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Impact of Power Plant on Environment: A Legal Challenge

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Abstract - The advent of industrialization in the second half of 18th century was a watershed moment in the history of humankind. It was the moment when the humankind denuded itself from the shackles of the past and strived to pave a way for a beautiful future. A future, when realized, was both blessed with the charm of technological advancements but at the same time was plagued by gruesome inequality and a terrible environment to live in. Since the end of the second world war, the modern nation-states have participated in numerous conventions to address this deteriorating problem of environmental degradation. The problem of environmental degradation has been attributed to the technological advancements which humankind has achieved with the help of industrialization which was consequently done with utter disregard to the environment by not focusing on the sustainable mode of development. Most of the environmental degradation was a direct result of energy generation through burning of fossil fuels. Life without energy sector is unthinkable in 21st century. Energy sector is considered as one of the chief contributors in the environmental degradation. It impacts environment at multiple stages of its development and use including in construction, electricity generation, dissemination and decommissioning and disposal. The recently held 26the Climate Change Conference of the United Nations (COP26) reiterated the urgent need and called upon the participating nations to reduce the greenhouse gas emissions and attain the net zero carbon emissions with alacrity. Against this backdrop, this article is an attempt to examine the significant impact of power plants on the environment and legal issues which are incidental to it with a special reference to India.

Keywords - Global Warming, Neutrality Rate, Paris Conference, Hydropower, Energy law

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INTRODUCTION

India is a developing economy and this peculiarity has been accomplished by advancement in various areas, like infrastructure, technology, medical care, telecom, etcetera. Infrastructure is respected to be the one of the foundations of any developing society, as it adds to exchange and business, just as to the expectations for everyday comforts of any general public.

Infrastructure covers regions, for example, power, streets, water ventures, rail routes, etc. India has the second biggest populace on the planet and to help this immense populace, India is continually working its energy sector to build its power producing limit, with the goal that it can meet its power needs.

Power is an important component of any country's infrastructure. India's electricity sector is one of the most diverse in the world. Traditional sources of power generation in India include coal, natural gas, oil, nuclear power, and hydropower, as well as less mainstream sources like wind, solar, and agricultural and domestic waste.

With India's fast rising electricity demand, there is a pressing need to expand the country's power plant generation capacity. In 2017, India was rated 26th in the World Bank's list of countries with access to electricity. The Indian government has made "Power for All" a priority. As a result, capacity expansion in the country has accelerated.

That being said, a power plant's environmental impact is multifaceted, encompassing both its construction and operation. These consequences, sometimes known as impacts, might be momentary or long-term. A power plant and its auxiliary components (such as natural gas pipelines, water intakes and discharges, coal delivery and storage systems, new transmission lines, and waste disposal sites) occupy space on the ground and in the air, consume water, and, in many cases, emit pollutants into the atmosphere. The plant's footprint on the

earth prevents others from purchasing or using the land. It may also have an impact on the current and future uses of adjacent and surrounding land parcels. A coal-fired power station has a lot of tall structures and tall exhaust stacks. The plant's height may pose a safety risk to airplanes or have a visual impact on nearby landowners. There would be implications on land use, soils, and wildlife on the site if the property to be utilised for the power plant is a "greenfield," an undeveloped lot with primarily vegetation (crops, pasture, or old-field vegetation).

Power Plants that burn fossil fuels or biomass, burn fuels to produce hot air or steam, which is used to spin turbines that generate electricity. The nuclear fission reaction is used in nuclear power plants to generate steam. Exhaust gases and other byproducts, such as air pollution, result from the combustion of fuel. Water from neighbouring rivers or lakes, as well as local subterranean water aquifers, is needed to generate steam, and it must be cleansed. After it has been used, water may need to be released from the plant. All elements must be examined, including the volume of utilised water discharged, the temperature of the discharge water, and the concentration of contaminants in the water.

Solid wastes can come in a variety of forms, all of which must be dealt with. As a solid byproduct, coal combustion produces ash. Spent nuclear fuel rods and low-level radioactive waste are produced by nuclear power reactors. Before discharging to surface waters, power facilities that utilise water to generate steam or cold must frequently filter and purify the water. The filtered solids are a waste product that must be properly disposed of.

To remove the heat from the water used for cooling, cooling towers are frequently employed. The air that has been warmed by the water in the cooling tower is released into the atmosphere, carrying large amounts of water in the form of vapour, in some cases millions of gallons every day. That lost water vapor, obtained locally, represents significant water consumption by the power plant.

Some aspects of the construction and operation of a power plant can have unsettling effects on the community in which the power plant is built. Construction of the power plant, while very organized, can be viewed by surrounding landowners and other citizens as ugly and chaotic and might have an effect on community aesthetics or business. Costs for community services such as police, fire protection, emergency medical service, and traffic control can increase. Additional requirements might be placed on the municipal water supply or wastewater treatment capacity, or on solid-waste management systems. Coal-fired power plants require an efficient, reliable and long-term means of coal delivery, usually by rail or barge. Nearby road or rail traffic might be complicated or burdened by construction traffic and the delivery of materials, particularly large items. Noise levels in neighborhoods might increase during construction, and power plant operation also creates noise and vibration. The cooling towers of an operating power plant can also create fog and rime ice. Air space issues and compatibility with local land use must be considered in light of the space the power plant occupies and the way it operates[21].

Now before delving into the intricacies of the impact, it is apposite here to establish the importance of judicial decisions which have time and again emphasized upon the sustainable mode of development which will constitute a significant part of this article because power sector and sustainable mode of development can't be kept separated.

Sustainable development is a typical benchmark through which all development projects are judged. Noticeably finding its origin in global policy from the Bruntland Report in 1987[22], it is frequently defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[23]. Having been embraced globally as the standard for development by nations, it is the bedrock upon which the Sustainable Development Goals[24]have been laid out. Their latest iteration, consisting of 17 SDGs, was adopted by all United Nations member States in 2015. Titled as the "2030 Agenda for Sustainable Development"[25], these SDGs are broad, with their focus being on overall development of society in a manner which comports with environmental preservation now and in trust for the future. SDG13 specifically focuses on "Climate Action", which is to be balanced with the other SDGs (such as SDG9, which encourages "Industry, Innovation and Infrastructure").

