ENERGY, ECONOMY, ENVIRONMENT VIS-A-VIS LAWS & POLICIES A CRITICAL APPRAISAL WITH FUTURE PROSPECT

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ABSTRACT

This paper sheds light on the interconnection between energy, economy, and environment as well as how the laws and regulation affect their dynamics; it highlights the complex relationship among these factors and examines how they could affect sustainable development. This examination provides future prospects while concentrating on existing solutions. The energy sector plays a significant role in driving economic growth and development however; laws and policies that govern various areas such as distribution, consumption, and environmental protection have a great influence on the energy sector as well as on the economy. This critical appraisal delves into the prospects of energy, economy, and environment it assesses their strengths weaknesses, and effectiveness in promoting sustainable development and suggests the potential renewable energy sources. Furthermore, it provides innovative policies to foster sustainable economic growth driving toward a more sustainable and resilient future. This research paper intends to offer insights for policymakers, researchers, and interested individuals, by critically examining the complex interaction between energy, economy, environment, and the influence of laws and policies. It emphasizes the value of a comprehensive strategy that strikes a balance between environmental sustainability and economic growth. The research findings add to the continuing discussion about creating efficient legal and regulatory frameworks to deal with the difficulties of the energy transition and advance a more sustainable and prosperous future.

INTRODUCTION

"Our universe is the sea of free energy, clean energy. It is all out there waiting for us to set sail upon it".

- Robert Adams

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India has the world's largest population and is the 5th largest economy in the world the way we harness and utilize energy becomes extremely important and it directly impacts our economies as well as social growth. Achieving goals such as sustainable development and addressing the challenges of environmental crisis require deep attention. For better understanding we first need to understand the relationship between these three i.e. energy, economy, and environment, and at the root of this relationship lies the critical role played by laws and policies which, regulate the interaction between energy production, economic growth, and environmental policies. However fulfilling all these objectives is not an easy task, as they can stand in conflict with each other.

This paper provides a comprehensive overview and discusses the present connection between energy, the economy, and the environment, with a prime focus on evaluating existing laws and policies. By dwelling on this complex web of factors, we aim to study and analyze current regulatory frameworks' effectiveness and identify their merits, demerits, and potential future challenges.

Energy security, easy access to energy for all, and industrial growth are the key factors required for a healthy economy, Policies that maintain balance between these domains and promote sustainable growth are essential for consistent economic growth. There is a need to create more green jobs, promote economic development, and address all the economic challenges coming in the near future, with the help of this paper we will try to evaluate the current economic framework and address all the disparities.

However while working, on the goals we also have to look forward to the protection and preservation of the environment. To be more specific we are talking about nature and its application of energy production and its effect on the environment, besides this is how we enforce our environmental policies and how they align with international commitments such as the Paris Agreement and the Vienna Convention for the protection of the ozone layer Etc.

With the help of this paper, we hope to contribute to the ongoing discussion on sustainable development and provide insightful information for policymakers, researchers, and people interested in fostering a more sustainable and prosperous future. In conclusion, this paper seeks to illuminate the complex relationship between energy, economy, and the environment.

CONCEPTUAL ANALYSIS

Energy

"A nation that can't control its energy sources can't control its future.''

- Barak Obama

Energy is not only the heart but also a very fundamental need for development that nurtures various aspects such as investment, new industries, and shaping the economy and environment. In the past 20 years world energy expenditures have doubled, More than US$6,000bn1 -10% of the world's gross domestic product(GDP) is spent each year in the world for energy purposes [Global energy data- Enerdata yet nearly 7OO million people live without electricity in the world which makes energy security a top priority, Reducing dependency, making new strategies and enhancing infrastructure is needed if an hour. Thus to regulate and govern the production, consumption and distribution there shall be a legal framework addressing diverse aspects of the energy sector.

Energy laws

Laws that regulate and govern the use of energy are called energy laws, it governs both renewable as well as non-renewable energy. 'Energy law includes the legal provision for oil, gasoline, and "extraction taxes." The practice of energy law includes contracts for siting, extraction, licenses for the acquisition and ownership rights in oil and gas both under the soil before discovery and after its capture, and adjudication regarding those rights' One of the crucial domains addressed by the energy laws is the promotion of renewable and clean sources, besides this, it also focus on energy efficiency, reduce energy dependency and promoting environment conservation. These laws not only contribute to enhancing energy security but also help lower energy costs. Energy laws also include international agreements, bilateral energy agreements, and commitments such as the Paris Agreement, International Solar Alliance, and the United Nations Framework Convention on Climate Change. Energy law promotes counties to fulfill their obligations and felicitate enforcement of robust energy laws essential for addressing environmental challenges.

