



**ASIAN INFRASTRUCTURE  
INVESTMENT BANK**

PD000368-IND  
April 16, 2023

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**Sovereign-Backed Financing**

**Project Document**

**P000368 Republic of India: Chennai Metro Rail Phase 2—Balance Corridor 5**

**Currency Equivalents**

(As of March 29, 2023)

Currency Unit – Indian Rupee (INR)

INR1.00 = USD0.012

USD1.00 = INR82.21

**Borrower's Fiscal Year**

April 1–March 31

**Abbreviations**

ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
BC5	Balance Corridor 5
BIM	Building Information Modeling
CAAA	Controller of Aid Accounts and Audit
CMA	Chennai Metropolitan Area
CMDA	Chennai Metropolitan Development Authority
CMBT	Chennai Mofussil Bus Terminal
CMP	Comprehensive Mobility Plan
CMRL	Chennai Metro Rail Limited
CPR	Common Property Resources
CUMTA	Chennai Unified Metropolitan Transport Authority
DPR	Detailed project report
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EMP	Environmental Management Plan
ES	Environmental and Social
ESP	Environmental and Social Policy
ESS	Environmental and Social Standards
FIRR	Financial Internal Rate of Return
GAP	Gender Action Plan
GBV	Gender-Based Violence
GESI	Gender Equality and Social Inclusion
GHG	Greenhouse Gas
GRM	Grievance Redress Mechanism
JICA	Japan International Cooperation Agency
MDB	Multilateral Development Bank
MoHUA	Ministry of Housing and Urban Affairs
MTC	Metropolitan Transport Corporation
O&M	Operation and Maintenance
PDS	Project Delivery Strategy
PPM	Project-affected People's Mechanism
RP	Resettlement Plan
SCADA	Supervisory Control and Data Acquisition
SEA	Sexual Exploitation and Abuse
SIA	Social Impact Assessment

VOC	Vehicle Operating Cost
VOT	Value Of Time

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## 1. Summary Sheet

Project No.	000368
Project Name	Chennai Metro Rail Phase 2—Balance Corridor 5
AIIB Member	Republic of India
Borrower	Republic of India
Project Implementation Entity	Chennai Metro Rail Limited
Sector	Transport
Subsector	Urban rail
Project Objective	Increase transport capacity and improve northwest-south connectivity in the Chennai Metropolitan Area by expanding the Chennai metro system.
Project Description	<p>Balance corridor 5, from Chennai Mofussil Bus Terminal (CMBT) to Okkiyam Thoraipakkam metro station, comprises the development of 24.04 kilometers (km) of the Chennai Metro with 23 elevated stations. The project will be cofinanced in parallel by the Asian Infrastructure Investment Bank (AIIB) and the Asian Development Bank (ADB), with counterpart funding by the Tamil Nadu government.</p> <p>AIIB will finance the following components (AIIB Supported Components):</p> <p><b>Component 1.</b> Construction of an elevated viaduct of 12.431 km, between CMBT (excluded) and Ullagaram metro station, including special spans and construction of 12 elevated stations.</p> <p><b>Component 2.</b> Construction of an elevated viaduct of 11.61 km, between Ullagaram metro station (excluded) and Okkiyam Thoraipakkam metro station (excluded), including construction of 11 of elevated stations.</p> <p>The remaining components and their financing sources are as follows:</p> <p><b>Component 3 by ADB.</b> Electrical and mechanical works, traction and power supply, telecommunications.</p> <p><b>Component 4 by the Tamil Nadu government.</b> The general consultant, signaling, lift and escalators, permanent way, platform screen doors and others, including overall state tax and the cost of land acquisition and resettlement (included under the AIIB Supported Components).</p>
Implementation Period	Start date: June 1, 2023 End date: May 31, 2026
Expected Loan Closing Date	December 31, 2026
Cost and Financing Plan	Project cost: USD999.10 million Financing plan: AIIB loan: USD438.75 (44 percent) ADB loan: USD121.78 (12 percent)

	Tamil Nadu government: USD438.57 (44 percent)
Size and Terms of AIIB Loan	USD438.75 million AIIB's standard interest rate for sovereign-backed loans.
Cofinancing (size and terms)	ADB: Proposed USD121.78 million (parallel cofinancing) for component 3
Environmental and Social Category	A
Risk (Low/Medium/High)	Medium
Key Covenants	(a) Furnish to AIIB, no later than November 30 of each year until the completion of the project, an annual work plan and budget for the project for the following fiscal year and implement the activities under the project during the relevant fiscal year in accordance with such plan and budget for the duration of the AIIB loan. (b) Not later than June 2024, contracts for electrification, signaling, telecommunications and tracks, financed by ADB and the Tamil Nadu government, are awarded to ensure the continued and effective implementation of Balanced Corridor 5.
Retroactive Financing (loan [percent] and dates)	Eligible expenditures incurred, not more than 18 months before the signing date of the loan agreement, for an amount of up to 30 percent of the loan amount.
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that AIIB is in compliance with the policies applicable to the Project.
Economic Capital Consumption	USD63.13 million (13.96 percent)

President	Jin Liqun
Vice President	Urjit Patel
Director General	Rajat Misra
Team Leader	Wenyu Gu, Senior Transport Specialist
Co-Team Leader	Pilar Lopez Camacho, Transport Specialist
Team Members	Abhijit Sen Gupta, Senior Economist Bernardita Saez, Senior Counsel Chang Tian, Project Assistant Gerardo Pio Parco, Senior Environmental Specialist Jurminla Jurminla, Senior Procurement Specialist Konain Khan, Technical Consultant Mengmeng He, Finance Associate Mohankumar Ramamurthy, Financial Consultant Siva Rama Krishna Sastry Jyosyula, Senior Social Development Specialist Yi Geng, Senior Financial Management Specialist

## 2. Project Description

### A. Project Overview

1. **Project Background.** Chennai Metropolitan Area (CMA), the capital of the Indian state of Tamil Nadu, is the fourth-most populous metropolitan area in India with a population of about 8.6 million and generates about 15.7 million passengers per day<sup>1</sup>. It is one of the biggest industrial and commercial centers of South India, as well as a major cultural, economic and educational center. The Chennai Metropolitan Development Authority (CMDA) estimated that the population and daily passenger traffic in the area would continue to grow to 12.6 million people and 20.8 million, respectively<sup>2</sup>, by 2026.

2. The rapid increase of the population and the development of economic activities in CMA have boosted the regional economy and job creation and accelerated urbanization growth but have also considerably strained the city's transportation system. Chennai ranked fifth in carbon emission generation from the transport sector among 54 South Asian cities<sup>3</sup>. Poor road conditions, low awareness of traffic discipline, and a high number of two-wheelers and other private vehicles have also contributed to the transport safety issues within CMA. In 2018, Chennai recorded the highest number of road incidents in India, with a staggering 7,580 cases<sup>4</sup>. The Comprehensive Mobility Plan (CMP) for CMA identified several challenges including the lack of land use transport integration and the absence of intermodal integration.

3. **Traffic in Chennai.** In 2018, the trips motorized in public transport (bus and rail) represented about 28.2%, while the trips motorized by two-wheeler or car represented about 36.7%. One of the disturbing trends of Chennai transport characteristics is the increasing share of private vehicles (the percentage of trips by two-wheeler and car increased from 31% in 2008 to 36.7% in 2018) at the cost of non-motorized transport and bus trips, leading to increased road congestion and pollution. The public transport system, which is dominated by buses, is overcrowded, and is not sufficient to meet the increasing demand for transport. In addition to the Metropolitan Transport Corporation (MTC) buses, the existing urban public system comprises one sub-urban rail system, Mass Rapid Transit System (MRTS) by Southern Railways and two metro rail corridors covering 54 km by Chennai Metro Rail Limited (CMRL).

4. CMA's existing transportation system is marked by high traffic density, carbon emissions, and frequent road incidents. In addition to the high volume of vehicles and already congested roads, inadequate parking space and the encroachment of street space by vendors on the major road have exacerbated traffic congestion. Expanding the current metro system with environmentally friendly and socially inclusive features is imperative to alleviate CMA's public transportation constraints and enhance accessibility to prominent and rapidly growing areas within CMA. The metro

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<sup>1</sup> Census 2011 population of CMA

<sup>2</sup> Second Master Plan for Chennai Metropolitan Area 2026, Chennai Metropolitan Development Authority, 2008.

<sup>3</sup> International Council for Local Environmental Initiative Study, 2012.

<sup>4</sup> Road Accidents in India, Ministry of Road Transport and Highways, 2018.

development should result in substantial improvement to the public transport system within CMA, relieving the traffic bottlenecks and enhancing the overall transport safety.

5. Phase 1 of the Metro Rail System consists of corridors 1 and 2 directly connecting northern and southern Chennai, including airport connectivity. It was commissioned in a phased approach between 2015 and 2019. CMRL is currently developing the Phase 2 which includes three corridors (3, 4 and 5)<sup>5</sup>, covering 118 km, and a mix of underground and elevated sections. The corridor 4 connects the eastern and western parts of Chennai, while corridors 3 and 5 enhance north-south connectivity together with Phase I corridors. The corridor 5 that comprises a total of 47 km and 48 stations provides northwest-south connectivity from Madhavaram Milk Colony in the north to Okkiyam Thoraipakkam in the south. The section from Madhavaram Milk Colony to Chennai Mofussil Bus Terminal (CMBT) covering about 17 km is funded by the Japan International Cooperation Agency (JICA).<sup>6</sup>

6. **Project Description.** The project comprises the construction of the Chennai Metro Rail Phase 2—Balance Corridor 5 (BC5), from CMBT to Okkiyam Thoraipakkam metro station, including the development of 24.04 kilometer (km) elevated viaduct and 23 stations with standard gauge (1,435 millimeters [mm]). The plan's financiers are listed in Table 1. The project is part of the Chennai Metro Phase 2 Metro Rail Plan. Corridors 3 and 4 are being developed in parallel with Corridor 5.

