

Promotion of Sustainable Development through Renewable Energy: Evaluating the Efficacy of Energy Laws in India

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Abstract: According to Ban ki - Moon, "Energy is the golden thread that connects economic growth, increased social equity, and an environment that allows the world to thrive". [Priscillia Andrieu, *Enhancing a Continental Policy on Energy Access in Africa* (2016).] Energy plays a pivotal role in running the processes of human sustenance starting from the fulfilment of basic needs to run the bigger industrial establishments including processing & manufacturing units, transportation, agricultural practices, healthcare facilities, business organizations, educational institutions, research facilities, entertainment facilities among others. In other words, energy is like live blood for human existence and survival. In line with the ideas of sustainable development, one should also consider the effects of procurement, generation, transmission, and storage of the energy and sources of energy on the environment even while one recognizes the need of energy. Consider that the most crucial energy source is electricity. The world's share of resources for power generation is 61% from fossil fuels, 30% from renewables, and the remaining 9.1% from nuclear sources, 2023 statistics show. But in India, the share of fossil fuels is higher than 78%; nuclear and renewable energy provide respectively 2.45% and 19.51%. Data for 2023 show that the world's share of resources for power generation is 61% from fossil fuels, 30% from renewables, and the remaining 9.1% from nuclear sources. However, in India, the proportion of fossil fuels surpasses 78%, with renewables and nuclear contributing 19.51% and 2.45% respectively. [Hannah Ritchie, Pablo Rosado & Max Roser, *Electricity Mix, OUR WORLD IN DATA* (2024), <https://ourworldindata.org/electricity-mix> (last visited Jul 14, 2024).] This impacts environment in two ways. At the one hand it is exhausting the finite reserves of fossil fuels, and on the other hand in the process of electricity generation by use of fossil fuels huge quantity of carbon dioxide is released in the atmosphere which in turn causes Green House Gas effect, which in turn causes climate change and all the devastations associated with climate change like temperature hike, melting of glaciers, drought, uneven rainfall, threat to food security among others. So, it is imperative to find some alternatives to the existing sources of energy which will be environment friendly and at the same time will fuel the processes of development. Here comes the role of renewable sources of energy like solar, wind, tidal, biomass, and hydro etc. to fulfil the requirements of energy. Here in this paper, we will discuss the efficacy of energy laws and policies of India towards promotion of renewable energy highlighting its challenges and opportunities in tandem with the principles of sustainable development which is need of the hour for the sake of environmental justice.

Keywords: Energy Law, Renewable Energy, Sustainable, Energy Sustainability, Fossil Fuel Dependency, Electricity Generation, Environmental Degradation, Renewable Energy Sources

1. Introduction

(a) Importance of sustainable development

The interaction between humans and nature begins at birth, or even before birth while in the mother's womb. Human beings, including animals, have depended on natural resources like water, air, vegetation, minerals, etc. for their survival for ages. These resources are finite in nature. So, with the increase in population and the advent of science and technology, the exploitation of natural resources increased at an exponential rate, which included the wastage of resources as well. Scholars felt that if the rate of resource exploitation continues unchecked, it will soon exhaust or pollute these resources to an unbearable level for human survival.

In that setting, the concept of protecting the natural environment and its components came into being. Simultaneously, the realization dawned that we, as human beings, cannot entirely cease our use of environmental resources. Therefore, we should choose a middle ground where we utilize resources sustainably to fulfill human needs without depleting or polluting the environment. To put it another way, we should advocate for practices that do not pose any significant harm to the environment or natural resources. Simultaneously, we must discover substitutes for non-renewable energy sources to alleviate the strain on

these traditional sources and achieve environmental conservation without impeding developmental activities. Here comes the role of sustainable development.

An analysis conducted by Influence Map indicates that between 2016 and 2022, a few 57 corporations were responsible for a staggering 80% of worldwide carbon dioxide emissions. The analysis, which has been published in the Carbon Majors Database, identifies the primary state-controlled agencies and investor-owned corporations that are responsible for exacerbating the climate catastrophe and contributing to global warming. In 2022, the global emissions of carbon dioxide from the production of coal, oil, natural gas, and cement amounted to around 30,000 megatons. China's state-controlled coal output has been the leading contributor to global carbon emissions since the passage of the Paris Agreement in 2015. It accounted for 25.79% of worldwide emissions from 2016 to 2022.¹

Since 2016, state-owned fossil fuel production businesses have accounted for the second highest portion, collectively

¹ Christian Thorsberg, *80 Percent of Global CO2 Emissions Come From Just 57 Companies, Report Shows*, SMITHSONIAN MAGAZINE, <https://www.smithsonianmag.com/smart-news/since-2016-80-percent-of-global-co2-emissions-come-from-just-57-companies-report-shows-180984118/> (last visited Jul 10, 2024).

emitting about 30, 000 megatons of carbon dioxide into the atmosphere. Historically, investor - owned corporations, like Exxon Mobil, Shell, BP, and Chevron, have been responsible for the highest levels of carbon emissions. Collectively, these companies have accounted for over 10% of emissions since 1854 and 5% after the signing of the Paris Agreement. The survey additionally revealed that there was a notable change in coal mining and utilization, particularly after 2016. Global consumption of coal witnessed a substantial 8% increase, while the production landscape experienced a considerable movement from private firms to state - controlled corporations and nation - states.²

So, Sustainable development in actual sense with special reference to clean and affordable energy having no or less carbon emissions is crucial because it aims to fulfill the requirements of the current generation without endangering the capacity of future generations to fulfill their own requirements. Sustainable development fundamentally entails achieving equilibrium among economic expansion, environmental preservation, and societal welfare. Ensuring a delicate equilibrium is essential for guaranteeing sustained affluence and well - being for every individual on the world.

