CHAPTER 09

INVESTMENT AND INFRASTRUCTURE: STRENGTHENING CONNECTIVITY, CAPACITY AND COMPETITIVENESS

Infrastructure continues to be central to India's growth strategy, with public capital expenditure following a sustained upward trajectory since FY15 and gaining further momentum in recent years. Large-scale investments across roads, railways, ports, power, aviation and digital infrastructure have strengthened connectivity, expanded capacity and improved logistics efficiency, generating strong multiplier effects for growth and productivity. This phase has been characterised not only by rapid asset creation but also by a shift towards integrated, system-level development.

A defining feature of this transition has been the institutionalisation of multimodal planning through PM GatiShakti, complemented by the National Logistics Policy and digital platforms that are reducing transaction costs and execution risks. Reforms in infrastructure financing—spanning project finance regulation, Public-Private Partnership (PPP) frameworks, asset monetisation and capital market instruments—are crowding-in private investment. At the same time, India's infrastructure base is broadening to include digital public infrastructure (DPI), clean energy, resilient water systems and emerging sectors. Sustaining investment momentum while aligning infrastructure with efficiency, sustainability and competitiveness will continue to remain key towards supporting India's medium-term growth and its long-term vision of Viksit Bharat @2047.

INTRODUCTION: INFRASTRUCTURE AS THE ENGINE OF GROWTH

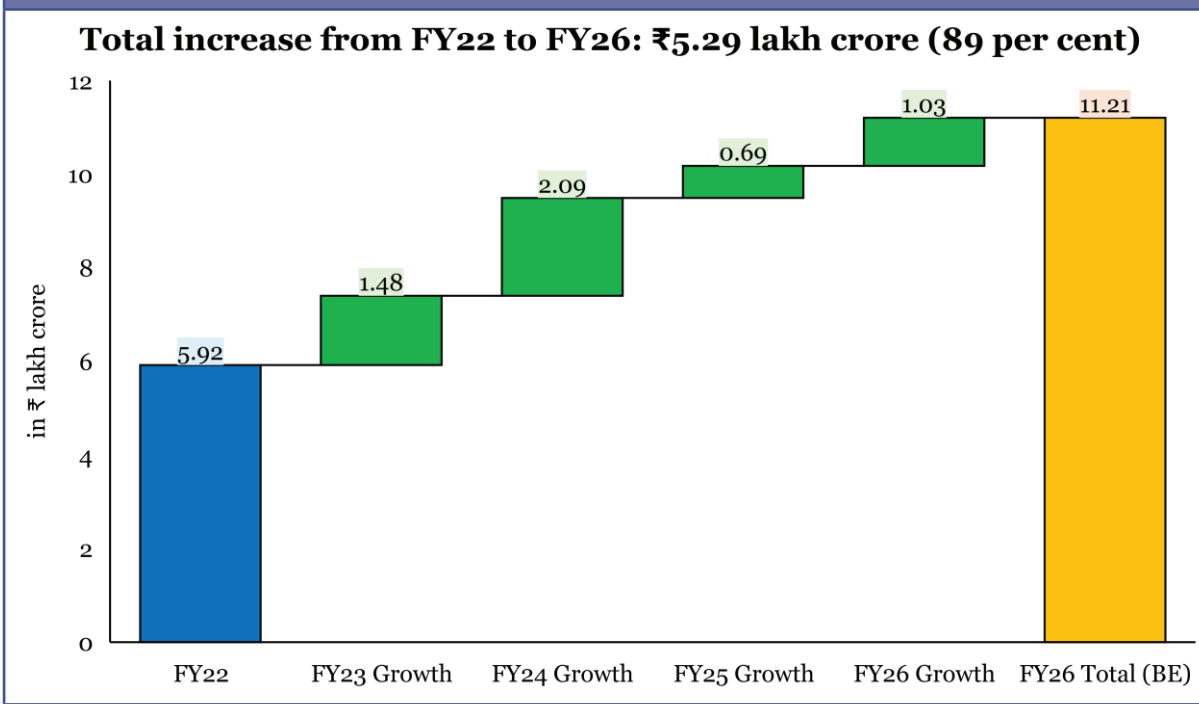
9.1 The decisive role of infrastructure investment in India's growth strategy has been a defining feature in recent years. Union Budget priorities since FY20 reflect a sustained shift toward large-scale public capital expenditure, supported by integrated planning, and the systemic modernisation of logistics and connectivity networks.

9.2 This period has been marked not just by the accelerated expansion of traditional infrastructure, such as highways, railways, ports, and energy systems, but also by the expansion of digital public infrastructure (DPI), data systems, and assets aligned with renewable energy. Together, these developments signal a shift in how India plans and finances infrastructure projects, moving beyond mere capacity addition to focusing on enhancing efficiency, competitiveness and network integration.

9.3 A major element of this shift has been the substantial increase in public capital expenditure. Between FY19 and FY22, the Government of India's capital expenditure increased by 92 per cent, from ₹3.07 lakh crore to ₹5.92 lakh crore. This momentum has been sustained over the subsequent fiscal years, reinforcing the objective of expanding access to quality infrastructure across the country.

9.4 The Government of India's capital outlay has increased by nearly 89 per cent, from ₹5.92 lakh crore in FY22 to a budgeted allocation of ₹11.21 lakh crore for FY26, recognising the strong multiplier effects that infrastructure generates on the economy. Public expenditure on infrastructure has a high multiplier effect, estimated by studies to be around 2.5 to 3.5 times the GDP over the medium term.[1] This means, for every rupee spent by the government in creating infrastructure, GDP gains worth ₹2.5-₹3.5 accrue.[2] The scale and consistency of this investment momentum have positioned infrastructure as a cornerstone of India's growth engine.

Chart IX.1: Government Capex has continued to rise steadily since FY22



Source: Union Budget Documents.

9.5 This investment push has been paired with major institutional and technological reforms designed to enhance planning quality and reduce execution risks also through private participation. The PM GatiShakti National Master Plan, launched in 2021, has successfully institutionalised multimodal, GIS-enabled planning. The recent launch of PM GatiShakti Public has further democratised the platform, providing regulated

1 Fiscal Multipliers for India (by Sukanya Bose & N. R. Bhanumurthy, NIPFP, 2013) https://tinyurl.com/4972rumk.

2 Speeding up with Gati Shakti (October 2021), NITI Aayog, available at https://www.niti.gov.in/speeding-gati-shakti.

access to geospatial data for private developers and researchers to leverage advanced analytics for infrastructure planning and investment decisions.[3]

9.6 Complementary initiatives under the National Logistics Policy (NLP) have supported the emergence of a more predictable and digitised logistics environment. The use of the Unified Logistics Interface Platform (ULIP) and the insights drawn from the Logistics Ease Across Different States (LEADS) framework are actively improving logistics efficiency, which directly affects the competitiveness of India's manufacturing sector. A detailed analysis of the impact of the PM GatiShakti framework, the National Logistics Policy, and other initiatives aimed at reducing logistics costs and improving competitiveness is presented in the Infrastructure and Logistics section in Chapter 8 on Industry.

9.7 Beyond physical assets, DPI acts as an essential force multiplier across the economy. The expansion of BharatNet, the deployment of 5G networks, and the continued growth of platforms like Unified Payments Interface (UPI) and Aadhaar, ULIP, DigiYatra, FASTag, form the essential digital backbone upon which smart, efficient, and inclusive infrastructure services are delivered at scale.

9.8 Overall, infrastructure remains a key lever for sustaining medium-term growth through (i) continued public capex and improved project planning and execution, (ii) crowding-in of private investment through a stronger Public-Private Partnership (PPP) pipeline, (iii) deeper and more resilient long-term financing via capital markets and prudentially sound bank/NBFC credit.

9.9 While public capital expenditure on infrastructure has expanded significantly in recent years, its effectiveness increasingly depends on the quality of project planning, prioritisation and execution. Evidence from various studies suggests that time and cost overruns in large infrastructure projects are often linked to gaps in upstream project preparation, including weak feasibility assessments, incomplete Detailed Project Reports (DPRs), rigid procurement practices, and delays in dispute resolution. Strengthening institutional capacity across the project lifecycle, including improved project preparation, lifecycle-based costing, standardised contracts, faster dispute resolution, wider adoption of technology, and skill development are critical to delivering infrastructure faster, at scale, and within budget.

9.10 The subsequent sections of this chapter discuss measures to enhance infrastructure financing and provide a detailed review of progress, outlook, and challenges across key infrastructure sub-sectors, including core physical infrastructure, energy sector, digital infrastructure, rural infrastructure and emerging

3 PIB Release available at https://tinyurl.com/nm83nmw7.

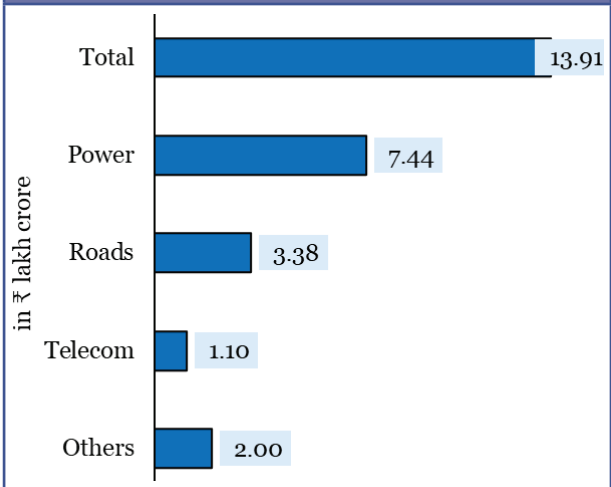
sectors infrastructure. Discussions pertaining to urban infrastructure and social infrastructures, such as health and education, are covered separately in Chapters 15 and 11, respectively.

ENHANCING INFRASTRUCTURE FINANCING AND PRIVATE PARTICIPATION

9.11 India's infrastructure financing landscape is undergoing a change and shifting from a historical dependence on bank credit toward a diversified ecosystem of alternative financing vehicles and capital market instruments. While bank credit to the infrastructure sector recorded a year-on-year (YoY) growth of 4.6 per cent in October 2025, recovering from 2.3 per cent YoY growth in October 2024, the incremental expansion of financing is increasingly being driven by non-bank channels.

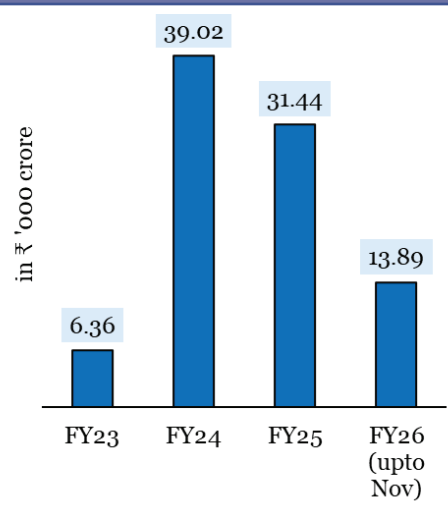
9.12 Credit flows from non-bank financial companies (NBFCs) (net of bank borrowings), to the commercial sector grew at a robust compound annual growth rate (CAGR) of 43.3 per cent during FY20 to FY25, significantly outpacing the 25 per cent CAGR recorded for non-food bank credit over the same period.[4] This evolving landscape has been further strengthened by the growing role of Infrastructure Investment Trusts (InvITs) and Real Estate Investment Trusts (REITs), which are enabling long-term institutional capital to participate in infrastructure assets (Chart IX.3). Together, these developments are helping to mitigate systemic risks by reducing asset–liability mismatches on bank balance sheets, while enhancing the sustainability of financing for long-gestation infrastructure projects.

Chart IX.2: Deployment of Gross Bank Credit to Infrastructure (Outstanding as on 31 October 2025)



Source: RBI, Sectoral Deployment of Bank Credit (October 2025).

Chart IX.3: Funds mobilised by REITs and InvITs



Source: SEBI

4 RBI Handbook of Statistics on the Indian Economy 2024-25, Table 63 (Statistical table on Flow of Resources to Commercial Sector in India)

9.13 A major regulatory milestone in infrastructure credit is the RBI (Project Finance) Directions 2025, effective from 01 October 2025. These guidelines introduce a unified framework for project lending across all financial institutions, ensuring a consistent approach to large-scale financing. A key feature of these directions is the revised treatment of the Date of Commencement of Commercial Operations (DCCO). This provides a more realistic way to handle project delays, which helps in better identifying actual stress and preventing the artificial 'evergreening' of loans. Furthermore, by aligning the definition of the 'Infrastructure Sector' with the government's Harmonised Master List (HML) of infrastructure sub-sectors, the RBI has ensured regulatory clarity and policy synchronisation across the entire financial ecosystem.

9.14 Capital-market channels for long-term funding and asset recycling have also been strengthened through incremental reforms. SEBI's Small and Medium Real Estate Investment Trusts (SM REIT) framework reduced the minimum asset size relative to existing REITs, from ₹500 crore to ₹50 crore. It also introduced a scheme-based structure, allowing multiple schemes to be managed under one SM REIT. Each scheme's proposed assets are generally required to be at least ₹50 crore and less than ₹500 crore. This broadens the universe of monetizable real estate assets and can support urban regeneration/commercial infrastructure by bringing smaller, stabilised assets into a regulated pooled vehicle.

