and extinction of habitats in the country and contribute in the development through fulfilling the energy needs of the country. In the recent years development does not only mean fulfilling the country's needs but also preserving the ecosystem in the country. In this light both tidal and geothermal forms of energy will help India to achieve the same.

*****

Energy Efficiency Interventions on MSMEs: Quest Towards A Sustainable Security

*Dr. Vani Kesari A**

Introduction

Despite India, emerging as the world's third largest producer of electric power, she is still not able to provide electricity to all and as per the International Energy Agency's World Energy Statistics 2013, places the country at a dismal 110th position in terms of per capita consumption of energy.[1] Thus the country is lagging both in terms of per capita consumption of electricity and access to all. As the county's economy expands, its appetite for power is definitely bound to keep further escalating in the years to come especially in the context of the thrust for industrial growth to be made at par with global standards. The industrial sector can be considered as one among the major consumer of power since almost two third of consumption comes from this sector.

In the industrial front, the Micro, Small and Medium Enterprises (MSME) sector has emerged as a dynamic sector of the Indian economy in the past five decades. MSMEs not only play crucial role in providing large employment opportunities at comparatively lower capital cost than large industries but it plays a key role in the industrialization of rural & backward areas, thereby, reducing regional imbalances, ensures more equitable distribution of national income and wealth. Moreover, MSMEs act as complementary to large industries primarily as ancillary units. Therefore this sector contributes immensely to the socio-economic development of the country.[2]

1 *Assistant Professor, School of Legal Studies, Cochin University of Science & Technology, Kochi.

2 Ms. Subina Syal, "*Role of MSMEs in the Growth of Indian Economy*, 4 G.J.C.M.P, 40-43 (2015).

Basic Understandings on the Role and Relevance of MSMEs

With the enactment of the Micro, Small and Medium Enterprises Development (MSMED) Act, 2006 the definition of Micro, small and Medium enterprises has been widened to include the service sector also.[3] The definition of these enterprises are based on investment and the enterprises have been distinguished as those engaged in manufacture and those in service sector. The definition of micro, small and medium enterprises is accordingly distinguished and laid down as :

Firstly, enterprises which are engaged in the manufacture or production, processing or preservation of goods as:

- **o** *Micro Enterprise* means an enterprise where investment in plant and machinery does not exceed Rs. 25 lakh;
- **o** *Small Enterprise* is an enterprise where the investment in plant and machinery is more than Rs. 25 lakh but does not exceed Rs. 5 crore.
- **o** *Medium Enterprise* is understood as an enterprise where the investment in plant and machinery is more than Rs 5 crore but does not exceed Rs 10 crore

In case of the above enterprises, it should be understood that the investment in plant and machinery is the original cost excluding land and building.

- o Secondly, enterprises engaged in the case of providing or rendering of services are also being classified as:
- o *Micro Enterprise* as an enterprise where the investment in equipment does not exceed Rs. 10 lakhs
- o *Small Enterprise* is an enterprise where the investment in equipment is more than Rs.10 lakh but does not exceed Rs. 2 crore;
- o *Medium Enterprise* is an enterprise where the investment in equipment is more than Rs. 2 crore but does not exceed Rs. 5 crore.

Services whose investment in equipment (original cost excluding land and building and furniture, fittings and other items not directly related to the service

3 *Available at* msme.gov.in/sites/default/files/MSMED2006.pdf, (Last accessed on 14/8/2017).

rendered or as may be notified under the MSMED Act, 2006. Registration under the MSME Act is not mandatory. It is just for receiving financial incentives that these enterprises need to be registered.

It is estimated that there are about 44 million MSME units in India which contribute 45% of the India's manufacturing output, account for about 35 % of our exports, and provide employment to more than 59 million people in the country.[4] Therefore the continuing growth, competitiveness and well-being of MSME units is intricately and intimately related to the health and growth of Indian economy. The large scale consumption of energy and limited energy efficiency employed by MSME Sector has led MSME to be a great contributing force behind energy depletion of India in the industrial arena. It is found that the Indian Small and Medium sector alone consumes energy equivalent to about 50 million tons of oil equivalent annually, which is about 20 to 25% of the energy consumption by large industries. [5]The Small and Medium Enterprises in India also exists in form of clusters which are spread across the length and breadth of the country, and are involved in producing textiles, bricks, hand tools, metal castings, forging and pumps etc. No doubt, MSME's contribute towards 8.9% of Gross Domestic Product of the country. However, MSMEs have fallen behind global benchmarks in terms of productivity, technology and end use energy efficiencies. This may be due to the fact that MSME's are vulnerable due to limited resources within which they function as well as constrained operating margins. Some of the other reasons include, the limited time available to the entrepreneur to identify, contract and finance energy efficiency opportunities, limited availability of local service providers who can support entrepreneurs in project development financing and implementation, and the almost complete lack of information in the development and deployment of new energy efficient technologies that are suitable for the MSME and that which can be adopted. Apart from this, the increasing transaction cost for shifting to energy efficient technologies or process, the perceived risks associated with the new technology adoption and the change in production line adds to the inherent barriers with

4 *Available At* https://beeindia.gov.in/content/small-medium-scale-enterprises-smele, (Last Accessed on 14/8/2017).

5 *Ibid*.

regard to adoption of energy efficient management in the MSME's in India[6].

The structure and patterns of energy consumption in the various industrial branches in India are very different and that has led to some inconsistencies and gaps. Some energy-intensive industries, including chemicals, cement, aluminium and, to some extent, steel, are dominated by large enterprises while other industries, particularly the brick industry, consist of thousands of small and medium enterprises (SMEs). The latter, with generally poor energy performance, account in total for about 45% of manufacturing output[7] It is found that the energy efficiency policies of the Indian government focus on the large consumers, for whom participation in an innovative market-based trading scheme for energy efficiency certificates is mandatory while the MSMEs have been put with little pressure with regard to controls on energy consumption.[8]

Legal Paradigm on Energy Law and Policy in India and Its Approach towards MSMEs

In practice, the Indian industries are deemed to be highly energy inefficient. However, during last 6 to 8 years some major large scale industries have paid attention towards energy conservation whereas the medium and small scale industries are, by and large indifferent towards energy conservation.[9] The Constitution of India places electricity on the concurrent list, that is, both the centre and state legislatures are authorised to enact law and make policies to promote the electricity sector. The key government agency or nodal ministries engaged in articulating policies are the Ministry of power, Ministry of new and renewable energy, Bureau of Energy Efficiency under the Ministry of Power, Central Electricity Commission and State Electricity Commissions, Central electricity authority, state level institutional mechanisms and concerned ministries etc

6 *Available At* http://www.cseindia.org/userfiles/BEE-SME-Brick-2016.pdf, (Last Accessed on 22/8?2017).

7 SME Chamber of India, 2015.

8 India Energy Outlook- World Energy Outlook Special Report 2015,IEA (21 Aug, 2017) *Available At* https://www.iea.org/publications/freepublications/publication/IndiaEnergyOutlook_WEO2015.pdf (Last Accessed on 21/8/2017).

9 Anjna N. Singh &,' Jagrati Sharma, *Energy Conservation in India: Challenges & Achievements* 1 IJMIE, 53, (2012).

The Electricity Act, 2003 framed by the Parliament covers major issues involving generation, distribution, transmission and trading of power.[10] After introduction of this enactment many MSMEs which are individually not capable to make substantial investments, have joined hands and formed Special Purpose Vehicle (SPV)[11] to set up Captive power plant [12]to meet their power requirements.[13] A captive power plant under the Act is understood as a power plant set up by any person to generate electricity primarily for his own use and includes a power plant set up by a cooperative society or association of persons for generating electricity primarily for their own use. In addition to this many industrial clusters also have set up Group Captive Power Plant to provide quality power to their member units. Though Electricity Act, 2003 was introduced to encourage setting up of captive power plant to ease the power supply position as well as to make them eligible for resultant incentives, it has been working negatively to the growth of the MSMEs as it is not clear whether a power plant set up as a Special Purpose Vehicle which is incorporated for the sole use of shareholders of such SPV's would fall within the definition of Captive power Plant. If it was so, it would have been more beneficial to existing MSMEs as it saves them from adverse financial liabilities.

The Group Captive Power Plants face numerous challenges and problems such as selection of appropriate technology, selection of proper suppliers and questions on deciding the number of different capacity engines which are suitable to its requirements. Moreover, the financing of investment in Power Plant by SPV is another challenge as it has no past experience in running such plant. The constant increase in fuel cost i.e. gas, coal is adding to the existing hurdles and quiet often it ends up pa,ying heavy O & M charges especially to supplier of plant as it has no technical capability. Adding to all these is the litigations on account of wrong interpretations.

10 *Available At* https://uk.practicallaw.thomsonreuters.com/6-525-supercritical 5272?transitionType=Default&contextData=(sc.Default)&firstPage=true&bhcp=1, (Last Accessed on 22/8/2017).

11 Section 2 (d); The Electricity Act of 2003.

12 Section 3; The Electricity Act of 2003.

13 Grant Thorton, *Vision 2020 : Implications for MSME's, Available At* http://ficci.in/spdocument/20143/Grant-Thornton-FICCI%20MSME.pdf, (Last Accessed on 27/8/2017).

The policy initiatives with regard to energy underwent a major change post 2000 period when the government adopted a double ended approach to cater to the energy demands of its citizens. While it attempted to ensure minimum growth in CO2 emissions so that global emissions do not lead to irreversible being caused to the eco system, on the generation side it brought forth newer strategies. Government started to promote greater use of renewable energy mainly through solar and wind energy and at the very same time shifting towards supercritical technologies for coal based power plants. The most striking development was the efforts made to efficiently use the energy in the demand side through innovative legislative policy such as the Energy Conservation Act 2001. This enactment not only created an institutional mechanism such as the Bureau of Energy Efficiency (BEE) as a statutory body at the Central level but it also provided regulatory mandate for standards and liability of equipment and appliances used, energy building codes for commercial group and the most important measure being , it brought forth energy consumption norms for energy intensive industries.[14] Under the provisions of the EC Act, the identified energy intensive industries (Designated Consumers) need to comply with the conduct of regular energy audits and implementation of techno-economically viable recommendations and establishment of energy management systems through appointment of certified Energy Manager, and meeting of specific energy consumption norms once developed. The major drawback of this Act however, was that the major consumers of energy namely the large enterprises have been mandated to report the extent of conservation in their annual reports while the statute remained silent as to the MSME's. There seems to be a doubt as to the application of the Act to MSME's as most of the MSME do not follow under its definition.[15]

However there are some policy initiatives by BEE such as Energy Efficient Technology Demonstrations through direct back ended subsidies to units, capacity building workshops. Energy mapping and performance benchmarks.

14 *Available At* http://powermin.nic.in/en/content/energy-efficiency, (Last accessed on 19/8/2017).

15 *Available At* http://www.pib.nic.in/newsite/mbErel.aspx?relid=144892, (Last Accessed on 10/9/2017).

Similarly under the United Nations Industrial Development Organisation (UNIDO) and the BEE stewardship promotion of energy efficiency in MSME is undertaken and programmes promoting use of renewable energy as an alternative in selected MSME clusters is initiated. Similarly efforts are being taken to increase capacity and demand of Energy Efficient Product and services. Measures to increased investment in energy efficient products and awareness building is being advocated too.[16] There are numerous policies and programmes for energy conservation and for increasing energy efficiency such as the National Electricity Policy, Rural Electricity Policy, Tariff Policy, Hydro Policy, Mega power project policy, Ultra Mega Power Policy, Jawaharlal Nehru National Solar Mission, Three Stage National Nuclear Power Generation Programme, etc [17]

Moreover energy efficiency strategies have been advocated by these policies such as standards and labelling program [18]which is a scheme to provide the consumer an informed choice about the energy saving and thereby the cost saving potential of the relevant marketed product, Demand Side Management Cells in utilities etc The Energy Conservation Amendment Act 2010 also envisage lot of strategies for increasing energy efficiency such as providing energy saving certificate to designated consumers whose energy consumption is less than the existing prescribed norms and standards, giving opportunity to designated consumers who consume more than the prescribed limit to purchase the same etc. Thus it is found that there are immense legislative and policy initiatives undertaken by government.

Specifically there are several Industrial energy efficiency programs too. Some of the prominent among them being primarily the National Mission for Enhanced Energy Efficiency (NMEEE) which has programmes based on Market Transformation for Energy Efficiency (MTEE), Energy Efficiency Financing Platform (EEFP) and Perform, Achieve, and Trade (PAT) Mechanism for Energy Efficiency Secondly the National Mission on Sustainable Habitat

16 *Available At* http://upneda.org.in/sites/all/themes/upneda/pdf/energy-conservation-event/Technical-Session-1_BEE_SME_By_Tarun-Dixit.pdf (Last accessed on 29/8/2017).

17 Patricia Park, International Law for Energy and Environment, 309 (2013).

18 *Available At* http://shodhganga.inflibnet.ac.in/bitstream/10603/46067/11/11_chapter%201.pdf, (Last accessed on 9/9/2017).

(NMSH) and finally the Small and Medium Enterprise (SME) Program. The MTNEE program seeks to accelerate the shift to energy efficient appliances in designated sectors, reducing the manufacturing cost to MSME's. However this scheme being to designated sectors fail to MSMEs which are spread over to several sectors. The Energy Conservation Act of 2001 identified 15 large energy-intensive industries for energy efficiency improvements. Sections 14 (e) and 14 (g) of the Act empowers the Union government, on the recommendations of BEE, to prescribe energy consumption norms and standards for energy intensive industries. The Energy Conservation Act names these energy intensive industries as designated consumers. Of the 15 designated consumers, eight (aluminum, textile, cement, chlor-alkali, pulp and paper, fertilizers, power generation plants, and iron and steel) are covered under the Perform, Achieve, and Trade (PAT) scheme. PAT is a market-based mechanism to reduce the specific energy consumption of these designated consumers The Energy Conservation Act was amended accordingly in 2010 to reduce the risk of noncompliance by increasing the penalty. Each designated consumer is given a specific energy consumption target to meet over a period of 3 years. Any additional savings can be used to earn energy saving certificates

(ESCerts), which are tradable with designated consumers who are short of targets.[19] However it is found that this scheme applies to only large industries and so most of the MSMEs are left out from the gains of the scheme. Another main shortcoming as to implementation of PAT scheme is the pathetic performance of agencies listed by State Designated agencies. The state governments, under the provisions of the EC Act, 2001 have been conferred the power to facilitate and enforce the efficient use of energy and its conservation. The state governments have to designate State Designated Agencies (SDAs) in consultation with the Bureau of Energy Efficiency to coordinate, regulate and enforce the provisions of the Act in the State Thus, the State Designated Agencies (SDAs) are the strategic partners for promotion of energy efficiency and programs under Perform, Achieve and Trade (PAT) and Market Transformation for Energy Efficiency

19 GHG Mitigation in India : An Overview of Current Policy Landscape , Working Paper World Resource Institute *Available At* https://www.wri.org/sites/default/files/wri_workingpaper_india_final.pdf (Last accessed on 9/9/2017).

(MTEE) for Bureau of Energy Efficiency (BEE), in the country. The SDAs have been set up in 32 states by designating one of the existing organization or by creating new agencies.

The disturbing feature of this initiative is that most of these organizations have had very limited experience in energy efficiency and conservation. This is because most of these agencies areas of operation are related to either renewable energy, or supply of electricity or being an inspectorate giving approvals under the relevant legislations. Hence policy implementation hardly takes place effectively.

The BEE has also initiated its Small and Medium Enterprises Program (SME program) which is primarily the cluster specific based program. The major lacuna is that rather than being cluster based it should have been industry based as hitherto industry based experience reveals that cluster based programmes have not yielded much results[20] energy saving certificate A challenge faced by MSME often with regard to policy measure is that are often lumped together—in making budgetary allocations, devising policy measures and in the subsequent application and implementation of policies so drafted be it with regard to energy efficiency or in its development generally. The distinction between them is not merely academic as often deemed but it comes with variations in their requirements and, therefore, holds practical value. [21]This is often found to be the major limitations as far as policy prerogatives are concerned. It is found that the Draft National Energy Policy, 2017 [22]has suggested for sectoral based energy conservation policy and similarly the 12th plan has also suggested the very same approach.[23]This can be regarded a more pragmatic view. To what extent it would be effective is yet to be seen.

Adding to this, is the Energy Intensive industries may vary in characteristics from one to another such as nature of the industrial activity undertaken, nature

20 Working Group on Power 2012.

21 *Available At* https://ccs.in/sites/default/files/research/regulatory-barriers-to-msme.pdf, (Last accessed on 29/8/2017).

22 *Available At* http://niti.gov.in/writereaddata/files/new_initiatives/NEP-ID_27.06.2017.pdf, (Last accessed on 29/8/2017).

23 India Energy Policy, Laws and Regulations Handbook 210 (2015).

of raw materials used, age of the plants etc. However it is found that none of the programmes or policies under BEE has included the different norms which are to be articulated for different types of industries.

The major portion of energy requirement in India is met from conventional energy like coal and petrol but vast majority of MSMEs should be equipped with power generation through wind, small hydro, biomass and solar energy. Dependence on non-renewable energy is not effectively undertaken.[24] The draft National Renewable Energy Act, 2015 which primarily aims to promote the production of energy from renewable energy sources and ensure energy security vests the government to articulate policies for the promotion of the same. The government had brought forth a sleuth of plans and programmes under the (ESCerts), banner of "Make in India" providing for incentives to start ups in using renewable energy and also manufacturing the same. However there are several stumbling blocks towards its implementations itself, for example the Action Plan of Start Up India Initiative 2017, vouches various initiatives and schemes to build a strong ecosystem for nurturing innovations that will drive sustainable economic growth and generate greater employment opportunities, however the definition of start-ups in the action plan itself is problematic The Action Plan defines a 'start up' to mean an entity incorporated or registered in India not prior to 5 years, with an annual turnover not exceeding Rs 25 crore in any preceding financial year, and which is working towards innovation, development, deployment of new products, processes or services driven by technology or intellectual property. It is to be noted that a firm involved in the mere act of developing a product or process, which does not have potential for commercialisation however will not be categorised as a Start-up.[25] Similarly, development of an undifferentiated product or process or service or such products or processes or services which have no or low incremental value will not be considered to be covered within the definition of a start-up. Further, an entity formed by splitting up/ reconstruction, of business already in existence would not qualify as a start up. A startup once incorporated / registered, will

24 Mohammad Naseem. Energy Law in India, 39 (2011).

25 *Available At* http://economictimes.indiatimes.com/articleshow/53783471.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst, (Last Accessed on 9/9/2017).

also need to obtain recognition from the Department of Industrial Policy and Promotion (DIPP) in order to be eligible for benefits under the Action Plan. The stipulations and procedure for getting such recognition is cumbersome and tardy. Thus there are numerous plans and policies for MSME's to develop and prosper by relying on renewable energy yet the fruitful percolation of these incentives is disheartening.

In India, it is found that there are numerous policies and programmes for energy conservation but the roles and responsibilities of ministries and agencies at the national and state levels are not clearly delineated, leading to a lack of coordination among institutions working in the same area. This has virtually affected effective implementation of energy efficient measures by MSMEs.

The Road towards a Sustainable Tomorrow

With the introduction of reform measures in India since 1991, the government of India has withdrawn many protective policies for the Micro, Small and Medium Enterprise (MSMEs) and introduced promotional policies to increase competitiveness of the sector. The MSMEs face ruthless competition from the large domestic firms and multinationals armed with improved technology, managerial ability, skilled workers, marketing skills, better product quality, and wide range of products. The small firms find it difficult to maintain their existence as the cases of merger and acquisition are continuously increasing. The MSMED Act of 2006 makes it mandatory for registration under it for receiving benefit and incentives under the Act. Chapter IV and Chapter V contains measures for promotion and development of MSME's but the Act does not contain any provision for MSMEs to incorporate energy conservation and energy efficiency measures in its operation. Amendments should be made to the Act to incorporate energy conservation as a primary measure to be undertaken by the National Board for MSME and governments. The lack of energy planning, effective energy audits, poor knowhow on energy efficient technologies coupled with lack of effective policy implementations had affected poor performance of MSMEs with regard to energy management. Again the

Energy conservation Act 2001 needs to be amended to include specifically the MSME's within its definition of "designated consumers".

In order to measure the future performance on energy management, the starting point is setting a baseline using the information on past energy consumption over a suitable time period by the MSME. While designing future energy efficiency programmes and schemes in the MSME clusters, role of cluster association should be enhanced as they are one of the agencies that remain with the unit owners till the end of cycle and beyond. For new energy efficiency programs, industry associations may be designated to monitor implementation and compliance process for all the units audited in a cluster, this would enable a more vigilant industry towards energy management.

A repository of best practices to enhance energy efficiency in the MSME units can be maintained in the public domain by the government. Units where energy audits have already taken place are well aware of the energy efficient technology interventions that can be implemented. However, transparent flow of information regarding implementation of energy efficient techniques are not being shared with other units. This can be overcome by creating a repository of best practices in energy management.

It is found that though units are aware of purchasing energy efficient equipment, the purchase orders raised do not always specify the purchase of energy efficient equipment or equipment with higher energy star rating. Techno-financial analysis before purchasing an energy efficient equipment is one of the main challenges faced by the MSME unit owners. A repository of all the energy efficient equipment suppliers can be maintained by the Cluster Association to support the units in getting quick service at a good price.[26]

Technical assistance to MSMEs in modernizing their production systems and making them more efficient can significantly reduce the energy inputs required for their operations, making them more profitable and economically

26 *Available At* http://shaktifoundation.in/wp-content/uploads/2014/02/Final-Project-Report_Shakti-MSME.pdf (Last Accessed on 9/9/2017).

competitive. In addition, demand for improved energy services can provide opportunities for entrepreneurs. In areas unserved by the electric grid, energy supplies can be provided by small-scale, locally owned businesses. This allows for growth of new MSMEs and creates an added source of employment in energy service provision and maintenance, agriculture, and business management.[27]

*****

27 Dr. Mateen Ahmed Siddiqui, *Role of MSMEs is setting up renewable energy systems in Indian Scenario*, 2 (5) IJCISS 35-41 (2015).

Is Renewable Energy A Viable Alternative? An Examination of The Draft National Energy Policy, 2017 Against The Backdrop of The German Energy Policy (Energiewende)

*Vidya Ann Jacob**

Introduction

Denial of a scientific proposition has never been conceived of as illogic for the simple reason that objections grounded in rationality are subsumed in the spirit of scepticism[1]. However, in contemporary times, opposition to scientific claims is entrenched in political dogmas; and ideological preferences are ostensibly deciding for people, whether experimentally determinable objective claims are acceptable[2]. What makes denial of the truth of climate change particularly dangerous, is the practical extension of this denial, through which distinct groups (e.g. coal manufacturing industries) in society can adversely affect the Earth's natural environment, and to that effect, the lives of its denizens.

The world is poised at this crucial juncture to plan reforms in energy production that will have near & far reaching consequences on the world[3]. There are currently 160 countries that have ratified the Paris Climate Agreement[4] which stands testament to the growing consensus on certain basic premises, such as

---

* Vidya Ann Jacob, Assistant Professor, School of Law, Christ University & Bharath G, Kiran S, Aman Khetwal; 3rd year BA.LLB students, Christ University.

1 Peter Klein, *Skepticism,* Stanford Encyclopedia of Philosophy, June 21 2015, *Available At* https://plato.stanford.edu/cgi-bin/encyclopedia/archinfo.cgi?entry=skepticism. (Last Accessed on 15/9/2017).

2 Emily Laber-Warren, Unconscious Reactions Separate Liberals and Conservatives, Scientific American, September 1 2012, *Available At* https://www.scientificamerican.com/article/calling-truce-political-wars/. (Last Accessed on 15/9/2017).

3 Alison Riddell et.al, *Towards Sustainable Energy: The current Fossil Fuel problem and the prospects of Geothermal and Nuclear power*, Stanford University, *Available At* https://web.stanford.edu/class/e297c/trade_environment/energy/hfossil.html. (Last Accessed on 15/9/2017).

4 *Paris Agreement- Status of Ratification*, United Nations Framework Convention on Climate Change, *Available At* http://unfccc.int/paris_agreement/items/9444.php. (Last Accessed on 15/9/2017).

global warming and the impossibility of long-term reliance on non-renewable energy sources. However, there are proponents of fossilised energy that believe that national and global demand can be met with the same[5]. Conceptualising and reforming energy policy, is a complex priority encompassing diverse criteria that underpin important aspects of the energy paradigm.

Why transitional food sources?

Prior to investigating the viability of nuclear energy as a transitional fuel source, it becomes crucial to understand why the *question* of transitional fuel sources is of significant import. The renewable *v* non-renewable energy debate, which is largely becoming politicised[6], needs objective examination, and as such, it is necessary to cognise certain dimensions of this question. The relevance of the question is brought to the fore, once the arguments made by proponents of non-renewable energy (i.e. fossilised energy sources) are understood. And upon the basis of the argument engendered by the proponents, they can be broadly sub-divided into the following categories:

1) Principal rejection of the scientific approach, and a subsequent denial of the justifications tendered in favour of renewable sources.
2) efficiency programmes
3) Selective rejection of the science of climate change, but not of the scientific method.
4) The non-renewable energy argument which accepts:
a) The veracity of climate change,
b) The inevitable depletion of non-renewable sources,
c) The long-term advantages of renewable energy sources;

But contends that non-renewable energy sources should be used as viable and complementary additions to a nation's energy policy, on the basis that renewable

5 Coral Davenport & Eric Lipton, *How G.O.P Leaders Came to View Climate Change as Fake Science,* New York Times, June 3, 2017, *Available At* https://www.nytimes.com/2017/06/03/us/politics/republican-leaders-climate-change.html?mcubz=3.

6 Caroline Kuzemko, *Politicising UK energy: what 'speaking energy security' can do,* 42(2), Policy and Politics, April 2, 2014, 259-274.

energy cannot account for current consumption trends. And until production technology of renewable resources rises to a certain level of self-sufficiency and stability, fossilised or nuclear energy sources should complement renewable energy.

Regarding the first category, there is no constructive manner in which the argument can be resolved in the spirit of engendering epistemic integrity. Two dichotomising positions are arrived at, with one standpoint observing no tenets of rationality, and the other abiding almost religiously by it[7]. Therefore, achieving consensus is fundamentally impossible. However, the second and third arguments rendered by proponents of non-renewable energy can be meaningfully construed to be real arguments, and can be critically evaluated.

First argument supporting non-renewable energy

The belief that climate change alone is fallacious, unaccompanied by a post-modern rejection of rationality, is unfortunately for climate science, a fairly ubiquitous proposition in contemporary times[8]. A selective rejection of climate science, and by extension the belief that coal, oil, and natural gas will not be depleted with usage is intuitively incorrect, as it hinges on the notion that there will be a timeless supply meeting human demand. There are several lines of argumentation that one can provide which substantiates the reality of coal, oil, and non-renewable energy depletion.

It is an accepted fact that natural resources cannot be manufactured in the laboratory. It takes thousands of years of fossilisation to produce these energy sources[9], and if their rate of replenishment exceeds the rate of consumption, then it is only logical to infer that they are getting exhausted. And the rate of their depletion is directly proportional to the growing divide between the rate of replenishment and rate of consumption. This logically derivable view has

7 John Cook et.al, *Quantifying the consensus on anthropogenic global warming in the scientific literature,* 8(2), Environmental Research Letters, October 30, 2013.

8 Dunlap Riley & Aaron M. McCright, *Organised Climate Change Denial,* (The Oxford Handbook of Climate Change and Society, 2011), 144-160.

9 *How Fossil Fuels were Formed,* United States Department of Energy, *Available At* https://fossil.energy.gov/education/energylessons/coal/gen_howformed.html, (Last Accessed on 15/9/2017).

been validated by several studies that show that coal reserves are fast becoming exhausted[10].

What must be noted however, is that the kind of justification tendered above, while being logically consistent, is an empirical claim. And therefore, climate sceptics are essentially rejecting the fact that non-renewable sources take thousands of years to be produced in nature. Another way in which they can reject claims is through rejecting the argument validity of the studies themselves which substantiate the arguments made. In rejecting the process, constant engagement with groups subscribing to this category (believing that no evidence exists for depletion of non-renewable sources) will allow for refinement and better presentation of data, and improvements in the procedural methodology of the investigation.

However, in rejecting the initial fact about fossilised energy sources requiring thousands of years prior to them achieving a state of utilisation, the non-renewable proponents are treading on dangerous territory, where they are in fact, rejecting the first law of thermodynamics. A different version of the law of conservation of energy, the first law states that the total energy of an isolated system remains constant[11]. Considering that this law applies only to closed systems, it is important to characterise the Earth as a closed system for the confines of this particular question. It must be stated at the very outset that the Earth is by no means, a closed system. There is obviously interaction with the rest of the universe, considering that large amounts of electromagnetic radiation come from the sun, and small amounts of debris do enter and exit the Earth. But for all intents and purposes, it can be construed as a closed system, as the quantity of matter that enters or exits the Earth is negligible. While energy enters and leaves the system, the amount of mass is practically constant[12].

10 S. Shafiee et.al, *"When will fossil fuel reserves be diminished"*, 37(1), Energy Policy, 2009, 181-189.

11 *The First Law of Thermodynamics,* National Aeronautics and Space Administration, *Available At* https://www.grc.nasa.gov/www/k-12/airplane/thermo1.html, (Last Accessed on 15/9/2017).

12 *Earth as a closed system,* The University of Vermont, *Available At* https://www.uvm.edu/~cmehrten/courses/earthhist/Earth%20Closed%20System.pdf, (Last Accessed on 15/9/2017).

Therefore, it can be asserted that almost every sizeable object (matter) that is existent, has been manifest for an extremely long duration of time, and its destruction/depletion rules out instantaneous creation. From an epistemological vantage, this scientific truth is inductive in nature[13]. There are no perpetual motion machines in existence, or any recorded observation for that matter, where energy is constantly and timelessly created. And when its inductive roots are examined, it becomes easy to understand the legitimacy of the propositions; climate change is real, and fossilised resources are getting depleted. An argument from analogy should justify the truth of the aforementioned statement. No individual, regardless of their political affiliations would argue that there are talking books. And it is known due to the fact that no one has ever seen a talking book. Inductive logic cannot be selectively applied.

But with regard to the third argument made, a clear systematic approach comprising of a comparative between possible transitional fuel sources must be conducted. If one takes cognisance of the fact that coal, oil, or natural gas are inefficient and significantly destroy the environment, then it becomes evident that the crucial question to answer would be centred on examining (what is construed by many) the "less dirty" nuclear energy as a viable transitional fuel source.

Is nuclear energy a transitional fuel source?

One of the primary contentions made by opponents to nuclear power, is the safety reason. The 'safe-premise' of nuclear energy hinges on the Black swan argument. That is, that accidents occurring as a result of nuclear reactors are very rare[14]. Their rarity is subsumed into a defence for their operational safety. In fact, there were several black-swan lies being propagated in the aftermath of the Fukushima disaster, and it isn't entirely an uncommon phenomenon, considering that the same defence was proselytised in the aftermath of the TMI incident, and the Chernobyl accident[15]. In 2011, several scientists and

13 Robert Audi, Epistemology a Contemporary Introduction to The Theory of Knowledge, (Third Edition, Routledge Taylor and Francis, 2011).

14 *Supra* Note 6, at pg. 118.

15 Kelly Servick, *Stanford expert: 'Black Swans' and 'Perfect Storms' become Lame Excuses for Bad Risk Management*, Stanford News, November 16, 2012, *Available At* http://news.stanford.edu/news/2012/november/black-swan-risk-111612.html, (Last Accessed on 15/9/2017).

newspapers reported on the Fukushima disaster and stated that core melt incidents are not common enough to warrant an upheaval of energy policy disfavouring nuclear energy as a source[16].