The principle of sustainable development has found consistent application in matters of environmental

[21] Citizens For Green Doon v. Union of India (Civil Appeal No 10930 of 2018)

[22]Our Common Future, also known as the Brundtland Report available athttps://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (Last visited on December28, 2021.)

[23] "Report of the World Commission on Environment and Development: Our Common Future" (1987) available at https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (Last visited on December 28, 2021.)

[24] Id

[25] Available at https://www.undp.org/sustainable-development-goals (Last visited on December28, 2021.)

law. Sustainable development has a multi-dimensional approach, with a focus on the development of the economy, protection of individual rights and environmental concerns, while ensuring both inter and intra-generational equity. This allows the principle of sustainable development to look beyond creating policy *goals* (which necessarily seek specific outcomes) towards creating policy *approaches* (which rather seek to provide better frameworks)[26]. The principle of sustainable development has been explicitly recognized in multiple judgments of this Court.

In *Indian Council for Enviro-Legal Action v. Union of India*[27], a three-judge Bench of the Supreme Court described the principle of sustainable development in the following terms:

> "31…While economic development should not be allowed to take place at the cost of ecology or by causing widespread environment destruction and violation; at the same time, the necessity to preserve ecology and environment should not hamper economic and other developments. Both development and environment must go hand in hand, in other words, there should not be development at the cost of environment and vice versa, but there should be development while taking due care and ensuring the protection of environment. This is sought to be achieved by issuing notifications like the present, relating to developmental activities being carried out in such a way so that unnecessary environmental degradation does not take place. In other words, in order to prevent ecological imbalance and degradation that developmental activity is sought to be regulated."

In *Essar Oil Ltd. v. Halar Utkarsh Samiti*[28] a two-judge Bench of the Supreme Court referred to the Stockholm Declaration while elucidating on the principle of sustainable development. It noted that while socio-economic needs could be fulfilled through development, environmental concerns will always remain. However, these concerns should not be seen as a deadlock between development and the environment but as an opportunity to harmonize both, through the principle of sustainable development. Speaking through Justice Ruma Pal, the Supreme Court observed:

> "27. This, therefore, is the aim, namely, to balance economic and social needs on the one hand with environmental considerations on the other. But in a sense all development is an environmental threat. Indeed, the very existence of humanity and the rapid increase in the population together with consequential demands to sustain the population has resulted in the concreting of open lands, cutting down of forests, the filling up of lakes and pollution of water resources and the very air which we breathe. However, there need not necessarily be a deadlock between development on the one hand and the environment on the other. The objective of all laws on environment should be to create harmony between the two since neither one can be sacrificed at the altar of the other…"

In *N.D. Jayal&Anr v. Union of India &Ors*[29], a three-judge Bench held that a balance between developmental activities and environmental protection could only be maintained through the principle of sustainable development. Doing this was held to be necessary, without which the future generations could be in jeopardy. Justice S Rajendra Babu (speaking for himself and Justice Mathur) held as under:

> "22. Before adverting to other issues, certain aspects pertaining to the preservation of ecology and development have to be noticed. In Vellore Citizen'' Welfare Forum v. Union of India [(1996) 5 SCC 647] and in M.C. Mehta v. Union of India [(2002) 4 SCC 356] it was observed that the balance between environmental protection and developmental activities could only be maintained by strictly following the principle of "sustainable development". This is a development strategy that caters to the needs of the present without negotiating the ability of upcoming generations to satisfy their needs. The strict observance of sustainable development will put us on a path that ensures development while protecting the environment, a path that works for all peoples and for all generations. It is a guarantee to the present and a bequeath to the future. All environment-related developmental activities should benefit more people while maintaining the environmental balance. This could be ensured only by strict adherence to sustainable development without which life of the coming generations will be in jeopardy."

Justice Babu also noted that while the right to a clean environment is guaranteed as an intrinsic part of the fundamental right to life and personal liberty,

[26] J B Ruhl, 'Sustainable Development: A Five-Dimensional Algorithm for Environmental Law' (1999) 18 Stanford Environmental Law Journal 31

[27] (1996) 5 SCC 281

[28] (2004) 2 SCC 392

[29] (2004) 9 SCC 362

the right to development can also be declared as a component of Article 21:

> "24. The right to development cannot be treated as a mere right to economic betterment or cannot be limited as a misnomer to simple construction activities. The right to development encompasses much more than economic well-being, and includes within its definition the guarantee of fundamental human rights. The "development" is not related only to the growth of GNP. In the classic work, Development As Freedom, the Nobel prize winner Amartya Sen pointed out that "the issue of development cannot be separated from the conceptual framework of human right". This idea is also part of the UN Declaration on the Right to Development. The right to development includes the whole spectrum of civil, cultural, economic, political and social process, for the improvement of people'' well-being and realization of their full potential. It is an integral part of human rights. Of course, construction of a dam or a mega project is definitely an attempt to achieve the goal of wholesome development. Such works could very well be treated as integral component for development."

More recently, in *Rajeev Suri v. Delhi*[30], a three judge Bench of this Court had to decide on the permissibility of the Central Vista Project. In considering the use of the principle of sustainable development, Justice A M Khanwilkar observed that the principle of sustainable development necessarily incorporates within it the principle of development – development which is sustainable and not environmentally degrading. He held as under:

> "507. The principle of sustainable development and precautionary principle need to be understood in a proper context. **The expression "sustainable development" incorporates a wide meaning within its fold. It contemplates that development ought to be sustainable with the idea of preservation of natural environment for present and future generations. It would not be without significance to note that sustainable development is indeed a principle of development–- it posits controlled development. The primary requirement underlying this principle is to ensure that every development work is sustainable; and this requirement of sustainability demands that the first attempt of every agency enforcing environmental rule of law in the country ought to be to alleviate environmental concerns by proper mitigating measures. The future generations have an equal stake in the environment and development. They are as much entitled to a developed society as they are to an environmentally secure society.**
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> 508 **The jurisprudence in environmental matters must acknowledge that there is immense inter-dependence between right to development and right to natural environment.** In International Law and Sustainable Development, Arjun Sengupta in the chapter "Implementing the Right to Development [International Law and Sustainable Development–- Principles and Practice, Edn. 2004, pg. 354]" notes thus:
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> "… Two rights are interdependent if the level of enjoyment of one is dependent on the level of enjoyment of the other…""

