

Environmental Concerns in Power Generation

Impact on Air, Water & Ash Management

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Air Pollution from Coal-Based Power Plants

- ▶ **Major Pollutants:** Sulphur dioxide (SO_2), nitrogen oxides (NO_x), particulate matter ($\text{PM}_{2.5}$, PM_{10})
- ▶ **Key Thermal Clusters in UP:**
- ▶ **Singrauli (NTPC, UPRVUNL units)** – one of India's largest coal power hubs.
- ▶ **Obra & Anpara (Sonbhadra district)** – significant SO_2 and NO_x contributors.
- ▶ **Unchahar (Raebareli)** – medium-sized coal plant affecting central UP.
- ▶ **Parichha & Harduaganj (Jhansi, Aligarh)** – smaller but regionally impactful.
- ▶ **Regional Impact:** Emissions disperse across districts, degrading AQI in surrounding areas.
- ▶ **Health Effects:** Respiratory illness, smog formation, acid rain potential.

Water Use and Pollution from Thermal Power Plants

▶ **High Water Demand:**

- ▶ Coal-based plants consume large volumes for cooling, boiler feed, and ash handling.
- ▶ Example: A 1000 MW plant can use **30–40 million liters/day**.

▶ **Groundwater Stress in UP:**

- ▶ Total groundwater resource ~**66.88 BCM**.
- ▶ Semi-critical zones include **Raebareli, Sonbhadra, Aligarh, Jhansi** (locations of plants).
- ▶ Lucknow itself faces depletion due to urban demand, but power clusters worsen stress in nearby districts.

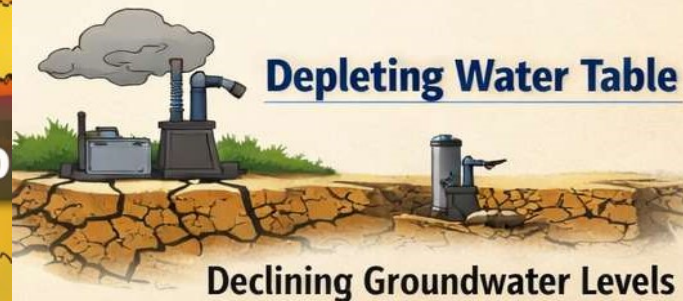
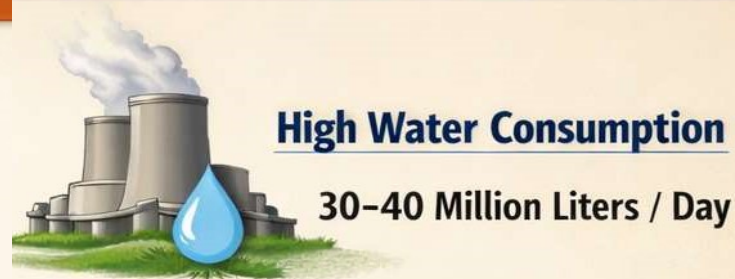
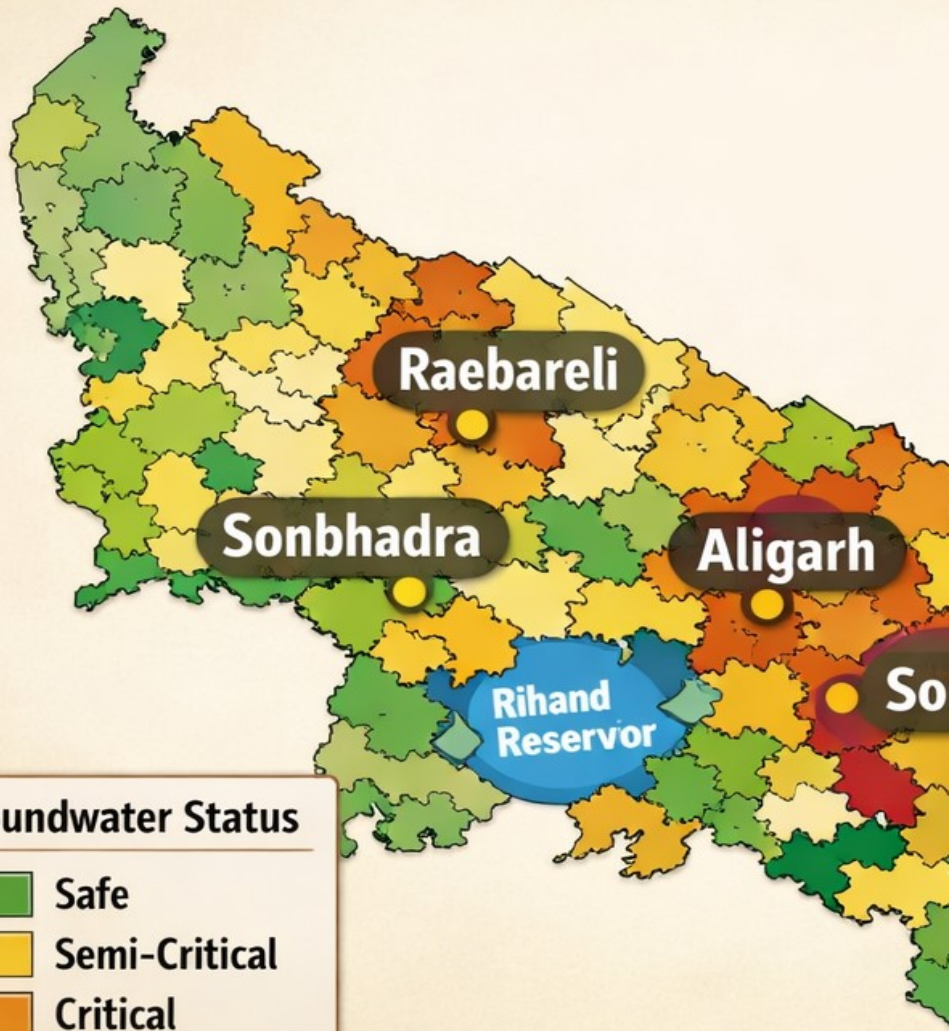
▶ **Effluent Discharge:**

