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NON-RENEWABLE ENERGY RESOURCES

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ABSTRACT

India's non-renewable energy resources consist mainly of coal, oil, natural gas, and nuclear energy. These are finite resources that play a dominant role in the country's energy supply, especially coal, which powers the majority of electricity generation. However, heavy reliance on imported oil and gas strains energy security. Non-renewables also contribute to environmental degradation, including air pollution and greenhouse gas emissions. Despite significant reserves of coal and modest amounts of oil, gas, and uranium, the depletion of these resources and their environmental impacts are prompting a shift toward renewable emissions, and their finite nature, have led to increasing efforts to explore and expand renewable energy options for a more sustainable future alternatives.

Nonrenewable energy comes from sources that will run out or will not be replenished in our lifetimes—or even in many, many lifetimes. Most nonrenewable energy sources are fossil fuels: coal, petroleum, and natural gas. Carbon is the main element in fossil fuels. The resources which cannot be immediately replaced once they are depleted are called non-renewable resources. Examples of non-renewable resources include fossil fuels, such as coal, petroleum, natural gas and rare minerals typically found in meteorites.

1. INTRODUCTION

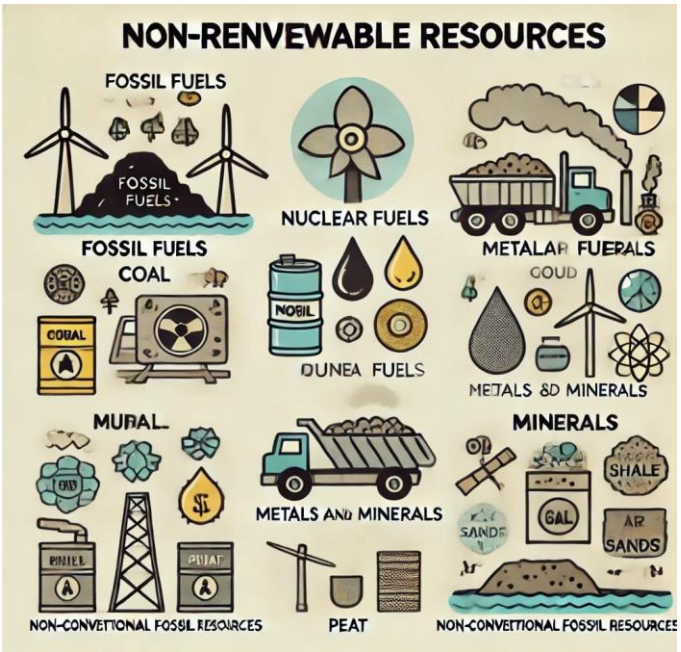
India's energy landscape is largely shaped by its dependence on non-renewable resources, which account for a significant portion of the country's energy consumption. These non-renewable resources, including coal, petroleum (oil), natural gas, and nuclear energy, are critical to India's industrial, transportation, and electricity sectors.

While coal remains the dominant energy source due to its vast reserves, the country also relies heavily on imported oil and gas to meet its growing energy demands. However, the environmental impacts of these resources, such as pollution and carbon

NON-RENEWABLE ENERGY RESOURCES

A non-renewable resource (also called a finite resource) is a natural resource that cannot be readily replaced by natural means at a pace quick enough to keep up with consumption.[1] An example is carbon-based fossil fuels. The original organic matter, with the aid of heat and pressure, be comes a fuel such as oil or gas. Earth minerals and metal ores, fossil fuels (coal, petroleum, natural gas) and groundwater in certain aquifers are all considered non-renewable

resources, though individual elements are always conserved (except in nuclear reactions, nuclear decay or atmospheric escape).



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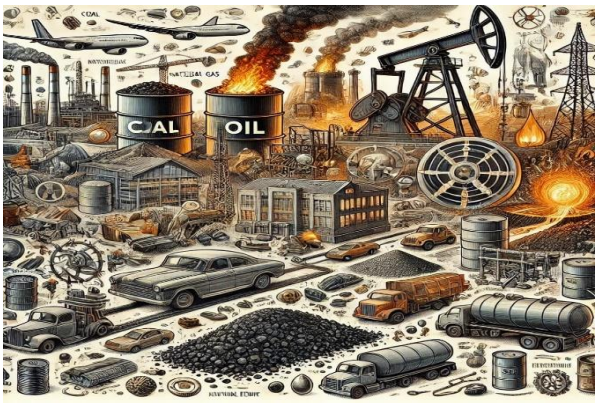
Conversely, resources such as timber (when harvested sustainably) and wind (use to power energy conversion system) are considered renewable resources, largely because their localized replenishment can also occur within human lifespans .