Similarly, in *Municipal Corporation of Greater Mumbai v. Ankita Sinha*[31], another three judge Bench of the Supreme Court ruled on the powers of the NGT under the National Green Tribunal Act 2010. The Court noted the significance of environmental justice and environmental equity, and highlighted how environmental harms cause disproportionate implications for the economically or socially marginalized groups. Thus, it was considered important to ensure that environmental equity was achieved, through the use of principles such as sustainable development. In this regard, speaking through Justice Hrishikesh Roy, the Court held as under:

"XI. ENVIRONMENTAL JUSTICE AND ENVIROMENTAL EQUITY

> 82 **Environmental equity as a developing concept has focused on the disproportionate implications of environmental harms on the economically or socially marginalized groups.** The concerns of human rights and environmental degradation overlap under this umbrella term, to highlight the human element, apart from economic and environmental ramifications. **Environmental equity thus stands to ensure a balanced distribution of environmental risks as well as protections, including application of sustainable development principles.**

In *Bengaluru Development Authority v. Sudhakar Hegde*[32], a two-judge Bench of this Court observed that there was no winner in environmental litigation, since both – development and protection of environment – are necessary. The Court clarified

[30] 2021 SCC OnLine SC 7

[31] 2021 SCC OnLine SC 897

[32] (2020) 15 SCC 63

that a framework created by environmental rule of law has to balance both these considerations by creating transparent and accountable institutions, while allowing for participatory democracy.

The notion of sustainable development is well ingrained in Indian environmental law jurisprudence[33]. It has evolved into a multi-faceted principle that does not obstruct progress but rather builds it around what is sustainable. Sustainable development encompasses two concepts: development that provides equity between present and future generations, as well as development that ensures equity between diverse sections of society now. While the notion of sustainable development has deep roots, there is a lack of clarity on how to determine if a given development initiative adheres to the principle.The idea of sustainable development may yield diverse and arbitrary measurements if the Court does not apply a single benchmark or standard in its study of the impact of development projects (depending on the nature of individual projects). This not only adds to the law's uncertainty, but it also makes the application of the principle of sustainable development more selective, limiting its ability to promote long-term change.[34]

Adopting the criteria of 'environmental rule of law' to verify governance decisions under which developmental projects are allowed is a viable solution to this challenge. The United Nations Environment Programme suggested such an approach in its 2015 Issue Brief, "Environmental Rule of Law: Critical to Sustainable Development," in the following terms:[35]:

> "Environmental rule of law integrates the critical environmental needs with the essential elements of the rule of law, and provides the basis for reforming environmental governance. It prioritizes environmental sustainability by connecting it with fundamental rights and obligations. It implicitly reflects universal moral values and ethical norms of behaviour, and it provides a foundation for environmental rights and obligations. Without environmental rule of law and the enforcement of legal rights and obligations, environmental governance may be arbitrary, that is, discretionary, subjective, and unpredictable."

UNEP has further reiterated the importance of the 'environmental rule of law' in its 2019 report titled "Environmental Rule of Law: First Global Report", where it notes:

> "Environmental rule of law is key to achieving the Sustainable Development Goals. Indeed, it lies at the core of Sustainable Development Goal 16, which commits to advancing "rule of law at the national and international levels" in order to "promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels."
>
> […]
>
> Environmental law and institutions have grown dramatically in the last few decades, but they are still maturing. Environmental laws have taken root around the globe as countries increasingly understand the vital linkages between environment, economic growth, public health, social cohesion, and security. Countries have adopted many implementing regulations and have started to enforce the laws. Too often, though, there remains an implementation gap.
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> Environmental rule of law seeks to address this gap and align actual practice with the environmental goals and laws on the books. To ensure that environmental law is effective in providing an enabling environment for sustainable development, environmental rule of law needs to be nurtured in a manner that builds strong institutions that engage the public, ensures access to information and justice, protects human rights, and advances true accountability for all environmental actors and decision makers…"

Authorization and Operating Requirements for the Establishment of Power Plants in India

Under the Electricity Act, generation of electricity (excluding hydro) is a delicensed industry, and putting up a power facility does not require a licence (but only the central government and state-owned corporations or authorities can generate, develop, utilise, or dispose of atomic energy). However, generating power is still subject to the necessary environmental and other permissions relevant to the generation plant's construction, development, and implementation. Developers of hydropower facilities frequently sign memorandums of understanding or implementation agreements with the state government where the project is being built.

The CEA is no longer required by the Indian government for techno-economic approval of a thermal energy project (however, this is still required for setting up a hydro plant).

[33] Supra note 4
[34] Id
[35] Available at <https://wedocs.unep.org/bitstream/handle/20.500.11822/10664/issue-brief-erol.pdf?sequence=1&amp%3BisAllowed=> (Last visited on December 28, 2021.)

Authorisation requirements vary based on the location of each project, as rules can be at the federal and state levels. The following are the main permits required to build a power plant (other permits may be required based on the type of fuel, location, and project):

- Environmental clearance for the specific project from the Ministry of Environment, Forests and Climate Change (MoEFCC).
- Consent to establish for the specific project by the state pollution control board under the Air (Prevention and control of Pollution) Act 1981 and the Water (Prevention and Control of Pollution) Act 1974.
- Approvals to acquire land for the project, including approvals from local bodies such as the village council (*gram panchayat*).
- Approval for site and building plan (including clearance for fire safety standards and protection apparatus and system) and licensing and registration of the project under the Factories Act 1948 (issued by the Chief Inspector of Factories).
- Certificate for use of boilers under the Indian Boilers Act 1923.
- Licence for storage and use of explosives under the Explosives Act 1884.
- Licence for storage and use of petroleum products under Petroleum Act 1934.
- Approvals, clearances or no objection certificates from authorities such as the Archaeological Survey of India, Ministry of Defence and Airports Authority of India (as applicable).

The consents required for renewable energy projects are state-specific and may vary from one state to another.