- ▶ Ash slurry and cooling water discharge contaminate rivers and ponds.
- ▶ Heavy metals (arsenic, mercury, lead) leach into water bodies.
- ▶ Case study: **Singrauli region** – contamination of Rihand reservoir.

▶ **Environmental Impact:**

- ▶ Reduced water availability for agriculture and drinking.
- ▶ Thermal discharge raises water temperature, affecting aquatic life.

Water Pollution and Usage in Operation - Uttar Pradesh



State Transformation Commission, U.P.

r, RLDA MoR Delhi | Ex Chief Engineer, Urban Local Bodies,

Fly Ash Generation and Sustainable Utilization

- **Scale of Generation:**

- UP's coal-based plants generate **millions of tonnes of fly ash annually**.
- Major contributors: **Singrauli, Obra, Anpara, Unchahar, Parichha, Harduaganj.**

- **Environmental Challenge:**

- Improper disposal leads to **airborne dust, soil contamination, and water pollution**.
- Ash ponds occupy large land areas and risk **leaching of heavy metals**.

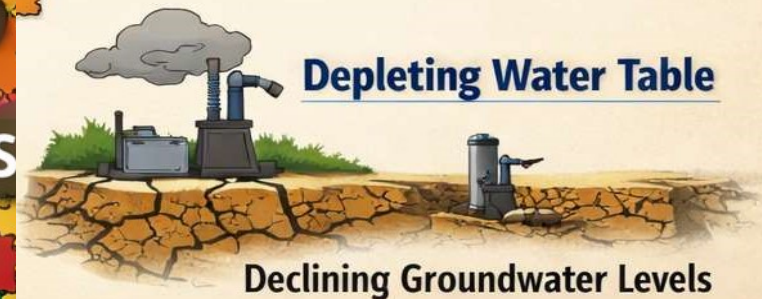
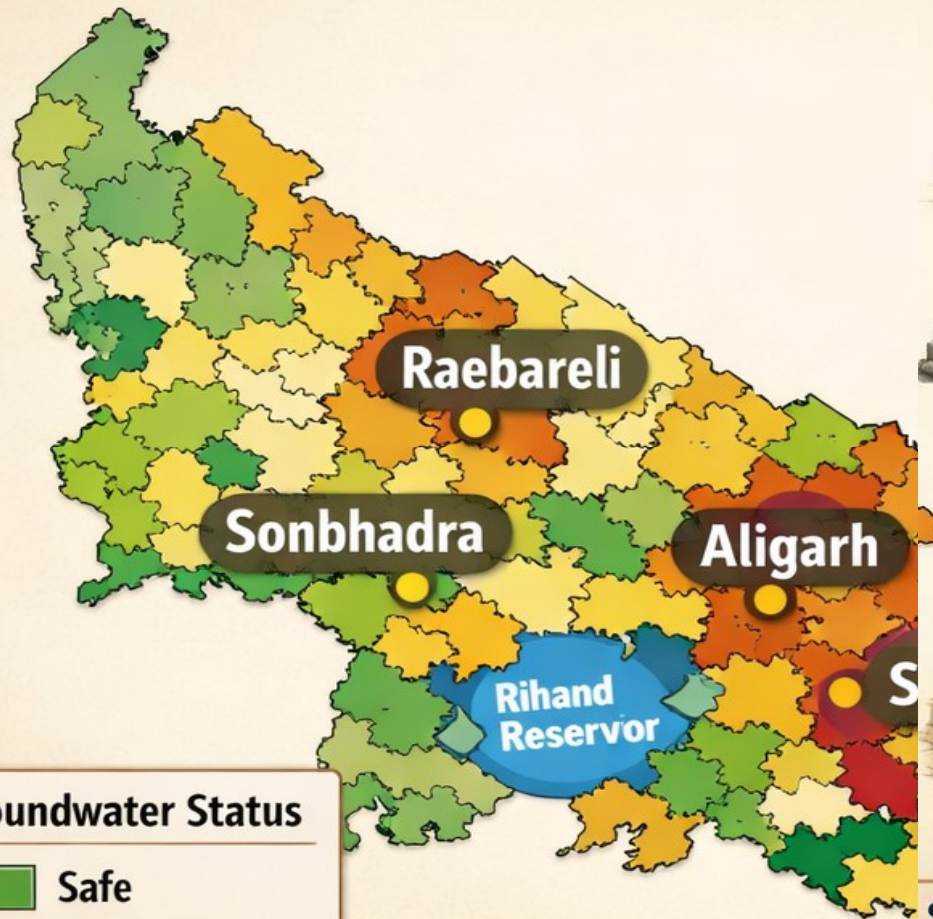
- **Regulatory Framework:**

- **Fly Ash Notification (1999 → 2021)** mandates 100 % utilization.
- Plants must supply ash free of cost to cement, brick, and road-construction industries.

- **Utilization Pathways:**

- **Cement manufacturing** – replaces clinker, reduces CO₂ footprint.
- **Fly-ash bricks** – lightweight, durable, eco-friendly.
