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From Installed Capacity to Decarbonised Electricity: The Capacity-Generation Gap in India's Green Transition, with Special Reference to Maharashtra and Vidarbha

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Abstract

India's green transition is conventionally judged by installed renewable capacity, which crossed 51 per cent of national capacity in March 2026. This paper argues that capacity is an incomplete indicator of decarbonisation and proposes a simple, replicable diagnostic, the Capacity–Generation Gap (CGG): the renewable share of installed capacity minus the renewable share of electricity generation. Using official data from the Ministry of New and Renewable Energy (MNRE), the Central Electricity Authority, India's Fourth Biennial Update Report and the Economic Survey of Maharashtra 2025-26, the study analyses India from 2015-16 to 2025-26 and all states for 2025-26. Renewables supplied 82 per cent of new capacity over the decade but only 43 per cent of new generation, and the national gap widened from 13.3 to 25.6 percentage points. Maharashtra, the third-largest renewable state (53.7 per cent of capacity), drew only 16.9 per cent of its electricity from renewables. Its gap of 36.9 points is the widest among the five leading states and survives the exclusion of rooftop solar. Because Vidarbha hosts the state's coal economy, this gap has direct consequences for a just transition. The paper recommends generation-based targets, storage- and evacuation-linked capacity planning, harmonised data, and a Vidarbha regional transition plan.

Keywords: Green economy; Climate change; Capacity–generation gap; Renewable energy; Maharashtra; Vidarbha

1. INTRODUCTION

1.1 Background

India's climate strategy rests on two headline commitments: lowering the emission intensity of GDP and raising the non-fossil share of installed power capacity. On both counts progress appears striking. Between 2005 and 2020, India's emission intensity of GDP fell by 36 per cent (Press Information Bureau [PIB],

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2025), and non-fossil sources reached 53.21 per cent of installed capacity by March 2026, well ahead of the 2030 target (Ministry of New and Renewable Energy [MNRE], 2026a). Yet the energy sector still accounted for 75.66 per cent of the 2,959 million tonnes of CO_2-equivalent emitted in 2020 (PIB, 2025), and thermal plants generated 1,307 billion units (BU) of electricity in 2025-26 (MNRE, 2026a). Capacity has crossed the halfway mark; generation has not. This measurement puzzle sits at the heart of India's green-economy debate. It is not resolved by the updated commitments: the NDC 3.0 approved in March 2026 targets a 47 per cent cut in emission intensity and 60 per cent non-fossil installed capacity by 2035 (Institute for Energy Economics and Financial Analysis [IEEFA], 2026), so the headline power-sector target remains expressed in capacity, not generation.

The puzzle matters for sustainable development in two ways. Climate benefits materialise only when clean capacity displaces fossil generation, not when it is merely commissioned. And the social costs of transition fall on particular places. In Maharashtra, the Chandrapur–Nagpur–Yavatmal belt of Vidarbha produces all of the state's coal and hosts nearly half of its coal-based power capacity (Indian Just Transition Centre [IJTC], 2025). Whether the state's rapid renewable build-out actually reduces fossil dependence therefore shapes the economic future of these districts.

1.2 Review of Literature

The Indian literature on the green economy falls into three strands. The first is macro-econometric. Udemba et al. (2021) applied ARDL and Toda–Yamamoto tests to 1975–2017 data and noted that there is no consensus on whether India has decoupled growth from CO_2 emissions. Onwe et al. (2024) used a Fourier ARDL model for 1970–2019 and found that renewable energy improves environmental quality, whereas economic growth and export diversification worsen it; they also observe that Indian studies have concentrated on carbon emissions and air quality. Tran (2024) reported asymmetric, quantile-specific effects of growth, globalisation, green growth and renewable energy on India's CO_2 emissions, and a 2026 wavelet-quantile study treats solar and biomass energy, education and globalisation as determinants of green growth ("Towards Green Growth," 2026). These studies share a design: national annual aggregates, with renewable energy entering as a consumption or capacity variable.

The second strand evaluates low-carbon policy. A case study of 2014–2023 reports that per-capita CO_2 emissions rose 24 per cent while emission intensity per ₹1 lakh of GDP fell 27 per cent, read by its authors as economic decoupling ("Balancing Carbon Emissions," 2025). A study covering 2014–2025 finds that intensity fell from 220 to 150 kg CO_2 per ₹1 lakh of GDP while renewable capacity rose from 28.1 to 170.2 GW, with a strong negative correlation ($r = -0.82$) ("Environmental Law and Climate Governance," 2026). Both are consistent with relative decoupling, in which emissions grow more slowly than output, but neither shows an absolute decline, and both lean on capacity expansion as the explanatory story. Climate Action Tracker (n.d.) records the discrepancy that this design cannot see: non-fossil capacity passed 50 per cent in 2025, yet the non-fossil share of generation stagnated at around 25 per cent until 2024-25.

