



Jus Corpus Law Journal

Open Access Law Journal – Copyright © 2023 – ISSN 2582-7820
Editor-in-Chief – Prof. (Dr.) Rhishikesh Dave; Publisher – Ayush Pandey

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Market Structure of Renewable Energy in India: An Analytical Study

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Received 12 March 2023; *Accepted* 03 April 2023; *Published* 07 April 2023

Since the advent of the concept of a new India which is modern in structure and classical in belief, the country has been rapidly moving towards its goal of becoming a global player in every forum. The market economy of a country has a substantial effect on its capabilities in the race to the pinnacle. In an age when natural resources are scarce and demands are high to keep the wheel of evolution in motion, each nation needs to think of alternate resources, commonly known as renewable resources. The global renewable energy market was valued at \$881.7 billion in 2020 and is projected to reach \$1,977.6 billion by 2030, growing at a CAGR of 8.4% from 2021 to 2030. As innovation drives costs lower and begins to fulfill the promise of a clean energy future, renewable energy is rising. This implies that "dirty" fossil fuels are being replaced with renewable energy sources in the power sector, which has the advantage of lowering carbon and other forms of pollution emissions. This article deals with the huge potential that India has in exploiting its renewable resources and thereby becoming a global power.

Keywords: *market economy, natural resources, renewable resources, global power.*

INTRODUCTION

Currently in South Asian countries such as India, Bangladesh, Pakistan and so on the way of using energy is considered to be non-sustainable owing to several issues such as geopolitical,

environmental, and regional energy trade which tends to zero, economic and technological options for energy exploitation.¹ The recent shift from using the age-old system of exploiting natural resources to exploring renewable resources is bound to play an important role in the dream of making the Indian economy a world-class economy. Using renewable resources has already proved to be helpful in different sectors like industry, business, trade, and many others sectors. With the rise in global consciousness about using limited natural resources in a way to provide enough resources not only for the present but also for the future generation using renewable resources becomes essential. In this article, we shall be looking into how renewable resources play one of the utmost and most important roles in the market structure of a country.

OBJECTIVES

This current work is aiming to find out the substance of the following concepts. For this, the author has taken into consideration journals, books, news clips, government data, records, etc. The objectives of this study are to explicate the contents of:

- Effect of Global warming on the usage of renewable resources;
- Pre and Post Covid 19 era in regards to usage of renewable resources.

CONCEPTUAL UNDERSTANDING

Global power: A sovereign state which has the power to exercise its influence on other nation-states is said to be a global power.

Global Warming: The annual global temperature has been increasing ever since the advent of the Industrial Revolution. Accurate record-keeping began in the year 1800 and by the next century,² it rose by an average of 0.07 degrees Celsius every decade³. The rate has more than

¹ Sultan Hafeez Rahman et al., 'ENERGY TRADE IN SOUTH ASIA OPPORTUNITIES AND CHALLENGES' (2011) Asian Development Bank <<https://www.adb.org/sites/default/files/publication/29703/energy-trade-south-asia.pdf>> accessed 08 March 2023

² Amanda MacMillan, 'Global warming 101' (NRDC, 07 April 2021) <<https://www.nrdc.org/stories/global-warming-101>> accessed 08 March 2023

³ 'World of Change: Global Temperatures' (NASA) <<https://earthobservatory.nasa.gov/world-of-change/global-temperatures>> accessed 08 March 2023

doubled since the year 1981 and now the present rate of temperature rise in each decade stands at 0.18 degrees Celsius.

Covid 19 pandemic: Covid 19 is an infectious disease. It is caused by the SARS-CoV-2 virus⁴. It originated in Wuhan which is situated in China. An outbreak of this said virus throughout the world with an alarming level of speed and severity made the WHO declare the outbreak a pandemic. The restriction of movement due to the lockdown affected the manufacturing industry, imports and exports, transportation, tourism, and ultimately the economy.⁵

Renewable Resources: Renewable resources are those which cannot be depleted and these are capable of providing a continuous source of clean energy. It includes geothermal power, solar energy, biomass energy (such as ethanol), wind energy, and hydropower.⁶

Natural resources: Resources that are driven by nature and are used with no or few modifications are known as natural resources.

Demand for Natural resources: As the population of the world is increasing and along with it the standard of living too is rising. Hence the demand for scarce natural resources is increasing.

Market economy: A market economy is an economic structure that allows unrestricted competition among different private organizations. The prices and production are also determined by the market competition.

