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Climate Change and Energy Challenge: India`s Perspective

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Abstract

The paper delivers an extensive examination of India's simultaneous pursuit of economic development and climate change response. India stands as a growing economy while being 3rd biggest greenhouse gas producer thus needing to resolve its development requirements against environmental preservation goals. The research delves into India's climate-sensitive issues which combine glacier regression with rising ocean heights as well as inconsistent rain patterns and its reliance on coal power generation together with expanding renewable power infrastructure. Despite strong renewable energy development plans India faces multiple challenges that prevent the actual achievement of its sustainability targets because of poor infrastructure combined with financial and social/political hurdles. The analysis investigates India's developing climate policies as well as its international relations and the sectoral barriers encountered in urban development and transportation and industrial sector de-carbonization. The paper highlights the requirement for purposeful financial investments together with technological innovation as well as inclusive energy system changes and international partnerships. India emerges as a forefront regional power for sustainable development while proving through its policies that climate initiatives and economic advancement can unitedly advance in Third World countries.

Key Words: Climate Change, Renewable Energy, Coal Dependency, Energy Policy, India's Sustainable Development

Introduction

One of the main reasons for climate change is anthropogenic greenhouse gas emission. It is caused mainly due to Carbon dioxide.[1] There is a need to reduce GHG emission on large scale to achieve newly developed goal i.e., 2°C.[2]

Prior to Paris agreement it was only USA- the world`s largest economy, who were to be blamed for climate change because of its past use of resources due to their upper hand in industrial era.[3] Now developing countries like- India and China are also coming up with their policy framework to reduce GHG emissions since they are also emitting very high irrespective of their per capita emission. Reduction of GHG by one country will not make a big difference to global climate change. Since India is also affected by climate change and it has also crafted National Action Plan on Climate Change[4]- it basically provides for different framework in different spheres in the area of energy to reduce GHG emissions.

Indian government need to adopt those policies which helps in present situation of climate change as well as feasible for our country. Everyone is suggesting to adopt renewable energy which include solar energy, wind power, nuclear energy etc. This reduction in GHG emissions at present is near to impossible for India because there are people who still doesn`t have access to energy. Moreover, to adopt renewable energy funds[5] and technology is imperative. A decent livelihood needs water, food and accessible energy access. In India, indigenous communities are the best guardian of eco-system but due to poverty they also end up destructing this environment. Further, coal (highest emitter of carbon) is dominating India`s energy sector and it can`t be entirely removed from our electricity markets.

Greenhouse Gas is the primary cause of climate change. US have held the biggest responsibility for pollution in past times but today India and China lead the way as major polluters while both nations establish new policies to decrease emissions. India faces climate change threats directly

[1] Intergovernmental Panel on Climate Change, *Fourth Assessment Report*, 2007.
[2] Paris Agreement, United Nations Framework Convention on Climate Change, 2015.
[3] Ibid.
[4] National Action Plan on Climate Change, Government of India, 2008.
[5] "India's 2022 Renewable Energy Goal Will Require Investment Four Times the Defence Budget", *Scroll.in*, available at: http://scroll.in/article/774844/indias-2022-renewable-energy-goal-will-require-investment-four-times-the-defence-budget (accessed on 5 March 2025).

so it created National Action Plan on Climate Change (NAPCC) for controlling emissions throughout different sectors.

The Indian nation struggles to decrease GHG emissions because many of its citizens remain without stable energy access throughout the country. For the adoption of renewable power sources including solar energy and wind power and nuclear systems India needs substantial financial backing together with technological assistance. Traditional guardians of ecosystems known as indigenous communities' struggle to protect their environment because poverty forces them toward environmental destruction. Coal continues as the main energy source while complete elimination seems unlikely during the current time period. India needs to create climate policies which deliver practical results while conforming to its present developmental and socio-economic circumstances.

Is Renewable Energy an alternative in India:

India`s economy is growing on a very high scale and it will surpass many developing countries soon. This bright economic side can`t undo the fact that 22 percent of our population is below poverty line. They don't have access to electricity also.

