



Impact of Climate Change on Water and Energy Demand

For Prelims: [Greenhouse Gases](#), [International Energy Agency](#), [Air Pollutants](#), [Biofuel](#), [Intergovernmental Panel on Climate Change](#), [Bioenergy](#), [United Nations Environment Programme](#), [World Meteorological Organization](#), [Desalination](#), [Drip Irrigation](#), [Wetlands](#).

For Mains: Mitigating climate change impact on water scarcity, and energy demand.

Source: DTE

Why in News?

The interplay between [climate change](#), [water availability](#) and [energy demand](#) represents one of the most **critical challenges** in sustainable development.

- Systemic solutions are required for [integrated resource management](#) as climate change rapidly affects both water and energy.

How Climate Change Affects Energy Demand?

- **Increased Energy Demand:** Global warming caused by [greenhouse gas emissions](#) leads to **higher demand for cooling systems** like air conditioners, especially in warmer regions.
 - According to the [International Energy Agency \(IEA\)](#), climate change could increase global energy demand by **25% to 58% by 2050**, driven largely by the need for cooling.
- **Seasonal Patterns:** Besides cooling, some regions might experience **increased heating** demand due to extreme temperature fluctuations, creating **uneven energy requirements globally**.
- **Rising Temperatures:** The surge in cooling demand due to [global warming](#) creates a **feedback loop**: increased energy production (mostly fossil-fuel-based) further accelerates climate change.
 - It further leads to higher emissions of [air pollutants](#) and **greenhouse gases**.
- **Disruptions to Energy Supply:** Declining **snowpack** and **extended droughts** reduce water availability for **cooling power plants** and [hydropower](#).
 - Industries like **petroleum refining** and **biofuel production**, which rely heavily on water, are affected by shortages.
- **Heat Effects:** High temperatures **reduce the carrying capacity of transmission lines**.
 - **Wildfires**, exacerbated by heat, destroy [transmission networks](#) and may start from faulty power lines.

Note: IEA reports that **fossil fuels** account for approximately **80% of global energy generation**.

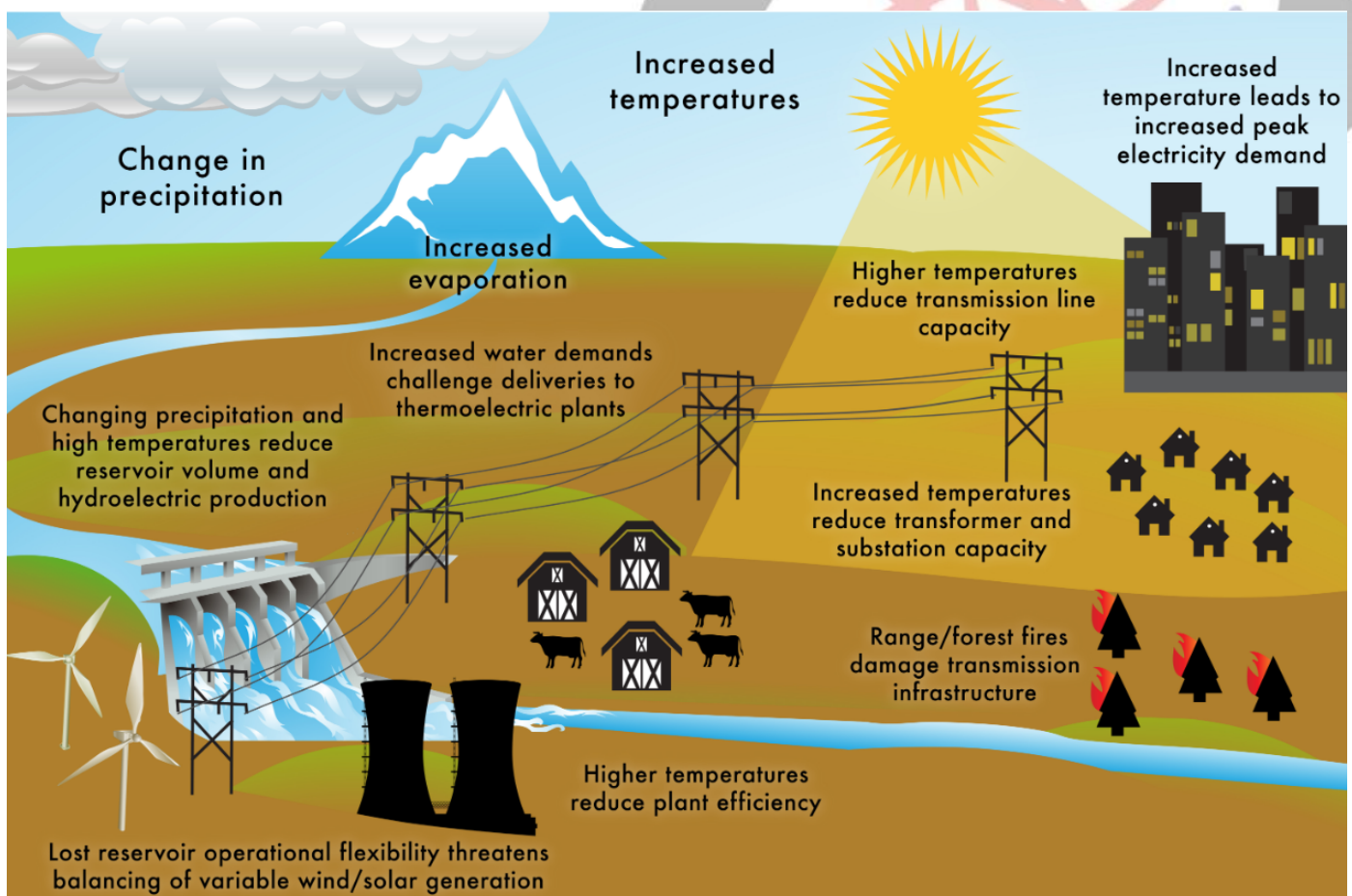
- The [Intergovernmental Panel on Climate Change](#) estimates that fossil fuels are responsible for 73% of greenhouse gas emissions.

