सत्यमेव जयते

National Infrastructure Pipeline

Report of the Task Force
Department of Economic Affairs
Ministry of Finance
Government of India

Volume II

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Abbreviations and Acronyms

AAI	Airports Authority of India
ACS	Average cost of supply
ADB	Asian Development Bank
AI	Artificial intelligence
ACI	Airport Council International
AERA	Airports Economic Regulatory Authority
AFD	Agence Francaise De Developpement
AGR	Adjusted gross revenue
AIIMS	All India Institute of Medical Sciences
AISHE	All India Survey on Higher Education
ALM	Asset-liability mismatch
AM	Asset monetisation
AMRUT	Atal Mission for Rejuvenation and Urban Transformation
APDRP	Accelerated Power Development and Reforms Programme
APLM	Agricultural Produce and Livestock Marketing
APMC	Agricultural Produce Marketing Committee
APMIP	Andhra Pradesh Micro Irrigation Project
ARPU	Average revenue per user
ARR	Average revenue realised
AT&C	Aggregate technical and commerical
ATF	Aviation turbine fuel
AUM	Assets under management
BGF	Bond guarantee fund
BIS	Bureau of Indian Standards
BLT	Build, lease and transfer
BOLT	Build, own, lease and transfer

BOO	Build, own and operate
BOOT	Build, own, operate and transfer
BOT	Build, operate and transfer
BRPL	BSES Rajdhani Power Limited
BRTS	Bus rapid transport system
BSNL	Bharat Sanchar Nigam Limited
BTKM	Billion tonne kilometre
BTS	Base transmitter station
BU	Billion unit
BYPL	BSES Yamuna Power Limited
CAGR	Compound annual growth rate
CAA	Constitutional Amendment Act
CADWM	Command Area Development and Water Management
CCEA	Cabinet Committee on Economic Affairs
CCI	Competition Commission of India
CCTV	Closed circuit television
CDRI	Coalition for Disaster Resilient Infrastructure
CEA	Central Electricity Authority
CEF	Credit enhancement fund
CERC	Central Energy Regulatory Commission
CFS	Container freight station
CGD	City gas distribution
CGWA	Central Ground Water Authority
CGWB	Central Groundwater Board
CIDCO	City and Industrial Development Corporation
CNG	Compressed natural gas
COAI	Cellular Operators Association of India
COD	Commercial operations date
CPCB	Central Pollution Control Board

CPHC	Comprehensive primary health care
CPSE	Central public sector enterprise
CRIF	Central Road and Infrastructure Fund
CRIS	CRISIL Risk and Infrastructure Solutions Limited
CRZ	Coastal regulation zone
CSC	Common service centre
CSR	Corporate social responsibility
CWC	Central Water Commission
DBFOT	Design, build, finance, operate and transfer
DBT	Direct benefit transfer
DCI	Dredging Corporation of India
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DEA	Department of Economic Affairs
DFC	Dedicated freight corridor
DFCCIL	Dedicated Freight Corridor Corporation of India Limited
DFI	Development finance institution
DFS	Department of Financial Services
DIPAM	Department of Investment and Public Asset Management
DISCOM	Distribution company
DMRC	Delhi Metro Rail Corporation
DOLA	Department of Legal Affairs
DPD	Direct port delivery
DPE	Department of Public Enterprises
DPIIT	Department for Promotion of Industry and Internal Trade
DPR	Detailed project report
DRC	Development rights certificate
DVC	Damodar Valley Corporation
ECA	Essential Commodities Act
EDFC	Eastern Dedicated Freight Corridor
EHS	Environment health and safety

ELRS	Expected loss rating scale
EODB	Ease of doing business
EPC	Engineering, procurement and construction
EPFO	Employee Provident Fund Organisation
EQUIP	Education Quality Upgradation and Inclusion Programme
ESG	Environmental, social and corporate governance
ETP	Effluent treatment plant
FAME	Faster Adoption and Manufacturing of Electric Vehicles
FAR	Floor area ratio
FCI	Food Corporation of India
FCNR	Foreign currency non resident account
FDI	Foreign direct investment
FEMA	Foreign Exchange Management Act
FHTC	Functional household tap connection
FIDIC	International Federation of Consulting Engineers
FOB	Free on board
FPI	Foreign portfolio investment
FRBM	Fiscal Responsibility and Budget Management
FSI	Floor space index
FY	Fiscal year
GAIL	Gas Authority of India Limited
GBPS	Giga bytes per second
GCA	Government contracting authorities
GDP	Gross domestic product
GER	Gross enrolment ratio
GGRC	Gujarat Green Revolution Company
GOI	Government of India
GPF	Global pension fund
GPS	Global positioning system
GST	Goods and Services Tax

GW	Giga watt
HAM	Hybrid annuity model
HEFA	Higher Education Funding Agency
HMIS	Health Management Information System
HPC	High powered committee
HRIDAY	Heritage City Development and Augmentation Yojana
HSR	High-speed rail
HUDCO	Housing and Urban Development Corporation Limited
IAP	Integrated Action Plan
IBC	Insolvency and Bankruptcy Code
ICAR	Indian Council of Agricultural Research
ICT	Information communication technology
IDF	Infrastructure Debt Fund
IEA	International Energy Agency
IEBR	Internal and extra budgetary resources
IECV	Initial estimated concession value
IFCI	Industrial Finance Corporation of India
IFSC	International Financial Services Centre
IGR	Investment grade rating
IIFCL	India Infrastructure Finance Company Limited
ILO	International Labour Organization
IMG	Inter-Ministerial Group
IMT	Irrigation management transfer
IMSC	Inter-Ministerial Steering Committee
INR	Indian national rupee
INVIT	Infrastructure investment trust
IOT	Internet of Things
IPDS	Integrated Power Development Scheme
IRC	Indian Road Congress
IRDAI	Insurance Regulatory and Development Authority of India

IREDA	Indian Renewable Energy Development Agency Limited
IRFC	Indian Railway Finance Corporation
IWT	Inland water transport
JICA	Japan International Cooperation Agency
JNPT	Jawaharlal Nehru Port Trust
JV	Joint venture
KRCL	Konkan Railway Corporation Limited
KUIDFC	Karnataka Urban Infrastructure Development and Finance Corporation
KWH	Kilo-watt hour
LAF	Liquidity adjustment facility
LAP	Local area plan
LBFT	Land based fiscal tools
LCC	Life cycle cost
LC	Letter of credit
LGBR	Load Generation Balance Report
LHB	Linke Hofmann Busch
LIDAR	Laser imaging detection and ranging
LNG	Liquefied natural gas
LPI	Logistics Performance Index
MCA	Model concession agreement
MHRD	Ministry of Human Resources Development
MMSCMD	Million metric standard cubic metre per day
MMTPA	Million metric tonne per annum
MoA	Ministry of Agriculture
MoCA	Ministry of Civil Aviation
MoEFCC	Ministry of Environment, Forest and Climate Change
MoRTH	Ministry of Road Transport and Highways
MoR	Ministry of Railways
MoSPI	Ministry of Statistics and Program Implementation
MoUD	Ministry of Urban Development

MRO	Maintenance, repair and overhaul
MRTS	Mass rapid transit system
MSP	Minimum support price
MSRDC	Maharashtra State Road Development Corporation
MTM	Mark to market
MTPA	Million tonne per annum
MVA	Megavolt amperes
MW	Mega watt
NABARD	National Bank for Agriculture and Rural Development
NAAC	National Assessment and Accreditation Council
NAM	National Agriculture Market
NBFC	Non-banking financial company
NDCP	National Digital Communication Policy
NEMMP	National Electric Mobility Mission Plan
NEP	National Energy Policy, 2019
NH	National Highway
NHAI	National Highways Authority of India
NHB	National Housing Bank
NHDP	National Highways Development Programme
NHSRCL	National High Speed Rail Corporation Limited
NIP	National Infrastructure Pipeline
NMCG	National Mission for Clean Ganga
NPA	Non performing asset
NPP	National Perspective Plan
NRI	Non-resident indian
NSE	National Stock Exchange
NWDA	National Water Development Agency
O&M	Operations and maintenance
ODF	Open defecation free
OMT	Operate-maintain-transfer

OTT	Over-the-top
OUIDF	Odisha Urban Infrastructure Development Fund
PCEC	Per capita electricity consumption
PE	Private equity
PFC	Power Finance Corporation Limited
PFRDA	Pension Fund Regulatory and Development Authority
PGCIL	Power Grid Corporation of India Limited
PIB	Press Information Bureau
PLF	Plant load factor
PMAY	Pradhan Mantri Awas Yojana
PMGSY	Pradhan Mantri Gram Sadak Yojana
PMKSY	Pradhan Mantri Krishi Sinchai Yojana
PNG	Petroleum and natural gas
PNGRB	Petroleum and Natural Gas Regulatory Board, India
PPP	Public-private partnership
PPPAC	Public Private Partnership Appraisal Committee
PRI	Principles for responsible investment
PSU	Public sector undertaking
PTR	Pupil-teacher ratio
RAPDRP	Restructured Accelerated Power Development and Reforms Programme
RBI	Reserve Bank of India
RCS	Regional Connectivity Scheme
RDA	Railway Development Authority
REIT	Real estate investment trust
RES	Renewable energy sources
RFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013
RFID	Radio frequency identification
RLDA	Railway Land Development Authority
ROB	Road over bridge
RUB	Road under bridge
SAUBHAGYA	Pradhan Mantri Sahaj Bijli Har Ghar Yojana

SLR	Statutory liquidity ratio
SME	Small and medium enterprises
SPM	Single point mooring
SPR	Strategic Petroleum Reserves
SPV	Special purpose vehicle
SRRDA	State Rural Road Development Agency
SWF	Sovereign wealth funds
SWM	Solid waste management
TAMP	Tariff Authority for Major Ports
TAT	Turnaround time
TDR	Transfer of development rights
TEG	Technical expert group
TEU	Twenty-foot equivalent unit
TOT	Toll, operate, transfer
UDAN	Ude Desh ka Aam Nagrik
UDAY	Ujwal Discom Assurance Yojana
ULB	Urban local body
UMTA	Urban Metro Transit Authority
USD	United States dollar
USO	Universal service obligation
VCF	Value capture finance
VGF	Viability-gap funding
WDFC	Western Dedicated Freight Corridor
WHO	World Health Organization

Conversion Factors

Rs 10 lakh	Rs 1 million
Rs 1 crore	Rs 10 million
Rs 100 crore	Rs 1 billion
Rs 1 lakh crore	Rs 1 trillion
$ 1	~ Rs 71

Infrastructure Progress

This chapter highlights infrastructure trends in India since fiscal 2013. It focuses on capital expenditure, improvements in sector-specific parameters, shortfalls compared with standard benchmarks, steps taken for improvement, and challenges that remain.

Global trends in infrastructure

According to the Global Infrastructure Outlook 2017 (Oxford Economics), global requirement of investment in infrastructure between calendar years 2016 and 2040 is expected to reach $ 94 trillion. An additional $ 3.5 trillion is required to meet Sustainable Development Goals (SDG) in water and electricity. Of this, 50% of the investment needs are in Asia. Electricity and roads sectors will constitute over two-thirds of this, followed by telecom, rail and water sectors.

The study also indicates that global spend on infrastructure is ~$ 2.3 trillion (2015). Going by the needs projected above, the annual spend would have to double. The report states that in a business-as-usual scenario, if the current investment trends continue, there would be an investment gap of $ 14 trillion by 2040. Thus there is a strong case for sharp increases in infrastructure spending. The report projects that over half the annual global spend would be contributed by just four countries – China, the United States (US), India and Japan. It is estimated that India would need to spend $ 4.5 trillion[1] on infrastructure by 2030 to realise the vision of a $ 5 trillion by 2025, and to continue on an escalated trajectory until 2030.

Recent Trends in Infrastructure Investments

This section highlights the trends in overall infrastructure investment in India between fiscals 2013 and 2019, as well as in the shares of the Centre, states, and private sector. It analyses sector-wise investments in this period and captures shifts among various sub-sectors.

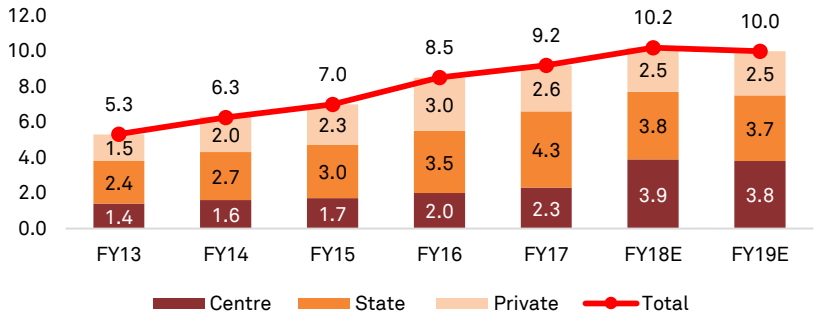
Investment and sector-wise shares

Infrastructure investment in India between fiscals 2013 and 2017 was estimated at Rs 57 lakh crore ($ 1.1 trillion at different annual exchange rates). The infrastructure investment was Rs ~36 lakh crore (at current prices) during fiscals 2013-17 or ~5.8% of gross domestic product (GDP). As per estimates, the total infrastructure spend in fiscals 2018 and 2019 was Rs 10.2 lakh crore and Rs 10 lakh crore, respectively.

The year-wise infrastructure investments since fiscal 2013 is shown in Figure 1. It also gives a split of this investment between the Centre, the states and the private sector.