Indian Market Economy: Indian economy is a middle-income developing market economy. It is the world's third-largest economy by purchasing power parity (PPP) and the fifth-largest in

⁴ Domenico Cucinotta & Maurizio Vanelli, 'WHO Declares COVID-19 a Pandemic' (2020) 91(1) Acta Biomed <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7569573/>> accessed 08 March 2023

⁵ 'The territorial impact of COVID-19: Managing the crisis across levels of government' <<https://www.oecd.org/coronavirus/policy-responses/theterritorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/>> accessed 08 March 2023

⁶ 'Renewable resources' (*National Geographic*) <<https://education.nationalgeographic.org/resource/renewable-resources>> accessed 08 March 2023

terms of nominal GDP. India, basically a domestic demand-driven economy, has consumption and investments as a 70 % contributor to the country's economy.⁷

METHODOLOGICAL ORIENTATION OF THE STUDY

This paper is a contextual paper concentrating on the analysis of the content available in different secondary sources related to the topic. This work is focusing on the Market economy, Natural resources, Demand for Natural resources, Renewable resources, and Global power. Again, to stress the content, this work is analyzing different information available in different articles, Journals, government documents, news clips, and many more.

EFFECT OF GLOBAL WARMING ON THE USAGE OF RENEWABLE RESOURCES

Energy is at the heart of the climate challenge and key to the solution. A large quantity of greenhouse gases traps the sun's heat and thereby increases the temperature of the planet which in turn leads to global warming. Greenhouse gases are released into the atmosphere mainly due to the burning of fossil fuels and these affect the climate adversely. The motto of the world at present is now to reduce the emissions of greenhouse gases to half by 2030 and to net zero by 2050. This can be achieved only if reliance on fossil fuel ends and the world starts investing in sources that are cleaner, sustainable, affordable, accessible, and reliable. Such is the present importance of renewable resources. At present only 29% of electricity comes from renewable resources. There are five reasons for using renewable resources:

1. Available in plenty;
2. Cheaper;
3. Healthier;
4. Every dollar of investment in renewable resources can create three times more jobs than the same investment in the fossil fuel industry;

⁷ 'About Indian Economy Growth Rate & Statistics' (IBEF, December 2022)
<<https://www.ibef.org/economy/indian-economy-overview>> accessed 08 March 2023

5. Renewable energy can absorb market shocks and helps to create a resilient market structure;⁸
6. Renewable energy is future-oriented and is supposed to give a full range of ancillary services.⁹

PRE & POST COVID-19 ERAS IN REGARDS TO THE USAGE OF RENEWABLE RESOURCES

Covid 19, which was declared a pandemic by the World Health Organization, has played a significant role in the usage of renewable resources. Before Covid-19, the rate of emission of life-threatening chemicals was far more. However, with the onset of Covid-19, owing to the lockdown, the rate of industrial production took a dramatic downward slide. As a consequence, the emission of toxic fumes also went down allowing humankind to breathe easily. But such a situation did not last long. Though the people took a sigh of relief with plummeting Covid cases, industrial production once again shot up causing an enormous rise in the production of poisonous gases which has already started taking its toll on human health and well-being. As the world approaches 2030 it must ensure to build on the extra edge given by Covid-19 in developing a market structure that is affordable, reliable, sustainable, and modern in nature. Countries must ensure that they safeguard the gains already achieved and accelerate efforts to achieve net zero emissions by 2050.

“Access to reliable energy is a lifeline, especially in the context of the COVID-19 crisis. It is essential not only for preventing and addressing the pandemic but also for accelerating the recovery and building back better by securing a more sustainable and resilient future for all,” said Riccardo Puliti, Global Director for Energy and Extractive Industries and Regional Director for Infrastructure in Africa at the

⁸ ‘Renewable energy – powering a safer future’ (United Nations)

<<https://www.un.org/en/climatechange/raising-ambition/renewable-energy>> accessed 08 March 2023

⁹ T. Bharath Kumar & Anoop Singh, ‘Ancillary services in the Indian power sector – A look at recent developments and prospects’ (2021) 149 Energy Policy <<https://doi.org/10.1016/j.enpol.2020.112020>> accessed 08 March 2023

World Bank.¹⁰ World to build a resilient future must work on the positives of Covid-19 and move ahead on its path to reach net-zero emissions.