The third strand is sub-national and social. IEEFA (2026) shows that five states hold about 66 per cent of India's non-fossil capacity and warns that this concentration may become a bottleneck for the 60 per cent target for 2035. The just-transition literature maps coal dependence: a review in *WIREs Climate Change* ("India's Coal Conundrum," 2025) documents the exposure of coal-dependent districts and the weak alignment of District Mineral Foundation spending with sustainable livelihoods, while iFOREST and IJTC

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(2025) identify fourteen transition-hotspot districts in Maharashtra, with Chandrapur, Nagpur and Yavatmal as priorities for regional plans.

1.3 Research Gap

Three gaps follow. First, capacity is treated as an outcome. The divergence between capacity and generation is noted by policy trackers but has not been formalised as an indicator or tested for its trend. Second, analysis is national, so state heterogeneity in what capacity actually delivers is unexplored, even though states are where power is dispatched and coal jobs are located. Third, just-transition studies map workers and districts but do not ask whether the state's power system is in fact shifting away from coal, and no official district-level series exists to answer this for Vidarbha. This paper addresses the first two gaps with official data and uses the results to frame the third.

2. OBJECTIVES

The study has four objectives:

1. To measure India's Capacity–Generation Gap from 2015-16 to 2025-26 and test whether renewable additions have been matched by additions in generation.
2. To compare the gap across states and position Maharashtra among the five leading renewable states.
3. To decompose Maharashtra's gap by source and test its robustness to measurement choices.
4. To draw implications for Vidarbha and recommend policy.

Two propositions guide the analysis. **P1:** the renewable share of generation lags the renewable share of capacity, and the lag has widened. **P2:** Maharashtra's lag exceeds that of the other leading renewable states.

3. METHODOLOGY

The study is descriptive and quantitative and relies entirely on secondary official data: MNRE's *Renewable Energy Statistics 2025-26* (capacity from MNRE and the Central Electricity Authority [CEA]; generation from CEA), MNRE physical-progress data to 31 August 2026, the 2025 PIB release on India's Fourth Biennial Update Report, and the *Economic Survey of Maharashtra 2025-26*. Renewable energy (RE) follows MNRE's classification and includes large hydro; nuclear is treated as non-RE. The units of analysis are India (annual, 2015-16 to 2025-26) and its states (2025-26).

Four indicators are computed. (1) The **Capacity–Generation Gap (CGG)** is the RE share of installed capacity minus the RE share of generation, in percentage points. (2) The **Generation-to-Capacity Ratio (GCR)** is the RE share of generation divided by the RE share of capacity. (3) **Additionality** compares the RE share of incremental capacity with the RE share of incremental generation over a period. (4) The **implied capacity utilisation factor (CUF)** is generation in million units divided by the average of opening and closing capacity in MW multiplied by 8.76. Robustness is checked by excluding rooftop solar, whose behind-the-meter output is likely under-captured in CEA generation data.

The CGG is a diagnostic, not a performance grade. Because solar and wind run at lower utilisation than thermal plants, a zero gap is neither expected nor a sensible target; the informative variation is the gap's trend over time and its dispersion across states with comparable technology mixes.

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Capacity is a year-end stock and generation an annual flow, so late additions depress the implied CUF. National and state figures cover reported systems only. District-level data are unavailable, so Vidarbha is analysed qualitatively. All datasets and formulas are supplied in the accompanying Excel workbook.

4. DISCUSSION AND ANALYSIS

4.1 India: Capacity versus Generation

Table 1 and Figure 1 show that the RE share of capacity rose from 29.3 to 51.6 per cent between 2015-16 and 2025-26, whereas its share of generation rose only from 16.0 to 26.0 per cent. The CGG therefore widened from 13.3 to 25.6 percentage points, which supports P1.