As stated above, determination of a policy's efficacy is dependent on several factors, primarily its effectiveness and its propensity to cause adverse unintended effects. The effectiveness of nuclear energy as a viable power source, is in of itself, suspect. Wind energy, the production of which is said to be inexpensive, is actually feasible. The International Energy Agency says global wind costs dropped to about 2 or 3 cents per Kilowatt/hr in 2010[17]. The agency's credit rating data shows that atomic energy costs are about eight times higher than wind-energy costs[18]. Therefore, price related inefficiency cannot possibly be assumed as a legitimate reason to dismiss wind-energy. Policy-utility analysis in the United States of America has shown that with the addition of wind energy to electricity generation programs, utility costs & consumer costs decrease exponentially[19]. And these figures are particularly troubling in light of the larger picture, when the fact that nuclear energy has been given 20 times more subsidies than the totality of all renewable energy production in the world is realised. Another important statistic to take cognisance of is the fact that renewable energy-technology prices are consistently decreasing, whereas the price of conventional and nuclear base energies have significantly risen[20].

To that effect, once it becomes clear that efficiency objections are not tenable, therefore, arguments about its alleged safety need to be deliberated. The black swan defence suffers from a few important fallacies which shall be detailed below:

The black swan argument is an instance of incorrect inductive logic, and these inductive premises are only as valid as the data supporting the claim. Industry

16 *Supra note* 15.

17 Smith, Insurmountable, *Renewables for Power Generation: Status and Prospects,* International Energy Agency (Paris: IEA), 152, 165.

18 Mukund Patel, *Wind and Solar Power Systems- Design Analysis and Operation,* (Second Edition, Boca Raton, Taylor and Francis Group, 2006), 303.

19 *Supra* note 6, at pg.193.

20 Stan Calvert et.al, *U.S. Department of Energy Wind Energy Research Program for Low Wind Speed Technology of the Future,* 124(4), Journal of Solar Energy Engineering, November 08, 2002, 455-458.

supplied guesses are prioritised over actual empirical data[21], and that by itself, poses serious problems, considering that the figures supporting the claims made by non-renewable energy's proponents are based on statistical fallacies. A statistical examination of an industry's rate of failures cannot utilise industry data in the generation of its conclusions. Therefore, policy evaluations of nuclear, or even coal safety must be government initiatives which take cognisance of unintended effects, and only after a rigorous cost-benefit analysis using statistically relevant data is conducted, can an active decision by government authorities be initiated. And another fundamental problem with the statistical analysis that is conducted, is with categorising subsets under labels. The list of accidents used in these risk-assessment studies do not include serious non-melt accidents, unintentional, and partial nuclear core melt accidents[22]. This presents an incomplete picture of the data.

This does not necessarily imply that there are no alternatives whatsoever. Biomass, (in particular, lignocellulosic biomass is a viable alternative source, which can in the future both supplement, and be of use as a transitional fuel source, considering that its abundance[23]. The primary problem is that it is structurally robust and extremely inert. Therefore, using it as a fuel source is a problem (i.e. difficulty of breakdown), and with Government approved research & development, and incentivisation to the private sector, it can futuristically become a viable alternative. It is, in fact, an economically efficient solution as well, as the infrastructure used in coal plants need not be replaced if industries from the private sector wish to diversify their interests.

Critique of The Draft National Energy Policy, 2017

It is of particular importance to ensuring the healthy socio - economic growth of any nation in the long run, that the leading policymakers be endowed with the singularly subjective quality of *vision.* While it is possible to consider

21 *Supra note* 6, at pg., 119.

22 *Ibid*, at 120-122.

23 Nathan Mosier et.al, *Features of Promising Technologies for Pretreatment of Lignocellulosic Biomass,* 96(6), Biosource Technology, 2005, 673-676.

this qualification slightly esoteric, vision is quite easy to identify and discern in potential policy makers. This is due to the fact that this quality finds manifestation, more often that not in those individuals who are capable of great foresight, that is premised on a commitment to the construction of well - reasoned foundations. The importance of allocating investments to securing a good foundational structure must indubitably precede any innovative recommendation that seeks to overhaul the current policy framework. In the current instance, the necessity for devising a permanent solution, for framing a roadmap so to speak in order to dictate the manner in which India combats the exponentially worsening problem of climate change through reassessing the sources of production of energy and the manner of consumption, cannot be understated.[24]

The National Energy Policy drafted recently in the first quarter of 2017 by the recently created NITI Aayog is aimed at creating a comprehensive plan of action in order to critically analyse India's current energy landscape and suggest recommendations to streamline the same.[25] This policy was institutionalised in order to replace the decade - old Integrated Energy Policy (IEP) that had been drafted by the predecessor of the NITI Aayog, i.e. the Planning Commission.[26] While in the case of the former, (the 2006 policy) the primary goal was to establish a roadmap that would chart the course of the development of India's energy sector,[27] the goal of the 2017 policy appears to be slightly different. While it does make ostensible efforts to create a roadmap of the future of Indian energy, by attempting to predict both the demand and supply side probabilistic scenarios in numerical terms, it prefers to restrict itself to a general degree of

24 EDN Editorial Team, *2015's Largest Global Emissions Increase Came from India*, Earth Day Network, *Available At* https://www.earthday.org/2016/06/14/largest-increase-global-co2-emissions-energy-use-2015-came-india/, (Last accessed on 16/9/2017.)

25 NITI Aayog, *Draft National Energy Policy,* Government of India, 2017, *Available At* http://niti.gov.in/writereaddata/files/new_initiatives/NEP-ID_27.06.2017.pdf; (Last accessed on 16/9/2017),

26 PTI, *PM Narendra Modi: Central Planning Commission to be disbanded*, The Economic Times, 15th August 2014, *Available At* http://economictimes.indiatimes.com/news/politics-and-nation/pm-narendra-modi-central-planning-commission-to-be-disbanded/articleshow/40301295.cms;

27 Expert Committee Report: Planning Commission of India, *Integrated Energy Policy,* Government of India, 2006, *Available At* http://planningcommission.gov.in/reports/genrep/rep_intengy.pdf; at pg: 6 & 7), (Last accessed on 16/9/2017).

ambiguity. This ambiguity can be observed in several instances, wherein instead of specifying a proper timeline within which, the government would seek to implement a particular scheme or achieve a pre - set goal, it rather presents the justification that growth is self - propagating or presents an ideal set of recommendations that must be implemented by the governmental machinery at any favourable timeslot in the future.[28]

This ambiguity of the NEP, 2017 does have its share of benefits and drawbacks. The benefits mostly include, the flexibility of operable policy that can emerge from the sub stratum of the NEP unencumbered by the limitative factors that strict timelines and schedules invariably impose. Additionally, it also provides the government with the option of being able to take quicker actions that are based on the dynamic socio - political factors (that play a crucial role in determining the viability and feasibility of these legislations) that are beyond the effective scope of a single centralised report.[29] On the other hand some of the disadvantages are as follows, governments (including future iterations of government) are directly disincentivised from taking immediate action regarding the recommendations mentioned in the policy, given its non - specific semantics. Following from the same, it is problematic to adopt a position that supports self - propagating growth (as against careful planning in light of probable projections of production and transmission patterns) from the perspective of effective policy drafting owing the fact that it does not lay down clear guidelines that serve the purpose of constituting the domain of well - understood projection - based scenarios. (In terms of energy production, post the year 2022)[30] Provided that guidelines are specified, governments are intimated as to what returns can be considered normal and those abnormal, thereby assisting the development of solid contingency plans for both extremities of the production spectrum. In the absence of concrete guidelines and scheduled plans, governments tend to

28 *Supra note* 25, at to page no – 41.

29 This is especially true in a large country like India, wherein the gathering of data across State lines is necessary and expensive, and hence is undertaken specifically prior to the passage of legislation regarding the subject.

30 *Supra note* 29.
"While a cumulative capacity target of 175 GW has been declared for the year 2022, by 2040 a likely capacity of 597-710 GW is expected to be achieved"

realise certain key latent externalities that emerge after a period of what can be classified as successful functioning, as was observed in the case of the German Green Energy revolution, or *Energiewende*.[31]

Examining the NEP in an isolated manner with the view of engendering constructive critique the first piece of interesting information that is encountered by the reviewer happens to be a sense of helpless self - awareness pertinent to the limitations placed on the authorities to craft lasting change. This is observable in several instances in which, the policy recognizes with a characteristic frankness, the areas of underperformance (such as large - hydropower projects)[32] and attempts to remedy the same via the route of advocating the route of a return to conventional energy sources.[33] (For example - coal, oil and natural gas) This approach lends a self - undermining quality to the policy, which renders it immune to constructive criticism, as it permits for the engenderment of the recognition bias. This essentially means that any potential reviewer arrives at the conclusion, that if the essence of the policy for instance is to support a return to the use of coal fired plants in order to generate the required energy to meet the exponential rise in demand,[34] the intrinsically problematic nature of such a suggestion is offset to a large degree by the recognition of the practical setbacks that one would face in ramping up generation of energy from renewable sources. (Like for example, the problem of grid integration - owing to the fact that the generation of renewable energy is characterised by two primary issues, firstly *intermittent supply* and secondly *variability* in power generation.)[35]

31 Dr. Patrick Graichen & Dr. Christian Redl, The German Energiewende and its Climate Paradox, 038/04-A, Agora Energiewende, 2014, 9 – 15.

32 *Supra note* 25, at page no – 42.
"There are adverse consequences, too, which call for quality research at the stage of project development and provision of funds for implementation of safeguards."

33 These conventional energy sources are undoubtedly used in modernized versions of production plants in order to maximise energy efficiency, by reducing wastage and Greenhouse Gas emissions.

34 TNN, *India Beats Major Economies in Energy Demand Growth*, Times of India, 11th June 2015, *Available At* http://timesofindia.indiatimes.com/business/india-business/India-beats-major-ecos-in-energy-demand-growth/articleshow/47621066.cms; "India's energy consumption grew at 7.1% in 2014-15, the highest rate of increase among major economies, while energy production rose by 4% to record the fastest pace in five years, according to BP Plc's Statistical Review of World Energy said on Wednesday."

35 JP Painuly, *Barriers to Renewable Energy Penetration; A Framework for Analysis*, 24(1), Renewable Energy, 2001,73, 73 – 89.

The NEP conforms to international opinion, that sustainable expansion that takes note of environmental concerns is of central importance to the development of energy policy in the future.[36] Keeping the same in mind, the NEP attempts to suggest an alternative mode of energy generation in the form of shifting the Indian fossil fuel sector from coal/oil/petroleum to the fairly cleaner natural gas. This shift would function as the buffer in the medium time period, (according to the NEP, this time period is between 2017 - 2040)[37] when India would invest heavily in the foundational infrastructure that would ensure the smooth integration of renewable energy into the mix. (This is under the assumption that no goals post 2022 for renewable energy are set, with the last mandated cap coming in at 15% or 175 GW of energy being generation from clean sources. And in the absence of any goals as well, one can reasonably expect autonomous growth in the sector, being commensurate with increasing investment in integration infrastructure.)

While the search for a transition fuel, so to speak is one that is discussed in the previous section (where a definitive answer is provided) is a definitively justifiable position to hold, it is important to ensure that this transition fuel does not possess any inherent latent defects. The use of natural gas in an expansive manner has several disadvantageous side effects, the chief amongst which being its polluting nature.[38] While it has a definite advantage over coal - firing, by producing less than half the aerial pollutants, the long term use (in the given scenario, the operational period is 50 years, and the use of the same commits to the generation of close to 300 billion metric tons of carbon emissions which constitutes half of the world's carbon budget.[39] (The exceeding of said budget

36 *Supra note* 25, at page no – 2.
"The adverse effects of climate change are much more discernible than ever before, with a better understanding of the relationship between energy use and poor environmental outcomes. While the global agenda is of common concern, there is a heightened consciousness of the need to fix poor air quality standards in Indian cities, which is being reflected in tough administrative actions and court mandated orders."

37 *Ibid*.

38 *Environmental Impacts of Natural Gas,* Union of Concerned Scientists, 2013, *Available At* http://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas#.Wb5-SEsjHrc. (Last accessed on 16/9/2017).

39 Nick Evershed, Carbon countdown clock: how much of the world's carbon budget have we spent? The Guardian, 19th January 2017, *Available At* https://www.theguardian.com/environment/datablog/2017/jan/19/carbon-countdown-clock-how-much-of-the-worlds-carbon-budget-have-we-spent, (Last accessed on 16/9/2017).

would ensure that the world faces the brunt of the oncoming climate change) Another disadvantage can ironically be found the in the cheap pricing of this natural gas, the abundance of which promotes a culture of dependence, leading to the flourishing and development of many allied industries in the wake of the natural gas boom.[40] The unintended effect of this status quo, is such that one sees a marked reduction in the amount of investment that is earmarked for renewable energy because while the price of the underlying technology is dropping with increased research into the field, it does not in any way pose a substantial competition to the prices dictated by the natural gas industry.

It must be noted that another shortcoming of the National Energy Policy is its inability to widen the ambit of its examination to include a comprehensive analysis of the potential influence of the implementation of the policy's recommendations on the current framework of fundamental rights that are pertinent to environmental conservation.[41] At the outset, this essay rejects the counterargument that a non - enforceable, technical policy framed with a teleology concerned with an exposition regarding the status quo on energy infrastructure should only suggest practical measures to improve the position of the same. This is primarily because, any policy that seeks to explore pragmatic and by extension (in the current instance) particularly scientific developments in the field of energy generation and accompanying infrastructure (to remain consistent with its initial premise) must confine its recommendations to solely infrastructural and technological advancements. However, the NEP exceeds this mandate and makes several policy based recommendations such as proposing a framework under which the Government of India must strive to reduce the consumption of electricity in the country, and also promote the use of renewable sources of energy in the private, rural sector in order to build a strong foundational structure for its future integration into mainstream energy production and at the same time improve the efficiency of energy consumption in India. In such a scenario, any policy that makes this form

40 *Infra note* 43.

41 The rights referenced include: The Right to Clean and Healthy Environment as has been laid down by the Supreme Court in various cases, see note 21; (Additionally, Art 37, 38, 47, 48[A], 48, 51[A] (g) of Part IV of Constitution of India).

of recommendations is vested with the responsibility to consider the legal feasibility of the same, seeing as to how any legal failure would potentially void the effective functioning of the policy.[42]

This position becomes contentious when one considers that the NEP as mentioned above advocates for a shift from an oil/coal based economy to a natural gas based economy and the expansion of upstream investment in exploration of India's sedimentary areas. (The policy notes that a mere 19% has been explored in a moderate/effective manner[43]) This exposes an underlying intent of the entire policy to streamline the current bureaucratic process in order to further exploration of potential mining sites in India through the medium term period (2017 - 2040) entrenching the Indian economy in an overt reliance on fossil fuels. This reliance wsould contribute further to atmospheric pollution in India, and make no long - term commitments towards improving the quality of environmental conditions in the country. An espousal of such a roadmap for the future would find itself in contradiction (if not explicitly, as the policy has not yet been provided effective legal sanction) with the right to clean and healthy environment guaranteed by the Supreme Court via the mode of interpretation in several landmark judgments,[44] commencing with Subhash Kumar v. State of Bihar.[45] Admitting the validity of the interpretation that duty imposed on the state by the wording of Art 21 is negative in nature or that of restraint, it can be observed that the right to a clean and healthy environment can also impose a negative duty on the state to ensure that no action is taken that can potentially vitiate said right, which then renders Art 21 violated. Taking the instant policy, the propositions of the NEP if translated into concrete policy would engender further deterioration of India's environmental conditions and incrementally increase the probability of the global community exceeding the

42 This would be observed through the possible filing of writ petition before a competent court which then may proceed to grant a writ in favour of the applicant, rendering the government's implementation of that aspect of the NEP void.

43 Supra note 25, see page no: 28 – 30.

44 Some important case laws on the issue are as follows -
- Shantistar Builders vs. Narayan Totame, 1990 1 SCC 520
- M. C. Mehta vs. Union of India, AIR 1996 SC 2715
- Vellore Citizens Welfare Forum vs. Union of India, 1996 3 SCC 212;

45 Subhash Kumar v. State of Bihar, 1991 1 SCC 598;

carbon budget. This essentially constitutes the concretization of state - sponsored policy that would substantively violate the interpreted provisions of Art 21, maturing into a health hazard implying grave consequences for Indian citizens.

By way of conclusion, this essay would exhort the government to consider immediate investment to merge the flourishing private solar energy generation sector[46] with the mainstream public electricity grids. Taking into account, the tropical nature of the climate in India it would be a suitable course of action for the government to make large investments into the solar and wind energy sector, (while the NEP does point to their preferential status) over large hydro especially, taking into account the staggering costs, time period of construction, (which on an average globally is 8.6 years and much longer in India) the widespread environmental damage and the potential to underwrite costs by neglecting the impact of inflation.[47] However, simultaneously the government must keenly invest in small hydro power as it is far less detrimental to environmental health, and does already contribute a certain amount to the production of renewable energy. In this manner, the term, *'During the medium term, we may strengthen the energy infrastructure'*[48] can be interpreted to include further support to the private generation of renewable power with the option of connecting to main grids provided that the quantum of generation can be scaled upwards with sufficient notice.

Germany's Energy Policy: Lessons to Be Learnt

The inherently dichotomous nature of Germany's energy policy has become apparent in light of recent understanding that has come to the fore, post the effectuation of *Energiewende. Energiewende* is Germany's energy policy that seeks to ensure that Germany possesses low carbon, environmentally sound, reliable,

46 Ministry of New and Renewable Energy, Annual Report 2015 - 2016, Government of India, *Available At* http://mnre.gov.in/file-manager/annual-report/2015-2016/EN/Chapter%201/chapter_1.htm, (Last accessed on 16/9/17).

47 David Biello, *Fact or Fiction? Natural Gas Will Reduce Global Warming Pollution, Scientific American*, 3rd August 2015, *Available At* https://www.scientificamerican.com/article/fact-or-fiction-natural-gas-will-reduce-global-warming-pollution, (Last accessed on 16/9/2017).

48 *Supra note* 25, at page no – 3.

and affordable energy supply.[49] Upon its conceptualization in its infancy (where it only sought to abandon nuclear and petroleum energy) in 1980, the term has expanded in scope to encapsulate several aspects of German energy policy, postulating significant changes both in principle and implementation. The policy was received with overwhelming support at the time of its initiation, and has retained support until recently, when certain defects in its implementation were brought to light. This section of the essay will essentially look to identify these defects and present them in the form of lessons to be taken into consideration by India, in the formulation and effectuation of *its* energy policy. Considering the fact that *Energiewende* did have a substantial impact on the perception of renewable energy both within Germany and in the international community, it is imperative for the purpose of this analysis that the benefits of the scheme are assessed against the backdrop of Indian energy policy as well.

Energiewende was perceived as being revolutionary, and the milestones that were reached by virtue of this policy cannot be ignored. Essentially, *Energiewende* looked towards revolutionizing the energy sector, by replacing historically extant utilisation of nuclear energy, fossil fuels, and coal with renewable and efficient forms of energy; primarily wind and solar technology. In the wake of the infamous Fukushima nuclear accident, the German government made it evidently clear that they wished to ultimately renunciate the utilisation of nuclear energy. Amidst large scale protests (that had begun in the 1970s[50]), Chancellor Angela Merkel famously declared that Germany would shut down all 17 of its nuclear reactors by 2022[51]. Similarly, Germany made several promises- to cut down its emissions by 40% before 2020, and by 2050, to the tune of at least 80%.[52] Germany's plan to achieve this objective, was sought to

49 Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, *Energy Concept for an Environmentally Sound, Reliable and Affordable Energy Supply*, 28th September 2010.

50 Rebecca Staudenmaier, *Germany's nuclear phase - out explained,* DW Organization, 15th June 2017, *Available At* http://www.dw.com/en/germanys-nuclear-phase-out-explained/a-39171204, (Last accessed on 16/9/2017).

51 Christoph Rasch, Supply Security is Even More Stable Despite Nuclear Phase Out - Fossil Reserve Power is Replaceable, Greenpeace Energy, *Available At* https://www.greenpeace-energy.de/fileadmin/docs/pressematerial/Hinkley_Point/PR_20160905_Nuclear_Phaseout_Supply_Security_EN.pdf, (Last accessed on 16/09/17).

52 Robert Kunzig, *Germany Could Be a Model for How We'll Get Power in the Future*, National Geographic Magazine, 2015, *Available At* http://www.nationalgeographic.com/magazine/2015/11/germany-renewable-energy-revolution/, (Last accessed on 16/9/2017).

be accomplished through reducing energy consumption by 50% before 2050. As of 2017, roughly 27% of German electricity is generated through renewable sources. At its face value, these contemporary statistics are ostensibly staggering. As per an official monitoring report from the German government's Federal Ministry for Economic Affairs and Energy in 2014, renewable energy was the number-one source of electricity, and energy efficiency increased by an annual average of 1.6% between 2008 and 2014.

Furthermore, the German populace overwhelmingly accepted solar and wind plants in their immediate neighbourhood[53]. The Government also invested heavily in research and development; 1.5 billion Euros were invested in energy research in 2013, out of which 820 million Euros was utilized to support projects that ranged from exploratory research to application-oriented research[54]. Subsequently, there has been a directly correlated increase in investments in Photovoltaics, wind-power, bio-mass and hydropower energy[55]. More than 1.5 million renewable power plants have been installed in Germany over the past fifteen years. The benefits are seemingly apparent when observed through the microcosm of private households, adopting measures to the tune of10,000 solar battery system-installations in 2014 alone[56].

However, such a revolutionary policy is not devoid of challenges, the foremost of which is infrastructure. Germany seemed to have addressed this grievance particularly well through the implementation of its grid system that integrated renewable energy programs into the already manifest energy infrastructure. *Energiewende* can be implemented with ease, once it is realised that the

53 *A power plant in your neighbourhood? German acceptance of power plants close to their homes,* Renewable Energy in Germany, 2014, *Available At* https://1-stromvergleich.com/strom-report/renewable-energy-germany/.

54 *Making a success of the energy transition,* Federal Ministry for Economic Affairs and Energy, September 2015, *Available At* http://www.bmwi.de/Redaktion/EN/Publikationen/making-a-success-of-the-energy-transition.pdf?__blob=publicationFile&v=6. (Last accessed on 16/9/2017).

55 Reports have suggested that in addition to 1.5 million solar power installations, 26,000 wind turbines, 8,900 biogas systems and 7,000 hydro power plants were installed, although the use of biomass as per the German Climate Action Plan 2050 will be limited and sourced mostly from waste.

56 Moss. T *et al*, *Whose energy transition is it, anyway? Organisation and ownership of the Energiewende in villages, cities and regions*, 20(12), Local Environment, 2015, 1547, 1547-1563.

infrastructure of grid systems supporting electricity generation can be utilised in the generation of renewable energy as well. Evidently, these challenges are not always met effectively, and even when met effectively in the short run, usually end up becoming counter-intuitive at a later point in time. The next section of this essay shall examine the defects of Germany's ostensibly sound energy policy.

Germany is still the world's leading producer of lignite, considered the dirtiest form of coal, due to its increased rate of emission of CO2, is also the cheapest fossil fuel on the market.[57] Herein lies one of its fundamental problems. While the influx of renewable energy in the infrastructural systems of Germany has plummeted the price of electricity, certain distinct problems with Energiewende has greatly escalated the average power price that the German consumer pays. The price reached a new peak in 2017, forcing consumers to pay 39 cents per kilowatt-hour, and to understand this statistic in the larger frame of things, an American need only pay an average power price of 10.4 cents per kilowatt-hour[58]. What this entails is a higher demand for hard coal, (i.e. lignite), and *this* demand is problematic as Germany's priority should be the elimination of fossil fuel-dependence in its entirety. This has expectedly caused immense difficulty to the German energy powerhouses (e.g. EON), who incur substantial losses, and to that effect, they become incentivised to invest in fossil fuel production.

One of the primary defects of Energiewende can be found in the arguments made by the energy enterprises when they defend generation of fossilised energy. This defect is rooted in industry observations which find that renewable energy is *efficient,* but at times, *unreliable*[59].This observation is substantiated by certain problems that can be found in Germany's geography, which pose difficult challenges to consistent production, e.g. the transportation of energy to meet small-industry and household services situated at distant locations, facilitated

57 *Ibid.*

58 Ellen Thalman & Benjamin Wehrmann, *What German Households pay for power,* Clean Energy Wire, 16th February 2017, *Available At* https://www.cleanenergywire.org/factsheets/what-german-households-pay-power; (Last accessed on 16/9/2017).

59 International Energy Agency, *Germany's Energiewende is to maintain a balance between sustainability, affordability and competitiveness*, 24th May 2013.

by way of inter-transmission grids in the intermediate regions, is hindered to a large degree by distance-related issues. While these limitative aspects inhibit renewable energy production to an extent, these problematic characteristics are in no way, a marker of the impossibility of sustained renewable energy production.

It was recently asserted that solar energy only works full time 8% of the entire year, and cost the government over 1.1 trillion dollars. And by virtue of the sheer price of the project, the government has often called upon power companies to generate electricity themselves to prevent substantial damage to the power grid. As a result, Germany was forced to recommission coal power plants, although the shutdown of 30 such plants has been called for by 2019. Therefore, the unfortunately manifest situation where the Government is utilising coal production to sustain *Energiewende* must be critically examined. What is surprising is that, keeping in mind the previously presented statistics, coal energy in 2015, still provided for 44 percent of the total percentage of Germany's power. Germany also has some of the highest per capita carbon emissions in Western Europe; *slightly more than half of U.S' emissions.*

This inherent problem thus presents itself as a major obstacle in the realization of what *Energiewende* seeks to achieve. If the implementation of an environmentally *friendly* policy requires environmentally backward steps to be taken, then its purpose is defeated. What one is left with is an incredibly superficial policy that *prima facie*, seems to solve several environmental problems, but is itself rife with hazardous foundations. Furthermore, large investment costs discourage renewable energy production, which in turn significantly affects the everyday consumer. One might argue that a simple cost-benefit analysis would suffice to establish that the benefits are merely a façade cloaking the overarching harms that arise.

The lessons that India can learn from this German policy are apparent. Germany must be given credit for championing the cause of renewable program energy by setting precedent, as a result of which, several countries such as Japan, United

States, and Australia are also espousing their intention to follow suit.[60] India and Germany very recently signed an agreement as part of the Indo-German Energy Programme-Green Energy Corridors (IGEN-GEC) plan, that seeks to "…improve the sector framework and conditions for grid integration of renewable energy". The obvious lesson that India must take is that when implementing radical changes in policy akin to *Energiewende,* the government should reasonably be expected to work in the long-run to achieve substantial long-term goals, of which environmental goals must be a necessary constituent. Germany's quick rise in showing results only led to steady fall, but that does not necessarily imply that the situation will continue to deteriorate. Although the grid system's implementation in India through this deal already signifies that India has begun to adopt the important components of *Energiewende,* it must do so consistently. It must commit itself to substantial research and development projects which while being expensive are necessary[61], as one of the problems that Germany faced is that in times of unreliability of renewable energy, no adequate transitional energy source was available (which served the dual objective of meeting both energy and environmental requirements), which led to the renewal of coal production. The amalgamation of German grid infrastructure into the current Indian grid system is commendable, considering it was a unanimously accepted component of *Energiewende.* India is thus moving in the right direction by adopting necessary measures. However, only time can tell if they will fall prey to implementational missteps in the process of effectuating immediacy in the promulgation of environmental policies, which should be examined as long-term solutions. This analysis however, does not suggest that the problems of *Energiewende,* are exclusive to the relevant arguments discussed in the previous paragraphs, but it must be noted that India is most susceptible to the above-mentioned deficits of *Energiewende*.

60 BETD Press Office, *Press Fact Sheet: German Energy Transition,* Berlin Energy Transition Dialogue, March 2016, *Available At* https://www.energiewende2016.com/wp-content/uploads/2016/03/BETD2016_Press_Factsheet_Layout_1603.pdf;

61 Any policy implemented devoid of research and development is suicidal and a ticket to disaster. These projects must substantially take into account the nature of wind, solar, and hydro energy in India, and the extent to which it is viable across the Indian peninsula, which presents itself not as heterogeneous as a country in Western Europe both geographically and demographically, the demographic of which would also determine to an extent the market and investment that revolves around the energy industry.

Conclusion

Through the course of this essay's investigation, the core epistemological, statistical, scientific, and policy-based fallacies of the arguments generated by proponents of non-renewable energy, are thoroughly examined. And via the examination, the essay expounds the necessity for renewable energy. The first section has additionally explored possible transitional sources of energy, and analyses their environmental and economic feasibility. Taking cognisance of the necessity for transitional fuel sources which ideally account for energy demands in the intermediate period, prior to the revamping of energy policy (favouring renewable energy over fossilised sources), this essay has also posited several reasons to support the encouragement of research and development into the large-scale production of biomass energy (i.e. specifically, lignocellulosic biomass).

The essay also conducts a practical investigation of policy on the subject matter, by way of dissecting the National Energy Policy. Through an analysis-centric approach, India's energy policy has been assessed in light of the nature of its effectiveness, equity, implementation, and costs. Additionally, the critique prefers the approach that does not merely present renewable energy as a viable alternative, but rather one that suggests the ideal composition of this futuristic iteration of the energy mix. (This approach would focus on those modes of renewable energy that would be best suited for climatic conditions of the country and other implementational factors) This section also advocates for the analysis to include an examination of the potential violation of fundamental rights guaranteed to the citizens of India by the state under the authority of the constitution; as a failure to do the same would engender unnecessary litigation that hinders effective implementation of the NEP.

An incompleteness in the mode of analysis adopted by the instant essay happens to be an inability to effectively posit practical implications of the suggestions made, as most of the reasoning was premised on theoretical principles. The third section of this piece, attempts to bridge the principle – pragmatic divide, by analysing the German renewable energy policy *Energiewende.* It infers that

India in pursuit of its eventual goal of replacing a dependence on fossil fuels with clean energy, must effectively implement the recommendations put forth in the NEP for strengthening grid infrastructure, whilst simultaneously reducing the medium-term period. (2017 – 2040) Adopting the aforementioned recommendations would ensure that India does not encounter the pitfalls that currently threaten to derail a project once hailed as the greenest experiment in the energy policy landscape around the world.

*****

India – Solar Panel Case at WTO and Its Impact on Indian Renewable Energy Sector and Environment

*Amit Kumar Akela**

Introduction

There is an ongoing debate whether trade in energy is governed by GATT/WTO or it is a special case and out of the preview of GATT regime. There are two opposing arguments. One supports the idea that energy is regulated by the WTO[1] and others oppose it[2]. Both arguments draw their strength from the history and objective of creation of GATT and WTO, different multilateral trade negotiations, GATT Rounds of negotiations and Uruguay Round of negotiations and establishment of WTO and different Rounds of talk after the establishment of WTO including Doha Round. However from the practical point of view we find that WTO Dispute Settlement Body (DSB) has taken up cases on energy issues[3] and it has now been generally accepted that WTO

* Ph.D. Research Scholar, South Asian University, New Delhi.