Authorization and Other Ongoing Requirements to operate Electricity Generation Plants

The Electricity Act does not require a licence to operate a generation plant (except hydro). However, a variety of permissions, consents, and permits from various federal and state agencies must be obtained and maintained during the plant's operation. The following are some of the most important authorizations:

- Consent to operate by the state pollution control board under the Air (Prevention and Control of Pollution) Act 1981 and the Water (Prevention and Control of Pollution) Act 1974 in relation to the project.
- Connectivity-related approvals to connect the interconnection facility to the transmission or distribution network.
- Commissioning certificates from the relevant authority.
- Compliance with the regulations issued by CEA such as:
- CEA (Safety Requirements for Construction, Operation and Maintenance of Electrical Plants and Electrical Lines) Regulations 2011; and
- periodical inspection of the electrical installations under the CEA (Measures relating to Safety and Electric Supply) 2010.
- Compliance with the electricity supply code, including the metering code and metering regulations framed by the relevant SERC.

The consents required for renewable energy projects are state-specific and may vary from one state to another.

Requirements Concerning Connection of Generation to the Transmission Network or a Distribution Network

The producing unit must link to the inter-state transmission system (in case of inter-state supply) for power delivery from the point of injection to the site of drawl, for which an application for connectivity is filed and an agreement is formed with the Central Transmission Utility (CTU). The following are required for interstate electricity supply:

- The right to use the inter-state transmission system (that is, open access) must be applied for to the CTU.
- After open access is granted, an agreement for long-term or medium-term access must be entered with the CTU.

CERC (Grant of Connectivity, Long-term Access, and Medium-term Open Access in Inter-State Transmission and Related Matters) Regulations 2009 control connectivity and open access in inter-state transmission systems (in case of inter-state supply). Similarly, the applicable SERC regulations govern connectivity and open access for intra-state supply.

Requirements Concerning the Decommissioning of a Power Plant at the end of its Period of Operation

When decommissioning a power plant, all state-specific rules governing equipment disposal must be followed. When it comes to nuclear power facilities, the Atomic Energy Regulatory Board (AERB) has

released safety manuals outlining the rules that must be followed when the plant is shut down. These include the adoption of a decommissioning plan to guarantee worker, public, and environmental safety.

Having now highlighted some of the landmark judicial pronouncements which have affirmed the value of rule of law and the environmental jurisprudence viz a viz sustainable development and the legal aspects regarding the construction of Power plants in India, I will now further move to establish the colossal impact of power plants on the environment by analyzing different modes which is employed for power generation.

1. Energy Generation through Thermal Power Plant

At present, thermal power accounts for almost 60 per cent of India's total installed power generation capacity. It is produced by burning fossil fuels like coal, gas, etc. Of this, coal alone accounts for more than half of India's installed electricity generation. It has been the centerpiece of India's energy ecosystem for several decades and is expected to continue being so for at least a decade or two, largely because it is the cheapest natural resource and is abundant in India.[36]

Coal is a fossil fuel formed from the decomposition of organic materials that have been subjected to geologic heat and pressure over millions of years. Coal is considered a nonrenewable resource because it cannot be replenished on a human time frame.

The activities involved in generating electricity from coal include mining, transport to power plants, and burning of the coal in power plants. Initially, coal is extracted from surface or underground mines. The coal is often cleaned or washed at the coal mine to remove impurities before it is transported to the power plant—usually by train, barge, or truck. Finally, at the power plant, coal is commonly burned in a boiler to produce steam. The steam is run through a turbine to generate electricity.[37]

Environmental Impacts

Air Emissions

When coal is burned, carbon dioxide, sulfur dioxide, nitrogen oxides, and mercury compounds are released. For that reason, coal-fired boilers are required to have control devices to reduce the of emissions that are released.

Mining, cleaning, and transporting coal to the power plant generate additional emissions. For example, methane, a potent greenhouse gas that is trapped in the coal, is often vented during these processes to increase safety.

Water Resource Use

Large quantities of water are frequently needed to remove impurities from coal at the mine. In addition, coal-fired power plants use large quantities of water for producing steam and for cooling. When coal-fired power plants remove water from a lake or river, fish and other aquatic life can be affected, as well as animals and people who depend on these aquatic resources.

Water Discharges

Pollutants accumulate in the water utilised in the boiler and cooling system of the power plant. Pollutants in the water can harm fish and plants if the water used in the power plant is released into a lake or river. Furthermore, if rain falls on coal stored in piles outside the power station, the water that washes off these piles can drain heavy metals from the coal into neighbouring bodies of water, such as arsenic and lead. When the water used to clean the coal is dumped back into the environment, it can contaminate bodies of water with heavy metals. This type of discharge normally necessitates a permit and is closely monitored.

Solid Waste Generation

When coal is burned, it produces ash, which is mostly made up of metal oxides and alkali. Coal has a ten percent ash content on average. When coal is cleaned in mines, as well as when air contaminants are removed from stack gas at power plants, solid waste is formed. Much of this trash ends up in landfills and abandoned mines, but some of it is now repurposed into usable goods like cement and construction materials.

Even when a coal-fired power station closes down, soil at the site can become contaminated with numerous contaminants from the coal and take a long time to recover. Coal mining and processing have a negative impact on the environment.Surface mining disturbs larger areas than underground mining.

2. Electricity from Hydropower

India has overtaken Japan, becoming the nation with fifth- largest hydropower production capacity in the world with total installed base at over 50GW, and is only behind Canada, US, Brazil and China according to International Hydropower Association (IHA).India

[36] https://www.thehindubusinessline.com/blexplainer/is-it-the-beginning-of-end-for-indias-thermal-power-plants/article38025578.ece

[37] Ibid

has the hydro power potential of around 145GW,of which 45GW is already been utilized[38].

Hydropower is a renewable energy source since it generates electricity using the Earth's water cycle. Water evaporates from the Earth's surface, condenses into clouds, rains back down, and flows into the ocean.

The kinetic energy created by the movement of water as it flows downstream can be transformed into electricity. A hydroelectric power plant turns this energy into electricity by forcing water through a hydraulic turbine attached to a generator, which is frequently held at a dam. The water is discharged from the turbine and returned to a stream or riverbed beneath the dam.Hydropower is primarily reliant on precipitation and elevation changes; in order to create electricity, high precipitation levels and large elevation shifts are required.. Therefore, an area such as the mountainous Pacific Northwest has more productive hydropower plants than an area such as the Gulf Coast, which might have large amounts of precipitation but is comparatively flat.