[1] *CRIS estimates*

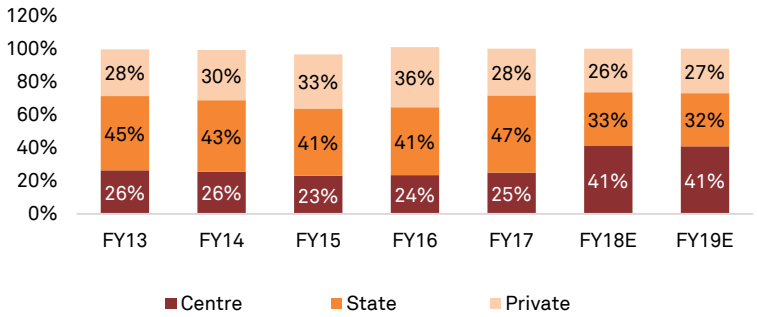
Figure 1 Year-wise investment trend in infrastructure (Rs lakh crore, FY13-17, FY18E and FY19E)



Source: Appraisal documents for five-year plans, CRIS estimates (investments mentioned are at current prices)

In terms of shares, infrastructure investments between fiscals 2013 and 2019 were predominantly made by the public sector, i.e., Centre and state governments (~70%), while the share of private sector has been ~30%. This split between the public and private sector is in sync with the rest of the world.

Figure 2 Share of infrastructure investment by the Centre, states and private sector



Source: Appraisal documents for five-year plans, CRIS estimates

Power, roads and bridges, telecommunications, railways, irrigation and urban accounted for ~95% of the infrastructure investment in this period. Centre and states were the major funding sources for power and roads, with a moderate participation from the private sector. Telecommunication investments were largely driven by private sector, while investments in irrigation sector were predominantly made by the states.

Table 1 Sectoral share of overall infrastructure investment (Rs lakh crore)

Sector	FY13	FY14	FY15	FY16	FY17	FY18E	FY19E	Total
Power	2.3	2.5	2.5	2.7	3.2	2.6	1.9	**17.7**
Roads and bridges	1.0	1.1	1.2	1.4	1.8	1.9	1.9	**10.3**
Urban	0.7	0.9	1.1	1.2	1.3	1.7	1.8	**8.7**
Telecommunication	0.4	0.7	1.1	1.6	1.1	1	1	**6.9**
Railways	0.4	0.4	0.4	0.8	0.9	1.3	1.4	**5.6**
Irrigation	0.5	0.5	0.5	0.7	0.8	1	1.2	**5.2**
Airports	0.0	0.1	0.1	0.1	0.1	0.1	0.1	**0.6**
Ports	0.1	0.1	0.1	0.1	0.1	0.1	0.1	**0.7**
Others	0.1	0.1	0.0	0.1	0.1	0.5	0.5	**1.4**
Total infra investments (A)	**5.3**	**6.3**	**7.0**	**8.5**	**9.2**	**10.2**	**10.0**	**56.7**
Nominal GDP (B)	99.4	112.3	124.7	137.6	153.6	171	190.1	**988.7**
% Infra investment of nominal GDP (A / B)	5.5%	5.6%	5.6%	6.2%	6.0%	6.0%	5.3%	**5.7%**

Source: Appraisal documents for five-year plans, CRIS estimates (investments and GDP values mentioned above are at current prices)

Energy

Sector Progress, Deficits and Challenges, Vision and Reforms

PPP in Power Distribution in Delhi

Project details

- Delhi power distribution segment was privatised in July 2002 by carving the city into three zones and privatising these by giving majority shareholding (51%) to the two largest private power sector players in India at that time: Tata Power (north and north-west Delhi) and BSES (BSES Rajdhani Power Ltd or BRPL - south and west Delhi and BSES Yamuna Power Ltd or BYPL - central and east Delhi)
- The transmission of power is still in the public sector while distribution has been transferred to the private sector
- The scope of concessionaires involved rehabilitation, development and operation and maintenance (O&M) of the brownfield assets. Concessionaires were responsible for funding, implementation plans and achievement of timelines

Salient features

- The subsidy for power distribution paid by the Delhi Government has come down drastically. Aggregate technical and commercial (AT&C) losses have come down to about 13% currently from over 50% at the point of privatisation in 2002
- During 1991-2002 (Delhi Vidyut Board period), the power tariffs increased at ~15% per annum while during PPP period from 2003-2012, rise in power tariffs was lower, only ~6.3% per annum
- Significant improvement in customer related parameters: Mean time to repair faults, meter replacement and bill complaint resolution. All concessionaires have set up call centres for addressing queries of consumers and for recording and responding to complaints. Websites have also been set up, which offer consumer-centric facilities

Energy sector includes conventional power, renewable energy (RE) and petroleum and natural gas. The power sector accounts for the largest share of investments in infrastructure. The energy use is projected to grow rapidly to fuel economic development, urbanisation and improved electricity access. Yet, India's per capita consumption of energy remains low even vis-à-vis developing countries. This calls for huge investments in the sector for installation of new capacities and upgradation of existing ones.

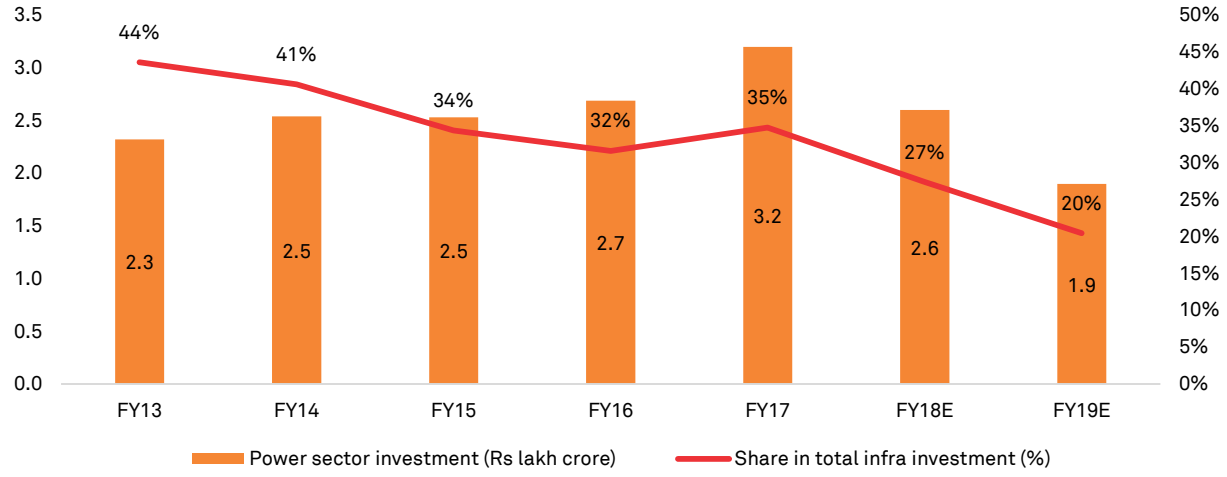
Power sector

Historical investment

Between fiscals 2013 and 2017, the share of power sector investment in overall infrastructure investment was ~37% rising at ~8% compound annual growth rate (CAGR).

For the 12th Five-Year-Plan, share of various segments in power sector investment was: generation (61%), transmission (20%) and distribution (19%).

Figure 3 Power sector investment (Rs lakh crore) and share in total infrastructure investment (%)



Source: Appraisal documents for five-year plans, CRIS estimates (investments mentioned are at current prices)

During the plan period, private sector investment declined mainly due to cancellation of allocated coal blocks, financial stress in distribution companies (discoms), leading to stressed assets and non-performing loans. It is critical to address these challenges to facilitate continued private sector contribution to power sector.

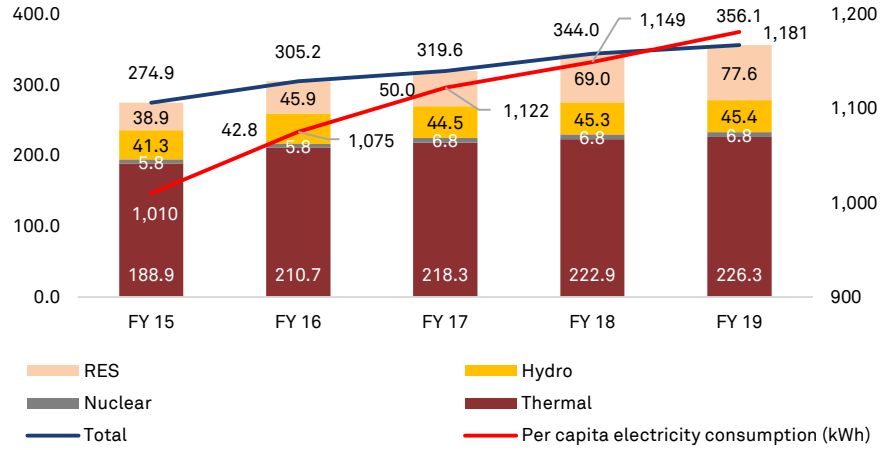
Power sector trends

Generation capacity

As of March 31, 2019, the generation capacity in India was 356 GW, with the Centre having 24% share, states 30%, and private sector 46%. The fuel mix continues to be dominated by thermal power (64%), followed by RE sources (22%), hydro (13%), and nuclear (1%).

The substantial increase in capacity of renewable energy can be attributed to strong government support, favourable policies and incentives, as well as falling cost of generation, particularly for the wind and solar power (refer to Figure 4).

Figure 4 Trends in power generation capacity (GW) and per capita electricity consumption in India (kWh)



Source: Central Electricity Authority (CEA)

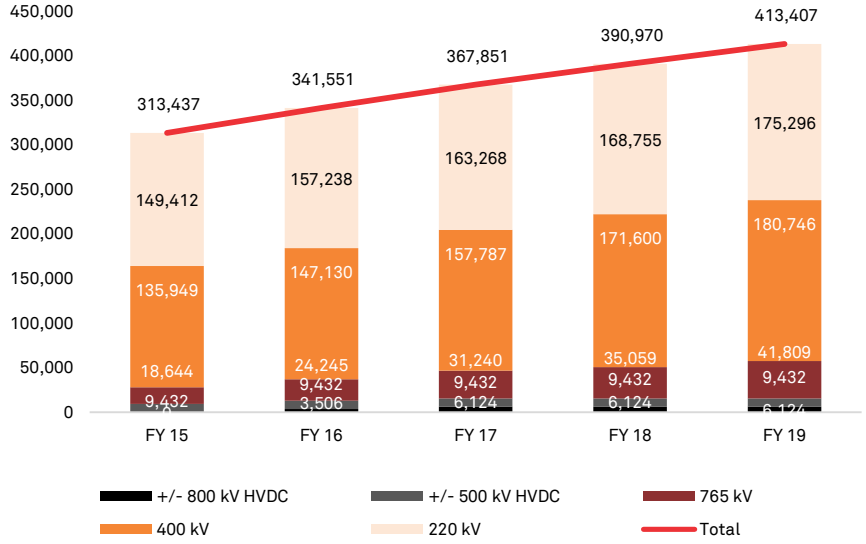
Per capita electricity consumption in India

India's annual per capita electricity consumption at 1,181 kWh has grown in recent years but remains far below the global average, which is estimated to be more than 3,200 kWh per capita as of March 31, 2018.

Transmission

As of March 31, 2019, the transmission lines in India aggregated to a total length of 413,407 circuit kilometre (ckm), growing at a healthy CAGR of 7% since 2015. The shares of the Centre, states and private sector in the overall length of the transmission lines were 38%, 54%, and 8%, respectively.

Figure 5 Trend in power transmission lines in India (ckm)



Source: CEA

Distribution

Distribution is the most critical link in the entire value chain of the power sector. Most of the distribution network is still managed by state distribution companies with little participation from the private sector. The distribution sector has seen many reforms in recent times, resulting in improved operational efficiency and power accessibility for the masses. However, more reforms are needed to strengthen this critical link and attract further investor interest in the sector.

AT&C losses

AT&C losses of utilities providing power directly to consumers marginally declined to 22.2% in fiscal 2020[2] from 22.6%[3] in fiscal 2014, highlighting the issues faced by the distribution sector. For fiscal 2018, states like Andhra Pradesh, Delhi, Goa, Gujarat and Himachal Pradesh achieved AT&C losses of less than 15% while Arunachal Pradesh, Bihar, Jammu and Kashmir, Jharkhand, Meghalaya, Nagaland, Sikkim, Tripura and Uttar Pradesh still had high AT&C losses (more than 30%).

Gap between average cost of supply (ACS) and average revenue realised (ARR)

ACS-ARR gap is an important indicator of the financial health of discoms. As of October 2019, the ACS-ARR gap was Rs 0.40/ kWh. This has been positive in the past because of high AT&C losses and inadequate tariff hikes. ACS-ARR gap remains a concern as it impacts the whole power sector value chain. However, it has narrowed in recent years.

Saubhagya scheme

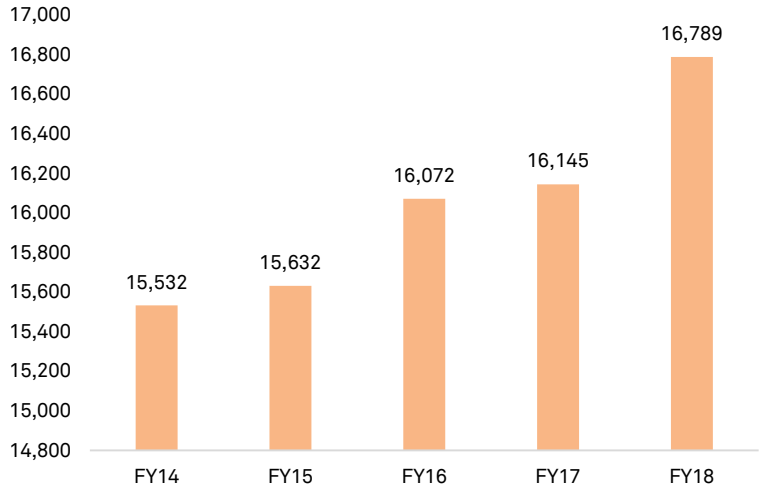
The Government of India launched the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya scheme) in September 2017 with a total outlay of Rs 16,320 crore to provide last mile connectivity and electricity connection to the remaining un-electrified households in the country. The scheme has been a big success and all states have reported electrification of all households, except few households in naxal-affected Bastar region of Chhattisgarh. More than 2.63 crore[4] households have been provided electricity connections between October 2017 and March 2019. The scheme has helped in providing access of electricity to un-electrified households thereby increasing the consumption of electricity and enhanced utilization of generation assets. It is also helping the country meet the climate change mitigation commitments by promoting uses of electricity in daily household chores including lighting and fan, heating, cooking and other household appliances.