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<sup>5</sup> The 2015 Comprehensive Mobility Plan for Chennai Metropolitan Area (CMA) shows CMA's present and future mobility patterns. The detailed study identifies three corridors (3, 4 and 5) for the Chennai Metro Phase 2 Metro Rail Plan, considering network coverage and ease of implementation.

<sup>6</sup> The loan agreement for JICA phase 2 financing was signed in January 2019 and became effective in April 2019.

**Table 1: Bilateral and Multilateral Assistance  
for the Chennai Metro Phase 2 Metro Rail Plan**

<b>Financier</b>	<b>Phase 2 Corridors</b>	<b>Proposed Total Length (kilometer)</b>	<b>Financing Arrangement</b>
JICA	3 and 5	52	Stand-alone
ADB	BC3 <sup>a</sup>	10.8	Stand-alone
AIIB, ADB, NDB	4	26.8	Parallel cofinancing
AIIB, ADB	BC5 <sup>b</sup>	24.04	Parallel cofinancing

ADB = Asian Development Bank, AIIB = Asian Infrastructure Investment Bank, BC5 = balance corridor 5, JICA = Japan International Cooperation Agency, NDB = New Development Bank.

<sup>a</sup> ADB will finance balance corridor 3 section, which is not financed by JICA as a stand-alone project

<sup>b</sup> ADB and AIIB will parallelly finance the Balance Corridor 5 section, which is not financed by JICA as a standalone project.

Source: CMRL

7. The project will be co-financed in parallel by the Asian Infrastructure Investment Bank (AIIB) and the Asian Development Bank (ADB), with counterpart funding by the Tamil Nadu government. AIIB Supported Components comprise the civil works while the ADB Supported Component covers the electrical and mechanical works, traction, power supply and telecommunications. The Tamil Nadu government will finance the general consultant, signaling, lift and escalators, permanent way, platform screen doors and others, including overall state tax, as well as costs associated with land acquisition and resettlement (included under the AIIB Supported Components).

8. CMRL is the project implementing entity. To help improve public transport in Chennai, the Government of India and the Tamil Nadu government established CMRL, a joint venture with equal equity ownership, in 2007.<sup>7</sup> CMRL is responsible for implementing, operating and maintaining the city's metro system.

9. To ensure that different needs, priorities and concerns of women, persons with disabilities, elderly and other vulnerable groups are reflected in the project design and implementation, consultations with relevant stakeholders were held and a Gender Action Plan (GAP) was developed (see Annex 5). To address these needs, the following gender-sensitive and inclusive design features have been incorporated into project station designs and operations: ramps and elevators, better lighting, security cameras, designated waiting areas for women's coaches, provision of speaking to the station masters during an emergency, etc. (see details in para 41). In addition to these gender sensitive and inclusive features, the project also focuses on enhancing women's access to employment during the operational phase and tracks two gender employment results framework indicators: a target on female employment (30%) and stations to be fully operated by women to encourage female workforce participation (2 out of 23).

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<sup>7</sup> CMRL has 13 board directors. Five, including the chair, are nominated by the Government of India. Five, including the managing director, are nominated by the Tamil Nadu government. Three functional directors are selected by a committee consisting of the chairman of the board of directors, the managing director, a director representing the Tamil Nadu government, and an outside expert.

10. **Project Objective.** Increase the transport capacity and efficiency of northwest-south connectivity in the CMA by expanding the Chennai metro system.

11. **Expected Results.** The project results will be monitored using key indicators (Annex 1):

- (a) Daily passengers.
- (b) Reduced journey time along the corridor.
- (c) Additional employment disaggregated by gender (at least 30 percent of jobs are for women).
- (d) Number of stations fully operated by women.
- (e) Number of stations that incorporate all the following gender-friendly and universal accessibility features: (i) CCTV, (ii) nappy changing facility, (iii) accessible toilet for persons with disabilities and (iv) women's helpline number, (v) access ramps and (vi) lifts or escalators.
- (f) Number of project staff trained on gender-sensitive transport project design and implementation.
- (g) Percentage of female passengers' satisfaction with station facilities and services.
- (h) Climate adaptation and resilience measures incorporated into the project design.

12. **Expected Beneficiaries.** The beneficiaries are metro passengers, who will gain from a metro transport that is faster and more reliable than public and private road transport.<sup>8</sup> The project components feature gender, inclusion-sensitive and universal accessibility designs that are considered good international practices to improve the safety, security, and accessibility of metro services for women, elderly people, people with disabilities, people traveling with small children or carrying luggage, and people with temporary mobility problems, encouraging them to engage in education, employment, social and economic activities. Existing metro passengers will benefit from improved coverage and service.<sup>9</sup> . Secondary beneficiaries are residential and commercial establishments along the new corridor, which will gain from improved accessibility and connectivity and increased economic opportunities.

## **B. Rationale**

13. **Strategic Fit for AIIB.** The project aligns with the following thematic strategies of AIIB:

- (i) **Transport Sector Strategy.** The project will enable seamless multimodal transport integration across Chennai by providing integrated access to suburban rail, bus and airport transport. The project will build urban transport capacity in rapidly growing areas within CMA, removing traffic bottlenecks.
- (ii) **Sustainable Cities Strategy.** The project will help improve urban mobility within CMA through a high-speed, reliable, safe, integrated and comfortable mode of travel.

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<sup>8</sup> Further detailed in Demand Forecast, Economic and Financial Analysis.

<sup>9</sup> In February 2020 (before the coronavirus disease [COVID-19] pandemic), average passenger traffic per day on corridor 1 was 113,207.

- (iii) **Alignment with the AIIB Corporate Strategy thematic priority of green infrastructure and technology-enabled infrastructure.** The project will ultimately enable the modal shift of passenger transport, thereby leading to greenhouse gas emission reduction. The project will incorporate climate-adaptive design and measures to increase its resilience to climate hazards. The project has adopted a technology model—building information modeling (BIM)—which will enhance efficiency across the project life cycle of planning, implementation and operation and maintenance (O&M).

14. **Value Addition by AIIB.** AIIB has taken on an important role in project preparation in areas including procurement and environmental and social (ES) aspects such as social inclusiveness, among others. AIIB's participation has strengthened the project by (a) providing continued support to CMRL to enhance its capacity to understand and adhere to Multilateral Development Bank (MDB) procurement and ES performance requirements for projects of such scale and complexity, (b) providing extensive technical assistance to CMRL in the civil tenders preparation process, such as (1) technical inputs related to interface and intermodal integration and for BIM module guidelines, adoption of green building features and climate adaptation design parameters, and (2) technical design considerations for disabled people, and (c) enabling a socially inclusive approach by incorporating targeted interventions such as predefined female employment during the operations stage, an annual survey of female passengers to ascertain service standards and dedicated stations operated by all-female staff.

15. The Bank is also helping Tamil Nadu develop Chennai Peripheral Ring Road Sections 2 and 3 (P000336), Chennai City Partnership: Sustainable Urban Services Program (P000477) and Chennai Metro Corridor 4 Project (P000301). Many agencies are involved in planning, operating and managing the CMA transport system. The Chennai City Partnership Project, that was approved in November 2021, proposes operationalizing the Chennai Unified Metropolitan Transport Authority (CUMTA). The CUMTA will improve coordination and streamlining of activities among agencies to efficiently utilize available infrastructure facilities and resources. The CUMTA was created by the Tamil Nadu government in 2011 but came into force only in 2019. BC5 will contribute to AIIB's positioning in the dialogue on addressing the major institutional challenges in urban mobility. (See details in Annex 3, paras. 4 and 5)

16. **Value Addition to AIIB.** The project will (a) further enhance the Bank's experience in urban transport, which will bring more opportunities to finance high-demand urban transport projects in India and the region and (b) help develop a close institutional partnership between AIIB and India's second-largest public metro rail services provider, CMRL, and hence consolidate AIIB's status as a reliable development partner.

17. **Lessons Learned from Previous Projects.** The project has been developed based on lessons learned from Phase 1 of Chennai Metro Rail and other AIIB-financed urban rail projects. The implementation of Phase 1 was adversely affected by delays in the land acquisition process and clearance from Defense, and Airport authorities for the elevated section, unexpected ground conditions, and poor performance of contractors

for the underground works, etc. The lessons incorporated into the proposed project include the following:

- (a) Optimize station sizes to avoid unnecessary land acquisition and require early and adequate planning and approval processes for land acquisition.
- (b) Carry out a geotechnical investigation and survey every 25 meters to minimize unforeseen risks associated with ground conditions.
- (c) Early on, identify utilities, prepare utility shifting plans and set up an adequate coordination mechanism among contractors and utility companies.
- (d) Prepare a robust tender evaluation.
- (e) Develop and document a close coordination mechanism with ADB during project preparation and implementation with a memorandum of understanding.
- (f) Incorporate design features that are friendly to the elderly, women and people with disabilities to improve safety and the overall passenger experience.
- (g) Include representatives of related departments in CMRL to ensure smooth project preparation and implementation.

