Geography · GS - I

India has immense potential of solar energy though there are regional variations in its developments. Elaborate.

EXAM YEAR	PAPER	SUBJECT
2020	GS - I	Geography

MARKS	WORD LIMIT
15	~250 words

Answer Hint

Solar radiation; geographical variations; Rajasthan and Gujarat; rooftop solar; solar parks; energy security; technological and infrastructural constraints; policy initiatives; balanced regional development

Model Answer

Introduction

India possesses substantial solar energy potential because of its tropical location, abundant sunshine and large areas suitable for solar installations. However, solar development varies across regions due to differences in solar radiation, land availability, infrastructure and investment.

Factors determining solar potential

- **Geographical location:** Western and northwestern India, particularly Rajasthan and Gujarat, receive high solar radiation and have extensive areas suitable for utility-scale solar parks.
- **Climatic conditions:** Cloud cover, rainfall, humidity and seasonal variations influence solar generation. Parts of central and southern India also offer favourable conditions.
- **Land availability:** Arid and semi-arid regions can accommodate large solar installations, although ecological sensitivity and competing land uses must be considered.

- **Rooftop opportunities:** Urban centres and industrial regions have significant potential for rooftop solar, reducing dependence on land-intensive projects.
- **Distributed generation:** Solar pumps, mini-grids and decentralised systems can improve electricity access in remote and rural areas.

Reasons for regional variations

- Differences in sunshine duration and weather conditions.
- Unequal availability of transmission infrastructure and grid connectivity.
- Land acquisition difficulties and competing agricultural or ecological needs.
- Variations in investment, state policies, financing and technical capacity.
- Storage costs and intermittency, particularly where grid flexibility is limited.

Measures to realise the potential

The National Solar Mission, solar parks, rooftop programmes and the PM-KUSUM scheme promote solar expansion. Further progress requires investment in transmission, battery storage, domestic manufacturing and research. Floating solar and agrivoltaics can reduce pressure on land, while decentralised systems can benefit underserved regions.

Conclusion

India's solar potential is substantial but unevenly distributed. A region-specific strategy combining large solar parks, rooftop systems, storage and stronger transmission networks can improve energy security and support a low-carbon transition.