Table 1. India: RE share of installed capacity and generation (selected years)

Year	RE share of capacity (%)	RE share of generation (%)	CGG (pp)	GCR
2015-16	29.3	16.0	13.3	0.55
2018-19	34.9	19.1	15.8	0.55
2021-22	39.2	21.7	17.5	0.55
2023-24	43.1	20.8	22.4	0.48
2024-25	46.3	22.1	24.2	0.48
2025-26	**51.6**	**26.0**	**25.6**	**0.50**

Source: Author's calculations from MNRE (2026a), Tables 1.1 and 3.1. RE includes large hydro.

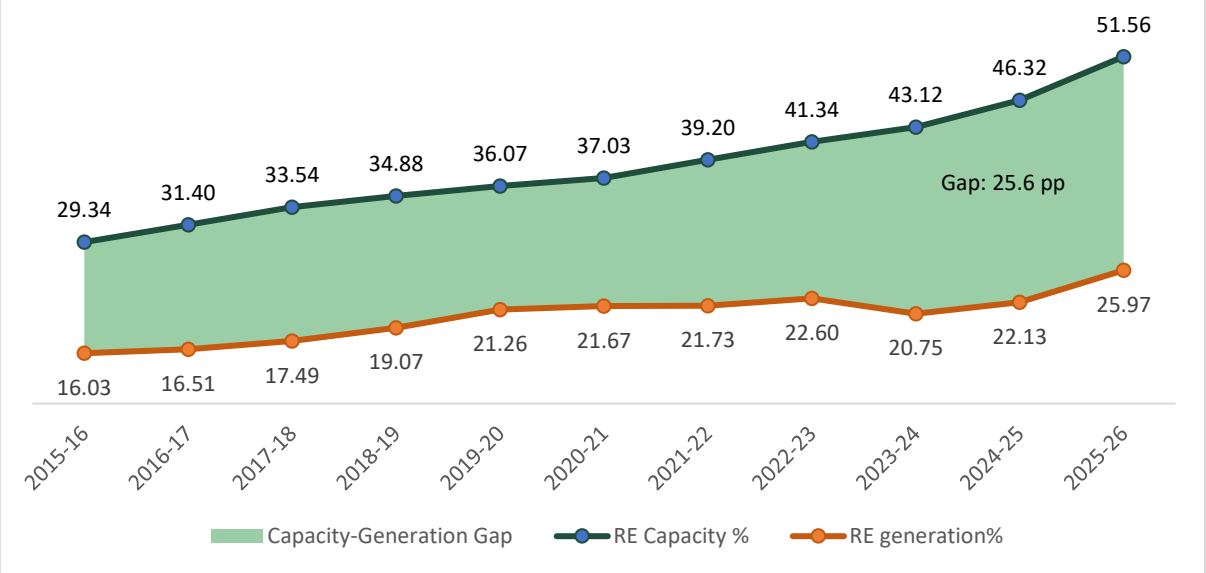


Figure 1. India: RE share of installed capacity and of generation, 2015-16 to 2025-26

Source: Author's calculations from MNRE (2026a).

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The additionality test sharpens the point. Over the decade, renewables supplied 81.6 per cent of the 226.4 GW added to India's capacity (184.8 GW) but only 43.2 per cent of the 672.5 BU added to annual generation. Over the last five years the contrast is starker: 88.9 per cent of new capacity against 38.6 per cent of new generation. Thermal generation in 2025-26 was still 38.6 per cent above its 2015-16 level (943.0 to 1,307.1 BU). In the power sector, therefore, India has achieved relative rather than absolute decoupling.

Two cautions apply. The gap is partly structural: variable sources such as solar run at lower utilisation than thermal plants, and Solar's share of RES capacity (solar, wind, bio-power and small hydro) rose from 15 to 67 per cent. And 2025-26 was exceptional: renewables added a record 54.6 GW, so 24.8 per cent of the year-end stock was commissioned within the year and could not generate for all of it. The widening from 13.3 to 22.4 points up to 2023-24, when annual capacity growth ranged from 6 to 15 per cent, is the more reliable signal. Notably, the 4.2 per cent fall in thermal output in 2025-26 came when total generation grew only 0.9 per cent (1,824.2 to 1,840.1 BU); whether displacement persists when demand growth revives is untested.