While our government is Committing itself to renewable energy but its increasing coal usage and import of coal shows that this goal can`t be achieved. India comes third in the list of largest coal producer. The government is still not able to balance demand and supply in energy sector through coal energy also.[6] Our government`s promise to give electricity to everyone can only be achieved by expansion of coal production. India`s overall economic growth can be achieved if it continues importing coal at least in near future. Government has also included private parties to increase production. Coal production industry has emerged as a feasible solution to provide electricity to people who doesn`t have access to electricity also. However, coal burning is listed as one of the top reasons which deteriorates health. Government put reforestation condition on coal mining companies to compensate for the land which they have exploited.[7] The big challenge of pollution is emerging day by day and we can`t deny the fact that pollution, hidden health costs add up in the cost of coal burning generated power plants. It is based on

[6] Ibid.
[7] Ibid.

the idea that environmentalist make market through putting charges on companies who participate in pollution by emitting GHG.[8]

It is clear from above facts that the main obstacle to fight with climate change is heavy dependence on coal in India. Today, operational power plants are more than 186 GW and this estimate doesn't include under-construction ones. India doesn`t even have faith in our potential to meet demands through renewable energy because government keep asking coal power companies to meet the desired targets.[9] India shows reluctance towards shutting down coal power plants and it doesn`t even have proper coherent policies to do this. Our government doesn`t go against the policies which tries to curb coal production but on the other hand encouraging the production is clearly contrary to clean energy objective.[10] Subsidies to these plants is not an indicator to adopt renewable energy in country. Coal India has not been able to achieve its mandated targets also. This creates a continuous rift between coal energy policies and solar energy policies.[11] India can`t even blindly go for solar panels because their costs are increasing in international markets. Demands of our population will not be satisfied by solar because immediately it can`t give energy at such a large scale. Our government`s 'Make in India' policy itself includes car production and such affairs which emit carbons in environment.[12]

India Solar Panel Case:

Earlier the solar power was not feasible for India because it was a costly affair. Various schemes have been created by government under NAPCC and the main purpose is to make India hub of solar energy so that it can spread across countries as soon as possible.[13] One of the reasons for its growth could be that India`s location on earth which is a good point for any kind of solar mission. India gets 4-7 kWh radiation every square metre in a day which happens

[8] Jagdish Bhagwati, *Environment in Peril*, (B.R. Publishing, 2004).
[9] "The International Solar Alliance Could Help India Align Its Energy Ambitions", *The Wire*, available at: http://thewire.in/23783/the-international-solar-alliance-could-help-india-align-its-energy-ambitions/ (accessed on 6 April 2025).
[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] Kumar S, Madlener R, "CO2 Emission Reduction Potential Assessment Using Renewable Energy in India", (2016) *Energy*, 273-282.97.

annually for 250-300 days.[14] Recently in India Solar panel case WTO ruled that India can`t give favourable treatment to its domestic suppliers of solar cells because it will be violation of the principle of National Treatment given under GATT.[15] This mission gave favourable treatment to domestic suppliers because it wanted indigenous industries to grow. Initial investment in solar panels was costly and to remove this obstacle government made a power purchase agreement with developers/investors. The mandate was that developers of solar power will use solar cells manufactured in India and government will buy electricity from them at a higher value than competitive market value for a long period of 25 years to compensate for initial investment.[16] Hence, US`s argument was relating to the discrimination towards imported solar cells. India argued that this condition comes under the scheme of government procurement which is allowed under GATT also. However, government procurement exception was not accepted because discrimination was against the inputs used in solar panels and not electricity per se.[17]

India also made argument that this action was justified under international environmental regulations such as UNFCCC.[18] It was rejected by stating that environmental treaties doesn`t put any binding commitments on nations who are party to UNFCCC.

Many environmentalists have criticised this case saying that in environment protection they can`t let cheaper Chinese solar cells to take over Indian market. Environment protection through employment of solar cells is very important. Their solar mission was to robust the domestic solar industry to tackle future crisis if imports will not be able to fulfil the demands.[19] Environmentalists argue that India should not put protectionist measure in place but there were problems relating to the application of 'government procurement' exception also. WTO should

[14] Rohankar N, Jain AK, Nangia OP, Dwivedi P, "A Study of Existing Solar Power Policy Framework in India for Viability of the Solar Projects Perspective", (2016) *Renewable and Sustainable Energy Reviews*, 56.
[15] "The International Solar Alliance Could Help India Align Its Energy Ambitions", *The Wire*, available at: http://thewire.in/23783/the-international-solar-alliance-could-help-india-align-its-energy-ambitions/ (accessed on 27 March 2025).
[16] Ibid.
[17] India — Certain Measures Relating to Solar Cells and Solar Modules, DS456, World Trade Organization, 2016.
[18] Ibid.
[19] Ibid.

interpret government purpose broadly and it should have included laws, regulation relating to government procurement also.

There are other measures apart from DCR (Domestic content requirement) which can be taken up by India to achieve its energy security goals. It is imperative that for clean and green energy we collaborate with international partners and apply the best available technology at reasonable rates. It can subsidies domestic manufacturing companies, tax relaxation, credit to companies at low rate, alliance with global community for R&D.[20] All these measures will bring efficiency in energy sector while combating with climate change.