According to Yüksel[39] hydropower does not pollute the air we breathe in the way that the energy source does not produce any air pollutants. Unlike thermal power plants for example, there are no gaseous of fly ash emissions emitted during the production. The fact that hydropower often replace fossil-fired generation, it can therefore also be said that it is reducing the problem with acid rain and smog. Despite all these advantages hydropower plants have, there may also be negative impacts. Lately the impact on the ecological aspects from the power plants has received attention. In the report from World Commission on Dams [40], it is stated that dams will have effects e.g. on the terrestrial ecosystem and biodiversity, the flow regime, migration of aquatic organisms, and can cause emissions of greenhouse gases. Bratrich[41]states that hydropower affects the flow regime, migration of organisms and transport of nutrients and sediments.

Abbasi [42] claim that hydropower plants cause major ecological impacts in all of the four different habitats, which are associated with the projects; the estuary into which the river flows, the downstream reaches of the dammed river, the reservoir catchment and the artificially created lake. Different research works from all corner of the world's reported considering the negative effects of hydropower on the environments and calls for the importance of adopting of appropriate mitigation measures. Therefore, to ensure sustainable development, various mitigation and enhancement measures have to be integrated at the early stages of project planning. Furthermore, appropriate mitigation measures not only for hydropower development that is newly planned and implemented in future, but also for the refurbishment and upgrading of hydropower plants which are currently in operation, need to be devised.

The Impact

Air Emissions

Hydropower's air emissions are negligible because no fuels are burned. However, if a large amount of vegetation is growing along the riverbed when a dam is built, it can decay in the lake that is created, causing the buildup and release of methane, a potent greenhouse gas.

Water Resource Use

Hydropower often requires the use of dams, which can greatly affect the flow of rivers, altering ecosystems and affecting the wildlife and people who depend on those waters.

Often, water at the bottom of the lake created by a dam is inhospitable to fish because it is much colder and oxygen-poor compared with water at the top. When this colder, oxygen-poor water is released into the river, it can kill fish living downstream that are accustomed to warmer, oxygen-rich water.

In addition, some dams withhold water and then release it all at once, causing the river downstream to suddenly flood. This action can disrupt plant and wildlife habitats and affect drinking water supplies.

Water Discharges

Hydroelectric power plants release water back into rivers after it passes through turbines. This water is not polluted by the process of creating electricity.

Land Resource Use

The construction of hydropower plants can alter sizable portions of land when dams are constructed

[38] Available at <https://www.ibef.org/archives/industry/renewable-energy-reports/indian-renewable-energy-industry-analysis-december-2021>

[39] https://www.sciencedirect.com/science/article/pii/S1364032109001592

[40] https://lupinepublishers.com/agriculture-journal/fulltext/environmental-impacts-of-hydropower-and-alternative-mitigation-measures.ID.000133.php

[41] https://onlinelibrary.wiley.com/doi/pdf/10.1002/rra.788

[42] https://www.sciencedirect.com/science/article/pii/S1364032110004193

and lakes are created, flooding land that may have once served as wildlife habitat, farmland, and scenic retreats. Hydroelectric dams can cause erosion along the riverbed upstream and downstream, which can further disturb wildlife ecosystems and fish populations. Whilst hydropower presents a cleaner option than dirtier forms of electricity production, it does not come without its negative impacts. This essay has identified a number of these environmental and social impacts occurring as a result of hydropower dam facilities. Environmental impacts include deforestation, the loss of wildlife, the loss of aquatic life, changes to the flow of waterways, changes in water temperature, the build-up of sediment and the creation of landslide hazards. Social impacts include human displacement, loss of livelihood and heightened flood risk. Schlosberg's environmental justice framework was then used to argue that the distributive injustice of tribal displacement, wrought by large hydropower schemes, was largely a result of the tribal communities lacking participation in the decision-making process and lacking recognition of their plight by government officials. Several policy and structural faults were identified to explain why the proliferation of hazardous large hydropower schemes continues to this day, despite the lessons learnt from the 2013 Uttarakhand flood disaster. This includes privatisation policies that shield investors from accountability, identified risks being ignored in favour of economic development and the recent reclassification of large hydropower schemes as 'renewable' sources of energy. Whilst small hydropower is shown to produce fewer negative impacts than large hydropower and is more cost-effective, it is not without its own risks. These risks stem from poor government policy that allows small hydro projects to be constructed without undergoing an environmental impact assessment.[43]

3. Natural Gas

In 2017, the Indian government announced that it would increase the share of natural gas in its energy mix to 15% by 2030. As of September 2021, natural gas made up 6.5% of India's energy mix. India is promoting natural gas as a 'transition fuel' as it moves towards using renewable energy as the main power source, as other countries in Southeast Asia and Africa are doing.[44]

Electricity from Natural Gas

Natural gas is a fossil fuel formed when layers of buried plants and animals are exposed to intense heat and pressure over thousands of years. The energy that the plants and animals originally obtained from the sun is stored in the form of carbon in natural gas. Natural gas is combusted to generate electricity, enabling this stored energy to be transformed into usable power. Natural gas is a nonrenewable resource because it cannot be replenished on a human time frame.

The natural gas power production process begins with the extraction of natural gas, continues with its treatment and transport to the power plants, and ends with its combustion in boilers and turbines to generate electricity.

Initially, wells are drilled into the ground to remove the natural gas. After the natural gas is extracted, it is treated at gas plants to remove impurities such as hydrogen sulfide, helium, carbon dioxide, hydrocarbons, and moisture. Pipelines then transport the natural gas from the gas plants to power plants.

Power plants use several methods to convert gas to electricity. One method is to burn the gas in a boiler to produce steam, which is then used by a steam turbine to generate electricity. A more common approach is to burn the gas in a combustion turbine to generate electricity.

Another technology, that is growing in popularity is to burn the natural gas in a combustion turbine and use the hot combustion turbine exhaust to make steam to drive a steam turbine. This technology is called "combined cycle" and achieves a higher efficiency by using the same fuel source twice.

Environmental Impacts

At the power plant, the burning of natural gas produces nitrogen oxides and carbon dioxide, but in lower quantities than burning coal or oil. Methane, a primary component of natural gas and a greenhouse gas, can also be emitted into the air when natural gas is not burned completely. Similarly, methane can be emitted as the result of leaks and losses during transportation. Emissions of sulfur dioxide and mercury compounds from burning natural gas are negligible.

Compared to the average air emissions from coal-fired generation, natural gas produces half as much carbon dioxide, less than a third as much nitrogen oxides, and one percent as much sulfur oxides at the power plant. In addition, the process of extraction, treatment, and transport of the natural gas to the power plant generates additional emissions.

