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Q16

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

UPSC Civil Services Mains 2020 · GS I · 15 marks · World's Physical Geography

Salient features of world's physical geography.

**Core demand of the question**

- India has immense potential of solar energy though there are regional variations in its developments. Elaborate
- Keep a 15-mark length

**Revision summary**

India has high tropical solar potential nationwide.

Utility parks cluster in Rajasthan, Gujarat, and the southern Deccan.

Cloud, land, and grid keep the Northeast and Himalaya on rooftop and pumps.

DISCOM risk and net-metering explain urban rooftop lag.

ISA, NSM, and KUSUM are the policy tools to spread development.

**Introduction**

India sits in the tropics with a huge rooftop and wasteland estate. Solar potential is national. Deployment is regional: the Thar and western parks lead, the humid east and high Himalaya lag. Policy - **ISA**, NSM, KUSUM - tries to close that map.

**Body****National potential**

- High insolation over most of the peninsula, falling winter sun in the far north, and a long dry season in the west make photovoltaic and, in pockets, solar-thermal plausible at terawatt-hour scale.
- **Co-benefits:** daytime peak shaving, irrigation pumps, and a diplomatic story through the **International Solar Alliance (ISA)** that India co-founded.

**Why development varies**

- **Resource:** Rajasthan, Gujarat, and the western Deccan have more clear-sky kWh/m<sup>2</sup> than the Northeast's cloud and the Himalaya's slope and snow.
- **Land:** **Bhadla**-type parks need square kilometres. Kerala, Bengal, and hill states lack cheap contiguous waste land; they need rooftop and agri-voltaic paths.
- **Grid:** Rajasthan parks wait on **green corridors** and storage; without wires, potential is stranded.
- **Finance and DISCOM health:** states with better payment and open-access practice attract IPPs; others stay on paper targets.

- **Policy stacking:** Gujarat and Rajasthan moved early on parks; some eastern states moved later on rooftop and **PM-KUSUM** pumps.

## Regional picture

- **Leaders:** Rajasthan (**Bhadla**), Gujarat, Tamil Nadu, Karnataka, Andhra, Madhya Pradesh - utility solar plus parks.
- **Middle:** Maharashtra, Telangana - mixed parks and industry rooftops.
- **Laggards in utility scale:** many Northeastern and densely farmed Gangetic districts, where the right technology is rooftop, canal-top, and pumps, not a second **Bhadla**.
- Urban rooftop still lags its potential even in rich metros because of net-metering friction.

## What would even the map

- Storage and round-the-clock tenders so western generation can firm eastern evenings.
- KUSUM and PM Surya Ghar to spread solar as a farm and household asset, not only a desert park.
- **ISA** knowledge and cheap finance for states that have cloud, not waste land.

## Flow diagram

Tropical insolation -> West parks Rajasthan Gujarat

Tropical insolation -> East hills rooftop KUSUM

Corridors storage -> West parks Rajasthan Gujarat

ISA NSM NSM -> National solar

## Conclusion

India's solar potential is immense and geographically uneven in ease, not in need. Parks in the west harvest the sun; the east and hills must harvest rooftops, pumps, and a stronger grid. **ISA** and national missions are the political roof over that regional variation.

## Facts & figures

### ISA

International Solar Alliance, co-founded by India, to pool tropical solar cooperation.

### Bhadla

Rajasthan park complex that shows western utility-scale leadership.

### JNNSM / NSM

National Solar Mission path that created park and tariff architecture.

### PM-KUSUM

Farm solar and pump scheme meant to regionalise solar beyond deserts.

### Green corridors

Transmission needed to move western solar toward eastern load.

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