### **C. Project Components**

18. The project cost and financing plan are presented in Table 2. The project includes the following components:

- (a) **Component 1.** Construction of a 12.431 km elevated viaduct between CMBT (excluded) and Ullagaram metro station, including special spans and construction of 12 elevated stations.
- (b) **Component 2.** Construction of an 11.61 km elevated viaduct between Ullagaram metro station (excluded) and Okkiyam Thoraipakkam metro station (excluded), including construction of 11 of elevated stations.
- (c) **Component 3.** Electrical and mechanical works, traction and power supply and telecommunications.
- (d) **Component 4.** The general consultant, signaling, lift and escalators, permanent way, platform screen doors and others, including overall central tax.

### **D. Cost and Financing Plan**

**Table 2: Project Cost and Financing Plan** (USD million, rounded)

Component	Project Cost	Financing		
		AIIB	ADB	Tamil Nadu Government
1. Construction of a 12.431 km elevated viaduct between CMBT (excluded) and Ullagaram metro station, including special spans and construction of 12 elevated stations	240.21	240.21	-	-
2. Construction of an 11.61 km elevated viaduct between Ullagaram metro station (excluded) and Okkiyam Thoraipakkam metro station (excluded), including construction of 11 of elevated stations	197.44	197.44	-	-
3. Electrical and mechanical works, traction and power supply and telecommunications	121.78	-	121.78	-
4. The general consultant, signaling, lift and escalators, permanent way, platform screen doors and others, including overall central tax	259.63	-	-	259.63
Land acquisition and resettlement	178.94	-	-	178.94
Front-end Fee	1.10	1.10		
<b>Total cost</b>	<b>999.10</b>	<b>438.75</b>	<b>121.78</b>	<b>438.57</b>

ADB = Asian Development Bank, AIIB = Asian Infrastructure Investment Bank, CMBT = Chennai Mofussil Bus Terminal.

Note: Contingencies are embedded in project costs. Any additional contingencies will be covered by the Tamil Nadu government.

19. Component 3 is expected to be financed by ADB. ADB policies will apply to ADB-financed activities, including procurement, ES policies and procedures and the independent accountability mechanism. Given the interlinked nature of works, AIIB and ADB have entered a Memorandum of Understanding to ensure close cooperation.

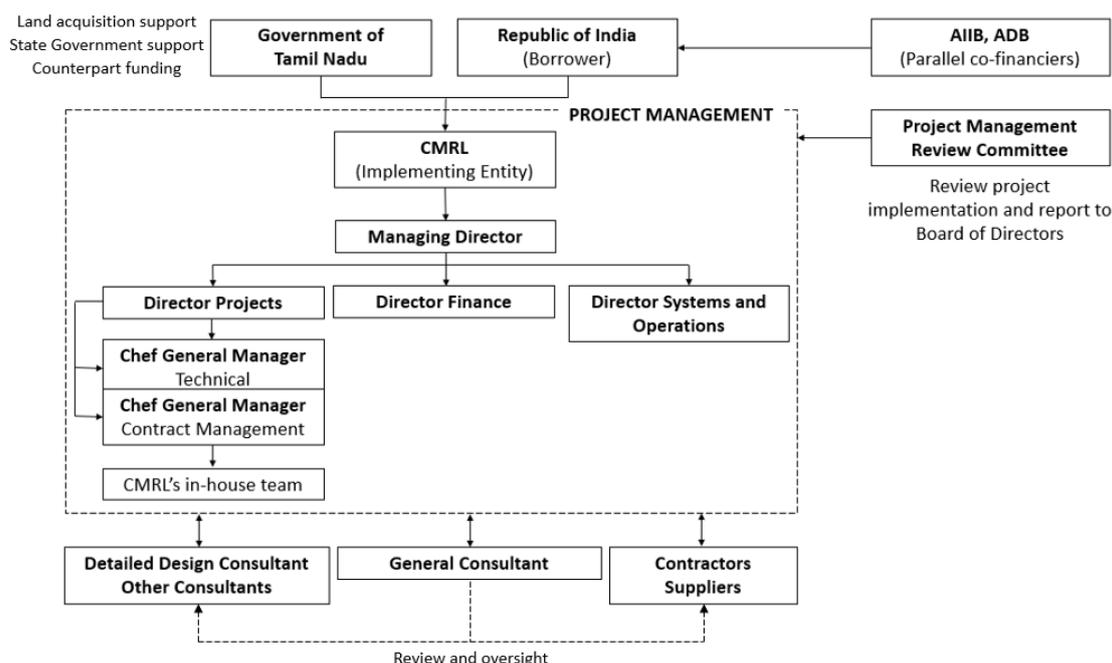
#### **E. Implementation Arrangements**

20. **Implementation Period.** The project is expected to have a 36-month implementation period, from June 2023 to May 2026. CMRL plans to commission BC5 by May 2026.

21. **Implementation Management.** CMRL will be the project implementing entity. It has a well-defined organizational management structure with clear roles and

responsibilities, headed by a Managing Director (See Annex 2, Figure A2.5 on details on CMRL’s organization structure). Supporting the Managing Director are directors for projects, finance and systems and operations and their teams. Chief Officers for vigilance, security and electrical matters assist the Managing Director. CMRL has acquired experience from constructing and operating Phase 1 of Chennai Metro Rail. To support project implementation and augment CMRL’s institutional capacity, consultants, including the general consultant, with terms of reference, qualifications and experience agreed with AIIB and ADB, were brought on board in November 2021. The detailed design consultant has been on board since July 2019.

**Figure 1. Project Implementation and Monitoring Structure**



Source: CMRL.

22. **Project Implementation.** The director of projects is a key management representative responsible for project execution. The director is supported by two Chief General Managers: one oversees the technical aspects of the civil works, the other contract management. A General Manager/Additional Manager will be the focal point for project execution, supported by one deputy general manager/Manager/assistant managers, an Architect and an in-house team of experts dedicated to the project.

23. The project management review committee, under the CMRL board of directors and chaired by the managing director, holds quarterly project implementation monitoring meetings to check projects’ physical and financial progress. A high-powered committee chaired by the Chief Secretary to the Tamil Nadu Government, composed of state government department secretaries and heads of civic bodies, sorts out issues regarding implementation, land acquisition, diversion of utilities, shifting of structures and other implementation-related matters. The committee also holds regular meetings to monitor CMRL projects’ physical and financial progress.

24. **General Consultant.** The general consultant has been in place since November 2021 to provide high-quality technical and project management. The Bank has reviewed and is satisfied with the consultant’s terms of reference, qualifications and experience.

The consultant's scope of work covers corridor 4, BC5 and Balance Corridor 3. The consultant will provide day-to-day contract management, procurement support, construction supervision, ES management activities and quality assurance. Besides having dedicated quality engineers, the consultant will assign experts to look after project quality and performance. The consultant will oversee construction, installation, testing and commissioning and act as the engineer. Since CMRL will implement in parallel the entire Phase 2 of Chennai Metro Rail, the consultant, along with the general consultant under the Japan International Cooperation Agency (JICA)-funded portion of Phase 2, will provide critical support to help CMRL oversee the implementation of the entire Phase 2.

25. **Detailed Design Consultant.** CMRL has contracted a consultant to develop concept planning, architectural drawings, detailed structure design and multimodal integration design, and to prepare the bill of quantities and cost estimates. The consultant will review the construction methodologies and plans for utility diversion.

26. **Procurement.** Procurement of contracts financed by AIIB was conducted in accordance with the provisions of the Bank's Procurement Policy. The procurement of works and goods followed international open competitive tender set out in paragraph 10.1 and national competitive tender in paragraph 10.4 of the PIR, using the Government of India's central [e-tendering platform](#).

27. **Financial Management.** CMRL will maintain the project's financial management system to ensure the proper use of project funds. CMRL will submit the unaudited project financial statements to the Bank within 60 days after the end of each quarter. CMRL will submit the audited annual financial statements, including project implementation status, to the Bank within 9 months after the end of each fiscal year. The project account audit will be carried out by the Comptroller and Auditor General of India or its appointed accounting firm.

28. **Monitoring and Evaluation.** CMRL will monitor the project, supported by the general consultant, and produce monthly or quarterly progress reports and share them with AIIB. As one of the main means of monitoring project implementation, the reports will highlight the status of achievement of agreed targets for monitoring indicators and detail implementation progress in every aspect of the project.

29. **AIIB's Implementation Support.** The Bank will conduct two field visits per year to monitor progress. The Bank may conduct more than two field visits as required, especially during the initial years. In addition to undertaking biannual visits, the Bank may engage local technical and ES consultants to more frequently supervise design, construction and ES management in the early stages of project implementation.

30. The Bank and the borrower will jointly carry out a midterm review mission, 20 months after the implementation start date. CMRL has implemented a centralized Project Monitoring Information System (PMIS) to help manage the project implementation. AIIB may coordinate with ADB on a joint mission.