On the economic front, sustainable development promotes economic policies that foster enduring financial stability and expansion. It facilitates the optimal utilization of resources, leading to cost reduction and fostering innovation. Implementing sustainable practices in agriculture, industry, and other sectors can result in the emergence of environmentally - friendly employment opportunities and the advancement of novel markets and technology. The presence of economic stability contributes to social stability by diminishing poverty and inequality, promoting inclusive growth that advantages all sectors of society.

Environmentally, sustainable development is crucial in tackling the urgent challenges of climate change, biodiversity depletion, and pollution. Sustainable development contributes to the preservation of the natural environment for future generations by prioritizing the utilization of renewable resources and the safeguarding of ecosystems. Environmental stewardship is crucial for preserving the planet's well - being and guaranteeing the continued availability of natural resources for future generations.

From social perspective, sustainable development aims to enhance the overall well - being of all individuals. It prioritizes fair and equal access to resources, education, healthcare, and opportunities, hence reducing inequalities and fostering social justice. Sustainable development promotes social cohesion and peace by creating inclusive societies that enable everyone to thrive.

Sustainable development fundamentally entails the establishment of a society that is both resilient and flexible, enabling it to thrive in the presence of many challenges. The approach is comprehensive, acknowledging the interdependence of economic, environmental, and social variables, and aiming to reconcile them for the advantage of

present and future generations. By embracing the ideas of sustainable development, we can guarantee a healthier, fairer, and more prosperous world for everyone.

In nutshell, the principle of sustainable development embodies the fundamental idea of global efforts to integrate development and the environment, which shaped the environmental discourse during the early 1970s and late 1980s. A greater emphasis on the harmonious relationships between the physical, economic, and social components of the environment and development is, in essence, its culmination and the overriding principle of environmental jurisprudence.³

(b) Role of renewable energy in achieving sustainability with reference to India

Renewable energy is essential for attaining sustainability as it helps to decrease greenhouse gas emissions, enhance air quality, and bolster energy security. Expanding the proportion of renewable energy consumption over a prolonged period can effectively reduce CO₂ emissions, generate additional employment opportunities, and decrease the expenses associated with energy sources.⁴

Renewable energy is also important as it offers energy that is clean, easily accessible, and cost - effective. Wind and solar, as renewable energy sources, have minimal to zero emissions of greenhouse gases, thereby aiding in the reduction of climate change. The advantages linked to the shift towards renewable energy can be succinctly described as follows.

Renewable energy sources decrease reliance on non - renewable fossil fuels, safeguarding nations against fluctuations in fuel prices and promoting economic development.⁵

The expense associated with renewable energy has considerably diminished, rendering it the most economical choice for electricity in several regions across the globe.

Transitioning to renewable energy sources leads to a higher number of job opportunities in comparison to fossil fuels, hence fostering social and economic progress.

In 2015, the world at large, through the United Nations, adopted an agenda with 17 goals, naming them the Sustainable Development Goals (SDGs), with Goal 7 dedicated to clean and affordable energy. Renewable energy also plays an important role in the fulfilment of other SDGs

³ G.S. Tiwari, *Sustainable Development as a Socio-Economic Growth Strategy: Expanding Horizons of Environmental Law in India*, 52 JOURNAL OF THE INDIAN LAW INSTITUTE 435 (2010), <https://www.jstor.org/stable/45148533> (last visited Jun 25, 2024).

⁴ Li Yang, Sumaiya Bashiru Danwana & Fadilul-lah Yassanah Issahaku, *Achieving Environmental Sustainability in Africa: The Role of Renewable Energy Consumption, Natural Resources, and Government Effectiveness—Evidence from Symmetric and Asymmetric ARDL Models*, 19 INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH 8038 (2022), <https://www.mdpi.com/1660-4601/19/13/8038> (last visited Jul 8, 2024).

⁵ INTERNATIONAL RENEWABLE ENERGY AGENCY, IRENA, GLOBAL RENEWABLES OUTLOOK: ENERGY TRANSFORMATION 2050 (2020).

² *Id.*

as well, since energy is the live blood for all the developmental processes, and without it consist availability and supply sustenance of life cannot be imagined on earth.

Energy is vital for driving economic, social, and environmental progress, and its sustainable production and usage are necessary for accomplishing broader objectives. Goal - 7 of the United Nations' Sustainable Development Goals (SDGs) for the year 2030 is focused on ensuring access to clean and cheap energy, with the aim of fostering sustainable development. Reliable and inexpensive energy is crucial for promoting economic growth, reducing poverty, fostering social development, protecting the environment, mitigating climate change, promoting resource efficiency, and enhancing resilience.⁶

Energy is crucial for fostering economic progress, mitigating poverty, and promoting social development. Electricity drives several sectors such as industries, enterprises, and infrastructure, resulting in enhanced efficiency and investment in environmentally friendly technologies. Sustainable energy solutions have the potential to alleviate poverty by enhancing living standards, facilitating income - producing endeavors, and offering employment prospects in the renewable energy industry.⁷

Climate change mitigation is essential for achieving sustainable development goals. Advocating for the use of sustainable energy sources and implementing strategies to improve energy efficiency can effectively mitigate emissions and restrict the extent of global warming. An energy system that is varied and decentralized, relying on sustainable sources, improves energy security and resilience.⁸

Ultimately, there is a strong relationship between energy and sustainable development. By advocating for sustainable energy solutions, we can foster a future that is fair, just, and environmentally conscious for everyone.