Gas transmission and distribution

At present, about 16,789 km long gas pipeline network is under operation. In recent years there has been huge impetus on increasing the mix of natural gas as source of energy with government envisaging a National Gas Grid to remove regional imbalance and provide access of natural gas to both domestic as well as industrial users throughout the country. About 14,700 km long additional gas pipeline has been approved and is at various stages of development to complete the grid. The most notable project is the 3,384 km Urja Ganga Pipeline having capacity of 16 million metric standard cubic metre per day (MMSCMD) which would connect the eastern states of Bihar, Jharkhand, West Bengal and Odisha to the national gas grid.

[2]UDAY (data as of October 1, 2019) – does not include Nagaland, Andaman and Nicobar Islands, Lakshadweep
[3]PFC Report – Performance of State Power Utilities
[4]Saubhagya dashboard (data as of March 31, 2019)

Figure 6 Length of natural gas pipeline in India (in km)

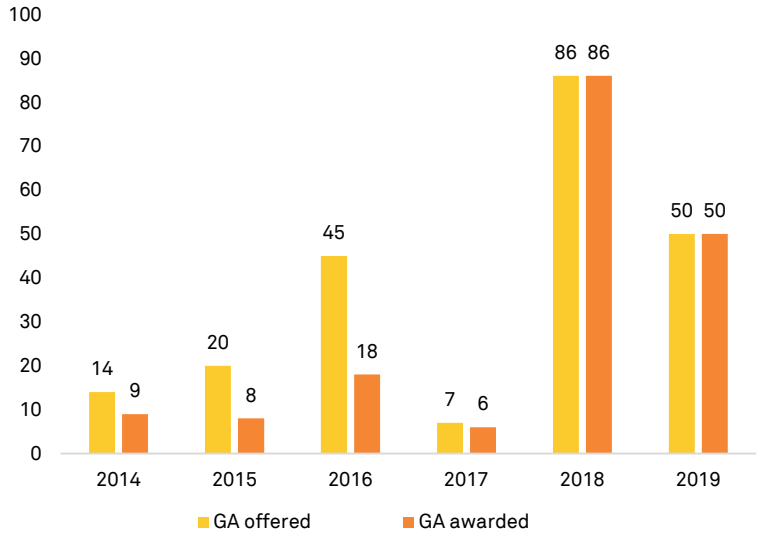


Source: Ministry of Petroleum and Natural Gas (MoPNG)

City gas distribution (CGD)

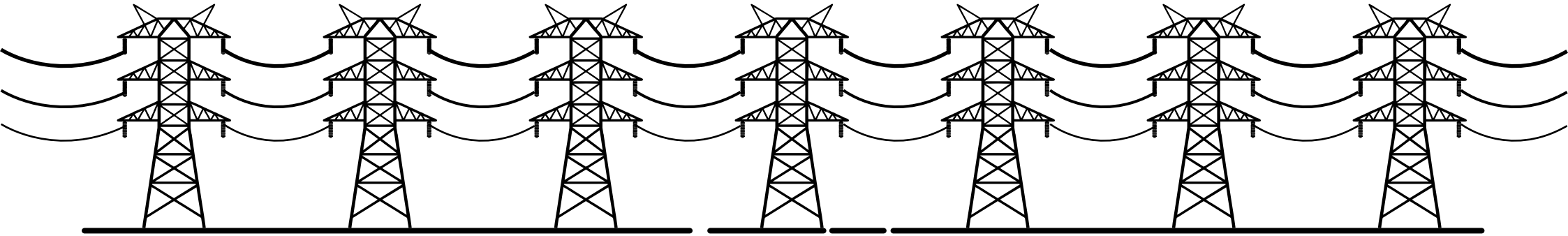
In order to make natural gas available to public at large, the government has emphasised on expansion of CGD network coverage across the country. CGD network ensures the supply of cleaner fuel (i.e., petroleum natural gas) to households, industrial and commercial units as well as transportation fuel (i.e., compressed natural gas) to vehicles. Till 2017, only 19% of the country's population spread over 11% of its area was covered by CGD in 96 geographical areas (GAs). To boost the CGD sector, 9th CGD bidding round was launched in April 2018 for 86 GAs covering 174 districts in 22 states / union territories of the country. 38 entities (public and private) have participated in this round and submitted total 406 bids. In the 10th round of bidding, 50 GAs covering 124 districts in 14 states and union territories were awarded in 2019. Post this ~ 70% of India's population and ~ 53% of its geographical area has been covered for the development of CGD network.

Figure 7 CGD bidding rounds snapshot



Source: Petroleum and Natural Gas Regulatory Board (PNGRB)

Energy sector reforms timeline



2013

Launch of Green Energy Corridor project to integrate renewable power with main grid

2014

Target of reducing emissions intensity of GDP by 33-35% by 2030 from 2005 levels, under nationally determined contributions (NDCs) to United Nations Framework Convention on Climate Change (UNFCCC), in order to move away from fossil-based energy. Target set for installation of 175 GW RE by December 2022

Launch of Ujwal Discom Assurance Yojana (UDAY) for operational improvement and financial turnaround of state distribution companies

2015

National Power Tariff Policy amended to promote RE and improve ease of doing business

National Gas Grid envisaged to remove regional imbalance within country to provide access to natural gas for different sectors

2016

India Grid Trust (IndiGrid) InvIT launched by Sterlite Power raises Rs 2,250 crore

Scheme for development of solar parks and ultra mega power projects launched to boost solar energy installation in country

Launch of Saubhagya scheme to ensure electrification of all urban and rural households

2017

Launch of Solar Rooftop Scheme Phase II, aimed at setting up 38,000 MW and Government Producer Scheme to set up 12,000 MW of grid-connected solar projects

PM-Kusum launched to solarise 10 lakh agricultural pumps, install 17.5 lakh standalone solar pumps; set up 10,000 MW small-size solar projects up to 2 MW on barren land

Large hydropower projects have been declared RE sources

2018

2019

Per capita electricity consumption (in kWh)	957	1,010	1,075	1,122	1,149	1,181

Launch of Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) and Integrated Power Development Scheme (IPDS) for strengthening and augmentation of sub-transmission and distribution network in rural and urban areas

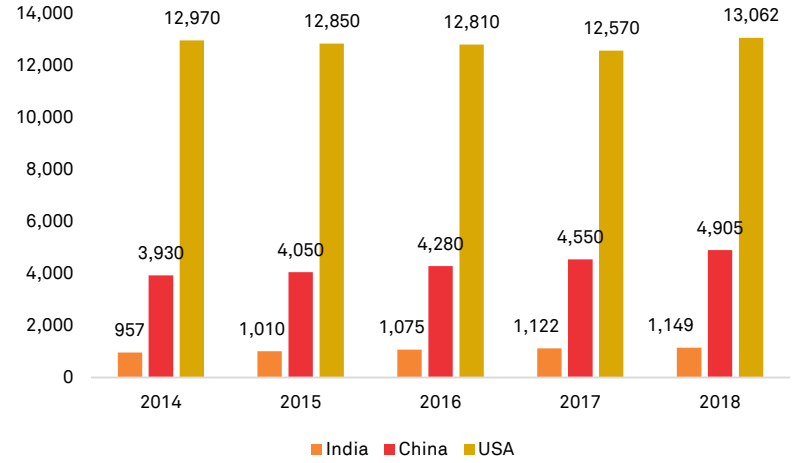
Launch of Ujjwala Yojana to provide liquefied petroleum gas (LPG) connection to every below poverty line (BPL) household

Launch of Pradhan Mantri Urja Ganga Project to ensure piped natural gas in eastern part of India

Phase II of Strategic Petroleum Reserves (SPR) programme for creating additional 6.5 million metric tonne (MMT) storage facilities launched

Infrastructure deficit in energy sector

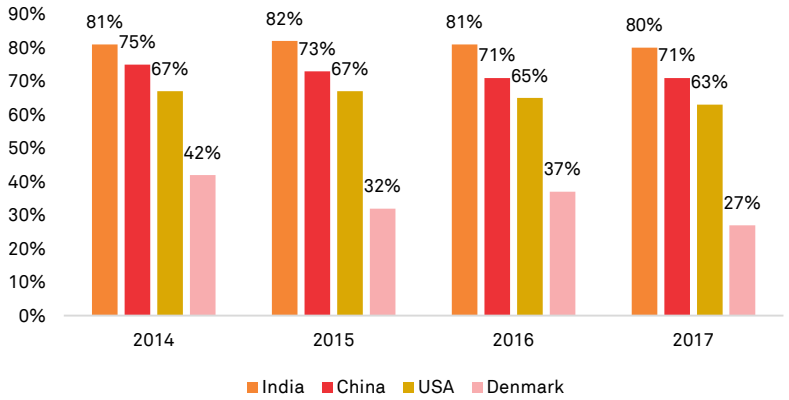
Figure 8 Per capita consumption (kWh/ person)



Source: International Energy Agency (IEA), CEIC - China, Energy Information Administration -USA, CEA - India

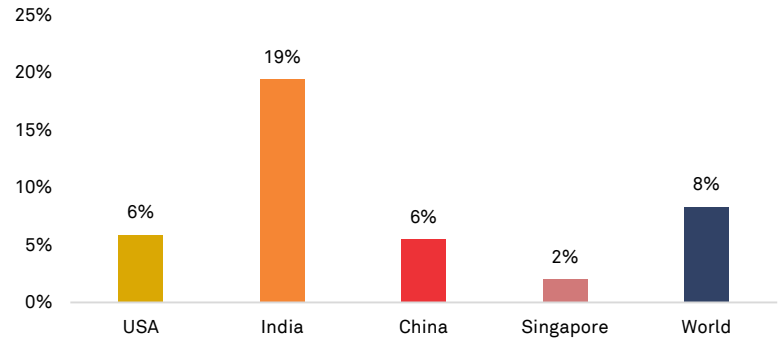
- Access to electricity in India is lower than its peers, owing to lower rural penetration. But, this is changing with all villages getting electrified recently under Saubhagya scheme and all households in these villages being connected to the grid progressively
- While the reported energy supply position makes India almost balanced (minimal deficit), current demand reporting does not capture unmet demand factors such as planned and unplanned load shedding, and large-scale back-up captive generation in many pockets
- Per capita consumption, while on the rise, is significantly lower than that of other comparable economies, and way below the world average

Figure 9 Share of fossil fuel in electricity generation (%)



Source: World Development Indicators; Global Energy Statistical Yearbook – ENER data

Figure 10 Electricity distribution losses (%)



Source: IEA Energy Atlas (2018)

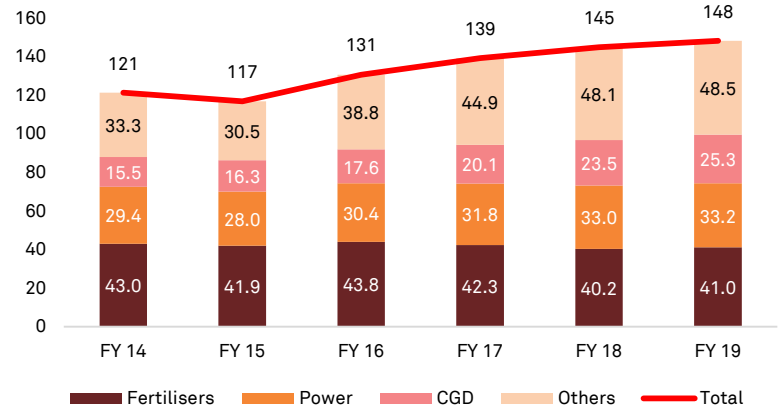
- Going forward, the energy mix should be designed taking into account India's intended NDC under its UNFCCC obligations. The country has pledged to reduce the emissions intensity of its GDP by 33-35% by 2030 from 2005 levels. It has also pledged to increase the share of non-fossil fuel-based electricity to 40%

- India's emissions intensity targets are similar to those of China. Its RE capacity stands at 86 GW as of December 2019, against a target of 175 GW installed capacity by December 2022 and 450 GW by 2030

- India's AT&C losses remain high compared to global peers

- The ARR-ACS gap, a key indicator of the financial health of distribution companies, has been consistently negative (though improving) during the past five years due to high AT&C losses and inadequate tariff hikes

Figure 11 Gas consumption by different sectors (in MMSCMD)



Source: MoPNG

- At present, natural gas accounts for ~6% in the country's primary energy mix against world average of ~24%. Among the available fossil fuels, natural gas, being an environment friendly clean fuel, has the potential to play a significant role in providing solutions to the environmental challenges. Power is one of the potential sectors which can facilitate an increase in the gas share in energy mix subject to improved affordability of power produced from gas. In order to move towards gas economy by increasing the share of natural gas to 15% in primary energy mix, India needs to focus on development of requisite gas infrastructure including National Gas Grid, CGD networks and re-gasified liquefied natural gas (R-LNG) terminals so as to improve the availability and accessibility of natural gas to public at large

Challenges in the energy sector

Power offtake and domestic fuel availability

Sluggish demand growth in the industrial and commercial sectors, and lack of capacity contracting by discoms have rendered a significant quantum of thermal capacity surplus, and without power purchase agreements (PPAs). Given this – along with financial distress and technical constraints – discoms have resorted to load shedding, resulting in suppressed demand and lower capacity offtake. Domestic coal supply has also been an area of concern owing to slow growth in production by Coal India Ltd, de-allocation of captive coal blocks and coal evacuation issues owing to constrained rail capacity.

Honouring of PPAs

Investors have become wary of state government utilities not honouring PPAs signed earlier. Some state governments have identified higher

tariff of wind and solar power PPAs as responsible for financial woes of state discoms and attempted to re-negotiate PPAs. Sanctity of contracts and timely dispute resolution are the key to retain and attract private sector participation besides protecting investments already made in these projects.

However, honouring PPAs should also be applicable to the private sector. Some thermal power projects recently managed to renegotiate PPAs. Given the country's low ranking on enforceability of contracts (163), sanctity of contracts should be upheld both by the public and the private sectors.