- **Road embankments & landfilling** – structural use of surplus ash.

Water Pollution and Usage in Generation - Uttar Pradesh



State Transformation Commission, U.P.

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Sustainable Solutions for Air, Water, and Ash Management

- ▶ **Air Pollution Control:**
- ▶ Installation of **Flue Gas Desulphurization (FGD)** units to reduce SO_2 emissions.
- ▶ Use of **Electrostatic Precipitators (ESP)** for particulate control.
- ▶ Adoption of **Low- NO_x burners** and improved combustion efficiency.
- ▶ Transition to **supercritical and ultra-supercritical technologies** for cleaner generation.

Water Conservation & Recycling:

- **Zero Liquid Discharge (ZLD)** systems in new plants.
- **Closed-loop cooling and reuse of treated effluent.**
- **Rainwater harvesting and ash-pond water recovery.**
- **Monitoring of groundwater abstraction under CGWA norms.**

Ash Management & Utilization:

- **Dry ash collection systems** to minimize slurry discharge.
- **Partnerships with cement and brick industries** for 100 % utilization.
- **Research on geopolymer concrete and road embankment applications**
- **Community awareness programs** for safe ash reuse.

Policy & Institutional Measures:

- Compliance with **MoEFCC Fly Ash Notification (2021)**.
- **State Pollution Control Board monitoring** and online emission tracking.
- **Public-private collaboration** for sustainable infrastructure.