9.15 Additionally, SEBI has decided that from 01 January 2026, investments by Mutual Funds and Specialised Investment Funds (SIFs) in REITs will be treated as equity-related instruments, which is expected to ease participation constraints and potentially improve secondary market liquidity. From April to November 2025, ₹13,893 crore was raised by listed Real Estate Investment Trusts (REITs) and Infrastructure Investment Trusts (InvITs).[5]

Public-Private Partnerships

9.16 PPPs are vital mechanisms through which governments can leverage private sector expertise and resources to address critical infrastructure needs. They play a significant role in bridging infrastructure gaps and enhancing the efficiency of service delivery. The success of PPPs is largely dependent on the robustness of institutional frameworks, financial support, and the adoption of standardised documents, such as the Model Request for Qualification (RfQ), Model Request for Proposal (RfP), and Model Concession Agreements (MCAs).

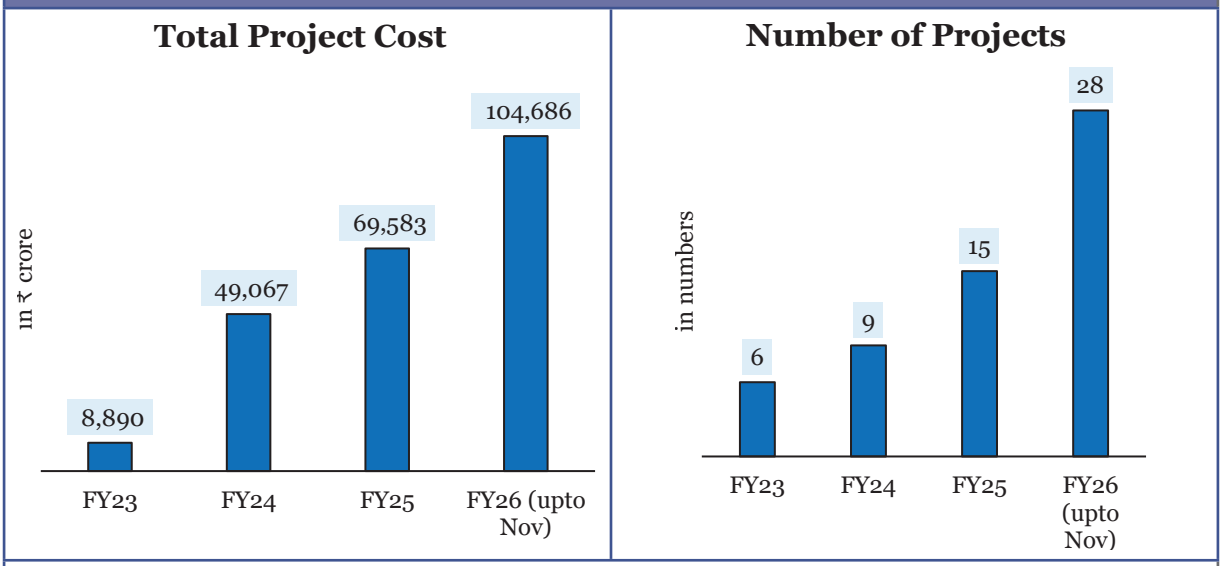
9.17 India's infrastructure programs support a variety of PPP models, including

5 SEBI statistics on fund raising by REITs and InvITs available at https://tinyurl.com/57u2rjtb. Note: Total funds mobilised by REITs & InvITs includes funds raised through public issue, private placement, preferential issue, institutional placement, rights issue.

management contracts like Build-Operate-Transfer (BOT), Design-Build-Finance-Operate-Transfer (DBFOT), Hybrid Annuity Model (HAM), and Toll-Operate-Transfer (TOT). Within the BOT framework, two variants exist—BOT (Toll) and BOT (Annuity)—distinguished by the allocation of traffic risk.

9.18 According to the World Bank's Private Participation in Infrastructure (PPI) Report 2024,[6] India has consistently ranked among the top five countries globally in terms of private investment in infrastructure among low- and middle-income economies. India also emerged as the largest recipient of PPI investment in South Asia, accounting for over 90 per cent of the region's total private infrastructure investment. This strong global standing is reflected domestically in the marked increase in project approvals by the Public-Private Partnership Appraisal Committee (PPPAC), as illustrated in Chart IX.4. The key institutional and policy mechanisms underpinning India's PPP framework are discussed in Box IX.1, while the priorities shaping its next phase are outlined in Box IX.2

Chart IX.4: Increase in project approvals by PPPAC



Source: PPP Database, Department of Economic Affairs, pppinindia.gov.in.

Box IX.1: Key Institutional Mechanisms to support PPPs in India

Public Private Partnership Appraisal Committee (PPPAC):

- Apex body for appraising and recommending central sector PPP projects. Chaired by the Secretary, Department of Economic Affairs (DEA), its members include Secretaries from the Department of Expenditure, Department of Legal Affairs, the sponsoring ministry/department, and the CEO of NITI Aayog.

6 Private Participation in Infrastructure (PPI) Annual Report (2024), World Bank available at https://tinyurl.com/muywbmcb.

- 129 projects with a Total Project Cost (TPC) of ₹5,60,965.71 crore have been recommended by the PPPAC [From 2014-15 to 2025-26 (up to 04 December 2025)].

Viability Gap Funding (VGF) Scheme:

- Provides financial assistance to projects that are economically desirable but commercially unviable.
- Economic sector projects may receive up to 40 per cent of capital expenditure (Capex) as a VGF grant, while social sector projects are eligible for grant up to 80 per cent of Capex and 50 per cent of operational expenditure for five years post-commercial operations.
- 72 projects have been approved, with a GoI VGF of ₹7,941.838 crore sanctioned (up to 04 December 2025). Out of this, ₹6,314.86 crore has already been disbursed.

India Infrastructure Project Development Fund (IIPDF):

- Aims to create a pipeline of viable, bankable projects by funding transaction advisers for central and state authorities.
- Notified in November 2022 with a total outlay of ₹150 crore for three years from FY23 to FY25.

Development of a Three-Year PPP Project Pipeline:

- Pursuant to the announcement in the Union Budget 2025-26, a 3-year PPP project pipeline has been created.
- The PPP project pipeline comprises 852 projects across central infrastructure ministries and States/Union Territories with a combined total project cost of over ₹17 lakh crore.

Standardisation and Institutional Capacity Building:

- Development of reference guides on risk allocation, PPP appraisal, and project implementation mode (Waterfall Framework) including sector-specific PPP structuring toolkits for Roads, Ports, Solid Waste Management, and Water & Sanitation have been done.
- Capacity Building Initiatives for States/UTs through workshops, seminars, and one-to-one guidance are ongoing.
- National Infrastructure Enablement Index (NIEI) has been developed to assess the institutional preparedness of States/UTs and Central Ministries/Departments.
- Model RfP (Request for Proposal) for single-stage PPP projects has been developed to embed best practices, ensure consistency, and enhance flexibility in procurement and contract management.

Box IX.2: Public–Private Partnerships (PPP)- Strengthening the Partnership Paradigm

India's PPP programme has traversed a full learning curve since the first wave of projects in the early 2000s. In the initial phase, multiple PPP models were tested across sectors, with some projects encountering stress or failure. These experiences informed successive improvements in model concession agreements, policy guidelines, and institutional practices by addressing contractual weaknesses, risk-allocation errors, and regulatory gaps. Over time, this iterative process has converted early experimentation into codified frameworks and institutional memory.

As a result, the environment for private participation in infrastructure is materially stronger in select core sectors. Roads, ports, power, and renewable energy now attract sustained private capital, supported by more stable policy regimes, standardised contracts, and clearer regulatory architectures. These sectors have transitioned from infancy to relative maturity through deliberate sequencing of reforms. For instance, tariff regulation in ports was initially institutionalised through the Tariff Authority for Major Ports (TAMP) and subsequently withdrawn as market depth and competition improved, underscoring the need for regulation to evolve with sector maturity.

The next challenge is to extend this maturity to a new generation of PPPs in emerging and socially critical sectors such as health, education, warehousing, sanitation, urban infrastructure, green hydrogen, and the broader energy transition. In these areas, conventional concession-style risk transfer is often insufficient. PPPs must increasingly reflect the third "P" — Partnership — where public and private actors co-design projects, share early-stage risks, and align incentives around long-term service outcomes rather than narrow financial closure.

Accordingly, India's PPP framework needs to move from transaction-centric execution toward system-level market building, with a sharper focus on reducing structural uncertainty. This requires clearer sectoral pipelines with multi-year visibility, a tighter linkage between national programmes (PM GatiShakti, National Infrastructure Pipeline, sector missions), and bankable project preparation, as well as disciplined pre-construction risk closure by the public authority. PPP outcomes have been weakest where land acquisition, statutory clearances, demand assessment, or utility shifting have remained unresolved. In the coming decade, a credible PPP regime will be defined less by risk transfer on paper and more by the State's capacity to absorb early-stage risks that private capital cannot efficiently price.

While PPP frameworks have matured at the central level and in select sectors, challenges persist at the sub-national level. The distinction between PPPs and Engineering Procurement and Construction (EPC) contracts—namely that PPPs are partnerships rather than vendor arrangements—is not always fully understood. Trust deficits and a limited understanding of risk–reward principles continue to constrain the uptake of PPPs in several states and urban local bodies. These challenges are compounded by uneven institutional capacity, even as states and cities account for a rising share of infrastructure demand. The next reform frontier lies in professionalising PPP cells, adopting programmatic approaches instead of project-by-project experimentation, and leveraging data platforms to track performance, renegotiation, and lifecycle outcomes. In this context, the Department of Economic Affairs'

schemes such as the India Infrastructure Project Development Fund (IIPDF) and Viability Gap Funding (VGF) are important.

An often-overlooked aspect relates to public perception. PPPs are sometimes perceived as 'selling of assets' rather than long-term service partnerships, particularly at the state level. Improving communication and transparency is therefore important for sustaining public acceptance and investor confidence, especially for projects with long concession periods. The perception principle has improved by a long margin among central projects as compared with States. The lesson is often lost that wrong signalling in this regard creates two problems – adversely affecting the public mood and driving away investors willing to stomach the entirety of risks across a long concession period (30-60 years).

India has also consciously deepened the financial architecture supporting PPPs since 2014. Long-term domestic capital, including pension funds, insurance funds, InvITs and Alternative Investment Funds (AIFs), has increasingly participated in brownfield assets. However, greenfield PPPs continue to rely heavily on bank balance sheets. Expanding construction-period risk mitigation tools, partial credit guarantees in social sectors, take-out financing, and standardised refinancing frameworks can materially lower the cost of capital. Equally important is creating predictable exit and restructuring pathways for stressed but viable projects, so that failure does not permanently impair investor confidence. A renegotiation framework for complex cases to prevent project termination is worth exploring. PPPs should be treated as evolving financial assets rather than one-time contracts frozen at financial close.

Finally, private sector participants that have benefitted from de-risked brownfield assets should be encouraged to increase their risk appetite for greenfield projects, particularly through pure-play PPP models such as BOT, especially in mature sectors like roads.

9.19 As also highlighted in the Economic Survey 2024-25, public sector efforts alone cannot meet India's growing infrastructure requirements. While public investment remains crucial, a multi-pronged financing approach is essential to attract the requisite investments from the private sector and long-term institutional investors. This strategy requires strengthening resource mobilisation across all levels through innovative measures, including viable user charges and empowering municipal bodies to float bonds for localised resource generation. It also involves accelerating private participation including through public-private partnerships (PPPs). A wider array of PPP models with nuanced risk-sharing, right-price infrastructure services and a pipeline of bankable projects can facilitate infrastructure development significantly. Improved project preparation, standardised contracts and dispute resolution mechanisms are also critical to sustaining investor confidence and scaling PPPs.

CORE PHYSICAL INFRASTRUCTURE

Roadways & Highways

9.20 The roads and highways sector continues to be a primary driver of India's infrastructure, transitioning from rapid capacity expansion to a focus on logistic

efficiency and technological integration. Over the past decade, sustained investment and policy reforms have significantly expanded the National Highway (NH) network and improved construction pace, laying a stronger foundation for multimodal connectivity and economic integration (Chart IX.5 to Chart IX.8). For FY26, 10,000 km of construction is targeted, of which 4,938 km have been completed as of 31 December 2025.[7] The key initiatives and reforms shaping the national highways programme are outlined in Box IX.3.