Renewable energy

Often renewable energy is also known as clean energy as it comes from natural resources, it also offers a sustainable and environmentally friendly alternative to traditional fossil fuels there are various renewable sources such as solar, wind, hydro, and biomass. Now that we have innovative and less expensive ways to capture and retain wind and solar energy, renewables are becoming more important power sources. India's total renewable energy capacity reached 122 gigawatts in February 2023 this was an increase of almost 15 % from February last year but still fell short by 30% of the 175-GW target that the central government aimed to reach by the end of 2022. Renewable sources offer numerous advantages in climate change by reducing greenhouse gas emissions and maintaining the global temperature. However, the full implementation and realization of renewable sources require countless efforts. Supporting policies and infrastructure as well as research and development are essential. Besides the government, individuals must also collaborate to speed up the adoption of renewable technologies.

In addition, traditional energy sources like coal and oil are associated with air pollution and negative health impacts. Renewable sources, on the other hand, produce clean energy without emitting harmful pollutants, improving air quality and reducing respiratory illnesses. By investing and embracing renewable sources, countries can pave the way towards a greener and more sustainable world.

Economic sustainability

Stockholm Conference of 1972 was the first ever conference to put environmental issues on its agenda, However, the term sustainable development was first adopted by the United Nations Conference on Environment and Development (UNCED). economic sustainability means the ability of an economy to maintain long-term growth and development while preserving resources and minimizing the negative impact on the environment, The goal of economic sustainability is to limit human activity and use more technological development so that consumption should not occur faster than the redemption, it recognizes the co-ordination between economic progress and social equity. Achieving such goals requires a balanced approach that ensures present needs are met without compromising the ability of future generations. The United Nations (UN)launched the 2030 agenda for sustainable development goals to mainstream sustainable development, India is also talking about efforts towards

reducing greenh[1]ouse gases which will ensure that the country's per capita emission of greenhouse gases will continue to be low until 2030-31 India's per capita GHG emission would stay under four tonnes of co2, which is lower than global per ca-pita commission of4.22tonnes of co2, Thus economic sustainability must be perused by safeguarding the natural resources and maintaining the planetary boundaries which will promote the social being in the future.

INTERNATIONAL LEGAL FRAMEWORK

"We must recognize that in a globalized world, we cannot remain insulated from external developments. India's trade performance in the current year has been robust, surpassing existing export levels and pre-crises growth trends. We have diversified our export baskets and our destinations."

- Pranab Mukherjee

As the growth in energy accelerates India's dependency on import energy intensified in recent years, energy import dependency is an important aspect of the energy landscape as India is heavily relying upon it to meet its energy demand. The major sources of energy imports for India include crude oil, natural gas, petroleum products, and coal. This heavy dependency on oil imports makes India vulnerable to global oil price fluctuations and geopolitical tension. Such fluctuation in global oil and gas prices can have a direct impact on India's energy cost, inflation rates, geopolitical tension, and on economic sustainability. The following table shows India's trends of Foreign Trade in Coal, Crude Oil, Petroleum Products, Natural gas, and electricity in India.

Trends of Foreign Trade in Coal, Crude Oil, Petroleum Products

(Million Tonnes)

Year	Coal			Crude Oil			Petroleum Products			Natural Gas (BCM)			Electricity(Gwh)		
	Gross Imports	Exports	Net Imports	Gross Imports	Exports	Net Imports	Gross Imports	Exports	Net Imports	Gross Imports	Exports	Net Imports	Gross Imports	Exports	Net Imports
1	2	3	4=(2)-(3)	5	6	7=(5)-(6)	8	9	10=(8)-(9)	11	12	13	14	15	16
2009-10	73.26	2.45	70.80	159.26	0.00	159.26	14.67	51.15	-36.49	12.92	0.00	12.92	5359	105	5254
2010-11	68.92	1.88	67.04	163.60	0.00	163.60	17.38	59.08	-41.70	12.93	0.00	12.93	5611	128	5482
2011-12	102.85	2.02	100.83	171.73	0.00	171.73	15.85	60.84	-44.99	18.00	0.00	18.00	5253	135	5118
2012-13	145.79	2.44	143.34	184.80	0.00	184.80	16.35	63.41	-47.05	17.61	0.00	17.61	4795	154	4641
2013-14	166.86	2.19	164.67	189.24	0.00	189.24	16.70	67.86	-51.17	17.80	0.00	17.80	5598	1651	3947
2014-15	212.10	1.24	210.87	189.43	0.00	189.43	21.30	63.93	-42.63	18.61	0.00	18.61	5008	4433	575
2015-16	203.95	1.58	202.37	202.85	0.00	202.85	29.46	60.54	-31.08	21.39	0.00	21.39	5244	5150	94
2016-17	190.95	1.77	189.18	213.93	0.00	213.93	36.29	65.51	-29.23	24.85	0.00	24.85	5617	6710	-1093
2017-18	208.27	1.50	206.77	220.43	0.00	220.43	35.46	66.83	-31.37	27.44	0.00	27.44	5072	7203	-2131
2018-19 (P)	235.24	1.31	233.93	226.50	0.00	226.50	33.35	61.10	-27.75	28.74	0.00	28.69	4657	8494	-3837
Growth rate of 2018-19 over 2017-18(%)	**12.95**	**-12.64**	**13.13**	**2.75**	**-**	**2.75**	**-5.96**	**-8.58**	**-11.55**	**4.74**	**-**	**4.56**	**-8.18**	**17.93**	**80.08**
CAGR 2009-10 to 2018-19 (%)	**12.37**	**-6.06**	**12.69**	**3.58**	**-**	**3.58**	**8.56**	**1.79**	**-2.70**	**8.32**		**8.30**	**-1.39**	**55.17**	