Management of discoms

UDAY was launched with the objective of revival and financial turnaround of power discoms. Many discoms have missed the targets set under UDAY, both in terms of tariff hikes and AT&C loss reduction. Slippages in the UDAY targets have resulted in significant cash losses for discoms, making working capital financing a challenge. Increase in tariff and making it cost reflective, as prescribed under UDAY, is proving to be a major challenge. Takeover of liabilities under UDAY has been a key reason for high fiscal deficits for state governments.

Inadequate gas pipeline infrastructure

Pipeline infrastructure and demand continue to face the 'chicken and egg' catch. The main obstacles to creating gas demand and boosting gas consumption are: domestic production difficulties, issues in the pricing and allocation of gas, and inadequate infrastructure. It is understood that creating adequate infrastructure is a pre-requisite to boost demand creation. Many pipeline projects have failed to move forward because of lack of demand or unfavourable economics. Another major issue has been under-utilisation of gas pipelines which is affecting risk-return profile for the existing owners - both public and private. The right of way issue also needs to be resolved among stakeholders to ensure timely completion of projects.

Vision 2025 for the energy sector

Current status

- Total capacity: 356 GW (as of March 31, 2019)[5]
- Thermal: 64%, renewable: 22%, hydro: 13%, nuclear: 1% as of 2019
- Low per-capita electricity consumption: 1,181 kWh (provisional as on March 31, 2019)
- RE share in consumption: ~10 %

- Load shedding: Discoms under huge debt burden and resort to unscheduled load-shedding
- High AT&C losses of discoms: currently at 8% to 41% (except J&K)

- Smart metering: <5% of meters as on June 30, 2018
- Level of digitisation: Services such as new connections, security deposits and reconnections, except bill payments and lodging of complaints, are not digitalised

- Low e-vehicle (EV) sales penetration: 2-3% for three-wheelers, but negligible for private and commercial cars, two-wheelers and buses

- Pipeline: Total length of operational gas pipeline is ~16,788 km with huge regional imbalance
- Installed capacity: 5.33 MMT for storing crude oil is available under SPR programme which can supply ~10 days of India's crude requirement

[5]*Source: CEA*

Vision 2025

- 24x7 clean and affordable power to be available to all households, industry, commercial businesses, agriculture in all states and union territories
- Total capacity: 583 GW[6]
- Thermal: 50%, renewable: 39%, hydro: 9%, nuclear: 2%
- RE share in generation capacity to increase, thermal to decline
- Substantial increase in per-capita electricity consumption to 1,616 kWh
- RE share in consumption to increase to ~20%
- Grid energy storage and offshore wind energy to be promoted

- Reformed discoms
  - Open access in power distribution
  - More cost reflective tariffs
  - Extensive metering
  - Payment to PPP operators through letter of credit (LC) mechanism
  - Subsidies to be switched to direct benefit transfer from government, allowing full commercial operation of discoms
  - Incentivise roof-top solar energy production

- Smart metering for all categories of customers, including prepaid meters
- Services such as new connections, security deposits, bill payments, lodging of complaints and reconnections through 100% digital platforms

- Public charging infrastructure within 3 km and in all commercial and multi storeyed buildings in urban areas leading to higher EV penetration using policies, such as NEMMP and FAME[7]: Private cars: ~5%[8], buses: ~11%, commercial cars: ~25%, two-wheelers: ~32% and three-wheelers: ~48%
- Highway charging infrastructure on all national highways every 25 km, including e-highway infrastructure in select corridors (overhead electric traction for heavy commercial vehicles)

- Under National Gas Grid project, there exists a need to add an additional ~14,700 km[9] to link each state to gas pipeline to ensure access to clean and green energy for all households and industries.
- In order to augment India's energy security, additional capacity of 6.5 MMT[10] crude oil storage needs to be added to provide buffer for overall ~22 days

[6]*Per capita electricity consumption to grow based on actual 10 year CAGR (FY08 - FY18) of ~5% and corresponding installed capacity addition based on government announced plans. NEP (Jan 2018) estimates installed capacity to be 583 GW at the end of FY25*
[7]*NEMMP - National Electric Mobility Mission Plan; FAME - Faster Adoption and Manufacturing of Electric Vehicles in India*
[8]*Source: Rocky Mountain Institute (RMI NITI Aayog) report titled India's Electric Mobility Transformation dated April 2019*
[9]*PIB National Gas Grid*
[10]*Implemented under Phase II of Strategic Petroleum Reserves*

Reform imperatives in energy sector

India's mission to become a $ 5 trillion economy hinges on rapid growth in the energy sector. Energy consumption in the country has almost doubled since 2000 and is set to grow further. This calls for huge investments over the next few years. It also entails segment-specific reforms in power generation, transmission and distribution and storage, to ensure uninterrupted power supply to urban and rural areas and meet the massive infrastructure needs of what may soon become the world's most populous country.

Conventional power

- **Improving the financial health of discoms:** Thermal assets of private power generation companies have come under increasing stress due to non-availability of long-term PPAs, dearth of credit provided by banks in the absence of long term PPAs and inadequate tariffs. It is important to improve the health of discoms so that they can procure power from power generation companies and pay their dues on time. Measures which have been introduced, such as letter of credit (LC) and other legal measures need to be enforced, to ensure honouring of power purchase and payment obligations. Bringing down AT&C losses along with achieving a commercial orientation in their functioning is the key to improving financial health of discoms

- **Ensuring adequate fuel supply:** There is an urgent need to address the concerns emanating from poor quality and erratic supply of coal as well as the stricter emission norms to be followed by thermal power plants. The recent policy change allowing 100% foreign direct investment (FDI) in coal mining is expected to provide a big thrust to foreign mining companies to enter India, bringing in their superior mining technology and increasing competition in the domestic market. This would bring in more efficiency and help reduce coal shortage in the power sector. It would also help reduce dependence on imported coal, and thereby lower the import bill. Similar issues have impacted gas-based power plants in India, where non-availability of domestic gas and high cost of imported gas have affected the financial viability of many gas assets

- **Resolving stressed and stranded thermal assets:** This is critical to unlocking bank exposure to infrastructure and releasing the same for re-investments. Recommendations of the High Level Empowered Committee set up for this purpose, may need to be fully implemented and monitored to ensure speedy resolution. Instead of setting up new thermal plants, resolving and putting to use stalled projects may be given the top priority

- **Planning for technology retrofits:** This is also required in our existing conventional power plants to enhance responsiveness to deal with steep ramp rates and shorter peaks in order to account for greater share of fluctuating renewable generation in our energy mix. Ministry of Power may enable an assessment by state and central utilities and plan for such retrofits

Renewable energy

- **Honouring PPAs:** Investors have become wary of state government utilities not honouring PPAs. Some state governments have identified higher tariff of wind and solar power PPAs as responsible for financial woes of state discoms and attempted to re-negotiate PPAs. Sanctity of contracts and timely dispute resolution are the key to retain and attract private sector participation. However, both public and private sector have to uphold sanctity of contracts

- **Improving scheduling and forecasting:** State regulations on scheduling and forecasting in line with the Central Electricity Regulatory Commission (CERC) framework will help to overcome the challenges of demand-supply mismatch and grid instability by ensuring better scheduling and forecasting mechanism

- **Providing bill discounting facility:** Many renewable and conventional power developers are selling power generated from their projects to state discoms. However, there have been significant delays in receipt of payments from the utilities leading to stress in the sector. The advent of a bill discounting facility will provide the much needed liquidity respite to developers as they will be able to raise upfront cash against receivables from discoms. Successful implementation of such a bill discounting facility will significantly reduce ongoing stress for renewable and conventional power developers

- **Boosting solar photovoltaic (PV) modules manufacturing:** While large scale investments are planned in this sector, India currently imports around 85% solar PV modules and cells from countries like China, Taiwan, Vietnam and Malaysia as they are cheaper. Huge investments are required in solar manufacturing to reduce imports. To make the domestic manufacturing competitive, targeted policy support should also be provided

Transmission and distribution

Despite implementation of several reforms in the sector by both Centre and states, state-run discoms remain the weakest link and have continued to make huge financial losses. The business sustainability of discoms remains a major concern for the sector's and economy's growth.

- **Asset monetisation**: Monetisation of seasoned transmission assets could help finance new transmission infrastructure, by bringing in much-needed capital

- **Introducing medium-term PPAs**: The present environment with sufficient installed power generation capacity, lower RE prices, and increased competition in the market would make medium-term PPAs (3 – 5 years) more attractive than long-term ones. As the tariffs especially of RE plants is falling, discoms are not willing to commit to long-term PPAs

- **Upgrading technology and infrastructure:** In order to reduce AT&C losses, discoms must invest in adoption of smart metering, which would monitor, control and disconnect consumers remotely, paving way for improving billing and collection efficiency

- **Introducing 'time of the day' pricing:** Discoms could also introduce "time-of-the-day" pricing in the commercial sector, in order to bring in efficiency. Under this, different rates would be applicable at different time slots in a day. This could substantially improve financial health of the utilities and smoothen the load curve

- **Improving subsidy policies of states**: Untargeted subsidies are one of the major causes of poor health of discoms. The discoms have been selling electricity to agricultural consumers and certain sections of domestic power consumers at highly subsidised prices, even lower than cost. In order to reduce this leakage, subsidies can be targeted through the direct benefit transfer mechanism, enabling discoms to become full commercial entities which is critical in reviving the investment cycle in the power sector. There is also a pressing need to further rationalize the subsidies to make the discoms more financially viable

- **Timely revision of tariff by discoms**: Delays in tariff revisions have resulted in deteriorating financial health of discoms. Tariffs should be cost reflective and in order to ensure that tariffs are revised from time to time, independent and autonomous functioning of the regulator is a must

- **Improving quality of baseline data before privatising discoms:** Efforts need to be made to build quality baseline data before embarking on a franchisee/ PPP model in power distribution. This must include data such as existing level of losses, network status,

consumer mix and sales, metering and billing. This is essential to provide confidence to prospective bidders, ensure they quote realistic bids, and increase accountability of the licensee as well as of the successful bidder for post-franchisee/ PPP performance

Power storage infrastructure

- **Pumped storage power plants and hydroplants with pondage** – These may be promoted to enable smoothening of the fluctuating output of intermittent renewable energy sources while also balancing base-load power plants, as the share of renewable energy grows. Immediate action to inventorise and assess potential for pumped storage may be carried out

- **Reducing construction delays of hydro plants** – Large hydro power projects commonly get embroiled in social and political issues mostly related to loss of significant areas of agricultural flood plains and forest lands and forced relocation without just compensation for affected rural communities. Interstate disputes over water rights can also often delay projects. In order to ensure more investments in hydro power projects and pumped hydro storage systems, it is important to address these concerns at the detailed project report (DPR) stage

- **Incentivising private investments in battery storage** – It has been estimated that over 70 GW and 200 GWh of energy storage would be required in India by 2022 and therefore we need to plan to strengthen our battery storage to meet this demand. Battery storage may be included in the harmonised master list of infrastructure to give it infrastructure status. To attract private participation in battery storage, it is important to incentivise setting up of such projects. They may be set up in existing solar parks, making them eligible for benefits associated with "infrastructure" status

- **Creating an enabling policy environment** – There can be a policy on comprehensive grid-connected storage, for viability gap funding, bringing in clarity for businesses to invest and develop a vibrant battery storage segment. This will also ensure that India takes the lead in creating storage manufacturing industry

Petroleum and natural gas

In order to expedite the execution of gas projects and to realise the desired socio-economic benefits from a gas economy, there is need for continuous efforts to create an enabling policy/regulatory framework.

- **Unbundling gas transmission and distribution segments** – To boost India's gas sector and make it more competitive, gas transmission and distribution segments need to be unbundled. This will enable non-discriminatory access to transmission network and improve the environment for improved usage of gas

- **Establishing a free gas market through trading hub/exchanges** – If India is to take meaningful strides to increase the share of gas in the energy mix, it is imperative to ramp up domestic gas output. For this, remunerative, market-linked price should be used prospectively, to encourage private investments. A gas trading platform will go a long way in enhancing trade transparency, boosting consumer confidence, and increasing market opportunities for suppliers. It will enable all stakeholders in the gas sector to have access to gas through a common platform, which would facilitate local gas price discovery in a fair and transparent manner

- **Creation of gas transport system operator (TSO)** - To enable uninterrupted gas flow from any gas source (domestic and imported) to any gas consuming market, setting up a TSO, without any conflict of interest, is necessary. It will facilitate in catalysing the creation of new gas markets along with interlinking regional networks to develop a single gas market in the country

- **Rationalisation of tax structure for natural gas:** The present tax structure for sale of natural gas (not under GST regime) increases input cost for the end-consumer. Further, varied VAT structure of states on natural gas is distorting the competitiveness of natural gas as against alternate fuels viz. LPG, furnace oil, petcoke which have already been covered under GST. There is a need to harmonise the tax structure for natural gas by bringing it under the GST regime. Tax reforms for gas will facilitate in attracting investment in gas infrastructure, which would lead to additional GST revenue. GST for gas will also displace polluting fossil fuels which would result in generating health and environmental dividend on account of reduced pollution

- **Expediting the process of granting permissions** – In order to set up City Gas Distribution (CGD) network, multiple clearances and permissions are required from many agencies — various departments of municipalities, railway authorities, the National Highways Authority of India, Public Works Department, traffic police, state road transport departments and other local authorities. These procedural delays tend to impact the pace of development of the CGD network. Providing single window clearances for the CGD network – at both state and district levels - is a key factor for their expeditious implementation. The option of acquiring such clearances before award may also be considered

- **Improving capacity utilisation of LNG terminals** – Currently, most LNG terminals in India are running well below their capacity, owing to several constraints related to laying of pipelines for delivering gas upstream to different regions. There is a need to provide adequate connectivity to ports and to expedite clearances and grant right of way for faster construction and operationalisation of pipelines

- **Improving oil production technologies** – Production from domestic fields has declined in recent years. As major oil fields are reaching their maturity stage, investment in enhanced oil recovery technologies is required to boost and maintain production