Chart IX.5: Total NH Network

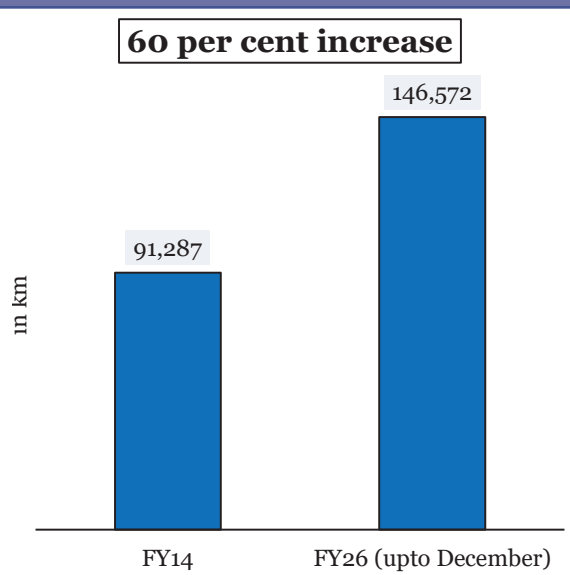
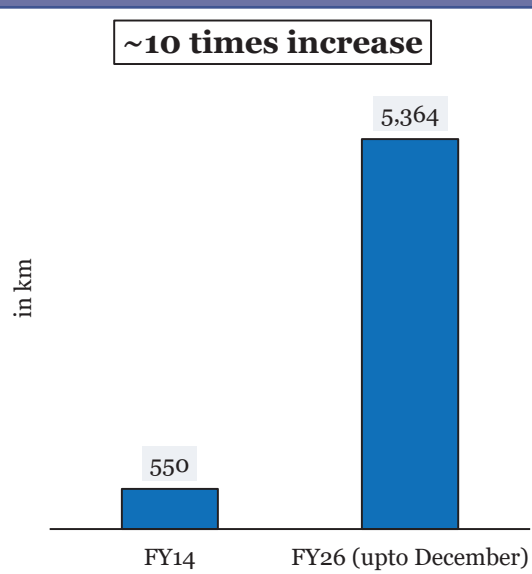


Chart IX.6: Operational High-Speed Corridors (HSCs)



Source: Ministry of Roads, Transport & Highways.
Note: 5,364 km of operational HSCs includes National HSCs of 3,052 km and State HSCs of 2,312 km.

Chart IX.7: Average Annual Construction

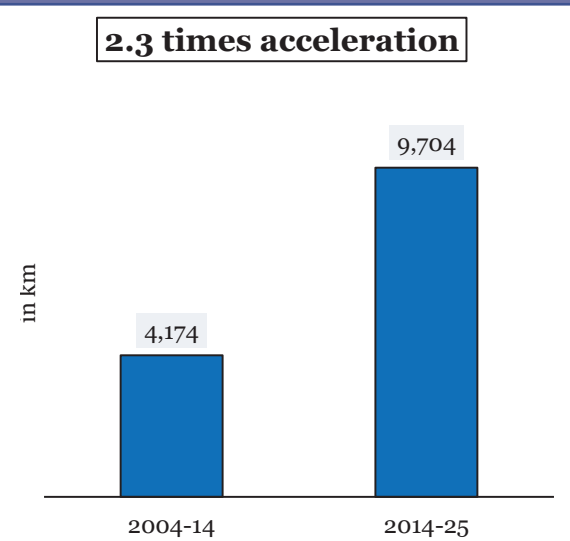
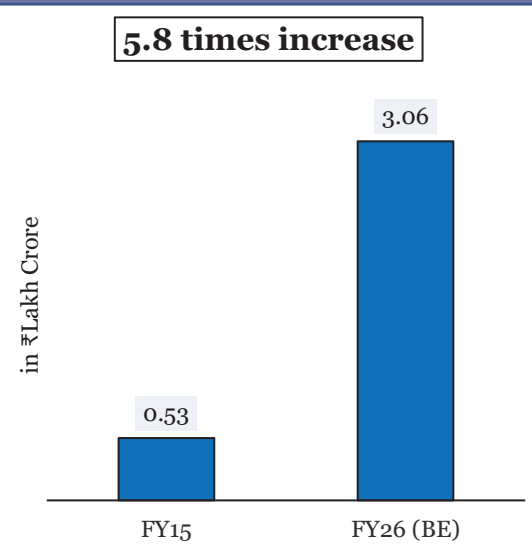


Chart IX.8: Capital Expenditure on Roads & Highways



Source: Ministry of Roads, Transport & Highways.

7 Ministry of Roads, Transport & Highways.

Box IX.3: Key Initiatives and Reforms in the Roadways & Highways Sector

High Speed Connectivity and Urban Integration:

- **High-Speed Corridor (HSC) Development:** To align freight speeds with global benchmarks, the HSC network expanded from 550 km in 2014 to 5,364 km by December 2025. A total network of approximately 26,000 km is targeted by FY33, with 9,366 km currently under implementation.[8]
- **Economic Node Connectivity:** Priority is accorded to highway projects linking ports, Inland Water Transport (IWT) terminals, and industrial corridors to lower logistics costs.
- **Urban Decongestion:** A new policy for access-controlled ring roads and bypasses has been finalised for cities with populations over 1 lakh. This employs innovative cost-sharing models, such as land pooling and value capture, to transform urban centres into growth engines.

Privatisation and Asset Monetisation Roadmap:

- **Public InvIT:** The first Public InvIT is planned for launch in 2026. This follows a successful cumulative monetisation of ₹1.52 lakh crore through ToT and private InvITs.
- **Project Pipeline:** In line with the Budget announcement FY26, a dedicated PPP pipeline of 13,400 km (estimated cost of ₹8.3 lakh crore) has been identified for development over the next three years.

Reforms for improving Project Quality:

- **Project Preparation:** Fixed-cost bidding and introduction of performance rating as part of bid evaluation.
- **Construction:** Stricter eligibility norms, Additional Performance Security for low bids and introducing contractor performance rating.
- **Use of Technology:** Mandated use of drone surveys for alignment planning, deployment of Automated Intelligent Machine-Aided Construction (AIMC), and the use of pre-cast components for non-critical items mandated for projects above ₹300 crores. Additionally, a Drone Analytics Monitoring System has been introduced for encroachment, along with AI-based detection of potholes and cracks using network survey vehicles.

9.21 Within the broader infrastructure landscape, rural roads development has played a critical role in improving last-mile connectivity and rural integration. The Pradhan Mantri Gram Sadak Yojana (PMGSY) has achieved near-universal rural connectivity, with over 99.7 per cent of eligible habitations connected, as of 31 December 2025.[9] The

8 ibid.

9 Department of Rural Development.

programme has been strengthened through focused initiatives, including a dedicated road connectivity vertical under PM-JANMAN (Pradhan Mantri Janjati Adivasi Nyaya Maha Abhiyan) to serve Particularly Vulnerable Tribal Groups (PTVGs), targeting 8,000 km of roads over the period 2023-28. As of 31 December 2025, 2,495 roads (7,323.96 km of road length) and 163 bridges have been sanctioned under PM-JANMAN for connecting 2,909 habitations, out of which 248 roads (1242.41 km of road length) has been completed.[10]

9.22 Further momentum has been reinforced through PMGSY-IV, launched in September 2024, which aims to connect 25,000 unconnected habitations by constructing or upgrading 62,500 km of roads and bridges at an estimated cost of ₹70,125 crore during FY25–FY29. The phase adopts international standards, GIS-based surveys, and the PM GatiShakti framework, while converging with the Dharti Abha–Janjatiya Gram Utkarsh Abhiyan (DA-JGUA) scheme to prioritise habitations with high Scheduled Tribes population. So far, 2,490 roads (8,655.378 km of road length) and 01 bridge have been sanctioned under PMGSY-IV, which will provide connectivity to 2,734 new habitations.

9.23 **Outlook:** India's roads and highways sector is moving from rapid network expansion towards greater logistics efficiency and quality. Sustained capital investment, expansion of high-speed corridors, multimodal integration under PM GatiShakti and reforms in project delivery are strengthening capacity and reliability. This infrastructure-led push is central for reducing logistics costs, easing congestion and improving connectivity.

Railways

9.24 Indian Railways continue to play a pivotal role in India's infrastructure landscape by expanding network capacity, modernising assets, and strengthening multimodal connectivity. As of March 2025, the rail network has expanded to 69,439 Rkm. During FY26, it is targeted to extend the network further by 3,500 km. Electrification has reached 99.1 per cent of the network by October 2025.[11] Sustained investments have enabled faster network expansion, with commissioning rates more than doubling in the post-2014 period compared to the previous decade (Chart IX.9).

10 ibid.

11 Ministry of Railways.

Chart IX.9: Average Commissioning of railway network per year

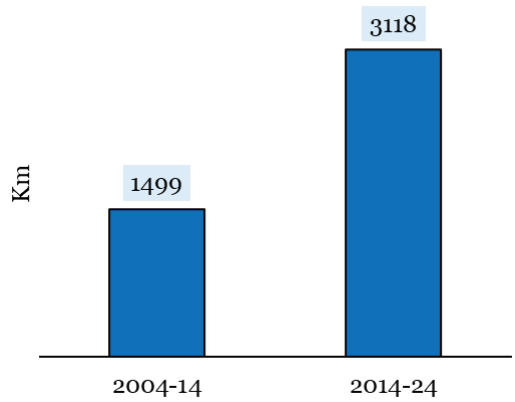
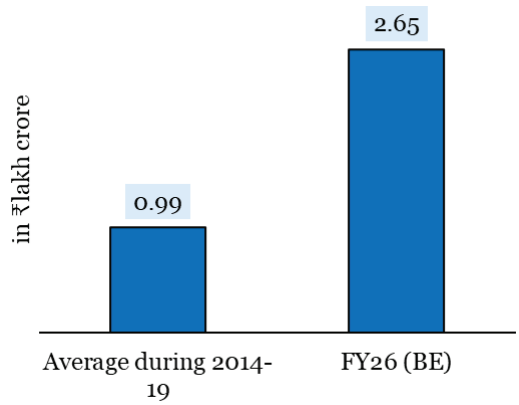


Chart IX.10: Capital Expenditure on Railways (in ₹ Lakh crore)



Source: Ministry of Railways.

9.25 A defining feature of recent years has been the record capital expenditure on railway infrastructure, with a focus on new lines, doubling and multi-tracking, rolling stock augmentation, signalling, and safety-related works. In FY26 (BE), capital outlay has been maintained at historically high levels, to accelerate capacity creation in a time bound manner (Chart IX.10).

9.26 Railways have also emerged as a backbone of India's freight and energy logistics, supporting coal movement, industrial supply chains, and containerised traffic through dedicated corridors, modern terminals, and first-mile connectivity projects. Parallel investments in stations, signalling, telecom and digital systems are improving network reliability, safety, and user experience (Box IX.4).

Box IX.4: Key Infrastructure Initiatives in the Railways Sector

- **Economic Railway Corridors (PM GatiShakti):** Three corridor programmes—Energy, Mineral & Cement; Port Connectivity; and High Traffic Density routes—are being implemented to strengthen multimodal connectivity and logistics efficiency. 434 projects with an outlay of ₹11.17 lakh crore have been identified under three corridors and mapped on the PM GatiShakti portal. Of these, 122 projects covering 12,150 km have been sanctioned, and 198 projects spanning 19,779 km are under different stages of appraisal.
- **Major ongoing projects:**
  - **Mumbai–Ahmedabad High Speed Rail (MAHSR):** Over 55 per cent physical progress has been achieved as on October 2025, with land acquisition completed and most civil packages awarded, marking a major step towards introducing high-speed rail infrastructure in India.
  - **Dedicated Freight Corridors (DFCs):** About 2,741 km (96.4 per cent) of the 2,843 km DFC network has been commissioned as of October 2025, with the Eastern

DFC (1,337 km) fully completed and 1,404 km of the 1,506 km Western DFC completed. These corridors are easing congestion on the passenger network, significantly reducing freight transit times and contributing to lowering logistics costs.

- **Station Redevelopment:** Under the Amrit Bharat Station Scheme, 1,337 stations have been identified for phased redevelopment, with works completed at select stations and progress underway across the country to improve capacity, accessibility and multimodal integration. Further, 15 stations have been identified to develop/redevelop on PPP mode.
- **Safety & Technology Upgradation:** Large-scale deployment of Kavach [Advance Train Protection (ATP) System], electronic interlocking, automatic block signalling, and track renewal are enhancing network safety and throughput.
- **Track upgradation:** More than 78 per cent of railway tracks have been upgraded for sectional speed of 110 kmph and above.
- **Public–Private Partnerships (PPPs):** 18 projects worth ₹16,636 crore have been completed and seven projects worth ₹16,334 crore are under implementation as on September 2025.[12]

9.27 **Outlook:** Indian Railways is undergoing a transformation, driven by sustained capital investment, rapid network expansion, near-universal electrification and a corridor-based approach to capacity creation. Continued focus on dedicated freight corridors, economic rail corridors under PM GatiShakti, and modern signalling and station infrastructure is improving throughput, reliability and multimodal integration. These infrastructure-led initiatives will be central for reducing logistics costs, and strengthening connectivity.