Integrated Mitigation Strategies in Power Generation

AIR



FGD Systems



Electrostatic
Precipitators



Low-NO_x Technology

Fly Ash Utilization Targets

1699



2021

Initial Notification 100 & Utilization

WATER



Zero Liquid Discharge



Water Recycling



Rainwater Harvesting

LIABILITY

ASH



Fly Ash Bricks



Cement & Roads



Innovative R&D

Greener Future

Assets, State Transformation Commission, U.P.

hi | Ex Member, RLDA MoR Delhi | Ex Chief Engineer, Urban

Transition to Cleaner and Sustainable Energy

▶ 1. Solar Energy

▶ **Principle:** Converts sunlight directly into electricity using photovoltaic (PV) cells.

▶ **Advantages:**

- ▶ Zero emissions during operation.
- ▶ Ideal for decentralized generation (rooftop and rural electrification).
- ▶ Abundant resource in Uttar Pradesh — average solar potential $> 5 \text{ kWh/m}^2/\text{day}$.

▶ **Example:** Bundelkhand Solar Park and rooftop solar initiatives by UPNEDA.

Transition to Cleaner and Sustainable Energy

Principle: Wind turbines convert kinetic energy of wind into electrical energy.

Advantages:

- Clean, renewable, and scalable.

- Low operational cost after installation.

- Complements solar during non-sunlight hours.

Example: Wind farms in coastal and high-wind regions (Gujarat, Tamil Nadu); potential expansion in UP's elevated zones.

Transition to Cleaner and Sustainable Energy

▶ **Nuclear Energy**

▶ **Principle:** Controlled nuclear fission releases heat to generate steam for turbines.

▶ **Advantages:**

- ▶ High energy density — small fuel quantity produces large output.
- ▶ Continuous base-load power with minimal greenhouse gas emissions.
- ▶ Long-term reliability and reduced dependence on fossil fuels.

▶ **Example:** Narora Atomic Power Station (Bulandshahr, U.P.) — 440 MW capacity.

Comparative Benefits

	Emission Level	Land Requirement	Reliability	Key Advantage
	None	Moderate	Daytime only	Decentralized, scalable
	None	Moderate	Variable	Complementary to
	Very low	Low	Continuous	High efficiency, baseload
	High	High	Continuous	Mature technology, low cost, but polluting