Application of DCR in solar panels is not helping to combat energy crisis in India because such action will end up using expensive and inefficient equipment. This solar panel judgment can be seen as a small victory as there are still possibilities of using more technology equipped equipment in clean energy on cheaper rates. However, there is no doubt that conflict between liberalized trade and climate change policies will keep on coming in its way to green and clean energy.

India`s policy goal is two-fold, it wanted to promote 'Make in India' scheme to achieve self-sufficiency through JNNSM and the other purpose is to create green energy at reasonable costs to balance demand supply in energy sector.[21] India made an argument that dependence on oil and coal will be less if solar technology is encouraged in trade also. This argument is not true in case of India because coal is the dominating in our country. To achieve solar energy goal government launched 'International Solar Alliance' to deploy solar technologies.[22] Such initiative will create a platform for renewable energy, sustainable development, access to energy in rural areas.

Many trade scholars argued that India could have applied tit-for-tat measure against USA because United States have established renewable energy schemes in its 8 states and favoured

[20] "India's Solar Panel Dispute: A Need to Look Within", *The Wire*, available at: http://thewire.in/24787/indias-solar-panel-dispute-a-need-to-look-within/ (accessed on 7 December 2016).
[21] Ibid.
[22] "The International Solar Alliance Could Help India Align Its Energy Ambitions", *The Wire*, available at: http://thewire.in/23783/the-international-solar-alliance-could-help-india-align-its-energy-ambitions/ (accessed on 25 March 2025).

them. Here we can see how this case is a reminder that international trading framework will trump environment and climate change considerations. This trading framework will not be affected by any bilateral treaties between India-USA which talk about energy security and climate change: India and USA.

Solar Panel case hasn`t curbed solar plans of India. It just tried to make it fair for international trade communities. However, trade policies should take into account clean energy and climate change consideration because they are global problems too. Our solar sector lacks competition because of following reasons: Factory size is small, Domestic suppliers are undeveloped, government doesn`t give full support.[23]

International Solar Alliance

ISA was inaugurated the India-France Business Summit in January 2016 and its headquarter is in Gurgaon. France and Indian government have committed to give it financial support in their best possible way. This alliance includes 120 sun-rich countries situated in the tropical areas and its goal is to generate power through clear energy resources so that it can fight with climate change. In this way, it is very different from International Renewable Energy Agency – IRENA which tries to establish co-operation and dialogue between many organisations to share their technology with others.

There are two big obstacles to this alliance i.e., technology and finances. Hence, to make things efficient- administrative procedure (main reasons for draining funds), should not be given much consideration. Government might link funds to its smart city programme of India. India`s solar power capacity is only 5 GW but it has committed itself for 100 GW by 2022.[24] India have to change its direction from fossil fuel to solar, no matter how slowly, to implement its clean energy agenda. The main obstacle here is that India doesn`t have proper policies to stop the rift between coal and solar.[25]

[23] KPMG, *Solar Manufacturing in India*, 2015.
[24] "The International Solar Alliance Could Help India Align Its Energy Ambitions", *The Wire*, available at: http://thewire.in/23783/the-international-solar-alliance-could-help-india-align-its-energy-ambitions/ (accessed on 8 April 2025).
[25] Ibid.

There are three main reasons why any solar project doesn`t get implemented in developing countries like India. ISA has tried to overcome the following obstacles.[26] Firstly, funding is a big problem in developing countries since solar projects are very expensive. Secondly, large scale programmes can only work when coordination happens between member states. Moreover, coherent policies are needed in countries like India who come under developing category. Thirdly, help in research and development from technology advanced countries is the most important criteria.

There is a danger of holding ISA directly accountable since it is directly linked to private sectors and it creates opportunities for developers, manufactures etc. [27] A typical international organisation can never have such feature. In ISA there can be fight between member countries over membership rights, procedural battles etc and these things goes against the nature of any international organisation.[28]

The way forward from Paris

India signed Paris agreement under which countries have to decide their Intended Nationally Determined Contributions. This agreement demand compliance from country`s internal laws and regulations for implementation. India said that by 2030 the most of the capacity will come from non-fossil sources.[29] We know that technology transfer from developed countries to developing countries is imperative for establishment for solar plants in developing countries and they don't want to invite IPR dispute litigation also.