31. **Retroactive Financing.** Since the project's procurement was completed in December 2021, 23 payments were incurred as of October 2022. The Borrower has requested to allow for an extension of the retroactive financing date from twelve (12)

months to eighteen (18) months and increase the total amount of retroactive financing amount from twenty (20) percent of the Loan amount to thirty (30) percent.

### 3. Project Assessment

#### A. Technical

32. **Project Assessment.** The project team visited the entire project alignment during the identification mission in February 2020. Since Tamil Nadu went into lockdown in March 2020 and travel to India was restricted, the project team has used video conferencing with CMRL to continue project assessment with the support of local consultants engaged in monitoring project preparation. The project team conducted several site visits in March, May and July 2022, and February and March 2023.

33. **Project Design.** The project is to provide connectivity between CMBT in the northwest and Okkiyam Thoraipakkam in the south. BC5 comprises a 24.04 km elevated stretch with 23 elevated stations. The project will be implemented with track on the standard gauge (1,435 mm). The geometric design criteria are based on international practices adopted for similar metro systems with a design speed of 80 km per hour. The alignment and station locations have been designed to connect densely populated areas in consideration of future development along the corridor as envisaged in the Chennai Second Master Plan 2026. See Annex 2 for the station location map.

34. **Elevated Section: Viaduct and Stations (Components 1 and 2).** The elevated section will run along the median of the existing roads in most areas. U-girders and I girders have been planned for the superstructure. Special spans with composite girders/balanced cantilevers have been planned in critical locations.

35. Stations have been planned to deal with the maximum peak hour traffic load. Station locations have been determined to serve major passenger catchment and destination areas and to enable convenient integration with other transport modes while considering inter-station distance, spacing, land availability and utilities. The stations will include gender-sensitive and socially inclusive features to provide universal accessibility, which will benefit women and the disabled. Green building features have been considered to help mitigate climate change effects. See Annex 2 for the station location map.

36. **Construction Interfaces with Other Agencies.** The State Highway Department has proposed a grade separator from Mugalivakkam to Madras Institute of Orthopaedics and Traumatology along the BC5 alignment. Due to the inherent nature and common alignment, it was decided to construct them as an integrated structure. Similarly, at another location the elevated viaduct of BC5 will pass over half of the ramp portion of a proposed road under bridge of the State Highway Department. CMRL will undertake these works along with BC5 under the same construction packages, and the State Highway Department will provide additional funds for the deposit works.

37. **Climate Change Resilience.** CMA is prone to cyclone risks within 20 km of the coast, and few areas in CMA are susceptible to flooding during heavy storms. The design adopts climate change resilience features to help reduce the project's vulnerability to the detrimental impacts of climate-related events. Features include temperature load

(considering overall temperature and differential temperature effects) and rainfall aligned with Indian Railways standards. The project alignment involves elevated sections; hence, flooding risks will be limited. The drainage design considers rainfall intensity and the catchment area to mitigate the detrimental effects of water accumulating during heavy rain.

38. **Geological risks.** CMRL has confirmed that topographical surveys and geotechnical investigations have been carried out to avoid delays that might occur because of possible unexpected site conditions during project implementation. The design will follow the relevant technical standards issued by the Bureau of Indian Standards to consider the micro zonation of Chennai in terms of seismic risks.

39. **Adoption of Green Building Features.** The design and construction of the project will have environment-friendly features to help reduce its carbon footprint. The stations are envisaged to qualify for a platinum rating from the Indian Green Building Council and will have features such as water and energy conservation, dedicated spaces for bicycles and green vehicles and signage to raise environmental awareness.

40. CMRL has installed rooftop solar plants in addition to ground-mounted solar plants at Chennai Metro Rail phase 1 stations. They have 5.6-megawatt peak capacity and daily average solar power generation of 22,400 kilowatt hours, catering to about 19 percent of lighting, lifts and escalators and other electric loads for non-traction purposes. Rooftop solar will also be installed at BC5 stations according to the feasibility. Other energy conservation initiatives are planned, including the use of LED lights, variable frequency drives for lifts, speed control mechanisms for escalators (stop, crawl, run) and electric vehicle charging facilities.

41. **Station Design for Safety, Accessibility and Gender Sensitivity.** The stations will include gender-sensitive and universal accessibility features, which will benefit women, children and people with disabilities. The stations will have full coverage by closed-circuit television cameras, all public areas will have adequate lighting to ensure there are no dark spots and designated areas for ladies' coaches will be provided on platforms. The project plans to have at least two stations entirely operated by female staff to encourage female workforce participation. CMRL has a dedicated general helpline number to resolve customer concerns. Women's helpline number and mobile app<sup>10</sup> will be prominently displayed at the stations to address any Gender-Based Violence (GBV) and Sexual Exploitation and Abuse (SEA) related incidences. Access ramps for people with disabilities, elevators, escalators, tactile paths for visually challenged passengers, seating areas with handrails and dedicated spaces for wheelchairs inside the train will be provided. Signage meeting international standards will help passengers locate ticketing areas, platforms and station exits. Half height Platform Screen Doors will separate the platform from the train to prevent accidents and further enhance passenger safety.

42. **Interface Management.** As the metro project involves many interconnected works, the general consultant's role in interface management will be critical to enable seamless integration of the components and of Chennai Metro Rail phases 1 and 2. The

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<sup>10</sup> <https://www.thehindu.com/news/national/tamil-nadu/explained-the-tamil-nadu-polices-kavalan-sos-app/article61634542.ece>

general consultant will include experts in system integration and interface management. To assist in interface management, CMRL has implemented BIM technology, which entails digital and graphic representation. In India, BIM has been proven to improve rail and metro project efficiency.

43. BIM technology eases integration of the design of various components and identifies potential conflicts, enabling early identification and obviation of time- and cost- overrun scenarios. 3D BIM model adoption is expected to have benefits in all phases of the program cycle:

- (a) **Planning.** Systematic feasibility study, reduction of unnecessary rework, increased accuracy of the early cost estimate, clearer design requirement and construction specification.
- (b) **Design.** Enhanced collaboration even from remote locations, automatic reflection of a design change to reduce errors, reduced time and money spent on corrections.
- (c) **Construction.** Enhanced collaboration between vendors, reduced time and cost, leaner construction, less onsite waste.
- (d) **O&M.** Increased accuracy of material maintenance and asset drawing to reduce maintenance downtime and asset duration.

44. A key to maximizing BIM's effect is involving decision makers and participants in the BIM process. To broaden participation and support CMRL in utilizing the technology, a BIM consultant has been mobilized. The consultant will closely coordinate with CMRL, the general consultant, the detailed design consultant and CMRL contractors.

45. **Intermodal Integration.** The project aligns operationally with other modes and systems and enhances inter-modal integration and synergies. The BC5 will run initially north-south, parallel to the Metro corridor 3, finally meeting it again at Okkiyam Thoraipakkam metro station. The project will have four interchange stations in corridor 4, at Alwarthirunagar, Valasaravakkam, Karabakkam and Alapakkam, one in corridors 1 at Alandur, one in corridor 2 at St.Thomas Mount and two in corridor 3, at Madhavaram Milk Colony in the northwest and Okkiyam Thoraipakkam in the south.

46. Furthermore, the project will help enhancing modal integration of other public transport modes including buses. The BC5 will connect three bus terminals/depots (Madhavaram Mofussil Bus Terminus, Vilivakkam Bus Terminus and Anna Nagar West Bus Depot and also the Chennai Suburban Rail system (third busiest suburban rail system in India that carries approximately 2.5 million passengers per day) at Villivakkam (West Line) and St. Thomas Mount (South Line) stations. Multimodal integration will be provided through walkways, elevators and convenient placement of entry and exit structures, depending on the location, to provide commuters with seamless transit options to other metro corridors, bus terminals and other transport modes. The Bank will monitor the implementation of these integration during construction.

47. Automated fare collection and payment mode integration with other transit and non-transit modes are proposed. As part of the National Common Mobility Card, CMRL

has implemented an integrated ticketing system to provide real time train information system to help plan travel and enhance the experience of using public transport. Passengers can use the CMRL mobile app to check real-time train arrival, route information, fares and feeder services available. Dynamic train timing displays, and passenger Information Kiosks are provided to facilitate passengers between Chennai central railway and Egmore stations. The CMRL plans to expand these facilities further, which are expected to benefit the BC5 users. The project will also have last-mile connectivity through nonmotorized transport options (bicycle rental services and bicycle parking areas) and feeder bus services.

48. **Public Utility Relocation Arrangement.** As the Chennai Metro Rail corridor alignment passes along existing roads at few places, CMRL collected data related to existing utilities along the alignment from the Chennai Metropolitan Water Supply and Sewerage Board, Tamil Nadu Electricity Board, Bharat Sanchar Nigam Limited (a telecommunications service provider), among others. The information has been included in the tender drawings as chartered utilities (a provisional sum for shifting such utilities has been allocated for chartered and unchartered utilities). Detailed design consultants have tried to avoid shifting the utilities wherever feasible by rearranging the spans or making minor adjustments in the alignment profile.

49. Since Phase 1, the utility agencies have allowed CMRL to carry out such diversions and, hence, the same is being done for Phase 2. CMRL has experienced officers on deputation from various utility departments, which will facilitate approvals or shifting by contractors if they satisfy the requirements.

50. **Implementation Arrangement.** The project is guided by the following time targets for system installation (Table 3).