4.2 States: Maharashtra's Outlier Gap

The gap appears in every leading state, but P2 singles out Maharashtra (Table 2, Figure 2). It ranks third in renewable capacity (31.98 GW, 11.64 per cent of India's), and RE accounts for 53.7 per cent of its installed capacity, above the national 51.6 per cent. Yet renewables supplied only 16.9 per cent of its 2025-26 electricity, against 26.0 per cent nationally and 37.8 to 54.3 per cent in the other four leading states. Its CGG of 36.9 points is the widest among the nine states that have at least 1 GW of RE, an RE capacity share of 40 per cent or more, and a non-renewable fleet. Its implied CUF of 12.2 per cent is about half that of Karnataka (26.4 per cent) and well below Gujarat (19.2), Rajasthan (19.4) and Tamil Nadu (21.0).

Table 2. Leading RE states, 2025-26: capacity share, generation share and gap

State	RE share of capacity (%)	RE share of generation (%)	CGG (pp)	Implied RE CUF (%)	CGG excl. rooftop solar (pp)
Gujarat	65.8	46.3	19.5	19.2	15.9
Rajasthan	77.5	50.2	27.3	19.4	26.5
Maharashtra	**53.7**	**16.9**	**36.9**	**12.2**	**32.2**
Tamil Nadu	61.1	37.8	23.3	21.0	22.0
Karnataka	71.3	54.3	17.0	26.4	16.4
India	51.6	26.0	25.6	22.0	23.1

Source: Author's calculations from MNRE (2026a), Tables 8.1, 8.3, 8.5 and 9.1. CUF uses average of opening and closing capacity.

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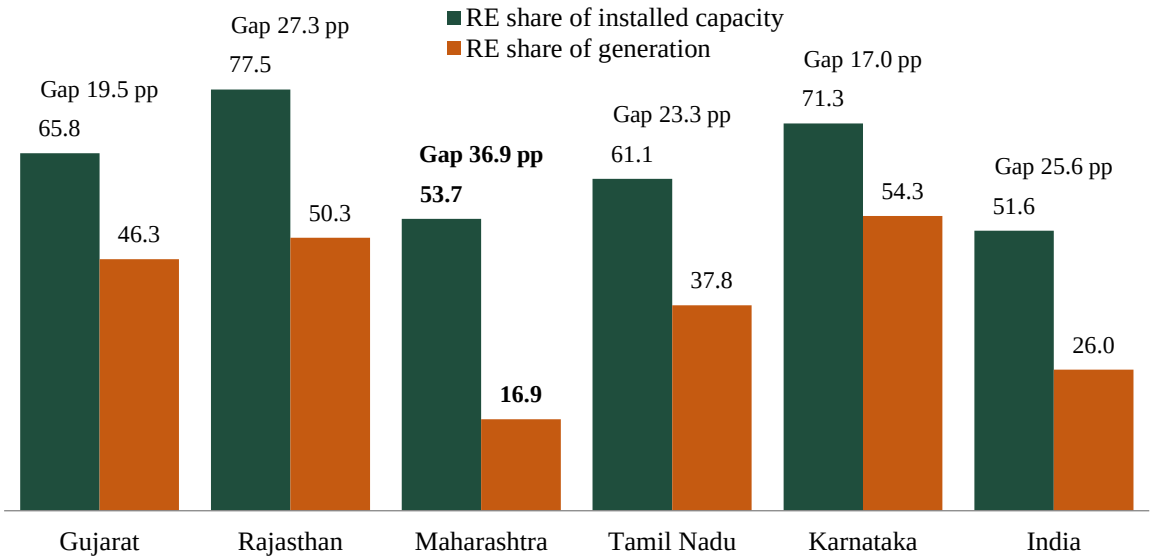


Figure 2. RE share of capacity and generation in leading states, 2025-26

Source: Author's calculations from MNRE (2026a).

The result is robust. Rooftop solar, 5.4 GW in Maharashtra and second only to Gujarat, may be under-captured in generation data. Excluding it lowers Maharashtra's capacity share to 49.1 per cent, but the gap remains 32.2 points, still the widest of the five (Table 2).

Concentration shows a similar contrast. The five leading states hold 66.3 per cent of India's RE capacity but produced 57.5 per cent of RE generation, so concentration is less extreme in output than in capacity, a point relevant to IEEFA's (2026) bottleneck concern.

The thermal base explains part of the pattern. Between 2017-18 and 2025-26, Maharashtra's RE capacity grew 2.78 times (13.6 per cent a year) while its non-renewable capacity fell 7.7 per cent (29.8 to 27.5 GW), yet thermal and nuclear plants still generated 83.1 per cent of the state's electricity (143.5 of 172.6 BU). Clean capacity has grown rapidly, but the grid still runs overwhelmingly on the conventional fleet.