India has to create low carbon strategies to meet its climate commitments. All the current and future measurements have to be done in every sphere of energy. The most necessary action is to upgrade their electricity/power grid so that they can absorb higher amount of renewable energy.[30] India has to implement it if it wants to meet its goal of instalment of 100 GW of solar

[26] "Can the International Solar Alliance Change the Game?", *The Hindu*, available at: http://www.thehindu.com/opinion/columns/Can-the-international-solar-alliance-change-the-game/article14589187.ece (accessed on 8 April 2025).
[27] Ibid.
[28] Ibid.
[29] "India and the Paris Agreement", *The Wire*, available at: http://thewire.in/69307/india-paris-agreement/ (accessed on 8 April 2025).
[30] "Joining the Climate High Table", *The Hindu*, available at: http://www.thehindu.com/opinion/editorial/Joining-the-climate-high-table/article15000788.ece (accessed on 9 April 2025).

energy by 2022. India should levy taxes on fossil fuels and encourage people to use environment-friendly alternatives, such as solar panels and other green energy initiatives. India should try to curb unnecessary expansion of coal energy. There is no doubt that coal energy can`t be banned as India`s economic condition can`t bear unrealistic goals. However, India should not unnecessarily encourage fossil fuels use just because you get that at lower rates. No one can deny funding problems but one should try to create coherent and strategic methods to get investors in our country. Developed countries should be true to their promises of technology transfer and funding to developing countries.

COP22 (Marrakech) is as important as COP21 Paris because it discusses the rules, problems and procedure in the implementation of INDC.[31]

Issues and Challenges of Climate Change

The Dual Imperative of Development and Sustainability

The Indian position regarding global climate change stands as a complex mix between its developing economy and its exposed climate risks. India operates as the fifth-largest economy worldwide with the position of being the third-largest greenhouse gas emitter while searching for solutions to meet its expanding energy requirements while upholding climate goals.[32] Per capita emissions in India stay low at 1.9 tons while the massive population of 1.4 billion people produces significant total environmental impact despite global average per capita emissions[33] India uses this contradiction to support its position at international climate talks because it seeks development opportunities without facing restrictions that were imposed on industrialized nations which accumulated most of the atmospheric carbon accumulation. Every sector in India's economy experiences this ongoing conflict between development goals and environmental objectives which produces a policy framework that presents both innovative solutions and contradictory actions.

[31] "From Paris to Marrakech", *Infracircle*, available at: http://infracircle.vccircle.com/from-paris-to-marrakech/ (accessed on 8 April 2025).
[32] Angela Williams, *Solidarity, Justice and Climate Change Law*, (2009) 10 MELB. J. INT'l L. 493 (October).
[33] Marcus DuBois King & Jay Gulledge, *The Climate Change and Energy Security Nexus*, (2013) 37 FLETCHER F. WORLD AFF. 25 (Summer).

Climate Vulnerabilities: A Nation at Risk

The geographical and socioeconomic characteristics of India increase its vulnerability to climate changes in the region. Mean temperatures across the Indian subcontinent have increased at a pace faster than the worldwide average by about 0.7°C since 1901 through 2018.[34] The Himalayan glaciers face dangerous retreat at 15 to 20 meters per year because of global warming which puts the water supply of major rivers at risk for 600 million people.[35] Studies indicate that the monsoon system which influences agricultural results for millions of farmers has become more unpredictable through a threefold increase in severe rain events since 1950.[36] Economic losses linked to climate shocks are very substantial because according to the World Bank India will face annual GDP losses reaching 2.8 percent of its total GDP throughout the year 2050 while agricultural yields may decrease by 10-40 percent by 2100 without implementing adaptation strategies.

Energy Landscape: Growth Versus Greening

The energy sector of India shows conflicting characteristics which mirror the challenges the nation faces during its development journey.[37] India ranks second globally as a coal consumer and obtains 55% of its primary energy needs from coal while utilizing 70% of its electricity through coal production reaching 893 million tons during the 2022-23 period. India depends on coal for power stability and energy protection because its coal reserves will maintain current extraction rates for more than one century. Environmental concerns continue to rise against the coal sector because coal plants produce more than half of India's particulate matter emissions and sixty percent of its CO2 emissions. The health of human beings suffers enormously because energy generation pollution results in 1.67 million premature deaths each year. The development narrative of India depends heavily on coal because it provides direct jobs for 400,000 people while creating millions of indirect job opportunities across coal-bearing states

[34] Thomas Kreuder, *Climate Change Litigation - A Promising Perspective?* (2023) 73 ZBORNIK PFZ 593.
[35] Ibid.
[36] Thomas C. Heller, *Environmental Realpolitik: Joint Implementation and Climate Change*, (1996) 3 IND. J. GLOBAL LEGAL STUD. 295 (Spring).
[37] Eeshan Chaturvedi, *Climate Change Litigation: Indian Perspective*, (2021) 22 GERMAN L.J. 1459 (December).