[1] https://www.livemint.com/news/india/indias-renewable-energy-capacity-at-122-gw-in-february-11680179203975.html

Fig no: 1 Trend of foreign trade in coal, crude oil, petroleum products[2]

Furthermore, India's energy import has led us to strengthen our diplomatic ties and engage in various joint ventures with energy-producing countries. Here are some key aspects of India's international policies and framework

1) Paris Agreement Commitments: One of the most important and significant treaties that treaties have signed is the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC)in Paris, This agreement was adopted by more than 196 countries and aims to reduce the global warming below 2 degrees Celsius. India ratified this treaty in 2016 and pledged to reduce its emissions of GDP by 33-35% below 2005 levels by 2030 and to generate 40% of power capacity from renewable sources, As a part of the treaty India has reaffirmed its commitment towards climate change.

2) International Solar Alliance (ISA) Framework Agreement: The International Solar Alliance (ISA) is a joint venture established by India and France in 2015, over 115 countries are members of this alliance aimed at promoting and deploying solar energy and reducing the cost of solar power generation globally. Besides this the alliance also help the member countries develop low-carbon growth specifically focusing on delivering impact in countries categorized as least developed countries (LDCs) and the small island developing state (SIDs), Also encourage the use of sustainable, low global warming and moralization of the finance for solar projects. Thus this alliance provides India with access to expertise, best practices, and promoting sustainable energy systems.

3) South Asian Association for Regional Cooperation (SAARC) Energy cooperation agreement: The SAARC framework agreement for energy cooperation(electricity) was signed by India and all other member states including Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, and Sri Lanka in the year 2014, with the objective of cross border trade of electricity among the members, This would facilitate surplus power of one number states to other states, this agreement also allows the members of the SAARC state including private or public power producers, power utilities, trading companies, transmission utilities, distribution companies or other institutions established under the law, to buy and sell electricity within the

[2] Energy Statistics (2020). Fig no: 4.1, page no 42.

region. The agreement also focuses on developing a regional power grid, enhancing cooperation in areas such as hydropower development and energy trade.

4) International Energy Agency (IEA) Association: In March 2017, India joined IEA as an associate member since then the partnership between India and IEA has gone from strength to strength, Both India and IEA have had benefits from this partnership. This association allows for cooperation and collaboration on energy-related issues including policy recommendations, data sharing, and technical cooperation as well. IEA also gives the best access to expertise and expansion of renewable, within four years of joining the IEA members India has also signed a framework for a strategic Partnership, Understanding the various issues and challenges the agency has come up with probable solutions and provided a platform for dialogue, information exchange and energy issues.

5) International Energy Forum (IEF): International Energy Forum is one of the largest energy ministries from 72 countries that includes both consuming as well as producing nations. IEF aims to access modern energy services including electricity, gas, and energy-efficient cooking stoves, and improves energy dialogues by fostering greater understanding Recognizing energy interdependence, IEF member countries work together within the forum's neutral framework to promote better mutual understanding and appreciation of common energy interests, thereby ensuring global energy security.

6) Convention on nuclear safety: India is a party to the CNS, an international treaty that sets international standards for nuclear safety. The treaty aims to promote a high level of nuclear safety around the world and requires member states to undertake regular reviews and reports on their safety measures. By signing this agreement, India demonstrates its commitment to maintaining the highest safety standards in its nuclear energy programs.

India's international energy policy emphasizes sustainable development, promotion of renewable energy, and mitigation of climate change. Through international cooperation, bilateral agreements, and participation in global initiatives, India will improve its energy security, reduce greenhouse gas emissions, and ensure that its growing population has access to affordable and clean energy.

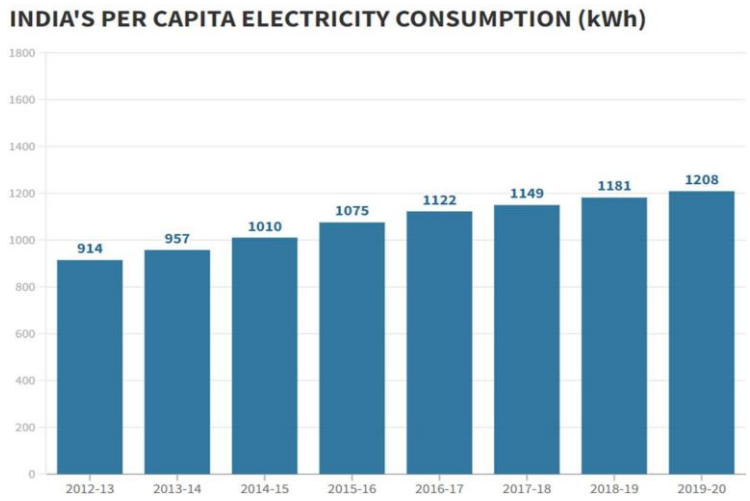
INDIAN PERSPECTIVE

"India should walk on her own shadow for that we must have own development model."