POWER EXCHANGE

The liquidity and effectiveness of Power Exchange, i.e., PX has taken a substantial leap since its commencement in the year 2008. With the Indian Electricity Act 2003 being enacted, provisions to end monopolies were initiated by various state electricity boards. This act did reform the electricity sector in India to a certain extent but the main objective of making a fully competitive electricity market has not yet been achieved.¹¹ Under this initiative, various assessments are carried out which reveal the total renewable energy source contribution through Power Exchange under RPO, i.e., Renewable Purchase Organization. In the year 2012, fifteen-minute bidding was introduced in the system of PX in India. This was based on the portfolio management of utilities. This helped to integrate renewable energy forms into the Indian Electricity Market.

LEGAL SITUATION SUBSIDIES AND INITIATIVES

Non-Fossil Fuel Obligations (NFFO) is a collection of orders requiring the electricity distribution network operators in England and Wales to purchase electricity from the nuclear power and renewable energy sectors. Similar methods can be seen in several other such as:

US	Renewable Energy Certificates (RECs)
Scotland	The Scottish Renewable Orders under the Scottish Renewables Obligation

¹⁰ 'COVID-19 intensifies the urgency to expand sustainable energy solutions worldwide' (WHO, 28 May 2020) <<https://www.who.int/news/item/28-05-2020-covid-19-intensifies-the-urgency-to-expand-sustainable-energy-solutions-worldwide>> accessed 08 March 2023

¹¹ Neeraj Kumar & M. M. Tripathi, 'Design of a novel Solar Energy Market Model for Indian scenario' (2021) 16 Journal of Electrical Engineering & Technology <<https://link.springer.com/article/10.1007/s42835-021-00802-9>> accessed 08 March 2023

Northern Ireland	The Northern Ireland Non-Fossil Fuel Obligation
Poland	Tradable Green Certificates
India	Jawaharlal Nehru National Solar Mission ¹² , Smart Grid, IDEEA Model-based scenarios ¹³ , INDC (Intended Nationally Determined Contributions) ¹⁴
Kyoto Protocol	Clean Development Mechanism (CDM) ¹⁵
Eskisehir, Turkey	Flat Plate Solar Collectors (FPSCs) ¹⁶

CHALLENGES

Limited and sustainable usage of any product is encouraged. But, if people look through history, they find that the use of certain renewable products as in Traditional Chinese Medicine

¹² Komali Yenneti, 'The grid-connected solar energy in India: Structures and challenges' (2016) 11-12 Energy Strategy Reviews Energy Strategy Reviews <<https://doi.org/10.1016/j.esr.2016.06.002>> accessed 08 March 2023

¹³ Oleg Lugovoy et al., 'Towards a Zero-Carbon Electricity System for India in 2050: IDEEA Model-Based Scenarios Integrating Wind and Solar Complementarity and Geospatial Endowments' (2021) 14(21) Energies <<https://doi.org/10.3390/en14217063>> accessed 08 March 2023

¹⁴ Joshua W. Busby and Sarang Shidore, 'When decarbonization meets development: The sectoral feasibility of greenhouse gas mitigation in India' (2017) 23 Energy Research & Social Science <<https://doi.org/10.1016/j.erss.2016.11.011>> accessed 08 March 2023

¹⁵ Amy Tang and John E. Taylor, 'Renewable Energy Investment in Emerging Markets: Evaluating Improvements to the Clean Development Mechanism' (2014) 2(2) <<http://dx.doi.org/10.13044/j.sdewes.2014.02.0014>> accessed 08 March 2023

¹⁶ Hakan Acaroğlu and M. Celalettin Baykul, 'Economic guideline about financial utilization of flat-plate solar collectors (FPSCs) for the consumer segment in the city of Eskisehir' (2018) 81(2) Renewable and Sustainable Energy Reviews <<https://doi.org/10.1016/j.rser.2017.05.291>> accessed 08 March 2023

endangers various species. In the past 40 years, the black market dealing with the trade of rhinoceros horns has reduced the same population by more than 90 percent.¹⁷

FINDINGS

1. Owing to the rise in consciousness in regards to the impacts of global warming and the spread of concern in matters to sustainable development the world is slowly moving towards its goal of achieving net zero carbon emission by 2050.
2. The Covid-19 Pandemic has given an upper hand to the nations as due to the worldwide lockdown industrial working, vehicular activities and other activities emitting greenhouse gases went down drastically.
3. Renewable resources as an alternative to fossil fuels has a five-point advantage over the latter, i.e. clean, sustainable, affordable, accessible, and reliable.
4. Sustainable development is directly correlated with the usage of renewable resources.