Jharkhand, Chhattisgarh, Odisha. The political economy barriers to shift away from fossil energy present major obstacles for any transition process.[38]

Renewable Energy Revolution: Progress and Pitfalls

Renewable energy deployment in India has transformed into a global leadership position since 2014 when the nation had 35 GW capacity until it reached over 170 GW by 2023. India stands as the fourth largest nation regarding wind power and solar capacity while surpassing its 40% non-fossil fuel capacity requirement in 2019 before the Paris Agreement deadline. Solar power has experienced a transformation through reduced tariffs that reached a new low of ₹1.99/kWh (≈$0.024) in auctions thus making solar cheaper than new coal power plants.[39] India showcases its expanding renewable energy capabilities by working on the 30 GW Kutch district park that could become the largest such facility worldwide. The fast-paced expansion of renewable energy faces three major obstacles: power grid compatibility issues lead to yearly renewable power reduction between 3-4% and land disputes cause project delays and distribution companies suffer from financial troubles exceeding ₹5.2 trillion ($63 billion) which reduces their capacity to buy renewable energy. The renewable energy workforce operates with staffing shortages because there are only 80,000 trained solar technicians although 300,000 skilled personnel are needed to sustain current installations.[40]

Policy Framework: Balancing Act

Indian climate policy combines policies designed for development alongside sustainability targets. The NAPCC is an important document in this field which created 8 missions relating to energy and conservation initiatives.[41] At COP26 Government also declared the "*Panchamrit*" strategy for non-fossil energy generation and net-zero emissions.[42] Due to the Ujala LED program 367 million bulbs were distributed which resulted in a peak demand

[38] Ibid.
[39] Ranidipa Ghosh, *Renewable Energy: Recourse to Control Human Induced Climate Change*, (2017) 7 GNLU J.L. DEV. & POL. 105 (October).
[40] Elisabeth Benecke, *Networking for Climate Change: Agency in the Context of Renewable Energy Governance in India*, (2011) 11 INT'l ENV't AGREEMENTS: POL. L. & ECONS. 23 (March).
[41] Surya Gupta & Kshitij Bansal, *Cities Take the Lead in Climate Change Governance*, (2020) 50 ENVTL. POL'y & L. 89.
[42] N. C. Patnaik & Durjoy Kumar Deb, *Access to Green Justice: Needs of the Hour*, (2022) 7 NUJS J. REGUL. STUD. 89 (January-March).

reduction of 20,000 MW. The government supports coal through Shakti policy schemes while simultaneously promoting renewable energy development. India maintains dual energy policies because it embraces practical approaches to energy security within its developing economy framework.

Urbanization and Transportation: The Next Frontier

The urban development in India creates both environmental difficulties and possibilities to take climate action. The urbanization rate in India has grown to 35% now but will expand to 50% by 2050 while cities generate 70% of India's Gross Domestic Product and produce an increasing amount of emissions.[43] The transportation sector includes 14% of all energy-related CO2 emissions in India but it continues to experience rapid electrification processes. The FAME-II scheme has enabled 1.44 million electric vehicles to be adopted while EVs now represent 6% of new vehicle sales during 2023. The current number of public charging stations in India stands at 12,000 while the necessary level for 2026 exceeds 400,000. Through its electrification drive for railways the Indian Railways aims to achieve a net-zero status by 2030 while having completed 82% of broad-gauge route electrification which decreases yearly carbon emissions by 24 million tons. The Smart Cities Mission under urban planning operates to integrate climate resilience across 100 selected cities but the execution has shown inconsistent results.[44]

Industrial Decarbonization: The Hardest Challenge

The energy-intensive industries which include steel and cement and chemicals manufacturing face the most difficult task in decarbonization because they produce 45% of India's industrial emissions. Each ton of crude steel produced by the steel sector leads to 2.5 tons of CO2 emissions which exceeds global steelmaking standards.[45] Since 1990 the cement industry has reduced its CO2 emissions by 0.5 tons per ton of cement through the use of alternative fuels and blended cement containing 35% fly ash. The National Green Hydrogen Mission of the

[43] Raj Kumar Garg, *Climate Change: India's Perception and Legal Framework*, (2021) 4 INT'l J.L. MGMT. & HUMAN. 276.
[44] *Climate Change, Sustainable Development, and Ecosystems*, (2011) ENV't. ENERGY & RESOURCES L.: YEAR REV. 32 (2011).
[45] Charvi Jain & Gunika Razdan, *Assessing the Necessity for a Separate Climate Change Legislation in India*, (2022) 3 JUS CORPUS L.J. 920 (December).

Indian government received ₹19,744 crore ($2.4 billion) in funding to produce 5 MMT green hydrogen yearly through 2030 which could reduce 50 MMT of CO2 emissions. The current price of green hydrogen at $4-5/kg needs to reduce to $1-2/kg for it to become competitive against fossil fuel alternatives.