1 See, Anna Marhold, 'The World Trade Organization and Energy: Fuel for Debate', ESIL, Vol 2 Issue 8, 30 Sept. 2013, *Available At* http://www.esil-sedi.eu/node/417 accessed 7 May 2017, Selivanova,'The WTO and Energy: WTO Rules and Agreements of Relevance to the Energy Sector', ICTSD Programme on Trade and Environment, August 2007, *Available At* http://www.ictsd.org/downloads/2012/03/the-wto-and-energy.pdf accessed 7 May 2017, James J. Nedumpara, 'Energy Security and the WTO Agreements', in S. Mathur (ed.), Trade, the WTO and Energy Security, IIFT, New Delhi, 2014, pp. 15-71. Nedumpara argues that specific disciplines on energy was never a part of GATT 1947 or WTO Treaty. But WTO rules apply when energy is traded as goods and services. Yanovich A , 'WTO rules and the energy sector. In: Selivanova J (ed) Regulation of energy' in International Trade Law: WTO, NAFTA and Energy Charter. Kluwer Law International, The Netherlands, pp 1–48, 2011. Yanovich argues that WTO rules apply only when energy good are traded and it does not apply to energy resources.

2 See, Leal-Arcas & Abu Gosh, 'Energy Trade as a Special Sector in the WTO: Unique Features, Unprecedented Challenges and Unresolved Issues', 6 Indian J. Int'l Econ. L. 1 2014.

3 Till now there are seven disputes brought before the WTO DSB out of which six has been decided by the Panel and Appellate Body. The seventh and the latest one is brought by India against the USA relating to subsidies on renewable energy. The latest happening in this regard is the formation of Panel by DSB on 21 March 2017. Other six disputes in alphabetical order are: Canada—Certain Measures Affecting the Renewable Energy Sector (WT/DS412/AB/R), China—Measures Concerning Wind Power Equipment (WT/DS419/1), Canada—Measures relating to the Feed-in Tariff Program (WT/DS426/AB/R), European Union and Certain Member States—Certain Measures Affecting the Renewable Energy Sector (WT/DS452/1), and European Union and Certain Member States—Certain Measures on the Importation and Marketing of Biodiesel and Measures Supporting the Biodiesel Industry (WT/DS459/1) and India—Certain Measures Relating to Solar Cells and Solar Modules (WT/DS456/1/Add.1).

has the jurisdiction to deal with energy matters. Therefore, if there are energy disputes between parties they can be dragged to the WTO DSB. The traditional debate has always centered around trade on one side and environment on the opposite side.[4] Basically the concept of sustainable development generated the debate as to how the balance of increasing trade can be made with a sustainable environment. But now there is a third angle of energy added to the everlasting contrast of trade and environment making it a tripartite issue.[5] But the interesting point to be noted here is that today when entire world is looking towards sustainable development, reducing greenhouse gases to fight climate change although on common but differentiated responsibilities and striving the make earth a cooler and better place to live in not only for the present but also future generations, the WTO disputes which have come up are based only on renewable energy matters and not on fossil fuel matters.[6] It is without a doubt that renewable energy is most environment friendly and fossil fuels are enemies of the environment. This has also to be kept in the mind that the future lies in energy security through never exhaustive renewable resources such as solar, air, the wind, hydrology etc. and not with fossil fuels which are in limited quantity and can be very well finished in few years if used unmindfully. The importance of renewable energy can be seen in terms of binding obligations taken by developed nations to mitigate the climate change and developments thereafter. There are 164 countries around the world till mid 2015 who have

4 Gro Harlem Brundtland, 'UN Report of the World Commission on Environment and Development: Our Common Future' United Nations, 1987 (Popularly called Brundtland Report) *Available At* http://www.exteriores.gob.es/Portal/es/PoliticaExteriorCooperacion/Desarrollosostenible/Documents/Informe%20Brundtland%20(En%20ingl%C3%A9s).pdf, Last accessed 2 May 2017, Thomas Cottier, Garba Malumfashi, Sofya Matteotti-Berkutova, Olga Nartova, Joëlle De Sépibus And Sadeq Z.Bigdeli, 'Energy in WTO law and policy', WTO, Individual Project No. 6, *Available At* https://www.wto.org/english/res_e/publications_e/wtr10_forum_e/wtr10_7may10_e.pdf. (Last accessed on 7/5/2017), On the issue of sea turtles see, Jenny Schultz, 'Balancing the Relationship between Trade and the Environment within the World Trade Organisation: Is This the End of the Sea Turtle' 4 Asia Pac. J. Envtl. L. 37 (1999).

5 Leal-Arcas & Abu Gosh, 'Energy Trade as a Special Sector in the WTO: Unique Features, Unprecedented Challenges and Unresolved Issues', 6 Indian J. Int'l Econ. L. 1 2014, at p. 4. For energy, environment and economy dilemma in China see, Xu Tang et. al., 'Dilemmas for China: Energy, Economy and Environment', Sustainability 2015, 7(5), 5508-5520, *Available At* http://www.mdpi.com/2071-1050/7/5/5508 (Last accessed 4/5/2017).

6 Henok Birhanu Asmelash, 'Energy Subsidies and WTO Dispute Settlement: Why Only Renewable Energy Subsidies Are Challenged' Journal of International Economic Law, 2015, 18, 261–285.

adopted at least one type of renewable energy target which is four times up from 2005.[7] There are European Commission Directives for its Members to use minimum 20 percent of their total energy needs from renewable sources.[8] The three targets of EC's 2030 Climate and Energy Framework are at least 40 percent cut in greenhouse gas emissions from 1990 level, at least 27 percent share of renewable energy in total energy consumption and 27 percent energy savings by improving efficiency.[9] As per 2017 IRENA Report on Renewable Capacity, the capacity of the world has doubled from 2007 to 2016 from 989 213 MW to 2 006 202 MW.[10] There is a shift in the approaches of states including developing and lest developed, to go for the renewable and for this they have brought in laws and policies.[11] The renewable energy sector is developing fast as a new branch to deal with under international trade and investment. This means in future we are surely going to see huge investments and trade in the renewable energy. This will bring in more disputes under the WTO and International Investment law.

At the WTO level countries have been challenging the violation of WTO obligations by members on different issues. But recent time has seen cases relating to renewable energy in the member states. Six cases have been reported yet and the seventh one is at the Panel formation stage which India has brought against the US for Domestic Content Requirements (DCRs) in six of its States. The paper will try to discuss the Indian Solar Panel case which was brought by the US against the DCRs in JNNSM program of India. Since India lost this before both Panel and Appellate Body, the paper will try to find out defenses put forth by India and

7 'Renewable Energy Target Setting', IRENA, June 2015, at p. 12, *Available At* http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Target_Setting_2015.pdf (Last accessed 1/5//2017).

8 Directive 2009/28/EC of The European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, para 13, *Available At* http://eur-lex.europa.eu/legal content/EN/TXT/PDF/?uri=CELEX:32009L0028&qid=1492856874059&from=en (Last accessed 1/5//2017).

9 Climate Action, 'Climate & Energy Framework', EU, *Available At* https://ec.europa.eu/clima/policies/strategies/2030_en), (Last accessed 7/5/2017).

10 Renewable Capacity Statistics, IRENA, 2017, at p. 2 *Available At* http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Capacity_Statistics_2017.pdf, (Last accessed 7/5/2017).

11 Some of the examples of states are India, Bangladesh, Egypt, South Africa, Thailand, Philippines, Pakistan, Kenya etc.

its possible impact on ambitious Indian solar energy program, renewable energy industry and environment concerns. Since this was not the first case of its kind, earlier Canada- Renewable Energy/Feed-in Tariff case was already decided by the Dispute Settlement Body (DSB), and India failed to differentiate its case from the Canada Renewable Energy/Feed-in Tariff case, it seems that in near future it will act as a detterance for developing countries to pursue their infant renewable energy industry with FIT programs attached with DCRs.

On this background the Part II will deal with renewable energy as a new development and a shift in country's approach towards renewable energy generation. It will analyze Indian renewable energy policies and schemes as a case study before switching over to Part III where the thrust will be on analyzing Feed-in Tariff schemes and DCRs. Here paper shall discuss the benefits with FITs, different FIT models and whether DCRs are necessary to improve renewable energy production and environmental safeguards. In the next part Indian Solar Panel case shall be discussed where in three defenses put forth by India and approaches of Panel and Appellate Body shall be discussed. In the Fifth part, the paper shall highlight some of the probable impacts this decision would have over India especially its renewable energy program and environment protection. Finally a conclusion will be drawn from the above discussions in part VI.

Renewable Energy Sector: New Development

The history of renewable energy in terms of trade is not very old. The first ever use of solar energy to generate steam to drive machinery took place in 1860 in France by Augustine Mouchot.[12] Then after sixteen years the first demonstration was done to generate electricity directly from the sunlight in a selenium solar cell. The year 1882 saw the first commercial scale hydroelectric power plant in Appleton, Wisconsin.[13] And the first solar cell containing silicon which is in practice today was built by Bell Laboratories in 1953.[14] The first ever use of solar cells for power supply to satellites were used by USA in 1958.[15] US President Jimmy Carter for the first time advocated for alternate energy in

12 'History of Alternative Energy and Fossil Fuels', ProCon.org, *Available At* http://alternativeenergy.procon.org/view.timeline.php?timelineID=000015 (Last accessed 2 May 2017.)

13 *Ibid*.

14 *Ibid*.

15 *Ibid*.

1977 in the form of a warning[16] and the same year the US Department of Energy launched the Solar Energy Research Institute (Golden, Colorado) now the National Renewable Energy Laboratory. But the rapid growth in this sector started with the threat of climate change and greenhouse emissions. Countries engaged in many international treaties to reduce the greenhouse gases by promoting sustainable development through renewable energy. But still this was not the primary focus for countries as there was no direct discussion on renewable energy trade in GATT discussions while discussing the creation of WTO. However after the rapid liberalization and globalization and excess use of fossil fuel to move the economy, the danger of climate change and government's intention to go renewable way made it a new and attractive sector for investors to go for research and development to make it not a very costly affair to deal with. The result is most of the countries have policies for strengthening their renewable energy industry because future lies in renewable energy. The job creation in the renewable energy sector is also a good sign. In 2015 in terms of all kinds of renewable energy technologies the biggest employers were China, Brazil, USA and India with more than 8.1 million jobs (excluding large-scale hydro power).[17]

India and Renewable Energy

Renewable energy sector in India is considered sunrise sector for its capacity to expand as clean energy provider[18]. India figured in top ten list of countries investing in renewable energy as per 2016 UNEP Global Trends in Renewable Energy Investment Report.[19] The revised target of Government for renewable energy till 2022 has been increased to 175 GW. Its highest target is in solar with 100 GW followed by Wind with 60 GW, Biomass 10 GW and Small Hydro with 5 GW.[20] India is striving hard to switch over to clean energy with

16 Peter Dykstra, 'Analysis: 35 years later, Jimmy Carter's energy warning', The Daily Climate, 15 July 2014, *Available At* http://www.dailyclimate.org/tdc-newsroom/2014/07/carter-crisis-speech-anniversary (Last accessed 7 May 2017).

17 Renewables 2016: Global Status Report, REN21 (Renewable Energy Policy Network for 21st Century), at p. 6, *Available At* http://www.ren21.net/wp-content/uploads/2016/10/REN21_GSR2016_FullReport_en_11.pdf (Last accessed 8 May 2017).

18 Utpal Bhaskar, 'Renewable energy—India's sunrise sector', Live Mint, 13 March 2015, *Available At* http://www.livemint.com/Politics/p17bEaMyU6xy6pMa2MisEO/Renewable-energyIndias-sunrise-sector.html (Last accessed 14 May 2017).

19 'Renewable Energy Sector: Achievement Report 2014-16', India, Available At http://www.makeinindia.com/article/-/v/renewable-energy-sector-achievement-report (Last accessed 9 May 2017).

20 *Ibid*.

its target to achieve 40 percent of total installed capacity from non-fossil fuel based energy resources and reducing emissions up to 35 percent by 2030.[21] India recently auctioned 1000 MW of wind energy project at INR 3.46 per unit[22].

Before that it had auctioned solar energy project at INR 2.97 per unit.[23] Apart from that power distributors are interested in the renewable energy venture as BSES Rajdhani Power Limited (BRPL) has entered in to an agreement with the Power Trading Corporation of India Limited for procuring 100 MW wind power. This is for 25 years starting from November 2018 at INR 3.46 per unit.[24] But still because of its large population and growing energy requirements the government is of the view that its reliance on coal cannot be wiped off. India uses just 1010 kWh as per 2015 report against China's 4000 kWh and developed countries average 15,000 kWh per capita.[25] Out of this around 50 percent are from commercial sources such as coal, petroleum and electricity.[26] India's existing energy generation capacity is heavily dominated by coal through thermal power as it accounts for 211 GW as of May 2016 making it 70 percent of its total capacity.[27] Thus switching to renewable energy is the core of Indian requirement. For this government's facilitation and regulations both are necessary. There is no legislation on renewable energy yet but a Draft Act called National Renewable Energy Act 2015 is there for suggestions and comments from the public before it could be finally brought as an Act.[28] In terms

21 *Ibid*.

22 Kaavya Chandrasekaran, 'Govt Auctions 1000 MW of Projects at Rs. 3.46 a unit', The Economic Times, 25 February 2017, *Available At* http://economictimes.indiatimes.com/industry/energy/power/govt-auctions-1000-mw-of-projects-at-rs-3-46-a-unit/articleshow/57333175.cms (Last accessed 7/5/2017).

23 *Ibid*

24 BRPL Signs Pact to Procure Wind Power, Delhi Metro, *The Hindu,* p.2, 5 May 2017

25 Utpal Bhashkar, 'India's per capita electricity consumption touches 1010 kWh', Live Mint, 20 July 2015, *Available At* http://www.livemint.com/Industry/jqvJpYRpSNyldcuUlZrqQM/Indias-per-capita-electricity-consumption-touches-1010-kWh.html (Last accessed 12/5/2017).

26 As per 2012 report, see, Asif Ali, Aarif Zaheer, and Osama Khan, 'Life Cycle Assessment of Solar Photovoltaic Electricity Generating System', International Journal of Mechanical and Production Engineering, Vol 1, issue 6, 2013, at p. 1, *Available At* http://www.iraj.in/journal/journal_file/journal_pdf/2-17-139054398308-11.pdf (Last accessed 7/5/2017).

27 Megha Kaladharan, 'Renewable Energy in India: An Analysis of the Regulatory Environment and Evolving Policy Trends', Working Paper, 2016, Initiative on Climate Energy and Environment, Centre for Policy Research, New Delhi, at p. 2. Available at http://www.cprindia.org/research/papers/renewable-energy-india-analysis-regulatory-environment-and-evolving-policy-trends (Last accessed 7/5/2017).

28 National Renewable Energy Act 2015, India, *Available At* http://mnre.gov.in/file-manager/UserFiles/draft-rea-2015.pdf (Last accessed 7/5/2017).

of facilitation and promotion of investment in renewable energy the government allows 100 percent FDI through automatic route for renewable energy projects subject to Electricity Act of 2003. There are further fiscal incentives such as accelerated depreciation, concessional customs duty, excise duty exemption, income tax holidays for 10 years etc.[29] Capital subsidies for general states and Union Territories up to 30 percent and for special category states up to 70 percent, and subsidies for roof top solar installations are other incentives.[30] The objective is to make India a global leader in solar energy. The inter-state transmission charges have been waved off since January 2016. Further, to give effect to National Action Plan on Climate Change 2008, the government came out with Jawaharlala Nehru National Solar Mission (JNNSM) which will work in three phases.[31] The 12th five year plan will be in phase I (2012-13), phase II (2013-17) and Phase III (2017-22). Modern renewable energy is being used increasingly in four distinct markets: power generation, heating and cooling, transport, and rural/off-grid energy services.[32] Similarly many countries in the world are switching over to renewable energy with fast speed. Among them European countries as well as China, South Africa, Malaysia, Egypt etc. to name a few are very important.

Feed-in Tariff (FIT) and Domestic Content Requirement (DCR)

FIT is the abbreviation for 'feed-in tariffs'. This is a policy measure by which the government guarantees for a fixed price of all renewable energy produced by producers for an agreed period of time provided certain conditions are met.[33] The

29 New and Renewable Energy Sector Achievement Report, MNRE, 18 January 2017, *Available At* https://drive.google.com/file/d/0B-Tv7_upCKANTTI1cURVMWwxa0k/view (Last accessed 9/5/2017),

30 *Ibid*.

31 Resolution No. 5/14/2008/P&C, 'Jawaharlal Nehru National Solar Mission', Ministry of New and Renewable Energy, *Available At* http://www.mnre.gov.in/solar-mission/jnnsm/resolution-2/ (Last accessed 9/5/2017.)

32 Renewable Energy and Green Growth in India, Draft Final Report, The Energy and Research Institute (TERI), 2015, p.1, *Available At* http://www.teriin.org/projects/green/pdf/National-RE.pdf (Last accessed 9/5/2017).

33 Solar Feed-In Tariff – Can you profit from the Feed-In Tariff? *Available At* https://www.solarguide.co.uk/feed-in-tariff-fit, accessed 7 May 2017 see also, 'Marie Wilke, Feed-in Tariffs for Renewable Energy and WTO Subsidy Rules: An Initial Legal Review', ICTSD Programme on Trade and Environment, Trade and Sustainable Energy Series 1 (International Centre for Trade and Sustainable Development, Geneva, Switz., Aug. 2011), *Available At* http://www.ictsd.org/downloads/2011/11/feed-in-tariffs-for-renewable-energy-and-wto-subsidy-rules.pdf (Last accessed 7/5/2017).

benefit to the producers is given at two stages. First, it is paid for all renewable energy produced, and second, when the extra energy left over after personal household use is given to the grid.[34] The earlier one is called Generation tariff and later one the Export tariff. The FIT is known with different names as well such as 'Electricity Feed Laws, Feed-in Laws, Feed-in Tariffs (FITs), Advanced Renewable Tariffs (ARTs), Renewable Tariffs, Renewable Energy Payments, and more recently CLEAN (for Clean Local Energy Accessible Now) contracts'.[35] Under the Malaysian Renewable Energy Act, 2011 FIT is defined as 'feed-in tariff means the special tariff payable to feed-in approval holders in consideration for renewable energy generated and sold to a distribution licensee as specified in the third column of the schedule'.[36] Whatever may be the name or terminologies used, the main theme underlined is to provide a policy measure where the aim is to grow the renewable energy fast. It gives the opportunity to everyone like individual, household, farmer or industry to generate renewable energy on the roof top, farm, or anywhere and can give to the grid whatever is left after personal use. An example of FITs can be found in disputes like Canada Renewables and Canada-Feed-In Tariffs, and India- Solar Panel dispute. FITs are not limited to only Canada or India. It is practiced in at least seventy three countries.[37] It is in practice in several countries such as China[38], Australia[39], Germany,[40]

34 *Ibid.*

35 'What are Feed-in Tariffs?' *Available At* http://www.wind-works.org/cms/index.php?id=86 accessed 8 May 2017 , see Rakesh Shah, 'Renewable Energy Tariffs: Regulations and Design', 5th Capacity Building Programme for Officers of Electricity Regulatory Commissions 18 – 23 Oct., 2012, Department of Industrial and Management Engineering Indian Institute of Technology Kanpur, *Available At* https://www.iitk.ac.in/ime/anoops/for12/2%20-%20Mr.%20Rakesh%20Shah%20%20- %20Renewable%20Energy%20Tariffs%20Regulations%20and%20Design.pdf (Last accessed 10/5/2017).

36 Interpretation, Section 2, Renewable Energy Act 2011, Malaysia.

37 Jean-François Mayoraz, Renewable Energy and WTO Subsidy Rules: The Feed-In Tariff Scheme of Switzerland, in Giovanna Adinolfi et. al edn., International Economic Law; Contemporary Issues, Springer, 2016, Abstract, *Available At* https://link.springer.com/chapter/10.1007/978-3-319-44645-5_10 (Last accessed 10/5/2017).

38 China's 2017 Feed-in Tariff Rates for PV Projects Discovered, EnergyTrend PV, 07 December 2016, *Available At* http://pv.energytrend.com/news/China_2017_Feed_in_Tariff_Rates_for_PV_Prpjects_Discovered.html (Last accessed 10/5/2017).

39 Feed-in Tariffs, Parliament of Australia, *Available At*, http://www.aph.gov.au/About_Parliament/Parliamentary_Departments/Parliamentary_Library/Browse_by_Topic/ClimateChangeold/governance/domestic/national/feed (Last accessed 12/5/2017) The information claims that there are around forty countries and federal states which are having FIT Schemes.

40 *Ibid.*

Japan,[41] New Zealand[42], South Korea[43], Singapore[44], Philippines[45], Brazil[46], South Africa,[47] Switzerland and Thailand[48] to name some of them. Twenty four out of twenty seven countries of European Union practice FIT schemes.[49] Not only that even in the US at least six states such as California, Hawaii, Maine, Oregon, Vermont, and Washington has mandatory FIT or similar program.[50]

Benefits of FIT Schemes:

"Feed-in tariffs (FITs), along with renewable electricity standards, are one of the most widely adopted renewable energy support policies around the world."[51] This is considered a very effective tool to fight climate change.[52] Therefore many countries used it widely for a substantial number of years. In Europe countries used it for expanding renewable energy generation and got very good result as they could create '15000 MW of solar PV power and more than 55,000MW

41 Opportunities in the Growth Markets in Asia-Pacific, KPMG Global Trends in Renewable Energy, 2016, *Available At* https://assets.kpmg.com/content/dam/kpmg/sg/pdf/2016/11/Global-Trends-in-Renewable-Energy.pdf, accessed 12 May 2017, also see Feed-in Tariff for electricity generated from renewable energy, Japan, IEA, *Available At* https://www.iea.org/policiesandmeasures/pams/japan/name-30660-en.php (Last accessed 12/5/2017).

42 *Ibid*.

43 *Ibid*.

44 *Ibid*.

45 *Ibid*.

46 Luiz Barroso, 'Renewable Energy Auctions: the Brazilian Experience', Novembar 2012, p.6, *Available At* https://www.irena.org/DocumentDownloads/events/2012/November/Tariff/4_Luiz_Barroso.pdf (Last accessed 12/5/2017).

47 State of Renewable Energy in South Africa, Department of Energy, Republic of South Africa, 2015, *Available At* http://www.gov.za/sites/www.gov.za/files/State%20of%20Renewable%20Energy%20in%20South%20Africa_s.pdf (Last accessed 12/5/2017).

48 Thailand Shifts From Renewable Energy Adder Rates To Feed-In Tariffs For VSPPs, Watson Farely & Williams LLP Report, March 2015, *Available At* http://www.wfw.com/wp-content/uploads/2015/03/WFW-Energy-ThailandFiTs-March2015.pdf (Last accessed 12/5/2017.)

49 Compare Support Schemes, RES LEGAL, *Available At* http://www.res-legal.eu/compare-support-schemes/. (Last accessed 12/5/2017).

50 Feed-in Tariffs, NREL, US Department of Energy, *Available At* http://www.nrel.gov/tech_deployment/state_local_governments/basics_tariffs.html (Last accessed 12/5/2017).

51 Sadie Cox and Sean Esterly, 'Feed-in Tariffs: Good Practices and Design Considerations', A Clean Energy Regulators Initiative Report, National Renewable Energy Laboratory, Technical Report NREL/TP-6A20-65503, January 2016, US Department of Energy, *Available At* http://www.nrel.gov/docs/fy16osti/65503.pdf (Last accessed 12/5/2017).

52 Kenina Lee, Note, An Inherent Conflict Between WTO Law and a Sustainable Future? Evaluating the Consistence of Canadian and Chinese Renewable Energy Policies with WTO Trade Law, 24 Geo. Int'l Envtl. L. Rev. 57, 85 (2011).

of wind power from 2000 to 2009.[53] This has helped to create 45 percent of global wind power and 75 percent of global solar PV.[54]

FIT Models:

There are different FIT models or designs followed by countries in their jurisdiction. Still a newer model can come in to picture if another country feels that is more suitable to them. One model is followed by Canada and India. In both cases there is a precondition that in order to qualify itself for a renewable energy project the SPDs must use a specific percentage of inputs in the final solar panel used by them which are manufactured domestically. Basically this requirement only was questioned in both WTO disputes against Canada and India. Another model is followed by Turkey[55] and Malaysia wherein they progressively incentivize the SPDs who follow DCR. In that model a basic feed-in tariff is available to all SPDs but a bonus or extra incentive is given to those who use more domestically produced solar cells or follow extended DCR.

What is DCR?

Domestic Content Requirement or local content requirement is a precondition for the industries coming to a country to do business in terms of using locally manufactured products in their final products what they will use. This is done for two reasons, first: create jobs at home rather than abroad and second: channelize business in such a manner that the subsidies given are circulated in the domestic economy.

This use of DCR under GATT is neither new nor restricted to the renewable energy.[56] Since global recession of 2008 more than 100 new domestic content

53 Toby D. Couture *et al.*, U.S. Dept. of Energy Nat'l Renewable Energy Laboratory, Policymaker's Guide to Feed-in Tariff Policy Design, (2010), as mentioned by Virginia R.Hildreth in , 2013-2014'Renewable Energy Subsidies and the GATT', 14 Chi. J. Int'l L. 702.

54 *Ibid*.

55 Derya Kaplan, 'Renewable Energy Turkey; Opportunities?' Embassy of the Kingdom of the Netherlands, October 2015 ,p.5-7, *Available At* https://www.rvo.nl/sites/default/files/2015/10/Renewable%20Energy%20Turkey.pdf (Last accessed 12/5/2017).

56 G. Hufbauer et al., 'Local Content Requirements: Report on a Global Problem', Peterson Inst. Intl. Econ., 28 June 2013, Washington DC, *Available At* http://files.publicaffairs.geblogs.com/files/2014/08/Local-Content-Requirements-Report-on-a-Global-Problem.pdf (Last accessed 12/5/2017).

requirements havhase been adopted by the countries like Argentina, Australia, Brazil, Canada, China, India, Indonesia, Kazakhstan and the United States.[57] India and Canada made it mandatory that for an SPD to qualify for a project under their renewable energy missions some parts of the solar panels must be domestically manufactured products, while the things were quite the opposite in cases of Germany and UK. In Canada Renewables and Feed-in Tariff case the main contention of the complainant European Union was that Canada's feed-in tariff rules require a mandatory domestic content level. It meant if an SPD does not meet the required domestic or local content level, it will not be eligible to participate in the program there by eliminating his chances to participate in the projects of the government for renewable energy generation.

Fit and Domestic Content Requirement: Is It Necessary to Achieve Desired Environmental Goals?

FIT schemes are not a watertight compartment from which derogation or changes are not possible. In fact different countries have used it with modifications to suit their policy measures. If we take cases of Canada, India, Germany and United Kingdoms who had this FITs scheme, it becomes clear that DCR is not necessary for it.

Indian Solar Panel Case

The case relates to Domestic Content Requirement in solar panels used for generating solar energy and providing it to grids for sale under Jawaharlal Nehru National Solar Mission (National Solar Mission). The solar mission was launched on the 11th January, 2010 by the Indian government with the aim of deploying 20,000 MW of grid connected solar power by 2022 aimed at reducing the cost of solar power generation in the country through (i) long term policy; (ii) large scale deployment goals; (iii) aggressive R&D; and (iv) domestic production of critical raw materials, components and products, as a result to

57 *Ibid.*

achieve grid tariff parity by 2022. Later on in June 2015 the government revised its target to 100,000 MW for the same period from the existing 20,000 MW.[58]

This is devised in three phase viz. first up to 2013, second up to 2017 and third up to 2022.[59]

In its complaint before the Panel the United States claimed that instruments in the form of different guidelines and Agreements required in Phase I and Phase II of the Solar Mission, certain domestic content requirements for the entities selling solar energy violate certain WTO obligation of India.[60] Under the solar mission, the government of India enters into long term (25 years) power purchase agreement (PPA) with the solar power developers (SDPs) at a fixed rate. The rate is determined at two levels by two government entities viz. Central Electricity Regulatory Commission at the national level, and the State Electricity Regulatory Commission at each state level. The purchased electricity from the SPDs is then sold to distributor companies (DISCOMs) by the government which in turn sells the electricity to the end consumers.[61] The MNRE is the government ministry dealing solely with renewable energy. Under the solar mission's three phases the MNRE had chosen NTPC Vidyut Vyapar Nigam Limited (NVVN) and Solar Energy Corporation of India (SECI) for implementing the solar power project selection process, including but not limited to issuing the Request for Selection document governing the selection of solar power projects. Regarding the domestic content requirement, it was set forth in guidelines document and reproduced in the *Request for Selection* document.[62] The applicable domestic content requirement was then reaffirmed in the model PPA and all of the individually executed PPAs in each Batch, and further implemented through a "specific plan". Further the SPDs had to explain how it would meet DCR. The DCR also differed in different batches.

58 Scheme/Documents, Ministry of New and Renewable Energy, Government of India, *Available At* http://www.mnre.gov.in/solar-mission/jnnsm/introduction-2/ (Last accessed 12/5/2017).

59 Targets set for development of Solar Power under NSM, Jawaharlal Nehru National Solar Mission, Guidelines for Solar Grid Power Projects, *Available At* http://www.nvvn.co.in/NVVN%20Presentation.pdf (Last accessed 10/5/2017).

60 Para 2.1 – 2.2, Panel Report, India – Certain Measures Relating to Solar Cells and Solar Modules, WT/DS456/R, 24 February 2016.

61 *Ibid*, para 7.2.

62 *Ibid*, para 7.8.

In phase I Batch I, the SPDs were selected if they comply the DCR. In Phase I Batch II, use of c-Si cells and modules\ produced in India was a mandatory requirement if C-Si based project is taken.[63] However the use of domestic or foreign modules made from thin-film technologies or concentrator PV cells was permitted.[64] Under Phase II Batch 1, projects were divided in two parts. One part required DCR and other did not.[65]

India put forth three defenses but lost on all counts in both Panel and Appellate Body.

Defences of India for Dcrs

India defended its DCR policies in the FIT program under three GATT provisions. The US had claimed before the Panel that India's DCR measures violated India's obligation under Article III:4 of GATT 1994 as well as Article 2.1 of TRIMS Agreement.[66] To it India first claimed that there is no violation of the above provisions and alternatively it presented that its actions are justified under Article III: 8(a), Article XX (j) or Article XX (d) of GATT 1994.[67] In appeal before the Appellate Body the above mentioned three provisions were discussed thoroughly.

a) ***Article III: 8 (a) - Derogation from national treatment under Article III:***

US argued that violation of Article 2.1 of the TRIMS Agreement is contingent on the finding of a violation of Article III: 4 of GATT. To which the Panel was of the view that if the measures fall under paragraph 1 of Article 1(a) of TRIMS Illustrative List, the matter gets over and no further discussion under Article

63 *Ibid*, para 7.8, also see, Jawaharlal Nehru National Solar Mission, Guidelines for Selection of New Grid Connected Solar Power Projects, *Available At* http://www.nvvn.co.in/Guidelines.pdf, Last accessed 12 May 2017, Jawaharlal Nehru National Solar Mission, Guidelines for Solar Grid Power Projects, *Available At* http://www.nvvn.co.in/NVVN%20Presentation.pdf (Last accessed 12/5/2017).

64 *Ibid*, para 7.9.

65 *Ibid*, para 7.10.

66 Panel Report, India – Certain Measures Relating to Solar Cells and Solar Modules, WT/DS456/R, 24 February 2016, para 3.1.

67 *Ibid*, para 3.2.

III:4 is needed. While discussing the DCRs at issue the Panel held that it violated both TRIMS provision as well as Article III: 4 of GATT. Now Article III:8 which is an exception to the Article III: 4 was discussed in order to find out whether Indian measure requiring DCR is justified or not. This was guided by the *Canada-Renewable Energy and Feed-in Tariff* case. In this case the AB had ruled out that in order to justify the derogation provided under Article III: 8, the product at question must be in direct competition with the product being discriminated.[68] The Panel had agreed with it which was challenged in appeal by India.