The data themselves are part of the problem. The Economic Survey reports Maharashtra's RE capacity in 2024-25 as 14,113 MW (Directorate of Economics and Statistics, 2026), whereas MNRE's location-based series shows 22,401 MW, an 8.3 GW difference that appears to reflect differing coverage and definitions.

These data show where the gap is largest, not why. Curtailment, transmission constraints, dispatch order, power-purchase-agreement structures and commissioning delays could each contribute, and the official series used here do not separate them. The gap is therefore a signal for investigation. The cross-state contrast suggests that technology mix alone is unlikely to be the whole explanation: Gujarat, with an almost identical solar share of RE capacity (62.1 against 61.4 per cent), reaches an implied CUF of 19.2 per cent, against Maharashtra's 12.2 per cent.

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4.3 Maharashtra by Source

Table 3 decomposes the state's gap. Solar makes up 61.4 per cent of RE capacity but only 36.3 per cent of RE generation (GCR 0.59). Wind (GCR 1.60), bio-power (1.29) and large hydro (1.98) deliver more energy per megawatt. Potential is vast: installed solar and wind are only 3.9 and 3.4 per cent of assessed potential of 503 GW and 174 GW respectively (MNRE, 2026a). The state's Renewable Energy and Storage Policy 2025–2035 targets 100 GW (Directorate of Economics and Statistics, 2026), which is feasible in resource terms. But if the additional gigawatts replicate today's solar-heavy mix without storage and evacuation capacity, the composition effect alone will pull the state's GCR down further.

Table 3. Maharashtra: RE by source (capacity at 31.03.2026; generation 2025-26)

Source	Share of RE capacity (%)	Share of RE generation (%)	GCR	Capacity as % of potential
Solar	61.4	36.3	0.59	3.9
Wind	18.5	29.6	1.60	3.4
Bio-power	9.4	12.1	1.29	45.8
Small hydro	1.2	3.2	2.67	48.9
Large hydro	9.5	18.8	1.98	96.9
Total RE	**100.0**	**100.0**	–	**4.7**

Source: Author's calculations from MNRE (2026a), Tables 7.1, 8.2 and 9.2.

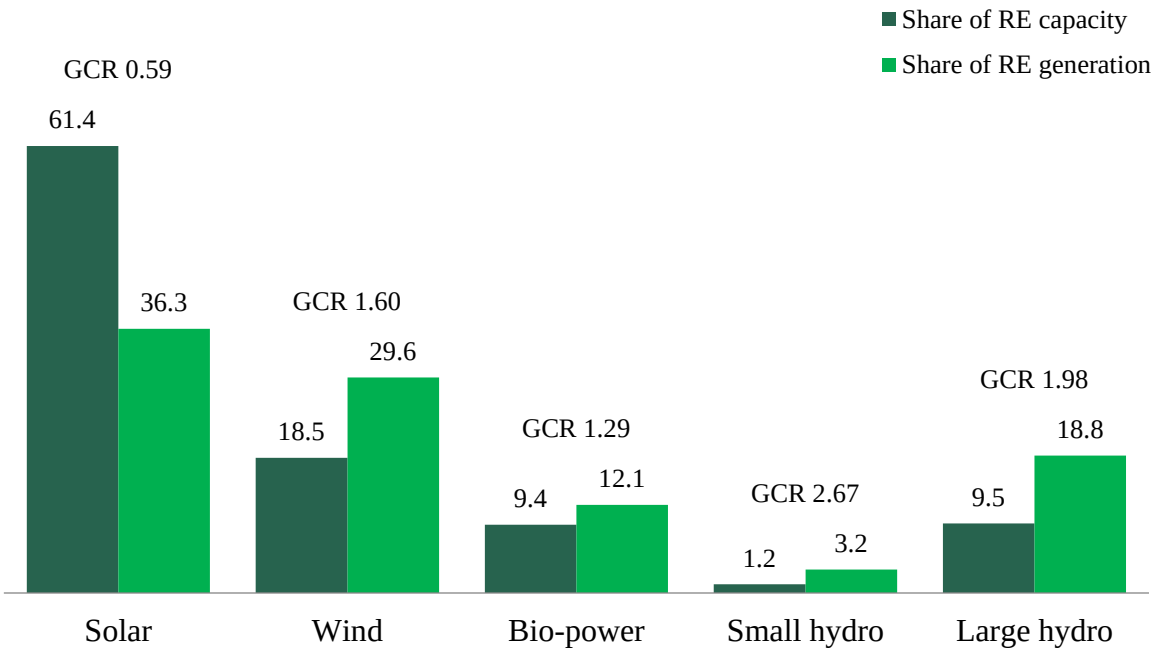


Figure 3. Maharashtra: share of RE capacity and generation by source

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Source: Author's calculations from MNRE (2026a), Tables 7.1, 8.2 and 9.2. GCR above 1 means a source supplies more of RE generation than its share of RE capacity.