Water Resource Use

The burning of natural gas in combustion turbines requires very little water. However, natural gas-fired boiler and combined cycle systems do require water for cooling purposes. When power plants remove

[43] Available at https://www.e-ir.info/2020/02/14/hydropower-in-india-a-source-of-heightened-risk-and-inequality/ .

[44] https://www.business-standard.com/article/current-affairs/how-natural-gas-could-thwart-or-support-india-s-renewables-progress-121101900140_1.html

water from a lake or river, fish and other aquatic life can be killed, affecting animals and people who depend on these aquatic resources.

Water Discharges

Combustion turbines do not produce any water discharges. However, pollutants and heat buildup in the water used in natural gas boilers and combined cycle systems. When these pollutants and heat reach certain levels, the water is often discharged into lakes or rivers. This discharge usually requires a permit and is monitored.

Land Resource Use

The extraction of natural gas and the construction of natural gas power plants can destroy natural habitat for animals and plants. Possible land resource impacts include erosion, loss of soil productivity, and landslides.

4. Solar Energy

Solar energy is a renewable resource because it is continuously supplied to the earth by the sun. There are two common ways to convert solar energy into electricity: photovoltaic and solar-thermal technologies. Photovoltaic systems consist of wafers made of silicon or other conductive materials. When sunlight hits the wafers, a chemical reaction occurs, resulting in the release of electricity. Solar-thermal technologies concentrate the sun's rays with mirrors or other reflective devices to heat a liquid to create steam, which is then used to turn a generator and create electricity.

Environmental Impacts

Water Resource Use

Photovoltaic systems do not require the use of any water to create electricity. Solar-thermal technologies may tap local water resources if the liquid that is being heated to create steam is water. In this case, the water can be re-used after it has been condensed from steam back into water.

Solid Waste Generation

Solar-thermal technologies do not produce any substantial amount of solid waste while creating electricity. The production of photovoltaic wafers creates very small amounts of hazardous materials that must be handled properly to avert risk to the environment or to people.

Land Resource Use

Photovoltaic systems require a negligible amount of land area because they are typically placed on existing structures. In contrast, solar-thermal technologies may require a significant amount of land, depending upon the specific solar-thermal technology used. Solar energy installations do not usually damage the land they occupy, but they prevent it from being used for other purposes. In addition, photovoltaic systems can negatively affect wildlife habitat because of the amount of land area the technology requires.

5. Biomass Energy

The term "biomass" is attributed to numerous fuel types from such sources as trees; construction, wood, and agricultural wastes; fuel crops; sewage sludge; and manure. Agricultural wastes include materials such as corn husks, rice hulls, peanut shells, grass clippings, and leaves. Trees and fuel crops (i.e., crops specifically grown for electricity production) can be replaced on a short time scale.

Organic wastes such as agricultural wastes, sewage sludge, and manure will continue to be created by society. As a result, biomass is seen as a renewable resource.

While plants are growing, biomass obtains its energy from the sun. Photosynthesis is the process through which plants transform solar energy into chemical energy. When the plant material is burned, this energy is released as heat. Biomass power plants use boilers to burn biomass fuel. The heat generated by this process is utilised to convert water into steam, which is then used to turn steam turbine to generate electricity.

Biomass is sometimes burned in combination with coal in boilers at power plants. This process, called co-firing, is typically used to reduce air emissions and other environmental impacts from burning coal. Co-firing biomass with coal may require a coal boiler to be modified somewhat so it can combust coal. When co-fired with coal, only a small amount of biomass is typically added (no more than 15 percent of the total amount of fuel going into the boiler) to maintain the boiler's efficiency.[45]

Environmental Impacts

Air Emissions

Biomass power plants emit nitrogen oxides and a small amount of sulfur dioxide. The amounts emitted depend on the type of biomass that is burned and the type of generator used. Although the burning of biomass also produces carbon dioxide, the primary greenhouse gas, it is considered to be part of the natural carbon cycle of the earth. The plants take up carbon dioxide from the air while they are growing

[45] Available at https://www.sciencedirect.com/topics/engineering/biomass-cofiring

and then return it to the air when they are burned, thereby causing no net increase.

Biomass contains much less sulfur and nitrogen than coal;6 therefore, when biomass is co-fired with coal, sulfur dioxide and nitrogen oxides emissions are lower than when coal is burned alone. When the role of renewable biomass in the carbon cycle is considered, the carbon dioxide emissions that result from co-firing biomass with coal are lower than those from burning coal alone.

Water Resource Use

Biomass power plants require the use of water, because the boilers burning the biomass need water for steam production and for cooling. If this water is used over and over again, the amount of water needed is reduced. Whenever any type of power plant removes water from a lake or river, fish and other aquatic life can be killed, which then affects those animals and people that depend on these aquatic resources.

Water Discharges

As is the case with fossil fuel power plants, biomass power plants have pollutant build-up in the water used in the boiler and cooling system. The water used for cooling is much warmer when it is returned to the lake or river than when it was removed. Pollutants in the water and the higher temperature of the water can harm fish and plants in the lake or river where the power plant water is discharged. This discharge usually requires a permit and is monitored.

In general, crops grown for biomass fuel require fewer pesticides and fertilizers than crops grown for food, which means that less pesticide and fertilizer runoff will reach local streams and ponds than if food crops are grown.

Solid Waste Generation

The burning of biomass in boilers creates a solid waste called ash that must be disposed of properly. However, the ash from biomass normally contains extremely low levels of hazardous elements.

Land Resource Use

Generating electricity from biomass can affect land resources in different ways. Biomass power plants, much like fossil fuel power plants, require large areas of land for equipment and fuel storage. If these biomass plants burn a waste source such as construction wood waste or agricultural waste, they can provide a benefit by freeing areas of land that might otherwise have been used for landfills or waste piles. Biomass grown for fuel purposes requires large areas of land and, over time, can deplete the soil of nutrients. Fuel crops must be managed so that they stabilize the soil, reduce erosion, provide wildlife habitat, and serve recreational purposes.

6. Wind Energy

Wind is created because the sun heats the Earth unevenly, due to the seasons and cloud cover. This uneven heating, in addition to the Earth's rotation, causes warmer air to move toward cooler air. This movement of air is wind.