Civil Aviation

9.28 India has emerged as the world's third-largest domestic aviation market. The number of airports increased from 74 in 2014 to 164 in 2025.[13] In FY25, Indian airports handled 412 million passengers, and the same is projected to increase to 665 million by FY31. Further, air cargo volume grew from 2.53 million metric tonnes (MMT) in FY15 to 3.72 MMT in FY25, and 2.95 MMT handled in FY26 (until December), driven by several key policy initiatives and reforms (Box IX.5).[14]

12 Ministry of Railways.

13 PIB Release: https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=2181865&reg=3&lang=2.

14 Ministry of Civil Aviation.

Chart IX.11: Air cargo handling (International and Domestic)

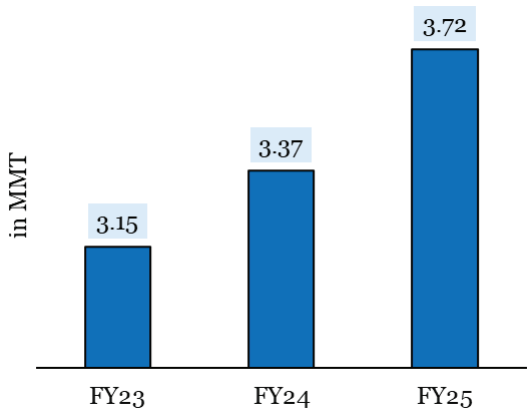
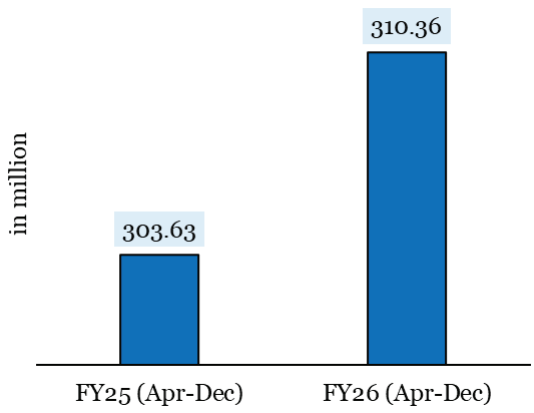


Chart IX.12: Passenger traffic at all airports



Source: Ministry of Civil Aviation.

Box IX.5: Key policy initiatives driving civil aviation growth

- **Regional Connectivity Scheme- Ude Desh ka Aam Nagrik (RCS-UDAN):** Operationalisation of 657 routes connecting 93 airports, including heliports and water aerodromes, has made air travel affordable while improving access to remote and aspirational regions. Further, the modified UDAN Scheme has been announced to increase regional connectivity to 120 new destinations and cater to 4 crore passengers over the next 10 years.
- **Greenfield Airports Policy:** In-principle approval for 24 Greenfield airports, with 13 already operational airports, including the Navi Mumbai International Airport, is expanding urban and regional capacity.
- **Airport Modernisation & Capacity Expansion:** Since FY20, modernisation projects at several airports across the country have successfully raised combined passenger-handling capacity of operational airports to approximately 575 million passengers per annum.
- **Digital & Technological Initiatives:** Expansion of Digi Yatra, liberalised drone regulations, PLI support for drone manufacturing, and focus on Advanced Air Mobility (AAM) have been ongoing.
- **Legislative Reforms:**
  - The **Bharatiya Vayuyan Vidheyak, 2024**, replacing the Aircraft Act, 1934, aims to modernize India's aviation sector by enhancing safety, innovation, growth, and global compliance.
  - The **Protection of Interests in Aircraft Objects Act, 2025**, aims to align India's aviation leasing laws with global standards to reduce leasing costs.

9.29 **Outlook:** India's civil aviation sector is on a sustained growth trajectory, supported by a conducive policy environment, rising demand and steady infrastructure expansion. While the sector remains sensitive to global economic cycles and the need for continuous capacity upgradation, the current passenger volumes represent only a fraction of India's potential. Further, India currently operates approximately 0.11 airports per million people, significantly lower than the US (47.35) and China (0.39)[15], signalling substantial headroom for further growth. Expansion in India's airport and air navigation infrastructure and a growing ancillary ecosystem, including Maintenance, Repair, and Overhaul (MRO) and leasing, are strengthening the sector. These developments, along with technology integration, positions civil aviation as a key driver of nationwide economic connectivity and integration.

Ports and Shipping

9.30 India's maritime sector has undergone significant modernisation and is emerging as an essential pillar of logistics competitiveness, industrial growth and global supply-chain integration. Under Maritime India Vision 2030 and Maritime Amrit Kaal Vision 2047, substantial progress has been made in upgrading port infrastructure, enhancing regulatory frameworks, improving operational efficiency, and increasing private sector participation.

9.31 India's ports have demonstrated strong growth momentum, driven by accelerated capacity creation and a substantial increase in cargo throughput (Chart IX.13). Furthermore, mechanisation, smart port initiatives, and digital trade facilitation have significantly improved operational efficiency across major ports, with the average container vessel turnaround time achieving near-global best standards (Chart IX.14). India's growing competitiveness is reflected in global rankings, with two Indian ports now featuring among the top 30 and seven among the top 100 in the World Bank's Container Port Performance Index 2024. Recent legislative reforms in the ports and shipping sector may be seen at Box IX.6.

15 Airport density figures are calculated based on the total number of operational airports (commercial and general aviation) as reported in the CIA World Factbook 2025 and International Civil Aviation Organization (ICAO) Data Plus (2025 estimates), divided by the mid-year population projections from the World Bank Open Data 2025. High values for the USA (~47 per million) reflect a mature market with a high concentration of general aviation and municipal airfields (over 15,000). For India, the focus is primarily on commercial hubs and regional airports under active development schemes, indicating significant structural headroom for future expansion.

Chart IX.13: Port Infrastructure Expansion and Record Cargo Performance

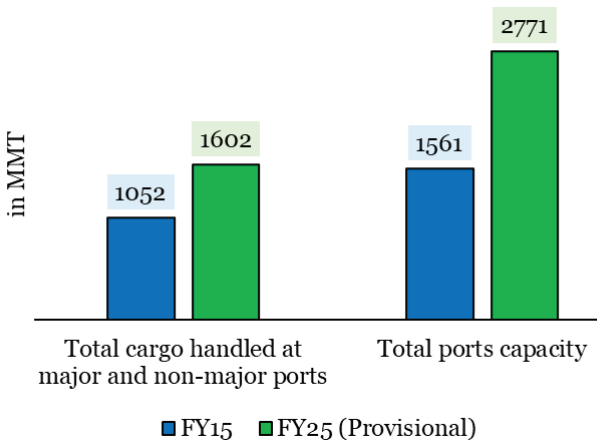
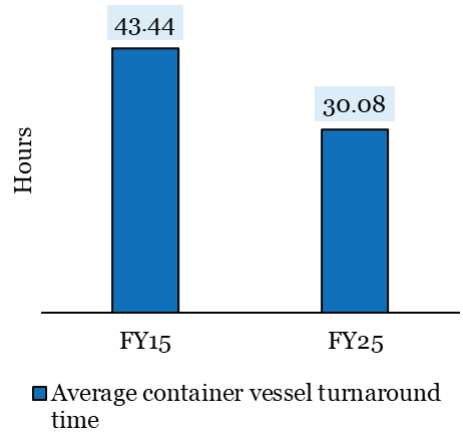


Chart IX.14: Reduction in average container vessel turnaround time



Source: Ministry of Ports, Shipping and Waterways.

9.32 India has further strengthened the landlord port model[16] to catalyse private investments in port development and operations. This strategic shift is evident in the substantial growth of PPP projects. The number of PPP projects awarded rose from 37 in FY15 to 87 in FY25, with the total value of PPP projects increasing from ₹16,180 crore to ₹61,029 crore, reflecting a 377 per cent rise. Currently, 57 operational PPP projects valued at ₹42,235 crore have increased port capacity by approximately 660 MTPA.

9.33 **Outlook:** PPP and captive operators are projected to handle 80 per cent of all cargo at major ports by 2030. A pipeline of 48 PPP projects worth approximately ₹23,000 crore (excluding the Development of Vadhvan Port Project of worth ₹76,220 crore) has been identified for the next five years (FY26 to FY31). These projects will further enhance the capacity and efficiency of India's Major Ports.[17]

Box IX.6: Recent Legislative Reforms in Ports and Shipping Sector

- **Merchant Shipping Act, 2025:** It aligns Indian maritime laws with global standards and International Maritime Organisation (IMO) conventions, promotes ease of doing business, ensures seafarer welfare and training, and enhances safety, environmental protection and emergency preparedness.
- **Coastal Shipping Act, 2025:** Promotes coastal shipping as an economical and eco-friendly mode, removes licensing requirements for Indian vessels in coasting trade and

16 In line with the Major Port Authorities Act, 2021, the landlord port model provides for port authorities to retain ownership of port land and core infrastructure while awarding long-term concessions to private operators for terminal development and operations, with an aim to enhance operational efficiency and modernize infrastructure through private investment.

17 Ministry of Ports, Shipping and Waterways.

introduces strategic planning for coastal and inland waterways integration and improves transparency through a National Coastal Shipping Database.

- **Indian Ports Act, 2025:** Establishes a comprehensive framework for long-term integrated port development, promotes collaboration between the Centre and States for strategic planning, mandates data sharing for transparency, and ensures compliance with international conventions on pollution prevention, safety and security, along with introduction of Maritime Single Window System to reduce logistics costs and strengthen competitiveness.
- **Bills of Lading Act, 2025:** Simplifies legal provisions on bills of lading, clearly defining transfer of rights and liabilities among carriers, shippers, and consignees to reduce disputes and improve trade efficiency.
- **Carriage of Goods by Sea Act, 2025:** Aligns India's sea trade laws with international norms, especially the Hague-Visby Rules, by defining carrier–shipper responsibilities and immunities, supporting agreements like India–UK CETA, and enhancing global maritime trade competitiveness.

Inland Water Transport

9.34 As of November 2025, 32 National Waterways (NWs) are operational, spanning 5,155 km, with cargo operations on 29 NWs, cruise operations on 15 NWs, and passenger services on 23 NWs; 11 NWs support all three modes, reflecting strong multimodal integration. Cargo movement through Inland Water Transport (IWT) has also risen significantly from 18 MMT in 2013-2014 to 146 MMT in 2024-2025, driven by several reforms and key projects in the sector (Box IX.7). Passenger movement has grown to 7.6 crore in 2024-25 from 1.61 crore in 2023-24.

Box IX.7: Inland waterways transformation: Achievements, Key Projects and Initiatives

Jal Marg Vikas Project (JMVP):

- ₹4,600 crore project for National Waterway-1 (NW-1), spanning 1,390 km waterway length (Varanasi to Haldia) with scheduled completion date as 30 June 2026.
- Cargo movement on NW-1 increased by 220 per cent, rising from 5.05 MMT (2014-15) to 16.38 MMT (2024-25).
- Major Multi-Modal Terminals (MMTs) (Varanasi, Sahibganj, Haldia) and the Inter-Modal Terminal (Kalughat) are operational.
- Quick Pontoon Opening Mechanism (QPOM) initiative has been undertaken which replaces bridge cutting/welding delays with a 5-minute vessel passage.
- **Arth Ganga Initiative:** 53 of 86 community jetties along NW-1 are operational (as of Nov 2025), promoting local trade and serving up to 1.22 lakh daily users.

River Cruise Tourism:

- Cruise vessels increased from 3 in 2013–14 to 25 in 2024–25 across 15 circuits on 13 NWs in 9 states, supported by a 4,000 km Varanasi–Dibrugarh corridor with 129 terminals.
- Four new cruise terminals at Silghat, Bishwanath Ghat, Neamati, and Guijan are planned by 2027.

Cargo Promotion: The Jalvahak Scheme, launched in 2024, provides incentives to vessel operators and promotes scheduled cargo services on NW-1, NW-2, and NW-16 via the IBP route.

Digital Initiatives:

- **Jal Samriddhi:** National Waterways (Construction of Jetties/Terminals) Regulations, 2025 notified a portal to streamline NoC applications for construction of jetties/ terminals to promote private investment.
- **Jalyan and Navic:** Unified platform for vessel and crew registry enabling 'One Nation–One Registration'.
- **Naudarshika:** A platform designed to ensure seamless and sustainable vessel movement, enhance operational efficiency, improve safety for vessels and passengers, provides live data on Least Available Depth (LAD) to aid navigation.

North-East Region: IWT projects are underway on NW-2 and NW-16; DPRs for Nagaland and Mizoram are under finalisation. Tripura is implementing a ₹24.53 crore project for connecting Gumti River, India–Meghna River, Bangladesh linkage.