2. Overview of Renewable Energy in India & the World - A Brief Description

With a target of one third of Total Final Energy Consumption (TFEC) by 2030, Target 7.2 of the Sustainable Development Goals asks for a significant increase in the share of renewable energy in the energy mix. Despite the COVID - 19 pandemic and the current energy crisis, renewable energy has a bright future everywhere thanks to legislation that support it. The share of renewables in TFEC is expected to rise from 18.5% in 2021 to 23% in 2030 under

the IEA's Stated Policies Scenario, with contemporary renewables rising from 12% in 2021 to 18% in 2030. According to IRENA's Planned Energy Scenario, by 2030, contemporary renewable energy will account for 16% of the total energy in the TFEC. Renewable energy sources in the power industry are still expanding at the quickest rate in the world, with solar photovoltaics and wind power showing the best results. Growth in end - use renewables, like contemporary bioenergy, is anticipated, with liquid biofuels and electromobility being the main drivers. New policy packages that boost agricultural output and carbon reductions—particularly those pertaining to transport biofuels—may need to include supportive measures.⁹

The 2030 Sustainable Development Goals (SDG) have the objective of augmenting the proportion of renewable energy in the worldwide energy combination. The primary measure employed to evaluate advancement is the percentage of renewable energy in total final energy consumption (TFEC). In 2019, the proportion of renewable electricity experienced a growth of more than 5%, establishing it as the most significant portion of renewable energy among end - use categories. However, just 20% of the world's total final energy consumption (TFEC) was made up of electricity.

Developing countries added a remarkable 246 watts per capita of renewable capacity in 2020. However, these countries are not currently on course to achieve net - zero scenarios or targets by 2030. To attain the goals of SDG 7.2 and 7. B.1, it is necessary to provide more policy support for renewable energy in all sectors and to increase the mobilization of private resources for renewable energy projects.¹⁰

Electricity accounted for 21% of global total final energy consumption (TFEC) in 2019. Electricity consumption has experienced rapid growth, doubling over the past 23 years, and increasing by 37 percent in the last decade. This makes it the fastest - growing energy end use.¹¹ Globally, renewable sources account for around 30% of electricity generation, while fossil fuels account for 70%. India is also heading or inching towards the global average. As of 2023, the share of renewables for electricity generation in India was around 19.51%, while the share of fossil fuels was 78%.¹² As of March 2024, thermal power generation capacity accounted for 56% of India's installed electricity - generating capacity, according to data from the Indian Brand Equity Foundation (IBEF). Hydroelectric power made up 11% of the capacity, and renewable energy sources (RES) made up 32%. Just 2% of the installed capacity was made up of nuclear power. [India's Clean Energy Revolution: Embracing Renewable Sources | IBEF, INDIA BRAND EQUITY FOUNDATION,

⁶ Goal 7 | Department of Economic and Social Affairs, 7, <https://sdgs.un.org/goals/goal7> (last visited Feb 23, 2024).

⁷ Emily Christley et al., *Sustainable Energy for Slums? Using the Sustainable Development Goals to Guide Energy Access Efforts in a Kenyan Informal Settlement*, 79 ENERGY RESEARCH & SOCIAL SCIENCE 102176 (2021), <https://www.sciencedirect.com/science/article/pii/S2214629621002693> (last visited Feb 23, 2024).

⁸ How Energy Efficiency Will Power Net Zero Climate Goals – Analysis, IEA, <https://www.iea.org/commentaries/how-energy-efficiency-will-power-net-zero-climate-goals> (last visited Feb 23, 2024).

⁹ Tracking SDG7: The Energy Progress Report, 2023 – Analysis, IEA (2023), <https://www.iea.org/reports/tracking-sdg7-the-energy-progress-report-2023> (last visited Jul 13, 2024).

¹⁰ Tracking SDG7: The Energy Progress Report 2022 | Department of Economic and Social Affairs, <https://sdgs.un.org/publications/tracking-sdg7-energy-progress-report-2022-47726> (last visited Jul 9, 2024).

¹¹ *Id.*

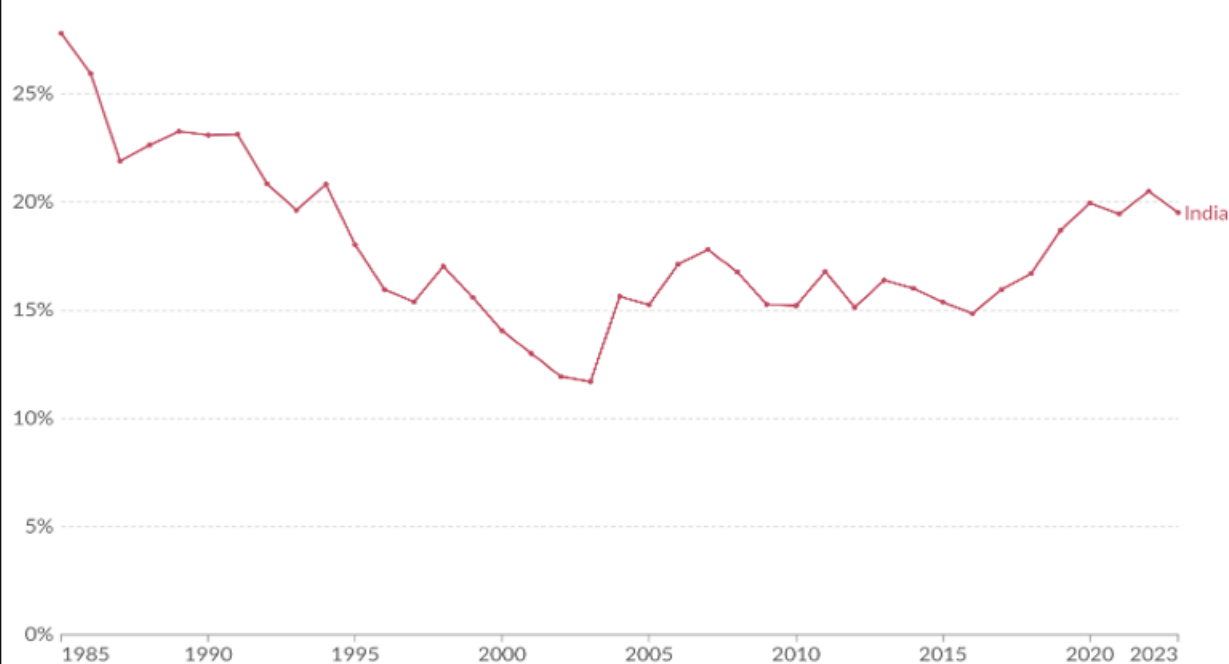
¹² Energy Data Explorer, OUR WORLD IN DATA, <https://ourworldindata.org/explorers/energy> (last visited Jul 9, 2024).