International Climate Diplomacy: Equity and Leadership

Climate negotiations find India at a prominent position because it backs the concepts of equity. During COP26 India achieved success by obtaining the Glasgow Climate Pact wording which stated "phasing down" instead of "phasing out" coal operations. Through the International Solar Alliance which India co-founded with 110 member countries the organization has raised $1 trillion in solar investments.[46] The "Lifestyle for Environment" (LiFE) initiative run by India works to establish sustainable consumption methods across the world. India upholds the position that developed nations must meet their climate finance promise of $100 billion despite their current $83 billion contribution while providing technology transfers for developing countries' transition support. India supports this position based on its calculations showing its total contributions to global warming amount to 3% while the U.S. accounts for 25% and the EU stands at 22%.

India must solve several conflicting goals when creating its climate-energy strategy because it needs to accelerate renewable power adoption while managing coal phaseout and maintain economic growth alongside environmental sustainability and lead global climate initiatives while defending its developmental needs. The successful implementation of these climate-energy efforts depends on quickening renewable energy installation to 50 GW per year from 15 GW and investing $30 billion to modernize power grids and developing 34 GW/136 GWh energy storage systems and establishing just transition policies for fossil fuel communities.[47] The achievement of India's NDC targets through 2030 depends on international climate finance and technology transfer support because it requires $2.5 trillion in investments. India's capacity to balance environmental concerns against its development needs will establish both its domestic path and provide major worldwide support for climate stabilization. The upcoming

[46] Ma Jianying, *Global Climate Diplomacy: Origin and Development*, (2010) 22 CHINA INT'l STUD. 157.
[47] N. C. Patnaik & Durjoy Kumar Deb, *Access to Green Justice: Needs of the Hour*, (2022) 7 NUJS J. REGUL. STUD. 89 (January-March).

decade will be vital for India to prove sustainable development can be achieved by large emerging economies.

India's Perspective on Climate Change

The nation of India finds itself at an essential point in its development path as it tackles both climate change requirements and expanding energy requirements. India's responses to these linked issues matter because it stands as the planet's biggest nation and ranks as the third-largest source of emissions. The energy-climate crisis in the nation emerged because it must improve millions of people's lives while creating sustainable energy infrastructure. The projected energy consumption growth in India will surpass all other major economies during the next few decades as the country accelerates its population urbanization and endeavors to achieve its economic growth targets.[48] At present India experiences rapid growth which coincides with the escalating climate change effects that include glacier melting in the Himalayas and rising sea levels affecting its entire coastal region.

India faces an essential trade-off regarding its energy-climate situation which requires managing national progress against ecological accountability. India defends its right to pursue economic growth and complete energy access across its population despite the fact that developed nations remain responsible for most past global emissions. From a diplomatic standpoint India adopts a climate approach that places emphasis on both climate responsibility fairness and the need for distinctive treatment during international climate negotiations. The domestic challenge requires India to move beyond coal power which produces 55% of primary energy consumption but retain security and accessibility of energy supplies.[49] Milions of people receive employment from the coal industry directly or indirectly which creates a complex situation for both political and social transition.

The high level of climate change exposure in India requires immediate action in its energy transformation process. Multiple climate risks affect India at once because the nation faces rising temperatures together with shifting rainfall patterns and increased frequency of severe

[48] Deepa Badrinarayana, *The Emerging Constitutional Challenge of Climate Change: India in Perspective*, (2009) 19 FORDHAM ENVTL. L. REV. 1 (Spring).
[49] Katak Malla, *International Environmental Law Perspective on Climate Change and Sustainable Energy Development*, (2014) 59 Scandinavian Stud. L. 109.

weather changes. Fifty percent of the Indian population depends on agricultural systems that are facing severe threats from changes in climate conditions. Climate-generated vulnerabilities combine to make India's development more difficult because climate changes threaten to negate progress in improving poverty levels while undermining food security and public health targets.[50] The demand for energy in India grows at a rate of 4-5% annually while the country undergoes industrialization and urbanization and improves standards of living.

The Indian government launched an extensive renewable energy program to handle these difficulties. Solar energy development in India has shown outstanding growth since 2015 when the country had less than 20 GW capacity to its current over 70 GW by 2023.[51] The growth of wind power installations has occurred at reduced speed compared to solar energy expansion. The renewable energy investments of the country receive additional support from projects aimed at enhancing energy efficiency throughout industrial facilities and residential and commercial buildings and household appliances.[52]

Renewable energy transition continues to face different structural barriers in its path. Governments need to devote huge capital to deploy energy storage systems alongside updating electrical grids to accommodate variable renewable energy integration. The process of acquiring land for big renewable energy projects frequently generates social disputes together with environmental conflicts.[53] The unstable financial condition of distribution companies hinders their ability to acquire renewable power. The sporadic behavior of wind and solar power systems requires keeping substantial backup capacity based on coal which impedes the process of fossil fuel reduction. India faces multiple difficulties in its energy transformation because its transition requires solutions which must combine technical capabilities with financial stability and social acceptance altogether.