Box IX.8: Urban Water Transport: Kochi Water Metro as a Scalable Model

The Kochi Water Metro (KWM), operational since 2023, represents a landmark shift in India's urban mobility by re-establishing inland waterways as a sustainable mass transit option. The project is institutionalised through a Special Purpose Vehicle (SPV) incorporated in 2021, with the Government of Kerala holding 74 per cent equity and Kochi Metro Rail Limited (KMRL) holding the remaining 26 per cent. KMRL itself is a joint venture between the Government of India and the Government of Kerala.[18]

The project entails a planned network of 15 routes covering approximately 78 km, connecting 10 islands through 38 modern terminals and jetties. With a total project cost of about ₹819 crore, financing includes an €85 million long-term concessional loan from the German development bank KfW under the Indo-German Financial Cooperation framework, complemented by state government support.[19]

18 Radhika P. Nair, "India is rediscovering its waterways. Can a Kochi experiment go national?," Mint (1 Dec 2025),available at https://tinyurl.com/7e7y9fcx

19 https://watermetro.co.in/about

A defining feature of KWM is its deployment of air-conditioned electric-hybrid ferries designed and built by Cochin Shipyard Limited following a global tender. Each vessel carries around 100 passengers and is powered by lithium titanate oxide (LTO) batteries, enabling rapid charging and high cycle life. The terminals are designed with universal accessibility standards, and the service is fully integrated with the Kochi Metro Rail system through unified digital ticketing and interoperable smart cards, enabling seamless multimodal travel. As of 2025, cumulative ridership has crossed five million passengers, with island communities such as Vypin, Bolgatty, and Mattancherry experiencing improved connectivity to the urban core.[20]

From a cost-effectiveness perspective, water metros offer a significant advantage over rail-based systems by leveraging existing waterways and minimising land acquisition and elevated infrastructure. Estimates suggest that a 75 km water metro network can be developed at roughly one-tenth the cost of a comparable elevated metro corridor, making it an attractive option for suitable urban geographies. However, scalability remains contingent on hydrological suitability, assured year-round navigability, availability of electric or alternative-fuel vessels, and coordinated financing across multiple levels of government.

The success of the KWM serves as a scalable model for other Indian cities with navigable water bodies, potentially offering sustainable and efficient transportation options.[21] The model is being replicated in 21 cities, with feasibility studies in several cities in process, including Ayodhya, Dhubri, Goa, Guwahati, Kollam, Kolkata, Prayagraj, Patna, Srinagar, Varanasi, Mumbai, Vasai, Mangalore (Gurupura River), Gandhinagar-Ahmedabad (Sabarmati River), Alleppey in Kerala, as well as Lakshadweep and Andaman & Nicobar Islands.[22]

Overall, the Kochi Water Metro demonstrates how institutional innovation, green technology, and multimodal integration can convert natural water assets into efficient urban infrastructure. While replication must remain context-specific and demand-driven, the model provides a credible template for sustainable urban transport in India's riverine and coastal cities.

9.35 **Outlook:** India aims to increase the Inland Water Transport modal share from 2 per cent to 5 per cent and raise cargo traffic to 200+ MMT by 2030 and 500 MMT by 2047 under the Maritime Amrit Kaal Vision.

9.36 **Shipbuilding:** In September 2025, the Government of India approved a comprehensive package of ₹69,725 crore (approximately USD 8.3 billion) to revitalise the country's shipbuilding and maritime ecosystem. The initiative adopts a four-pillar approach aimed at developing a globally competitive, technologically advanced and sustainable maritime sector. Key policy initiatives and achievements driving the maritime transformation are elaborated in Box IX.9.

20 Ibid.

21 https://www.pppinindia.gov.in/bestpractices/best-practice-detail/kochi-water-metro-project

22 PIB Release available at https://tinyurl.com/2wxpk2fa.

Box IX.9: Shipbuilding: Reforms, Achievements, Key Projects and Initiatives

- **Shipbuilding Financial Assistance Scheme (SBFAS):** The Scheme, with a corpus of ₹24,736 crore and validity up to 31 March 2036, provides structured incentives for shipbuilding within India, including a shipbreaking credit note of ₹4,001 crore to promote environmentally responsible recycling and green shipbuilding practices.
- **Maritime Financing and Investment Framework:** A dedicated Maritime Development Fund (MDF) of ₹25,000 crore has been approved to strengthen long-term sectoral financing, attract investment and promote PPPs. This includes:
  i. Maritime Investment Fund of ₹20,000 crore, with 49 per cent participation from the Government of India, and
  ii. Interest Incentivization Fund of ₹5,000 crore to lower financing costs and enhance project viability.
- **Shipbuilding Development Scheme (SbDS):** With an outlay of ₹19,989 crore, the SbDS seeks to enhance shipbuilding capacity to 4.5 million Gross Tonnage (GT) annually and support development of greenfield mega shipbuilding clusters, modernization of existing shipyards, risk and insurance support for shipbuilding projects, and establishment of an India Ship Technology Centre to help develop India's capabilities related to shipbuilding design, training of manpower, R&D in shipbuilding and co-ordination for testing facilities.
- **Inclusion of Ships in Infrastructure Category:** Large ships (above a specified size) have been included in the Infrastructure Harmonised Master List (HML) in September 2025.

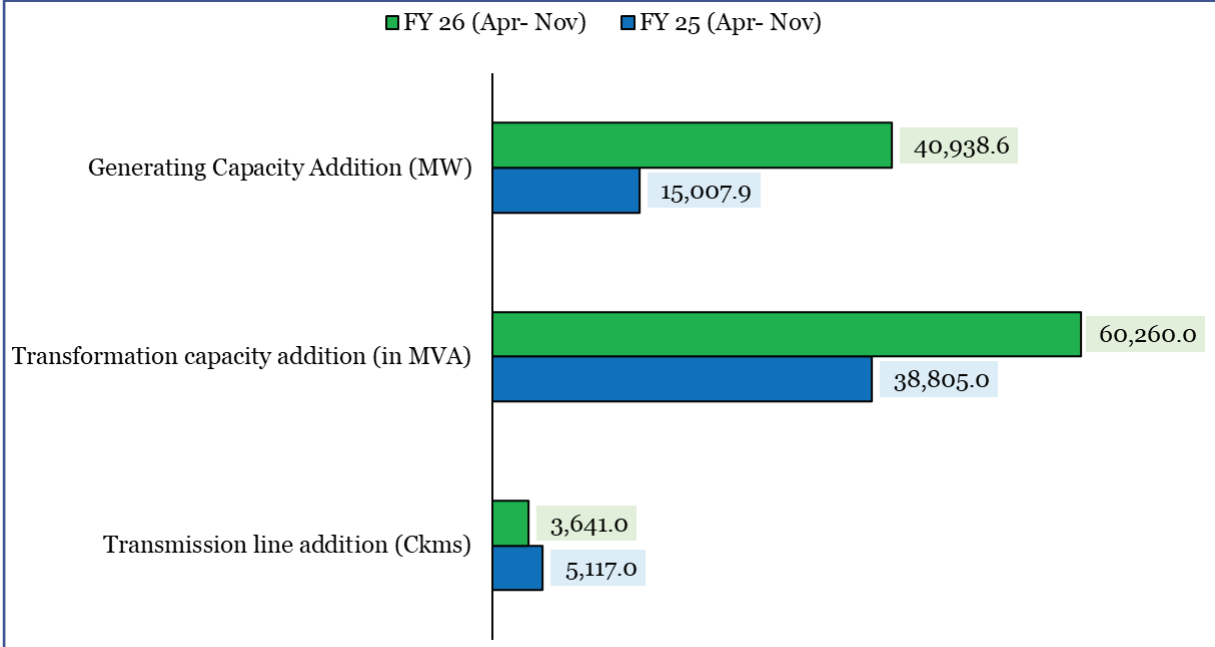
ENERGY SECTOR

Power

9.37 The power sector continues to expand, with the installed capacity rising by 11.6 per cent year-on-year to 509.74 GW as of November 2025.[23] The addition of transformation capacity also gained momentum this year (Chart IX.15).

23 Installed Capacity Report (November 2025), Central Electricity Authority available at https://cea.nic.in/installed-capacity-report/?lang=en.

Chart IX.15: Capacity addition in the power sector



Source: Executive Summary Report (November 2025), Central Electricity Authority.

9.38 The Government of India implemented multiple initiatives aimed at supporting States/distribution utilities for providing uninterrupted power supply to every household. Under the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), the Integrated Power Development Scheme (IPDS), introduced in 2014, and the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA), introduced in 2017, about ₹1.85 lakh crore has also been invested to boost distribution infrastructure across various states. Around, 18,374 villages were electrified under DDUGJY, and 2.86 crore households have gained access to electricity during SAUBHAGYA period. To further support States to improve financial sustainability and operational efficiency of distribution utilities, the Revamped Distribution Sector Scheme was launched in 2021 with an outlay of ₹3.03 lakh crore, wherein projects worth ₹2.8 lakh crore have been approved to improve distribution infrastructure and implement smart metering solutions.[24]

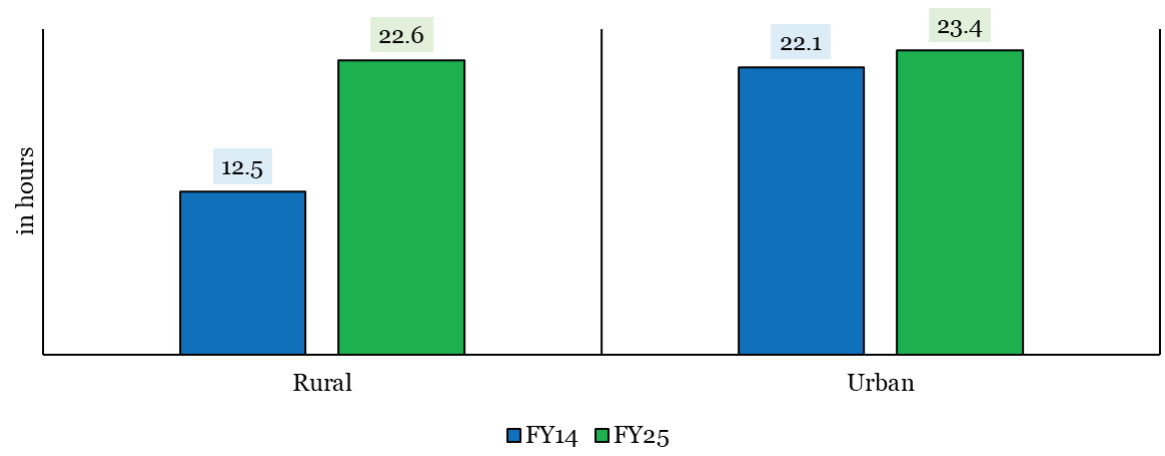
9.39 These interventions have contributed significantly in improving power availability and reliability, particularly in rural areas (Chart IX.16). The gap between energy demand and supply has also declined from 4.2 per cent in FY14 to nil by November 2025.[25] Besides, several initiatives have been undertaken to strengthen the viability and operational efficiency of Distribution Companies (DISCOMs) (Box IX.10).

24 Ministry of Power.

25 ibid.

9.40 To further strengthen distribution sector, the Government has proposed the Electricity (Amendment) Bill, 2026, with the objective of enhancing efficiency, competition, and financial discipline in the power sector. The Bill seeks to enable regulated competition in electricity distribution, promote cost-reflective tariffs, strengthen payment security for generators, and improve regulatory accountability, while continuing to safeguard subsidised supply for vulnerable consumers.[26]

Chart IX.16: Improvement in Daily Average Power Supply



Source: Ministry of Power.

Box IX.10: Reforming the last mile - Key initiatives to strengthen DISCOM finances

The distribution sector remains the most critical yet financially vulnerable segment of India's power value chain. Operating as regulatory monopolies, many DISCOMs face operational inefficiency and financial distress. Between 2020-21 and 2024-25, accumulated losses rose from ₹5.5 lakh crore to ₹6.47 lakh crore, with outstanding debt increasing to ₹7.26 lakh crore. This is rooted in non-cost-reflective tariffs, delayed state subsidies payment, and high Aggregate Technical and Commercial (AT&C) losses. To safeguard the long-term sustainability of the sector, the Government of India has introduced several reforms to strengthen the DISCOM finances, reduce losses, and ensure long-term sector sustainability including the following:-

1. **Late Payment Surcharge (LPS) Rules:** Streamlined payment discipline has sharply reduced outstanding dues from ₹1.4 lakh crore (June 2022) to ₹4,927 crore (January 2026).
2. **Automatic Monthly Fuel & Power Purchase Cost Adjustment:** Rules to provide for formula-based monthly tariff adjustments were notified to prevent cash-flow gaps for DISCOMs.
3. **Recognition of Prudent Costs:** Rules notified to allow pass through of prudent power procurement and distribution network costs, subject to regulatory approval.

26 PIB Release available at https://tinyurl.com/f5cst2k6.

4. **Timely Recovery of Change-in-Law Costs:** The 2021 Rules provide for automatic tariff adjustment to restore affected generators or licensees to their original economic position.

5. **Effective Subsidy Accounting:** Standard operating procedures laid to ensure timely release of state government subsidies and improve financial transparency.

6. **Aggregate Technical and Commercial Loss Reduction Mandate:** Loss reduction trajectories to be aligned with targets agreed under national schemes, promoting cost-reflective tariffs.

7. **Return on Equity (RoE) Alignment:** State Commissions should allow reasonable RoE aligned with Central Electricity Regulatory Commission (CERC) norms, improving investor confidence.

8. **Cost-Reflective Tariffs & Revenue Gap Liquidation:** Tariffs must match the approved Annual Revenue Requirement, with any gap capped at 3 per cent (except during natural calamities). New gaps must be cleared in three annual instalments, while legacy gaps (as of Jan 2024) must be recovered over seven instalments.