However India had tried to make differences between Indian measure and Canadian measure to avoid the implication of Canada- Feed-in Tariff case.[69] It argued that products at hand 'solar panels and modules are 'integral input' while products such as electric wiring and inverters are 'ancillary'.[70] To it AB agreed with the Panel and held that solar cells and modules subject to the measure did not constitute 'inputs and processes of production' for the purposes of Article III: 8 (a)[71]. Therefore the AB used the rationale in *Canada-Renewable Energy and Feed-in Tariff* and agreed with the Panel's finding that Indian measure is not justified based on the same argument accepted by AB in Canada- Renewable and Feed-in Tariff case. It held that "Article III: 8(a), the product purchased by way of procurement must necessarily be 'like' or 'directly competitive' with or 'substitutable' for – in other words, in a 'competitive relationship' with – the foreign product subject to discrimination[72] as the question had turned in to whether government of India was purchasing solar modules or it was purchasing electricity.[73]

68 Appellate Body Report, Canada-Renewable Energy/ Canada Feed-in Tariff Program, para 5.55.

69 Panel Report, India – Certain Measures Relating to Solar Cells and Solar Modules, WT/DS456/R, 24 February 2016, , para 7.109, 7.124 and 7.127. also see, Appellate Body Report, India – Certain Measures Relating to Solar Cells and Solar Modules, WT/DS456/AB/R 15 September 2016, para 5.7-5.11.

70 *Ibid*.

71 Appellate Body Report, India – Certain Measures Relating to Solar Cells and Solar Modules, WT/DS456/AB/R 15 September 2016, para 5.31.

72 Appellate Body Report, India – Certain Measures Relating to Solar Cells and Solar Modules WT/DS456/AB/R, Para 5.40.

73 *Ibid*, para 5.42-44.

(b) The Exception under Article XX (j) - General or Local Short Supply:

This provision falls under Article XX which is exceptions to General provisions of GATT 1994. To bring a measure under it, measures have to pass through two tier test. First, it has to satisfy its consistency with at least one of the exceptions enumerated under Article XX (a) to (j) and, second, it has to satisfy its consistency with the *chapeau.*[74] In the present dispute whether DCR of Indian measures will justify the two tier test was a question. India had argued that lack of capacity to manufacture solar cells and modules in India amounted to a situation of local and general short supply and its DCR measures are to remove short supply situations under Article XX (j).[75]According to Indian argument 'general or local short supply' in Article XX (j) 'contemplates short supply that is distinct from situations that can be addressed by 'international supply'.[76] It further argues that an 'interpretation that Article XX(j) cannot be applied when imports are available fundamentally veers towards the position that only export restraints will qualify for consideration under Article XX(j), and not import restraints'. Had this been intention of drafters, they would have done it explicitly as in Article XI: 2 of the GATT 1994[77]. For the AB it was the first time that the interpretation and application of Article XX (j) were brought before it. So for literature and guidance it looked in to the jurisprudence associated with Article XX as well as Article XX (d). While analyzing AB Reports in earlier cases it found that a defense under Article XX (d) requires that the initial threshold should be to find out laws and regulations prevailing which are not GATT inconsistent with which the proposed measure is willing to comply with.[78] Once

74 See Appellate Body Report, United States – Standards for Reformulated and Conventional Gasoline, WT/DS2/AB/R, p. 22, Appellate Body Reports, Dominican Republic – Import and Sale of Cigarettes, WT/DS302/AB/R, para. 64, Appellate Body Report, United States – Import Prohibition of Certain Shrimp and Shrimp Products, WT/DS58/AB/R, paras. 119-120; and Appellate Body Reports, European Communities – Measures Prohibiting the Importation and Marketing of Seal Products, WT/DS400/AB/R / WT/DS401/AB/R, para. 5.169.

75 Appellate Body Report, India – Certain Measures Relating to Solar Cells and Solar Modules WT/DS456/AB/R, Para 5.51.

76 *Ibid*, para 5.51.

77 *Ibid*.

78 Appellate Body Report, Colombia – Measures Relating to the Importation of Textiles, Apparel and Footwear, WT/DS461/AB/R, para. 5.126 (referring to Appellate Body Report, Argentina – Financial Services, para. 6.203). paras. 5.68-5.69 (referring to Appellate Body Reports,

the measure is found not consistent with the laws and regulations consistent with GATT, it is considered that the measures are not justified under Article XX (d) and any further enquiry is stopped.[79] The second requirement under Article XX (d) is of 'necessity'. The AB is of view that 'necessary' requirement looks for a holistic and in-depth analysis of inconsistent measure vis a vis the relevant laws and regulations.[80] The AB analyzed that elements of analysis under Article XX (d) is relevant mutatis mutandis also under Article XX (j)[81]. Therefore the AB assessed the extent to which the measures taken by India in question is justified in its contribution towards 'the acquisition or distribution of products in general or local short supply', the relative importance of the societal interests or values that the measure is intended to protect; and the trade-restrictiveness of the challenged measure.[82] In most cases, a comparison between the challenged measure and reasonably available alternative measures should then be undertaken. In its analysis of Article XX (j) it required being analyzed the extent to which a particular product is 'available' for purchase in a particular geographical area or market also noting not only the domestic production rather also the purchasing power of the consumers and the role producers play in the domestic market. It also asserted that due regard should be given to the total quantity of imports which can be made available to counter the short supply. Thus to succeed the claim under Article XX (j) the respondent must show that the quantity of 'available' supply from both domestic and international sources are insufficient to meet the demand in the relevant domestic or geographical market.[83] However giving due respect to the WTO Agreement the AB noted that the objective of sustainable development, protection and preservation of the environment, different levels of economic development of Members etc.

Argentina – Financial Services, para. 6.203; Appellate Body Report, Mexico – Tax Measures on Soft Drinks and Other Beverages, WT/DS308/AB/R, para. 72; Appellate Body Report, United States – Import Prohibition of Certain Shrimp and Shrimp Products, WT/DS58/AB/R, paras. 135-142; and Appellate Body Reports, European Communities – Measures Prohibiting the Importation and Marketing of Seal Products, WT/DS400/AB/R / WT/DS401/AB/R, para. 5.144.

79 Appellate Body Report, India – Certain Measures Relating to Solar Cells and Solar Modules WT/DS456/AB/R, Para 5.58.

80 Ibid, para 5.59.

81 Ibid, para 5.60.

82 Ibid, para 5.63.

83 *Ibid*, para 5.71.

should be kept in mind while interpreting Article XX (j)[84]. But at the end to conclude the AB held that since India could not justify its claim that quantity of 'available' supply of solar cells and solar modules from both domestic and international sources are insufficient to meet the demand in the relevant domestic or geographical market, Panel was right in saying that Indian measures are not justified under Article XX (j)[85].

c. ***Exception under Article XX (d)***

Under Article XX (d) those measures are exempted which are necessary to seek compliance with domestic law or regulations consistent with GATT 1994. This provision was dealt with in *Korea- beef* case[86] and Mexico- Taxes on soft drinks case[87]. In the Korean beef case the AB elaborated it saying that to justify exceptions under Article XX (d) the party must show first, the measure is 'designed to ensure compliance with the domestic law' and second, the domestic law itself is not inconsistent with the GATT. Further in Mexico- Taxes on soft drink case the AB held that laws or regulations cover rules that form part of the domestic legal system including international agreements incorporated in the domestic system or having a direct effect up on the WTO Member's system.[88]

In the present case the Panel and AB rejected all defenses of India. India's first argument was that DCRs at issue were essential in ensuring compliance by India with its obligations under international law. It put forth the example of UN Framework Convention on Climate Change, UN Conference on Environment and Development, Biodiversity Convention, Electricity Act, Electricity Policy etc.[89]. This was vehemently opposed by the US and EU on the ground that laws and regulations cited by India do not specify the DCR requirements. Also they were broad policy guidelines and they cited GATT era cases EEC-Parts and

84 *Ibid*, para 5.72.

85 *Ibid*, para 5.89-90.

86 WTO Appellate Body Report, Korea—Measures Affecting Imports of Fresh, Chilled and Frozen Beef, 31 July 2000, WTO Doc. WT/DS161/AB/R.

87 WTO Appellate Body Report, Mexico—Tax Measures on Soft Drinks and Other Beverages, 6 March 2006, WTO Doc. WT/DS308/AB/R.

88 *Ibid*, para 69 and 79.

89 WTO Panel Report, para 7.294-297.

Components where it was said by the Panel that compliance meant 'to enforce obligations' and not 'to ensure the attainment of the objectives of laws and regulations'.[90] On the same tune the EU quoted panel report in Colombia-Ports of Entry where it was held that 'securing compliance' meant only enforcement of obligations and not the attainment of objectives of laws and regulations[91]. The same was accepted by the Panel.[92] In appeal the AB considered this argument and also relied on *Mexico-Taxes on Soft Drinks*[93] as well as *Argentina-Financial Services*[94] to reach the same conclusion as the Panel. It said that 'to secure compliance' is not to be read as meaning to 'enforce compliance' instead, it is important to distinguish between specific rules, obligations or requirements under which compliance is claimed from and on the other hand, objectives of the relevant laws or regulations.[95]

On the matter of domestic instruments of India such as National Electricity Plan, National Electricity Policy and National Action Plan on Climate Change the AB held in consonance with the Panel that it failed to understand how these instruments read together could be understood to set out a 'rule' to ensure ecologically sustainable growth of India as India itself submitted that they are non-binding legal documents.[96] Similarly it rejected binding obligation under section 3 of Electricity Act as it understood that the provision does not speak as to which extent these non-binding domestic instruments are to be observed or complied under the domestic legal system.[97]

---

90 GATT Panel Report, EEC—Regulation on Imports of Parts and Components, 16 May 1990, GATT Doc. No. BISD 37S/132.

91 WTO Panel Report, Colombia –Indicative Prices and Restrictions on Ports of Entry, 27 April 2009, WTO Doc. WT/DS366/R at para. 7.538 as cited by EU "Third Party Written Submission by the European Union", India—Certain Measures Relating to Solar Cells and Solar Modules, 19 December 2014, WTO Doc. WT/DS456, at para. 67

92 WTO Panel Report, India- Solar, para 7.267.

93 WTO Appellate Body Report, Mexico—Tax Measures on Soft Drinks and Other Beverages, 6 March 2006, WTO Doc. WT/DS308/AB/R, para 8.175.

94 Appellate Body Report, Argentina – Measures Relating to Trade in Goods and Services, WT/DS453/AB/R, fn 495 to para 6.203.

95 AB Report, India- Solar Panel, para 5.108-110.

96 *Ibid*, Para 5.133 along with fn. 362.

97 *Ibid*, para 5.136.

On India's claim before the AB that Panel erred in recognizing India's obligation under International Instrument should be reversed, India gave two arguments in its support. First, India does not need domestic legislation to implement international obligations which has 'direct effect' as the executive of the central government can directly implement them and second, 'direct effect' of the identified international instruments 'are the sustainable development principles recognized by the Supreme Court in environmental and developmental governance in India'[98]. The AB relied on above mentioned argument that for a measure to be exempted under the Article XX (d) it has to be specific and not the whole objective of the laws and regulations.[99] In order to know 'direct effect' of international instruments, the AB looked in to Indian submissions where it had cited its Supreme Court jurisprudence of sustainable development principles. It concluded that nowhere the Supreme Court had discussed the binding or non-binding nature of environmental principles or instruments rather, it only used them as a guidance or relevance.[100] Since they concluded that Indian measures of DCR do not qualify under Article XX (d) and (j) the AB did not go for chapeau requirements under Article XX.[101]

Impact of Indian Solar Panel Decision on Indian Redevelopment

Ha-Joon Chang in his famous book 'Kicking Away the Ladder: Development Strategy in a Historical Perspective'[102] very beautifully showed how all developed countries including the US used the protectionist measures as well as various subsidies in order to uplift the infant industries. Still six States in the US uses DCR in its schemes which India has challenged before the WTO DSB.[103] This indicates that countries do need them for their benefits which are not only trade

98 *Ibid*, para 5.138.
99 *Ibid*, para 5.145.
100 *Ibid*, para 1.145-47.
101 *Ibid*, para 5.155.
102 Ha-Joon Chang, *Kicking Away the Ladder: Development Strategy in a Historical Perspective*, 1st edn., Anthem Press 2002, London.
103 See, Feed-in Tariffs, NREL, US Department of Energy, *Available At* http://www.nrel.gov/tech_deployment/state_local_governments/basics_tariffs.html (Last accessed 12/5/2017).

centric but also for job creation. Countries like India have to feed billions as its large chunk of the population live below poverty line. The present AB report in India- Solar Panel dispute might be true on the legal point under the WTO system but we should not forget that the problem is not limited to compliance with GATT or other WTO Agreements rather it is something else also. As we see in the Indian JNNSM program India clearly puts out the objective as to also create jobs along with the promotion of green industries.[104] On merit AB is justified in relying heavily on *Canada-Renewable Energy/Feed in Tariff case* and commentators who claim that AB has given a proper decision is right. But the other aspect of this decision lies in the fact that the source of the problem is in the not enough specificity in the WTO law of subsidies as 'even though statutory language is framed prohibitively, it realistically allows nothing'.[105] This makes very difficult to achieve the economic and environmental goals by the developing countries as they do not know which policy to form that will be WTO compliant as well. Umair is right in arguing that for the US it was very easy to contend that it is not against the Indian renewable energy program rather its DCR which is restricting market access but what the US did not take in to account was India's requirement of creation of jobs and renewable energy industry development.[106] Had they seen from this angle, they would have found that the DCR was fulfilling both the requirements. But this argument will take us to the evergreen debate of developing country versus developed country. International trade or relation does not work on morality. It is very hard reality that countries see only their own interest and they bargain for their maximum benefit which was reflected in several Rounds of GATT before we got the WTO. But critical point lies in the fact that there is a lack of specificity in WTO subsidies law which keeps member states in confusion or ambiguity. As incentive is the most effective way of supporting an infant industry, developing countries will keep using them and be dragged to WTO DSB. Here two things are clear. One, the outcome of the dispute will be known in well in advance based on previous cases, and, two, the developing countries will be forced to

104 Panel Report, India- Solar Panel, para 7.58.

105 Umair Hafeez Ghori, "Reverse Permissibility" in the Renewable Energy Sector: Going Beyond the US-India Solar Cells Dispute, Asian Journal of International Law, 2016, p. 1-28, at 18.

106 *Ibid*.

give those incentives and breach WTO laws. Another problem lies in the fact of ambiguity as to conflict between GATT Article III:4 and TRIMS Agreement.

From the Panel Report it is clear that third parties such as EU, Brazil, Canada, Japan and Korea all have divergent views on the application of GATT Article III: 4 and TRIMS Agreement.[107] While EU felt that Article 2.1 of Illustrative List of TRIMS is more specific and should be discussed before GATT Article III: 4, Canada and Japan disagreed with EU's giving primacy to the TRIMS.[108] Again Brazil is of the view that GATT Article III: 4 should get priority over TRIMS Agreement. Korea followed the mid path by saying that AB gave flexibility to the Panel to structure the analysis applying the law, it should do it as per the requirement and claims presented by parties for effective redress of claims.[109] A comparison of cases involving these two laws shows that Panel has not been consistent in its approach giving further uncertainty in a similar case of India-Solar Panel for analyzing whether DCR measure is inconsistent with GATT Article III: 4 if it fell within paragraph 1 (a) of TRIMS Agreement.[110] There might be a different conclusion in that case. Now the question is about direct or indirect bearings of this decision on Indian renewable energy program, renewable energy industry, sustainable development and job creation. The discussion below will try to find them out.

Renewable Energy Industry: Of course for an infant industry certain incentives are necessary to grow. This has been done by several countries including the developed one. The issue for developing countries is not much as to whether there will be a surge in the use of renewable energy or not, rather the real issue is whose renewable energy products will be used. In the present case the US and third parties were safeguarding their own renewable industry where as India was safeguarding its own renewable industry through DCR mechanism. One example of China can be taken here. In the wind energy sector China used

107 Panel Report, India- Solar Panel, para 7. 45.

108 *Ibid*.

109 *Ibid*.

110 Comparison of four Panel Reports in Indonesia- Autos, Canada- Autos, India- Autos, Canada- Renewable Energy/Feed-in Tariff, shows non-confirmity in the structural analysis of TRIMS and GATT Article III:4. For more detail see, Umair Hafeez Ghori, "Reverse Permissibility" in the Renewable Energy Sector: Going Beyond the US-India Solar Cells Dispute, Asian Journal of International Law, 2016, p. 1-28, at 20.

DCR in 2007 when its Renewable Energy Law was enforced to speed up its program. Its DCR requirement was up to 70 percent and it was repealed only in 2010 when its domestic industry was matured.[111] One reason for removing DCR was also the WTO cases filed by the USA against it.[112] But within one year from 2007 to 2008 the number of wind turbine manufacturers grew from 40 to 70. In 2009 it also introduced a feed-in tariff for wind energy. And we can see that it increased its installed wind capacity to 44,733 MW from 2599 MW in 2006 along with strengthening its wind energy generating capacity. Surprisingly in 2004 China's 82 percent wind manufacturing equipment was foreign but till 2010 it strengthened its capacity so much so that 90 percent of the manufacturing equipment was its own.[113] Although China had to either terminate these DCR at consultation stage and lose them in some case before the WTO DSB. But the resultant had been the overall strengthening of domestic renewable industry which can compete with international renewable firms and all these happened in the meantime when that incentive existed.[114] In the solar energy sector also China is going to achieve its 2020 target of solar power installations by two years in advance.[115] In 2016 China's capacity was 77.42

GW which is expected to grow by 188 GW till 2020.[116] This shows how domestic manufacturing can increase the penetration of renewable energy generation. In the absence of incentives it is difficult for developing countries like India to develop its renewable energy industry however it can go on with the renewable energy projects of energy generation without hindrance. For

111 China: Market Overview, IRENA-GWEC: 30 Years of Policies For Wind Energy, Phase 3, p. 50 and fn. 29, IRENA, *Available At* https://www.irena.org/DocumentDownloads/Publications/GWEC_China.pdf (Last accessed 14/5/2017).

112 Some of the cases were China- Rare Earths, China- Raw Materials, China- Measures concerning Wind Power Equipment etc.

113 ICTSD, "US Proclaims Victory in Wind Power Case; China Ends Challenged Subsidies" Bridges (8 June 2011), ICTSD, *Available At* http://www.ictsd.org/bridges-news/bridges/news/us-proclaims-victory-in-wind-power-case-china-ends-challenged-subsidies (Last accessed 12/5/2017).

114 Umair Hafeez Ghori, "Reverse Permissibility" in the Renewable Energy Sector: Going Beyond the US-India Solar Cells Dispute, Asian Journal of International Law, 2016, p. 1-28 at 21.

115 Lauri Myllyvirta, China kept on smashing renewables records in 2016, Greenpeace, *Available At* http://energydesk.greenpeace.org/2017/01/06/china-five-year-plan-energy-solar-record-2016/ (Last accessed 14/5/2017).

116 Ryan Woo, 'China's solar power capacity more than doubles in 2016', Reuters, *Available At* http://www.reuters.com/article/us-china-solar-idUSKBN15J0G7 (Last accessed 12/5/2017).

developed countries DCR might not be a requirement as UK and Germany do not have DCR in their policies[117] and countries like Singapore feels that FITs distorts energy market and goes against the benefits of consumers.[118] However since the JNNSM was started in 11th January 2010 and the decision of Appellate Body on 16th September 2016, there was around six and half year time leaving aside the extra compliance period as mutually agreed between parties, to improve and strengthen its domestic renewable energy products manufacturing industry like China. To what extent India could use this opportunity is yet to be seen. Around 293 global and domestic companies have committed to producing 266 GW of renewable energy in next 5-10 years.[119] The Indian government has already announced a massive renewable energy production target of 175,000

MW till 2022 out of which 100,000 MW is from solar power. It has to be seen how much of it is achieved by the domestic renewable industry.[120]

Renewable energy program: The WTO AB did not stop JNNSM which even US and third parties did not ask for. What was held illegal was the prescription of DCRs in the FIT scheme of JNNSM. Thus JNNSM minus the DCR can run successfully[121]. Obviously this is possible and in fact there are chances that solar panels will be made available at lower cost than the domestically produced ones. Experts in India do not find any serious problem with removal of DCRs

117 'Marie Wilke, Feed-in Tariffs for Renewable Energy and WTO Subsidy Rules: An Initial Legal Review', ICTSD Programme on Trade and Environment, Trade and Sustainable Energy Series 1 (International Centre for Trade and Sustainable Development, Geneva, Switz., Aug. 2011), at p.6, *Available At* http://www.ictsd.org/downloads/2011/11/feed-in-tariffs-for-renewable-energy-and-wto-subsidy-rules.pdf (Last accessed 12/5/2017).

118 Top 10 Most Popular FAQs, Renewable Energy, 'Is the Singapore Government providing subsidies (e.g. Feed-in Tariffs) to promote renewable energy?', Energy Market Authority, Singapore Government, *Available At* http://www.ifaq.gov.sg/EMA/apps/fcd_faqmain.aspx?qst=hRhkP9BzcBKnt75r%2Bl1bopmAANxUYJsZ1XtCavhh%2Bg8uifs%2FSSJBsGYI6ofcvWrA6xnjWN%2Bwv3G7p3b7ofZXKXdHEJ9UzF81IrGm7X3%2F%2BON4qdCexOyopJl2eNEjZvEX0OKDxGJN3MP8zRJdTRhoUM0u6KdQGd0w#FAQ. _161690 (Last accessed 12/5/2017).

119 Power Sector in India, investment scenario, India Brand Equity Foundation (IBEF), April 2017, available at https://www.ibef.org/industry/power-sector-india.aspx (Last accessed 14 /5/2017).

120 *Ibid*, Government Initiatives.

121 Prabhash Ranjan, 'A Case for Accepting the WTO Ruling', The Hindu, 28 September 2016, *Available At* http://www.thehindu.com/opinion/columns/A-case-for-accepting-the-WTO-ruling/article15002418.ece (Last accessed 12/5/2017).

in Indian renewal energy sector especially in solar panels.[122] The imported solar panels are at least ten percent cheaper than locally manufactured solar panels.[123] Thus when panels are available at cheaper rates it will cost less from the individuals, households, farmers or anyone who want to generate solar electricity for personal, domestic or industrial use.

Environmental Safeguards and Sustainable Development: the decision of the India-Solar Panel case does not restrict the use of any of the environment friendly law provisions or policies. In fact Article XX exceptions GATT is very well intact.[124] If DCRs are not attached to the program, all the programs can very well take off. And as discussed above, the renewable energy programs are not going to be hampered so if the envisaged renewable energy program does not get hindered, where is the question of harming the environmental goals and sustainable development objectives. Moreover, when there are cheaper solar panels available from imports, it will be increasing for the individuals and other industry users to apply them and increase solar energy thereby helping in improving the environment.

Conclusion

Strengthening own renewable energy industry and renewable energy generation are two different things. Renewable energy can be produced and procured for domestic use even without having own production or SPDs provided the relevant geographical market gets sufficient solar panels at competitive and cost effective prices. It does not mean one should not have their own strengthened domestic renewable energy industry. But in the light of India- Solar Panel case one thing is clear that India could not justify its DCR use under the existing GATT/WTO framework like its predecessors such as Canada and China.

122 Debjoy Sengupta, 'Removal of domestic content requirement in solar not a big blow', The Economic Times, 19 September 2016, *Available At* http://economictimes.indiatimes.com/news/industry/energy/power/removal-of-domestic-content-requirement-in-solar-not-a-big-blow/articleshow/54412591.cms (Last accessed 14/5/2017).

123 *Ibid*.

124 Prabhash Ranjan, 'A Case for Accepting the WTO Ruling', The Hindu, 28 September 2016, *Available At* http://www.thehindu.com/opinion/columns/A-case-for-accepting-the-WTO-ruling/article15002418.ece (Last accessed 12/5/2017).

But from losing the case at WTO DSB on DCR issue does not make massive renewable energy projects hampered in India. However certainly India will lose its share of the pie in terms of job creation and industry strengthening. But till now we do not know how much benefit India could take in last six or seven years when the DCR was in use until WTO DSB put an end to it. If like China it could have developed its renewable energy manufacturing product industry then it can cheer and compete with the global competitors and there is nothing to worry about it. But we are aware of the fact that India is not that aggressive as China when it comes to Industry development and production of goods. Only time and analysis on those lines will tell how much India could achieve on that front. In terms of job creation through DCR certainly it is a loss but its environmental goals are not going to suffer. India should always keep in mind that it is very difficult to make changes in existing WTO framework as we see a failure of Doha Round of WTO. So even if developing countries in the leadership of India wants a new or amended agreement especially for renewable energy, it will take a lot of time and nobody knows when it can see the light of the day. So in the meantime India has to abide by the decision and envisage new forms of incentives not inconsistent with GATT for domestic players. Also it should approach DSB if other countries use DCR as it has rightly done against the US in March 2017 by asking for Panel formation.

*****

Sustainable Development Through Renewable Energy: Perspectives on Enabling Mechanisms and Recommended Policy Guidelines

Aditya Sethi *

Introduction

Development aspirations of nations has resulted in rapid industrialization, with resultant pressure on limited fossil fuel resources and increasing emission of greenhouse gases. Growing global climate concerns have thrown open wide ranging and complex arguments, '*conventional fuel*' v. '*renewable energy*', '*climate obligations*' v. '*sustainable development*', '*investment on expensive renewable energy technology*' v. '*expenditure on basic social welfare*' and so on. There are no easy solutions to the issues at hand, yet it is widely appreciated that long term innovative strategies on sustainable development with a wide scope of social inclusion, employment generation, energy access & security and climate safeguards need to be adopted. Renewable energy is an apt and clean substitute for limited fossil fuels as also hold the key to social inclusion requirement of sustainable development. The renewable energy technologies and compatible infrastructure, in this regard, are likely to be the potential solution for future energy requirements and sustainable development. Various renewable energy sources such as wind, photovoltaic cell, hydropower, biomass and biofuel are going to play an important role in sustainable energy development. The global trend of growing usage of reliable energy is indicative of its wide acceptability and its catalyst role in sustainable development.

As a key component for framing policy on sustainable development, environmental laws assume great significance. Over several decades, environmental law critiques have raised concern over issues like enforcement of environmental law, public participation in environmental decision-making, exposure to toxins, etc. The spectrum of vital activities specific to each

* 3rd Year, BBA. LL.B, School of Law, Christ University, Bengaluru.

country for sustainable development comes under the scanner of these very environmental factors. It is thus prudent that a holistic and balanced policy on environment laws, sustainable development and renewable energy is drawn out to maximize benefits.

Sustainable Development and Renewable Sources of Energy as a Catalyst

Sustainable Development emerged in the political, public and academic arena in 1972 with the Founex Report in 1972 and in 1987 with the publication of the World Commission on Environment and Development Report (WCED) also known as the Brundtland Report. This Report defined 'sustainable development' as 'development that meets the needs of the present without compromising the ability of our future generations to meet their own needs.' The Brundtland Report mobilized public interest in ecology and sustainability which stimulated the urgent need and focus towards the danger facing the environment.[1]

The concept of '*sustainability*' has been framed in the three-pillar model - Economy, Ecology and Society which implicitly acknowledges the encompassing nature of the sustainability concept[2] and allows a schematic categorization of sustainability issues. The United Nations General Assembly aims for action to promote the integration of three components of Sustainable Development - economic development, social development and environment protection as interdependent and mutually reinforcing pillars[3]. The three-pillar model subscribes to an understanding of certain actions which can fulfil all the three development goals simultaneously.

The conceptual framework of sustainable development can also be viewed as a perspective on the two factors of weak sustainability and strong sustainability which differ in assumptions about the sustainability of natural and man-made

1 J. Bojö , K.G. Maler, & L. Unemo, Environment And Development: An Economic Approach (Kluwer Academic Publishers 1992).

2 BMU (1998), Nachhaltige Entwicklung in Deutschland, Entwurf eines umweltpolitischen Schwerpunktprogramms. Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit (BMU), Bonn, Germany.

3 (2005), World Summit Outcome, Resolution Adopted by the General Assembly, A/RES/60/1, United Nations, New York, NY, USA.

resources. From the Weak Sustainability[4] perspective, natural resources can be substituted with man- made capital without compromising the future requirements. It implies that environmental degradation can be compensated for with man- made capital such as machinery, transport, infrastructure, education and information technology. The concept of strong sustainability[5] provides an ecological point of view with the intent of proposing socio- economic development based on the belief that natural capital cannot be substituted for production purposes.

Therefore, renewable energy as an alternative can contribute to the development goals of the three- pillar model and will sustain natural capital as long as its resource use does not reduce the potential for future harvest.

Reliance on fossil fuel energy along with the legal framework that supports it, may pose the greatest barrier to sustainable development goals.[6] The energy used around the world derives overwhelmingly from coal, oil, and natural gas.[7] Production and consumption of these resources has many harmful environmental effects on land as in case of surface mining and disposal of wastes; water and air pollution[8].

Sustainable development aims to achieve energy access, eradication of hunger, provisioning advance health services, education, and gender equality.[9] Renewable energy advances sustainable development in a number of ways. First, renewable energy is not a finite resource, so its use can be sustained.[10] As of 2012, more than half of the countries in the world had adopted renewable energy targets

4 E. Neumayer, Weak Versus Strong Sustainability: Exploring The Limits of Two Opposing Paradigms, 1 (2nd Ed. Edward Elgar 2003).

5 D. Pearce, "et al" *Measuring sustainable development: Progress on Indicators,* 1, Environment and Development Economics, 85-101, (1996).

6 Lincoln Davies, *Alternative Energy and the Energy-Environment Disconnect,* 46 Idaho Law Review, 473-507, (2010).

7 U.S. Energy Information Administration, International Energy Outlook, (2011) *Available At* http://www.eia.gov/forecasts/ieo/pdf/0484(2011).pdf. (Last Accessed on 10 Aug 2017).

8 Air and Radiation, U.S. EPA, http://www.epa.gov/air/ (Last Accessed on 15/8/2017).

9 J. Andrew Hoerner & Nia Robinson, A Climate of Change: African Americans, Global Warming, and A Just Climate Policy for The US (July 2008).

10 O. Edenhofer, IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation 165 (eds., 2011), Available At http://srren.ipccwg3.de/report/IPCCSRRENCh01.pdf. (Last accessed on 23/8/2017).

or other policies designed to promote renewables.[11] This indicates recognition of the benefits of increasing renewable energy production to meet new demand and displace fossil energy. Second, renewable energy largely avoids sources of pollution. Renewable energy projects may not eliminate existing polluting facilities, but they can reduce the number of new fossil energy plants.[12] This is also important from the perspective of developing countries on their right to social and economic advancement for sustainable development [13] by the use of electricity.[14] Renewable energy can answer this need while helping the economic development of these countries which have increased energy consumption by limiting greenhouse gas emissions. It also allows developing countries the opportunity to avoid undergoing the same pollution-intensive stages which the industrialized countries have gone through to achieve economic development.[15] It also holds the prospects for '*social inclusion*,' that is, reducing poverty by providing training or jobs and improving incomes.[16] Green jobs reduce poverty by improving incomes and providing healthier work environments.[17] Third, renewable energy holds promise for addressing issues such as energy access and energy security[18], with less environmental impact. Renewable energy can even support a higher standard of living in rural areas through community-based

11 Renewable Energy Policy Network for the 21st Century, Renewables 2011 Global Status Report 17 (2011) *Available At* http://www.map.ren21.net/GSR/GSR2012.pdf. (Last accessed on 23/8/2017).

12 Stephen Pacala & Robert Socolow, *Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies,* 305(5686) Issue of Science 968-72(2004).