**Table 3: Critical Output and Projected Timeline**

No.	Critical Output	Timeline
1	Completion of geotechnical works	November 2019 (Completed)
2	Civil tenders awarded	November 2021 (Completed)
3	Appointment of general consultant	November 2021 (Completed)
4	100 percent of land is available for commencing construction	June 2023
5	System tenders awarded	December 2023
6	Completion of civil construction	December 2024
7	Commissioning Balance Corridor 5	May 2026

Source: Chennai Metro Rail Limited.

51. **Operations.** CMRL plans to start BC5 operations in May 2026 by using Poonamallee depot in corridor 4. Chennai Metro Rail Phase 2 is planned to start operations in stages (Annex 2).

52. **Operational Sustainability.** O&M activities will be primarily outsourced. CMRL has comprehensive training programs for outsourced staff to conduct satisfactory O&M. The key O&M activities for outsourcing include housekeeping, ticketing, train operation, security, maintenance of systems and rolling stock. CMRL will control O&M planning, execution and monitoring. Key performance indicators are linked with payment to outsourced domestic private contractors. All outsourced contractors for O&M are selected by CMRL through competitive bidding. The CMRL board of directors has established an O&M committee to regularly review O&M, develop targets and recommend initiatives to improve operational performance and results. To improve operating revenue, CMRL plans to adopt measures to increase the non-farebox revenue from advertising, kiosk and shop rentals, semi-naming rights licensing and others.

## B. Economic and Financial Analysis

53. **Demand Forecast.** The Detailed Project Report (DPR), including traffic demand studies, was prepared by RITES, a domestic consulting enterprise. It performed traffic demand studies after collecting about 23,400 household samples as part of detailed traffic and household surveys. It developed an urban transport model as part of the feasibility study to assess travel demand and determine influential mass rapid transit corridors. The 30-year traffic forecast for corridor 5 is summarized in Table 4.

**Table 4. Traffic Forecast for Chennai Metro Rail Corridor 5 Project**

Year	Maximum PHPDT	Daily Boarding (million)	Daily Passenger Kilometers (million)	Average Trip Length (kilometer)
2026	17,539	0.72	5.67	12.26
2035	24,528	1.32	8.83	12.29
2045	29,441	1.56	9.25	12.41
2055	35,714	1.85	9.68	12.41

PHPDT = peak hour peak direction traffic.

Source: Detailed project report.

54. **Economic Analysis.** The project will support the construction of corridor 5, which, along with corridors 3 and 4, is part of Chennai Metro Rail phase 2. The three corridors will together cover 118.9 km and include a mix of underground and elevated stations. The project's economic viability was assessed using a cost-benefit analysis by comparing with- and without-project scenarios. The economic cost estimates include upfront capital costs, including construction cost but excluding taxes, contingencies and resettlement and rehabilitation. The estimates also include incremental capital costs and O&M costs. All costs were brought to 2020 prices using a five percent escalation factor per annum. A standard conversion factor of 0.83 was used to derive the economic value of the costs.

55. The quantifiable economic benefits comprise Vehicle Operating Cost (VOC) savings, Value Of Time (VOT) savings, reduction in greenhouse gas emissions and

accidents and road maintenance cost savings. The benefits from VOT savings arise mainly from modal shift, lower congestion and increased speed on the road, while those on account of VOC savings are mainly due to lower congestion and reduction in demand for vehicles as passengers shift to using the metro. Traffic demand estimates were derived from the DPR based on income and population growth and the modal shift from other forms of transport.

56. Corridor 5 is economically viable, with an economic internal rate of return of 19.41 percent, as is phase 2, with 14.45 percent, well above the social discount rate of 9.0 percent.

57. A sensitivity analysis was undertaken comprising (a) cost increase of 15 percent, (b) reduction in benefits by 15 percent, and (c) cost increase of 15 percent and reduction in benefits by 15 percent. The analysis indicates that the project yields a higher return than the discount rate across all these scenarios, and corridor 5 and phase II remain economically viable under these adverse conditions.

58. **Financial Analysis.** The capital and operating expenses (for staff, power, and maintenance) were referenced with the DPR estimates, and details of the existing operations (Phase 1) of CMRL escalated to the date of the financial analysis.<sup>11</sup> Capital costs included replacement and augmentation of assets needed for the metro rail's operating life. Farebox revenues were assumed a ramp up of operations starting FY2027, conservatively at 25 percent of the DPR ridership numbers in the first year of operations and gradually increasing to 100 percent in the fourth year. The travel distance matrix as estimated in the DPR and the existing (graded) fare structure were used to estimate farebox revenues. Non-farebox revenues were conservatively assumed at 20 percent of farebox revenues, in line with the proportion generally seen in other metros in India. The rationale behind this estimation is that most non-farebox revenues are linked to commercial endeavors or advertising revenue, both of which are correlated to the number of passengers that use the metro facilities.

59. Based on the assumptions, Corridor 5 was found to have a post-tax real financial rate of return of 6.13 percent and a net present value of negative USD33.9 million, indicating that CMRL will have a slight net financial loss when all the investment is considered. The financial discount rate used for the analysis was the risk-free return based on a 10-year Government of India paper traded in India's financial market (at 6.24 percent as of Aug. 20, 2021).<sup>12</sup> Further details of the financial analysis are in Annex 6.

### C. Fiduciary and Governance

60. **Procurement.** Contracts financed by AIIB are procured in accordance with the provisions of AIIB's Procurement Policy. Procurement of contracts financed by other parallel co-financiers will follow their own procurement policies and procedures. A Project Delivery Strategy (PDS) has been prepared by CMRL and agreed with the Bank. The PDS outlines details of procurement arrangements, including capacity assessment, tendering and contracting strategies, assessment of operational factors affecting

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<sup>11</sup> Updated DPR (March 2020) for Chennai Metro Rail phase 2 prepared by RITES.

<sup>12</sup> Trading Economics. [India Government Bond 10Y](#). (Accessed 20 August 2021.)

procurement, supply market assessment, procurement risk and proposed mitigation measures and prior review thresholds for the project. Based on the outcome of the overall assessment of the procurement process, the procurement risk for the project is *medium*.

61. CMRL is implementing Chennai Metro Rail Corridor 4, financed by AIIB, and procurement arrangements for BC5 will follow a similar approach. As proposed in the PDS, CMRL will use the Bank's standard tender document for large works and International Federation of Consulting Engineers (FIDIC) 2010 contract conditions for the two civil works packages. Lessons learned in tender procedures in the Corridor 4 project were fully considered while preparing the PDS for BC5.

62. Per the procurement plan, the project has only two large civil works packages, and both were conducted using the international open competitive tender method, following AIIB's procurement policy. The contracts for both packages were awarded and started in November and December 2021, respectively.

63. Both packages are procured using the Government of India's [e-tendering platform](#) to enhance transparency and efficiency. The platform is used by other MDBs, which have assessed it as credible and secure.

64. **Financial Management.** The project team has assessed the project's financial management arrangements and found them satisfactory and meeting the requirements of the Operational Policy on Financing (Oct. 22, 2021). Adequate financial management arrangements will be in place for the project to provide reasonable assurance that the financing proceeds will be used properly.

65. CMRL has successfully implemented the JICA-financed portion of Chennai Metro Rail Phase 1 and accumulated experience in fiduciary requirements and processing procedures. Key financial staff are experienced and competent, including the finance manager, with more than 20 years of financial management experience, and the accounting team, composed of seven staff with relevant educational background and working experience. The financial management system of budgeting, accounting, financial reporting, funds flow, internal control, including internal audit, and external audit has been assessed as acceptable.

66. **Accounting and Reporting.** CMRL has implemented the Indian Accounting Standards since April 1, 2016,<sup>13</sup> using a comprehensive accounting procedure manual, a codified document to standardize its accounting and financial reporting work. CMRL uses an open-source accounting enterprise resource planning software, Odoo (version 12), to keep financial records. Every project is captured by an "analytical account" (project code). CMRL will adopt accrual basis accounting to record all transactions, following internal review and approval procedures. Project financial statements reflecting all sources and usage of all project funds can be generated from the system and will be submitted to the Bank periodically.

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<sup>13</sup> See Annexure to the Companies (Indian Accounting Standards) Rules, 2015.

67. **Counterpart Funding.** Since BC5 is a state project, the Tamil Nadu government will provide initial advance and counterpart funds for land acquisition and resettlement.<sup>14</sup>

68. **Internal Control.** Appropriate internal control and review procedures will be in place in contract management, and an internal audit will precede final payment. All Bank payments follow strict authorization levels, and the daily bank reconciliation system is in place. For fixed asset management, separate software is maintained to update asset details, including location and date of capitalization. Internal audit reports are discussed in the quarterly Audit Committee meetings and appropriate actions taken to address issues.