9. **Revamped Distribution Sector Scheme (RDSS):** RDSS launched with the objective of improving the quality and reliability of power through a financially sustainable and operationally efficient distribution sector. The release of funds under the scheme is linked to States/ distribution utilities taking necessary measures to improve their performance.

10. **Additional Prudential Norms:** As per the norms, financing to State-owned power utilities is linked to the operational performance of their respective State distribution utilities.

As a result of these measures, in a historic first, the country's power distribution utilities (DISCOMs and power departments) have recorded a positive Profit After Tax (PAT) of ₹2,701 crore in FY25, marking a decisive turnaround from a loss of ₹67,962 crore in FY14. This improvement has been accompanied by a sustained reduction in Aggregate Technical and Commercial (AT&C) losses, from 22.62 per cent in FY14 to 15.04 per cent in FY25. Further, the Average Cost of Supply–Average Revenue Realised (ACS–ARR) gap (on an accrual basis) has also narrowed from ₹0.78/kWh in FY14 to ₹0.06/kWh in FY25, signalling much improved cost recovery.

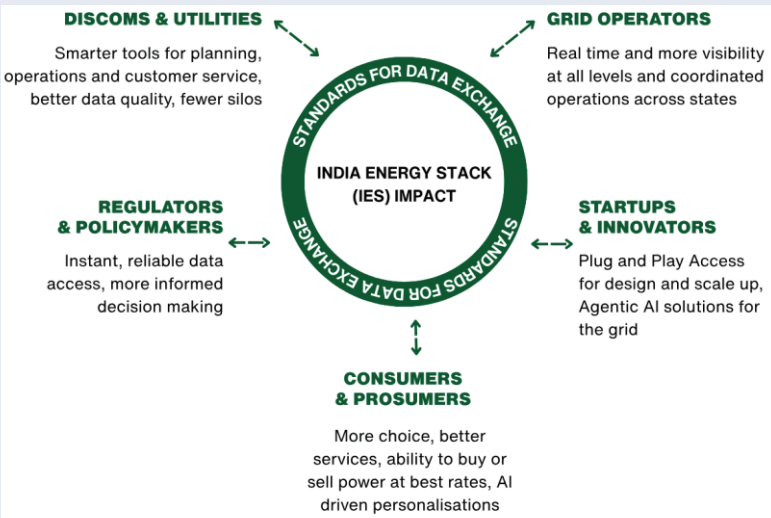
Box IX.11: Enabling Consumer Agency, Open Innovation, and System Efficiency through India Energy Stack (IES)

India's energy transition is reshaping the power sector from a centrally managed system to one that is increasingly distributed, digital, and participatory. Rooftop solar, smart meters, storage, electric mobility, and flexible demand are turning households, farmers, and MSMEs into active energy participants. This transition is not only about cleaner energy- it also carries the potential to create livelihoods and income opportunities for millions of small energy participants.

Yet the digital foundations of the sector remain fragmented. Data is locked in silos, integrations are bespoke and costly, and market participation does not scale. This limits consumer choice, constrains innovation, and creates inefficiencies for utilities and regulators alike and prevents distributed energy assets from translating into reliable income streams. The result is an energy system where value exists but remains difficult to access for ordinary consumers.[27]

India Energy Stack (IES) will address this foundational gap. Conceived as a Digital Public Infrastructure (DPI) for the power sector, IES is envisioned to provide common digital rails that will enable trusted interactions among stakeholders and assets through open standards and protocols.[28] Under the Ministry of Power's leadership, a Taskforce has been setup with REC Limited as the nodal agency for driving the design, coordination, and phased implementation of India Energy Stack, leveraging its sector-wide institutional reach, financing expertise, and convening role across DISCOMs, state governments, and private stakeholders. IES is neither a centralised platform nor a central database. Data remains with rightful owners and is shared only through consent-based mechanisms. By standardising identity, data exchange, measurement, and settlement, IES will help create a power ecosystem that is interoperable, competitive, consumer-centric and capable of converting participation into economic value (see Chart IX.17).

Chart IX.17: IES impact on stakeholders



Source: REC Ltd.

1. Consumer value at the core: choice, participation, and income

At its heart, IES aims at strengthening energy agency—the ability of consumers to choose services, participate in markets, and monetise their assets or actions.

- **Simpler and portable participation:** IES will facilitate interoperable interfaces with standardised onboarding and verified credentials. Consumers will not have to

27 REC Ltd.

28 Ministry of Power. India Energy Stack (IES) strategy document: Version 0.2. Government of India (2025); India Energy Stack (IES) architecture document: Version 0.2. Government of India.

repeat documentation or technical integrations for each utility or service provider. IES will enable once-only participation across services, vendors, and geographies lowering transaction costs for all participants.

- **Meaningful consumer choice through consent-based data sharing:** IES will enable consumers to share their data securely and selectively with service providers of their choice. This will unlock competition in energy advisory, billing support, efficiency services, EV charging, and demand response. By making data portable, IES intends to avoid lock-in into a single utility or vendor workflow thereby enabling competition for better services on value, transparency, and outcomes.
- **Monetisation of distributed assets:** Small and distributed assets—rooftop solar, batteries, EV chargers, and flexible loads—only translate into income when measurement, verification, and settlement are reliable at scale. IES aims at standardising these foundational functions, enabling aggregation and market participation with confidence. Consumers will transform from passive recipients of energy into active participants.

2. Open innovation and scalable energy markets

IES does not prescribe business models. Instead, it creates the enabling conditions for markets to emerge. By lowering entry barriers and standardising interfaces, IES will enable a new ecosystem of service providers: peer-to-peer (P2P) trading platforms, demand-response and flexibility aggregators, rooftop and battery optimisation firms, EV charging operators, settlement and compliance services, and local energy advisors. These firms can operate locally while scaling nationally through common specifications creating significant economic value for the consumers in this process.

Peer-to-peer electricity trading offers a clear illustration. Prosumers—households, farmers, or MSMEs with surplus generation—will be able to sell electricity directly to other consumers, subject to grid and regulatory constraints. Without common protocols, P2P remains confined to pilots, and the IES will enable P2P trading at scale, including across utility jurisdictions, converting surplus energy into a tradable economic asset.

As these markets mature, advanced analytics and AI-enabled agents can generate insights or automate trading and flexibility decisions on behalf of consumers. This deepens participation while reducing complexity, allowing even small consumers to engage confidently in energy markets.

3. Structural benefits for DISCOMs and regulators

IES is envisaged to improve coordination in a distributed grid by providing common rules for trusted interaction reducing disputes, delays, and operational risk as transaction volumes scale.

For DISCOMs, scaled P2P trading reduces exposure to surplus energy payouts already settled between peers, while improving collection efficiency through wheeling charges. Standardised, near–real-time settlement improves demand forecasting and operational planning. Over time, this shifts utilities from being sole intermediaries to being system orchestrators in a more dynamic market.

Regulators benefit from enhanced transparency and enforceability. IES enables policy as code, where rules for settlement, penalties, compliance, and market participation are embedded into standardised protocols.

4. Enhancing livelihoods, and inclusion

IES is intended to ultimately connect system efficiency directly to consumer welfare and livelihood creation by enabling flexibility and participation as earn-able activities. With implementation of standardised use cases at scale, Households, MSMEs, and agricultural consumers can monetise actions through options like off-peak EV charging, reduced cooling loads, or temporary load curtailment. IES enables verification and settlement at scale, allowing millions of small actions to be bundled into dependable grid support. This creates a new class of energy micro-entrepreneurs who earn not only by generating power, but also through consumer flexibility and services.

IES-enabled markets also align strongly with women-led livelihood programmes such as DAY–NRLM (Jeevika). Women Self-Help Groups can collectively own rooftop or community solar assets, trade surplus electricity, and power micro-enterprises in food processing, tailoring, dairy, and agri-allied activities. Reliable and affordable electricity improves productivity through mechanisation and cold-chain access, while participation in digital energy platforms strengthens financial inclusion, digital literacy, and leadership within village institutions. This convergence demonstrates how energy reform can advance inclusive growth and climate-resilient rural development simultaneously.

Openness with safeguards

IES balances open innovation with strong safeguards for privacy, cybersecurity, and grid security through verified identities, consent, audit trails, and conformance checks.

From energy access to energy agency: IES is not merely a technology initiative- it is a market-enabling reform that shifts the focus of India's power sector from energy access to energy agency. By aligning consumer empowerment, open innovation, system efficiency and livelihood creation, IES gives every consumer the ability to choose, act, and earn from the energy transition at national scale.

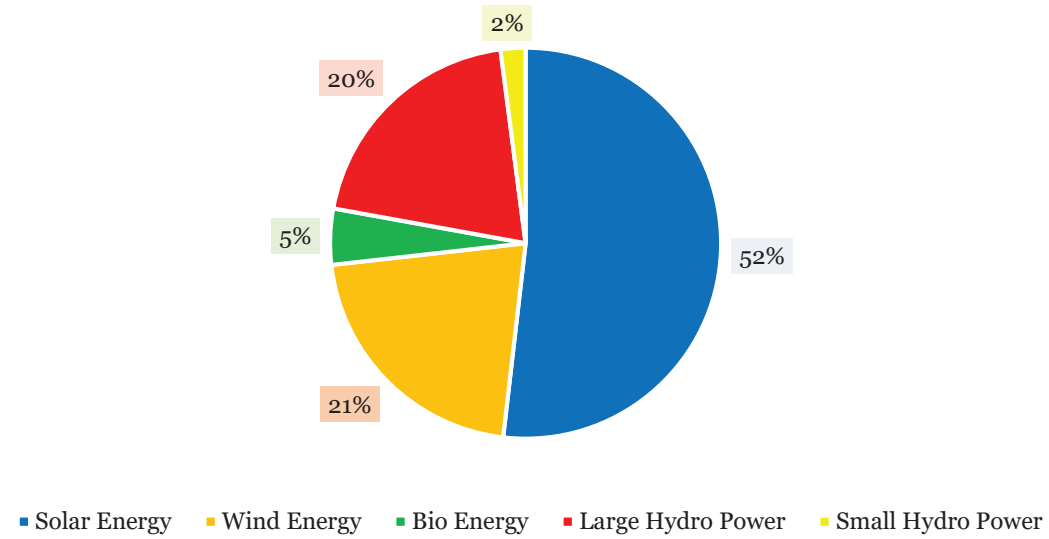
Renewable energy

9.41 India's energy landscape is undergoing a structural transformation, with renewable energy (RE) now constituting around 49.83 per cent of the total installed power generation capacity as of 30 November 2025.[29] The country maintains a dominant global presence, ranking third in overall RE capacity and installed solar capacity and fourth in installed wind capacity. Total RE capacity witnessed a more than threefold increase over the last decade, surging from 76.38 GW in March 2014 to 253.96 GW by November 2025.[30] This substantial growth reflects the effectiveness of national renewable energy policies, large-scale project execution, and strong private sector participation in advancing India's clean energy transition.

29 Ministry of New and Renewable Energy.

30 ibid.

Chart IX.18: Total installed RE capacity: 253.96 GW (Nov'25)



Source: Ministry of New and Renewable Energy.

9.42 The first eight months of FY26 (up to November 2025) recorded a historic 34.56 GW addition—the largest ever annual increase in non-fossil capacity. This expansion was led by Solar (27.20 GW), followed by Wind (3.95 GW), Hydro (2.68 GW), Bio-Power (0.03 GW) and Nuclear (0.70 GW).

9.43 **Outlook:** To sustain India's renewable energy momentum, challenges such as high capital costs, land acquisition delays, and grid availability need to be addressed through appropriate instruments including innovative financing mechanisms and optimised project execution. Further, large-scale integration of Battery Energy Storage Systems (BESS) and Pumped Storage Hydropower (PSP) can address the inherent variability of renewables, ensure grid stability and peak-load management, and enable reliable, large-scale adoption of renewables to support the transition to a clean, secure, and resilient power system.

FUTURE-READY DIGITAL INFRASTRUCTURE

Telecommunications

9.44 India's telecom sector has undergone a significant transformation, driven by initiatives such as 5G deployment, 6G research, BharatNet, and Digital Bharat Nidhi, reflecting the Government's vision of a digitally empowered nation. With innovations including indigenous 4G by BSNL, 100 5G Labs, and citizen-centric platforms, the sector is advancing toward self-reliance, enhanced security, and global leadership. Efforts are focused on creating a telecom ecosystem that is *Samaveshit* (ubiquitous connectivity fuelling inclusive growth), *Viksit* (developed India through a triad of perform, reform,

and transform), *Tvarit* (accelerated development and swift resolutions), and *Surakshit* (safe and secure).

9.45 As a result of these initiatives, India's telecommunications sector expanded rapidly over the last decade, accompanied by a sustained improvement in tele-density from 75.23 per cent to 86.76 per cent.[31] Growth in rural telephone connections outpaced urban growth, indicating a narrowing digital access divide. Furthermore, internet and broadband subscriptions have also witnessed a multi-fold growth over the last decade, underscoring the transition from basic connectivity to data-intensive digital usage across households and enterprises (Chart IX.19 and Chart IX.20).