13 United Nations Conference on Environment and Development, Rio de Janeiro, Brazil, June 3-14, 1992, Rio Declaration on Environment and Development, U.N. Doc. A/CONF.151/26/ Rev., 1, Annex I, Principles 2 and 3 (Aug. 12, 1992), *Available At* http://www.un.org/ documents/ga/confl51/aconfl 5126-1 annex l.html,(Last accessed on 25/8/2017).

14 Lakshman Guruswamy, Energy Justice and Sustainable Development, 21 Colo J. Envtl. L. & Pol'y 231 (2010).

15 U.N. Secretary-General's Advisory Group on Energy and Climate Change (AGECC), *Energy for a Sustainable Future: Summary Report and Recommendations* 8 (2010), *Available At* http:// www.un.org/wcm/webdav/site/climatechange/shared/Documents/AGECC%. (Last Accessed on 25/8/2017).

16 Working towards Sustainable Development: Opportunities for Decent Work and Social Inclusion in A Green Economy, Report by Green Jobs Initiative/United Nations Environment Programme (2012), *Available At* http://www.ilo.org/global/publications/ilo-bookstore/ orderonline/books/WCMS. (Last accessed on 27/8/2017).

17 Poverty Reduction - Can Renewable Energy make a real contribution?, Global Network on Energy for Sustainable Development (GNESD), Summary for policy-makers. (2006), *Available At* www.gnesd.org/downloadables/povertyreductionspm.pdf. (Last accessed on 27/8/2017).

18 O. Edenhofer, IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation 165 (eds., 2011), *Available At* http://srren.ipccwg3.de/report/IPCCSRRENCh01. pdf. (Last accessed on 29/8/2017).

energy generation[19]. *For all these reasons, renewable energy is the key to economic, social and environmental aspirations of sustainable development.*

Key Requisites for Sustainable Development Using Renewable Energy

Though central to sustainable development, the utilization of renewable resources faces challenges in planning, implementation, and management on account of environmental law framework, government policies, technology and infrastructure development.

Renewable energy generation necessitates selection of most viable energy source specific to a region and along with it adoption of latest technology in that field, integration of energy generated to the main grid as also management of supply of energy to consumers and demand management.

The process of technology selection relies upon various technical as well as commercial indices represented in the form of a *sustainability matrix* as in table shown below.[20] The table[21] is indicative of preferable renewable technologies in the Indian scenario and suggests that wind and biomass power generation look promising. Renewable energy technology is also very expensive and cost of investment can only be reduced by efficient technologies.

19 United Nations Environment Programme, *Green Jobs: Towards Decent Work In a Sustainable* Low-Carbon World, (2008), http://www.unep.org/labour-environment/features/greenjobs-report.asp.(Last accessed on 29/8/2017).

20 M. J. Newton & P. D. Hopewell, *Costs of sustainable electricity generation*, Vol.11No.2 Engineering Science and Education Journal, 49–55 (2002).

21 Renewable Energy Technologies: A Guide for Z. P. Officials of Energy Development Cell. Pune, India: Maharashtra Energy Development Agency (MEDA), (May 2004).

Sustainability Matrix for Indian Scenario

	Potential available	Per kW installation cost	Emissions	Maintenance cost	Fuel cost	Weather/Location dependency	Reliability	Technology status	Life span	Regulatory issues	Modularity	Index
Index weight	0.15	0.33	0.08	0.05	0.12	0.05	0.09	0.08	0.01	0.03	0.01	1.00
Small hydro	6	6	10	8	10	5	8	8	9	7	1	7.20
Wind	9	7	10	9	10	5	7	9	9	9	2	8.09
Solar	7	1	10	9	10	6	7	7	9	4	9	5.62
Municipal/Industrial waste	2	8	7	7	5	8	9	2	7	3	8	6.06
Biomass	7	9	8	6	7	9	9	8	8	7	7	8.06
Bagasse	7	9	8	6	7	7	9	8	8	7	5	7.94
Biofuel	6	8	8	7	6	8	9	7	8	5	9	7.34
Tidal power	1	2	10	5	10	8	7	2	8	1	1	4.37

The renewable energy, although clean and green, may not lead to a reliable power supply solution. Intermittency of the wind and sunlight makes them unsuitable for most of the commercial and industrial applications.[22]. Alternatively, such resources can be operated in conjunction with the utility grid. The grid-connected operation leads to other set of issues related to voltage stability, reactive power demand, etc. These issues depend upon characteristics of the local network and there is a need to develop practices for each grid for each type of energy resource.

Water, wind, and photo-voltic cell are pollution free power generating technologies. The other technologies like biomass, biogas etc., pollute the environment in a manner same as a coal-fired power plant. Improved technology in distributed energy resources can reduce the emissions to permissible level. New power generation technologies like stirling engine, combined heat and power, co-generation, etc., can improve the energy extraction from the renewable resources.

22 Ernst Scholtz, *Grid Integration of Renewables: Challenges and Technologies*, MITEI Symposium on Managing Large-Scale Penetration of Intermittent Renewables, Cambridge/U.S.A, (20 Apr 2011).

To build an intelligent and sustainable power system for future, it is essential to bridge the gap between local networks, and to create a modern infrastructure with capabilities of integrating the Distributed Energy Resources at the local community level.[23]The enabling infrastructure essentially required to be developed for sustainable energy scenario are as follows**.**

The energy storage devices play an important role in enhancing energy production from the renewable energy technologies like wind and photo-voltic cell. The supply inconsistency due to intermittency of weather conditions can be mitigated up to some extent by providing backup from the energy storage devices.[24] Among the various energy storage technologies, the battery technology is the most developed, and is well established for a variety of applications.

The renewable energy technologies when operated in standalone mode fail to satisfy reliability issues. A profound approach is to connect the resources into a Micro Grid. Since different types of resources are interconnected, diversity in fuel and loading conditions can be achieved. The components of the Micro Grid complement with each other and thus reduce the dependence on the main grid.[25]

The infrastructure development for the existing power system and the information and communication technology are equally important to realize sustainable energy scenario.[26]The information and communication technology makes the conventional power system more intelligent, self-managing, self-healing and capable of catering for many of the functionalities of the electricity network.

23 Troy Rule, *Renewable Energy and the Neighbours*, 4 Utah L. Rev. 1223 (2010).

24 R. B. Schainker, "Executive overview: Energy storage options for a sustainable energy future," in Proc. Power Engineering Society General Meeting, 2, 2309–2314, (June 2004).

25 Maarten Wolsink, Renewable Energy Development in Rural Areas, *Distributed Generation Of Sustainable Energy as a Common Pool Resource: Social Acceptance* in Rural Settings of Smart (Micro) Grid Configurations, Chap IV, 36, (2014).

26 A. Zahedi, *Developing a System Model for Future Smart Grid*, Proceedings in 2011 IEEE PES Innovative Smart Grid Technologies Conference.

Compatible Legal Framework for Sustainable Development

The Supreme Court with its high level of judicial activism in the area of environmental rights has guided the legal courses on energy and sustainable development matters. Legal experts believe that the Supreme Court 'will continue to play a significant role in facilitating adaptation to climate change.[27] Considerable progress has been made towards maturing of renewable energy policy framework and enactments. Issues of environmental justice and policy framework on renewable energy in India are discussed here.

Environmental Jurisprudence in India

The highlights of a few landmark judgments by the Supreme Court on environment cases need to be taken into perspective.

The Supreme Court formulated the doctrine of absolute liability in *MC Mehta v. Union of India*[28] for harm caused by hazardous and inherently dangerous industries by interpreting the scope of the power under Article 32 of the Constitution. The Court reiterated and re-examined this principle in *Indian Council for Enviro-Legal Action v. Union of India.*[29] that the industries are absolutely responsible not only for remedial action as well as compensation for the loss and suffering sustained by the villagers, although the quantum of damages could be determined by a competent civil court.

The Court in *Vellore Citizen's Welfare Forum v. Union of India*[30] declared that polluter pays principle is an essential attribute of sustainable development. Remediation of the damaged environment is part of the process 'sustainable development' and the polluter is liable to pay the cost to the individual sufferers as well as the cost of reversing the damaged ecology.

---

27 Aitken Hem, *The Role of the Supreme Court in Facilitating Adaption to Climate Change Impacts in India,* Vol. 7, No. 1, Journal of Environmental Research and Development, 155-165 (2012).

28 MC Mehta v. Union of India, AIR (1987) SC 1086.

29 Indian Council for Enviro-Legal Action v. Union of India, (1996) 3 SCC 212.

30 Vellore Citizen's Welfare Forum v. Union of India, (1996) 5 SCC 647.

The Court in *Banwasi Sewa Ashram v. State of Uttar Pradesh*[31] detailed safeguards to protect tribal and forest dwellers who were being ousted from their forest land by the National Thermal Power Corporation Limited (NTPC) for the Rihand Super thermal Power Project. The Court permitted the acquisition of the land only after the NTPC agreed to provide certain court- approved facilities to ousted forest dwellers.

In *Municipal Council, Ratlam v. Vardichand*[32] the Court held that 'public nuisance' of open drains, garbage, and pollutants' being discharged by big factories to the detriment of those living nearby is detrimental to 'social justice.'

This indicates that the jurisprudence of the Supreme Court has evolved significantly in environmental matters, which has been useful for climate change mitigation through litigation.

Current Renewable Energy Policies in India

Some of the major developments in the areas of legislative policy, regulatory and institutional transformation are listed below:

The Electricity Act, 2003 provided the first comprehensive framework for the development of renewable power in India at the national level. The Act has aimed at fostering competition, significant private investment and the concept of power for all. The role of renewable projects has been explicitly recognized for supplying power to the utility grid and has provided an overall framework for preferential feed-in –tariffs and quotas for renewable energy. These steps have had a substantial impact on attracting private investment into the power sector.

The National Electricity Policy, 2005 stipulated the progressive increase of Renewable Energy Purchase Obligation (RPO) and mandated a competitive bidding process for their purchase by power distribution companies. It addressed issues such as rural electrification, recovery of cost of services and targeted subsidies and energy conservation.

31 Banwasi Sewa Ashram v. State of Uttar Pradesh, AIR 1987 SC 374.

32 AIR 1980 SC 1622.

The National Tariff Policy, 2006 required State Energy Regulatory Commission to fix a minimum percentage of state RPO and set a preferential rate for renewable power in their States.

National Renewable Energy Act, 2015, a national renewable energy law is in the process of development. This is expected to provide a comprehensive national program to promote renewable energy, including a system of the tradable energy certificates, feed-in tariffs for solar power, and feed-in tariffs for grid-connected wind power

Organizations and their Contribution to Renewable Energy Development

A number of key dedicated institutions have been created to facilitate development of renewable energy. The Commission for Additional Sources of Energy (CASE) was established in 1981, which became a full- fledged Ministry of Non-Conventional Energy in 1992 renamed as the Ministry of New and Renewable Energy in 2006.

The Ministry of New and Renewable Energy has been involved in dealing with all matters related to planning national policies and deployment of new and renewable energy. The Ministry has been undertaking initiatives for harnessing renewable power energy in rural areas. There are a number of R&D institutes under the MNRE, including the Solar Energy Centre (SEC) and the Centre for Wind Energy Technology (C-WET) [33].

IREDA was established in 1987 as a non-financial institution to provide financial assistance for renewable energy and energy conservation projects.

The CERC has the authority to set the generic tariff for renewable based electricity and non- fossil based co- generation[34]. The SERCs at the State level have rights to decide on state RPOs and renewable tariffs in accordance with CERC guidelines.

33 *Available At* www.mnre.gov.in. (Last accessed on 31/8/2017).
34 Petition No. 256/2010 (Suo-Motu), New Delhi.

The JNNSM was launched in 2010 to accelerate the growth of solar capacity through a Solar Purchase Obligation (SPO) as part of the RPO and financial incentives like capital subsidies and custom duty exemptions. The policy anticipates that solar power would achieve grid parity by 2022 and coal thermal power parity by 2030.

The NVVN is a wholly owned subsidiary and nodal agency of NTPC providing for power with coal- generated electricity at lower overall cost combined with other power utilities at regulated tariff plus facilitation charges[35]

A large number of private companies have played an important role in the development of the renewable energy sector in India. One of the major players in wind industry is Suzlon Energy, which had the world's fifth largest wind turbine manufacturing capacity at the end of 2011[36]. Tata BP Solar is the largest solar company in India, created as a JV between Tata Power and BP Solar in 1989. Azure Power Pvt. Ltd[37] developed the first solar power project in India.

Barriers for Renewable Energies in the Context of Sustainable Development

The integration of renewable energy policymaking and execution of projects provide inter- linkages with the three pillars of sustainable development. However the implementation of renewable energy technology projects are generally met with certain socio- cultural, information and awareness and economic barriers which need to be understood and removed..

***Socio-Cultural Barriers*:** Socio- cultural barriers with respect to the deployment of renewable energy in sustainable goals are linked to societal and personal values.[38] These barriers are related to behaviour, natural habitats, natural and human heritage sites, impacts on biodiversity and ecosystem, landscape aesthetics etc. The development of renewable energy has implications on the

35 NVVN, Guidelines for Solar Grid Power Projects (2010).

36 Annual Report 2010-11, *Available: At* www.suzlon.com.

37 '*IFC to invest $10 mn in Azure Power for solar projects*', Financial Express, 22 March (2010).

38 B.K Sovacool, &R.F. Hirsh, *Beyond batteries: An Examination of the Benefits and Barriers to Plug In Hybrid Electric Vehicles (PHEVs) and a Vehicle-to-Grid (V2G)Transition,* 37(3) Energy Policy,1095-1103 (2009).

behavioural attributes[39] that challenge social and cultural values, norms and perspectives. Displacement and resettlement of communities for development of various projects often raises concerns for complex resettlement and compensation issues.[40] Land use issues and occupational concerns regarding human and labour rights such as working conditions are important factors to be considered in this context.

Information and Awareness Barriers. The limited technical and business skills with the absence of technical support system fail to give anecdotal evidence of the role of renewable energy pilot projects in energy-poor communities.[41] The gap in awareness of the contribution of renewable energy projects with local communities in aspects of employment opportunities, skill development, investment opportunities and technology transfer is an important factor affecting the deployment of renewable energy and development of small and medium enterprises that contribute towards economic growth.

Economic Barriers. The aspect of high- upfront costs of renewable energy technologies inhibit the utilization by consumers who prefer to keep the initial cost low rather than minimizing the operating costs, which run over a long period.[42] High costs may reflect high risk perceptions of investors due to lack of financing instruments. There is thus a need for entrepreneurial support systems to ensure availability of the technical capacity required to operate and maintain the system to stimulate renewable energy in rural economies.[43]

One of the major concerns affecting wind energy in India is the rising capital costs of wind plants from Rs. 4/MW in 2003 to Rs. 6/MW in 2008 despite

---

39 *Renewable Energy Technologies and Poverty Alleviation: Overcoming Barriers and Unlocking Potentials*, Global Network on Energy for Sustainable Development (GNESD), Roskilde, Denmark.

40 B.D. Richter, *Lost in development's shadow: The Downstream Human Consequences of Dams,* Water Alternatives, 3(2), 14-42 (2010).

41 S. Karekezi & W. Kithyoma, *Renewable Energy in Africa: Prospects and Limits. In: Republic of Senegal and United Nations* ,Workshop for African Energy Experts on Operationalizing the NEPAD Energy Initiative, Dakar, Senegal, 2-4 June 2003, 30 (2003), *Available At* www.un.org/esa/sustdev/sdissues/energy/op/nepadkarekezi. (Last Accessed on 02/9/2017).

42 C.N. Brunnschweiler, *Finance for Renewable Energy: An Empirical Analysis of Developing and Transition Economies*, Environment and Development Economics, 241-274 (2010).

43 O Davidson, *The Development and Climate Nexus: The case of Sub-Saharan Africa*, Climate Policy, 3(Supplement 1), 97-113 (2003).

technology upgradation and improvements. The cost plus approach to tariff setting combined with technology specific focus has hindered the economic development of renewable resources in India.

Various incentives offered by different central and state agencies like generation-based incentives, feed-in tariffs and regional capital subsidies have reduced fiscal discipline and transparency and have caused ineffective leverage for the amount spent on renewable energy deployment.

Utilities offered to consumers in the form of tariff revisions are not revised on a yearly basis which causes the industrial customers to look for ways to purchase cheaper power through third party sales or captive generation. This causes the regulators to constrain open access in order to ensure that the utilities retain their paying consumers and remain financially secure.

In India, least attention is given towards the development of less expensive resources of power such as small hydropower and biomass. Solar Power and Wind Energy being the most expensive source of power get more attention and investment as compared to less expensive sectors such as small hydropower and biomass.

There is a mismatch between the availability of funds and cash flow of renewable energy projects which makes financiers reluctant to accept the technology risk because they are unable to evaluate its technical feasibility. This problem limits access to finance and introduces a bias towards investment in fossil fuel based technology. In many cases, project developers have to assume refinancing risk, making it difficult for new entrants and small and medium size developers to raise finance.

Functional Problems

Delays in clearances and approvals and steps taken to simplify and streamline the regulatory processes have often failed to function in practice. Mechanisms such as single- window clearances, facilitation by state nodal agencies for the regulation of small renewable energy projects have not worked well. In

India, a small hydropower project takes four to eight years from conception to commissioning contrary to the timeline of four to six months projected by the state agencies for obtaining all clearances.[44] Land and resource acquisition issues also represent obstacles. Speculative blocking by unscrupulous middlemen has led to unsustainable price increases which have caused extensive delays in allotting sites and difficulties in determining appropriate price. Therefore, there is a need to facilitate fair and timely acquisition of land which does not take place because the state administrations are reluctant to comply with the same due to political considerations and the low priority given to renewable energy projects.

Policy Recommendations and Measures to Promote Sustainable Development by Using Renewable Energy

Strategies for sustainable development at international, national and local levels as well as in private and nongovernmental spheres of society can help overcome barriers and create opportunities for renewable energy practices. Strategies include: removal of mechanisms that are perceived as to work against sustainable development; mechanisms for sustainable development that promote environmental and social factors; and integration of renewable energy and sustainable development strategies.

Government Policy Enactments

The start point for the renewable energy based development plan should be policy enactment specific to each State by respective State Energy Regulatory Commission. It needs to set short and long term national targets for renewable energy based on the potential identified by the renewable energy supply curve that corresponds to the economic cost of power as suggested by NAPCC.

To harness the full potential of renewable energy sources, major technological changes are needed along with policies and regulation. It also requires detailed

44 Unleashing the Potential of Renewable Energy in India, Energy Sector Management Assistance Program (2010).

scientific differentiation and qualification of renewable electricity sources required to assess the huge diversity in the field.[45]

The renewable energy technologies related to power generation, micro grid, power storage, information & communications, etc., discussed in this paper will play an increasingly important role in the world energy system over the next several decades.

Major renewable energy sectors (solar, biomass, small hydropower) suffer from significant supply chain and industrial development challenges. The solar power sector needs a strong local R&D and manufacturing to bring down costs over long term. Small hydropower and biomass producers suffer from significant capacity constraints and lack standardization which can cut costs effectively. Even though MNRE has invested considerably in renewable energy, its basic data of generation volume is not available in public domain. The pattern of alternative energy has been altered significantly affecting estimate of biomass surplus, data relating to hydrology and wind energy. There is a need to integrate these data resources and provide to potential developers in a user- friendly way.

In response to enabling framework conditions at international and national levels, cities and local governments can independently use their legislative and purchasing power to implement renewable energy initiatives in their wider community. Typically, local policy initiatives are motivated by sustainability goals such as renewable electricity production or total energy consumption.[46] Other such initiatives are inclusion of renewable energy in urban planning, building permits, municipal infrastructure, voluntary actions and regulatory measures.[47]

This essentially translates into involvement of community-based organizations to mitigate local opposition to renewable energy installations by facilitating

45 A Verbruggen & V. Lauber, *Basic Concepts for Designing Renewable Electricity Support Aiming at a Full-Scale Transition by 2050.* Energy Policy, 5732-5743 (2009).

46 P.A Ostergaard & H. Lund , *A Renewable Energy System in Frederikshavn using Low Temperature Geothermal Energy for District Heating*, Applied Energy, 88(2),479-487 (2010).

47 Renewables Global Status Report: 2009 Update, Renewable Energy Policy Network for the 21st Century Secretariat, Paris, France, 42 (2009).

local ownership and sharing of benefits and empowerment[48] of rural women in order to seek the best solutions for community energy needs.[49]

Economic Policies and Instruments

Various actions can be taken to address financial viability and bankability issues. There is a need to simplify the numerous and overlapping financial incentives and put them on a sound economic and market foundation. The following actions could be lead to a cogent set of synchronized and simplified policies that provide comprehensive solutions to the high financial generation cost of renewable energy.

(a) Allow states and utilities to move to technology- neutral feed in tariff based on the economic avoided cost of power including premiums for local externalities

(b) Elimination of technology specific incentives like capital subsidies and accelerated depreciation. Competitive procurement of renewable energy in accordance with the objectives of national tariff policy providing procurement of power from non-conventional sources shall be done through competitive bidding.

(c) Direct Purchase and Grid Connected distributed generation of renewable energy will streamline financial incentive program to reduce renewable energy subsidies and enhance the ability of market based- mechanisms to integrate renewable energy into production of power.

(d) Removal of fossil fuel subsidies to open up opportunities for more extensive use or even market entry of renewable energy. In order to do so, the first step is expanding rural electrification[50] , concurrently phase out fossil fuel subsidies and redirect the same to create further incentives for business activities.[51]

(e) Introduction of 'Green Certificates' or 'Renewable Energy Certificates' as part of energy supplier obligation schemes to increase the possibility that bilateral agreements between states.

---

48 J.C. Rogers, *Public Perceptions of Opportunities for Community-based Renewable Energy Projects*, Energy Policy, 4217-4226 (2008).

49 A.M. Omer, *Implications of Renewable Energy for Women in Sudan: Challenges and opportunities*, 6(2) International Journal of Sustainable Development, 246-259 (2003).

50 D. Angel-Urdinola & Q.Wodon, *Do Utility Subsidies Reach the Poor?* , Framework and Evidence for Cape Verde, Sao Tome, and Rwanda. Economics Bulletin, 1-7 (2007).

51 D Barnes, & J. Halpern, *Reaching the Poor: Designing Energy Subsidies to Benefit those that Need It,* Refocus, 2(6), 32-34 (2001).

(f) Creation of a national renewable energy fund to mitigate and reduce the financial impact of renewable energy procurement on utilities.

Implementation of Economic Instruments

The following universally accepted economic instruments / arrangements are recommended to be adopted in Indian case also:

(i) "*On-Bill Finance*"[52] aims to establish the energy provider's legal relationships with its investors, as well as covering its operating costs. These are long-term financial instruments that offer various repayment modes to cover the costs of energy efficiency measures.

(ii) Contract between governments and private companies can take place in the form of "build-own-operate-transfer" (BOOT).[53] For the BOOT to function, favourable legal arrangements are required at the local, national and international levels.

(iii) The "white certificate" is another economic instrument. It is a document issued by a legally authorized governmental institution, which certifies that, a specified amount of energy savings are being achieved by a specific company or consumer.[54] The certificates can be sold and bought among companies based on the energy saved in compliance with the targets.

(iv) "Feed-in tariffs" (FiTs) is essentially a policy designed to enhance investment in technologies for renewable energy.[55] FiTs is designed for long-term contracts to renewable energy producers, it offers cost-based compensation, e.g. providing price certainty and financing renewable energy development through technological development. Deutsche Bank has made a significant contribution to global wind power development through their utilisation of FiTs.[56]

52 Philip Henderson, *On-Bill Financing Overview and Key Considerations for Program Design*, Natural Resources Defense Council (NRDC) Issue Brief, (2013).

53 Gilberto M. Llanto, *A Review of Build-Operate-Transfer for Infrastructure Development: Some Lessons for Policy Reform,* Philippine Institute for Development Studies, Discussion Paper Series No. 2008-25.

54 Paolo Bertoldi & Silvia Rezessy, Energy Saving Obligations and Tradable White Certificates, Joint Research Centre of the European Commission, (2009).

55 T Couture, "*et al*", *A Policy Guide Feed-in Tariffs Design*, National Renewable Energy Laboratory, U.S. Dept. of Energy (2010).

56 *Ibid.*

(v) The Green Energy Corridor agreement between Germany and India[57], shares some characteristics with the bilateral Renewable Energy Certificates model. The Green Energy Corridor is a loan or aid for developing suitable conditions in India, i.e. provide technical assistance to set up a functional FiT scheme

Conclusion

Renewable energy holds promise for sustainable development while addressing issues such as energy access and energy security, with less environmental impact. It can facilitate higher standard of living in rural areas through community based energy generation project and at the same time poverty eradication by additional job generation. Renewable energy is thus the key to economic, social and environmental aspirations of sustainable development.

Due to technical limitations and being expensive, renewable energy can be best exploited gainfully by adopting efficient technologies and developing complementary infrastructure. Since, renewable energy is expensive, its fruitful exploitation calls for promotion of private, community based and non-governmental participation in local and regional projects. The key to success of these projects rests in innovative governmental policies on social awareness, mobilization of community support, policy on tax or any other subsidy to private investment in renewable energy, removing subsidy on fossil fuel, implementation of favourable economic instruments etc.

The legal framework on renewable energy can also be a catalyst for sustainable development. The work for timely accomplishment of mission statement of the National Renewable Energy Act 2015 (Draft) must progress on war footing with the implementation of enabling government policies recommended in this paper.

57 Anisha Dutta, *MNRE signs agreement with Germany to improve renewable energy grid integration,* The Economic Times, August 28, 2017, *Available At* https://energy.economictimes.indiatimes.com/news/renewable/mnre-signs-agreement-with-germany-to-improve-renewable-energy-grid-integration/60261, (Last Accessed on 16/8/2017).

In the broad sense, the exploitation of renewable energy in the context of sustainable development is a function of multi-spectrum activities by multiple agencies through the process of multi-level planning and yet single point of implementation for the community or regional benefits. The concept of sustainable development through renewable energy is far from simple and only a focused approach and sincerity of purpose can assure positive results.

*****

Sustainable Energy Future in India: Policy Initiatives to Develop Tidal and Geothermal Energy In India

*Anand Jagmalani & Ambuj Tiwari**

Introduction

India is well gifted will all the natural resources which can help India to show their potential in energy creation. Tidal energy and geothermal energy are the two forms of energy which need some initiative in in India. In tidal energy tides in the ocean helps to create electricity or other power. The revolution of earth, sun and moon plays a vital role in creating tides and ultimately this energy can be created. Tidal streams, barrages and tidal lagoons are the three ways to create this energy. On the other hand geothermal energy in India is at the beginning stage. It is created with the heat within the earth. Temperature inside the earth crust helps to form this energy. Most of the dry spots are found in Himachal Pradesh and central India. It has been identified that about 340 geothermal hot springs in the country. Both the energy is inexhaustible in nature with low maintenance. This energy give high efficiency and environmentally friendly. With this energy the Government needs to take this initiative and play a vital role. There are so many countries that are following these techniques and giving better results. This is the better way to lead development and a means to give a good future to our new generations.

Sustainable Development basically represents the whole new opportunity to construct a new approach towards the development of country. The success of these efforts must have powerful implications for the issues related to peace and security.

Sustainable Development has become a major and important topic of discussion mainly among statesmen and leaders, social scientist and social organizations. Almost during a century, the industrial-technological and economic development registered by the mankind has actually not proved to

* 3rd year, BA.LL.B. Amity Law School, Mumbai.

be real development as it has created imbalances in the environment as well as among nations.

Basically, the development should be done without harming the human rights of the people, especially of those whose life is directly related with such projects. Thus, Sustainable Development is now held to be an essential requirement for securing stable, enduring, real and sustainable world[1].

In this paper we are going to discuss about the two most affective natural resources i.e. Geothermal and Tidal energy. It's various prospects, history and how the policy is currently in India. Solutions to the problems which are being faced by not giving the importance to these two resources and the suggestions to that problems are mentioned in this research paper.

Definition & History

Economic Development conducted without the depletion of natural resources. Basically, Sustainable Development is the development which is done so as to meet the current needs without compromising the ability of future generations to meet their own needs. Sustainable Development is all about finding the better and correct ways of doing things whether it's for future or for present. Here the correct way means, doing things which will never endanger the present or future needs.

The World Commission on Environment and Development (the Brundtland Commission) in its report to the United Nations in 1987 defined sustainable development as- Meeting the needs of the present without compromising the ability of future generation to meet their own needs.

The concept of Sustainable Development, first thrown in front of the world in 1970s, which was widely disseminated in the early 1980s by the World Conservation Strategy IUCN (International Union for Conservation of Nature), UNEP (United Nations Environment Programme) and WWF(World Wide

1 Dinesh, Sustainable Development: Introduction, Meaning and Other Details, *Available At* http://www.yourarticlelibrary.com/sustainable-development/sustainable-development-introduction-meaning-and-other-details/48533, (Last Accessed on 20/08/2107).

Fund for Nature), 1980, which basically called for the maintenance of essential ecological processes; the preservation of biodiversity; and sustainable use of the species and ecosystems[2].

Sustainable Development was the basis of the United Nations Conference on Environment and Development held in Brazil in 1992[3]. This was the first International attempt towards the action plans and strategies for moving towards a more sustainable pattern of development.

Brundtland Commission in the year 1987 suggested that Sustainable Development can be the solution for the problems of environmental degradation.

Importance of Sustainable Energy

Energy is an essential factor for sustainable development. It is estimated that in 2015 about 1.1 billion people do not have electricity and around 4.3 million people are dying every year due to indoor pollution causing due to cooking and heating with unsustainable fuels. Currently India is the fourth largest energy consumer in the world and is likely to overtake China in next few decades as the primary source of growth in global energy demand. According to NAPCC(National Action Plan on Climate Change) recommends that the country generate 10% of its power from Renewable Sources by 2015 and is hoping to increase by 5% i.e. 15% in 2020[4].

India is one of those countries which are putting efforts to shift to a sustainable, low carbon path that will eventually improve human health, will confront climate changes and will foster prosperity for all. This could be the most successful if it is integrated with efforts to tackle the current energy access challenges,

2 Puja Mondal,What is the Importance of Sustainable Development? *Available At* http://www.yourarticlelibrary.com/environment.

3 Sustainable Development Commission, What is Sustainable Development? *Available At* http://www.sd-commission.org.uk/pages/history_sd.html, (Last Accessed on 20/08/2107).

4 Sonia Luthra, Assistant Director for Outreach at NBR- India's Shift to a Sustainable Energy Future, *Available At* http://www.wri.org/blog/2014/03/indias-shift-sustainable-energy-future, (Last Accessed on 20/08/2107).

water security, disaster resilience and much broader economic development goals of the country. According to World Bank, over 400 million people in India are living without electricity. Agenda 21, which was adopted during the UNCED (United Nations Conference on Environment and Development) called Earth Summit held in Rio De Janerio in Brazil in the year 1992 is a blue print which is basically based on how to make development Socially, Economically and Environmentally Sustainable[5]. The other reason of shifting towards the Sustainable Energy is Global Warming. The Global Warming is caused when Air Pollutants, Greenhouse Gasses and Carbon dioxide collect in the atmosphere and solar radiation and sunlight that have bounced off the earth's surface has been absorbed. Generally, this radiation escapes in the space but these air pollutants, which lasts for years in the atmosphere, traps the heat which ultimately leads to rise in temperature. Burning of Fossil Fuels to make electricity is the largest source of heat trapping pollution. The biggest polluters by far are the Coal Burning plants. Burning Coal releases substances that can cause acid rains. Burning produces smog (smoke+ fog) which is really for living beings. There is high risk of oil spills. Transportation Sector also at some extent generate tons of CO_2 every year. So, Because of such Non-Renewable Resources the global warming is cause. There are various dis-advantages of global warming some of them are: Flooding due to higher sea level, increased frequency of severe and catastrophic storms, increases diseases in humans and animals, increased air pollutions and etc. This is one of the reasons we should start moving towards sustainable development through the proper use of sustainable energies.

