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# The Energy to Change: A Sustainable World

**(**Clean energy: A Special Focus On Fossil Fuels And Health Impacts In India.)

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**REVIEW ARTICLE**

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**Abstract:** The world is changing every day and with increased collective awareness of the damaging effects of fossil fuels. The Public health is a key issue in India. The air and water pollution emitted by coal and natural gas plants is linked with breathing problems, neurological damage, heart attacks, cancer, premature death, and a host of other serious problems. Most of these negative health impacts come from air and water pollution. In India Global warming Emission are extracted from the electricity sectors most of those emission come from fossil fuels like coal and natural gas.

Clean energy technologies could provide a solution to this problem. The Government of India has been focusing in implementing clean energy technologies. The focus of this article is to bring to light the problems faced in India in terms of energy consumption as well as the hindrances faced by clean energy-based technologies. Government policies aimed at addressing these issues, as well as the current state of clean energy technologies in India are discussed, so as to analyse the possibility of a solution to the problems of finding a sustainable method to eradicate clean energy technologies in India. The research reveals that the Government of India has been unable to meet some of its unrealistic development goals, and in order to achieve the remaining goals it will have to take drastic steps. The Government will have to be more aggressive in the promotion of clean energy technologies in order to achieve sustainable development in India.

***Keywords:*** *India, Fossil Fuels, Health impacts, Clean Energy Technologies, Development Goals.*

## 1. INTRODUCTION:

### 1.1 Clean energy and fossil fuel:

India's energy needs are largely met by three fuels – coal, oil and biomass. These sources have, in aggregate, consistently met over 80% of India's total energy demand since 1990. Coal has strengthened its role as the dominant energy source, maintaining its strong position in power generation as well as being fuel of choice for many industries mainly heavy industries such as iron and steel. As the India's Energy Outlook 2021 Results states that the Coal demand nearly tripled between 2000 and 2019, accounting for half of primary energy demand growth. Today coal meets 44% of India's primary energy demand, up from 33% in 2000. Coal has played a significant role in India's economic development while also contributing to air pollution and growing GHG emission[1].

New Technology has revealed to solve these negative impacts that climate change may have on economic growth and health.The impacts of economic change are based on the assumption that greenhouse gases will raise the average temperature in the next 50 Years by between 2°C and 3°C, which represents a threat to the basic elements of human life in different parts of world: access to water, food production, health, land use, and environment. Furthermore, these harmful effects resulting from climate change will be accelerated to the extent that the world will warm more, with poor countries being mainly affected. Weather conditions affect the patterns of diseases such as diarrhea, malaria, malnutrition, etc., most of which affect children and youth in low-income countries. Some of these effects have already taken place, not by generating new diseases, but rather by exacerbating existing illnesses, the effects concerning respiratory diseases being particularly important. Clean energy is a critical component to sustainable development throughout the world. Clean energy technology not only improves our quality of life by reducing air and water pollution, it also mitigates energy dependence by creating renewable resources in local communities [2].

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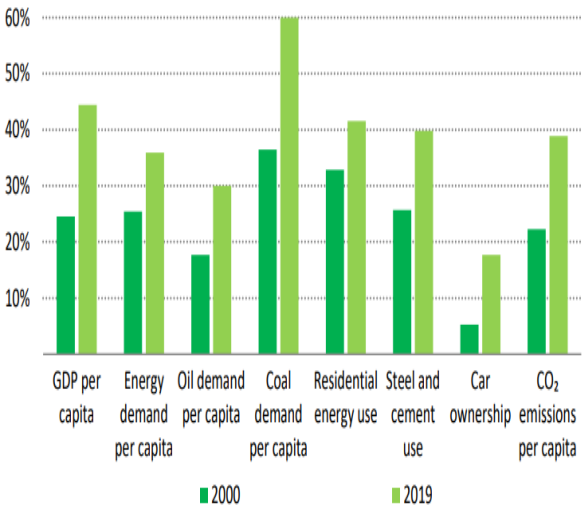


*Fig.1. Energy in India as a percentage of global averages. Source: IEA Analysis World Energy Outlook 2021.*