<https://www.ibef.org/blogs/clean-energy-revolution-india-s-transition-towards-renewable-energy-sources> (last visited Jul 9, 2024).]

Share of electricity production from renewables

Renewables include electricity production from hydropower, solar, wind, biomass & waste, geothermal, wave, and tidal sources.

Our World
in Data



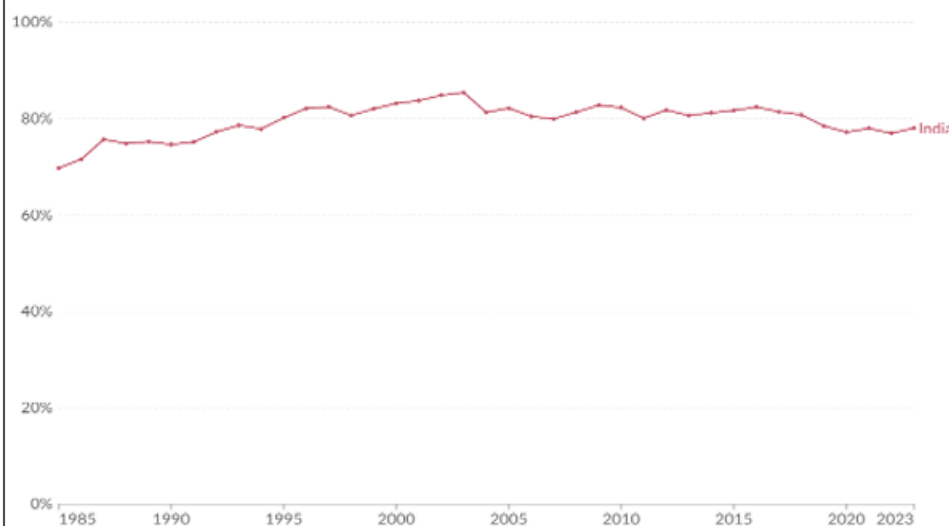
Data source: Ember (2024); Energy Institute - Statistical Review of World Energy (2024)

OurWorldInData.org/energy | CC BY

Share of electricity production from fossil fuels

Measured as a percentage of total electricity.

Our World
in Data



Data source: Ember (2024); Energy Institute - Statistical Review of World Energy (2024)

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Between 2008 and 2009, the share of installed capacity devoted to thermal power production was 63.3%; by 2023–24, that share had dropped to 56%. While the capacity from renewable energy sources increased significantly from 8.9% to 32%, the percentage of hydro - based power generation capacity fell from 25% to 11% at the same time. The total installed capacity for electricity generation had a compound annual growth rate (CAGR) of 7.7% between 2009 and 2023; for renewable energy sources (RES), this rate was 17.4%, and for all other sources, it was 5.7%. With 53.4% of

the total renewable energy produced, solar energy has the highest share in the industry. After biopower and waste to energy, wind power comes in second with 34.1% and third place, respectively, with 8.2%. The final 3.9% are small hydro projects.¹³

India's target is to attain a 20% ethanol blend in fuel by 2025 - 26, necessitating almost 1, 016 crore gallons of ethanol to

¹³ *Id.*

substitute an equal volume of petrol. The National Green Hydrogen Mission was approved in January 2023 and given a US\$ 2.4 billion financial allocation. This financing is primarily intended for the SIGHT initiative, which stands for Strategic Interventions for Green Hydrogen Transition. The SIGHT program aims to promote the production of electrolyzers and green hydrogen within the country, with the goal of capturing a portion of the projected worldwide demand of 200 million tonnes by 2030.¹⁴

Electric vehicles (EVs) are gaining popularity because of their minimal carbon dioxide (CO₂) emissions and growing consumer demand. The Indian government has established lofty goals for the adoption of electric vehicles (EVs) by 2030.¹⁵ These goals call for private cars to make up 30% of EV sales, followed by commercial vehicles at 70% and two- and three-wheelers at 80%. The IEA estimates that decarbonization of the Indian electric vehicle (EV) fleet could contribute to a reduction of around 5 million metric tons (Mt) of carbon emissions, in line with global efforts to combat climate change.¹⁶

Aiming for a maximum installed capacity of 500 GW from non-fossil fuel sources by the year 2029-2030, the Central Electricity Authority (CEA) has revealed the National Electricity Plan (NEP) for the period of 2022-2032. The plan also emphasizes ambitious goals for wind and solar energy, with a projected 50% increase in levelized solar energy over this specific timeframe.¹⁷

India is actively pursuing a sustainable future by implementing projects such as the PLI scheme for solar photovoltaics, which involves a substantial investment of US\$ 2.9 billion. India is positioned as a major worldwide leader in renewable energy by the growing momentum in this area, which shows its will to reach international climate targets and create a sustainable and dependable future for energy.¹⁸