Geothermal Energy

Introduction and Historical Background

At present most of our energy demand is met by the energy which is obtained from conventional fossil fuels such as coal, diesel, petrol, natural gas, etc. It has been estimated that we could run out of oil in about 40 years and of natural gas soon after. It's just not like fossil fuels are running out, but they

5 RikinShah,Sustainable Development: Definition, Principles and Other Details, *Available At* http://www.biologydiscussion.com/sustainable-development, (Last Accessed on 20/08/2107).

are adding to our environmental problems by releasing hazardous byproducts, which ultimately increases the pollution and contribute to Global Warming. A number of geothermal power plants has been installed over 24 countries of the world, which generate more than 10,000 MW power are operational. Geothermal energy can save between 25% to 50% in energy consumption when compared to conventional heating and cooling systems. Comparatively they have low annual costs and lasts longer[6].

Many ancient peoples, including the Romans, Chinese, and Native Americans, used hot mineral springs for bathing, cooking, and heating. Water from hot springs is now used world-wide in spas, for heating buildings, and for agricultural and industrial uses. Many people believe hot mineral springs have natural healing powers.

Using geothermal energy to produce electricity is a relatively new industry. It was initiated by a group of Italians who built an electric generator at Lardarello in 1904. Their generator was powered by the natural steam erupting from the earth.The first attempt to develop geothermal power in the United States came in 1922 at The Geysers steam field in northern California. The project failed because the pipes and turbines of the day could not stand up to the abrasion and corrosion of the particles and impurities that were in the steam.

What is Geothermal Energy?

Geothermal Energy is the energy is the energy which is produced from the heat of the earth. Geothermal energy is one of the most potential sources of energy which has been very beneficial to both industrial and domestic requirement of energy in may part of the world since few decades. The term Geothermal has been derived from the two Greek words, Geo which means 'Earth', and Therme means 'Heat'. So, Geothermal Energy is the heat from the earth. Geothermal Energy's resources basically ranges from the moderate-to-low temperature hot spring systems to hot rock found a few miles beneath the earth's surface

6 Colorado State University, Introduction to Geothermal Energy, [08/11/2017], *Available At* http://extension.colostate.edu/topic-areas/energy-resources-geothermal-energy/introduction-to-geothermal-energy/ (Last Accessed on 20/08/2107).

and down deeper to the extremely high temperature of molten rocks. Heat is continually produced in Magma which is layer of hot and molten rocks below the earth's crust. This heat is generally produced from the decay of radioactive materials such as uranium and potassium. The heat which is produced at the magnum flows outwards from the earth's interior. The interesting fact is that, the amount of heat produced within the 10,000 meters of earth's surface is 50,000 times more than the other current oil and natural gas resources in the world.

Uses and Prospects

Now, the question which arises is that how geothermal can be made useful for human beings?

So, there are Hotspots, where we can actually capture the geothermal energy. Now, Hotspot is an area which is of reduced thickness in the mantel which basically allows the excess heat which is been produced at the interior of the earth to flow to the outer crust. Mineral deposits, volcanic islands and geysers which are commonly known as Hot springs. Chhumathang is one of the examples of hot springs, which is located 40 kms north of Puga, Ladakh.

There are three types of geothermal power plants: Binary, dry steam and flash. In Binary plants, the hot water is basically passed by secondary fluid with much lower boiling point than that of water. This leads the secondary fluid to turn into vapor, which then ultimately drives the turbine. Dry steam is the oldest technology. In this plant, the steam is being taken out of the fractures which is directly used to drive the turbine. Now, the third plant i.e. Flash plants. It basically pull deep, high pressure hot water into the cooler, low pressure water. The steam that is produced from this process is being used to drive the turbine[7].

Fortunately, India has huge potential to become a leading contributor in generating Eco- friendly and cost effective geothermal power. The power generations through geothermal energy in India is still at nascent stage. According to Geological Survey of India, it has identified around 340 hot springs

7 Geothermal Energy, *Available At* http://www.nationalgeographic.com/environment/global-warming/geothermal-energy (Last Accessed on 20/08/2107).

in India. Most of them are at low surface area and their temperature ranges from 37^o C to 90^o C which is perfectly suitable for the direct heat applications. These 340 hot springs are grouped into seven geothermal provinces which are: Himalayan, Sahara Valley, Cambay Basin, Son- Narmada- Tapi (SONATA), West Coast, Godavari basin and Mahanadi basin. Recently, the newly locations has been found for the geothermal power energy in Tattapani in Chhattisgarh.

Hot springs temperature in Puga Valley generally ranges from 30^o C to 84^o C and discharges around 300 liters per minute. In total, around 34 boreholes ranging in depths from 28.5 m to 384.7 m have been drilled till date in Puga Valley.

Another hot spring area Chhumathang which is located 40 kms north of Puga is quite similar to the thermal waters of Puga with one difference and that is the pH level is relatively higher in Sulphate. On the right bank of Parvati River over a distance of about 1.25 kms, we can find some geothermal activity at Manikaran in the form of hot springs with the temperature ranging from 34^o C to 96^o C. The highest temperature recorded was about 65^o C at Tapovan geothermal area. 0.83 to 9.2 liters per second is the range off discharge from this spring. Himachal Pradesh has decided to select some geothermal resources of Beas Valley, Satluj Valley, Spiti Valley and Parvati Valley for deep drilling upto 2 kms for exploitation of geothermal energy. Around 60 thermal water springs occur at 18 localities in the West Coast hot spring belt. One geo thermal power project has been installed with a capacity of 25MW.

So, in all we can say that, the Geothermal Energy is the most efficient energy. It is green, clean and most importantly it is naturally occurring renewable source of energy. The geothermal hot water can be used for the purposes which require heating such as heating buildings, raising plants in greenhouses, drying crops, heating water at fish farms, and in many industrial processes. And one of the most important use of geothermal energy is that we can generate electricity. Since, this all can be done with the help of geothermal energy so, it is necessary to develop and establish more Geothermal Power Plants in India[8].

8 Oum Prakash Sharma & Poonam Trikha, Volume 7, Indira Gandhi National University, August, 2013.

A. *Advantages of Geothermal Energy*

1. Practically it is impossible to exhaust this source of energy.
2. There are no harmful emissions when geothermal energy is used to either produce electricity, heat water or heat buildings, unlike when burning coal or oils are used for the same purposes.
3. One of the important advantages is that, since it is a form of renewable energy, there can be government subsidies as well as tax benefits for using it.
4. Overall amount of land which is required to build a geothermal power plant is generally less than that of other types of power plants.
5. Harnessing this energy lessens our dependency on foreign oil.
6. Geothermal energy is a very stable and consistent source of energy. Solar panels don't produce electricity at night, wind speeds can fluctuates which affects the wind power and lastly, hydro energy can be impacted by changes in water flows. But geothermal energy is the same all time.

B. Policies Initiated by the Government

- India proposes to harness 10 GW of geothermal energy by 2030 through the collaboration with US, Philippines, Mexico and New Zealand. The draft policy released by MNRE also gives stress on the role and active participation which needs to be played by states.
- The central government has been really into the support of research in geothermal energy.
- 1973 was the year when systematic efforts were made to explore geothermal energy resources in India and afterwards several site were finalized. Cambay Graben in Gujarat, Puga and Chhumathang in Jammu and Kashmir, Tattapani in Chhattisgarh, Manikaran in Himachal Pradesh, Ratnagiri in Maharashtra and Rajgir in Bihar are some of the places which were finalized[9].

9 Mayank Aggarwal, *India Looks to Harness 10 GW Geothermal Power by 2030*, *Available At* http://www.livemint.com/Industry/qFWtAToDvYCYqtKjTcfixH/India-looks-to-harness-10-GW-geothermal-power-by2030.html, (Last Accessed on 22/08/2107).

Tidal Energy

The planet earth consist 70% of its surface under water[10]. So there should be optimum utilization of this area. Tidal power is one of the important sources which can actually help to utilize this precious natural resource. Tidal energy is a type of hydropower which uses tides to form electricity or other power which will be very helpful for the society. This energy is also known as lunar energy. It uses the gravitational force of both earth and moon and sometimes sun also to form energy[11].

A. *How Tides are Produced?*

This energy uses the tides to form electricity, but the question then arise that how the tide is produced? Moon rotates around the earth and earth revolves around the sun. So millions of water gallons were created by the gravitational pull of all the three things i.e. earth, moon and sun. The gravitational relation between the earth and the moon creates two types of tide viz., high tide and low tide.

When the moon stands at the center of the earth and sun and produces perfect alignment between them, in that situation the gravitational pull become much stronger and create high tide. This type of tides is also known as spring tides. This type of tides occurs during the full moon phase. Other than the spring tides there is the situation in which the gravity of the earth and the moon is 90^{o} to each other. This relation creates the situation of low tide. This is also known as neap tides. These situations will weak the gravitation force on earth and water flown away from earth as so the movement of mass. This form of tides occurs during the quarter moon phase[12].

10 Anand Prakash Yadav, Kundan Kumar & Priyank Srivastava, A Review on Tidal Scope & Its Sope in Indian Peninsular Area, Vol. 8, issue 2, 97-102,97(2016).

11 Tidal energy, *Available At* http://www.tidalenergyltd.com/?page_id=1370. (Last Accessed on 22/08/2107).

12 Tidal energy, alternative energy tutorials, *Available At* http://www.alternative-energy-tutorials.com/tidal-energy/tidal-energy.html, (Last Accessed on 20/08/2107).

The difference between the high tide and the low tide is called tidal range. The mid-ocean tidal range is from 0.5 and 1.0 meters and it is larger at the shelves of the continent. The tidal range keeps on changing between islands and straits like in the Bristol Channel (UK) it is 12 m and in the Bay of Fundy (Nova Scotia), the range of tidal is 13 m, which is the maximum range in the world[13]. The Two high tides and two low tides each day constantly moving in the ocean water. The high tide changes to low tides and again converts into high tide. This shifting of high tide to low tide is a tide cycle called diurnal circle and this cycle takes about 12 hour and 24 minutes to happen[14].

B. *Historical Background*

In the middle ages small tidal mills like windmills were used in England were used which produce limited mechanical power. Some of them are still operational today. Power produced by such mills in the order of 50 to 100 KW[15]. The barrage concept attributed to Thomas Telford was put forward in 1849 and the first serious proposal which involved electricity production came in 1920 from the Ministry of Transport[16]. In 1933, Severn Creek tidal plant was activated by government of UK and at the same time USA also started working on their small tidal project in the Bay of Passamaquoddy, which was eventually stopped in the year 1935 due to exorbitant costs. Then no work was done in the next 25 years in the field of tidal energy[17].

The first tidal plant was constructed at La Rance France in the year 1966. This plant was commissioned by L B Bernshtein of Russia and R Gibrat. This plant generated 240 MW using 24 law-head Kaplan Turbines[18]. In 1968, a small power station was created in Kislaya Guba in Russia which was an experimental power station. This was the only plant which was made by women only[19]. This

13 John Andrew & Nick Jelly, Energy Science, 80 (2011).

14 Tidal energy, alternative energy tutorials,(29/08/ 2017), *Available At* http://www.alternative-energy-tutorials.com/tidal-energy/tidal-energy.html. (Last Accessed on 27/08/2107).

15 M MDandekar& K N Sharma, Water Power Engineering, 478 (2nd ed. 2013).

16 Renewable Energy- Power for a Sustainable Future, 243 (Godfrey Boyle ed, 3rd, 2012).

17 *Supra* at 15.

18 *Supra* at 13.

19 *Supra* at 15.

plant contained the capacity of 400 kW. In 1975, an unimplemented project was proposed, which was much larger 15 GW, to enclose large area of sea form ST Malo in the south to Cap De Carterel in the north. This project was named 'Ile De Chausey Project'[20]. Other than La Rance plant the only tidal plant was proposed to be built at Bay of Fundy at Canada. It was completed in the year 1984. Apart from the emphasis of UK, till date many countries have worked on this technique in the smaller amount which became helpful for them. The first commercial-scale grid linked tidal current turbine, which consist of 1.2 MW and having two bladed unit has been operating successfully in Strangeford Narrows in Northern Island since 2008[21].

The tidal energy has a biggest advantage which is that the tides are predictable unlilke the wind and solar energy. Larger the coastline used for tidal energy more the energy can be produced. Therefore the tidal energy is considered as a important sustainable energy as this energy used the tides which was formed with the gravitational forces of earth and moon and the relation between the earth, moon and sun can never be finished. There are three different types of tidal energy system which contains their own strength to produce the energy.

C. *Types of Tidal Energy*

Tidal Barrage

In this type of tidal power the energy is generated through a large dam called barrage. This barrage will help water to spill over or through turbines in the dam as the dam is set low. This controllable way is called "sluice gates"[22]. It generally generate with the help of the difference in the vertical height between the coming high tide and the going low tide. The barrage gates are open as the tide rises. At high tide are closed which create a pool. The water will bereleased through the barrage's turbine. The energy created can be controlled through this process.

20 Renewable Energy- Power for A Sustainable Future, 243 (Godfrey Boyle ed, 3rd, 2012).
21 *Ibid*.
22 Tidal Energy, Alternative Energy Tutorials, *Available At* http://www.alternative-energy-tutorials.com/tidal-energy/tidal-energy.html, (Last Accessed on 27/08/2107).

The tidal power plant at the Rance River. In Brittarey, France uses a barrage. This plant uses two sources of energy;- tidal from the English Channel and river Current Energy from the Rance River[23].

Tidal Lagoon

Tidal lagoon is much function like a barrage. It involves construction on lagoons. Basically it is a body of ocean water which is partly enclosed by natural and manmade barrier. Lagoons have the advantage over barrage they it would not involve blocking off an estuary and with this advantage it has a lesser impact on environment. With the help of double barrage idea, lagoons could enable phased operation and pumping between segments.

The potential sites of tidal lagoons is being investigated by US company Tidal Electric in the countries of Alaska, Africa Mexico, India and China. In the writing a 1000 MW project is being considered in India and the company has also being in discussion with the Chinese government. It has also expressed the interest in a 300 MW tidal lagoon to be built at Yulu River[24]. This construction was done with North Korea. Three sites are under consideration in UK. There was also planning of a small tidal lagoon power plant in Swansea Bay in Wales by a private company[25].

Tidal Stream

This type of energy is better than the other two types of energy. To generate the energy with this type, turbines are placed in tidal streams. The tidal energy through streams is much likely the wind energy. But tidal energy is much powerful than wind energy because water is much dense than air and it is also predictable and stable in nature[26].

23 Tidal energy, National Geographic, *Available At* https://www.nationalgeographic.org/encyclopedia/tidal-energy. (Last Accessed on 27/08/2107).

24 Renewable Energy-Power for a Sustainable Future, 269 (Godgrey Boyle, 3rd Ed, 2012).

25 Tidal energy, National Geographic, *Available At* https://www.nationalgeographic.org/encyclopedia/tidal-energy. (Last Accessed on 27/08/2107).

26 *Ibid*.

The best advantage of the tidal stream is that the blades of tidal stream moves very slow which helps marine life i.e. aquatic animal to move properly and avoid migration and getting caught in the system of energy creation. Plant in Strangeford Laugh in Northern Ireland was the first tidal power in the world to be constructed in a larger scale. The turbine are placed between the Strangford laugh inlet and the irist sea. The tide in that area move at 4 meters per second which is of 13 feet[27].

D. *Advantages of Tidal Energy*

There are various advantages of tidal energy which are as follows;

1. The tides are predictable in nature.
2. Tidal energy is renewable in nature and there is no fuel needed to run the turbines.
3. No waste of bi-products is produced.
4. Tidal energy reduces the dependency of fossil fuel.
5. Clean energy is being produced by tidal and it has effect on green house gas.
6. The tidal plant has a long economic life of 75 to 100 years.
7. No solid pollution was created by tidal plant.

E. *Usage of Tidal Plant Around the World*

The world's tidal power potential is estimated at 4,000 GW, Almost equivalent to the river Hydropower potential[28]. The Bay of Fundy has the highest tidal range in the world. the cost of argentina, NW Australia, Brazil, China, France, India, South Korea, UK, Russia and the American[29].

South Korea

In the year 2003 in Uldolmog on the south coast containing 5.5 m current speed. In sihwa area there are some plans for ocean current power farm of tidal

27 *Ibid*.
28 M M Dandekar& K N Sharma, Water Power Engineering, 478 (2nd Ed. 2013).
29 *Ibid*.

barrage which is at the last stage of completion. In Warando, there is the facility of largest power plant which has 300 MW of tidal current turbines installed by 2015. Voith was supposed to be installed with three bladed facility up to 600 of its 1 MW seaturtle tidal corrent turbines[30].

USA

In New York verdant plant was tested at East River near Roosevelt Island with the capacity of 35 KW. USA found the importance of this energy and claimed to clocked up to 9000 turbines operating hours and said to increase 30 more turbines for this energy. Massachusetts Tidal Energy Company played a crucial role in developing this energy. Series of two way 45 kW underwater electric kite ducted turbine is also planned to set up in the mouth of river Delware, by UEK Corporation. The country of San Francisco as well as the golden gate energy company to introduce and implement schemes on tidal power[31].

Canada

Canada is looking for the method called tidal stream as they has enough involvement in the barrage. At Bay of Fundy 600 MW was installed by the energy company. Canadian companies working in the field of clean current.

Their companies are also working with UK's MCT to install plant at Bay of Fundy[32].

F. *Tidal Energy in India*

India is blessed with the huge water boundaries. The west coast region contains the highest capacity to form tidal plant for energy creation. Gulf of Khambat and Gulf of Kuchchh are the two cites which is famous for tidal plant. The mean tidal range is 7 m in the bay of khambat. The max tidal range at these stations was up to 8m to 11m and average is 5m to 7m[33]. The Ganges Delta,

30 *Ibid* ar 24

31 Renewable Energy- Power for A Sustainable Future, 287 (Godfrey Boyle ed, 3rd, 2012).

32 *Ibid* at 288.

33 Rijuldhinra & Abhinav Jain *et al*, Assessment of Renewable Energy in India, International Journal of Environmental Sciene and Development, Vol. 5, no. 5, October 2014, 460.

Sunder bans West Bengal too has good locations for small scale tidal power development. London based company Atlentis Resourse Corporation along with Gujarat Power Corporation, started jointly to make 50 MW tidal plant[34]. This plant will be first of its kind. To produce the tidal energy the height of the tides should be greater than 4 m. The area under the Mumbai forms the tides between 4-6 meter. So that part can be the major source for the tidal energy. Mumbai is also known as financial capital of the country. A large scale tidal power plant can be installed there. A proposed should be initiated. According the IIT Madras India has 150 GW potential energy creation but it has created only 14% of that information given[35]. Which Indian can create huge amount of energy with reference to the available resources.

In a study it was said that India could profitably install over 550 turbines of 6 m diameter. This study was taken by tidal power cell of Central Electricity Authority of India. The tidal power potential at Khambat is of the order of 7000 MW, or 15 TWh annually. It is also reported that in the Gulf of Kuhchh the tidal farm of 50 MW is expandable up to 200 MW.

Suggestions and Recommendations

For Geothermal Energy

- The material used for the installation of powerplant should be made little cheper so as to facilitate the more number of installation of power plant.
- Foreign direct investment should be allowed, so that the big companies can invest and build more powerplant which eventually will grow our economy.
- Proper legal framework should be formed for effective and smooth working in this sector.
- Government should allow the private companies to enter into this industry and establish the plant
- Proper guidelines should be given for license.

34 *Supra* at 15.
35 *Supra* at 10.

- Law should try to focus on awareness and advocacy of Geothermal.
- Government should try to focus on the policies for displacement.
- India should try to adopt the Tax Incentives like USA.

For Tidal Energy

1. Marine life:-spinning blades can actually kill the marine life so the life of aquatic animal should be taken into consideration while constructing power of this energy. So we would suggest that there should be more usage of tidal stream because the blades of tidal stream moves very slow and there will be no interference in aquatic life.
2. Privatization of tidal plant:- for establishing tidal plants we require huge funds, so to raise funds for project and to improve the quality of plant we should privatize the plant and we can also allow foreign investment in this plant because several foreign countries like USA produced better results after foreign investment in this plant.
3. Soil for the plant:- soil for the tidal plant should be hard and not soft because soil should have the capacity to bear the weight of plant.
4. Energy law:- we have energy conservation act as well as electricity act, but there is no specific tidal energy act available in India. There should be a specific act on tidal energy which will form laws and policies only in the field of tidal energy.
5. Maintenance of tidal plants:- cost to establish this plant is much but it is only one time investment but apart from this regular maintenance should done to increase the lifetime of this plant.
6. Private body:- India is having the capacity of 550 turbines and potential of 150 GW of energy creation so we cannot neglect this plant therefore we suggest that there should be some private body or a central private body which will frame policies for this energy.

Conclusion

Sustainable development guides us how to develop the country and world without harming the environment and without endangering the needs of present and future generations. It was all started in the year 1987, in Brundtland commission. Sustainable development is the development of an economy without the depletion of natural resources. It is an alternative and secured way to fulfill the needs.

It was surveyed that we cannot run the current oil more than 40 years from now and usage of fossil fuels are aiding problems to our environment. These problems release hazardous byproducts which create pollution and contribute overall in global warming. Global energy is produced from the heat of earth. it has been proved to be very beneficial to both industrial and domestic requirement of energy. The geothermal energy can be captured on the hotspots only. It is basically the area which allows the excess head produced in the interior of the earth to flow to the outer crust, this happens at the mantel. India has around 340 hotsprings which can ultimately help to produce energy for this country. Binary, dry steam and flash are the various types of power plants which help to produce this energy. Till now there were not much policies implemented in India. Till now only 300 GW of power plant has been installed and has the capacity to install more of such type of plant. So there is the larger scope of this energy are the capacity and potential is much higher then implemented. If the country could work upon the suggestions and policies framed by government, then it will be easier to achieve the targets well.

The earth consist 70% of its surface under water. So there should optimum utilization of this resource. Tidal energy is the only source in which we can use these resources in a better way. Tidal energy is created with the help of tides produced in the ocean. Tides are formed with the gravitational pull of earth in relation with moon and sun. The range of tides should be above 4 meter tidal energy will be very effective to use the natural resource. This form of energy is used in many countries in the world like USA, China, Norway, Canada, UK, India etc. The whole world has produced better result for energy creation. This energy has not implemented well in India. India is having the potential to produce 150 GW of energy and has the capacity to install 550 turbines of 6 diameters. But in India there are only three major plants established so far, i.e. Gulf of Khambat, Gulf of Kuchchh and Sunderban area. India has not work according to the potential and capacity to create this energy. Area around Mumbai can become useful for this technique as tides in that area are more than 4 meters. So there is a large scope of energy creation through tidal plant for this India should work upon the suggestions and the policies framed by the government.

These two types of energies are being neglected by the government of this country because of heavy cost in it and the lack of awareness among the people. But these two energy has the capacity of around 500 GW of energy which cannot be neglected and can be helpful for the development of this country. So the policies which are suggested should be implement to achieve the capable targets.

*****

The Uncertain Future of The Middle Children of India's Renewable Energy Family

*Rhiti C. and Vaitasta Tickoo**

In 2002, a report titled 'The Living Planet Report' by the World Wildlife Fund estimated that at then current rates of population growth, economic development and technological change, humans would consume between 180% and 220% of the Earth's biological capacity by 2050. Both widely touted and criticized by environmental scientists, the report highlighted the conflicting views of the two camps of population growth theorists. While the Malthusians believe that uncontrolled growth of human population will eventually result in total environmental destruction and the end of the world as we know it, traditionally subscribing to the "peak oil" theory first proposed by geologist M. King Hubbert; Cornucopians hold that advances in technology will take care of the growing population's needs. Ecologists call this phenomenon "niche construction" and economists call it "innovation". The truth is however, that the limiting factor on humans' use of non-renewable energy sources will not be the debilitation of economically recoverable energy sources, but the exhaustion of the Earth's capacity to withstand the harmful by-products of fuel combustion.

The need for the global community to lay emphasis on sustainable development keeping in mind the repercussions of continued fossil fuel usage, among other environmentally harmful activities, was first recognized at the United Nations Conference on Environment and Development (UNCED), held at Rio De Janeiro, Brazil in 1992. The Earth Summit brought together scientists, diplomats, media personnel, non-governmental organization representatives and policy makers from 179 countries in an effort to arrest if not alleviate the impact of human production and consumption on the ecology. Transitioning from a largely fossil fuel based energy economy, to one that is predominantly renewable energy based has been the flagship model of the sustainable development enterprise.

* 3rd Year, BA. LLB, Hidayatullah National Law Univeristy Raipur.

Use of renewable energy sources apart from being inexhaustible, have little to no harmful emissions, stabilize energy prices, improve public health and environmental quality and create an all-around more reliable and resilient energy system. According to the data provided by the Renewable Energy Policy Network for the 21st century (REN21), a global renewable energy multi-stakeholder policy network, renewable energy sources contributed 19.3% to global final energy consumption in 2015. Of this, 8.9% was the contribution of traditional biomass, 4.2% was contributed by heat energy (modern biomass, geothermal and solar heat), 3.9% by hydroelectricity and 2.2% was electricity from wind, solar, geothermal and biomass.[1] In India renewable energy sources contributed around 20% of the total grid connected installed capacity of energy production.[2]

While hydel, solar and wind continue to be the big players in the renewable energy market, tidal and geothermal energy remain largely as untapped potential across national energy systems, notably in India. It cannot be denied that some attempts have been made at policy-making in this specific area, however, considering the lack of legislative follow up and proper implementation, they have been rendered fruitless. Sufficient investment has also not been made in research and development to appropriately optimize existing technology to Indian conditions. The real risk here is that the Ministry of New Renewable Energy's (MNRE) lacklustre approach towards this potential gold-mine may be the last nail in the coffin of the proposed expansion programme which aims to reach 175 GW of energy production by 2022; certainly, no modest claim.

By the means of this paper, we make the following contributions:

- We study the various methods of energy generation from geothermal and tidal resources and give the benefits of these methods versus other more traditional renewable energy sources.
- We analyse the policy measures undertaken by the MNRE in the field of geothermal and tidal energy generation, legislation and implementation of the same, and the past successes and failures in the field. (refer to Chapter 2)
- We present a review of the existing policy and legislative measures in light

1 Renewables 2016 Global Status Report 28 (REN21 2016).
2 Executive Summary Power Sector Feb-2017 43 (Central Electricity Authority 2017).

of the steps undertaken by the global giants in the field and the potential loss we could incur by continuing to underutilize these valuable resources. (refer to Chapter 3).

Methods of Generation

Tidal Energy

Tidal energy is one of the more predictable and reliable renewable energy sources.[3] Tidal movements are generated from the gravitational and centrifugal forces between the earth, moon and sun.[4] Each landmass is exposed to two high tides and two low tides during each period of rotation of the earth.[5] Tidal variations not only result in rise and fall of the ocean surface but can also lead to tidal currents. These currents flow in two directions; the current moving in the direction of the coast is known as the flood current and the current receding from the coast is known as the ebb current. These currents can also be used to generate electricity.

Tidal Stream

The vertical rise and fall of water, known as tides, is also accompanied by an incoming or outgoing horizontal flow of water in bays, harbours, estuaries and straits. This is what is known as tidal current or tidal stream. Much like wind turbines, tidal stream devices use water currents in place of wind to turn turbines and convert kinetic energy into electricity. However, there are striking differences between the operation of the two since the density of water and air greatly differs under ambient conditions.

The different types of devices that convert the kinetic energy of the flowing water into electricity may be grouped under the following heads:

---

3 Rajat Mazumder & Makoto Arima, *Tidal Rhythmites and Their Implications*, 69 Earth-Science Reviews 79-95,1–2 (2005).

4 Future Energy: Improved, Sustainable and Clean Options for Our Planet 111–128 (Trevor M. Letcher 2008).

5 J. A. Clarke et al, *Regulating the Output Characteristics of Tidal Current Power Stations to Facilitate Better Base Load Matching Over the Lunar Cycle*, Renewable Energy 173-180 (2006).

i. Horizontal-Axis Turbine – Similar to a wind turbine, the turbine blades rotate about a horizontal axis which is parallel to the direction of the flow of water. This operates a rotor, which converts mechanical energy to electrical energy using a generator.[6]

ii. Vertical-Axis Turbine – As opposed to the horizontal-axis turbine, the turbine blades rotate about a vertical axis which is perpendicular to the direction of the flow of water.[7]

iii. Oscillating Hydrofoil - Oscillating hydrofoils comprise a hydrofoil located at the end of a swing arm, which is allowed to oscillate in pitching mode by a control system. The rotational motion that results can be converted to electricity through a generator.[8]

Several sites worldwide offer potential for the exploitation of energy from tidal current, however, factors such as technology status, water depth, wave exposure and seabed exposure require consideration in assessing the practical energy resource availability at a particular location. In general, tidal current sites with water flow speed greater than 2.5 m/s are considered to have significant practical energy resource and are economically viable.[9] Today there is almost 4.3 MW of commercial tidal stream installed capacity and the largest two plants are at the Uldolmok Tidal Power Station in South Korea and MCT's SeaGen installation in Strangford Lough, Northern Ireland.

Tidal Range

Tidal range technology is similar to hydroelectric power generation, wherein the artificially raised height of one body of water with respect to another body of water created by a dam or barrier is used to create gravitational potential energy which is harnessed with the help of a low-head hydroelectric turbine.

6 I. G. Bryden et al, *Matching Tidal Current Plants to Local Flow Conditions Energy* 23 PII 699 (1998).

7 S. Kiho et al, *The Power Generation from Tidal Currents by Darrieus Turbine* 9 Renewable Energy 9, 1242 (1996).

8 World Energy Council, *World Energy Resources Marine Energy*, 2016, World Energy Council *Available At* https://www.worldenergy.org/wp-content/uploads/2017/03/WEResources_Marine_2016.pdf, (Last Accessed on 20/8/2017).

9 Ian G. Bryden & Scott J. Couch, *ME1—Marine Energy Extraction: Tidal Resource Analysis*, 31, 133 (2006).

Tidal range plants are of two types, tidal barrage or tidal lagoon. Tidal barrages work by the use of dams to restrict the flow of water into or out of a tidal inlet. Tidal lagoons on the other hand, are independent enclosures located away from the estuarine areas, which are more flexible in terms of capacity, cost effective and have minimal harmful impact on the environment. The primary advantage of tidal range technology is that it is very predictable and could therefore be an important source of baseline electricity generation at easily forecast-able times of the day.[10]

The world's first large-scale tidal range power plant was the la Rance Tidal Power Station (240 MW) that became operational in 1966 in Brittany, France and still operates today. Other major projects were subsequently developed including the 20 MW Annapolis Royale plant in Canada installed in 1982 and the 254 MW Sihwa tidal plant in South Korea. These developments along with a host of smaller scale projects have resulted in approximately 521 MW of tidal range capacity worldwide with another 1.7 GW under construction.[11]

Benefits of Tidal Energy

Although at present tidal energy is not widely used, it deserves significant investment in the coming years because of its numerous benefits. Whether we are talking about tidal barrages, stream generators or the more recent technology, OTEC, the power source of tidal energy is veritably inexhaustible. The production of tidal energy does not result in any harmful emissions. Sea currents are highly predictable, with well documented cycles, which make it easier to construct tidal energy systems with the correct dimensions. Tidal turbines also work at various speeds, including low speeds of 1 minute per second. Tidal energy plants have a long lifespan, the La Rance tidal barrage power plant was constructed in 1966 and is still generating large amounts of electricity up to this day. For coastal nations, harnessing tidal energy would mean reduction of fuel imports and higher energy security. Small dams and barrages along the coast could also work to protect the ship ports and coastal

10 *Supra* note 9.