There is huge potential for further growth in energy service demand in India due to an expanding economy and the forces of urbanisation and industrialization. There are, however, critical questions about how demand growth will be met. With the notable exceptions of solar, coal and wind, India is generally resource-constrained. India is also very densely populated, with relatively high levels of water stress and land-use constraints, and structural poverty and other socio-economic factors mean that the affordability of energy is a major issue. India is currently producing about 729 million tonnes of coal in the year 2020. India has imported 247 million tonnes of coal last year and had spent 1.58 lakh crore as foreign exchange. Despite India being world's second largest coal producer and being the 5th largest country in terms of coal deposits, with coal reserves but nonetheless is one of the world's major coal importers. India is a major center for global oil refining, but relies overwhelmingly on imported crude. Many consumers face unreliable electricity supply, and there are significant commercial and technical losses at the distribution level, but in aggregate there is currently a surplus of generation capacity over demand. India's annual co2 emissions are now the third-highest in the world, but barely make the top 100 as measured by emissions are per capita, and are lower still if historical emissions per capita are considered[3,4].

### 1.2 India and Clean Energy:-

The clean energy industry generates hundreds of billions in economic activity, and is expected to continue to grow rapidly in the coming years. There is tremendous economic opportunity for the countries that invent, manufacture and export clean energy technologies.Responsible development of all of Indian's rich energy, resources includingsolar, wind, water, geothermal, bioenergy & nuclear e nergy will help ensure Indian's continued leadership in clean energy. Moving forward, the Energy Department must continue to drive strategic investments in the transition to a cleaner, domestic and more secure energy future.

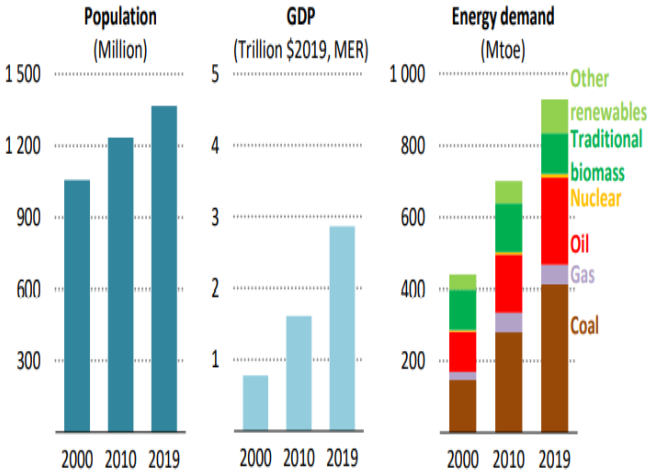


*Fig.2Energy Level in India.*
*Source: IEA Analysis World Energy Outlook 2021.*

India has the largest clean energy expansion plan globally. India ranks 3rd in renewable energy country in 2021.The country has set an ambitious target to achieve a capacity of 175 GW worth of Clean energy by the end of 2022, which expands to 450 GW by 2030. This is the world's largest expansion plan is in renewable energy[5].

As of 31 June 2021, the total installed capacity for renewable energy in India is 96.95 GW. The following is the breakup of total installed capacity for renewables, as of 31 May 2021:

- Wind power: 39.44GW
- Solar power: 41.09 GW
- Bio Power: 10.34 GW
- Small Hydro power: 4.79GW.

Wind energy capacity in India has increased by 2.2 times from FY 2016-17 to FY 2020-21.

Solar power capacity has increased by more than 5 times in the last five years from 6.7 GW to 40 GW in March 2021. Government of India further targets to increase the total Renewable Energy Capacity to 450GW by 2030.

- 42 solar parks of aggregate capacity 23,499 MW have been approved in 17 states up to March 2019.
- Solar Parks in Pavagada(2 GW), Kurnool (1 GW) and Bhadla-II (648 MW) included in top 5 operational solar parks of 7 GW capacity in the country.
- The world's largest renewable energy park of 30 GW capacity solar-wind hybrid project is under installation

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in Gujarat [6].