Government Initiatives and Policies

In the Union Budget 2023, the Indian government unveiled significant initiatives and programs designed to advance

sustainable living and renewable energy. A scheme on viability gap funding has been developed by the Ministry of Power to support the construction of battery energy storage systems with a 4,000 MWh capacity. Customs taxes would be waived until March 31, 2024, for imports of capital goods and machinery required to manufacture lithium-ion cells for electric vehicles. The Green Hydrogen Mission, which would cost Rs.19,700 crores, is one of the major initiatives. Other important initiatives include the payment of the viability gap for 4,000 MWh battery energy storage systems and the allocation of Rs.35,000 crores for priority capital investments.¹⁹

The government also plans to invest Rs.20,700 crores strengthening the interstate transmission network to evacuate and integrate 13 GW of renewable energy from Ladakh into the grid. Furthermore announced by the government are initiatives such as the 12000 MW CPSU Scheme Phase II, Solar Rooftop Phase II, and Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan (PM-KUSUM). The government has also set guidelines for power distribution against letters of credit (LC) or advance payment to ensure that holders of distribution licenses pay renewable energy producers on schedule.²⁰

With an eye toward less reliance on fossil fuels for the generation of power, the Indian government has instituted several initiatives and rules to assist renewable energy. While the State Electricity Regulatory Commissions set better pricing for renewable energy purchases, the Ministry of New and Renewable Energy (MNRE) promotes renewable energy resources and manages official business. Aiming to raise the portion of electricity generated from renewable sources, the National Electricity Policy (2005) supports competitive bidding for power purchases.

Introduced in 2008 to help to fulfill energy demand and lower carbon emissions, the National Action Plan on Climate Change (NAPCC) By 2022, the Jawaharlal Nehru National Solar Mission (JNNRM) seeks to build 22,000 MW of grid-connected and off-grid power plants as well as increase solar energy output. Driven by foreign investment and a change in the Central Government, India is now seeing one of the biggest clean energy expansions in world. To take the lead in renewable energy, India must address long-standing problems impeding its expansion and adopt effective RE sector policies from other leaders like China, Japan, Germany, and the US.²¹

India is focusing on developing technologies such as tiny fuel cells, floating wind turbines, and concentrated solar

¹⁴ Business Standard, *India's Target of 20% Ethanol Blending Advanced from 2030 to 2025-26*, (2023), https://www.business-standard.com/india-news/india-s-target-of-20-ethanol-blending-advanced-from-2030-to-2025-26-123041800070_1.html (last visited Jul 11, 2024); India's Clean Energy Revolution, *supra* note 15.

¹⁵ India's EV Economy: The Future of Automotive Transportation, <https://www.investindia.gov.in/team-india-blogs/indias-ev-economy-future-automotive-transportation> (last visited Jul 11, 2024).

¹⁶ NITI Aayog convenes India's Electric Mobility Enablers under G20 Presidency, <https://pib.gov.in/pib.gov.in/Pressreleaseshare.aspx?PRID=1941114> (last visited Jul 11, 2024).

¹⁷ Sarthak Takyar, *CEA Notifies the National Electricity Plan for 2022 to 2032*, RENEWABLE WATCH (2023), <https://renewablewatch.in/2023/06/01/cea-notifies-the-national-electricity-plan-for-2022-to-2032/> (last visited Jul 11, 2024).

¹⁸ Production Linked Incentive (PLI) Scheme: National Programme on High Efficiency Solar PV Modules | Ministry of New and Renewable Energy | India, <https://mnre.gov.in/production-linked-incentive-pli/> (last visited Jul 11, 2024).

¹⁹ PROMOTION OF CLEAN ENERGY - Major steps taken by the Government to accelerate the Indian economy's transition to one powered by green energy – Union Power & NRE Minister, <https://pib.gov.in/Pressreleaseshare.aspx?PRID=1907698> (last visited Jul 14, 2024).

²⁰ *Id.*

²¹ Rajvikram Madurai Elavarasan et al., *A Comprehensive Review on Renewable Energy Development, Challenges, and Policies of Leading Indian States With an International Perspective*, 8 IEEE ACCESS 74432 (2020), <https://ieeexplore.ieee.org/document/9072152/?arnumber=9072152> (last visited Jul 11, 2024).

power to increase efficiency. The country's top renewable energy source is wind energy, and updating the country's current wind farms is crucial for increasing productivity and lowering operating expenses. Smarter turbines with integrated blade intelligence can significantly lower rotor blade loads and costs.

With an expected 13.5 GW renewable energy capacity built in 2023, India's Ministry of New and Renewable Energy wants to reach 500 GW Non - Fossil based electricity generating capacity by 2030. The nation ranks fifth in solar power capacity, fourth in wind power capacity, and fourth in installed capacity of renewable energy overall. The National Green Hydrogen Mission seeks to position India as the Global Hub for Green Hydrogen manufacture, application, and export. In order to reach manufacturing capacity of Giga Watt (GW) scale in high - efficiency solar PV modules, the government is running the Production Linked Incentive (PLI) Scheme for the National Program on High Efficiency Solar PV Modules. With an estimated 70 GW off the coast of Gujarat and Tamil Nadu, India has great offshore wind energy generating potential. In twelve states around the nation, the government has approved fifty solar parks with combined capacity of around 37, 490 MW. On March 13, 2023 the Reserve Bank of India gave IREDA Infrastructure Finance Company (IFC) classification. India took over from The International Renewable Energy Agency (IRENA) in Abu Dhabi the 13th Assembly.²²

With investments of around Rs.3000000 million over the next 25 years, India has numerous potential to become a worldwide leader in generation of renewable energy.²³

3. Energy Laws in India

Since Bradbrook's 1986 paper, energy law literature has developed, concentrating on the regulation of stakeholders' rights and duties throughout the energy life cycle.²⁴ It includes the laws, rules, and policies that control how energy is produced, distributed, and used. This includes both renewable and non - renewable energy sources. Regulations pertaining to energy resources, the environment, energy infrastructure, energy contracts and transactions, electricity market regulation, renewable energy incentives and policies, and international energy law are only a few of the topics covered by energy law. Ensuring effective and sustainable management of energy resources, addressing environmental issues, and promoting innovation in the energy industry are the objectives. The sections that follow will address the effectiveness of these laws and policies.