Chart IX.19: Expansion of Telecom Access

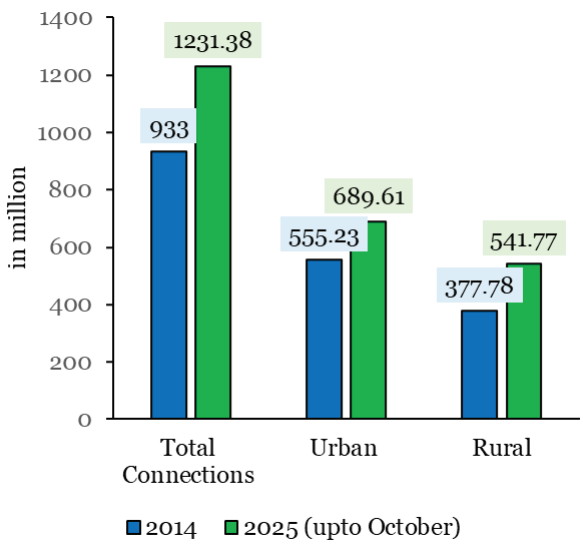
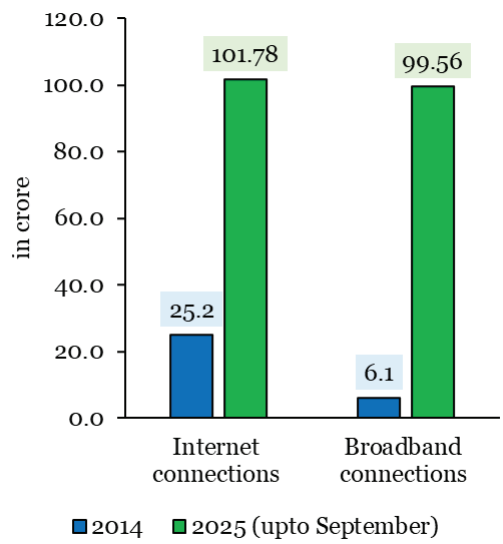


Chart IX.20: Expansion of Internet and Broadband Connectivity

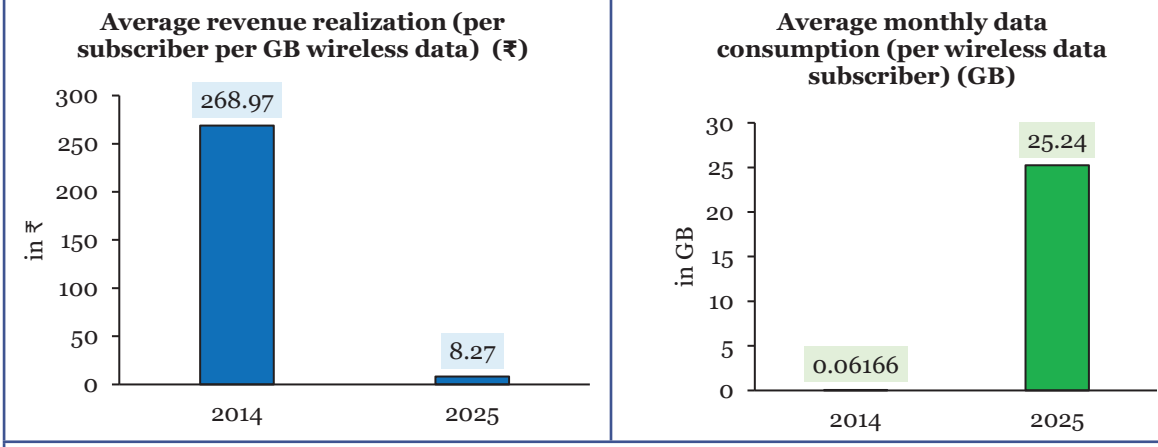


Source: Department of Telecommunications.

9.46 Sharp declines in wireless data prices were associated with an exponential rise in average monthly data consumption, highlighting the role of affordability in driving mass digital adoption (Chart IX.21). Further, Network infrastructure was also strengthened to 31.87 lakh Mobile Base Transceiver Stations (BTS) and 8.48 lakh mobile towers as of December 2025. Key developments in the telecom sector are highlighted in Box IX.12.

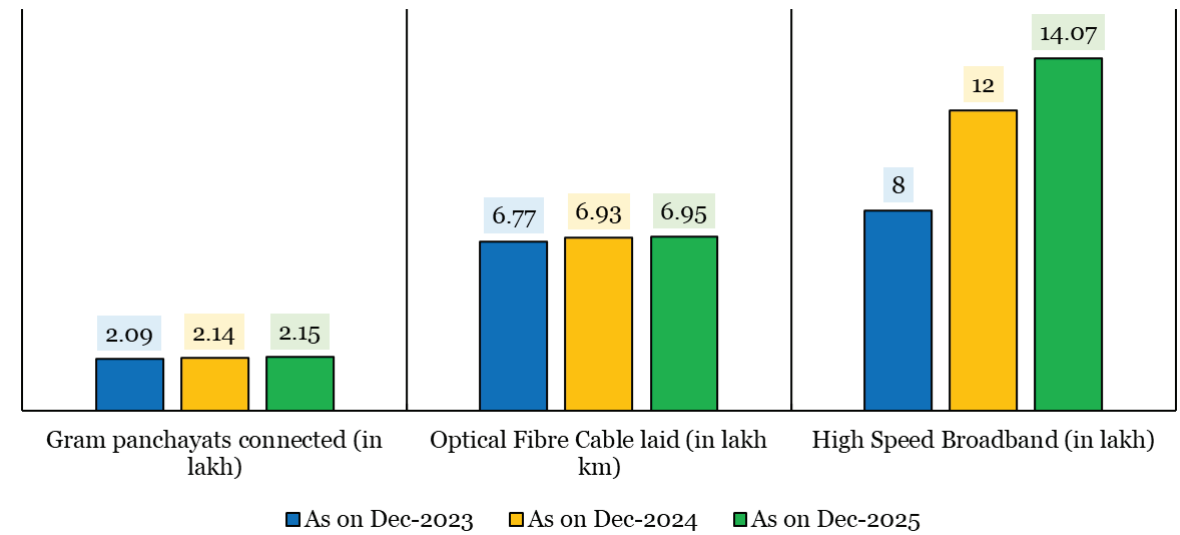
31 Department of Telecommunications.

Chart IX.21: Affordability driving surge in monthly data consumption



Source: Department of Telecommunications.
*Note: Data for 2025 is as of September 2025.

Chart IX.22: Progress in Telecommunication Infrastructure (Bharat Net Progress)



Source: Digital Bharat Nidhi Dashboard, Department of Telecommunications.

BOX IX.12: Key Developments in India's Telecom Sector

- **Nationwide 5G Rollout:** 5G networks have been rolled out in all States/UTs across the country and presently 5G services are available in 99.9 per cent districts in the country, supported by 5.18 lakh 5G BTS. The rollout has been enabled by timely spectrum auctions, financial reforms to rationalize Adjusted Gross Revenue (AGR), Bank Guarantees and interest rates, removal of spectrum usage charges of those acquired in and after 2022, simplified procedure for Standing Advisory Committee on Radio Frequency Allocations (SACFA) clearances, the GatiShakti Sanchar portal and streamlined RoW (Right of Way) clearances.

- **Advances in 5G/6G Innovation:** 100 5G Use Case Labs have been set up to promote research, skill development and start-up collaboration. As part of this initiative, 5G

Innovation Hackathon 2025 was also launched. Further, the Bharat 6G Vision (launched in 2023) and Bharat 6G Alliance (a collaborative platform) guide India's pathway toward global 6G leadership, focusing on research, development and standardisation of 6G technology.

- **Rural Connectivity Expansion:** For implementation of the project for saturation of 4G Mobile service approved in 2022, around 13,415 towers have been made functional, covering 19,901 villages, while the BharatNet project has provided broadband connectivity to 2.14 lakh Gram Panchayats through optical fibre cable and satellite media.
- **Strengthening Domestic Telecom Manufacturing:** The PLI Scheme launched in 2021 with an outlay of ₹12,195 crore, to boost domestic manufacturing of telecom products has attracted over ₹4,700 crore investments, enabled over ₹1,00,000 crore sales, including ₹21,000 crore exports and also has created around 30,000 jobs.
- **R&D and Technology Development Support:** Through the Digital Bharat Nidhi and the Telecom Technology Development Fund (TTDF), support has been extended to fund R&D in rural-specific communication technologies to promote indigenous telecom solutions. As of now, TTDF has approved 136 projects across 6G, SatCom, Open RAN, AI-in-Telecom, security, and other telecom technologies with ₹542.23 crore funding.
- **Citizen-Centric and Security Measures:** Initiatives such as Sanchar Saathi, Digital Intelligence Platform, ASTR- AI Driven Fraud Detection, and Financial Fraud Risk Indicator (FRI), International Incoming Spoofed Calls Prevention system and Device Setu Indian Counterfeited Device Restriction (ICDR) system are operational to strengthen telecom cyber security and enhance protection against telecom enabled frauds. These tools have detected and disconnected around 3.3 crore fraudulent connections, declined/ generated alerts for around 90 lakh fraudulent financial transactions, preventing financial losses of approximately ₹660 crore.[32]
- **Efficient Infrastructure and Spectrum Management:** The centralized Right of Way (RoW) portal was launched in 2022 to address obstacles in telecom infrastructure deployment by reducing paperwork, transparent application processes, and streamlining approvals of Tower and OFC permissions in time-bound manner. It has reduced application processing time from 451 days in 2019 to 40 days in 2025, enabling the approval of 3.60 lakh applications. Spectrum reforms have also ensured optimal utilisation of spectrum and sufficient availability of spectrum for different radio communication services. The National Frequency Allocation Plan (NFAP)-2025 reflects evolving national and global requirements and provides the regulatory framework for efficient spectrum use in India. The Spectrum Roadmap for 6G Services, 2025 provides clear visibility on spectrum availability, quantum, and timelines across various radio frequency (RF) bands over the next decade.

Information Technology

9.47 India's IT infrastructure underpins the expansion of digital governance, economic activity and advanced technologies. Data centres form a critical component

32 ibid.

of this ecosystem, supporting application hosting, data processing and storage for government platforms, financial services, enterprises and citizen-centric applications. As per industry estimates, as of June 2025, India's installed data centre capacity stood at around 1,280 MW, with about 130 privately operated data centres and 49 data centres run by government agencies at the central and state levels.[33] Driven by rapid digitisation and the adoption of technologies such as cloud computing, artificial intelligence, IoT and 5G, data centre capacity is projected to expand further to around 4 GW by 2030 as per industry estimates. The sector remains largely private-led and deregulated, facilitated by policy initiatives under Make in India and Atmanirbhar Bharat to strengthen domestic electronics and semiconductor manufacturing across the data centre value chain.

9.48 To enable efficient and secure digital service delivery by government, the GI Cloud initiative, known as MeghRaj, has been launched to provide secure and scalable cloud-based ICT services to Central and State/UT government departments, enabling optimal use of IT infrastructure and faster deployment of e-Governance applications such as digital payments, identity verification, and consent-based data-sharing systems. As of December 2025, 26 Cloud Service Providers have been empanelled under MeghRaj.[34] Together, the expansion of data centre capacity and institutionalisation of cloud services are reinforcing India's digital infrastructure backbone and supporting the transition towards a digitally enabled economy.

SOCIAL AND EMERGING SECTOR INFRASTRUCTURE

9.49 India's infrastructure development has increasingly transitioned towards a service-delivery–oriented paradigm, wherein physical assets are closely aligned with social outcomes, economic inclusion, and strategic capability building. This section reviews progress in strengthening last-mile delivery of essential services—particularly safe drinking water and water resources management—while also examining the expansion of tourism infrastructure as a key enabler of regional development. Further, it highlights advances in the space sector, where indigenous technological capabilities and growing private-sector participation are enhancing India's strategic resilience and reinforcing its presence in the global space economy.

