Science & Technology · GS - III

Space-based solar energy and orbital data centres are emerging as potential components of future digital infrastructure. Examine their technological opportunities, environmental implications and strategic challenges.

EXAM YEAR	PAPER	SUBJECT
DAILY PRACTICE 12/11/2026	GS - III	Science & Technology

MARKS	WORD LIMIT
10	~150 words

Answer Hint

Space-based solar power, uninterrupted solar energy, satellite-based AI infrastructure, photovoltaic technology, radiative heat management, orbital debris, launch costs, space sustainability, spectrum and orbital regulation, international cooperation.

Model Answer

Introduction

Growing demand for artificial intelligence and digital services is increasing pressure on terrestrial energy and data infrastructure. Space-based solar systems and orbital data centres are being explored as possible alternatives.

Technological Opportunities

Orbital solar arrays can access sunlight without atmospheric interference and may provide more consistent energy generation. Integrating solar power with satellite-based computing could support communication, data processing and certain AI applications. Wireless transmission through microwaves or lasers may also enable future space-based power systems.

Challenges and Environmental Implications

High launch and manufacturing costs, radiation exposure, equipment maintenance and limited heat dissipation pose major engineering challenges. Spacecraft must rely on radiative cooling because convection does not occur in vacuum. Large satellite constellations may increase orbital congestion, collision risks and space debris. Their full environmental footprint, including launch emissions and manufacturing impacts, also requires assessment.

Way Forward

Investment in efficient solar cells, thermal management, debris mitigation and international space governance is essential. Life-cycle environmental assessments and transparent regulation should accompany commercial expansion.

Conclusion

Space-based infrastructure offers significant possibilities, but its viability depends on technological feasibility, economic sustainability and responsible use of outer space.

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