## 2. FOSSIL FUELS AND ELECTRICITY IN INDIA:

India will stay addicted to fossil fuels for decades despite the government's attempts to cast the country as health conscious and spur investments in clean energy. In Fossil fuel power plants burn coal or oil to create heat which is in turn used to generate steam to drive turbines which generate electricity. In gas plants hot gases drive a turbine to generate electricity, whereas a combined cycle gas turbine (CCGT) plant also uses a steam generator to increase the amount of electricity produced. In 2017, fossil fuels generated 64.5% of electricity worldwide. These plants generate electricity reliably over long periods of time, and are generally cheap to build. However, burning carbon-based fuels produces large amounts of carbon dioxide, which drives climate change. These plants also produce other pollutants, such as oxides of Sulphur and nitrogen, which cause acid rain. [7].

The burning of fossil fuels for energy causes considerable numbers of deaths due to air pollution. About 2.5 million Indians die every year from air pollution caused by burning fossil fuels, Scientists from Harvard University, published in the journal Environmental Research a study has said. This translates to about 30.7 per cent deaths every year because of air pollution. About 8 million people died worldwide in 2018 because of air pollution caused due to fossil fuels like coal, diesel, and petrol. India and China see the highest number of deaths due to fossil fuel burning. While 3.91 million Chinese die every year because of air pollution, the corresponding number for India stands at 2.46 million.[8].

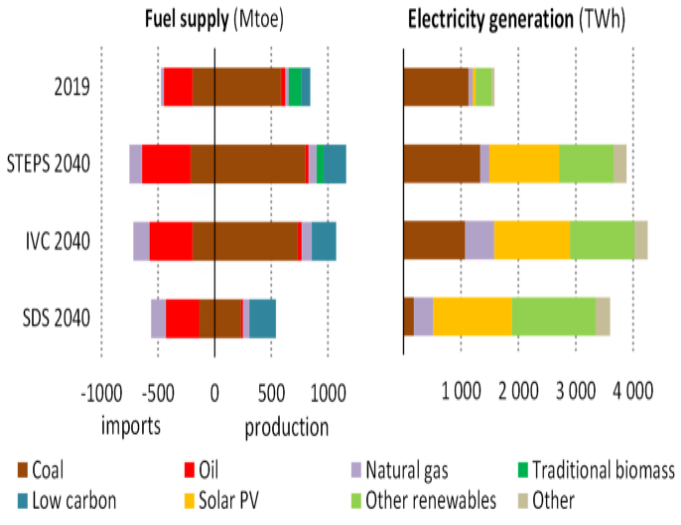


***Fig.3*** *Fuel supply and Electricity generation in India.*
*Source: IEA Analysis World Energy Outlook.*

Over the past century, the main energy sources used for generating electricity have been fossil fuels, hydroelectricity and, since the 1950s, nuclear energy. Despite the strong growth of renewables over the last few decades, fossil-based fuels remain dominant worldwide. Their use for electricity generation continues to increase in both absolute and relative terms: in 2017, fossil fuels generated 64.5% of worldwide electricity, compared with 61.9% in 1990. Access to reliable electricity is vital for human wellbeing. Currently one in seven people in the world has no access to electricity. As such, electricity demand will continue to rise. At the same time, greenhouse gas emissions must decrease drastically if we are to mitigate climate change, and we must switch to cleaner sources of energy to reduce air pollution.

In order to achieve a sustainable world, all sectors of the economy will need to be decarbonized, including transport, heat and industry. Electricity provides the means to utilize low-carbon energy sources, and so widespread electrification is seen as a key tool for decarbonizing sectors traditionally powered by fossil fuels. As the end uses for electricity grow, and as the benefits of electricity are extended to all people, demand will grow significantly [7].

## 3. HEALTH IMPACT AND CLEAN ENERGY TECHNOLOGIES:

Studies have been conducted on the issues related to health impacts using clean energy Technologies in developing countries. Here, only those issues which pertain to India will be discussed. The issues related to fossil fuels based health impacts are mainly discussed.

The burning of fossil fuels is the world's largest contributor to air pollution kills an estimated seven million people worldwide every year and is a major global public health concern. It releases a wide array of harmful pollutants, including particulate matter, ozone, nitrogen dioxide, sulfur dioxide, mercury, and other hazardous air pollutants. The health effects of breathing polluted air include reduced lung function, asthma, cardiovascular disease, preterm birth, and premature death. Generally, older people are more susceptible to premature death due to air pollution. While children are especially vulnerable to asthma and impaired lung function development. Air pollution, predominantly from burning fossil fuels, reduces worldwide average life expectancy by nearly three years. If fossil fuel emissions were completely eliminated, the global average life expectancy would increase by 1.1 years [9].