- Dr APJ Abdul Kalam

Carrier Overview

India is one of the world's fastest-growing economies with a population of 1.486 billion and the third largest economy, measured by purchasing power parity (PPP)[3], In the recent decade India has made a deep recession in poverty level, better energy access for its citizen and has set a target growth rate of 9% on its way to becoming a $5trillion economy by 2024-2025 making it fastest growing economies in the world, although there has been remarkable progress in human development through economic and social growth, India still has a long way to go It ranked 132 out of 191 in human development index (HDI) this is because of poor performance in education and health indicators. This recent rapid economic might have reduced the absolute number of people living in the poverty line but it failed miserably to achieve economic balance in rural and urban areas. Around 45% of the land area is agricultural and 24% is forest. Two-thirds of the population live in rural areas.[4] In addition, the country faces critical challenges in meeting its energy needs, ensuring energy security, and addressing environmental concerns, besides India's per capita electricity consumption has grown steadily and rapidly in recent years, country's per capita power consumption rose to 1208 kilowatt-hours, or kWh, in 2019-20.[5] The following chart shows India's per capita electricity consumption.



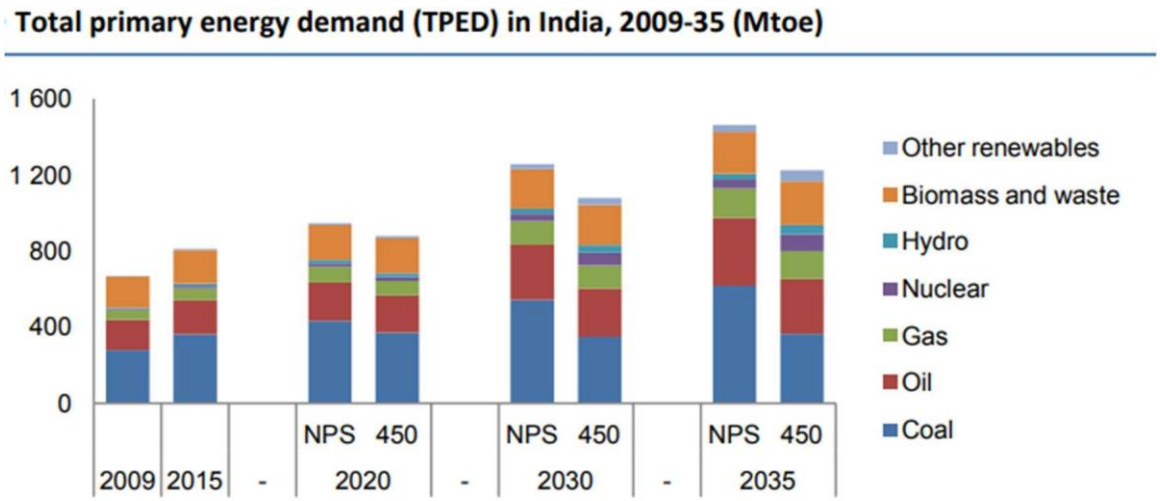
[3] https://economictimes.indiatimes.com/news/economy/indicators/india-retains-its-position-as-3rd-largest-economy-on-ppp-basis-for-2017/articleshow/76532262.cms?from=mdr (Last accessed on 19\08\2023, 13:39 Hrs.)
[4] https://www.fao.org/3/i2490e/i2490e01a.pdf (Last accessed on 19\08\2023, 13:30 Hrs.)
[5] Central Electricity Authority (CEA).

Fig no: 2 India's per capita electricity consumption (kWH)[6]

Major energy demand and supply

Energy demand: India's energy demand has been experiencing significant growth in recent years because of factors such as urbanization, population, increased energy access, and industrial development. The rising middle class and improving living standards have led to higher electricity demand, to meet this ever-increasing demand India has been working towards diversifying its energy mix as fossil fuel in particular dominates the energy sector according to the New Policies scenario(NPS) energy demand in India will grow rapidly, reaching 1,464 Mtoe by 2035, growing at a compound annual growth rate (CAGR) of 3.1% from 2009 to 2035 which is higher than doubled global energy demand at a CAGR of 1.3% over the same period.[7]