2. METHODS OF A NON, RENEWABLE

ENERGY RESOURCES:

India utilizes various methods to extract and manage non-renewable resources such as fossil fuels (coal, petroleum, natural gas), minerals, and certain metals. Here's a breakdown of the methods employed:

1. Coal Mining

Surface Mining (Opencast Mining): This is the most common method in India. Large-scale operations like in Jharkhand, Odisha, and Chhattisgarh use this method to extract coal that is near the surface.

Underground Mining: Deeper coal reserves are extracted using underground methods, though this is less common due to higher costs and complexity.

2. Petroleum and Natural Gas Extraction

Onshore Drilling: Major oilfields in Assam, Gujarat, and Rajasthan use onshore drilling techniques to extract oil. The Oil and Natural Gas Corporation (ONGC) is a key point.

Offshore Drilling: Offshore rigs in the Bombay High and Krishna- Godavari Basin are significant contributors to India's oil and gas production.

Hydraulic Fracturing (Fraking):- While not widely used, fracking is being explored for extracting shale gas.

3. Mineral Mining:-

Open-pit Mining: For resources like iron ore, bauxite, and limestone, open-pit mining is a common practice in states like Odisha, Goa, and Karnataka

Underground Mining: Minerals like zinc, copper, and gold are sometimes extracted using underground methods, especially in Rajasthan and Karnataka.

4. Nuclear Fuel Mining

Uranium Mining: India has limited uranium reserves, which are extracted through underground mining in places like the Jaduguda mines in Jharkhand.

5. Sustainability Concerns

Environmental Regulations: India's government has enacted various laws like the Mines and Minerals (Development and Regulation) Act, and it requires companies to carry out Environmental Impact Assessments (EIA) before starting large projects.

Renewable Energy Transition: Given the heavy reliance on non-renewable resources, India is increasingly focusing on expanding its renewable energy sector (like solar and wind energy) to reduce the depletion of its non-renewable reserves.

These methods provide the backbone for India's industrial and energy needs but also pose environmental and social challenges.

Now we will see the types of non-renewable energy resources, their characteristics, uses.

1. Fossil Fuels

Fossil fuels are formed from ancient organic matter—plants and animals—buried under layers of sediment and rock. Over millions of years, heat and pressure transformed this material into the fossil fuels we use today.

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a. Coal

Formation: Formed from dead plant material accumulated in swamps millions of years ago.

Types of Coal:

Anthracite: Highest carbon content and energy content; used for electricity and heating.

Bituminous: Commonly used in power plants for electricity and steel production.

Sub-bituminous: Used in electricity production; has lower sulfur content.

Lignite: Known as "brown coal," used primarily in electricity production with lower efficiency.

Uses: Power generation, steel manufacturing, and cement production.

Environmental Impact: High carbon emissions, acid rain from sulfur dioxide, and land degradation from mining.

b. Oil (Petroleum)

Formation: Created from tiny sea creatures and plants in ancient oceans, trapped under sediment and transformed over millions of years.

Types of Oil:

Crude Oil: The raw form extracted from the earth, refined into various products.

Gasoline: Used primarily for cars and light trucks.

Diesel: Used in trucks, buses, ships, and some power plants.

Kerosene: Used as jet fuel and in heating.

Uses: Transportation (gasoline and diesel), heating, electricity, plastics, and chemicals.

Environmental Impact: Greenhouse gas emissions, oil spills, habitat destruction, and pollution.

c. Natural Gas

Formation: Often found alongside oil, formed from marine organisms and plants. The primary component is methane.

Types of Natural Gas:

Conventional Natural Gas: Extracted from natural gas fields.

Shale Gas: Extracted from shale rock formations through hydraulic fracturing (fracking).