NIP project summaries and marquee projects

Power sector

In the power sector, an estimated total capital expenditure of Rs 1,410,428 crore by both the Centre and states would be incurred over fiscals 2020 to 2025. For the identified projects to be executed by central PSUs and private players, the break-up of total estimated expenditure of Rs 953,895 crore is as follows: an amount of Rs 326,811 crore will be expended on electricity generation projects, Rs 323,034 crore will be expended on electricity distribution projects, while an amount of Rs 304,050 crore will be expended on electricity transmission projects. The summary of the projects is highlighted in the table below:

Category	Capex over FY20–FY25 (Rs crore)
Generation	326,811
NTPC	119,991
NHPC	44,049
THDC	10,385
SJVN	10,334
DVC	2,848
State (Hydro)	75,375
Private (Hydro)	63,829
Distribution	323,034
DDUGJY, IPDS, Proposed New Scheme	323,034
Transmission	304,050
PGCIL	65,500
DVC	549
State	190,001
Private	48,000
Total	**953,895**
States	456,533
Overall total	**1,410,428**

- In generation, projects include greenfield/expansion of super thermal power projects such as Lara super thermal power station, Barh super thermal power station, etc; Hydropower plants undertaken by NHPC such as Dibang, Tawang – I&II, Teesta – IV, etc, and the solar PV plants undertaken by THDC

- In transmission, PGCIL is undertaking major projects such as HVDC Bipole Link between western and southern regions, interstate Green Energy Corridor Transmission Link and construction of substations

- In the distribution segment, many projects are being executed under the Integrated Power Development Scheme (IPDS) and Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) to strengthen the distribution network in urban and rural areas in order to provide continuous power supply

Capital expenditure over FY20 to FY25

Rs crore	FY20	FY21	FY22	FY23	FY24	FY25	Total
Generation	30,056	53,819	63,789	63,474	64,982	50,690	**326,811**
Distribution	21,127	42,000	44,207	60,000	70,000	85,700	**323,034**
Transmission	54,875	53,897	50,712	51,522	51,522	41,522	**304,050**
Total	**106,058**	**149,716**	**158,708**	**174,996**	**186,504**	**177,912**	**953,895**
States[11]	58,081	75,834	63,027	48,491	38,732	33,090	**456,533**
Overall total[12]	**164,140**	**225,551**	**221,734**	**223,487**	**225,236**	**211,002**	**1,410,428**

[11]States/UTs include Uttar Pradesh, Maharashtra, Gujarat, Telangana, Jharkhand, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Karnataka, Haryana, Punjab, Delhi, Kerala, Odisha, Chhattisgarh, West Bengal Sikkim, Mizoram, Andaman & Nicobar, Chandigarh and Puducherry. For some projects, year-wise phasing has not been provided, so capital outlay for FY20 to FY25 will not add up to total capital outlay.
[12]Includes projects where yearly capex phasing has not been provided.

Marquee project

Dibang Hydel Power Project

- National Hydro Power Corporation (NHPC) would be implementing the 2,880 MW Dibang Hydel Power Project from October 2020 and the project is expected to be completed by the end of September 2029
- The project is estimated to be built at a total project cost of Rs 28,007 crore. This project will be built over Brahmaputra river in Arunachal Pradesh and is envisaged as a storage-based hydroelectric project with flood moderation as the key objective
- An estimated capital expenditure of Rs 15,150 crore will be incurred on this project between fiscals 2020 and 2025

High Voltage Direct Current (HVDC) Bipole Link Project

- Power Grid Corporation of India Limited (PGCIL) is implementing the HVDC Bipole Link between the western region (Raigarh, Chhattisgarh) and southern region (Pugalur, Tamil Nadu) at an estimated cost of Rs 14,733 crore
- The project objective is to improve the import capability of the southern region which is facing a huge power deficit due to delay in many anticipated generation projects. Therefore, to facilitate the import of power into the southern region and considering the long distance, it has been proposed that power be transferred over HVDC system ±800 KV 6000 MW HVDC link with terminals at Raigarh and Pugalur along with VSC-based 2000 MW HVDC link between Pugalur and north Trichur (Kerala)

Atomic energy

About seven generation projects have been identified to be implemented during 2020-25 with an estimated capital expenditure of Rs 155,503 crore over fiscals 2020 to 2025. These projects will be implemented by the central agency – Nuclear Power Corporation of India (NPCIL) through the EPC route. The summary of the projects is highlighted in the table below:

Category	No. of projects	Mode of implementation	Capex over FY20–FY25 (Rs crore)
Generation			
NPCIL	7	EPC	155,503
Total	**7**		**155,503**

- The projects include commissioning of new nuclear reactors such as Kundankulam Nuclear Project Units 3&4 and Units 5&6 - each 1,000 MWe reactor, commissioning a prototype 500 MWe fast breeder reactor, etc

Capital expenditure over FY20 to FY25

Rs crore	FY20	FY21	FY22	FY23	FY24	FY25	Total
Capital expenditure	11,635	21,462	28,324	33,124	32,674	28,284	**155,503**

Marquee project

Kudankulam Nuclear Power Project

- Kudankulam Nuclear Power Project Units 3&4 and Units 5&6 are being built at an estimated total project cost of Rs 89,470 crore and are expected to be completed by December 2025

Renewable energy

The category of projects included are solar, wind, small hydro and bio power. The capital expenditure for these projects is estimated at Rs 929,500 crore. The summary of the projects is highlighted in the table below:

Category	Target by Dec 25 (in GW)	Actual achievement till Oct 19 (in GW)	Capacity to be added by FY25 (in GW)	Capex over FY20–FY25 (Rs crore)
Solar power	149.7	31.7	118	472,000
Wind power	96.99	37.09	59.90	419,300
Small hydro power	7	4.65	2.35	23,500
Bio power	12.04	9.94	2.10	14,700
Total	**265.73**	**83.38**	**182.35**	**929,500**

Capital expenditure over FY20 to FY25

Rs crore	FY20	FY21	FY22	FY23	FY24	FY25	Total
Capital expenditure	30,500	151,000	144,000	170,000	217,000	217,000	**929,500**

Petroleum and natural gas (PNG)

An overall total capital expenditure of Rs 194,572 crore by both the Centre and states would be made over fiscals 2020 to 2025. About 163 projects have been identified to be implemented in 2020-25. The capital expenditure to be incurred by the Centre for these projects over fiscals 2020 – 2025 is estimated at Rs 193,126 crore. Out of the above 163 projects are to be executed by the Centre, 136 projects (~Rs 154,089 crore) are to be implemented through the EPC mode, two projects worth Rs 10,751 crore are to be implemented through PPP mode and 25 projects worth Rs 28,286 crore are to be implemented as joint ventures. The summary of the projects is highlighted in the table below:

Category	No. of projects	Mode of implementation	Capex over FY20–FY25 (Rs crore)
Gas pipelines	17	EPC	51,860
Oil pipelines	35	EPC	52,278
Oil/ Gas/ LNG storage facilities			
	40	EPC	19,692
	2	PPP	10,751
Others			
	44	EPC	30,260
	25	JV	28,285
Total	**163**		**193,126**

- The projects include various natural gas pipelines such as between Haridwar-Dehradun, Jagdispur-Haldia, and Bokaro – Dhamra, etc; city gas distribution network in different cities and LNG terminals in Gopalpur, Krishnapatnam, etc

Capital expenditure over FY20 to FY25

Rs crore	FY20	FY21	FY22	FY23	FY24	FY25	Total
Centre	27,006	43,056	48,147	41,524	22,858	10,535	**193,126**
States[13]	326	454	167				**1,446**
Overall total[14]	**27,332**	**43,510**	**48,314**	**41,523**	**22,858**	**10,535**	**194,572**

[13]States/UTs include Uttar Pradesh, Maharashtra, Gujarat, Telangana, Jharkhand, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Karnataka, Haryana, Punjab, Delhi, Kerala, Odisha, Chhattisgarh, West Bengal, Sikkim, Mizoram, Andaman & Nicobar, Chandigarh and Puducherry. For some projects, year-wise capex phasing has not been provided, so capital outlay for FY20 to FY25 will not add up to total capital outlay.
[14]Includes projects where yearly capex phasing has not been provided.

Marquee project

Strategic Petroleum Reserve (Phase II) at Chandikhol and Padur

- Indian Strategic Petroleum Reserve Limited (ISPRL) would be constructing strategic petroleum reserve of 6.5 million metric tonne at Chandikhol in Odisha and Padur in Karnataka
- Strategic petroleum reserves will be implemented under PPP mode, whereas the SPM and pipelines are proposed to be built by the public sector
- The project will augment India's energy security and will serve as a cushion during any supply disruption

Jagdishpur–Haldia /Bokaro–Dhamra Natural Gas Pipeline and Barauni–Guwahati Pipeline (JHBDPL & BGPL)

- GAIL (India) Ltd is implementing the Jagdishpur–Haldia/ Bokaro–Dhamra Natural Gas Pipeline and Barauni-Guwahati Natural Gas Pipeline at an estimated cost of Rs 15,520 crore to be completed by December 2021
- The JHBDPL and BGPL project is a 3,384 km-long gas pipeline system being developed in the states of Uttar Pradesh, Bihar, Odisha, Jharkhand, West Bengal and Assam and is intended to connect the eastern and northeastern part of the country with the National Gas Grid
- The project will ensure widespread supply of natural gas for the domestic, industrial and transport sectors

Total energy sector capital expenditure to be incurred from FY20 to FY25

Rs crore	FY20	FY21	FY22	FY23	FY24	FY25	Total
Power	164,140	225,551	221,734	223,487	225,236	211,002	**1,410,428**
Renewable energy	30,500	151,000	144,000	170,000	217,000	217,000	**929,500**
Atomic energy	11,635	21,462	28,324	33,124	32,674	28,284	**155,503**
PNG	27,332	43,510	48,314	41,523	22,858	10,535	**194,572**
Total[15]	**233,607**	**441,522**	**442,372**	**468,134**	**497,768**	**466,821**	**2,690,003**

[15]*Includes projects where yearly phasing has not been provided.*

Roads

Sector Progress, Deficits and Challenges, Vision and Reforms

Eastern Peripheral Expressway and Western Peripheral Expressway

Project details

- Both peripheral expressways are six-lane access-controlled expressways built with the objective of diverting heavy traffic passing through Delhi which are bound for other parts of the country, thereby decongesting road traffic and reducing pollution in Delhi
- The Eastern Peripheral Expressway (EPE) begins at Kundli and passes through Sonipat, Baghpat, Ghaziabad, Noida and Faridabad districts. It joins the Western Peripheral Expressway (WPE) near Palwal which also starts at Kundli, but passes through Manesar to reach Palwal. The expressways have a combined length of 270 km
- The WPE is constructed at a total cost of around Rs 6,400 crore and EPE is constructed at a total cost of around Rs 11,000 crore. The WPE passes through major cities of Sonipat, Bahadurgarh, Jhajjar, Manesar, Sohna, Hathin and Palwal

Salient features

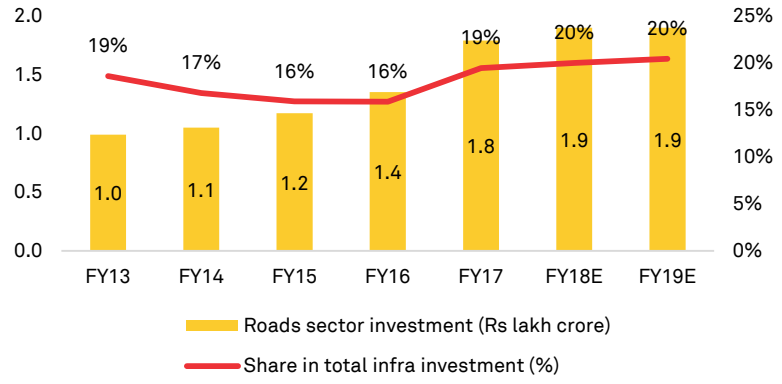
- The expressways aim to provide a high-speed link between the northern and southern districts of Haryana and provide an uninterrupted high-speed link for commercial traffic from Haryana to its neighbouring states
- The expressway is equipped with the latest, world-class smart technology and road safety features such as intelligent highway traffic management system, video incident detection system and a closed tolling system, where toll will be charged on the distance travelled
- The expressway is the country's first green highway with landscaping, plantation of nearly 2.5 lakh trees and fully lit by solar energy

The roads sector has attracted significant investment over the past 10 years. The sector has pioneered several innovative public-private partnership (PPP) models besides having a strong contractual framework compared with other sectors. These factors have led to significant investments from private players in the sector. There is a need to further boost connectivity as national and state highways constitute only 4.7% of the surfaced roads in India. This makes it imperative to strengthen hinterland connectivity with ports and other key locations including consumption centres, metros, Tier-2 cities and places of strategic importance so that people and goods can move at a faster pace.

Historical investments

The share of roads sector investment in the overall infrastructure investment was ~17% between fiscals 2013 and 2017, rising at ~16% CAGR (refer to Figure 12).

Figure 12 Roads sector infrastructure investment (Rs lakh crore) and share in total infrastructure investment (%)



Source: Appraisal documents for five-year plans, CRIS estimates (Investments mentioned are at current prices)

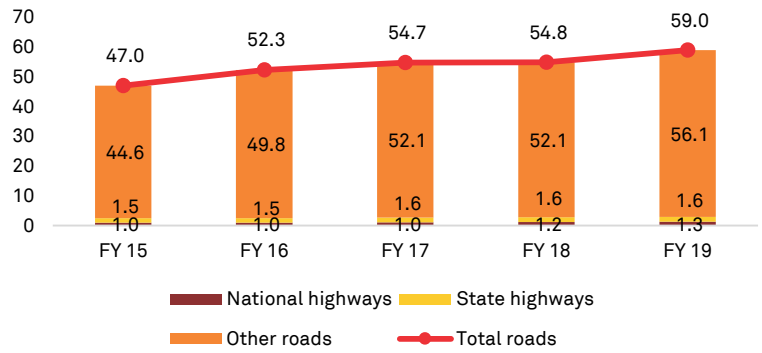
Private sector participation in the roads sector declined towards the end of the Twelfth Five Year Plan owing to land acquisition and utility clearance hurdles, inadequate dispute resolution mechanism, poor project preparation resulting in frequent change of scope and aggressive bidding by developers. In the light of falling private sector participation, the allocation of central government funds to the roads and bridges sector has increased considerably, as models such as Engineering, Procurement, and Construction (EPC) and hybrid annuity model (HAM) have been preferred in recent times.