11 *Ibid.*

areas from potentially dangerous tides during storms and related bad weather conditions.

Geothermal Energy

Geothermal energy is the energy contained in the earth's interior in the form of heat. The inner core of the earth reaches a maximum temperature of about 4000°C. Generally, the heat is transferred from depth to sub-surface regions mostly through the solid, sub-marine and land surface mainly by conduction and occasionally by active convective currents of carrier geothermal fluids such as molten magma or heated water. The heated water is essentially rainwater that has penetrated the earth's crust from the recharge areas. The water gets heated through contact with hot rocks, and accumulates in aquifers, occasionally at high pressures and temperatures of up to above 300°C. These aquifers (reservoirs) are the essential parts of most geothermal fields.[12]

Geothermal Turbines

The use of geothermal energy for electric power generation from turbines requires heat energy with higher temperature. In dry steam power stations, they directly use geothermal steam of 150 °C or greater to turn turbines.[13] Then, in a condenser, the water cools and is emitted back into the soil. In flash steam stations, deep high-pressure hot water is pumped into low pressure tanks and the resulting flash steam is used to drive the turbines. These kind of power stations use geothermal reservoirs of water with temperatures higher than 182 °C and can be highly sustainable sources of energy. In binary cycle power stations, a recent development, temperature of geothermal reservoir can be as low as 57 °C.[14] The relatively hotter geothermal water is passed by a secondary fluid with a significantly lower boiling point than water. This causes the secondary fluid to flash vaporize, the resulting steam then drives the turbines.

12 Enrico Barbier, *Geothermal Energy Technology and Current Status: An Overview*, Renewable & Sustainable Energy Reviews 6, 3 (2014).

13 Fridleifsson, Ingvar B. *et al*, *The Possible Role and Contribution of Geothermal Energy to The Mitigation of Climate Change*, 59 (2009).

14 Erkan, K. et al, *Understanding the Chena Hot Springs, Alaska,* 37 (565–585).

Ground Source Heat Pumps

Often, it may better suit to directly heat buildings with the help of geothermal energy or it can also be used for preheating of other conventional high temperature energy facilities. For example, heat from near-surface ground or lakes is often used for heat pumps. According to the reports published in the World Geothermal Congress 2010, the installed capacity of ground source heat pumps in the world is 52.7 GW up to the year 2013. More than 3 million GSHP units installed worldwide in 43 countries.

Benefits of Geothermal Energy

There are certain benefits or advantages of geothermal energy which must be considered while planning the development of geothermal energy plants. An average geothermal plant emits one eighth the carbon dioxide that a coal power plant would. After installation, no mining or transportation activity is necessary. The energy in the geothermal reservoirs is sustainable and self-replenishing. The power output of a geothermal plant is stable and easily predictable and does not undergo any variations like solar or wind energy. As it can directly be used for heating and cooling it is significantly less troublesome than other renewable power generation methods. The result is that less energy is used for heating homes and offices which results in significant savings for home owners. As per the international reports a 1 MW Geothermal Power Plant generates about 8.3 Million Units (MU) per MW per annum, compared to Solar 1.6 MU per MW, Wind 1.9 MU per MW and Hydro 3.9 MU per MW.[15] Many homes and offices who continue to use geothermal energy for heating and cooling purpose for their offices and homes, this results in many savings.

Geothermal and Tidal Energy in India

India, the world's fourth highest energy consumer, has been trying to harness the 10,000 MW power potential[16] of the geothermal energy and 9,000 MW

15 Enrico Barbier, *Geothermal Energy Technology and Current Status: An Overview*, Renewable & Sustainable Energy Reviews 6, 3 (2014).

16 Ministry of New and Renewable Energy, *Geothermal Energy*, Ministry of new and Renewable Energy *Available At* http://mnre.gov.in/schemes/new-technologies/tidal-energy/ (Last Accessed on 22/8/2017).

of the tidal energy potential[17] for various purposes for the last 25 years. On the other hand, countries like the US, Philippines, Indonesia, Mexico, Italy and Iceland have already begun to use geothermal energy for electricity generation and heating purposes[18] However, with the emphasis given on replenish-able energy resources in the 12th Five Year Plan[19], it is likely that India will finally take a step towards the 'Transformative Change in Energy Supply'.

Geothermal Energy

The history of exploration of geothermal energy can be traced back to 1968 when a report by the 'Hot Spring Committee' set up by the Government of India, for the first time, gave birth to the idea of exploring and exploiting the thermal reserves of the country.[20] In consequence, various valuation studies and surveys were undertaken by the Geological Survey of India (GSI) in 1973 and 340 potential geothermal sites were identified. The GSI also prepared the Geothermal Atlas of India to collect all the available information on thermal springs in India. These hot springs have been grouped into seven provinces which include the Cambay Basin, Son-Narmada-Tapi also called SONATA lineament belt, Himalayan, West coast, Godavari basin, Sahara valley and Mahanadi basin. Exploration of thirty-one major geothermal energy spots in India and shallow drilling of sixteen areas has been recorded so far.

Puga valley of Jammu and Kashmir is one of the six most prominent geothermal reserves for the development of geothermal energy in India. Researchers suggested that India, as it lies in the low and medium enthalpy zone with surface temperature varying from 35° C to a peak 98° C, can easily use geothermal energy for heating and cooling purposes. Various conferences and discussions were held to deliberate on the scope of geothermal energy in India. The 'International Conference on Geothermal Energy: Exploration and

17 Ministry of New and Renewable Energy, *Ocean Energy*, Ministry of New and Renewable Energy *Available At* http://mnre.gov.in/schemes/new-technologies/tidal-energy/.

18 Renewables 2016 Global Status Report 28 (Ren21 2016).

19 Ministry of New and Renewable Energy, *Indian Geothermal Energy Development Framework,* Ministry of New and Renewable Energy *Available At* http://mnre.gov.in/file-manager/UserFiles/Draft-Geothermal-frame-work-for-comments.pdf, (Last Accessed on 22/8/2017).

20 Geological Survey of India, Geothermal Atlas of India (Special publication 19, 1991).

Exploitation' organized by Centre of Excellence for Geothermal Energy(CEGE) in 2015 focused on bringing industry professionals, scientists, researchers, experts, policy makers, academicians and students together to discuss the issues and challenges in investigation and exploitation of geothermal energy[21] The Government of India, Ministry of New and Renewable Energy has been working with the Research and Development (R&D) to develop technology, processes, material components, sub-systems and products to indigenously manufacture renewable energy products and systems.

As these developments were made, the Ministry of New and Renewable energy drafted a geothermal energy development framework to focus on the study of exploitation of such a viable energy resource. The Draft[22] includes a preamble that establishes that development of geothermal energy is the focal point of the policy and provides a vision and a goal to be accomplished by the policy. Inter alia, the draft expands upon the following topics:

i. The Policy provides a brief introduction to the Ground Source Heat Pumps (GSHP) which can be used for cooling and heating purposes.

ii. The policy encourages the public as well as private sector to carry out projects in India for research, investigation and development of geothermal energy. The universities, organizations or other three-level institutions undertaking such projects will be supported by MNRE and other governmental bodies.

iii. Allotment of a potential geothermal zone for exploration will be done by the State Government.

iv. Facilitation and methodology for geothermal energy include foreign collaboration, benefits to be provided by the finance ministry and funding made by the government. There are five categories of projects that can be undertaken: R&D projects, Industrial projects, Public good, GSHP's, Geo-exchange cooling projects. All such projects will be funded if found to be approved by the MNRE.

21 International Conference on Geothermal Energy: Exploration and Exploitation, Ministry of New and Renewable Energy *Available At* http://mnre.gov.in/file-manager/UserFiles/Geothermal-conference-01052015.htm, (Last Accessed on 22/8/2017).

22 Ministry of New and Renewable Energy, Indian Geothermal Energy Development Framework, *Available At* http://mnre.gov.in/file-manager/UserFiles/Draft-Geothermal-frame-work-for-comments.pdf, (Last Accessed on 22/8/2017).

iv. The State Government may facilitate the land acquisition, provide funds and form a committee to supervise the projects. The committee may consist of three members comprising representatives of MNRE, State Government and Industry.

v. The applicants must demonstrate strong technical and theoretical foundation for their technology. The theoretical model must provide evidence for the performance and cost of the proposed device.

vi. The proposals will be scrutinized by the MNRE and at last, the eligible projects will be approved.

Currently, the major ongoing projects include the Magneto-telluric investigation in Tattapani geothermal area in Madhya Pradesh and Magneto-telluric investigation in Puga Geothermal area in Ladakh region[23] Another major achievement is the completion of the Geothermal Space Heating and Cooling System at the Swaminarayan Temple, Dholera village of Gujarat which is the first of its kind in India[24] Though, India has been one of the earliest countries to begin geothermal projects, but at present there is no operational plant, only direct use of geothermal energy has been reported.

Tidal Energy

India has a cumulative coastline of around 7,500 km which has the potential to produce 9000 MW of energy.[25] Tidal energy is another renewable energy source in its nascent stage. As per the studies carried out by the Central Water and Power Commission (CWPC) in 1975, the Gulf of Kutch and Gulf of Khambat in Gujarat and the Sunderbans in West Bengal are the best sites for tidal energy production[26] In the 1980's, the Central Electricity Authority (CEA)

23 Dr. S.S. Verma, *Geothermal Energy in India,* Ministry of New and Renewable Energy, *Available At* http://mnre.gov.in/file-manager/akshay-urja/january-april-2017/EN/Images/28-33.pdf. (Last Accessed on 25/8/2017)

24 Ministry of New and Renewable Energy, *Geothermal Space Heating and Cooling System, Dholera Gujarat (Dec 13, 2016) Available At* http://mnre.gov.in/file-manager/UserFiles/PDPU-Dholera-plant.pdf, (Last Accessed on 25/8/2017).

25 *Supra note* 20.

26 Vikas Mendi, Subba Rao & Jaya Kumar Seelam, Tidal Energy: A Review 22-25 (21st International Conference on Hydraulics, Water Resources and Coastal Engineering, 2016).

listed the quantum of potential energy output that these locations are capable of producing, which is 7000 MW for the Gulf of Khambat, 1200 MW for the Gulf of Kutch and 100 MW for the Gangetic Delta[27]

Based on the assessment of the data gathered from the National Institute of Oceanography (NIO), the wave power potential in India was estimated at 40,000 MW approximately.[28] In 2001, West Bengal Renewable Development Agency (WBREDA) submitted a report proposing the setting up a tidal power station at Durg Duani Creeks of the Sunderbans estuary for studying, testing and assessing the potential of Tidal Energy in India.[29] In 2007, the monitoring of the project was assigned to the National Hydroelectric Power Corporation. The project was abandoned by the State Government in 2013 due to massive cost escalation. The Gujarat Government, in 2011, after signing a deal with Atlantis Resources Corporation, London, decided to set up a tidal power plant at the Gulf of Kutch with an initial capacity of 50 MW.[30] MNRE in 2011 declared that it will provide financial incentives for up to 50 percent of the cost for projects seeking to develop tidal power.[31] In 2014, Indian Renewable Energy Development Agency Limited (IREDA) presented their final report on the 'Study on Tidal & Waves Energy in India; Survey on the Potential and Proposition of a Roadmap'. Recently, the cabinet even approved of India joining the International Energy Agency- Ocean Energy Systems (IEA-OES) by signing the Implementing Agreement.[32] India will now have access to advanced R&D teams and technologies across the world which will help in its own research projects.

27 *Id* Pg. 31.

28 Study on Tidal & Waves Energy in India: Survey on the Potential & Proposition of a Roadmap, CRISIL Risk and Infrastructure Solutions Limited with Indian Institute of Technology Madras (Dec 2014) *Available At* http://www.ireda.gov.in/writereaddata/AFD_Tidal.pdf.

29 Indrani Dutta, *Sunderbans Tidal Project axed*, The Hindu, April 07, 2013 at 4.

30 *Gujarat aims for Asia's biggest Tidal power plant*, TOI, January 20, 2011, at 8.

31 Ministry of New and Renewable Energy, Ocean Energy, *Available At* http://mnre.gov.in/schemes/new-technologies/tidal-energy/. (Last Accessed on 25/8/2017)

32 Government of India, *Cabinet approves India joining the International Energy Agency-Ocean Energy Systems*, Jan 13, 2016, Government of India, *Available At* http://pib.nic.in/newsite/PrintRelease.aspx?relid=134427, (Last Accessed on 28/8/2017).

Global Giants of Tidal and Geothermal Energy

Across the globe, concerns regarding rising global warming, climate change and over-use of fossil fuels has led to adoption of various non-conventional energy resources. Geothermal and Tidal energy are the 'New Generation of Renewable Resources' which have recently proved to be of great value in terms of energy output. Due to the supply of clean, renewable power round the clock, emission of little or no greenhouse gases and taking very small environmental footprint to develop, they have proved to be more vital than ever. India, a relative newcomer to fields of tidal and geothermal energy, has much to learn from the successes of the global giants in the field.

Geothermal Energy

Geothermal Energy giants include the United States, Italy, Mexico, Philippines and Iceland. The largest dry-steam geothermal plant is the Geysers Complex, located in the Mayacamas Mountains, California, USA. The complex has 22 geothermal plants with a combined installed capacity of 1,520 MW.[33] The Geothermal Technologies Office researches, develops, and validates new, innovative and cost- competitive technologies to locate, access and develop geothermal resources in the US. They work along with industry, academia and the Department of Energy (DOE)'s national laboratories on research and development activities focused on Enhanced Geothermal Systems, Hydrothermal Resources, Low temperature & Coproduced Systems and System Analysis.

In 1970, The Geothermal Steam Act was enacted which provided the Secretary of the Interior with the authority to lease public lands for geothermal exploration and development. Formation of the DOE and enactment of the Public Regulatory Policies Act further enhanced the working on exploitation of the thermal resources of the US. Initiation of various programs like 'Geo-Powering the West' by the DOE has actively increased the rate of development of other

33 Ronald Dipippo, Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact, 324 (2nd Ed. 2007).

geothermal plants there. The Energy Policy Act of 2005 changed U.S. energy policy by providing tax incentives and loan guarantees for various types of energy production and also amended the Geothermal Steam Act of 1970.[34] Other acts such as the Advanced Geothermal Research and Development Act, 2007 provided authorization and direction for DOE's geothermal research activities. It is observed that there is adequate monitoring facilities and legislation to support geothermal energy development in USA of the nature that is severely lacking in India.

After USA, Philippines is the largest producer of geothermal energy. The enactment of the Renewable Energy Act in 2008 for promoting the development, utilization and commercialization of Renewable Energy Resources provided for additional incentives in geothermal development because it is the banner resource in the campaign for the Act. Another major step towards the exploitation of geothermal energy resources was introduction of Open and Competitive Selection Process (OSCP) which is an investment promotion campaign in which prospect areas are offered and bid-out to private investors.

Iceland, transformed from a nation almost dependent upon imported oil and coal, to one where practically 86 percent[35] of primary energy is derived from renewable sources. Hellisheidi Power station, the largest geothermal power station in the world is in Iceland.[36] This is the result of effective policy aimed at making renewable energy a long-term priority in Iceland. The Ministry of Industries and Innovation has authored the Resource Act and the Electricity Act, the two main instruments of legislation that govern geothermal energy exploration and utilization in Iceland. The Ministry has also established an organization called Orkustofnun which is responsible for advising the government on geothermal and other energy issues, promoting energy research and administering development

34 Office of Energy Efficiency & Renewable Energy, *A History of Geothermal Energy in America*, U.S. Department of Energy, *Available At* https://energy.gov/eere/geothermal/history-geothermal-energy-america, (Last Accessed on 25/8/2017).

35 Jonas Ketilsson *et al*, *Legal Framework and National Policy for Geothermal Development in Iceland*, *Proceedings World Geothermal Congress 2015 (Apr. 19-25, 2015) Available At* https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/03019.pdf, (Last Accessed on 25/8/2017).

36 David Chernicoff, *Iceland's giant geothermal power plants*, *Datacentre Dynamics (Sept. 11, 2015*).

and exploitation of energy resources. The Icelandic National Renewable Energy Action Plan (NREAP) of 2012 outlines the strategy and goals of geothermal utilization amongst other renewable energy resources.[37]

Tidal Energy

The first tidal power station in the history of the world was the Rance tidal power plant built at La Rance, France.[38] It is operated by Electricite de France and was the largest tidal power station in the world by installed capacity until the South Korean Station. It has a 240 MW installed capacity. In France, electricity generation from renewable resources is encouraged through the means of a feed-in tariff, a premium tariff and tax benefits among other measures. The generation of heat through renewable energy plants is promoted through several energy subsidies, tax regulation mechanisms as well as through a zero percent-interest loan.

Since 2007, France has put in place an ambitious strategy for the development of renewable energies within its territory. A major national consultation, the "Grenelle Environment Forum", led to the emergence of priority targets in terms of controlling energy consumption and promoting renewable energies. It brought together all interested parties including State, local authorities, employers, Trade Unions and associations and has been unanimously recognized as a solid starting point for later decisions in terms of sustainable development in the territory. Following this consultation, a working group met to establish a reference scenario to achieve the target of 23% of renewable energies in the total final energy consumption. In 2009, France passed the National Action Plan for the Promotion of Renewable Energies (2009-2020) in accordance with Article 4 of the European Union's Directive in 2009. The Sihwa Lake Tidal Power Plant in South Korea, completed in 2011 is the largest tidal power installation in the world and has an installed capacity of 265 MW.[39] South

37 Jonas Ketilsson et al, *Legal Framework and National Policy for Geothermal Development in Iceland*, Proceedings World Geothermal Congress 2015 (Apr. 19-25, 2015) *Available At* https://pangea.stanford.edu/ERE/db/WGC/papers/WGC/2015/03019, (Last Accessed on 29/8/2017).

38 Ocean Energy Council, *Tidal Energy: Pros for Wave and Tidal Power,* 22 (2011).

39 Cha Seo Jung, *Tidal power plant nears completion,* Yonhap News, Dec 25, 2010, at 7.

Korea is a highly industrialized country and in particular, has many industries that are considered energy intensive.

As the country lacks sufficient natural resources, nearly all of its energy sources are imported. It has however, taken measures to expand the deployment of new and renewable energy. State-owned power generation companies (GENCOs) and independent power producers (IPPs) that generate over 500MW are required to include a certain percentage of renewable energy in their production portfolio. GENCOs and IPPs that meet the 500MW threshold must generate 10% of electricity from renewable energy by 2023.[40]

The very first tidal power site in North America was the Annapolis Royal Generating Station in Nova Scotia, on an inlet of the Bay of Fundy, which opened in 1984.[41] Currently it has a relatively low installed capacity of 20 MW. Within Canada the provinces of Nova Scotia and British Columbia are very well suited for tidal development given their tidal geography and location. Canada's leading test centre for in-stream tidal energy technology is the Fundy Ocean Research Centre for Energy (FORCE) which collaborates with industry, government, and researchers to study the interaction between Bay of Fundy environment and the tidal energy generation machines. Making great strides in the field of renewable energy legislation, in December 2015, the Province's Marine Renewable-Energy Act was passed to provide a clear, predictable and efficient process to support the sustainable growth of the sector. The Community Feed-in Tariff Program provides projects owned by community-based entities the opportunity to participate in the production of renewable electricity. Eligible groups receive price certainty for a period of 20 years for smaller-scale distribution-connected tidal projects.

Review of Indian Policy

India has a renewable energy potential of 150 GW, yet it has only developed about 14 percent of it. According to the UNERG's Synthesis Report, developing

40 Nohyoung Park, *Sihwa Tidal Power Plant:* A Success of Environment and Energy Policy in Korea, Korea University (May 30, 2016).

41 Emily Boucher, *Canada's Oldest Tidal Power Plant,* The Globe and Mail, Aug 29, 2004 at 3.

countries are, in general, well suited to the use of new and renewable sources of energy because unlike industrialized countries which have large, centralized, interconnected power grids, developing countries frequently require low-powered and decentralized energy supplies.[42] After all the studies, assessments, projects and exploration done by various governmental bodies, organizations and universities, India seems to stand right where it started. All the projects are still in their early stages. The major reason for failure of its geothermal and tidal projects is the lack of legislation.

Taking into consideration the proper legal framework that countries like the USA and Iceland have, the Indian government has only set targets for renewables. Although several incentives and policy initiatives have been taken at the Central and State levels and there are several acts and organizations which focus on the development of renewable energy resources, there is no legislation yet to contribute in the development of geothermal or tidal energy. The draft plan for geothermal energy development is the only laudable move taken by the Ministry of New and Renewable Energy so far. India not only lacks in the framing of legislations but in technology as well. The technology required for setting up of geothermal and tidal plants is relatively new and expensive for the Indian government to acquire. Indian implementation of laws has lacunae that cannot be neglected. Therefore, today India stands at a position where it needs new technology, better drafted legislations, more specialized policies and capital to be able to exploit the true potential of its geothermal and tidal reserves.

Conclusion

By 2022, India aims to reach 175 GW of installed capacity produced solely from renewable energy sources. It is no paltry goal, and certainly not one that can be achieved while utilizing a fraction of her renewable energy potential. It is about time that we pull out all the stops and use all the guns in the arsenal. What this means for our country moving forward is that poorly followed through policy initiatives can no longer be accepted as satisfactory when

42 DH, *New and Renewable Sources of Energy: What are the choices?,* 10 Royal Swedish Academy of Sciences, Energy: The Alternatives, 231-232 (1981).

it comes to the development of geothermal and tidal energy in India. The government, in particular, the Ministry of New and Renewable Energy, must frame proper legislation, establish authorities, chalk out their functions and duties, make regulations for the acquisition of technology and machinery and place of operation.

As discussed in the paper, tidal and geothermal energy have myriad advantages over the more conventional energy sources, not to mention the vast potential that India has for the development of the same being a peninsular state of its unique topography. To undervalue and underestimate such potential is truly a mistake that we cannot afford to make. Further, the initiatives taken by the government in this direction so far have been poorly executed and woefully insufficient. When we take into consideration the incentives provided by countries like the United States, France, South Korea, Philippines to domestic and foreign energy producers to encourage the shift to renewable resource, we see the stark divide that still needs to be bridged in terms of mainstream energy production in India. However, it cannot be said that that there is an absolute lack of action when it comes to exploiting India's geothermal and tidal potential. In particular, direct use of geothermal energy for heating and cooling remains to be the most accessible and popular means of such exploitation.

Once for all, it is time to acknowledge the long-term effects of our energy consumption patterns. The transition to sustainable energy production is well and truly underway and development at the cost of irreparable environmental damage is no longer the norm and what has been conclusively proven by this paper is that, India as a nation of 1.2 billion people, can no longer afford the consequences of ignoring the energy potential of tidal and geothermal energy.

*****

Revival of Jatropha Bio-Diesel Production in India – A Re-Look at Drivers and Determinants

*Anwesha Bhattacharyya & Riddhi Mundhra**

Introduction

The concept of bio-fuels has spurred interest of policy makers and farmers alike because of "JATROPHA", the potential oil-crop which has the capacity to grow on degraded soil with fewer inputs; it is a drought resistant crop; it grows round-the-year. For developing countries, bio-fuel production meant not only achieving economic growth, but also creating job opportunities/ livelihood for the farmers involved. Before analysing the determinants and constraints of Jatropha, it is ideal to know what is bio-diesel is.

The idea of Biodiesel dates back to 1885 when Dr. Rudolf Diesel constructed the first diesel engine with full intention of running it on vegetative source. He ran the engine on hydrocarbon fuel source - gasoline and peanut oil. In 1912, he predicted that fuel from vegetative source would be invaluable over the coming years. His words came to be true indeed. Researchers found that the consistency of vegetable oils could be lessened by a simple procedure and in 1970, came about- Bio Diesel. Bio-fuel/bio-diesel is derived directly from plants, or indirectly from agricultural, commercial, domestic, and/or industrial wastes.

Biodiesel does not contain oil, but rather it can be blended with oil and a biodiesel mix. Biodiesel is bio-degradable and non-toxic. It has even been guaranteed to be less lethal than basic salt. Many sources can be used to make bio-diesel, for instance, Sharma & Singh [1] delivered biodiesel from non-edible feedstock; Saka & Kusdiana[2] delivered biodiesel from rape seed vegetable oil;

* 2nd Year, BA, LL.B, Symbiosis Law School, Hyderabad.

1 Y. C. Singh, B. *A Hybrid Feedstock for a Very Efficient Preparation of Biodiesel Fuel Process. Technol.* 2010, 91(10),1267–1273,2017, *Available At* http://www.sciencedirect.com/science/journal/03783820/91/10?sdc=2, (Last Accessed on 1/9/2017).

2 Saka, S. and Kusdiana, D. Biodiesel Fuel from Rapeseed Oil as Prepared in Supercritical Methanol. Fuel 2011, *80*, 225–231,2017 *Available At* http://nopr.niscair.res.in/bitstream/123456789/4842/1/JSIR%2065(5)%20420-425.pdf, (Last Accessed on 1/9/2017).

Venkanna & Reddy [3]created biodiesel from honne oil. Biodiesel is made by artificially reacting lipids with an alcohol producing fatty acid esters. The power yield of biodiesel relies solely upon its blend, its quality and load conditions under which the fuel is burned. The thermal efficiency of the fuel is based on many things that include- viscosity, specific density and flash point.Biodiesel is produced using vegetable oil through a procedure called transesterification.

It is assumed that Bio-diesel is going to fetch advantage to India given its large oil consumption pattern and ever increasing demand for the same. In 2005, India consumed 30 million tons of oil in the transport arena, of which 29% was gas and 71% was diesel. The Indian energy demand is expected to develop at a yearly rate of 4.8% since a couple of decades. It has been anticipated that in India, the local generation of unrefined petroleum in the year 2003– 2004 was 33.38 million tons, while an amount of 90.43 million tons of oil (which adds up to 73% of aggregate oil expended) was imported. Despite what might be expected, the consumption of crude oil has been increasing at a very fast pace whereas the generation rate has remained practically static.[4] As the fuel importation rate is expanding at a faster pace, the nation is overly depending on the fuel-delivering nations. India will increase its oil utilization at a rate twice than the present, which will in turn lead to India turning into third biggest oil buyer on the planet by 2030. The regularly incrementing cost of fuel may likewise influence the economy of such a fuel-importing nation as India in an antagonistic way. So it is time that an alternative fuel was created to diminish raw petroleum import.

This is the point where Jatropha, a bio-diesel made from vegetative sources emerges. This will surely decrease the oil import charge and enhance the economy of the nation. Renewable resources, especially biodiesel, ought to get more consideration in India in light of the many guarantees it offers. Scientists are endeavoring to discover a few approaches to make biodiesel from various

3 Venkanna, B. K. and Reddy, C, Biodiesel Production and Optimization from Calophyllum Inophyllum Linn Oil (Honne Oil)—A Three Stage Method. Bioresour. Technol, 2009, Aug, 10th, *Available At* http://europepmc.org/abstract/med/19505820, (Last Accessed on 1/9/2017).

4 Report of United States Energy Information Administration, *Available At*.http://www.eia.doe.gov/ September,2017, (Last Accessed on 1/9/2017).

feed stocks, for example, consumable oil, nonedible oil, squander vegetable oil, green growth, creature fat and fats, and so forth. As India's population and urbanization is growing, the demand for renewable energy sources is increasing. In an attempt to secure its energy supply, India has inclined towards development of bio-fuel production. Thus, a large-scale government programme was launched for promotion and implementation of Jatropha cultivation in South India in 2003.

Some studies later showed the unsuccessful side of Jatropha cultivation, for instance, in 2010, an interview of 106 Jatropha farmers revealed that 85% of the Jatropha farmers have discontinued cultivation of Jatropha because of (a) ecological problems and economic losses, (b) failure to provide income to the farmer, (c) problems in the development and execution of the government Jatropha programme, (d) lack of support from authorities to farmers.

As the Jatropha programme was not as successful as expected, the expected positive environmental and socio-economic impacts have not been realized. In 2015, Times of India reported that the search for replacements to petrol and diesel had generated much hope in Jatropha seeds, but, Jatropha proved to be commercially unviable.

While the government lost hope on Jatropha being a replacement for oil, Indian Railways reported success by using bio-diesel at different points of time. For instance, on 31st December, 2002, the Indian Railways successfully completed the first trial of a superfast passenger train by using five percent of "biodiesel" as fuel in Delhi-Amritsar Shatabdi Express.[5] After successfully completing the first biodiesel test, Railways did not only plan to save their fuel cost but also to control the environmental pollution by using a mixture of biodiesel and conventional diesel. After introducing Jatropha in India, on July 2006, Indian Railways used Jatropha bio-fuel as an experiment for the short distances train running mainly on the narrow gauge on the lines of Raipur-Rajim and Raipur-

5 Vinay Kumar, First Trial Run of Train on Biodiesel, Excerpt From The Hindu, 2017, *Available At* http://www.thehindu.com/2003/01/03/stories/2003010300620900.htm, (Last Accessed on 1/9/2017).

Dhamtari.[6] 800 liters of Jatropha was bought by the Railways from Chhattisgarh Government and the mixture of 5 percent of bio-fuel and conventional diesel was used as an experiment. When Jatropha cultivation stopped in India in around 2012, there was a hope of revival of Jatropha in India by Indian Railways. Indian Railways did not only plan to use Jatropha bio-fuel but also cleared the tests for using Jatropha bio-diesel for field trials. "Research Design Standard Organization has cleared Jatropha bio-diesel of Central Salt Marine & Chemical Research Institute for field trials in locomotives. A few more approvals are required and possibly in next 3-4 months we shall commence the trials on two locomotives in Jetalsar, a Western Railway official said[7] in 2013.

The present study begins from here and re-looks at the gaps in performance of Jatropha production, vis-a-vis environmental and socio-economic impacts of the same from an agricultural and a policy making perspective in India. The study re-recommends changes that ought to be made at a policy and an agricultural level and suggests a revival of Jatropha in India.

Insight into the Jatropha Crop

It has been very difficult for the scientists to define the origin of the plant Jatropha but it has been found from some of the sources that it has been found that it originally belongs to Mexico as well as to Central America[8] where it occurred naturally in the forests of coastal regions. It was distributed by the Portuguese from Caribbean through Cape Verde islands[9].

Jatropha is a drought resistant monoecism small tree or large bush which is an oil producing plant that belongs to the euphorbia family with an average 3-5

6 Railways Test Running Engines with bio-Fuel, excerpt from the Thinkers Network, 2017,Aug 13, *Available At* http://thinkers.net/magazine/News-Features/Social/Travel/bio-fuel.html.

7 *Railways clear Jatropha bio-diesel for field trails*, excerpt from The Economic Times, 2017, Aug 05, *Available At* http://economictimes.indiatimes.com/industry/transportation/railways/railways-clear-jatropha-bio-diesel-for-field-trials/articleshow/22437040.cms; Retrieved September 2013, (Last Accessed on 1/9/2017).

8 History of Jatropha, 2017, Sept, 05, *Available At* https://jatropha.pro/history-of-jatropha-curcas-l/, (Last Accessed on 1/9/2017).

9 Akhilesh Kumar and S.K. Tiwari, Origin, Distribution, Ethno botany and Pharmacology of *Jatropha curcas, Available At* http://scialert.net/fulltext/?doi=rjmp.2015, (Last Accessed on 1/9/2017).

and up to 8 m height, with a single main straight stem and multiple secondary branches with leaves arranged alternately on the stem.