CONCLUSION

To respond to the clarion call of the present era of sustainable development the only weapon in hand for the present-day man is the usage of renewable resources.¹⁸ Indeed, in recent years, there has been an unprecedented rise in explosive growth in the usage of renewable energy.¹⁹ India has been working on this subject matter for a long time. Back in the 1990s India had opened up wind energy investments to the private sector.²⁰ Renewable resources also known as perpetual or flow resources if used properly keeping in mind the pros and cons then will indeed

¹⁷ Aakanksha Gaur, 'Traditional Chinese Medicine (*Britannica*, 01 March 2023)

<<https://www.britannica.com/science/traditional-Chinese-medicine> > accessed 08 March 2023

¹⁸ Avik Sinha et al., 'Dependence structure between Indian financial market and energy commodities: a cross-quantilogram based evidence' (2022) 313 *Annals of Operations Research* <<https://doi.org/10.1007/s10479-021-04511-4>> accessed 08 March 2023

¹⁹ Tatyana Lanshina and Vera Barinova, 'The Global Governance of Renewable Energy: International Trends and Russia' (2017) 12(1) *International Organisations Research Journal* <<https://iorj.hse.ru/en/2017-12-1/204246130.html>> accessed 08 March 2023

²⁰ Scott Mayer McKinney et al., 'International evaluation of an AI system for breast cancer screening' (2020) 577 *Nature* <<https://doi.org/10.1038/s41586-019-1799-6>> accessed 08 March 2023

benefit the Earth. Moreover, if each country can achieve its respective goal of achieving net zero carbon emission by 2050 the Earth will be greener, happier, and cooler.

At present 96 percent of India's total installed Renewable Energy (RE) utilities are owned by the private sector which makes India's energy sector a sector that is extensively driven by entrepreneurship.²¹ India has also installed almost sixty-seven microgrids in different parts of the country.²² India is progressing rapidly towards fulfilling its aim of integrating transactive energy in fulfilling its aim of making smart, futuristic rural network electrification.²³ India has set an ambition of producing 450 GW of energy using renewable technologies by the year 2030. Indeed, it is a herculean task and will require approximately \$600 billion which includes an investment of \$200 billion in the wind capacity and PV sector.²⁴ There has also been a proposed structure and approach regarding the demand response for the integration of variable renewable energy resources.²⁵

The present era calls for sustainable development and for a society that is futuristic in opinion. At the present moment in India, efforts to prioritize the barriers to the development of technologies related to renewable energy are being carried out by using the integrated Analytical Hierarchy Process (AHP) method and the Modified Delphi method.²⁶ Moreover, the fuzzy MICMAC approach and the integrated Interpretive Structural Modelling (ISM) methodology help in the analysis and identification of barriers to the implementation of solar

²¹ Stuti Haldar, 'A landscape level analysis of entrepreneurship and sustainable energy transitions: Evidences from Gujarat, India' (2022) 30(4) Sustainable Development <<https://doi.org/10.1002/sd.2244>> accessed 08 March 2023

²² Kapil Gandhi and S.K. Gupta, 'Operational strategies and electricity market structure of microgrid: A critical review Author links open overlay panel' (2021) 39 Renewable Energy Focus <<https://doi.org/10.1016/j.ref.2021.09.001>> > accessed 08 March 2023

²³ Mohammadreza Daneshvar et al., 'Transactive energy integration in future smart rural network electrification' (2018) 119 Journal of Cleaner Production <<https://doi.org/10.1016/j.jclepro.2018.04.043>> accessed 08 March 2023

²⁴ Hemi H. Gandhi et al., 'Strategic investment risks threatening India's renewable energy ambition' (2022) 43 Energy Strategy Reviews <<https://doi.org/10.1016/j.esr.2022.100921>> accessed 12 March 2023

²⁵ Madeleine McPherson and Brady Stoll, 'Demand response for variable renewable energy integration: A proposed approach and its impacts' (2020) 197 Energy <<https://doi.org/10.1016/j.energy.2020.117205>> accessed 12 March 2023

²⁶ Sudhir Kumar Pathak et al., 'Prioritization of barriers to the development of renewable energy technologies in India using integrated Modified Delphi and AHP method' (2022) 50 Sustainable Energy Technologies and Assessments <<https://doi.org/10.1016/j.seta.2021.101818>> accessed 12 March 2023

energy in the rural sectors of India.²⁷ Thus, the present market structure of renewable energy in India is prospective in nature and the Indian government too is interested in using renewable resources.

²⁷ Sonal Sindhu et al., 'Identification and analysis of barriers in implementation of solar energy in Indian rural sector using integrated ISM and fuzzy MICMAC approach' (2016) 62 *Renewable and Sustainable Energy Reviews* <<https://doi.org/10.1016/j.rser.2016.04.033>> accessed 12 March 2023