Trend in roads sector

India has the second-largest road network globally. Roads can be classified into: national highways, expressways, state highways, major district roads and rural roads.

The total road network in India was 59 lakh km as of March 31, 2019. Of this, national highways and expressways comprised 132,500 km and state highways 156,694 km. Major district roads and rural roads accounted for the remaining 56 lakh km.

Figure 13 Trend in road network in India (lakh km)

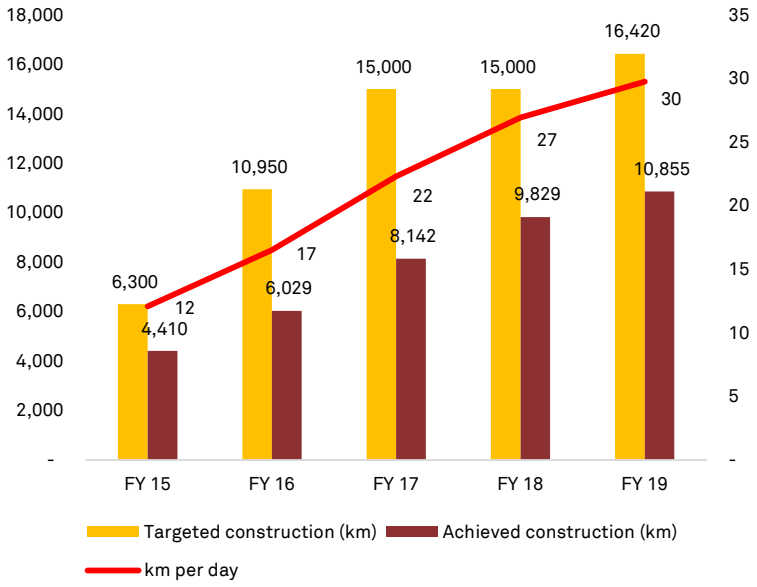


Source: MoRTH annual reports

Trends in project award and project completion

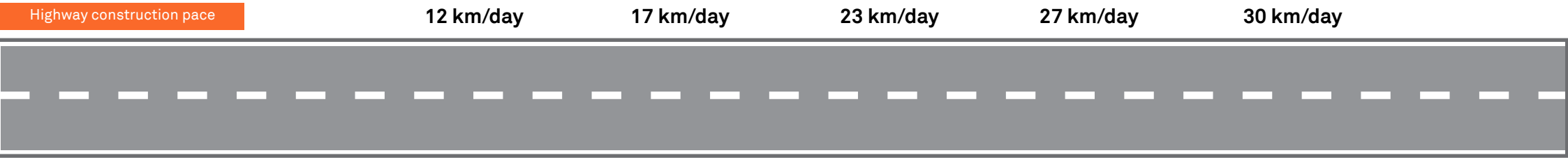
Ministry of Road Transport and Highways (MoRTH) constructed 10,855 km of national highways against the targeted 16,420 km in fiscal 2019 with an average daily construction rate of about 30 km. The rate of construction of national highways has more than doubled since fiscal 2015. The increase in the average daily construction rate of national highways can be attributed to the introduction of comparatively de-risked models (for the private sector) such as EPC and HAM, besides policy reforms such as the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, for facilitating land acquisition, etc.

Figure 14 Achievement targets set by MoRTH



Source: MoRTH annual reports

Roads sector reforms timeline



2013

First electronic tolling collection system launched for near non-stop toll collection and traffic monitoring

Facilitating harmonious substitution of concessionaire in case of both ongoing and completed projects

Infrastructure Debt Fund (IDF) set up to enhance flow of long-term infrastructure debt

2014

2015

2016

HAM launched to boost private sector participation in road projects

Setu Bharatam launched to make all national highways free of railway crossings

IDF set up to enhance flow of long-term infrastructure debt

2017

Bharatmala Pariyojana launched to improve economic corridor connectivity

IRB garners Rs 50.50 billion from public issue of India's first Infrastructure Investment Trust (InvIT)

2018

The NHAI raises Rs 96.81 billion by monetising road assets through toll-operate-transfer (TOT) model

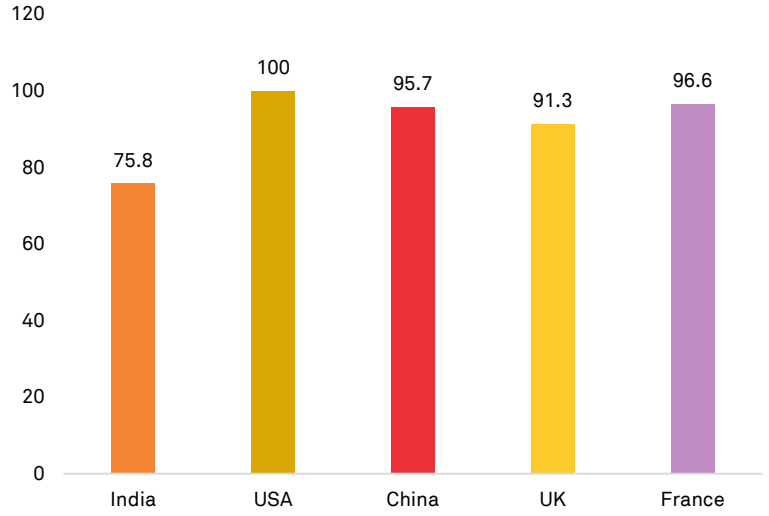
2019

Cube Highways emerges as winner for TOT Bundle 3 with price bid of Rs 50.11 billion

Infrastructure deficit in roads

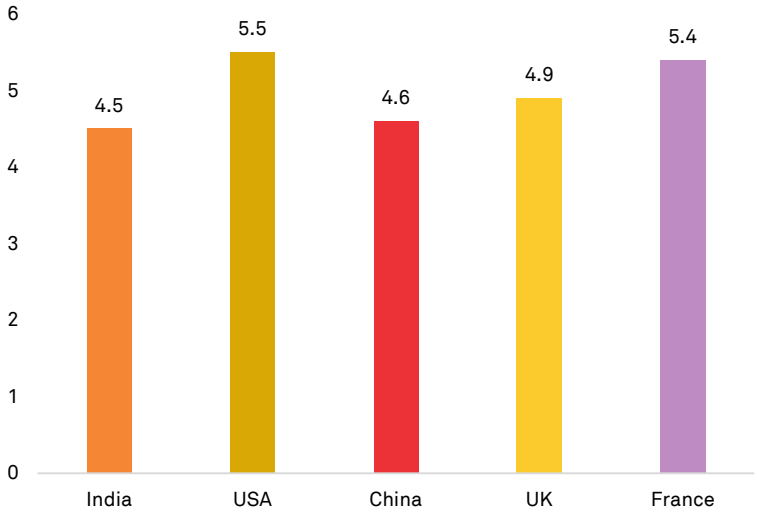
Dominant modal share in passenger and freight transport; road quality, connectivity and safety remain issues

Figure 15 Road connectivity (Score: 1 - 100)[16]



Source: WEF Global Competitiveness Report, Transport Competitiveness Report

Figure 16 Quality of road infrastructure (Score: 1 – 7)[17]



Source: WEF Global Competitiveness Report, Transport Competitiveness Report

[16]Score on the Road Connectivity Index, which measures average speed and straightness of a driving itinerary connecting the 10 or more largest cities that together account for at least 15% of the economy's total population. The scale ranges from 0 to 100 (excellent). This Index, developed by the World Economic Forum, comprises two elements: (1) a measure of the average speed of a driving itinerary connecting the 10 or more largest cities in an economy accounting for at least 15% of the economy's total population; and (2) a measure of road straightness.
[17]Response to the survey question "In your country, what is the quality (extensiveness and condition) of road infrastructure?" [1 = extremely poor—among the worst in the world; 7 = extremely good—among the best in the world] |Source: World Economic Forum, Executive Opinion Survey

- The modal share of roads for both passenger and freight traffic remains high at 85% and 59% in 2018. As roads account for the bulk of the passenger and freight movements, quality and end-to-end connectivity is essential

- India scores only a moderate 76% on the World Economic Forum's Road Connectivity Index that measures the average speed and straightness of roads connecting the country's 15 major cities

- There is a need to improve the quality of rural and border roads and make them all-weather to boost connectivity and economic activity in remote areas

- With a fatality rate of 17 per hour, road safety remains a concern

Challenges in the roads sector

Delays in achieving financial closure of new projects

Banks are becoming conservative in lending to private players in the roads and highways sector. The problem is especially acute for mid-sized players which have recently won projects from the National Highways Authority of India (NHAI).

Delayed award of contracts owing to delays in approvals and clearances

The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR), 2013, has made land acquisition more expensive. The land acquisition cost has tripled from around Rs 80 lakh per hectare to around Rs 2.38 crore per hectare. To avoid project delays, the NHAI only issues tenders for projects that have achieved 80% land acquisition. Non-provision of contiguous stretches of land causes slowdown and increases costs for contractors. The lengthy land acquisition process has led to a slowdown in project awards as limited tenders are getting issued. However, it is an international best practice to launch well-prepared projects, including 80% land acquisition. Delays in fixing appointed dates after award

due to non-fulfilment of conditions precedent affect the bidding capacity of contractors. Hence, NHAI may consider procuring all approvals and at least 90% contiguous land in advance before award of contracts.

Issues related to sanctity of contracts and delayed dispute resolution

Enhancing the enforceability of contracts and striving for predictability in execution is critical to attract and sustain private capital for funding infrastructure in key sectors such as roads. Another challenge is delayed resolution of disputes. Delays in resolution as well as execution of awards causes liquidity crunch for contractors. In order to ensure sustained private sector participation, all arbitration claims have to be expeditiously settled in an unbiased, user-friendly and cost-effective manner. The recent Cabinet decision on enforcing payment of 75% of awards has been of help. It has also been noticed that contracting agencies invariably appeal against arbitration awards and most of them result in confirmation of awards by courts, but with huge delays that are fatal to expeditious resolution of disputes.

Need for rapid asset monetisation

The NHAI has a huge backlog of projects. However, it also has a number of completed roads that can be monetised by ToT, InvIT, or asset securitisation models, to take up more greenfield project funding without increasing debt levels. This brownfield asset monetisation strategy for funding more greenfield projects should be increasingly used. The NHAI has proposed to monetise 12 more bundles of roads covering 6,000 km. This needs to be expedited to enable it to raise more funds for new roads.

Need for IT-based infrastructure maintenance and accident monitoring

State and national highways account for 63% of all fatalities related to road accidents. One of the reasons for these fatalities is ill-maintained roads and vehicles. Extreme weather also leads to a deterioration in the condition of roads. In addition, the absence of emergency medical facilities around the highway network system leads to significant treatment delays. Hence, casualty rates in case of any accident on highways remain high.

Vision 2025 for the Roads sector

Current status

- National Highways (NH) total length ~1.32 lakh km[18] ; including expressways of ~1,600 km
- Low private sector participation in NH - 15% (~17,150km)
- Poor connectivity of remote areas with trunk routes and metros

- Key component in Bharatmala Pariyojana is to improve the existing low quality and low connectivity of existing border and international connectivity roads

- Nascent stage for utilisation of asset monetisation options, such as InvIT and ToT, for good quality operating road assets
- Asset ownership mainly with public authorities and Indian developers, with limited participation from private equity players

- Higher share of cash collection resulting in revenue leakages and congestion at toll plazas

- Tolling mainly involves charging users a flat-rate toll for a particular stretch, irrespective of the actual distance travelled

- Limited use of advanced technology in traffic management, safety and security

[18] *As of March 31, 2019*
Source: NHAI, MORTH

Vision 2025

- Last-mile connectivity – improved access to all remote areas after the completion of Bharatmala Phase-1
- Improved connectivity to key airports, ports, railway stations, military, other strategic installations, rail, intercity bus, metro, ferry terminals
- Development of overall 60,000 km of national highways including 2,500 km of expressways, 9,000 km of economic corridors, 2,000 km of coastal and port connectivity, bypasses for 45 towns and enhanced connectivity for 100 tourist destinations by 2024
- Reduce fatalities by 25%
- Significantly higher share of private sector in national highways

- Improved connectivity for border areas and international connectivity roads of high quality - all-weather, motorable and well-maintained roads

- Higher penetration of asset monetisation options, such as InvITs, ToT, securitisation of portfolio
- Asset ownership to tilt in favour of asset aggregators/private equity players
- Improved PPP models and agreements with more balanced risk-reward sharing

- Rs 1 lakh crore through asset monetisation by 2024
- Increased used of Fastag and RFID devices to shorten waiting time at toll plazas and plug revenue leakages

- Long-term financing through credit-enhanced project bonds
- Innovative models of financing – NIIF-led project development
- Value capture financing
- Tolling mainly based on 'pay as per use' concept, resulting in lower transportation cost
- Green highways or plantation-surrounding roads to result in lesser pollution

- Higher penetration of advanced technology in traffic management, safety and security
  - Use of LIDAR[19] guns and drones
  - Speed regulators on roads
  - Digital message signs on roads
  - Automated traffic control devices specifying alternate lanes/ roads in case of congestion
  - Extensive investment in automated road condition monitoring system
  - Intelligent geo-referenced traffic monitoring systems integrated with police databases for accident monitoring

[19] *LIDAR – Laser Imaging Detection and Ranging*

Reform imperatives in roads

Approximately 18% of the Rs 111 lakh crore investment targeted over fiscals 2020-25 is expected to be made in the roads sector – the bulk of it in augmenting road length and safety features. Given the ambitious target, increased private sector participation is critical. The following reform measures could attract more private investment in the sector.