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[50] Suddha Chakaravarti, *India's Energy Policy Challenges: A Development Perspective*, (2011) 1 ENVTL. L. & PRAC. REV. 115.
[51] Ibid.
[52] Uma Outka, *Accelerating Energy Transition in India: A Comparative Perspective*, (2020) 50 ENVTL. L. REP. 10459 (June).
[53] Randall S. Abate, Patricia Galvao Ferreira, Jae-Hyup Lee, Esmeralda Colombo & Damilola S. Olawuyi, *Global Perspective on Climate and Energy Justice*, (2021) 51 ENVTL. L. REP. 10457 (June).

India faces its energy and climate challenge most substantially through the transport sector. The expanding number of vehicles due to rising income levels positions transport emissions to become a significant source of carbon emissions for India. The government supports electric vehicles scheme while focusing specifically on two- and three-wheeled vehicles which make up most urban transportation.[54] Numerous problems stem from EV charging setup limitations in addition to battery system expenses and sources for carrying electrical power. Electric mobility requires evaluation of lithium-ion battery sustainability throughout production and recycling because it demands circular economy solutions.

Indian industrial sector which includes steel and cement production and chemical manufacturing offers challenges as well as possibilities for implementing decarbonization initiatives. The sectors present substantial challenges for abatement efforts because of existing technological and economic limitations yet remain vital for India to achieve its manufacturing goals. Some emerging technological applications including green hydrogen together with carbon capture stand to become important elements but their large-scale commercial deployment remains doubtful. A successful implementation of The National Green Hydrogen Mission initiative would both decrease industrial pollution and establish new business opportunities.[55]

India faces energy-climate challenges that stem from its ongoing urban development process. The population of urban residents in India will increase by 400 million by 2050 which demands immense infrastructure development. The construction methods of these cities through energy systems together with transport networks and building designs will permanently establish emission patterns which extend into multiple decades. Idea-based urban initiatives together with green building standards attempt to build sustainable municipalities however their enforcement shows inconsistent results between different municipal governments.[56] Rapid

[54] Daniel Farber, *Climate Change: A U.S. Perspective*, (2011) 2 YONSEI L.J. 1 (May).
[55] Prashant Kumar, *Climate Change and Environmental Justice in India*, (2022) 5 INT'l J.L. MGMT. & HUMAN. 1901.
[56] N. C. Patnaik & Durjoy Kumar Deb, *Access to Green Justice: Needs of the Hour*, (2022) 7 NUJS J. REGUL. STUD. 89 (January-March).

urban expansion creates a dilemma between sustainable development planning which demonstrates the general difficulty of uniting development requirements with climate targets.

The international community recognizes India as a major participant in climate negotiations while it promotes fair treatment for developing nations and financial assistance. Through the International Solar Alliance India has taken a leading position to advance the global implementation of solar energy systems. India brings the domestic circumstances that shape its diplomatic position through climate negotiations by supporting development needs and steadily increasing environmental responsibility.[57] India's diplomatic approach between domestic concerns and climate commitments will determine its future participation in international climate policy discussions involving financial support and technology sharing and compensations.

Resolving financial issues to power the transition remains an essential barrier to overcome. The net-zero target for India by 2070 demands $10 trillion worth of investments across the country. Strategic financing instruments need to be developed to gather capital such as green bonds combined with climate funds along with blended financial instruments. The amount of international climate finance reaching India falls short of requirements while public domestic funds face limitations from other development needs.[58] For clean energy project investment to increase from the private sector the government must provide clear policies with risk reduction tools to attract funding.

India's energy transition requires attention to its social elements. A coal energy transition requires a strategy to support the employment of millions who depend on the coal sector together with their supporting communities. A social framework for transitioning justly must contain job training programs and different work opportunities besides spreading economic diversity across regions to guarantee fair distribution when moving to renewable energy. Renewable energy expansion must provide its social advantages to disadvantaged populations by implementing decentralized distribution systems together with inclusive business structures.

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[57] Ibid.

[58] *Climate Change, Sustainable Development, and Ecosystems*, (2011) ENV't. ENERGY & RESOURCES L.: YEAR REV. 32 (2011).

The energy-climate challenge in India demands crucial technological innovations as its main solution.[59] Modern information technology functions strongly in India which enables digital solutions to manage energy consumption. The wider implementation of such technologies needs improved cooperation between research centres and industry partners and the government with increased expenditure on R&D programs.