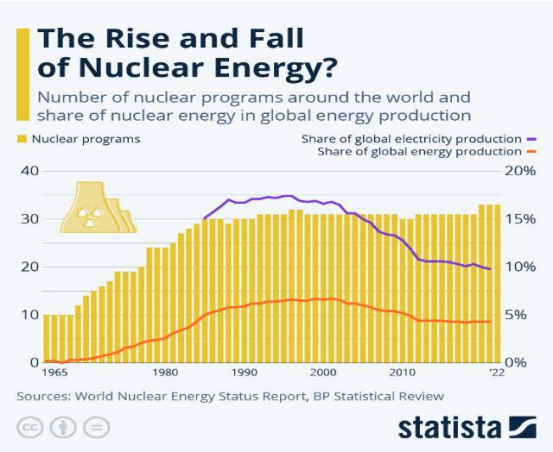
Liquefied Natural Gas (LNG): Natural gas converted to liquid form for easier transport.

Uses: Heating, cooking, electricity generation, and as fuel for vehicles.

Environmental Impact: Emits less CO_2 than coal and oil but methane leaks during extraction and transportation can contribute to climate change.

2. Nuclear Energy

Nuclear energy is produced from the splitting of uranium or plutonium atoms, a process known as nuclear fission. This releases a large amount of heat, which is then used to produce steam and generate electricity.



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Uranium

Characteristics: Uranium-235, a rare isotope, is primarily used in nuclear reactors. It undergoes controlled fission to produce energy.

Extraction: Mined from underground, usually in the form of uranium oxide.

Processing: Enriched to increase the proportion of Uranium-235 for use in reactors.

Uses: Primarily in nuclear power plants and submarines.

Environmental Impact: Nuclear waste is highly radioactive and requires secure, long-term storage.

Plutonium

Characteristics: Plutonium-239 is created from Uranium-238 in reactors and can be used as nuclear fuel.

Uses: Limited mainly to military and specialized reactors, as it is challenging and hazardous to handle.

Environmental Impact: Similar to uranium, with additional concerns regarding its use in nuclear weapons.

Additional Considerations

Energy Density:

Fossil fuels and nuclear energy have high energy density, meaning they produce a large amount of energy per unit of fuel compared to renewables.

Resource Depletion:

Unlike renewable sources, non-renewable resources do not regenerate within a human timescale.

Cost of Extraction and Environmental Risks: Mining and drilling for fossil fuels and uranium can lead to habitat destruction, pollution, and carbon emissions. Nuclear energy, while low-emission, produces radioactive waste, which remains hazardous for thousands of years.

Examples of non-renewable resources include:

Coal: Used primarily for electricity generation and industrial processes.

Crude Oil (Petroleum):

Refined into gasoline, diesel, and other petrochemicals for transport and industrial use

Natural Gas: Used for heating, electricity generation, and as a raw material in manufacturing.

Peat: Used in some regions for heating and electricity generation.

Summary Comparison Table

Resource Type	Examples	Primary Uses	Pros	Cons
Coal	Anthracite, Lignite	Electricity, Steel Production	High energy density	High CO_2 emissions, pollution
Oil	Crude Oil, Gasoline	Transportation, Plastics	Widely used, transportable	Oil spills, greenhouse gases, finite
Natural Gas	LNG, Shale Gas	Heating, Electricity	Lower CO_2 than coal, abundant	Methane leaks, environmental fracking issues
Nuclear	Uranium, Plutonium	Electricity, Military	Low operational emissions	Radioactive waste, high setup cost

Examples of Non-Renewable Energy Resources

1. Coal

Example: **Taichung Power Plant** in Taiwan

Description: The Taichung Power Plant, located in Taiwan, is one of the largest coal-fired power stations in the world. It has a capacity of over 5,500 megawatts and is a critical source of electricity for Taiwan, providing power to millions of homes and industries. However, its heavy coal usage makes it a significant contributor to carbon emissions in the region.

2. Oil (Petroleum)

Example: **Ghawar Oil Field** in Saudi Arabia

Description: The Ghawar Oil Field is the largest conventional oil field in the world, located in eastern Saudi Arabia. It has an estimated production of over 3 million barrels of oil per day. This oil is refined into various products, such as gasoline, diesel, and jet fuel, supplying both domestic and international energy demands. The field has been operational since the 1950s, and while it remains productive, concerns exist over its long-term sustainability.