How Climate Change Affects Water Resources?

- **Energy Production:** Power plants require substantial **water for cooling to operate efficiently**, but this may be limited by water scarcity.
 - Changes in **streamflow (volume and timing)** affect hydroelectric dams.
 - **A kilowatt-hour of electricity** requires approximately **25 gallons of water** from rivers or lakes.
- **Altered Precipitation Pattern:** Global warming induced **drought** and **reduced rainfall** threaten water access for **drinking, irrigation, and energy**.
 - Declining snowpack reduces water supplies in regions dependent on snowmelt.
- **Bioenergy and Agriculture:** Growing crops for **bioenergy, such as rapeseed, sunflower, soybean, palm, or castor oil**, can place additional stress on water resources.
 - Rising temperatures increase **irrigation needs**, potentially over longer distances, increasing energy consumption.
- **Energy-Intensive Water Management:** Declining freshwater may require **energy-intensive desalination** to convert saltwater into drinking water and groundwater extraction.

Note: According to the [World Resources Institute](#), by **2040, 33 countries** will experience extreme water stress, with over **80% of their water resources withdrawn annually**.

- The [United Nations Environment Programme](#) anticipates a **30% increase in droughts by 2030**, particularly in vulnerable areas.
- The [World Meteorological Organization](#) reports a **fivefold increase** in climate-related disasters over the **past 50 years**, compounding global water stress.



How to Manage Climate-Water-Energy Correlation?

- **Water-Efficient Technologies:** Power plants can reduce water consumption by **up to 90%** through dry cooling systems with slight reduction in efficiency.
 - A dry cooler uses **air to cool fluids** instead of water.
- **Regional Energy Strategy:** High-resolution models **integrate crop, water, and economic data** to identify local resource constraints and develop **regional energy-economic strategies** that address specific needs at a local level.
- **Energy-Efficient Water Management:**
 - **Conventional Treatment:** Prioritising **low-water-intensity** (opposed to **desalination**) solutions like **conventional water treatment** and **water-saving practices** can help balance energy and water needs.
 - **Water-Efficient Practices:** Efficient irrigation systems like **drip irrigation** and **wastewater treatment**, can reduce energy consumption and water wastage.
 - **Water Recycling:** Recycling **greywater** and industrial water can greatly **reduce freshwater demand** in agriculture and industry.
- **Maximise Renewable Energy:** Decentralized systems like **solar and wind** use minimal water (less than 1% of the water used by fossil fuels), reducing competition and supporting sustainable energy.
- **Nature-Based Solutions (NbS):** Restoring ecosystems such as **wetlands, forests,** and **watersheds** enhances water security and reduces energy demands associated with artificial water management systems.
- **Capacity Building:** Building capacity to **design, implement,** and **manage** sustainable energy and water systems is key to long-term success.

Conclusion

The climate-water-energy correlation presents **complex challenges** that require integrated solutions. Prioritising **water-efficient technologies**, renewable energy, and sustainable management practices is essential to mitigating **climate change** impacts. Effective strategies, including **nature-based solutions and capacity building**, are crucial for achieving long-term sustainability and resilience in resource management.

Drishti Mains Question:

Discuss the interlinkages between climate change, water availability, and energy demand. How can integrated resource management address these challenges?

UPSC Civil Services Examination, Previous Year Question (PYQ)

Prelims

Q. Which one of the following ancient towns is well known for its elaborate system of water harvesting and management by building a series of dams and channelizing water into connected reservoirs? (2021)

- (a) Dholavira
- (b) Kalibangan
- (c) Rakhigarhi
- (d) Ropar

Ans: (a)

Q. With reference to 'Water Credit', consider the following statements:

1. It puts microfinance tools to work in the water and sanitation sector.
2. It is a global initiative launched under the aegis of the World Health Organization and the World Bank.
3. It aims to enable the poor people to meet their water needs without depending on subsidies.

Which of the statements given above are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

Ans: (c)

Mains

Q.1 What are the salient features of the Jal Shakti Abhiyan launched by the Government of India for water conservation and water security? (2020)

Q.2 Suggest measures to improve water storage and irrigation system to make its judicious use under the depleting scenario. (2020)

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