A. Key Energy Laws and Regulations

India's energy sector is governed by various laws and regulations designed to promote industrial growth while

safeguarding environmental sanctity. The Electricity Act of 2003, Energy Conservation Act of 2001, and the National Green Tribunal Act of 2010 form the cornerstone of India's energy legislation. These acts aim to provide a stable supply of electricity, promote efficient energy use, and address environmental concerns arising from energy projects.

The Renewable Energy Bill, still in its draft form, aims to revolutionize the sector by setting ambitious targets for clean energy production. The legislation and policies related to the energy sector have a direct bearing on sustainable development and environmental concerns as per national and international commitments. Key initiatives include the National Solar Mission, Wind Energy Policy, and Bioenergy Policy.

Provisions pertaining to renewable energy integration, tariff reforms, and the creation of a National Renewable Energy Policy help the Electricity (Amendment) Bill, 2020 strive to bring changes in the electricity sector. The Energy Conservation Act, 2001 requires energy audits, energy consumption guidelines, and application of energy - saving techniques. Setting energy performance criteria for appliances and equipment and supporting energy efficiency labels, the Bureau of Energy Efficiency (BEE) manages energy efficiency and conservation activities in India.

The Clean Energy Cess Act, 2010 provides for the levy and collection of a cess on coal, lignite, and peat produced or imported into India, intended for financing activities to promote clean energy and environmental projects. The National Biofuel Policy, 2018 encourages the use of biofuels, while State Electricity Regulatory Commissions (SERCs) regulate the electricity sector within each state.

General regulations and policies pertaining to the energy sector comprise the Hydrocarbon Exploration and Licensing Policy (HELP), Environmental Impact Assessment (EIA) Notifications, 1994, 2006 & 2020 and the National Green Tribunal (NGT) Act, 2010. The industry is dynamic, hence new laws and revisions could be included to handle new possibilities and problems in the energy scene.

4. Evaluation of the Efficacy of Energy Laws in Promotion of Sustainable Development

In one way or another, the energy industry has assumed a leading role in achieving the Sustainable Development Goals. Finding and evaluating the energy laws and regulations, as well as how they support environmental justice and sustainable development, is now crucial. By providing incentives like feed - in - tariffs and building energy performance certification programs to encourage the adoption of renewable energy, energy regulations play a critical role in encouraging renewable energy sources. In order to address environmental problems and attain energy sustainability, these regulations seek to replace fossil fuels with clean, sustainable energy sources.

Energy regulations in the current Indian setting strive to support sustainability and energy development at the same time. Since energy is now essential to all human activities, from daily life to the operation of large institutions and

²² Year End Review 2023 of Ministry of New & Renewable Energy, <https://pib.gov.in/pib.gov.in/Pressreleaseshare.aspx?PRID=199273> 2 (last visited Jul 14, 2024).

²³ Elavarasan et al., *supra* note 24.

²⁴ treatise for energy law | The Journal of World Energy Law & Business | Oxford Academic, <https://academic.oup.com/jwelb/article/11/1/34/4792991> (last visited Jul 11, 2024).

industrial facilities, the need for energy has grown tremendously even in the face of several energy efficiency initiatives. From 20, 874 Megajoules in 2012–13 to 24, 453 Megajoules in 2021–22, the per - capita energy consumption has grown even after all the efficiency measures with reference to appliances and gadgets.²⁵

In addition, the population is growing at a startling rate. The aforementioned numbers can be used to calculate the strain on energy sources. This can be accomplished by putting an emphasis on addressing environmental issues, energy security, accessibility, and cost. The emphasis is on diversifying the energy mix by including solar, wind, and hydropower among other renewable energy sources. The government has instituted laws and rules including renewable purchase commitments, tax exemptions, and subsidies in order to promote the use of renewable energy sources and reduce reliance on fossil fuels. In order to lower energy consumption and encourage sustainable practices, the Bureau of Energy Efficiency prioritizes energy efficiency measures across a number of sectors.

At this point, I'd want to talk about and examine a few significant clauses included in foundational laws that pertain to India's energy industry. The regulations pertaining to fossil fuels primarily place more emphasis on promoting economic growth and development than they do on resource preservation and sustainability. Their main goal is to increase energy supply and production in order to satisfy the growing demands of urbanization and industrialization. As of right now, the majority of human activities, from basic requirements to large businesses and institutions, depend on the production of electricity, which is primarily derived from fossil fuels.

Therefore, the Electricity Act of 2003 has several significant measures that are in line with the aforementioned goal in accordance with the national and international commitments to sustainable development. The Act's long title outlines its goals, some of which include environmentally friendly activities. Aiming to "promote efficient and environmentally benign policies and consolidate the laws relating to generation, transmission, distribution, trading, and use of electricity," the act reads as follows.