India's market share in global energy demand is set to increase from 5.5% in 2009 to 8.6% in 2035. Growth will come from all fuels. The strongest growth in demand will come from coal, nearly tripling 280 Mtoe in 2009 to 618 Mtoe by 2035 at a CAGR of 3.1%. Oil demand will show significant growth from 159 million to 356 million at 3.1%. For natural gas, it will drop from 49 Mtoe in 2009 to 154 Mtoe in 2035. Nuclear demand will reach 48 Mtoe in 2035 compared to 5 Mtoe in 2009 while renewable energy demand increased from 2 Mtoe in 2009 to 36 Mtoe. India's Energy Demand Rises are mainly based on hydrocarbons.[8]



[6] https://www.moneycontrol.com/news/trends/current-affairs-trends/indias-per-capita-power- consumption-rising-but-wide-variations-persist-across-states-6663841.html (Last accessed on 19\08\2023, 13:22 Hrs.)

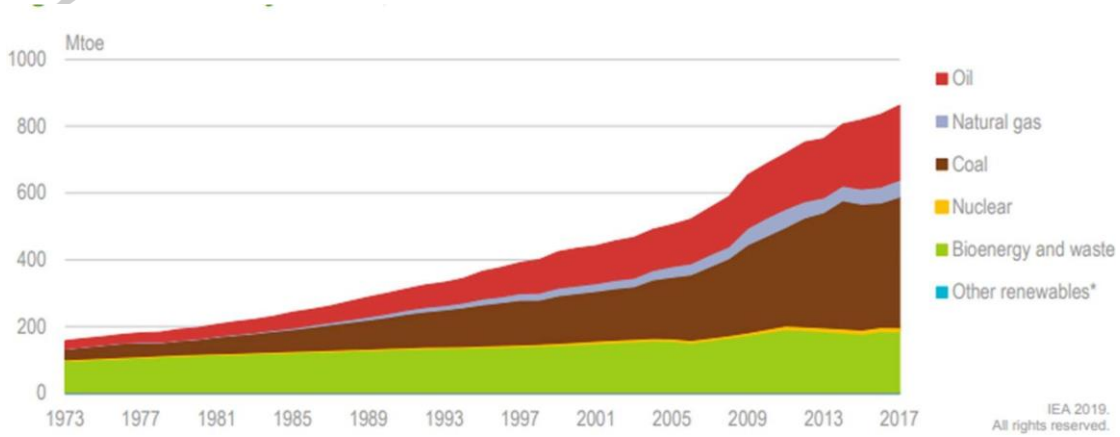
[7] Understanding Energy Challenges in India Policies, Players and Issues by International Energy Agency (2012). Page no. 24.

[8] Understanding Energy Challenges in India Policies, Players and Issues by International Energy Agency (2012),Page no.24.

Fig no: 3 Total Primary Energy Demand in India, 2009-35[9]

Thus, India's efforts to promote energy security, energy efficiency, and the use of sustainability are essential to cope with the growing energy demand in a responsible manner.

Energy supply: India's energy supply is a mix of various sources such as fossil fuels, renewable energy, and nuclear power, the government is looking forward to decreasing its energy dependency from traditional fossil fuels to renewable sources. Various policies and other institutional arrangements are in place to attract investments and promote the development of renewable energy. The total final consumption TFC's rapid growth led to the rise of total primary energy supply (TPES) by 55%, majorly filled with fossil fuels, coal meets 44%of the TPES which is more than half of the energy supply growth over the past decade, Beside this the second largest source was oil providing 25%TPES in 2017. Natural gas, on the other hand, cannot meet the growing demand, and its share in power generation and TPES has decreased in the past five years. Bio-energy is the third largest primary energy source in India, estimated to provide 21% TPES in 2017. The hydroelectric power supply is also relatively stable, with about 10% growth over the past decade.[10] On the other hand, wind and sun have developed very rapidly, but to a much lesser extent. In 2017, they represented only 1% of the TPES. India also has a nuclear power plant, which contributes about 1% to TPES.[11] Following chart shows the Total Primary Energy supply (TPES) by sources,1973-2017.



[9] Understanding Energy Challenges in India Policies, Players and Issues by International Energy Agency (2012).
Fig no. 4, Page no. 24.
[10] India 2020 -Energy Policy Review ,IEA.
[11] India 2020 -Energy Policy Review ,IEA.

Fig no: 4 Total Primary Energy supply by source, 1973-2017[12]

In summary, India's energy supply is characterized by a combination of fossil fuels, renewable energy sources, and nuclear power. With fossil fuels now dominating the energy mix, expanding renewable energy capacity and reducing reliance on traditional energy sources are gaining increasing attention.

Energy consumption

India is currently the third largest energy consumer in the world, after China and the United States. The country's energy needs are diverse and cover a wide variety of sectors including industrial, transportation, residential, and commercial. The industrial sector is the largest consumer of energy, followed by the residential sector, which covers household cooking fuel and electricity needs. The below-mentioned table shows the Total final consumption of energy by sectors, 2000-17.