Jatropha plant has been produced in India for several decades as biodiesel for the diesel fuel requirements of remote rural and forest communities. It is widely cultivated in the tropics as a live fence and can be cultivated in deserts as well. It can also be grown in the non-agricultural lands hence giving farmers and villagers an opportunity to convert the non- agricultural land to a source of income. Jatropha is a high resident plant that can withstand a high degree of aridity. Jatropha starts producing after 2-3 years of plantation and produces for 30-35 years. Jatropha has the potential to provide economic benefits at the local level under sustainable management. Creation of the sustainable bio-fuel economy will also help to reduce poverty.

On the basis of the weight, the oil content of the Jatropha seed is 30-35% which can be used as a biodiesel when processed. It can also be used to replace petro, diesel and lubricant.

An integrated Jatropha bio-diesel project has three stages : i) the first stage of the production process of bio-diesel production from the seeds of Jatropha is the plantation stage, ii) extraction stages of bio-diesel production, and iii) the final stage of bio-diesel production is the trans esterification stage in which raw oil is trans esterified to bio-diesel.

Positive Aspects of Jatropha

Jatropha oil production delivers economic benefits to India such as, (a) it reduces the nation's fossil fuel import bill for diesel production, (b)helps in minimizing the expenditure of India's foreign-currency reserves for fuel, (c) helps in improving country's carbon emissions profile, (d) has the potential to provide economic benefits at the local level under sustainable management, such as reduction of poverty.

In India, cultivation of Jatropha was feasible because India has about 17.45% of wasteland which is suitable for cultivation of Jatropha. Jatropha doesn't need any agricultural land as it can be cultivated in no-agricultural land too. Jatropha is eco-friendly nature as a fuel as it is a renewable biological crop and it also maintains a closed carbon cycle.

The by products of Jatropha are Glycerin, which can be used to make soaps, and crushed and processed seeds can be used as fertilizers and roots of Jatropha have therapeutic properties such as cure for snake bite.

Jatropha in India

India was one of the highest Jatropha cultivating country but expectations of the production of biodiesel/bio-fuel from the Jatropha has not been successful due to the difficulties in reaching satisfying yields. Jatropha is a highly cultivated crop that can be cultivated in a wide range of ecological conditions. But the potential yields of Jatropha cultivation differs widely among the different parts of India because the cultivation of Jatropha highly depends upon the agricultural environment and on cultivation techniques. Eastern states and small parts of southern states of Tamil Nadu, Karnataka and Kerala are the most productive areas in India.

There have been a lot of criticisms in Jatropha programme due to doubtful environmental impact and failure in reaching satisfied yields. The maximum dispute that arrived at the local level is the appropriation of the land used for Jatropha cultivation. The most important thing that was required in the Jatropha programme was the classification of the wastelands which also helps in calculating the land that is available for Jatropha cultivation. Jatropha can be cultivated in wastelands, for instance, large areas within the forest which further includes degraded and under-stocked forest and arid and semi-arid ecosystems. The land that is owned by the government departments and is not private property has also been classified as waste land, for instance, barren land, land under non-agricultural uses, and degraded forest. Landless and poor people generally rely for food and energy and for gazing of animals on these lands who do not consider it to be a wasteland.

Performance of Jatropha Programme in India (2003-2010)

Environmental Impact:

There are several environmental impacts of the Jatropha biodiesel/biofuel production[10], for instance, in 2007 cultivation of Jatropha had a positive energy balance. Because of the differences in cultivation intensity, there have been a lot of differences in the requirement of energy. It doesn't always mean that the higher cultivation will give the higher energy production. To achieve the maximum positive energy optimization of inputs and yields is required. Another environmental impact of Jatropha biodiesel/bio-fuel production is the Global Warming effect. As compared to the production of fossil diesel, the production of Jatropha biodiesel/bio-fuel releases less Greenhouse Gas. Cultivation of Jatropha is expected to have a positive impact on soil by improving the soil structure, prevention of soil erosion and carbon sequestration. Cultivation of Jatropha on waste lands like barren lands and unused wasteland can help restore local biodiversity but the replacing natural or semi-natural vegetation land for the cultivation of Jatropha can have a negative effect on biodiversity. Cultivation of Jatropha doesn't require a lot of water because of its drought resistance and low water requirement. Jatropha has an ability to grow in the dry condition as well and it can also be grown in the areas where there is a scarcity of water. Thus, Jatropha cultivation is environment friendly.

Cultivation of Jatropha

Jatropha can be cultivated by using several different methods like direct seeding, pre-cultivation of seedlings, transplantation of spontaneous wild plants, and direct planting of cuttings.

Spacing is one of the factors that has to be considered while cultivation. If the spacing is wider, it allows the plant to grow larger and hence, makes the

10 Lisa Axelsson and Maria Franzén, *Performance of Jatropha Biodiesel Production and its Environmental and Socio-Economic Impacts*, *Available At* http://www.focali.se/filer/FRT%20201006%20-%20Jatropha.pdf, (Last Accessed on 5/9/2017).

cultivation difficult. While the narrow spacing requires more labor so as to make sure that the plant does not grow into each other. Jatropha usually needs 2.5 meters to 3 meters and also when Jatropha is used as a live fencing there should be 25 cm spacing between the plants. According to the studies, Jatropha can also be cultivated in the embankments surrounding fields which are known as bunds that help to improve rainwater infiltration.

While cultivating Jatropha, weeding, pruning and thinning are the few activities that should be taken into consideration. Weeding is requiredbefore Jatropha plants mature and shade the ground. Pruning is required during the dry season when the plant is unresponsive so as to increase the branching of the plants. It is also recommended for the thinning of the plantation when the trees are mature.

Jatropha is a low input crop but it also requires irrigation and fertilizers to maintain a productive crop. The places where the rain is not sufficient for the cultivation of Jatropha, irrigation is needed after planting which can further be discontinued after the plant has developed its root. Cultivation of Jatropha can take place throughout the year in wet climate while it can be cultivated only for two months in the semi-arid regions.

Reasons Why Jatropha Cultivation could not Reach its Objectives

The principal hindrances that occurred during the cultivation of Jatropha are associated with ecological issues experienced by the farmers. The most significant issue is that Jatropha could not meet the expectation because of dry spell resistance, and farmers encountered water shortage as the fundamental issue that hindered Jatropha production. Farmers encountered low yield as the water shortage continued.

Another major problem faced was the economic losses. The farmers who were promised to be given subsidy were not given that, the implementation process was faulty.

The positive financial effects anticipated from Jatropha production were not obtained. Rather than getting extra income from Jatropha ranches, farmers have encountered monetary misfortunes and diminished income.

With better implementation and planning the extreme outcomes and financial misfortunes for the farmers could have been stayed away from. In the event that such research would have been made before the execution, the issues could have been found and the administration offices could have minimized the losses of the farmers. Pre-studies could likewise have taken into consideration better-performing assortments to be created. Better data on Jatropha and its qualities would have empowered the farmers, and therefore the implementation could have been better. It appears like the Government of India has understood that the first policy was not ideal, as they prematurely ended the National Mission on Biofuels[11] and supplanted it with another arrangement.

One case that unmistakably represents the lack of common sense of the Jatropha program is the hole between figured land necessity and the planned cultivation in the main period of the program. In the National Mission on Biofuels, the Planning Commission expressed that a blend of 5 percent ought to be come to by 2006-07. To achieve this, they ascertained an interest for 2.62 million tons of biodiesel, which would require 2.19 MHa of land for generation. In the meantime the national mission expressed that the primary period of the Jatropha program ought to be a trial venture, where 0.4 MHa of Jatropha estates would deliver 0.48 million tons of biodiesel. Consequently, with the arranged usage there was no way to achieve the predetermined objectives.

Another issue is the targeting of poor and peripheral farmers. The thought was for Jatropha to give a chance to utilize and reestablish their poor land and to give extra incomes to the family. Be that as it may, rather these farmers have endured the most since they have the land with the worst plausible conditions.

To execute the Jatropha program the administration utilized the chance to target farmers through existing poverty alleviation activities and to utilize funds

11 Salman Zafar;Biodieselprogram in India-An Analysis: *Available At* https://www.bioenergyconsult.com/tag/national-biodiesel-mission/ (Last Accessed on 5/9/2017).

accessible in these activities. Thusly, funds expected to improve the vocations in poor provincial territories have been utilized for an unsuccessful task that has been counterproductive to the destinations of the aims and has disturbed the circumstance for focused farmers.

Ideally different states can gain from the oversights made in Andhra Pradesh and Tamil Nadu. Results in Andhra Pradesh and Tamil Nadu clarified at an opportune time that it was not possible to achieve the National Mission on Biofuels mixing focus of 20 percent by 2012. With the detailed poor execution of Jatropha and the absence of research and specialized data, the National Biofuel Policy focus for biodiesel created from Jatropha does not appear to probably be attainable either. Different feedstock will be required to achieve 20 percent biodiesel blending by 2017. [12]

Revival of Jatropha in India

Jatropha's dry spell resistance gave a chance to farmers on rainfed lands, who had been experiencing dry spell. Be that as it may, under harsh rainfed conditions, particularly in the extremely dry and water rare parts of Andhra Pradesh, Jatropha fields could not yield the expected produce. The single biggest hindrance proceeded with development of Jatropha was water shortage. The driest region went to in Andhra Pradesh, with a yearly normal precipitation of 553 mm, was Anantapur. As indicated by existing Jatropha hypothesis, this water supply ought to be sufficient for survival of the plant, yet it is a long way from the perfect circumstance for seed generation, 1000 to 1500 mm. In many spots endowments for establishment of water system offices were guaranteed, yet in the water rare ranges, where even access to drinking water is an issue, it is impractical to introduce water system frameworks and utilize the significant water for water system of biofuel plants.

Another issue experienced, for the most part by ranchers in Tamil Nadu, was pests. At times the pests were minimal and could be tackled by utilization of pesticides, yet some of the time the pests were more extreme and seriously degraded the

12 *Supra*, at 10.

development of the plant. This negates the conviction that Jatropha ought to be more impervious to pests than different yields. In any case, as indicated by farmers and government authorities in Tamil Nadu the state encountered a bizarrely expansive assault of pests in 2006-07 that influenced most harvests in the region. Maybe Jatropha in any case ought to be more resistant, yet the resistance will not be sufficient when confronting a serious assault.

All these environmental issues experienced could have been found and stayed away from if investigations of Jatropha on existing soils had been made preceding usage. It is regular practice in the contemplated locale to make a specialized appraisal and present a logical convention before the arrival of new yields to guarantee similarity with better yielded conditions. On account of Jatropha no trials were made, rather specialists and agriculturists were furnished with data from state government.

According to the National Mission on Bio-Fuels:[13]

"*Cultivators, farmers, landless laborers etc. will be encouraged to undertake plantations that provide the feedstock for bio-diesel and bio-ethanol. Corporates will also be enabled to undertake plantations through contract farming by involving farmers, cooperatives and Self Help Groups etc. in consultation with Panchayats, where necessary. Such cultivation / plantation will be supported through a Minimum Support Price for the non-edible oil seeds used to produce bio-diesel*"

Though this was the goal, it wasn't properly achieved. The Government, more often than not, needs to intervene which was not done. No follow up was done on behalf of the Government.

If the Government follows up with the Farmers then they will know the very basic needs of the farmers, the reasons why the Jatropha can fail also whether the fiancés which has been issued by the Centre has at all reached the farmers.

Again according to the National Mission on Bio-Fuels-

13 National Policy on Bio-Fuels, 2009, 2017, *Available At* http://mnre.gov.in/file-manager/UserFiles/biofuel_policy.pdf, (Last Accessed on 10/9/2017).

"*National Bank of Agriculture and Rural Development (NABARD) would provide re-financing towards loans to farmers for plantations. Indian Renewable Energy Development Agency (IREDA), Small Industries Development Bank of India (SIDBI) and other financing agencies as well commercial banks would be actively involved in providing finance for various activities under the entire biofuel value chain, at different levels*."

These initiatives can help on lower level as now the farmers would be given financial help from the Government which would aid in building up their morale and therefore more people would want to take up this farming opportunity.

The National Biofuel Policy specifies that with the exception of a concessional obligation of 16% for every penny on bioethanol, no other taxes shall be levied; obligations are to be exacted on biodiesel and bioethanol. Be that as it may, the tax strategies of various states towards biofuels are not uniform.

The tax structure contrasts generally crosswise over states with the rates and types of taxation shifting from state to state. Different types of taxes include sales tax, import fee, license fee, permit fee, excise administration fee, privilege fee organization expense, benefit charge, and so forth. Such different tax structures are seen as an obstacle in the fast usage of obtainment, transportation and exchange of biofuels. Besides, high rates of state taxes, import fees are rendering biofuel blending industrially unviable at many places. Endeavors are being made by the MoPNG[14] to determine these issues and realize consistency in tax organization.

Conclusion

The principal hindrances that occurred during the cultivation of Jatropha are associated with ecological issues experienced by the farmers. All these environmental issues experienced could have been found and stayed away from if investigations of Jatropha on existing soils had been made preceding usage. Now, Given the advantages of the Jatropha, we can say that Jatropha cultivation

14 Ministry of Petroleum and Natural Gas.

should be revived in India mainly because of the positive environmental and financial effect that it has over the fossil fuels. It is not only eco-friendly but it can also aid India in reducing its expenditure on oil. Revival of Jatropha can also help India to put to use the wasteland or the non-agricultural fields which is unproductive in other ways. It reduces the nation's fossil fuel import bill for diesel production, helps in minimizing the expenditure of India's foreign-currency reserves for fuel. Keeping the advantages in mind, if the Government of India takes more initiative to follow up the goals which it had set for itself in the National Mission of Biofuels, then the aim to meet 20% of India's diesel demand from plants source can be met. India already has the experience and resources to cultivate Jatropha, therefore, India need not invest or train. Revival of Jatropha takes us one step forward towards the better future, a better India.

*****

Liberalization of Nuclear Power Industry

*Xavier Joseph**

There is a stigma attached to nuclear power springing from misunderstanding and confusion. The term "Nuclear power" draws negative connotations after the infamous Chernobyl, Three Mile Island and, more recently, Fukushima accidents. The negative bias is worsened by concerns for safety, environmental impact and waste management issues.

The complexity of nuclear power breeds misunderstanding and confusion fuelling the negative stigma against it. Humans by nature are suspicious and fearful of things we do not understand. We shun away things which are outside our understanding and are comfortable with things we understand. For instance people are sometimes afraid of getting eaten by sharks or being struck by lightning even though chances of it happening are very remote. Whereas they will smoke cigarettes and drive cars without a seat belt even though these habits are thousands of times more dangerous and present a very real and significant risk to their health and safety.[1]

A similar situation occurs with nuclear power, coal has been around for a long time and is something that is encountered very frequently, and people are comfortable with it. In contrast, nuclear energy is something far more technologically complex and mysterious, and people view it with suspicion and confusion. The reality, though, is that estimates suggest that around 10,000 people die every year as a direct result of the normal coal-producing and burning industry, whereas no known death has ever occurred from normal use of nuclear energy[2]

---

* Student, NUALS. Kochi

1 Why do we use nuclear energy if it is so harmful?, UC Santa Barbara *Available At* http://scienceline.ucsb.edu/getkey.php?key=1361, (Last accessed on 05/11/2017).

2 *Ibid.*

Nuclear Safety

Nuclear safety has come a long way since Chernobyl. Several scientific and regulatory safeguards have been put in place to prevent nuclear accidents of any scale. The Chernobyl accident happened at a plant without concrete containment structures, a necessary safeguard to ensure deadly radiation does not escape into the atmosphere. Nuclear power plants today have a variety of safeguard mechanisms such as containment structures, back-up cooling systems and emergency equipment. Nuclear plant operators have learned from prior accidents, improving overall safety[3]

Environmental Impact

Nuclear power is an effective zero carbon emission source of energy. Carbon emissions is a major cause of air pollution. According to WHO, air pollution claims 6, 00,000 Indian lives every year[4]. India and China account for 60% of the deaths due to air pollution. Furthermore, Carbon emissions are the major greenhouse gases which cause global warming. Three main sources of carbon emissions are power generation, transportation and industry. Power generation and transportation sector account for 47.6% and 22% of the carbon emissions in the world[5].Additionally, the current universal plan to convert petrol/diesel cars to electric cars to reduce pollution would be counter-productive if the power/electricity needed for the electric cars are produced from coal or other fossil fuels instead of zero carbon emission sources of energy.

Nuclear power plants produce negligible amount of carbon emissions. Nuclear power generation is an effective zero carbon emissions energy source. For Instance, the comprehensive nuclear power generation program of France has kept the country's carbon emission rate remarkably low.

3 Erin Rode, *Stigma Against Nuclear Energy Needs to Change*, Daily Trojan, October 7, 2014 *Available At* http://dailytrojan.com/2014/10/07/stigma-against-nuclear-energy-needs-to-change/, (Last accessed on 05/11/2017).

4 *Ibid.*

5 CO_2 Emissions from full combustion highlights (2015), International Energy Agency, *Available At* https://www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2015.pdf (Last accessed on 05/11/2017).

Nuclear Waste

Nuclear waste produced is small and manageable. According to the Wall Street Journal "all the nuclear waste produced so far in the U.S. would only cover a football field about 5 yards deep". Scientific experts have accepted nuclear wastes can be stored in onsite cooling vats till it can be disposed safely.

It is a much safer source of power than it ever was. Nuclear power is safer, more efficient and less carbon polluting alternative than any other alternative source of power.

Alternative sources of energy

Nuclear power is more reliable and efficient source of energy. Solar and wind energy can be produced only during certain hours of the day, under certain weather and climatic conditions. They require large expensive batteries to store power for usage when solar or wind energy is not producing. Whereas, nuclear power generation is not dependant on external weather or climatic conditions. Nuclear power can be produced 24x7 without any interruption.

Nuclear power is the most efficient alternate source of energy. Nuclear power source can produce more energy than solar and wind sources for each rupee spent on energy production.

Nuclear power plants have low land requirements. Solar and wind energy farms require anywhere from 50,000 to 180,000 acres of land compared to an average 400 acres for a nuclear power plant. This can be crucial point of consideration in areas which are in short of land.[6]

Why do we need Liberalization of Indian Nuclear Industry

These advantages of nuclear power was recognized by Homi Bhabha, who then formulated a comprehensive three stage nuclear power programme for India in

6 Erin, *supra* note, at 3.

1950's. The primary aim of the Nuclear power programme was to make India an energy self-sufficient country.

These plans have been implemented by India along the years with India planning 14GWe nuclear capacity on line by 2024 and 63GWe by 2032. India aims to supply 25% of the electricity by nuclear power by 2050.[7]

The Modi government has ambitious plans to double the nuclear power generation capacity to 10,000 MW in the next 5 years.[8] It is to execute, support and sustain this plan and to guarantee fuel to the current and future nuclear reactors that the Indian government has entered into the India–United States Civil Nuclear Agreement and has been trying very hard to enter the Nuclear Suppliers Group

The Indian government has overlooked liberalization as a viable means to achieve its nuclear power generation goals. Liberalization is a much easier, quicker and more efficient way to achieve India's nuclear power generation goals. Building nuclear power plants can be a heavy burden on the public exchequer and especially when factoring in the energy surplus state of the Indian electricity market. By opening up nuclear power generation to private players, the state would be able to tap into the enormous capital, knowledge, experience and skills of private players to help build more nuclear plants at a faster pace and operate them in a sustainable and efficient manner without putting a heavy burden on the tax payers.

What are the Legal Reforms Needed to Liberalize Indian Nuclear Industry

Under Indian nuclear law, absolute power to develop, produce, use atomic energy and operate nuclear power plants is vested with the government, which

7 Nuclear Power in India, World Nuclear Association, November 21, 2016, *Available At* http://www.world-nuclear.org/information-library/country-profiles/countries-g-n/india.aspx (Last accessed on 05/11/2017).

8 Amit Bhandari, *Why India's Nuclear Power Output is Surging*, Business Standard, February 3, 2015, *Available At* http://www.business-standard.com/article/economy-policy/why-india-s-nuclear-power-output-is-surging-115020300354_1.html (Last accessed on 05/11/2017).

has to be amended in order to allow private players to develop, produce and use atomic energy and operate nuclear power plants. An amendment to allow private and foreign entry in the field of nuclear power generation was proposed in the economic survey 2008-2009.[9]

Nuclear power is a matter of national interest and security due to the risk attached to it, As such the subject of atomic energy and mineral resources necessary for nuclear power generation is included in the union list. It vests exclusive power over all fields remotely linked to atomic energy on the Parliament.

The Parliament in exercise of this power enacted the Atomic Energy Act, 1962 vesting the Government of India with exclusive authority over all the activities relating to development, control and use of atomic energy for the welfare of the people and for other peaceful purposes.

The Atomic energy act vests the central government with complete control over all things associated with the use of nuclear energy. It grants the central government with absolute power over production and use of atomic energy, discovery and mining of radioactive minerals, manufacture and use of radioactive substances and non-disclosure of information relating to atomic activities.[10]

The central government by exercise of its rule making power under the act has notified various rules covering spread over different fields of atomic energy such as Radioactive waste disposal, Food irradiation, Arbitration, Industrial safety of DEA factories, Radiation protection and Licensing for working of mines and minerals and handling of prescribed substances.[11]

The act confers the central government the absolute and exclusive permission to develop, produce and use nuclear power generated which would have to be amended so as to allow for private and foreign entry to enter the Indian nuclear power industry. The entry could be allowed to private and foreign companies

9 Economic Survey 2008-09, 31(2009) *Available At* http://indiabudget.nic.in/es2008-09/chapt2009/chap24.pdf (Last accessed on 05/11/2017).

10 Yash Thomas Mannully, *Law Relating to Nuclear Energy in India*, Manupatra, *Available At* http://d1.manupatra.in/ShowPDF.asp?fname=Law_Relating_to_Nuclear_Energy_in_IndialawrelatingnucenergyindiaCOM833718.pdf, (Last accessed on 05/011/2017).

11 *Ibid.*

or private public partnership with the government holding majority stake in order ensure national security.

Safety and Regulatory Body

The central government under the provisions of the Atomic Energy Act has established the Atomic energy commission and the Atomic energy regulatory board (AERB) for the purpose of setting safety standards and enforcing regulations and safety standards.

Atomic energy regulatory board is responsible for the protection of workers at the site, public and the environment against the nuclear accidents. It is responsible to the atomic energy commission.[12]

The atomic energy commission is responsible for licensing and control regime governing radioactive materials, disposal of radioactive wastes, industrial safety aspects of DAE installations, working of mines, minerals and handling of prescribed substances, food irradiation and environment protection. The board and the Atomic energy commission are collectively responsible for safety and regulation of the nuclear industry.[13]

The safety standards set by the Atomic energy regulatory board and Atomic energy commission is not in conformity International Atomic Energy Agency standards. This hinders international trade of nuclear material especially nuclear fuel needed to run India's nuclear reactors. This further restricts development, use and production of nuclear power generation. The safety standards of AERB and Atomic energy commission should be raised to make it in conformity with IAEA safeguards.

Private operators of nuclear facilities should be subjected to the same regulations and safety standards as Nuclear Power Corporation of India Limited (NPCIL). Private operators should be required acquire same licenses and registration from the AERB and atomic energy commission as required by the Nuclear Power

12 *Ibid*, 4.
13 *Ibid*, 4.

Corporation of India Limited when setting up a nuclear facility. There should be level playing field between NPCIL and private operators.

Liability and Compensation for Nuclear Damages

Nuclear liability and compensation laws are essential for the protection of human health and environment from hazards attached to nuclear energy and radioactive material. Nuclear liability law play central role in the development of the nuclear industry by providing clarity regarding compensation to be paid in case of a nuclear accident. This in turn would allow operators to insure themselves against nuclear accidents.

The atomic energy act doesn't not deal with compensating nuclear damages. In fact, Section 29 of the act confers immunity from legal action to the government or any person or any authority in respect of anything done by them in good faith in pursuance of the act.[14] However the Supreme Court through its interpretation of Art 21 and evolution of principles of absolute liability has rendered this immunity conferred by S.29 of the atomic energy act redundant.[15]

India recently, enacted the Civil Liability for Nuclear Damage Act, 2010 with aim to operationalize the India-US Civilian Nuclear Agreement, 2008. The Civil Liability for Nuclear Damage Act created a mechanism for compensating victims of nuclear accident, allocating liability and specifying procedures for compensation.

The Act hold operators of nuclear facility primarily liable for a nuclear incident and any residual liability arising from a nuclear incident is mitigated by an insurance pool.

Section 6 of the Act puts a limit on the damages the operator of nuclear facility or government is liable to pay in a nuclear incident. The liability is capped at amount equivalent to 300 million special drawing rights i.e. 238 million USD. The liability of the operator of a nuclear facility is capped below INR 1500

14 Section 29, Atomic Energy Act, 1962.
15 Yash, *Supra* at 6.

crores if the nuclear incident is a result of a natural disaster, armed conflict, terrorism.[16]

Rule 24 of the rules made under the act which is an extension of Section 17 states that a contract between an operator and a supplier of the nuclear facility shall include a provision for the right of recourse against the supplier for not less than the extent of the operator's liability under the Act, or the value of the contract, whichever is less. This creates a disproportionate burden on the supplier discouraging him from entering into transactions with nuclear facilities in India.[17]

Nuclear Liability laws in India have to be amended and changed in order to account for private players before liberalization of nuclear industry is possible. The current liability laws have been made under the consideration that government or The Nuclear Power Corporation of India Limited as the only operator of nuclear facilities. Therefore, the current state of Indian nuclear laws are in favour of operators of nuclear facilities by limiting their liability and shifting majority of their burden to the suppliers of the nuclear facilities or the government.

The limit of liability of the operator must be reworked and re-evaluated. Capping of liability for damages at 300 million SDR [18]is very low compared to the disastrous nature of damages caused by nuclear incidents. A very low limit would also mean more use of tax payers' money to compensate the victims of nuclear incident caused by private individual which could be heavy burden on the public exchequer. The limit on liability must be raised to hold an operator liable for at least majority of damages caused by the nuclear incident and to reduce the burden on the exchequer. It must be raised to at least 500 million USD to account for patent and latent effects of nuclear disasters.

The liability on the supplier of nuclear material is disproportionate to their service. Shifting majority of the liability onto the suppliers of nuclear power

16 Section 6 , Civil Liability for Nuclear Damage Act, 2010.

17 *Ibid*, Section 17.

18 *Ibid*, Section 6.

facilities would discourage the suppliers from engaging in transactions with operators of Indian nuclear facilities. Liability of the suppliers should be reduced or should be left to the contracting parties to decide.

Public Access to Information and Good Governance

The public is in the dark when it comes to India's nuclear power industry. The public is denied access to information relating to the nuclear industry. The Atomic energy Act empowers the government to exclude information of national importance from the public. The government exercises this power to exclude information from the public merely on the grounds that it would be detrimental to the government's image[19] Atomic Energy Act grants complete power to the central government to restrict all information associated to nuclear activity. Even the much revered right to information act is of not much use as most of the information sought under the right to information act are easily classified as matters of national importance and kept out of the access of the public[20]

Lack of public access to information limits the study on implications of nuclear activities on environment and puts the public at risk. Lack of complete and proper information restricts comprehensive and independent study into nuclear energy and its implications on human beings and the environment. It also poses a threat to human life as lack of proper knowledge of nuclear energy and its related activities restrict our ability to contain and remedy a nuclear incident.

Allowing entry of private players to nuclear industry will allow the public better public access to information and better governance in the nuclear industry. The Nuclear Power Corporation of India Ltd, which is basically the entire Indian nuclear industry, is wholly owned company of the government and the balance sheet or the governance of the company is not available to the public. The public is denied access to the track record of NPCIL and the Department of Atomic Energy. There is very little information as to the workings of the nuclear industry. This has been cited as one of reasons for the resistance by

19 Yash, *Supra* at 7.
20 Section 18, Atomic Energy Act, 1962.

the opposition against expansion of nuclear power capacity. Whereas, private players in the nuclear industry would be required to publish their balance sheets allowing greater clarity in Industry and better governance of the industry.

Conclusion

The earth is getting warmer by the year. The poles are melting. The lands are getting dryer. The climates are changing drastically. We know the cause of these changes and the implication of it. We have been looking for the solution to this problem for a while and now we not only need a solution but also it has to be quick solution. Nuclear power can be this solution to our problem. Even though nuclear power is not yet a perfected source of energy, It is the most efficient and viable alternative source of energy. A few of the concerns of nuclear power are warranted. However the benefits of nuclear power outweigh the costs of it. Nuclear power is at present the best option compared to other sources of energy including wind, solar, coal etc. It is only viable option for a bright pollution free sustainable future.

But the bright pollution free future can only be achieved with help of liberalization of the nuclear industry. Liberalization of nuclear energy is essential to meet the massive and fast growing energy needs of India with zero carbon emission source of energy. The government does not possess the resources or the know-how to implement its ambitious nuclear plans not just in size but also at the pace required. Liberalization of nuclear power industry and opening it up to private player is essential and the only way to achieve the government's plans.

Opening up the Indian nuclear industry would automatically lead to massive private investment in nuclear facilities, technical know-how, research and development in the field of nuclear power and better transparency, visibility and governance of the nuclear industry. This would not only lead to a high growth Indian nuclear industry but also an India which is energy self-sufficient. But the most important benefit of opening up the nuclear industry would be the astonishing low carbon emission rates. This would turn India from one of the largest producers of carbon emissions to one of the smallest producers of carbon emissions.

Liberalization of the nuclear industry would need a complete overhaul of the Indian nuclear law. It would need to shift from operator favouring legal ecosystem to impartial and unbiased legal system. The parliament in exercise of its powers under the union list would have to put in place a modern enactment replacing the conservative and archaic nuclear laws. The parliament will have to take away the government's exclusive power to develop, produce, use and operate nuclear power plants and open it to private and foreign player, while drawing exact lines which cannot be crossed by the private and foreign players. The government will have to level the playing field between NPCIL and new entries at the same time keep a check on the private and foreign players entering the nuclear industry.

The government will have to separate itself into the regulator and the operator or restrict its role to solely that of a regulator. The nuclear liability laws would require some tweaks and would need to be shifted from operator favouring laws to unbiased. The current liability cap put in place are low and would have to be raised in order to take into account both the direct and latent effects of nuclear disaster. The government would also have to reshape its policies into ensure easier setting up of nuclear power plants and to ensure uninterrupted supply of nuclear fuel to the nuclear power plants.

These legal reforms would open up our nuclear industry to the world. It would allow capable individuals with right technical know-how to invest in the Indian nuclear industry. It would not only allow them to set up nuclear power plants but also operate and develop nuclear power. This would lead to self-sufficient and green India of our dreams. Liberalization is the only way to a self-sufficient and super power India without sacrificing the our world.

*****

FORM IV

Place of Publication	:	Bengaluru
Periodicity of Publication	:	Annual - Special Edition
Printer's Name	:	National Printing Press
Address	:	580, K R Garden, Koramangala, Bengaluru-95
Publisher's Name	:	Prof. [Dr.] R. Venkata Rao Vice Chancellor, National Law School of India University, Bengaluru
Chief Editor's Name	:	Prof. [Dr.] Sairam Bhat Professor of Law National Law School of India University, Bengaluru

I, Dr. R Venkata Rao, on behalf of National Law School of India University, Bengaluru, hereby declare that the particulars given above are true to the best of my knowledge and belief.

For National Law School of India University

Sd/-

Prof. [Dr.] R Venkata Rao

National Law School of India University,
P.O. Box 7201, Nagarbhavi,
Bengaluru - 560 242 (Old Pin: 560 072)