69. **Fund Flow Arrangements.** The Tamil Nadu Finance Department will make an annual budget allocation in its budget estimate based on CMRL's request. The request will be based on the estimated AIIB annual loan disbursement requirement and funds coursed through the Tamil Nadu government as pass-through assistance. The Tamil Nadu government will facilitate both its counterpart funding requirement and the pass-through assistance in its annual budgetary allocation for CMRL. Using the budgetary fund allocation from the Tamil Nadu government, CMRL will pay contractors and consultants and submit their claims to the Controller of Aid Accounts and Audit (CAAA), Ministry of Finance, Government of India. CAAA will approve all withdrawals and submit applications to the Bank. A designated account opened and managed by CAAA will meet funding needs during implementation. The pass-through assistance at the central or state level is an established government process for metro projects in India and will support the timely release of project funds.<sup>15</sup>

70. **Disbursements.** AIIB disbursements will be made in accordance with the loan agreement between the Bank and the Borrower, the disbursement letter issued by the Bank, the disbursement manual and other relevant policies and guidelines. The disbursement arrangement will be reimbursement based and/or advance method. The Tamil Nadu government will provide adequate counterpart funds. CAAA will submit the withdrawal application, together with supporting documents, to the Bank. The Bank will verify the eligibility of the expenditures and reimburse CMRL if the documents are in line with the requirements of the disbursement letter. The detailed disbursement arrangements are set out in the Project's disbursement letter.

71. **Governance and Anti-corruption.** AIIB is committed to preventing fraud and corruption in the projects it finances. AIIB places the highest priority on ensuring that the projects are implemented in compliance with its Policy on Prohibited Practices (2016). AIIB staff will regularly monitor implementation. The Bank reserves the right to investigate, directly or indirectly through its agents, any alleged corrupt, fraudulent, collusive, coercive or obstructive practices and misuse of resources and theft or coercive practices relating to project activities financed by the Bank and will require the borrower to take measures to mitigate the risk of such practices and address any

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<sup>14</sup> All requisite approvals have been granted via Government Order, July 30, 2021 (G.O. Ms. No. 43).

<sup>15</sup>

Central sector projects adopt the same mechanism adopted by the Ministry of Housing and Urban Affairs, Government of India.

issues in a timely manner. AIIB will monitor the work related to tender document preparation and tender and proposal evaluation under Bank financing.

#### **D. Environmental and Social**

72. **Applicable Environmental and Social Policies.** AIIB's Environmental and Social Policy (ESP) will apply to the AIIB Supported Components (i.e. Components 1, 2, and 4). The ADB Supported Component (Component 3) will be considered as an associated facility under the ESP. The project description in AIIB's loan agreement with the Borrower will be limited to include AIIB Supported Components. Therefore, the project will be governed by different ES policies, depending on which parallel cofinancier is financing the project component. AIIB's Environmental and Social Policy (ESP), including the Environment and Social Standards (ESSs) and the Environmental and Social Exclusion List will apply to AIIB Supported Components. ESS 1 (ES assessment and management) and ESS 2 (Land acquisition and involuntary resettlement) apply to the AIIB Supported Components of the project.

73. **Categorization and Instruments.** The AIIB Supported Components project components have been screened and reviewed in accordance with the ESP and ESSs and classified as category A. The ES documentation is prepared following adoption of a harmonized approach among AIIB, ADB and the Tamil Nadu government. An environmental impact assessment (EIA) has been prepared as part of CMRL's DPR and updated in accordance with ESP requirements. A social impact assessment/resettlement plan (SIA/RP) has been prepared to fully assess the anticipated significant social impacts and to address issues of physical and economic displacement. The EIA and SIA/RP cover the AIIB Supported Components as well as the ADB Supported Component. The EIA includes an environmental management plan (EMP) to address project-related environmental issues. Associated facilities assessed as part of the EIA include, in addition to the ADB Supported Components, the sections financed by JICA (Madhavaram to CMBT) and electrical facilities such as substations to be supplied by the Tamil Nadu Generation and Distribution Corporation Limited.

74. **Environmental Aspects.** The overall project is expected to reduce automotive exhaust emissions and serve growing travel demand. Construction-related environmental impacts are temporary and typical of metro rail construction. The main residual negative impacts of BC5 include fugitive and point source dust emission, noise from construction and operation, disposal of large quantities of construction waste and occupational and community health and safety, which are mainly temporary and localized and can be managed by implementing the EMP and good international industry practice. Metro construction and operation will produce noise and vibration. Sensitive receptors along the corridor have been identified. An EMP, with institutional arrangements, budgetary provisions and a schedule for its implementation and monitoring, has been prepared, including mitigation measures, occupational health and safety provisions, labor camp and construction site management and traffic and public utility management to address all impacts during project pre-construction, construction and operation.

75. **Climate Change Risks and Opportunities.** 100% of AIIB's financing will qualify as climate mitigation finance based on the joint MDB methodology for climate finance tracking. The project design considers climate change effects of anticipated continuous

increase in ambient temperature, intensity of cyclones and storm surge, heavy precipitation events and sea-level rise. The project alignment involves elevated sections; hence, flooding risks will be limited. Green building features have been incorporated into station design, which will include rainwater harvesting, solar energy panels at elevated stations and energy-efficient air-conditioning and lighting. Passive lighting to provide adequate daylight will be included through fenestration design. Waste will be efficiently segregated and recycled.

76. **Social Aspects.** Key project social risks associated with the project are related to land acquisition and physical and/or economic displacement. Land is required for the project along the corridor for viaducts, for stations and for parking lots. The requirement is predominantly linear in nature with small land parcels, frontages of structures. The land is being acquired following RP, cleared by AIIB. Permanent land acquisition is carried out mainly through negotiation and a few land parcels are acquired through Act implementation. Use rights below viaducts are acquired through MoU process, wherein the land is continued to be owned by the respective owners while CMRL acquires the rights to access the land parcels below viaducts to undertake maintenance activities. Through this process CMRL has been successful in significantly reducing the permanent land acquisition and resulting impacts. As of Mar 2023, 95% of the land required for the project is acquired by CMRL while the remaining process is likely to be completed by May 2023. Bank staff conducted multiple field missions to review and strengthen the implementation of RP.

77. Based on the detailed designs and surveys, the land requirement for Balance C5 (BC5) is assessed to be 2.04 ha of private land, 1.21 ha government land for stations: and 3.4 ha of private land and 1.53 ha of government land for viaduct. About 421 structures are affected, of which 261 are partially affected. The project identified 663 project affected families of which 345 are title holders and 318 families are non-title holder families receiving the R&R benefits. Through careful planning, design and addressing about 161 grievances so far, BC5 project resulted in permanent displacement of project-affected families of 6 residential structures, 57 commercial structures and 10 commercial plus residential structures only. Compensation for loss of livelihood is awarded to 70 PAFs. 37 kiosks and 24 common property resources (CPRs) have also been affected for the project. The implementation progress will be periodically reported by CMRL while the Bank will monitor the progress through periodic field visits and third-party semiannual reports.

78. **Occupational Health and Safety, Labor and Employment Conditions.** The EMP and the Safety, Health and Environment Manual of CMRL, is formulated in accordance with the ESP. CMRL requires civil works contractors to comply with all applicable labor laws and regulations and adopt and enforce codes of conduct for all workers.

79. **Gender and Inclusion Aspects.** The project will increase the ease and safety of travel of women commuters and thereby, increase access to markets, employment, education and health services. CMRL has women employees working in all fields— systems, operation and maintenance, human resources, and finance. The project aims to promote female employment at the operations stage and has set a target of 30 percent of jobs for women. Female labor force participation is expected to increase in

these components as contractors and subcontractors will be encouraged to employ women wherever feasible. Internal Complaints Committee (ICC) at CMRL will ensure that any GBV/SEA related grievances are handled timely and effectively. More broadly, the project will help reduce poverty by improving public services, particularly for the poor, women, and other vulnerable groups, creating more and better jobs by promoting economic activity and improving social development outcomes. The potential impact of the AIIB-supported components on women in the community has been assessed in the SIA, and CMRL has prepared a GAP in close coordination with AIIB and other MDBs for the entire Phase II of the Chennai Metro Network program. In consultation with relevant stakeholders, including CMRL and community members, contractors will continually strengthen measures to prevent potential adverse impacts caused by the influx of migrant workers and the risk of GBV, and implement the management plans. (See Annex 5 for details).

80. **Stakeholder Engagement, Consultation and Information Disclosure.** During EIA and SIA/RP preparation, CMRL consulted affected people such as traders, women, people living in quarters, kiosk owners and other vulnerable groups. The consultations will continue during project implementation. The English versions of EIA and SIA/RP and the Tamil version of the Executive Summaries of the EIA and SIA/RP have been posted on CMRL's <sup>16</sup> and AIIB's websites (<https://www.aiib.org/en/projects/details/2020/proposed/India-Chennai-Metro-Rail-Phase-2-Project-Balance-Corridor-5.html>) and made available in hard copies in the Project area.

81. **Project Grievance Redress Mechanism.** A multi-tier Grievance Redress Mechanism (GRM) has been constituted for the overall project in line with the requirements of AIIB and ADB, building on the existing complaint mechanisms within CMRL. Communities and individuals who believe that they are adversely affected by the Project will be able to submit complaints to the project-level GRM for their resolution. In addition to the above GRM for addressing complaints from the local community, a GRM has already been established at the contractor level for addressing worker grievances. The GRM process and functioning is reviewed by AIIB team during field missions and additional improvement measures have been put in place.