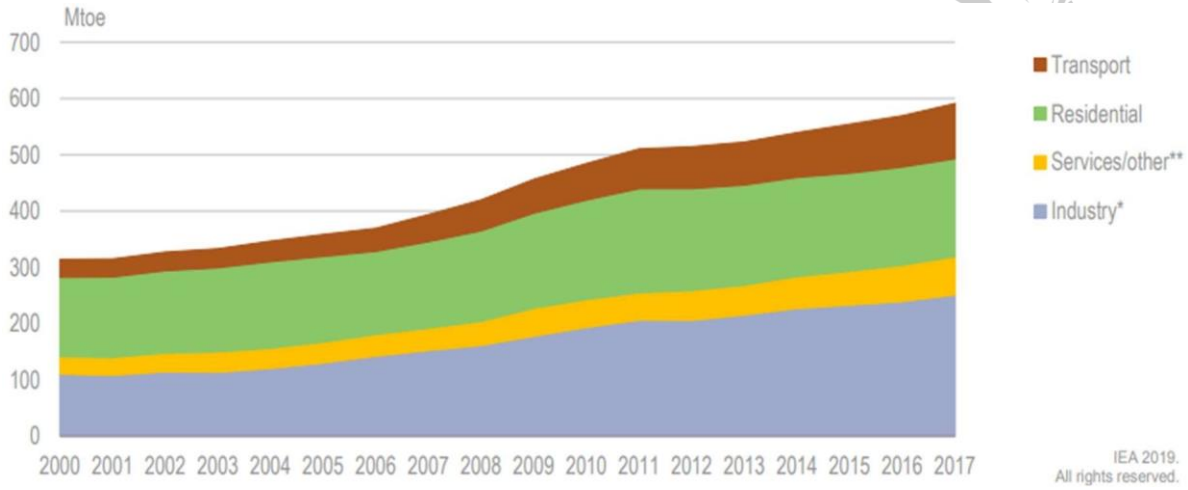


Fig no: 5 Energy TFC by sector, 2000-17[13]

Efforts to promote energy saving and efficiency have gained momentum in India. The Bureau of Energy Efficiency (BEE) implements a variety of initiatives to improve energy efficiency across all areas, including standards and labeling programs for equipment, energy audits, and energy-saving construction rules. Balancing growing energy demand with energy security, sustainability, and environmental considerations remains a major challenge. India's efforts to

[12] India 2020 energy policy review fig no :2.5 page n:o 23
[13] India 2020 energy policy review ,fig no 4.4 page no 80 www.iea.org/statistics/.

promote energy efficiency, diversify the energy mix, and adopt cleaner technologies are key to addressing these challenges and ensuring a sustainable and safe energy future.

Laws & Policies

There are a number of law and policy bodies in India with the Ministry of Power (MoP) and the Ministry of New and Renewable Energy (MNRE) at the top, These ministries play striking roles in legislating, formulating, and in enforcement of the energy laws and policies in the country, The ministry of Power looks after all development and regulation of power sector in India, While ministry of new and renewable energy (MNRE) is responsible for the promotion and development of renewable energy sources in India, it also plays a key role in setting renewable energy target and felicitate research and development in the renewable sector. Several other independent bodies such as the Central Electricity Regulatory Commission(CERC), the National Institution for Transforming India (NITI Aayog), and the Bureau of Energy Efficiency (BEE) responsible for the transmission and distribution of electricity. These bodies, ministries, and agencies work in collaboration to develop and enforce energy laws and policies in India.

Some of the prominent energy laws in India include:

1) Electricity Act, 2013: This enactment governs the legal framework for the generation, distribution, and transmission of electricity; it also focuses on the protection of consumer interest and ensures affordable and reliable energy supply.[14]

2) Renewable Energy Act, 2010: India has legislated their own renewable energy that seeks to develop the usage of renewable energy sources these laws provide incentives, rules, and regulations for purchasing, generating, and distributing renewable energy.

3) National Electricity Policy, 2005: National electricity policy emphasizes reliable and affordable power supply encouraging rural electrification and ensuring environmental sustainability.

4) Environment impact assessment (EIA) notification, 2006: EIA notification governs the environmental permitting process for various development projects involving the energy

[14] The Electricity (Amendment)Bill,2022.

sector. Project developers should assess and mitigate the potential environmental impacts of their projects.

5) Energy Conservation Act, 2001: Under the provisions of this law Bureau of Energy Efficiency (BEE)was established which keep check on energy audits, energy labeling of appliances, and energy consumption standards for industries with a focus on energy efficiency and conservation in India.

6) Air (prevention and control of pollution) Act, 1981: The main reason behind enactment was to prevent and control air pollution, this will enable central and state environmental protection agencies to enforce emissions standards and take steps to improve air quality.

7) Water (Prevention and Control of Pollution) Act 1974: This law deals with water pollution, conservation, and management of water resources. It regulates the discharge of pollutants into water from factories, power plants, etc.

Besides energy laws, India has also implemented some significant energy policies to address various aspects of the energy sector and to accelerate energy developments.