Section 3 and 4 of the Act²⁶ demand the Central Government to create the National Electricity Policy and Tariff Policy for the development of the power system based on the most efficient use of resources like coal, natural gas, nuclear materials or substances, hydropower, and renewable energy sources. Correspondingly, the Indian government's Ministry of Power created the National Electricity Policy in 2005. Emphasizing the importance of environmental preservation and the utilization of renewable energy sources, it addresses many difficulties, including the generation of cheap power. The Policy gives great weight on the importance of using non - conventional energy resources, especially nuclear

power, in order to alleviate environmental issues. The emphasis on rural electrification also includes motivating the use of distributed renewable energy solutions in isolated and off - grid sites, therefore improving access to electricity and preserving environmental sustainability. The Policy makes five - year National power Plans conceivable which evaluate and apply sustainable measures for the manufacturing, generation, and distribution of reasonably priced electricity to every home possible.

Section 61 and 62 of the Act, which control tariffs, stipulate among other things that the values awarding performance efficiency and multi - year tariff principles will also influence the circumstances and conditions under which a tariff will be decided. These rules will also cover the encouragement of cogeneration and the producing of power from renewable energy sources. It talks on a possible incentive scheme meant to boost the consumption of sustainable energy sources.

India's main energy consumption rose from about 441 Mtoe in 2000 to almost 775 Mtoe in 2013. Projections from the Integrated Energy Policy Report and the International Energy Agency indicate that by 2030 this demand will climb from about 1250 million to 1500 million toe. Improving energy efficiency supports sustainable development and helps the economy to get more competitive.²⁷

Passed even before the Electricity Act of 2023, the Energy Conservation Act of 2001 was passed by the Indian government to help to reduce the energy intensity of the Indian economy. To aid in the EC Act's implementation, the Bureau of Energy Efficiency (BEE) was established as a statutory body under Section 3 of the EC Act. The Act's sections 14 and 15 give the federal government and state governments the authority to create and implement a standards and labeling (S&L) program, which will be carried out by the Bureau of Energy Efficiency (BEE). One of the best ways to reduce consumer energy bills and increase the energy efficiency of appliances and equipment is through governmental measures like this one. Consumers can choose energy - efficient products that save energy and save costs by using labels that explain energy performance in conjunction with mandatory energy efficiency standards. Here, public involvement and government initiative are both encouraged for a sustainable future.²⁸

Still, the Energy Conservation Act of 2001 makes no clear reference of the encouragement of electric cars. The Act mostly addresses effective use of energy and conservation of it. Still, the requirements of the Energy Conservation Act resulted in the Bureau of Energy Efficiency (BEE), engaged in the deployment of EV public charging systems. Through bettering the necessary infrastructure, this can help to indirectly promote the use of electric cars and reduce the environmental hazards and load connected with the consumption of fuels. Thus, initiatives to counteract the

²⁵ ENERGY STATISTICS INDIA 2023, 1 (2023), https://mospi.gov.in/sites/default/files/publication_reports/Energy_Statistics_2023/Energy%20Statistics%20India%202023_07022024.pdf.

²⁶ The Electricity Act, 2003

²⁷ Overview | Government of India | Ministry of Power, <https://powermin.gov.in/en/content/overview-2> (last visited Feb 29, 2024).

²⁸ *Id.*

serious worldwide threat presented by climate change also support each other.²⁹

The Renewable Energy Act, which is currently in draft form, aims to set high standards for the production of sustainable energy and transform the industry. "To develop new and renewable energy technologies, processes, materials, components, sub - systems, products & services at par with international specifications, standards, and performance parameters to make the country a net foreign exchange earner in the sector and deploy such indigenously developed and/or manufactured products and services in furtherance of the national goal of energy security, " is the mission statement of the Ministry of New and Renewable Energy (MNRE), a special ministry of the Indian government that operates in accordance with the Energy Conservation Act of 2001 and the Electricity Act of 2003.³⁰

By means of development and deployment of alternative fuels including hydrogen, biofuels, and synthetic fuels and their applications, the ministry seeks to fill the gap between local oil supply and demand and lessen dependency on oil imports. To increase the percentage of clean power, efforts are also being made to boost fossil fuel - based electricity generating by means of renewable energy sources including wind, hydro, solar, geothermal, bio, and tidal power. Apart from generating electricity, its main focus is on offering easily accessible and fairly priced energy to satisfy the needs of the industrial, commercial, rural, and heating sectors as well as for motive power, cooking, and captive production.³¹

5. Obstacles to the Production of Sustainable Energy

India's rapidly expanding economy causes a huge increase in the country's energy needs. Fossil fuels continue to dominate the world's energy consumption, resulting in large emissions of greenhouse gases (GHGs). India must triple its capacity for wind, solar, and massive hydropower in order to solve the issue, producing more than 500 GW of renewable energy over the course of the next ten years. This necessitates a move away from fossil fuels and large investments.³²

Investments in the energy transition must be significant. It is predicted that the average yearly investment on clean energy assets is \$9.2 trillion, and this amount has to increase by an additional \$3.5 trillion. That works out to almost \$275 trillion from 2021 to 2050. For sustained development, it is

imperative that this financial obstacle be overcome. India must therefore provide incentives for investment in this area.

Other than this Robust infrastructure and effective grid integration are necessary for increasing the capacity of renewable energy. Managing intermittent renewable sources, maintaining grid stability, and balancing supply and demand are difficult tasks. India has to improve its distribution and transmission systems to handle the flood of renewable energy. To minimize the burden of protecting the environment from climate change and the disasters that follow, we also need to limit our consumption patterns.