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3. Natural Gas

Example: **ZapSibNeftekhim** in Russia

Description: ZapSibNeftekhim is a massive petrochemical complex in Siberia, Russia. It uses natural gas as a feedstock to produce a variety of petrochemical products, including polyethylene and polypropylene, which are critical components in the plastic manufacturing industry. Natural gas is also used to power the facility, demonstrating its dual role as both a power source and a raw material for industrial production.

4. **Nuclear Energy**

Example: **Kashiwazaki-Kariwa Nuclear Power Plant** in Japan

Description:

the Kashiwazaki-Kariwa plant, located in Niigata Prefecture, Japan, is one of the largest nuclear power plants in the world. With a capacity of around 8,000 megawatts, it can generate enough electricity to power millions of homes. Although

Summary of Examples

Resource Type	Example	Location	Capacity	Uses
Coal	Taichung Power Plant	Taiwan	5,500 MW	Electricity production
Oil	Ghawar Oil Field	Saudi Arabia	3 million barrels/day	Fuel for transport, industrial applications
Natural Gas	ZapSibNeftekhim	Russia	Industrial complex	Petrochemicals, heating, electricity
Nuclear	Kashiwazaki-Kariwa Nuclear Plant	Japan	8,000 MW	Electricity for residential and commercial use

nuclear power has the benefit of low carbon emissions, this plant has faced significant scrutiny following the 2011 Fukushima disaster, highlighting the risks associated with nuclear energy in areas prone to natural disasters.

here are some references and resources related to nanotechnology in renewable energy:

1. **Books:**

   "Nanotechnology for Renewable Energy" by H. S. Nalwa (Editor) - This book covers various aspects of nanotechnology applications in renewable energy sources, including solar cells and fuel cells.

   "Nanotechnology in Renewable Energy: Materials, Devices, and Applications" by S. J. Park and T. M. K. M. Alhazmi - This text provides insights into the latest developments in nanomaterials for renewable energy applications.

2. **Journal Articles:**

   "Nanomaterials for Renewable Energy Applications: Solar Cells, Hydrogen Production, and Fuel Cells" - This review article discusses the role of nanomaterials in enhancing the efficiency of solar cells, hydrogen production, and fuel cells.

   "Nanotechnology in Energy Production and Storage: Applications and Future Directions" - This article provides an overview of how nanotechnology can improve energy storage systems and production efficiency.

3. **Online Resources:**

   National Renewable Energy Laboratory (NREL): Their website offers research reports and publications related to renewable energy technologies, including those involving nanotechnology.

   U.S. Department of Energy (DOE): The DOE's Office of Science provides resources and publications on nanotechnology applications in energy systems.

4. **Research Databases:**

   ScienceDirect and SpringerLink: These databases contain numerous articles and research papers on nanotechnology and renewable energy. You can search for specific topics like "nanomaterials in solar energy" or "nanotechnology in energy storage."

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3. CONCLUSION

Non-renewable energy sources like coal, oil, natural gas, and uranium are running out, and once they're gone, we can't get them back. Using these fuels also harms our planet by causing pollution and climate change.

To protect our environment and ensure we have energy in the future, we need to start using more renewable energy sources like solar, wind, and water. These energy sources won't run out and are much cleaner for the planet.

By saving energy, using renewable options when we can, and supporting clean energy, we can all help create a healthier, more sustainable future. Small steps add up, and together, we can make a big difference.

4. REFERENCES

[1] Global Energy Outlook 2024: Peaks or Plateaus? - This report explores the projected decline in fossil fuel demand and increased reliance on renewable energy sources, detailing various scenarios and highlighting the importance of policies for achieving carbon reduction goals. It includes projections for oil, gas, and coal usage and provides insights on carbon capture, use, and storage (CCUS) technologies (Resources for the Futureps://www.rff.org/publications/reports/global-energy-outlook-2024/)).

[2] IEA Renewables 2024 Report - The International Energy Agency's analysis discusses the anticipated rapid growth of renewable energy, particularly solar and wind, which are expected to become major players in the global energy mix by 2030. It covers renewables in electricity, transport, and heating, and addresses the challenges of int IEA able sources in a balanced, flexible energy system (IEA, 2024).