Notable energy policies in India include:

- Integrated energy policy: This policy was made with the aim ‘ to prepare an integrated energy policy linked with sustainable development that covers all sources of energy and addresses all aspects of energy use supply including energy security, access, and availability as well as efficiency in environment concern.
- Ujwal DISCOM Assurance Yojana (UDAY): UDAY is a financial restructuring and reform program for India's electricity distribution sector. The policy aims to improve the financial health and operational efficiency of the Electricity Distribution Company (DISCOM) by reducing losses, improving metering and billing systems, and promoting energy conservation. It also aims to reduce DISCOM's financial burden through debt restructuring and state-level reforms.
- National Solar Mission: National Solar Mission was launched in the year 2010 prominently focusing on the development of solar energy in India, it aimed to achieve 100GW of solar power capacity by 2022, Along with various incentives, subsidiaries, and mechanisms to attract the investments in solar energy.

- Perform, Achieve, and Trade (PAT) Scheme: The PAT program is an energy efficiency initiative for energy-intensive industries. While Setting energy consumption targets for specific industries and providing incentives to exceed them. This policy seeks to reduce energy consumption and improve industrial energy efficiency.
- National Electric Mobility Mission Plan (NEMMP): The NEMMP encourages the adoption of electronic vehicle (EVs) in the country, it also provide financial subsidies, research grants, and other incentive to enhance the production of electric vehicle in India.

These are some key policies and enactments governing the energy sector in India.

ENERGY CRISIS AND ECONOMIC SUSTAINABILITY

"What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and one another."

- zMahatma Gandhi

Energy crisis

Energy is one of the crucial factors we need in our day-to-day life to improve in various sectors like agriculture, medicine, industries, and many more, however in India's power sector is under considerable stress as energy crises are an annual problem in India, if we are already not in crisis, we are gradually grappling towards one. With severe energy crisis that threatens our sociolect-economic progress, the energy crisis is characterized by a persistent gap between energy demand and supply leading toward power shortage, also the dependency on fossil fuels especially coal for electricity generation exacerbates the energy crisis, such reliance on coal not only contributes to environmental degradation but also depletion in the level of fossil fuel and expose the country to the supply disruption and price volatility. The energy crisis is characterized by challenges such as power shortages, dependence on fossil fuels, inadequate infrastructure, and limited access to energy services, the energy crisis has far-reaching consequences that hamper our socioeconomic development. Some of the prominent energy crises are:

Poor infrastructure and power shortage: India's growing population and industrialization have led to a significant increase in energy demand and our present infrastructure is not inadequate

to meet these growing demands which led to frequent blackouts and power cuts that may last for hours or even days, this energy insufficiency is also affecting the country's rural development where many people do not have access to the electricity. This poses the challenge of meeting the energy demands of homes, businesses, and industries.

Energy access and energy poverty: In spite of the remarkable development in the energy sector significant portion of the Indian population still lacks access to reliable and affordable energy, energy poverty affects many rural and marginalized communities as a result they rely on traditional biomass fuels for cooking and heating purposes, which expose them to the health risks as well.

Import dependency: India's energy imports are estimated to surge by 43.6% in this year[15], energy imports of fossil fuel especially oil, gas, crude oil, and coal will impact our import bill. If such import growth remains constant then our import bill will soon surpass remaining merchandise import bill projections and could exceed USD 1 trillion by 2026, this will also adversely affect Geo-political tension.

Aging infrastructure and transmission: India's energy infrastructure, including its transmission and distribution networks, faces challenges such as technical losses, theft, and inefficiencies. These problems lead to significant transmission and distribution losses, affecting the reliability and affordability of the power supply.

Weak financial health of power distribution companies (DISCOMSs): Many power distribution companies in India are facing problems because of inadequate tariff structure, electricity theft, and high transmission and distribution losses. Due to this many power distribution companies in India are suffering financial losses. Their ability to improve infrastructure, purchase electricity from generators, and ensure a stable power supply has been affected.

India's energy crisis poses some serious challenges to its socioeconomic growth, however with a holistic and strategic approach these problems can be tackled, by improving energy efficiency, and infrastructure and prioritizing renewable energy, India can pave the way for a sustainable future such efforts will not only be beneficial to country's economy but also to the sustainability.

[15] Estimates are based on current growth rate & Estimated -Apr-Feb import data for FY 2023.