Alternative Energys for a Sustainable Future

Solar Power

**Renewable &
Zero Emissions**



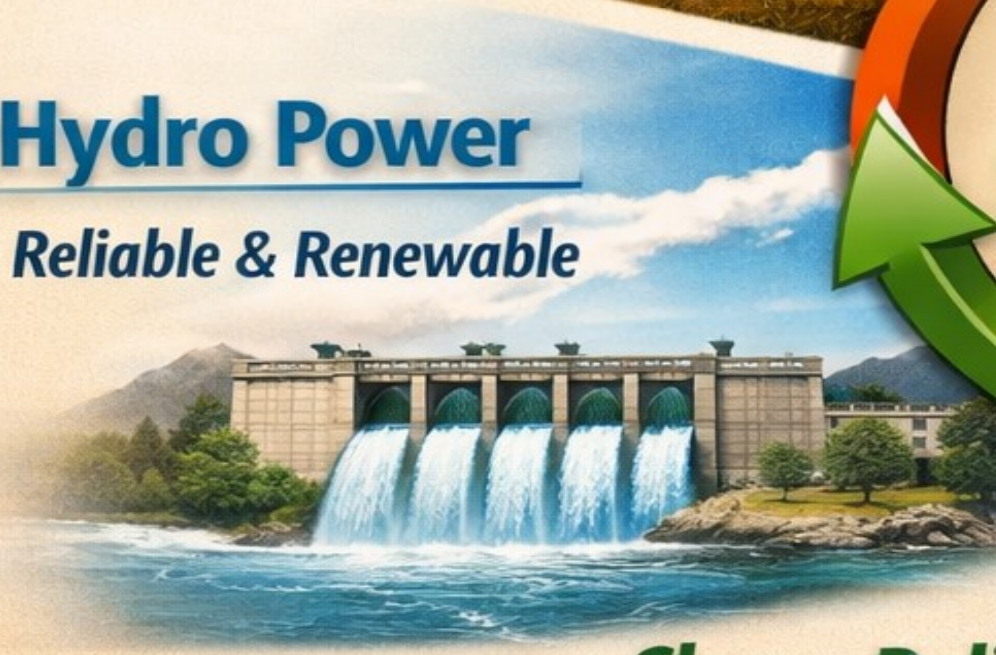
Wind Energy

Clean & Cost-Effective



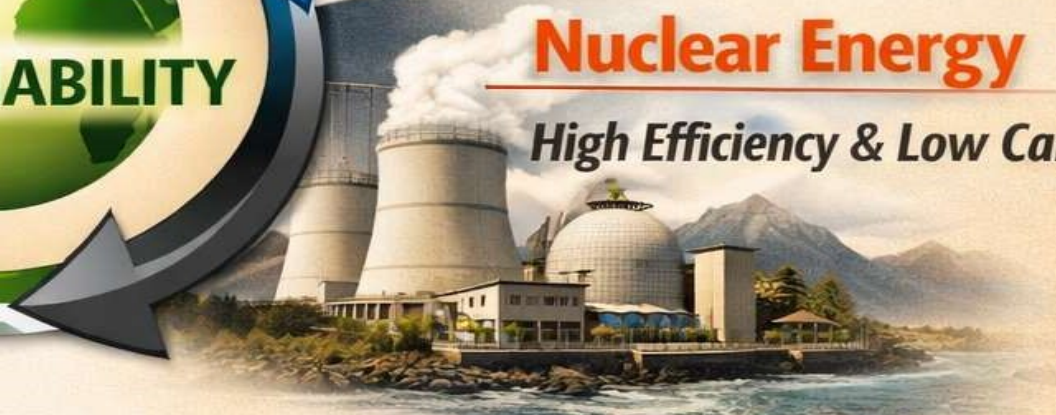
Hydro Power

Reliable & Renewable



Nuclear Energy

High Efficiency & Low Ca



Diverse Energy Mix



dro



Nuclear



Plus Hydro

Clean, Rel

Assets, State Transformation Commission, U.P.

Pathway to Sustainable Power Generation

1. Energy Mix Optimization:

- ▶ Gradually reduce coal dependency to below 50 % by 2030.
- ▶ Expand solar, wind, hydro, and nuclear capacity for balanced generation.

2. Technology Upgradation:

- ▶ Promote **carbon-capture and storage (CCS)** in existing thermal plants.
- ▶ Encourage **smart grids** and **energy-storage systems** for renewables.

3. Policy & Governance:

- ▶ Strengthen **State Energy Transition Policy** with clear emission targets.
- ▶ Incentivize **private investment** in clean-energy infrastructure.
- ▶ Enforce **real-time emission monitoring** and public disclosure.

4. Community & Awareness:

- ▶ Promote **energy literacy** and **consumer participation** in rooftop solar.
- ▶ Encourage **green building codes** and **energy-efficient appliances**.

Future Outlook & Policy Recommendations for Sustainable Power Generation

2020

Coal-Dominant

Over 60% Dependency



2030

Balanced Energy Mix

50% Renewables Target



2050

Net Zero Emissions

Clean & Green Future



**Carbon Capture
& Storage**



**Clean Energy
Investments**



**Smart Grids
& Storage**



**Green Policy
& Awareness**

Uttar Pradesh – From Power Generation to Power Sustainability

Empowering Growth, Preserving the Planet

“From Power Generation to Power Sustainability”

- ▶ “As we conclude, let us remember that power generation is not merely an engineering challenge — it is a responsibility toward our environment and future generations. Uttar Pradesh stands at a pivotal moment: from coal-based dependency to a diversified, cleaner, and smarter energy mix. By integrating solar, wind, hydro, and nuclear power with advanced technologies like carbon capture and smart grids, we can achieve both growth and sustainability. The path ahead demands innovation, policy commitment, and public participation. Together, we can transform our state’s energy landscape — empowering progress while preserving the planet.”



THANK YOU!
Attention!
For



Renewable Energy Future