Wind turbines use two or three long blades to collect the energy in the wind and convert it to electricity. The blades spin when the wind blows over them. The energy of motion contained in the wind is then converted into electricity as the spinning turbine blades turn a generator. To create enough electricity for a town or city, several wind turbine towers need to be placed together in groups or rows to create a "wind farm."

Environmental Impacts

Land Resource Use

Wind turbines generally require the use of land, although they may also be sited offshore. Land around wind turbines can be used for other purposes, such as the grazing of cattle or farming.

When wind turbines are removed from land, there are no solid wastes or fuel residues left behind. However, large wind farms pose aesthetic concerns and wind turbines that are improperly installed or landscaped may create soil erosion problems. Wind farms can also have noise impacts, depending on the number of wind turbines on the farm. New blade designs are being used to reduce the amount of noise. Bird and bat mortality has been an issue at some wind farms. Improvements to wind turbine technologies and turbine sitting have helped mitigate bird mortality. Research on impacts to bats is now underway.

7. Nuclear Power Plants and the Environment

Nuclear energy originates from the splitting of uranium atoms in a process called fission. Fission releases energy that can be used to make steam, which is used in a turbine to generate electricity. Uranium is a nonrenewable resource that cannot be replenished on a human time scale. Uranium is extracted from the earth through traditional mining techniques or chemical leaching. Once mined, the uranium ore is sent to a processing plant to be concentrated into enriched fuel (i.e., uranium oxide pellets). Enriched fuel is then transported to the nuclear power plant. In the plant's nuclear reactor, neutrons from uranium atoms collide with each other, releasing heat and neutrons in a chain reaction. This heat is used to generate steam, which powers a turbine to generate electricity. Nuclear power generates a number of radioactive by-

products, including tritium, cesium, krypton, neptunium and forms of iodine. The nuclear waste has become an acute problem as it can remain active for thousand of years.

The incidences of Three Miles Island nuclear power plants accident in US (1979)[46], Chernobyl accident in Soviet Union (1986)[47], Fukushima nuclear plant disaster in Japan (2011)[48] have posed a new threat to the humanity and the environment.

Environmental Impacts

Nuclear Energy contributes to the environmental pollution in two ways:

1) Nuclear explosion or use of nuclear ballistic missiles; and

2) Use of and residue of nuclear power plants in storage, transportation and disposal of nuclear waste.

Air Emissions

Nuclear power plants do not emit carbon dioxide, sulfur dioxide, or nitrogen oxides as part of the power generation process. However, fossil fuel emissions are associated with the uranium mining and uranium enrichment process as well as the transport of the uranium fuel to and from the nuclear plant.

Water Resource Use

Nuclear power plants use large quantities of water for steam production and for cooling. Some nuclear power plants remove large quantities of water from a lake or river, which could affect fish and other aquatic life.

Water Discharges

Heavy metals and salts build up in the water used in all power plant systems, including nuclear ones. These water pollutants, as well as the higher temperature of the water discharged from the power plant, can negatively affect water quality and aquatic life. Nuclear power plants sometimes discharge small amounts of tritium and other radioactive elements as allowed by their individual wastewater permits.

Waste generated from uranium mining operations and rainwater runoff can contaminate groundwater and surface water resources with heavy metals and traces of radioactive uranium.

Every 18 to 24 months, nuclear power plants must shut down to remove and replace the "spent" uranium fuel.2 This spent fuel has released most of its energy as a result of the fission process and has become radioactive waste.[49]

Radioactive Waste Generation

Enrichment of uranium ore into fuel and the operation of nuclear power plants generate wastes that contain low-levels of radioactivity. These wastes are shipped to a few specially designed and licensed disposal sites.

When a nuclear power plant is closed, some equipment and structural materials become radioactive wastes. This type of radioactive waste is currently being stored at the closed plants until an appropriate disposal site is opened.

Radioactive wastes are classified as low-level waste or high-level waste. The radioactivity of these wastes can range from a little higher than natural background levels, such as for uranium mill tailings, to the much higher radioactivity of used (spent) reactor fuel and parts of nuclear reactors. The radioactivity of nuclear waste decreases over time through a process called radioactive decay. The amount of time it takes for the radioactivity of radioactive material to decrease to half its original level is called the radioactive half-life. Radioactive waste with a short half-life is often stored temporarily before disposal to reduce potential radiation doses to workers who handle and transport the waste. This storage system also reduces the radiation levels at disposal sites.

By volume, most of the waste related to the nuclear power industry has a relatively low level of radioactivity. Uranium mill tailings contain the radioactive element radium, which decays to produce the radioactive gas radon. Most uranium mill tailings are placed near the processing facility, or *mill*, where they come from. Uranium mill tailings are covered with a sealing barrier of material such as clay to prevent radon from escaping into the atmosphere. The sealing barrier is covered by a

[46] Available at <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/three-mile-island-accident.aspx#:~:text=In%201979%20at%20Three%20Mile,background%20levels%20to%20local%20residents.>

[47] Available at <https://www.google.com/search?q=chernobyl+accident+in+russia&oq=Chernobyl+accident+in+Russia&aqs=chrome.0.0i512j0i22i30l3j0i390l4.1849j0j4&sourceid=chrome&ie=UTF-8>

[48] Available at <https://world-nuclear.org/information-library/safety-and-security/safety-of-plants/fukushima-daiichi-accident.aspx>

[49] Available at https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/radwaste.html (Last visited on December 29, 2021.)

layer of soil, rocks, or other materials to prevent erosion of the sealing barrier.

The other types of low-level radioactive waste are the tools, protective clothing, wiping cloths, and other disposable items that become contaminated with small amounts of radioactive dust or particles at nuclear fuel processing facilities and nuclear power plants. These materials are subject to special regulations for their handling, storage, and disposal so they will not come in contact with the outside environment.

High-level radioactive waste consists of *irradiated*, or *spent*, nuclear reactor fuel (fuel that is no longer useful for producing electricity). The spent reactor fuel is in a solid form, consisting of small fuel pellets in long metal tubes called rods.

Spent reactor fuel storage and reactor decommissioning

Spent reactor fuel assemblies are highly radioactive and, initially, must be stored in specially designed pools of water. The water cools the fuel and acts as a radiation shield. Spent reactor fuel assemblies can also be stored in specially designed dry storage containers. An increasing number of reactor operators now store their older spent fuel in dry storage facilities using special outdoor concrete or steel containers with air cooling. The United States does not currently have a permanent disposal facility for high-level nuclear waste.