Increased investment in technology

Investing in technology is essential to improving and enforcing safety conditions. Technology can also be a revenue enabler. Better safety conditions and road design will increase traffic throughput and, eventually, toll revenue.

- Adoption of cashless modes of payment such as electronic toll collection, FASTag and RFID-related technologies at more lanes of toll plazas reduces waiting time and cash leakages. This has a two-fold effect of improving consumer experience and augmenting revenue
- Technology can be leveraged to improve road safety. There are advanced technologies such as Intelligent Traffic Management Systems, LIDAR gun, speed regulators, limiting the maximum speed permitted for commercial vehicles, variable digital message signs, traffic control devices specifying alternative lanes/roads in case of congestion, centralised incident management system, etc

Emphasis on improving road safety

Many road accidents are the result of faulty road design, poor engineering and deplorable road conditions.

- In order to improve the quality and safety aspect of roads, it is paramount to benchmark Indian roads against quality roads in developed countries and adopt international quality standards for parameters such as Surface Roughness Index, safety norms, etc. The large-scale use of automated road condition monitoring systems may be deployed on national highways which will ensure better transparency and service levels in road maintenance
- With a view to improve road safety and reduce number of accidents, real-time geo-tagged Road Accident Data Management Systems integrated with police databases should be launched all over the country which would help bring international best practices in collating, managing, analysing and using data on road accidents in India. This repository can help develop required solutions for the problem

Prioritisation of projects for development and key reforms to attract private sector

Attracting private investments throughout the lifecycle of the project will require a host of reforms. The risk appetite of private companies varies. For instance, banks and finance institutions with dedicated project finance units can finance greenfield projects. Pension funds and insurance companies with access to long-term funds and a low risk-return preference would be interested in investing at the post-construction, operational stage. This is when operational assets with an established track record of financial viability are refinanced. The suggested reform options are:

- At the construction stage of important projects, the focus should be on strong project preparation, upfront procurement of key approvals /clearances, and availability of required land. This is to streamline existing processes and thus develop a healthy project pipeline. Such steps will reduce the probability of time and cost overruns during implementation

- Key measures to improve private participation in the roads sector include ensuring better contract enforceability and robust dispute resolution mechanism

- The suggested reforms will help achieve the ambitious project construction targets of Vision 2025. Once completed, such a shelf of operational projects will also create a pipeline of investment-worthy road assets with high demand from long-term investors such as pension funds and insurance companies through the TOT and InvIT routes. This will ensure a virtuous cycle of asset creation and unlocking of growth capital through monetisation of mature assets. Such monetisation proceeds, in turn, can be used to finance more greenfield assets. The need is also to downplay HAM as it has adversely impacted BOT (Toll) concessioning and financial health of the NHAI

Project clearances - Enhancing the 'ease-of-doing-infrastructure'

Time and cost overruns in highways projects have been a serious concern. In the flash report for projects costing over Rs 150 crore, MoSPI has indicated that out of 1,623 projects, 552 are delayed (34%). Project delays and consequent disputes have been amongst the major causes that have taken a toll on developer finances and led to insolvencies. Enabling shorter project cycles and ease-of-doing-infrastructure are amongst the reform goals that need to be put in place.

- **Conditions precedent:** 90% of contiguous land needs to be acquired along with project clearances before awarding projects. Project SPVs need to procure these clearances, which may be made conditions-precedent (CP). This will ensure that contractors or developers are not affected by delays on this count

- **Railway clearances:** Road over bridge (ROB) or crossings often delay projects. Hence, a system by which such clearances can be fast-tracked through standardised design documents may be considered

Asset recycling for improving efficiency and mobilising resources

There is a need to increase use of financing options introduced in the last few years such as InvITs and TOT.

InvITs

- InvITs help developers/NHAI recycle invested capital in mature assets. These can attract and on-board the right investors, or patient capital, such as sovereign wealth funds, strategic investors and other long-term investors. These include pension funds, which have their return expectations in-line with the long-term cashflow profile of the underlying assets. This will help finance infrastructure without asset-liability mismatch usually associated with bank financing of infrastructure

Key reforms that may improve investor participation in InvITs are:

- InvITs suit the investment objectives of insurance companies and pension funds. The Insurance Regulatory and Development Authority of India (IRDAI) should revisit the prescribed cap of 5% for insurance companies' investment in a single InvIT, in line with the limit prescribed by the Securities and Exchange Board of India for mutual funds and its own cap for insurance companies while investing in listed equities

- IRDAI should come out with clear guidelines allowing insurance companies to invest in debt securities issued by InvITs, in line with traditional companies. This will help issuers significantly. Similarly, the Pension Fund Regulatory and Development Authority mandates a minimum credit rating of AA for the sponsor of an InvIT in order

to allow participation of pension funds. As InvITs are independent of their sponsors, the rating threshold should be made applicable only to InvITs and not the sponsors

Toll Operate Transfer (TOT)

- This has evolved from the operate-maintain-transfer (OMT) model, wherein the concessioning authority securitises the toll receivables by collecting upfront concession fee or initial estimated concession value (IECV). The major revenue source is toll collection and given the established revenue streams in operational assets there is low revenue risk for the concessionaire. Further, minimal construction risk attracts patient capital

- The key success factors of the TOT model include operational asset mix (underlying assets with established cashflows), well-defined contractual framework, and good growth potential

- The TOT model allows monetisation of a portfolio of operational road assets at one go

- A reform that could improve investor participation in the model is flexibility in the concession period of the underlying assets. This may encourage more companies to participate in such bids

Enabling NHAI to raise long-term money

- It is critical for NHAI to meet its financing needs from a wider investor base at competitive rates and for longer tenures compared with the predominant share of public sources of financing and conventional bank borrowings. Central Road and Infrastructure Fund (CRIF) provides capital through excise duty in diesel and motor spirit. In Budget Estimate 2020-21, Rs 1.26 lakh crore is to be collected. CRIF should be largely allotted to entities such as NHAI that are able to leverage it from the market using these funds, rather than ministries which use CRIF as grants for EPC projects. This will boost the multiplier effect on government allocations

- While NHAI has indeed raised taxable bonds with tenures of 25 to 30 years under its long-term borrowing programme, these currently constitute a smaller proportion of its total outstanding debt. Hence, it is imperative for NHAI to explore mechanisms to raise more low-cost funds at tenures matching the long life of its road projects, possibly through tax-free bonds

- NHAI can consider raising long-term funds through securitisation of toll proceeds of its operational highways and also seek participation from Life Insurance Corporation of India and Employees' Provident Fund Organisation to invest patient capital in part-financing its investment needs. Having an escrow arrangement for servicing such financing along with NHAI tapping into tools for monetisation of highways through the InvIT, TOT route, etc, will also help attract more long-term funds to refinance its existing short-to-medium-term debt

NIP project summaries and marquee projects

In the roads sector, total capital expenditure of Rs 2,033,823 crore by both the Centre and states would be made between fiscals 2020 and 2025. About 1,820 projects have been identified to be implemented in 2020-25. The total capital expenditure for these projects by the Centre is estimated at Rs 13.8 lakh crore over fiscals 2020 to 2025.

The summary of the projects is highlighted in the table below:

Category	No. of projects	Length (km)	Capex over FY20 – FY25 (Rs lakh crore)
National highways	1,815	87,162	1,280,638
Expressways	5	2,142	101,742
Total	**1,820**	**89,304**	**1,382,380**

- The projects include construction of new expressways such as Delhi–Mumbai Expressway, Bengaluru–Chennai Expressway, etc. Several projects being implemented include four laning/ two laning or widening of existing highways
- In order to improve the safety of highways, many projects include upgrading or re-construction of existing roads, bridges and construction of ROBs at level crossings

Capital expenditure to be incurred over FY20 to FY25

Rs crore	FY20	FY21	FY22	FY23	FY24	FY25	Total
Centre	247,838	259,714	251,695	172,484	170,238	280,411	**1,382,380**
States[20]	84,721	123,569	105,271	80,296	70,523	52,249	**651,444**
Total[21]	**332,559**	**383,283**	**356,966**	**252,780**	**240,761**	**332,659**	**2,033,823**

Marquee project

Delhi-Mumbai Expressway

- The Delhi-Mumbai Expressway is a 1,320 km greenfield expressway project which will be built at an estimated total project cost of Rs 90,000 crore
- The construction of the expressway will be undertaken in 40 packages under the EPC model and till October 31, 2019, 19 packages have been awarded by NHAI amounting to Rs 24,097 crore
- The project is estimated to be completed by the end of March 2023. The expressway would provide seamless connectivity between Delhi and Mumbai and further ease traffic congestion on this trunk national corridor

Chennai–Bengaluru Expressway

- The Chennai–Bengaluru Expressway is a 262 km project which would be built at an estimated total project cost of Rs 20,000 crore. The project will be built under HAM model and is estimated to be completed by the end of fiscal 2024
- The expressway would have six-lane divided carriageway with design speed of 120 mph
- The project's main aim is to boost commerce and trade between cities across south India

[20]States/UTs include Uttar Pradesh, Maharashtra, Gujarat, Telangana, Jharkhand, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Karnataka, Haryana, Punjab, Delhi, Kerala, Odisha, Chhattisgarh, West Bengal, Sikkim, Mizoram, Andaman & Nicobar, Chandigarh and Puducherry. For some projects year-wise phasing has not been provided, so capital outlay for FY20 to FY25 will not add up to total capital outlay.
[21]Includes projects where yearly phasing has not been provided.

Railways

Sector Progress, Deficits and Challenges, Vision and Reforms

Bogibeel Bridge

Project details

- The 4.94 km-long double-decker Bogibeel bridge connects the south bank of the Brahmaputra river in Assam's Dibrugarh to Silapathar in Dhemaji bordering Arunachal Pradesh
- The bridge has a two-line railway track on the lower deck and a three-lane road on the top deck
- The project was constructed at an actual total project cost of Rs 5,900 crore and was built under the EPC mode. Work started in April 2002 and the project was inaugurated in May 2017, post completion of construction

Salient features

- This bridge is Asia's second-longest rail-cum-road bridge and is expected to boost India's defence logistics along the China border and reduce travel time for rail passengers and road users
- This bridge has cut down the train-travel time between Tinsukia in Assam to Naharlagun town of Arunachal Pradesh by more than 10 hours
- This project has immensely benefitted the people of Dhemaji as major hospitals, medical colleges and the airport are in Dibrugarh, the third-largest city in the Northeast

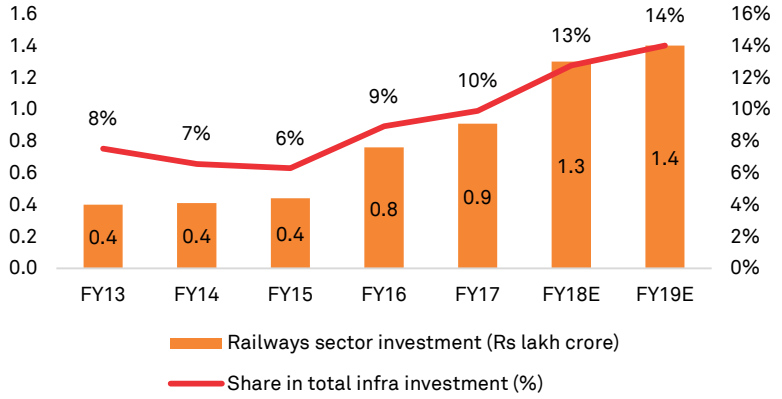
The Indian Railways has been investing significantly to enhance safety, augment the speed of trains, improve freight efficiency, enhance passenger amenities, and ensure better connectivity. To remain competitive vis-à-vis other transportation modes, there is an urgent need to upgrade and expand the railway infrastructure. It is thus important to engage the private sector to bring more funds and efficiency, thereby enhancing railway infrastructure.

Historical investments

Investments in the railways have remained subdued in comparison with the power and road sectors, though it picked up pace since 2016. The key focus areas have been decongestion of over utilised rail network, construction of new lines, doubling, tripling, quadrupling of rail lines and purchase of rolling stock such as wagons, locomotives, coaches, etc.

Between fiscals 2013 and 2017, the share of the railways sector investment in the overall infrastructure investment was ~8%, rising at a CAGR of ~23% (refer to Figure 17).

Figure 17 Railways infrastructure investment (Rs lakh crore) and share in total infrastructure investment (%)



Source: Appraisal documents for five-year plans, CRIS estimates (Investments mentioned are at current prices)

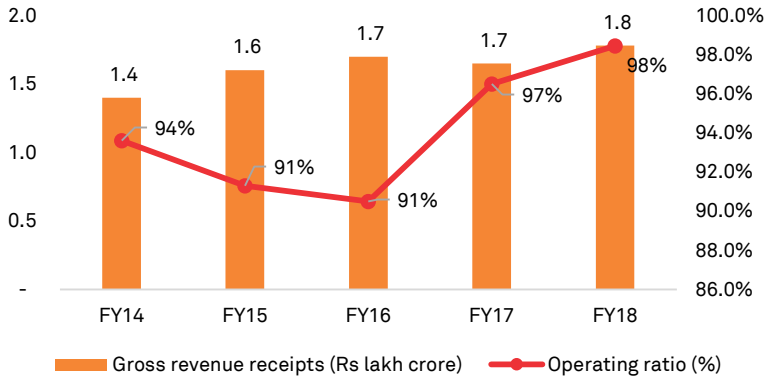
Historically, capital investment in railways has been mainly from the government, with little private sector investment. Private sector involvement is limited to allied activities such as track laying and maintenance, maintenance of coaches and wagons, construction of bridges, stations, signaling, and telecommunication works.

Trend in railways

Revenue and operating ratio

For fiscal 2018, the gross revenue receipts of the Indian Railways was Rs 1.78 lakh crore, growing at ~6% CAGR between fiscals 2014 and 2018. Traditionally, the operating ratio of the Indian Railways has been high, with the highest in fiscal 2018 at 98%. The alarming increase in operating expenses vis-à-vis revenue receipts can be attributed to implementation of the Sixth and Seventh Pay Commission awards, sticky passenger fares, and declining market share in freight traffic. Higher operating ratio in the Railways curtails its ability to make fresh investments through internal accruals.