4.4 Implications for Vidarbha

District-level effects cannot be measured with official data, but the state-level pattern shows where risk lies. The Chandrapur–Nagpur–Yavatmal belt supplies all of Maharashtra's coal and hosts nearly half its coal-based capacity (IJTC, 2025), while the conventional fleet still generates more than four-fifths of state electricity. Vidarbha therefore faces a prolonged period of uncertainty rather than sudden closure: the pace at which generation, not capacity, shifts will determine when coal jobs, mine-linked local revenues and freight demand contract. Capacity targets say little about this timeline.

Vidarbha also carries climate risk on the farm side. Press analysis of the 2025-26 Economic Survey notes that Vidarbha and Marathwada lag in industrialisation, infrastructure and incomes, and that despite monsoon rainfall at 109 per cent of normal in 2025, climate volatility damaged nearly 95 lakh hectares of farmland (Policy Circle, 2026). Maharashtra also leads in decentralised solar: it holds 4.84 lakh of India's 13.80 lakh solar pumps (35 per cent) (MNRE, 2026a), an asset for climate-resilient agriculture on which a regional plan could build.

5. FINDINGS

1. **Capacity overstates decarbonisation.** Renewables provided 81.6 per cent of new capacity but 43.2 per cent of new generation between 2015-16 and 2025-26 (88.9 against 38.6 per cent in the last five years).
2. **The national gap has widened** from 13.3 to 25.6 percentage points, partly for structural reasons (Solar's rising share) and partly because of the timing of record 2025-26 additions.
3. **Decoupling in power is relative, not absolute.** Thermal generation is 38.6 per cent above its 2015-16 level, and its 2025-26 decline coincided with only 0.9 per cent growth in total generation.
4. **Maharashtra has the widest gap** among leading states: 36.9 points (32.2 excluding rooftop solar), with the lowest implied CUF (12.2 per cent). P1 and P2 are supported.
5. **Mix matters.** Solar is 61.4 per cent of Maharashtra's RE capacity but yields 36.3 per cent of RE generation, and the state has used under 4 per cent of its solar and wind potential.
6. **Data are not yet fit for tracking the transition.** State and central capacity series differ by 8.3 GW, rooftop generation is probably under-captured, and no official district series exists for Vidarbha.
7. **Vidarbha's transition risk is concentrated and timing-dependent.** The belt holds all of the state's coal and nearly half its coal-based capacity, and conventional plants still supply 83.1 per cent of state generation.

6. CONCLUSION AND POLICY IMPLICATIONS

India's renewable expansion is real and fast, but installed capacity is a misleading measure of decarbonisation. The RE share of capacity has pulled steadily ahead of its share of generation, and Maharashtra shows the pattern most sharply: third in the country for renewable capacity, yet drawing only

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one-sixth of its electricity from renewables. The green-economy challenge is now less about adding megawatts than about converting them into displaced fossil generation and managing the regional consequences of that displacement. Five measures follow.

1. **Adopt generation-based indicators.** Add a renewable-generation-share target, and publish the CGG annually, alongside the 2035 capacity target of 60 per cent non-fossil capacity, including in the Economic Surveys of the Union and the states.
2. **Link capacity to system integration.** Phase Maharashtra's 100 GW target with evacuation lines, pumped and battery storage, and a more diversified mix of wind, hydro and bio-energy that delivers more energy per megawatt.
3. **Harmonise data.** Align state and MNRE definitions, capture rooftop and off-grid generation, and publish district-level capacity, generation and emissions.
4. **Prepare a Vidarbha regional just-transition plan** for the Chandrapur–Nagpur–Yavatmal belt, sequenced to observed shifts in generation, with District Mineral Foundation funds directed to skills and livelihood diversification.
5. **Build on existing strengths.** Use Maharashtra's lead in solar pumps to link decentralised solar with agricultural resilience in Vidarbha.

Future research should use hourly dispatch and curtailment data, build a district-level panel for Vidarbha, and test the determinants of the gap econometrically.

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