When a nuclear reactor stops operating, it must be decommissioned. Decommissioning involves safely removing from service the reactor and all equipment that has become radioactive and reducing radioactivity to a level that permits other uses of the property.[50]

Cooling Water System

Cooling systems are used to keep nuclear power plants from overheating. There are two main environmental problems associated with nuclear power plant cooling systems. First, the cooling system pulls water from an ocean or river source. Fish are inadvertently captured in the cooling system intake and killed. Second, after the water is used to cool the power plant, it is returned to the ocean or river. The water that is returned is approximately 25 degrees warmer than the water was originally. The warmer water kills some species of fish and plant life.

Nuclear Energy and Indian Legal Regime

India's first nuclear reactor was Apsara. It was also the first nuclear reactor in Asia. Nuclear power is the fifth largest source of electricity in India after thermal, hydroelectric, natural gas, and renewable sources of electricity. As of 2021, India has 23 operational nuclear reactors with an installed capacity of about 6,780 MW which amounts to 2.2 percent of total production of electricity in India.

India passed the Atomic Energy Act in 1962 and Radiation Protection Rules of 2004 and has also passed the Civil Liability for Nuclear Damage Act in 2010 to deal with the gigantic problem. The Atomic Energy Act is "for the development, control and use of atomic energy for the welfare of people of India and for other peaceful purposes and for matters connected therewith.[51]" The Civil Liability for Nuclear Damage Act, 2010 has been passed to "provide for nuclear damage and prompt compensation to the victims of a nuclear incident through a no-fault liability regime channelizing liability to the operator, appointment of Claims Commissioner, establishment of Nuclear Damage Claims Commission and for the matters connected therewith or incidental thereto.[52]" Thus, the act is based on the theory of "absolute liability " or "no fault liability" as was pronounced by the Supreme Court in *M.C. Mehta v. Union of India*[53].

G Sundaram v. Union of India[54] : A Historic Case Pertaining to Nuclear Energy.

This case involved the subject matter in which India had entered into an agreement with erstwhile Russia in November 1988 and a supplementary agreement in June, 1998 establishing a nuclear power plant (NPP) at Kudankulam (Tamil Nadu). It was set up accordingly as it was in tune with the Indian national policy to use nuclear power for peaceful purposes. Various objections were made by individuals and institutions for setting up this plant on myriad grounds. The court declined to interfere in the establishment of the plant but culled out several significant points which were to be taken into consideration while establishing other nuclear reactors.

It was concluded by the Court that there are many such nuclear power projects operational in India working very successfully and efficiently, with no

[50] Available at <https://www.eia.gov/energyexplained/nuclear/nuclear-power-and-the-environment.php> (Last visited on December 29, 2021.)

[51] Available at <https://legislative.gov.in/sites/default/files/A1962-33.pdf>

[52] Available at <https://indiacode.nic.in/bitstream/123456789/2084/1/201038.pdf>

[53] (1987) 1 SCC 395

[54](2013) 6 SCC 620.

occurrence of mishap. A nuclear project cannot be stopped only on apprehension and conjectures.

Accordingly, “economic scientific benefits” with “minor radiological detriments” have to be taken into consideration and larger public interest has to be protected along with small harm. It also held that nuclear power plant is being established not to negate right to life but to protect the right to life guaranteed under Article 21 of the Constitution while conforming and achieving the purpose of Atomic Energy Act.

The pronouncement has firmly settled the doctrine that public welfare and public interest is the supreme law of the land and a balance must be striked out to achieve the goals of sustainable development and public safety.

CONCLUSION

True, life would be unintelligible without the energy industry, and no activity is without effects, and power plants are no exception. Environmental law has established itself as a "radical intruder" in the development process. Fossil energy dominance is preserved by a legislation designed for a time before renewables and climate change "equilibrium." Environmental law, when viewed critically and with a focus on more rapid renewable energy development, reinforces renewable energy's "cost barriers" by giving structural and specific deference to traditional resources, even as regulatory reform tightens controls on fossil-fuel electricity generation.

In India, the government has realized the deadly effects of coal based power plant which contributes more than 65 percent of India’s energy sector and it has made bold commitments at international forums more recently at Conference of Parties, 2021 (COP26) by showing its commitment to achieve inter alia, net zero emissions by 2070,committed to increase non-fossil fuel energy capacity to 500 GW, meet 50 percent of its energy requirements from renewable energy, reduce carbon emissions by one billion tons, and bring down the economy’s carbon intensity below 45 percent, all by 2030. It can also be gleaned from the above discussion the crucial role the Indian Supreme Court has played in the development of Indian environmental jurisprudence by reiterating the importance of sustainable development. There are enough laws and regulations which are in place to address the lacunas which pose a threat to the environmental degradation. With regard to the power plants, the compliance mechanism for setting up and running it is quite strong to ensure that no contravention is done to the statutory and regulatory provisions.

The government is committed to increasing the usage of clean energy sources and is now working on a number of large-scale sustainable power projects as well as extensively promoting green energy. Furthermore, renewable energy has the potential to provide a large number of jobs at all levels, particularly in rural areas. The Ministry of New and Renewable Energy (MNRE) has set a lofty goal of building 227 GW of renewable energy capacity by 2022, with around 114 GW planned for solar, 67 GW for wind, and the rest for hydro and bio, among other things. In the next four years, India's renewable energy sector is predicted to receive $80 billion in investment. By 2023, India will have around 5,000 compressed biogas plants.

By 2040, it is predicted that renewable energy would generate roughly 49% of total electricity, thanks to the use of more effective batteries to store electricity, which will reduce the cost of solar energy by 66 percent compared to today's cost.

The Indian government plans to create a "green city" in each state that is powered by renewable energy. Solar rooftop systems on all of the city's houses, solar parks on the outskirts, waste to energy facilities, and electric mobility-enabled public transportation systems will all be used to mainstream environmentally friendly power in the 'green city.'

With that being said, the future prospects as regards the power sector in India looks very bright. Especially its strong commitment towards relying on renewable energy which is more environment friendly. It only remains to be seen how steadfast we will act as a nation to achieve the ambitious goals while fulfilling our constitutional and global obligations.

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