### 3.1 Coal impacts:

Burning coal releases a number of harmful pollutants, including particulate matter, sulfur dioxide, nitrogen dioxide, and metals such as mercury, arsenic, chromium, and other known and possible carcinogens. The public health consequences of extracting, processing, and burning coal include respiratory

illness, cancer, cardiovascular disease, kidney disease, poor birth outcomes, poor quality of life, mental health problems, and death. More than 3,000 deaths every year are attributable to pollution from coal-fired power plants. Exposure to mercury released from power plants has been linked to an increased risk of diabetes and autoimmune dysfunction in adults and permanent neurological damage in children.Coal-fired power plants also harm public health by producing immense quantities of coal ash, a byproduct of burning coal that contains numerous toxic metals including mercury, arsenic, lead, chromium, cadmium, nickel, zinc, and others. There are at least 737 coal ash dumps in 17 states, nearly all of which are contaminating groundwater with toxins. Power plants typically dispose of coal ash in surface impoundments, often unlined, which leak into surrounding soil, groundwater and surface water, and are disproportionately likely to be located near low-income communities. Breathing and ingesting coal ash toxins can cause a multitude of health problems including cancer, cardiovascular problems, and nervous system damage[10].

**3.2 Oil and Gas pollution:**

More than 50 million Indians live near oil and gas operations that have measured air pollution levels exceeding the federal health standard. Oil and gas operations are the leading industrial source of smog-forming volatile organic compounds, releasing numerous toxic chemicals, such as hydrogen sulfide, toluene, xylene, benzene, and formaldehyde, have serious public health impacts. Exposure to air pollution released by the oil and gas sector is expected to cause 2,000 premature deaths, 3,600 emergency room visits, 100,000 lost days of work, and over a million asthma exacerbations annually by 2025 and each year thereafter, resulting in annual health damages of 26 billion. Studies have also linked living near oil and gas wells to lower birth weights, preterm births, and other negative birth outcomes in Colorado, Pennsylvania, Oklahoma, and Texas. A study found that pregnant women living near the highest-producing wells in the state were 40 percent more likely to have low birth weight babies than people living farther away or near inactive sites[10].

**3.3 Transportation pollution**

The transportation sector, which relies almost entirely on fossil fuels, is the largest source of India greenhouse gas emissions and accounts for more than two-thirds of all oil burned in India every day. Pollution emitted by the transportation sector includes particulate matter, volatile organic compounds, nitrogen oxides, carbon monoxide, and sulfur dioxide, and causes a wide array of health impacts ranging from respiratory, cardiovascular, and immune system problems to cancer and premature death. Air pollution due to vehicular traffic in urban dwellings can sensitize residents to pollens and is also associated with eczema in children. Self-reported nasal discharge, blocked nose, sneezing and itching were strongly associated with living close to heavy traffic. Proximity of residence of women during pregnancy to main road also increased the association of diagnosis of asthma and atopic eczema in the infants born to these women[10].

**3.4 CO2 emission:**

CO2 is the fourth most abundant gas in the earth's atmosphere CO2 is also produced when fossil fuels are burned or decaying vegetation.CO2 can produce a variety of health effects. These may include headaches, dizziness, restlessness, a tingling or pins or needles feeling, difficulty breathing, sweating, tiredness, increased heart rate, elevated blood pressure, coma, asphyxia, and convulsions.

- 400 ppm: average outdoor air level.
- 400–1,000 ppm in typical level found in occupied spaces with good air exchange.
- 1,000–2,000 ppm in level associated with complaints of drowsiness and poor air.
- 2,000–5,000 ppm in level associated with headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate and slight nausea may also be present.
- 5,000 ppm in this indicates unusual air conditions where high levels of other gases could also be present. Toxicity or oxygen deprivation could occur. This is the permissible exposure limit for daily workplace exposures.
- 40,000 ppm in this level is immediately harmful due to oxygen deprivation. These levels of CO2in the air causes potential health problems[11].