Rural Drinking Water and Sanitation

9.50 **Jal Jeevan Mission (Har Ghar Jal):** India has attained a significant milestone under the Jal Jeevan Mission, with over 81 per cent of rural households now having access to clean tap water.[35] As of 01 December 2025, more than 15.76 crore rural

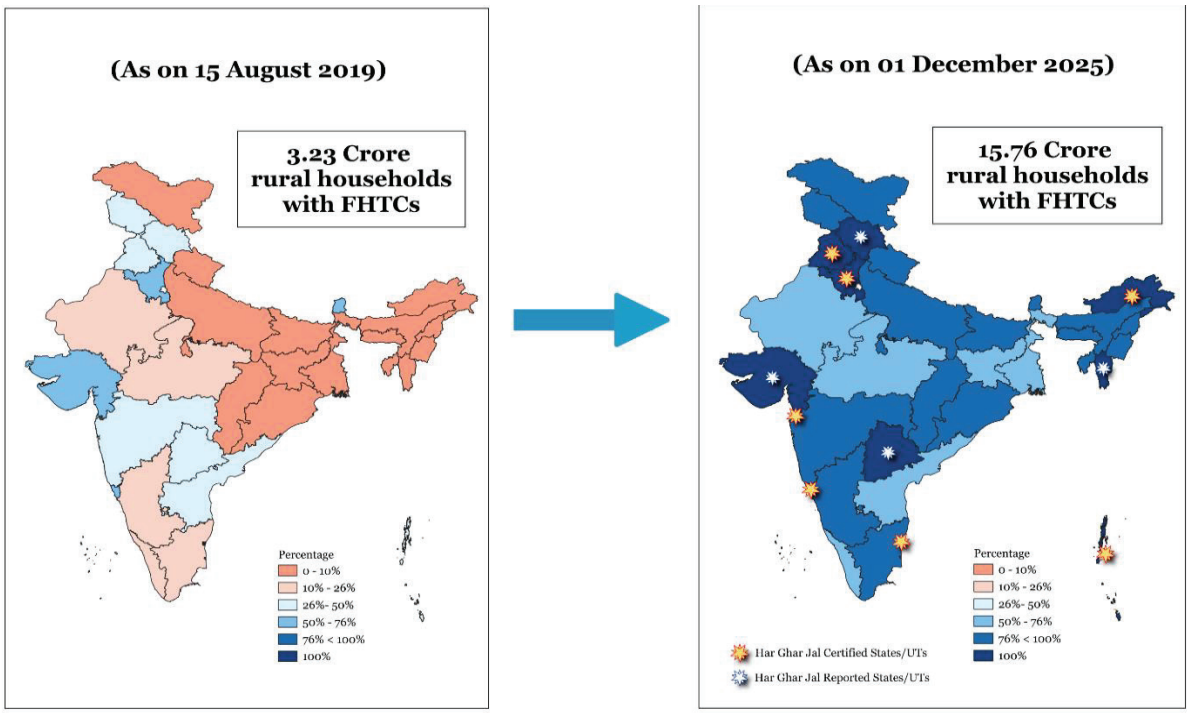
33 Ministry of Electronics and Information Technology.

34 PIB release available at https://tinyurl.com/mthk2jxj.

35 PIB release available at https://tinyurl.com/yckymz2v.

homes have received safe drinking water through household taps, marking a major step towards achieving universal water security in rural India.[36] The Mission, launched in 2019 and supported by an initial central outlay of ₹2,08,652 crore, has enabled States and Union Territories to implement water supply schemes, develop infrastructure, and promote efficient water management practices. In addition, it has strengthened local governance, enhanced community participation, and raised awareness on water conservation, thereby improving health, sanitation, and the overall quality of life in rural communities. To achieve 100 per cent coverage, the Mission has been extended until 2028 with an enhanced allocation of ₹67,000 crore in the Union Budget 2025-26.[37]

Chart IX.23: Status of tap water supply in rural homes under JJM



Source: Jal Jeevan Mission Dashboard.
*Note: FHTC- Functional Household Tap Connection

Water Resources Management Sector

9.51 **The Namami Gange Programme** is a comprehensive river-conservation initiative aimed at rejuvenating the Ganga basin. It focuses on ensuring clean (Nirmal Dhara) and continuous (Aviral Dhara) flow, restoring natural habitats, reviving biodiversity, and promoting sustainable water governance through integrated infrastructure and community participation.

36 Jal Jeevan Mission Dashboard accessed on 01 December 2025 at https://tinyurl.com/yfujh6ty.

37 PIB Release available at https://tinyurl.com/zcbf3euf.

9.52 To ensure long-term operational efficiency, the program has pioneered the Hybrid Annuity Model (HAM-PPP) for Sewage Treatment Plants (STPs). By linking payments to verified performance, this model ensures the sustainability of assets. Furthermore, the 'One City One Operator' model has been successfully institutionalised in major urban hubs like Kanpur and Prayagraj to streamline operations. In land-constrained geographies such as Muni Ki Reti, Rishikesh, the deployment of vertical STPs highlights the program's focus on space-efficient engineering. Further, Green STPs powered by solar and biogas energy are reducing the carbon footprint of waste management. Complementing this, afforestation across 33,024 hectares along the Ganga corridor has bolstered riverbank stability, enhanced carbon sequestration, and strengthened climate resilience.

9.53 The improvement in the river's ecological health is evident from the significant increase in the Gangetic Dolphin population, which increased from approximately 3,500 in 2015 to 6,327 as per the 2021–2023 nationwide assessment. Further, 20 Red-Crowned Roofed Turtles were reintroduced into the basin in April 2025, marking a shift towards ecological restoration alongside pollution abatement.[38] Key achievements and initiatives in the water resources management sector are highlighted in Box IX.13.

BOX IX.13: Key achievements and initiatives in water resource management

- **Modernization of Command Area Development (M-CADWM):** Launched on a pilot basis for FY26 under Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), with the aim to provide assured irrigation, promote efficient water use, and encourage participatory governance through Water User Societies (WUS). It leverages Supervisory Control and Data Acquisition (SCADA) and Internet of things (IoT) technology for water accounting and management.
- **C-Flood Platform:** Unified Inundation Forecasting System developed by Centre for Development of Advanced Computing (C-DAC) and the Central Water Commission (CWC), provides two-day advance village-level flood forecasts. Integrating multi-agency models, it currently monitors the Mahanadi, Godavari, and Tapi basins to mitigate disaster risks.
- **National Register of Specified Dams 2025:** The updated register includes data on 6,628 dams, strengthening planning and dam-safety systems.
- **River Cities Alliance (RCA) – Action Plan 2025:** A collaborative initiative between Ministry of Housing and Urban Affairs (MoHUA) and the National Mission for Clean Ganga (NMCG), the RCA has expanded from 30 to 145 cities. The 2025 Plan prioritizes river-sensitive urban planning and the formulation of 60 Urban River Management Plans.

38 Department of Water Resources, River Development and Ganga Rejuvenation.

- **National Water Resource Censuses:** Four national surveys—the 7th Minor Irrigation Census, 2nd Census of Water Bodies, 1st Census of Major & Medium Irrigation Projects, and 1st Census of Springs—are underway to enable evidence-based policymaking and precise resource mapping.

Tourism

9.54 The Government of India has revamped the Swadesh Darshan scheme as Swadesh Darshan 2.0 (SD 2.0), aimed at developing sustainable and responsible tourism destinations. Under this initiative, 53 projects worth ₹2,208.87 crore have been sanctioned across various States/UTs. Additionally, under the Challenge-Based Destination Development (CBDD) sub-scheme, 38 projects in 24 States/UTs have been approved with a total allocation of ₹697.68 crore. Both SD 2.0 and CBDD focus on providing enhanced tourism experiences and improved amenities at major destinations.[39]

9.55 The National Mission on Pilgrimage Rejuvenation and Spiritual, Heritage Augmentation Drive (PRASHAD) has been launched as a Central Sector Scheme to support integrated development of selected pilgrimage and heritage sites. The scheme aims at infrastructure development including upgradation of tourist arrival areas with tourist facilitation centres, approach roads and parking, provision of basic amenities and development of utility infrastructure such as solid waste management, water supply, and sanitation, landscaping, etc. Total of 54 projects have been sanctioned in 28 States/UTs, with an estimated cost of ₹1,726.74 crore, since its launch in January 2015.[40]

Space Sector

9.56 India currently operates 56 active space assets, including 20 communication satellites, eight navigation satellites, four scientific satellites, 21 earth observation satellites and three technology demonstration missions.[41]

9.57 The year 2025 has witnessed a significant achievement of India's space program, characterized by indigenous technological breakthroughs and expanded global footprints. India became the fourth nation to achieve autonomous satellite docking via the SpaDeX (Space Docking Experiment) mission. Additionally, the GSLV-F15 with indigenous Cryogenic stage launched the NVS-02 satellite on 29 January 2025, marking the 100th lift-off from Sriharikota. Global collaboration reached new heights with the successful completion of the Axiom-04 mission in July 2025, which saw an

39 Ministry of Tourism.

40 ibid.

41 Department of Space.

Indian astronaut conduct microgravity experiments aboard the International Space Station. This synergy was further reinforced by the launch of NASA ISRO Synthetic Aperture Radar Mission (NISAR), a global, microwave imaging mission, in July 2025. In December 2025, the LVM3-M6 vehicle successfully injected the BlueBird Block-2 communication satellite in the intended orbit —the heaviest payload to be placed into the Low Earth Orbit (LEO) in Indian space history,[42] bolstering the nation's strategic infrastructure.

9.58 Further, ISRO's advanced geospatial platforms are significantly strengthening infrastructure monitoring and management for various sectors in India. Through the Bhuvan platform, high-resolution Cartosat imagery is used to geotag and monitor 296 watershed development activities under PM Krishi Sinchayee Yojana 2.0 (PMKSY 2.0), and to monitor vegetation and green cover along national highways across the country. The Yuktdhara platform supports decentralised planning by enabling the monitoring of labour-driven natural resource management works. For urban water management, the Urban Water Information System (UWIS), a web-GIS decision support tool, has been developed for groundwater sustainability and monitoring in 10 AMRUT cities. ISRO's Remote sensing enabled Online Chemical Emergency Response System (ROCERS) has been developed to monitor major hazardous industries by establishing network of chemical sensors and automatic weather stations to facilitate real time alerts. Additionally, in continuation to the large scale 2-D urban geospatial database for 238 Class-1 cities, database for 71 Class-II towns (AMRUT 2.0) is being created to support GIS-based master planning by Urban Local Bodies.

BOX IX.14: Enhancing Private Participation in the Space Sector

The Space Sector Reforms of 2020, followed by the Indian Space Policy–2023, have created a structured and forward-looking framework to enable private-sector participation and enhance India's role in the global space economy. Recent achievements and key initiatives to promote private participation in the sector include:

- Emergence of 300+ space start-ups contributing to innovations across space technologies and services.
- IN-SPACe functioning as a single-window agency to promote, regulate, and authorize activities of Non-Governmental Entities (NGEs), ensuring streamlined governance.
- Liberalised FDI policy, allowing up to 100 per cent foreign investment through the automatic route in less sensitive categories, with graded caps (up to 74 per cent or 49 per cent) for sensitive segments.
- The Union Cabinet approved a ₹1,000 crore venture capital fund under IN-SPACe in October 2024 and launched a ₹500 crore Technology Adoption Fund in February 2025 to accelerate space start-ups and technology-led growth.

42 ISRO https://tinyurl.com/yzw7z8hz.

- Successful sub-orbital launches were done by companies such as M/s Skyroot Aerospace and M/s Agnikul Cosmos in 2023 and 2024 respectively.
- Successful launch of satellites by NGEs such as Pixxel Space, Azista, Hex20, and TakeMe2Space, indicate rising indigenous capabilities.
- 70+ technology transfers from ISRO to private industry, supporting commercialization and scale-up.
- Establishment of a dedicated launch pad and integration facility at Kulasekarapattinam, Tamil Nadu is underway which will strengthen India's launch infrastructure.

9.59 **Outlook:** Aligned with India's Space Vision 2047, the Government has set ambitious targets, including establishing the Bharatiya Antariksh Station by 2035 and conducting India's first manned lunar mission by 2040. Towards this, Government has approved five key projects: the Gaganyaan follow-on mission, which will pave the way for the establishment of the first module of the Bhartiya Antariksh Station; the Chandrayaan-4 Lunar Sample Return Mission; the Chandrayaan-5/LUPEX mission (Lunar Polar Exploration Mission); the Venus Orbiter Mission; and the development of the Next Generation Launch Vehicle. These initiatives aim to enhance India's technological capabilities, foster industry collaboration, and strengthen the country's position in global space exploration.

CONCLUSION

9.60 India's infrastructure strategy over recent years reflects a decisive shift towards scale, integration and quality, with sustained public capital expenditure acting as a powerful catalyst for growth. Coordinated investments across roads, railways, ports, civil aviation, energy, digital and rural infrastructure have begun to yield tangible efficiency gains—shorter travel times, faster freight movement, improved logistics performance and wider access to essential services. The institutionalisation of integrated planning through PM GatiShakti, alongside reforms in financing, asset monetisation and public–private partnerships, has strengthened project preparation and execution while crowding-in private investment.

9.61 Improvements in transport connectivity are enhancing ease of travel for people and businesses by reducing travel times, lowering transaction costs and expanding access to markets. Enhanced multimodal integration and more reliable freight movements are strengthening regional integration and improving the competitiveness of the Indian economy by enabling firms to participate more effectively in domestic and global value chains.

9.62 At the same time, the concept of infrastructure is evolving beyond physical networks to encompass digital public infrastructure, clean energy systems, resilient water management and future-ready technologies. This widened infrastructure base is also enhancing productivity, competitiveness, innovation and sustainability across the economy. Looking ahead, maintaining investment momentum, deepening private participation and aligning infrastructure development with emerging priorities—such as decarbonisation, digitalisation and resilience—will be critical. Together, these efforts position infrastructure as a central pillar of India's medium-term growth strategy and a key enabler of its long-term development vision under *Viksit Bharat @2047*.

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