India's energy policy framework predominantly excludes energy storage from crucial programs and efforts, creating an obstacle for potential investments. The country's main energy policies consist of the 2003 Electricity Act and the 2006 Integrated Energy Policy. These policies address key aspects related to the production, distribution, transmission, operation of the power grid, and power trading. While these regulations do not specifically include energy storage, recent changes to the National Electricity Policy and Tariff Policy have focused on promoting renewable energy and components that are compatible with energy storage.³³

The 2006 Integrated Energy Policy and the proposed revision in 2017 both acknowledge the potential of storage as a means to support the rapid expansion of variable renewable energy sources and to stabilize fluctuations in energy demand. NITI Aayog proposes that the combination of renewable energy sources and storage technology will result in the extensive elimination of coal usage throughout India. Power Minister Singh has suggested implementing a renewable purchasing obligation to encourage the use of energy storage for continuous power supply.³⁴

Energy storage is increasingly being prioritized in national planning processes. The CEA, which is tasked with developing India's long - term strategy for the power industry, has always regarded PSH as the exclusive technology for energy storage in its National Electricity Plan. The most recent Report on Optimal Generation Capacity Mix for the years 2029 - 2030 includes candidate technologies such as 4 - hour battery storage and pumped storage hydroelectricity (PSH). The results of the base scenario indicate that a total of 27 gigawatts (GW) of battery storage, in addition to 10 GW of pumped storage hydro (PSH), will be required by the year 2029 - 2030.

By incorporating explicit policy directives in the forthcoming revisions of the National Electricity Policy, Tariff Policy, and the final iteration of NITI Aayog's 2017 Draft National Energy Policy, regarding energy storage, it is possible to send a market indication that will stimulate progress and prompt regulatory bodies to initiate the enforcement of specific regulations.

²⁹ Energy Efficiency (EE) for Climate Action: Evolution of India's EE Policies and Way Forward | SpringerLink, https://link.springer.com/referenceworkentry/10.1007/978-981-19-6778-8_28 (last visited Feb 29, 2024).

³⁰ Md Enam Firdos & Dr. Ghulam Yazdani, *Energy Laws, and Sustainable Development in India: A Brief Review in Quest of Environmental Justice*, 9 INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT a744 (2024).

³¹ *Id.*

³² Rajat Verma, *India's Energy Transition: Challenges and Opportunities for a Sustainable Future*, THE TIMES OF INDIA, Jul. 8, 2023, <https://timesofindia.indiatimes.com/blogs/voices/indias-energy-transition-challenges-and-opportunities-for-a-sustainable-future/> (last visited Mar 4, 2024).

³³ AMY ROSE ET AL., *Policy and Regulatory Environment for Utility-Scale Energy Storage: India*, (2020), <https://www.osti.gov/biblio/1756708> (last visited Jul 11, 2024).

³⁴ *Id.*

6. Conclusion

Energy is undeniably vital for driving economic growth, promoting social equality, and ensuring the long-term health of our planet. The procurement, generation, transmission, and storage of energy have substantial environmental impacts, primarily due to the reliance on fossil fuels. Fossil fuel-based electricity generation is a major contributor to climate change and the devastating consequences it brings. Hence, it is crucial to explore alternative energy sources that are both eco-friendly and capable of driving progress.

Renewable sources of energy, including solar, wind, tidal, biomass, and hydro, provide a viable solution to meet energy needs while also promoting sustainable development. These sources have very low or no emissions of greenhouse gases and play a role in mitigating climate change. By 2030, India's Ministry of New and Renewable Energy projects 500 GW of non-fossil-based energy generating capacity. An estimated 13.5 GW of new renewable energy capacity will be built in 2023. India now ranks fourth in solar power capacity, fourth in wind power capacity, and fourth in installed capacity for renewable energy overall. Through the National Green Hydrogen Mission, the nation also hopes to become a worldwide center for green hydrogen generation, application, and export. The Production Linked Incentive (PLI) Scheme is being used by the government to advance high-efficiency solar PV module manufacturing capability. With an estimated 70 GW off the coast of Gujarat and Tamil Nadu, India boasts great offshore wind energy generating potential. Furthermore, approved by the government are 50 solar farms totaling roughly 37,490 MW spread over 12 states.

Achieving sustainability and supporting renewable energy in India depend much on the efficiency of energy laws and policies. Establishing a framework to promote the acceptance of environmentally friendly and energy-efficient methods, the Electricity Act of 2003 and the Energy Conservation Act of 2001. The National Electricity Policy and Tariff Policy underline the need of applying energy efficiency strategies and using alternative energy sources. The suggested Renewable electricity Act establishes high benchmarks for generation of environmentally friendly electricity.

Nevertheless, there are challenges that hinder the production of sustainable energy in India. Significant investments in renewable energy infrastructure are necessary to meet the demands of a rapidly expanding economy and increasing energy needs. Managing energy supply and demand can be challenging due to the intermittent nature of renewable sources and the requirement for effective grid integration. In addition, the energy policy framework lacks sufficient consideration for energy storage, which is impeding potential investments in this field.

India grapples with the challenge of balancing energy requirements with environmental sustainability, a task made more complex by its growing population and emerging economy. To address these issues, India is implementing comprehensive reforms in its energy legislation and

regulations, including initiatives like the National Action Plan on Climate Change and the International Solar Alliance. Collaborations with international colleagues and organizations facilitate the rapid sharing of knowledge and transfer of technology, accelerating India's transition to a more environmentally friendly energy future.

In order to address these challenges, India should consider offering attractive incentives to encourage investment in renewable energy. Additionally, there is a need to focus on enhancing infrastructure and grid integration to ensure smooth functioning of renewable energy sources. Furthermore, it is crucial for India to prioritize energy storage in its national planning processes. India can promote sustainable development, reduce reliance on fossil fuels, and mitigate the impacts of climate change by addressing these challenges and implementing effective energy laws and policies. Striving for a harmonious combination of economic growth, social development, and environmental preservation is crucial in creating a better, more equitable, and prosperous future for everyone.