82. **Independent Accountability Mechanisms (IAM).** AIIB's Policy on the Project-affected Peoples Mechanism (PPM) will apply to AIIB Supported Components. The PPM has been established by AIIB to provide an opportunity for an independent and impartial review of submissions from Project-affected people who believe they have been or are likely to be adversely affected by AIIB's failure to implement the ESP in situations when their concerns cannot be addressed satisfactorily through the GRM or the processes of AIIB's Management. Information on AIIB's PPM is available at:

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<sup>16</sup> [https://chennaietrorail.org/wp-content/uploads/2021/11/Balance-Corridor-5\\_EIA\\_March-2021.pdf](https://chennaietrorail.org/wp-content/uploads/2021/11/Balance-Corridor-5_EIA_March-2021.pdf)  
<https://chennaietrorail.org/wp-content/uploads/2021/11/Executive-summary-Balance-Corridor-5-Tamil1.pdf>  
<https://chennaietrorail.org/wp-content/uploads/2021/11/Executive-summary-Balance-Corridor-5-English1.pdf>  
<https://chennaietrorail.org/wp-content/uploads/2018/07/Approved-Social-Impact-Assessment-Resettlement-Plan-Corridor-5.pdf>

<https://www.aiib.org/en/about-aiib/who-we-are/project-affected-peoples-mechanism/how-we-assist-you/index.html>.

83. ADB's Accountability Mechanism will handle complains relating to ES issues that may arise under the ADB Supported Component. Consequently, in accordance with AIIB's Policy on the Project-affected People's Mechanism, submissions to the PPM under the ADB Supported Component will not be eligible for consideration by the PPM. Information on the ADB's Accountability Mechanism is available at: <https://www.adb.org/who-we-are/accountability-mechanism/main>.

84. **Monitoring and Supervision Arrangements.** The project team will carry out field-based ES supervision during implementation. CMRL will be responsible for overall coordination, supervision and monitoring of the project's compliance with ES matters. CMRL will submit regular ES monitoring reports to AIIB during project implementation.

#### E. Risks and Mitigation Measures

85. The Bank team assigns a *Medium* overall risk rating to the project (Table 5).

**Table 5: Summary of Risks and Mitigating Measures**

Risk Description	Assessment Ratings (High, Medium, Low)	Mitigation Measures
<b>Land acquisition</b> Delays in land acquisition and approval processes	Low	About 95 percent of the land required for the project has been acquired by CMRL. The balance land acquisition is expected to be completed by May 2023.
<b>Environmental, social and Gender aspects</b> Noncompliance with ES plans and GBV/SEA risks	Medium	<p>The environmental and social management plan as reviewed by AIIB was incorporated into civil works contracts.</p> <p>The general consultant provides ES support by facilitating the implementation of ES instruments and prepares a quarterly ES monitoring report. The general consultant has qualified and experienced personnel such as a environment, health and safety expert to support and monitor the project's ES performance. In close coordination with the Gender Focal Point at CMLR, GAP will be implemented, regularly monitored and reported.</p> <p>A third party will periodically monitor and evaluate the implementation of</p>

Risk Description	Assessment Ratings (High, Medium, Low)	Mitigation Measures
		ES plans and produce semiannual monitoring reports.
<p><b>Implementation</b> Delay due to lack of coordination between contractors and utility companies. Because CMRL will implement the entire phase 2 at the same time, the team might be overloaded.</p>	Medium	<p>CMRL, supported by the general consultant, will monitor coordination between the contractors and the utility companies to ensure timely execution of utility identification and diversion.</p> <p>CMRL will leverage its experience from Phase 1. Overload risk will be mitigated through support from the general consultant.</p>
<p><b>Financial management</b> Timely availability of counterpart funds and funds for the deposit work</p>	Low	The Tamil Nadu government will contribute the counterpart funds, ensure that budget allocations are enough and make funds available to CMRL on time, including for cost overruns. The Controller of Aid Accounts and Audit will open and manage a designated account to meet funding needs during implementation.
<p><b>Operation setup and delays</b> The operational setup contributes greatly to the final project outcome and is determined by interventions that are beyond the project's control.</p> <p>Considering the project's complexity, the interconnected works of the various components financed by other cofinanciers and integration with phases 1 and 2, as well as the impact of the COVID19 pandemic, the operation date of July</p>	Low	<p>The general consultant has been on board since November 2021 and is assisting in interface management.</p> <p>CMRL has adopted BIM technology, which will enhance efficiency across the project life cycle of planning, implementation and operation and maintenance.</p> <p>AIIB and ADB have signed a Memorandum of Understanding to enhance their cooperation during project preparation and implementation.</p>

<b>Risk Description</b>	<b>Assessment Ratings (High, Medium, Low)</b>	<b>Mitigation Measures</b>
2025 might be delayed.		

ADB = Asian Development Bank, AIIB = Asian Infrastructure Investment Bank, CMRL = Chennai Metro Rail Limited, COVID-19 = coronavirus disease, ES = environmental and social, ha = hectare.

## Annex 1: Project Results Framework and Monitoring

<b>Project Objective</b>	Increase transport capacity and efficiency of northwest-south connectivity in the Chennai Metropolitan Area by expanding the Chennai metro system.							
Indicator Name	Unit of Measure	Baseline Data	2022	2023	2024 <sup>1</sup>	End Target	Frequency	Responsibility
		2021				2026		
<b>Project Objective Indicators</b>								
1. Daily passengers	Number	0	N/A	N/A	N/A	661,000 <sup>a</sup>	First year of operation	CMRL
2. Reduced journey time	Minutes	138 <sup>b</sup>	N/A	N/A	N/A	82	First year of operation	CMRL
<b>Results Indicators</b>								
3. Employment during project operations stage, including depot, disaggregated by gender (30% of jobs are for women)	Percentage	0	N/A	N/A	N/A	30	First year of operation	CMRL
4. Number of project stations designated to be fully operated by women	Number	0	N/A	N/A	N/A	2	First year of operation	CMRL
5. Percentage of female passengers satisfied with station facilities and services during project operations stage	Percentage	0	N/A	N/A	N/A	75	First year of operation	CMRL

<sup>1</sup> The year 2025 is not included in this table for the following reason: i) The civil works (Component 1 and 2 financed by AIIB) are expected to be completed by December 2024. ii) The commission of the BC5 is expected for May 2026, after completion of the other works (Components 3 and 4 financed by ADB and GoTN).

<b>Project Objective</b>	Increase transport capacity and efficiency of northwest-south connectivity in the Chennai Metropolitan Area by expanding the Chennai metro system.							
<b>Indicator Name</b>	<b>Unit of Measure</b>	<b>Baseline Data</b>	<b>2022</b>	<b>2023</b>	<b>2024<sup>1</sup></b>	<b>End Target</b>	<b>Frequency</b>	<b>Responsibility</b>
		<b>2021</b>	<b>2026</b>					
6. Number of stations that incorporate all the following gender-friendly and universal accessibility features: (i) CCTV, (ii) nappy changing facility, (iii) accessible toilet for persons with disabilities and (iv) women's helpline number, (v) access ramps and (vi) lifts or escalator	Number	No	N/A	N/A	N/A	23 <sup>2</sup>	First year of operation	CMRL
7. Number of project staff trained on gender-sensitive transport project design and implementation	Number	No	N/A	N/A	N/A	50	First year of operation	CMRL
8. Indian Green Building Council platinum rating for elevated stations	Number	0	N/A	N/A	N/A	23	First year of operation	CMRL
<b>Intermediate Results Indicators</b>								
9. Elevated viaducts constructed	Km	0	7	15	24.04	24.04	Annually	CMRL
10. Elevated stations constructed	Number	0	0	0	23	23	Annually	CMRL

<sup>2</sup> Only 5 stations out of 23 will incorporate nappy changing facility.

<b>Project Objective</b>	Increase transport capacity and efficiency of northwest-south connectivity in the Chennai Metropolitan Area by expanding the Chennai metro system.							
<b>Indicator Name</b>	<b>Unit of Measure</b>	<b>Baseline Data</b>	<b>2022</b>	<b>2023</b>	<b>2024<sup>1</sup></b>	<b>End Target</b>	<b>Frequency</b>	<b>Responsibility</b>
		<b>2021</b>				<b>2026</b>		
11. Climate adaptation and resilience measures incorporated into project design	Yes/No	No	Yes	Yes	Yes	Yes	Annually	CMRL

<sup>a</sup> Assumes ridership as per the detailed project report.

<sup>b</sup> Based on journey time by bus (13 kilometers per hour) from the beginning to the end of the proposed line in 2021.

## Annex 2: Detailed Project Description

### A. Chennai Metro Rail

1. Chennai Metro Rail Phase 2 has three corridors and is 118.9 kilometers (km). The project provides northwest-south connectivity together with corridor 3, while corridor 4 enhances east-west connectivity. The three corridors will comprise elevated and underground sections (Table A2.1).

**Table A2.1: Phase 2 Corridors Route Length**  
(kilometers)

<b>Corridor</b>	<b>Total Length</b>	<b>Elevated</b>	<b>Underground</b>
Corridor 3	45.8	19.1	26.7
Corridor 4	26.1	16.0	10.1
Corridor 5	47.0	41.2	5.8

Source: Chennai Metro Rail Limited.

2. The three corridors share interchanges. Corridors 3 and 5 have two interchange stations at Madhavaram Milk Colony in the northwest and Okkiyam Thoraipakkam in the south. Corridor 4 has four stations in common with corridor 5, which will act as interchange stations, and corridor 4 will be connected to corridor 3 at Thirumayilai station to give passengers flexibility. The corridors also have interchange stations with corridors 1 and 2 (Phase 1). Corridor 1 provides a connection to Chennai Airport. The network of Chennai metro Phases 1 and 2 is illustrated in Figure A2.1.