**4. CLEAN ENERGY TECHNOLOGIES:**

**4.1. Solar energy:**

Solar energyis the energy produced by technologies using the sun radiation. Solar energy technologiesare divided into:

1. Photovoltaic solar systems, which directly convert the solar energy to electricity.
2. Active solar systems, which convert the solar radiation in heat.
3. Bioclimatic design and passive solar systems, which include architectural solutions and the use of appropriate building materials to maximize the direct utilization of solar energy for heating, air conditioning, or lighting[12].

**4.2. Wind Energy:**

Wind is used to produce electricity using the kinetic energy created by air in motion. This is transformed into electrical energy using wind turbines or wind energy conversion systems. Wind first hits a turbine’s blades, causing them to rotate and turn the turbine connected to them. That changes the kinetic

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energy to rotational energy, by moving a shaft which is connected to a generator, and thereby producing electrical energy through electromagnetism [13].

**4.3. Geothermal Energy:**

Geothermal energy is the heat extracted from Earth. This Technology results In clean and sustainable world. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma. Geothermal energy, as natural steam and hot water, has been exploited for decades to generate electricity, and both in space heating and industrial processes [14].

**4.4. Hydroelectric energy:**

Hydroelectric energy, also called hydroelectric power or hydroelectricity, is a form of energy that harnesses the power of water in motion-such as water flowing over a waterfall-to generate electricity. There are three different types of hydroelectric energy plants.

1. Impoundment facility, Dam is used to control the flow of water stored in a pool or reservoir. When more energy is needed, water is released from the dam. Once water is released, gravity takes over and the water flows downward through a turbine. As the blades of the turbine spin, they power a generator.
2. Diversion facility, this type of plant is unique because it does not use a dam. Instead, it uses a series of canals to channel flowing river water toward the generator-powering turbines.
3. Pumped-storage facility, this plant collects the energy produced from solar, wind, and nuclear power and stores it for future use. The plant stores energy by pumping water uphill from a pool at a lower elevation to a reservoir located at a higher elevation. When there is high demand for electricity, water located in the higher pool is released. As this water flows back down to the lower reservoir, it turns a turbine to generate more electricity.

Renewable energy is providing affordable electricity right now and can help stabilize energy prices in the feature although renewable facilities require upfront investments to build they can then operate at very low cost for most clean energy technologies that fuel is free. In addition to the jobs directly created in the renewable energy industry growth and clean energy can create positive economic ripple effects[15].

**5. THE ENERGY TO CHANGE:**

**I**ndia can become world's most important energy transition in future.

The choices will make or break the world's fight against climate change, for if India chooses fossil fuels to power its growing economy, its carbon emission could explode, making it the world's number one emitter later this century. Still, for most Indian's fossil fuels are a luxury. Most live in rural areas, and wood, cow dung and bioenergy sources account for two-thirds of household energy use. Just 6% of Indians own cars, and 2% have air conditioning. Indians will need far more energy to escape poverty and live modern, dignified lifestyles. By 2050 most will live in cities, and they'll want to drive to work and cool their homes. Along the way, India will become the world's most populous country, home to 1.6 billion people by mid-century. Its economy could multiply tenfold, its energy needs could quardruple.

Today, coal, oil and gas supply three-quarters of Indian's energy, producing electricity, fueling vehicles and powering Indian's factories. If, by 2050, India still gets the same proportion from fossil fuels, it'll be a disaster for everyone, not least local populations, vulnerable to pollution, climate change or rapacious new coal mining. Instead, India can make renewable energy the beating heart of a reimagined economy in three goals to achieving affordable, reliable, sustainable and clean energy all at the same time.It's a route no country in history has ever taken, but it is possible, and this moment demands it.

India will need to build solar and wind power at an unprecedented scale and speed, replacing coal-fired power plants.

India will need to extend the reach of that renewable energy to power sectors of the economy like industry and transportation that haven't traditionally used electricity.

India must become radically more energy-efficient [16].

**6. RESULT:**

**Goals to achieve clean energy:**

**Goal 1:** India must build thousands of gigawatts of solar and wind power.it will be more than enough renewable energy to power all of America. Fortunately, India is blessed with abundant sunshine.it could supply all of needs by tapping the sunlight that shines on less than 10 % of India's wastelands.

