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EDITORIAL ANALYSIS

India's Sunset Problem — Solar Is Booming but the Grid Peaks at Night

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THE EDITORIAL ARGUMENT

On **April 25, 2026**, India's power grid reached a **record peak demand of 256.11 GW** — and met it without load-shedding. The Ministry of Power and grid operator **POSOCO (Power System Operation Corporation of India)** — recently merged into the **Grid Controller of India (GCI)** — heralded this as a success. They were right. But the bigger management challenge is not peak demand; it is the **sunset ramp** — the steep surge in demand that hits every evening when 150 GW of solar generation switches off simultaneously as the sun sets.

This is the **duck curve** problem — familiar to every grid operator with high solar penetration — and India needs to invest significantly faster to manage it.

THE DUCK CURVE: WHY IT MATTERS

The **"duck curve"** gets its name from the shape of a daily demand curve when solar is abundant:

- **Morning:** Demand rises, solar begins generating — the system looks manageable
- **Afternoon:** Solar at peak, thermal plants must back down — demand curve dips (the "belly of the duck")
- **Evening:** Solar generation falls off the cliff as the sun sets, demand surges for cooling and cooking — thermal plants must ramp up very quickly (the "neck of the duck")

The problem is that **coal-fired thermal plants** — which still provide approximately 70% of India's firm power — cannot ramp quickly. They have **minimum load constraints** (cannot go below ~40-50% of rated capacity without risk), take hours to start from cold, and suffer efficiency losses from rapid load changes. Meanwhile, with 150 GW of solar going offline in a 2-3 hour window, the grid faces a steep ramp that thermal plants struggle to provide cleanly.

Additional stress in 2026: With pre-monsoon heatwave temperatures exceeding 44-48°C across Rajasthan, UP, MP, and Maharashtra, air conditioner loads have surged during the post-sunset window, exactly when solar is unavailable. **18–21 GW of coal plant capacity** is also offline for scheduled maintenance (coal plants are typically maintained pre-monsoon when demand is somewhat lower — this year that window has been eliminated).

INDIA'S BATTERY STORAGE GAP

The Central Electricity Authority (CEA) has set a target of **47 GW of BESS (Battery Energy Storage Systems) + 27 GW of pumped hydro storage** (total 74 GW of storage) by **2031-32**. These targets are technically correct for managing India's solar-heavy future grid. The problem is implementation pace:

STORAGE TYPE	TARGET 2031-32	INSTALLED (EARLY 2026)	GAP
BESS	47 GW	~4-5 GW	~42 GW
Pumped Hydro	27 GW	~4.7 GW operational + some under construction	~20+ GW
Total	**74 GW**	**~9-10 GW**	**~64 GW**

India is adding storage, but not fast enough. At current trajectory, achieving 74 GW by 2031-32 requires approximately **10-12 GW of new storage per year** for the next 6 years — vs. approximately 2-3 GW being added currently.

THE POLICY LEVERS

1. BESS manufacturing incentives. The PLI (Production-Linked Incentive) scheme for **Advanced Chemistry Cell (ACC) battery manufacturing** — approved at ₹18,100 crore — aims to build 50 GWh of domestic BESS manufacturing. This must be accelerated; current domestic manufacturing capacity is minimal and most BESS procurements use imported cells (predominantly from China).

2. Time-of-Day (ToD) tariffs. Electricity pricing reform is essential. If consumers pay more during the evening peak (6-10 PM) and less during the solar midday (11 AM-3 PM), demand management occurs automatically. CERC (Central Electricity Regulatory Commission) and SERC regulations require ToD tariff implementation for commercial and industrial consumers — retail consumer ToD is the missing element.

3. Demand Side Management (DSM). Smart meters (under RDSS — Revamped Distribution Sector Scheme) enable DSM — shifting flexible loads (water heating, EV charging, industrial process cooling) to off-peak solar hours. India's 250 million smart meter rollout is critical infrastructure for this.

4. Inter-state grid strengthening. Moving solar power from surplus states (Rajasthan, Gujarat — daytime surplus) to deficit states (East/South India — evening deficit) requires upgraded interstate transmission capacity. The Green Energy Corridors programme addresses this but needs acceleration.

THE BROADER LESSON

India's renewable energy journey is a genuine success story — **150+ GW of solar capacity** (from near-zero in 2010) is an extraordinary achievement. The challenge is that **grid management complexity scales non-linearly with renewable penetration**. At 15-20% solar share, the duck curve is manageable. At 40-50% — which India will reach by 2030 — it is the defining technical challenge of the energy transition.

The investments in storage, transmission, and demand management are not optional additions to the renewable programme. They ARE the renewable programme.

UPSC RELEVANCE

PAPER	ANGLE
GS3 — Economy/Energy	Solar energy, grid management, BESS, pumped hydro, PLI for ACC batteries
GS3 — Environment	Renewable energy transition, thermal phase-down, carbon commitments
GS2 — Governance	CERC, electricity regulation, Centre-State power sector reforms, RDSS

Mains Keywords: Duck curve, BESS (Battery Energy Storage System), CEA storage targets, POSOCO/Grid Controller of India, solar peak demand, time-of-day tariffs, PLI for ACC batteries, Green Energy Corridors, RDSS (Revamped Distribution Sector Scheme), CERC, India's 500 GW renewable target, pumped hydro storage

Prelims Facts Corner

ITEM	FACT
India peak demand record	256.11 GW — April 25, 2026
Solar capacity (2026)	150+ GW
Duck curve	Demand shape when solar-heavy grid faces evening ramp
India BESS target	47 GW by 2031-32 (CEA)
India pumped hydro target	27 GW by 2031-32 (CEA)
Total storage target	74 GW by 2031-32
PLI for ACC batteries	₹18,100 crore; 50 GWh domestic manufacturing target
CERC	Central Electricity Regulatory Commission
RDSS	Revamped Distribution Sector Scheme — smart meter rollout
Green Energy Corridors	Inter-state transmission for renewable surplus areas
Grid Controller of India	New name for POSOCO after reorganisation

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