Effect of the energy crisis on Economic sustainability

Economic sustainability means the ability of a society to conserve its natural and financial resources to achieve long-term economic growth and development for example by reducing the usage and dependency on fossil fuel and focusing on other alternative sources of fuel, including the management of the equitable wealth distribution, environmental stewardship and responsible resource management, economic sustainability and understand the inter-dependency among these domain and emphasizes the need of balanced approach, Achieving economic sustainability is crucial to ensure the well being of the current and future generation. However, there is a significant impact of the energy crisis on economic sustainability such as reduced industrial productivity, unreliable energy supply, and energy shortage that hamper industrial growth, as industries are heavily dependent on energy for their production. Such energy shortage directly increases the operational cost, which affects the profitability of industries notably the energy-intensive sectors; this may also reduce investments and business closure. Besides, dependency on conventional sources and imported fossil fuels such as oil, gas, and coal impacts the country‘s energy import bill putting pressure on foreign exchange reserves and geopolitics, which may affect long-term economic sustainability and stability. The reliance on fossil fuels for energy generation has a severe impact on the environment and health costs, the burning of fossil fuels leads to air pollution causing respiratory diseases and health issues.

To diminish the effect of the energy crisis on economic sustainability, India needs to focus on renewable energy sources, energy security, and affordable energy access for all. Implementation of these factors requires major policy reforms, investment in the renewable sector, and public-private collaboration, By addressing the energy crisis India can improve industrial productivity, reduce operational costs, stimulate economic growth, and enhance long-term economic sustainability.

POSSIBLE SOLUTIONS & SUGGESTION

“Forests are the lungs of our land purifying the air and giving fresh strength to the people.”

- Franklin D. Roosevelt

Recently energy crisis in India has been a wake-up call and requires immediate attention, the central electricity authority revealed that India in past few months has consumed the highest

unit of electricity since July 2019, as the country surged into various energy crises including power shortages, dependency over fossils fuel and imports, ageing energy infrastructure and lastly inadequate energy supply, a worrying impact of these energy crises can be seen on various states of the country like Rajasthan, Maharashtra, Punjab and Bihar. Amid these problems, there are some ways to overcome these hurdles and pave the way towards a greener, sustainable, and safe energy future. This paper examines the potential solution to the growing energy crisis in India.

Promote renewable sources: Energy shortage crisis can be averted by implementing renewable sources of energy such as solar, hydro, air, and biomass and by reducing our dependency on traditional fossil fuels, also government can provide incentives and subsidiaries to promote the renewable energy project and encourage private sector investments in such projects. By adopting these measures, India can address these challenges effectively.

Energy reserve technology: As energy is an essential commodity it must be saved and reserved, this can be done with the help of energy storage technologies such as batteries, hydro storage pumps, and freewheel storage systems. Energy storage systems can also store surplus energy during peak generation periods and release it during high demand ensuring a stable and reliable power supply. Deployment of such energy storage technologies can meet everyday energy needs and reduce carbon footprint. Energy storage devices can also reduce the dependency on the grid and build an environment that is more resilient and less dependent.

Investment in domestic exploration and production: To address the dependency problem India must explore its options to increase local and domestic production; The government should provide incentives and subsidiaries to promote investment in the domestic energy sector. Apart from this, we should also improve the quality of domestic coal and put carbon pricing which can stimulate the use of renewable energy by invoking fine on carbon emissions.

Advancement and upgradation: Modernization of the infrastructure including transmission and distribution networks can improve grid stability. Smart grid technologies improve the monitoring, control, and management of energy systems, enabling efficient energy distribution and demand response mechanisms. Such advancement can also reduce transmission losses and enable better adaptation of energy sources; this can be achieved by upgrading existing infrastructure.

Need for policy reform: Most of our energy laws and policy frameworks are old and there is a need for timely reforms in such policies. Laws and policy reform enable the government to effectively respond to emerging issues and adapt to new circumstances, it also provides a platform for making comprehensive strategies to address various energy-associated issues.

International collaborations In the era of industrialization energy crisis has become a global issue that goes beyond national boundaries, collaborating with international partner accelerate the adoption of clean energy solution in India, The expertise support, and knowledge sharing by other countries can benefit India in technological advancement, attack foreign investment and foster more interconnected and sustainable energy landscape. Thus implementation of these solutions is not only for government initiatives but also for private sector participation, it is important to address these problems and there is a need for a holistic approach and public awareness. Moreover, regular review and updating of energy policies and strategies based on evolving technology and market conditions is essential for sustainable and long-term progress.

CONCLUSION

"A transition to clean energy is about investing in our future."

- Gloria Reuben

Energy, Economy and Environment, and at the root of this relationship lies the critical role played by laws and policies that regulate the interaction between energy production, economic growth, and environmental policies. This critical appraisal has examined the current landscape, identified challenges, and explored future prospects. The dependency on fossil fuels had a significant effect on the environment and balancing economic growth along with energy security and environmental protection requires collaboration between government and citizen. Financial and regulatory frameworks must support the energy transition and accommodate technological advancements. Challenges such as transportation emissions and energy access require targeted policies. These frameworks should encourage investment in renewable energy infrastructure, incentivize energy efficiency measures, and create market mechanisms that favor sustainable practices. However, realizing this potential requires concerted efforts from multiple stakeholders and the strengthening of institutional capacities. Laws and policies play a pivotal role in shaping this relationship by regulating energy production, fostering economic growth, and protecting the environment.