Climate adaptation has gained growing interest in India because the nation faces stronger climate impacts. The NAPCC contains 8 missions that direct adaptation measures toward vital sectors including water resources and agriculture together with Himalayan regions. The development of state-level action plans exists to find solutions for specific regional weaknesses. These measures face two main barriers to their optimal success: failure to execute strategies properly and a lack of necessary financial resources. Building better climate resilience demands all government levels to integrate climate risks fully within their development planning framework.

India faces enhanced energy and climate challenges because of the COVID-19 pandemic along with the economic recovery programs. The pandemic exposed critical weaknesses in worldwide energy infrastructure and worldwide supply networks leading to evaluations of security frameworks for energy resources. The recovery packages give India the chance to speed up investments in clean energy and construct better infrastructure. The development direction India selects following the pandemic will establish enduring consequences regarding both its energy resource management and its climate change responsibilities.

Multiple energy and climate pathways exist for India to pursue during future development. India will maintain coal dependency while slowly integrating renewable energies into its power sector under this typical recovery approach. Both technical and financial hurdles will stand between India and its position as a front-runner in clean energy while an accelerated transition would be possible. The path India will follow will result from both domestic policies and international cooperation as well as technological developments and climate changes occurring.

[59] Makhan Saikia, *Global Climate Diplomacy - Challenges & Opportunities*, (2022) 7 NUJS J. REGUL. STUD. 12 (July-September).

The Indian response to energy challenges together with climate change issues stems from specific developmental circumstances and nation-building objectives. The nation aims to prove that developing the economy and protecting the environment can go together but achieving this balance requires searching for new solutions. India will serve as a global climate leadership force which will trigger worldwide observation of its domestic actions to prove that developing economies can achieve sustainable development without following fossil fuel-based growth patterns of industrialized nations.[60]

India will determine its future energy path as well as climate resilience during the upcoming ten years. The current policy choices will establish whether India can reach its development objectives together with its commitment to worldwide climate stability. To reach success demands extraordinary unity between government departments and active involvement from both the private sector and civil society groups along with international cooperation. Despite enormous hurdles India possesses both magnitude and creative capabilities to prove that sustainable development remains within reach.

The path India took toward energy development and climate protection provides knowledge that helps other developing nations solve their energy-construction dilemmas. The Indian case demonstrates how renewable energy growth works in developing countries together with its implementation barriers. The situation shows that nations need to create customized approaches for climate policy and actively participate in international collaboration. India proves that sustainable climate action requires complete alignment with general developmental needs to gain both political backing and social fairness.

The combination of worsening climate effects and rising energy requirements made by India will create global repercussions. The ways India manages its energy-climate challenge will demonstrate useful techniques to other countries in development while helping fulfill global climate commitments. The achievement of this goal depends on strong political dedication combined with technological advances and financial resources and international backing. The

[60] Randall S. Abate, Patricia Galvao Ferreira, Jae-Hyup Lee, Esmeralda Colombo & Damilola S. Olawuyi, *Global Perspective on Climate and Energy Justice*, (2021) 51 ENVTL. L. REP. 10457 (June).

situation demands the highest level of attention because it affects both India's path to development and Earth's climate equilibrium.

Conclusion

It is easy to state the problems in such high and ambitious commitments of India under Paris Agreement but one need to appreciate the strategies employed to combat with climate change and become a participant in this affair.

India`s energy crisis is a growing day by day. Our government are slowly making a shift from fossil fuels by removing subsidies plan from coal fossil fuel. That money should be used in subsidizing solar panels, wind energy etc. Once solar panels cost become competitive in free market then feed-in-tariff should also be removed.[61] It can be burden to economy if the solar prices doesn`t get the enough competitive cost.

Another way to promote renewable energy is to increase prices of coal. It is difficult to reduce the price of renewables immediately and this cannot be current course of action. IMF and World bank are also curbing subsidies of fossil fuels and putting fees on coal energy. IPR in technology is important for developed countries and they want to get benefit from their innovations. Hence, if global communities want to combat with climate change, then it has to relax it IPR related laws and regulations.[62] Such action will help developing countries to adopt clean and green energy, resulting into stabilisation in the environment.

[61] "In Its Path to Adopting the Paris Agreement, India Has to Drastically Alter Its Energy Roadmap", *Scroll.in*, available at: http://scroll.in/article/818514/in-its-path-to-adopting-the-paris-agreement-india-has-to-drastically-alter-its-energy-roadmap (accessed on 8 April 2025).
[62] "Solar v Coal: Can India Shift from Fossils to Sunbeams Fast Enough?", *Climate Change News*, available at: http://www.climatechangenews.com/2015/11/24/solar-v-coal-can-india-shift-from-fossils-to-sunbeams-fast-enough/ (accessed on 8 April 2025).