Figure 18 Gross revenues and operating ratio (Rs lakh crore, %)

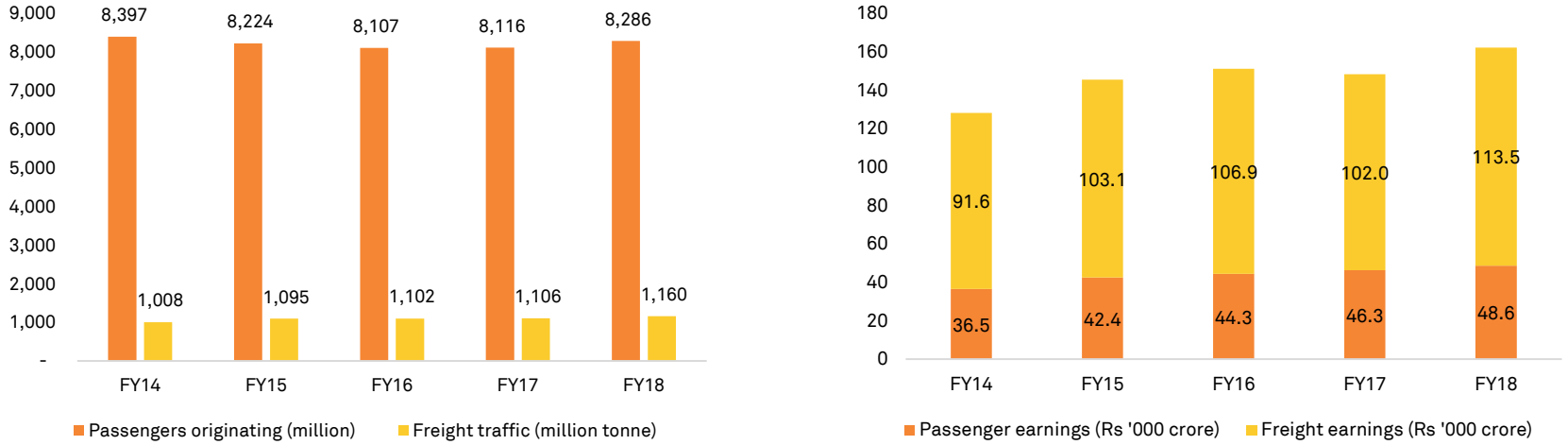


Source: Indian Railways Statistical Summary

Passenger and freight traffic and earnings

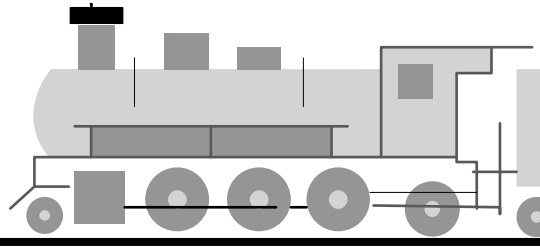
In fiscal 2018, the Indian Railways served 8.3 billion passenger trips and transported 1.2 billion tonne of freight. Freight traffic growth has been impacted by high freight rates, a decline in coal traffic for thermal power plants, slowdown in container traffic, and low volumes of cement traffic (together comprising 60-65% of rail freight). Freight revenue was the major contributor to the Indian Railways' revenue with 64% share, vis-à-vis 27% share of passenger revenue, and the rest coming from non-fare revenue and indirect earnings.

Figure 19 Trend in passenger and freight traffic and earnings



Source: Indian Railways Statistical Summary

Railways sector reforms timeline

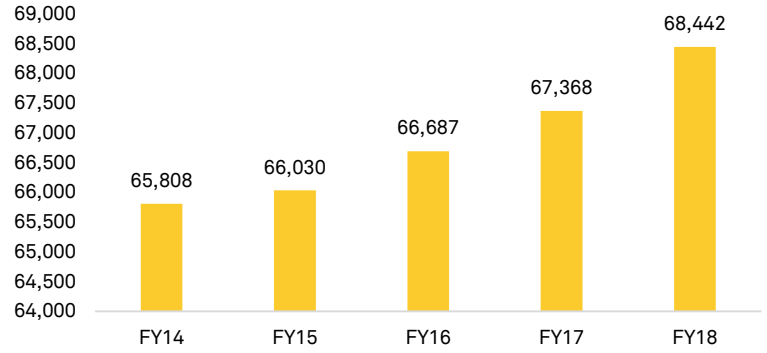


	2016	2017	2018	2019
	National High Speed Rail Corporation Limited formed to implement Mumbai – Ahmedabad high-speed bullet train project	Railway modernisation plans, fast-track electrification and doubling of tracks to enhance capacity and increase capex spend	Approval for formation of Rail Development Authority as an independent regulator for railways	First private train operation given to IRCTC, which will have full control over determining fare and services offered to passengers
		Implementation of dedicated freight corridors (DFCs) sanctioned to improve freight capacity and reduce freight costs	Station redevelopment scheme launched to modernise infrastructure at major stations	Launch of first indigenously manufactured semi high-speed train, Vande Bharat Express
			First railway project under PPP annuity transferred to a private player to construct a section of Eastern DFC	
Freight carried (in million tonne)	1,102	1,106	1,160	1,221

Infrastructure deficit in railways

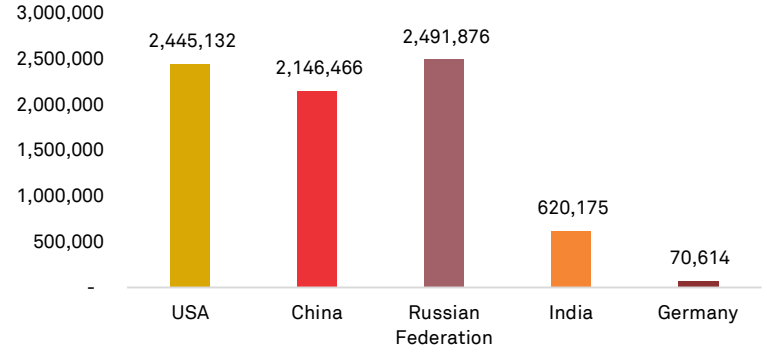
Route km nearly stagnant, freight throughput lags passenger throughput

Figure 20 Rail lines (total route-km)



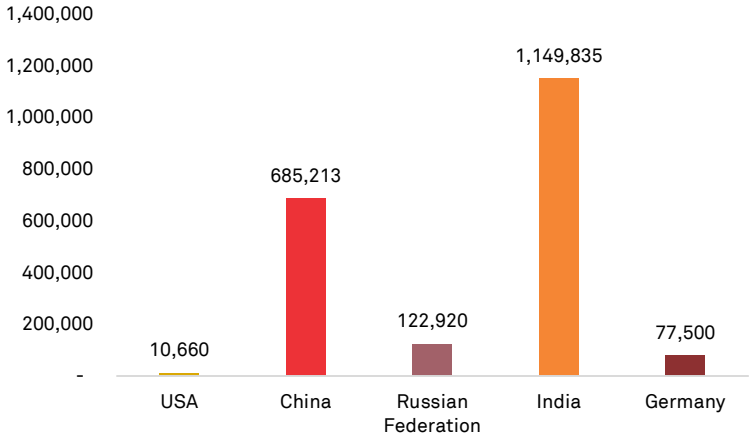
Source: Indian Railways Statistical Summary

Figure 21 Indian Railways – Peer comparison for goods transported in 2017 (million tonne – km)



Source: World Development Indicators-World Bank, IR Yearbook 2018

Figure 22 Indian Railways – Peer comparison for passengers transported in 2017 (million passenger-km)



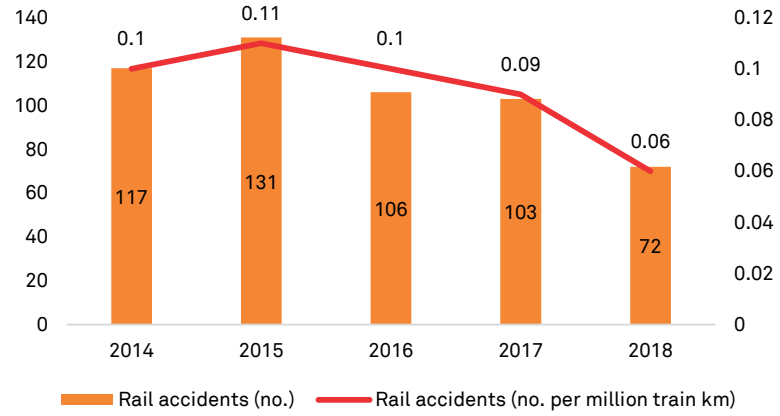
Source: World Development Indicators- World Bank, IR Yearbook 2018

- Over 1954-2016, freight loading grew 1,344% and passenger kilometres 1,642%, but route kilometres rose only 23%. Of 247 sections, 161 (or 65%) are running at 100% or above line capacity on high density network (HDN) routes^
- Due to low fares, passenger traffic uses two-thirds of capacity, but generates only one-third of revenue. High freight tariff is getting out-priced in the market
- As a result, railway finances with over 98% operating ratio (operating cost/ operating revenue) leave no surplus for capital investment. Persistent time and cost overruns for projects lead to low expenditure efficiency

Source: PIB, ^HDN are Delhi-Howrah, Delhi-Mumbai, Mumbai-Howrah, Howrah-Chennai, Mumbai-Chennai, Delhi-Guwahati and Delhi-Chennai

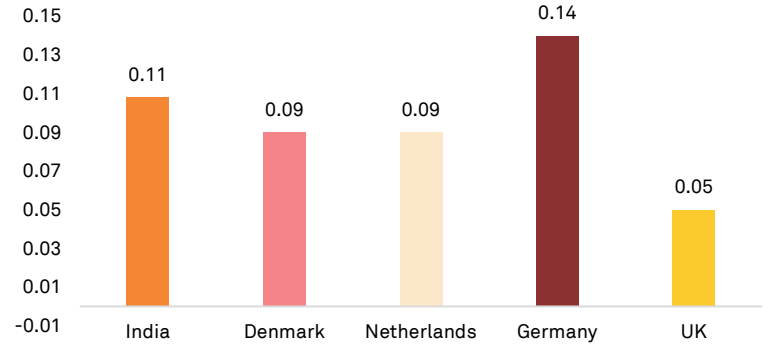
Need for improving rail safety

Figure 23 Rail safety: Accidents in Indian Railways



Source: IR Yearbook 2018, Lok Sabha Secretariat; 2018 data excludes KRCL

Figure 24 Rail accidents (in numbers per million train km, 2012-16)



Source: IR Yearbook 2018, EU Transport Scorecard, Standing Committee on Railway Safety

- Most casualties happen due to derailments caused by defects in the track or rolling stock. Of the total track length, 5,000 km is due for renewal this year. However, only 2,700 km has been targeted for renewal

- Further, increased congestion and saturated usage of line capacity reduce the headway — the interval between two consecutive trains running on the same route — thus increasing the chances of collisions on very busy stretches. So, congestion needs to be reduced

Challenges in the railways sector

Lack of investment for capacity augmentation

More than 100% utilisation of many routes has led to gradual wear and tear of tracks and decline in average speed of trains, necessitating large investments in network expansion and decongestion projects. Demand, too, has increased exponentially, with the supply-side struggling to keep pace. This has created a significant investment gap for capacity expansion, given the high operating ratio. Indian Railways has also been marred by ever-mounting debt. The debt-servicing costs are set to rise at a much faster rate as the repayment obligations related to DFC and High Speed Rail (HSR) network will kick in. High debt servicing cost would put further strain on railway finances.

Lack of rake availability for cargo movement

This is a major issue for freight transportation by rail. It is further aggravated in the case of unregulated sectors such as steel and cement. In these sectors, rail transport is a major component of the supply chain for sourcing raw materials and placing finished products in the market. In the existing scenario, end-users switch to other modes of transport, leading to a sub-optimal modal share of railways.

Loss of passenger share to airlines

The development of airports and thrust of airlines in Tier-2 and-3 cities has led to railways losing out on passenger traffic. Traditionally, railways has had an edge over air travel on pricing. However, the emergence of numerous budget airlines now operating in many cities has led to more passengers shifting to air travel.

Passenger traffic crowding out freight traffic

Freight trains have to run at half the speed of passenger trains, as the latter get priority in railways' scheduling. In addition, freight rates have risen 91% over the past decade compared with a 28% increase in passenger rates. Due to this, railways has been steadily losing freight market share to road transport. This, coupled with an estimated increase in permitted axle load of commercial vehicles by 25%, may lead to further reduction in modal share of railways in freight transport.

Independent regulation of passenger and freight fares

There is a need for autonomous regulation of passenger fares and freight rates. The government had approved setting up of Railway Development Authority (RDA) in this regard. However, the RDA has not become operational yet. Operationalisation will ensure that regulation of pricing and services is shifted from the Ministry of Railways to an independent regulator. Such regulation is expected to be one of the key reforms for improving private sector participation.

However, the delay in setting up of RDA also opens up avenues for other options like setting up a multi-sectoral regulator by allocating railway regulatory functions to an existing transport sector regulator such as Airports Economic Regulatory Authority (AERA) because the objectives of independent regulation are similar across sectors -- the need for conserving skills, and for preventing regulatory capture.

Urgent need for station redevelopment

An ambitious programme of station redevelopment has been announced but there has been little headway. There is a need to monetise non-core assets such as surplus land parcels available with the Indian Railways by providing them on long-term lease to fund the station re-development programme.

Lack of safety-related infrastructure

Track renewals are imperative to ensure safety. Therefore, backlog in track renewals has to be cleared rapidly. Out of 68,000 km of track, over 7,000 km is more than 30 years old and needs immediate replacement.

Slow progress in improving operating ratio

The poor operating ratio of the Indian Railways has constrained effective operations besides restricting investments in capacity augmentation and modernisation. The major reason for poor operating ratio is that the Railways have been priced out in the freight segment and passenger fares are highly subsidised.