India also has substantial untapped wind potential on land and offshore. Wind and solar complement each other because the wind often blows harder when it's less sunny, like during the monsoon rains.

Wind and solar power are now cheaper than coal power, and it costs less to build a solar farm in India than anywhere else in the world. Batteries have also become dramatically cheaper, making it possible to store and deliver energy on demand. Renewable energy has risen rapidly but it will need to grow even more explosively through mid-century.

This is the critical decade to invest in solar and wind power and avoid locking in new, long-lived coal power plants. India must

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also urgently expand its grid to deliver power for massive solar and wind plants in the sun-soaked deserts of Rajasthan or the windy coast of Gujarat, to energy hungry cities like Mumbai. Not all renewables should be built at massive scale. Distributed solar, on the rooftops of warehouses or the outskirts of sprawling cities, can produces power close to where it's needed.

Nuclear and hydropower will be essential to energy transition around the world . But India simply lacks the state capacity needed to build complex pricey projects at a breakneck pace, and all that push to build renewable wind and solar power best plays to Indian's strengths.

**Goal 2:** use renewable energy across the economy, including in sectors like industry and transportation that don't use electricity today. As rising renewable energy makes the power grid cleaner, India should make all of Its trains run on electricity and move more heavy freight from heavy trucks to rail. India's road vehicle fleet can also go electric. The most important thing is to use electric vehicles, but these two and three-wheelers make up more than 80% of India's vehicle fleet. To accelerate the adoption of electric scooters and rickshaws, India should build out charging stations and beef up local power grids to handle the influx of electricity demand. Still, electrification won't work everywhere. It may not be possible to use electricity to power some heavy industrial processes in the fast-growing steel, cement, fertilizer and petrochemical sectors. Plants may need to add equipment to capture carbon emissions from burning fossil fuels.

Another solution to this problem is clean hydrogen. Surplus renewable electricity can run machines called electrolyzers that can split water into oxygen and hydrogen and green hydrogen fuel. That hydrogen can then power applications in transportation and industry, such as making steel or chemicals. Hydrogen can also act as a sort of battery, storing surplus wind and solar power to be used later.

**Goal 3:** Improve energy efficiency: If there's any country in the world where efficiency is all-important, it's India. Even if India builds a massive supply of renewable energy and extends the reach of that energy by stitching together its economy, it won't be enough without energy efficiency. Because if India's voracious demand for energy rises too quickly, it'll have to fill the gap with polluting fossil fuels. Here is a statistic solution, just to power the insane demand for air conditioning, India will need to add 70% of the power system capacity of all of Europe today and because much of India is hot and humid, air conditioning demand will peak during summer, making it tough for solar to power ACs . But far more efficient air conditioners could make it possible to power the aspirations of a rising middle class with renewable energy.

India's big advantage is that it's largely a clean slate. An incredible 70% of India's infrastructure in 2030 hasn't been built yet. That presents a huge opportunity to enact stringent efficiency standards and design energy-efficient buildings and cities. Still, there are warning signs that India's energy transition could sputter out. COVID-19 sharply slowed the building of new renewable energy plants. Even larger challenges loom.

India's electricity distribution utilities are mismanaged, economically fragile and force by many states to subsidize power to farmers and residential customers. India needs reforms to more efficiently combat energy poverty while overhauling unprofitable utilities so they can pay for clean energy on time. Doing so will make it possible to raise trillions of dollars at home and abroad to finance India's clean energy transition.

**7. CONCLUTION:**

That transition will stall without new and improved technologies. economic opportunity for India to cultivate advanced clean energy industries. In future India should manufacture and export energy-efficient air conditioners, electric two and three-wheelers and equipment to produce and use hydrogen.

India's already strong in wind power manufacturing, and it could become a global leader in digital energy technologies.

The international community can help by funding innovation to make India's energy transition faster and more affordable.

Finally, coal isn't going away without a fight. its big business in India. Near Korba, India's coal capital, private companies are pushing ahead to expand coal mining, even deforesting an elephant preserve to dig out the coal underneath. The wind turbine blades are manufactured in India, and the electricity they'll go on to generate will help power economic growth.

Renewable energy offers India a cleaner and more prosperous future than coal ever can. Unless we hasten the transition, air pollution and climate change will continue to ravage the country and endanger the planet.

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