Figure A2.1: Chennai Metro Network, Phases 1 and 2

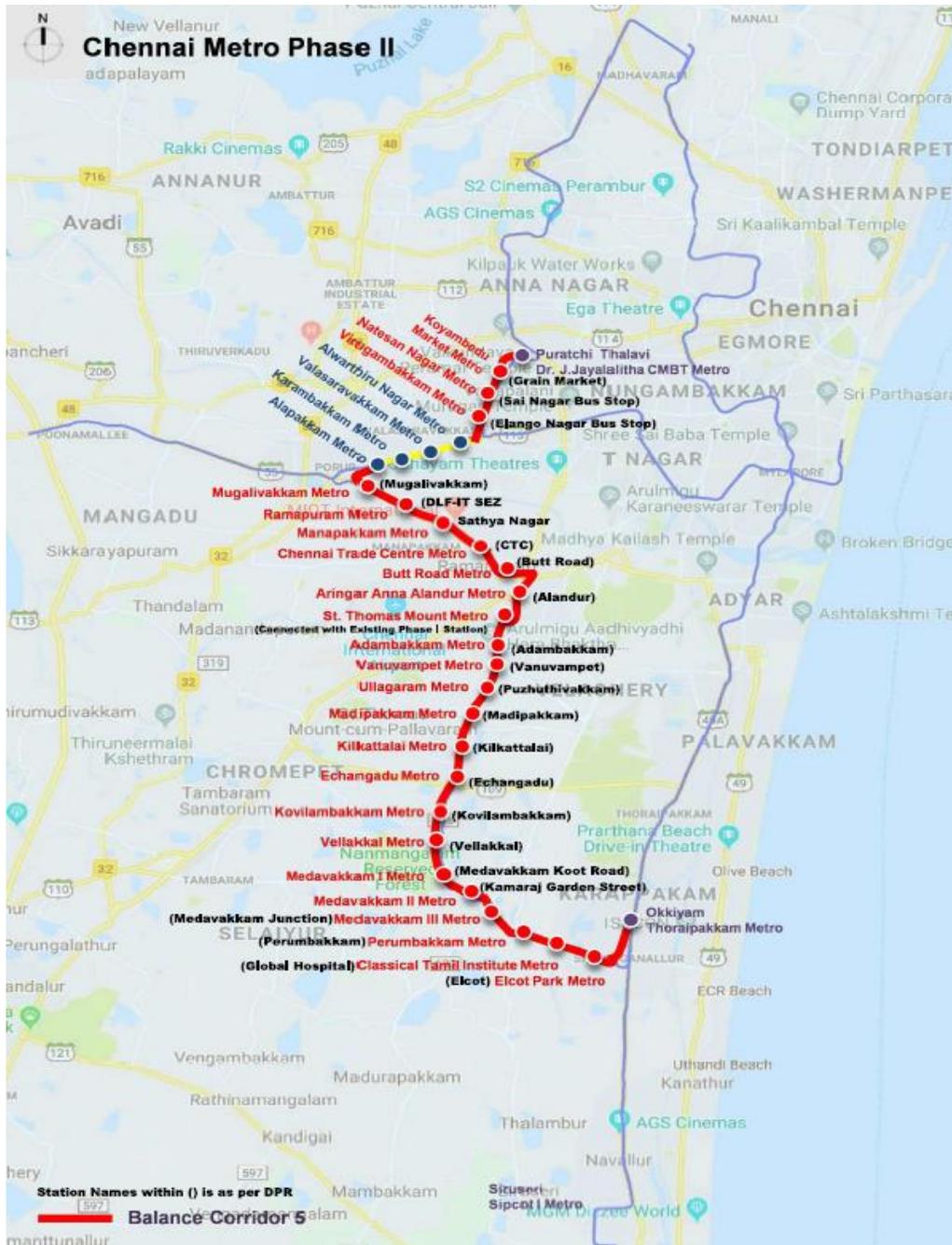


Source: Chennai Metro Rail Limited.

3. Chennai metro Phase 2 corridor 5 is proposed to provide northwest-south connectivity from Madhavaram Milk Colony in the north to Okkiyam Thoraipakkam in the south. Corridor 5 comprises a total of 47 km (41.2 km of elevated line and 5.8 km of underground line) and a total of 48 stations (42 elevated and six underground). Funding for the section from Madhavaram Milk Colony to Chennai Mofussil Bus Terminal (CMBT) (17 km) is linked with the Japan International

Cooperation Agency (JICA).<sup>1</sup> AIIB will finance civil works of balance corridor 5 (BC5), the section from CMBT to Okkiyam Thoraipakkam, which is 24.04 km with 23 stations<sup>2</sup> (Figure A2.2).

**Figure A2.2: Chennai Metro Network, Balance Corridor 5**



Source: Chennai Metro Rail Limited.

<sup>1</sup> The loan agreement for JICA phase 2 financing was signed in January 2019 and became effective in April 2019.

<sup>2</sup> The 5.959 km difference is caused by the following: (a) the joint C4-C5 alignment (3.705 km) is financed under the corridor 4 project, (b) the section from Alandur to STM station (1.37 km)—the existing viaduct of phase 1—is being utilized and (c) other minor alignment revisions are being done.

## B. Detailed Description of Project Components

4. The project is estimated to cost USD999.1 million. AIIB will finance the BC5 civil works. The project includes the following:

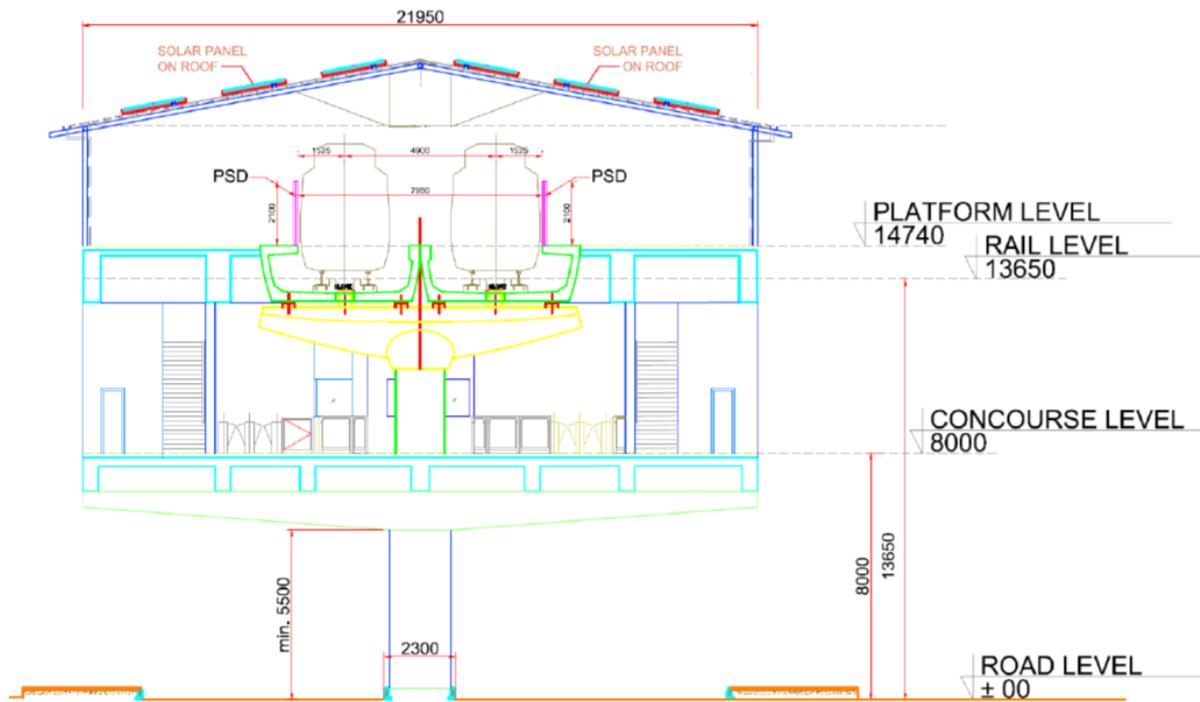
- (a) **Component 1.** Construction of a 12.431 km elevated viaduct between CMBT (excluded) and Ullagaram metro stations, including special spans and construction of elevated stations at Koyambedu Market, Natesan Nagar, Virugambakkam, Mugalivakkam, Ramapuram, Manapakkam, Chennai Trade Centre, Butt Road, Alandur, Adambakkam, Vanuvampet and Ullagaram.
- (b) **Component 2.** Construction of an 11.61 km elevated viaduct between Ullagaram (excluded) and Okkiyam Thoraipakkam metro stations (excluded), including construction of elevated stations at Madipakkam, Kilkattalai, Echanguadu, Kovilambakkam, Vellakkal, Medavakkam I, Medavakkam II, Medavakkam III, Perumbakkam, Classical Tamil Institute and Elcot and all associated works.
- (c) **Component 3.** Electrical and mechanical works, traction and power supply and telecommunications.
- (d) **Component 4.** The general consultant, signaling, lifts and escalators, permanent ways, platform screen doors and others, including overall state tax.

5. **Structures.** A detailed topographical survey was carried out. The geotechnical investigations determined the strength characteristics of the underlying soil and rock strata needed by the foundation of the proposed structure. Bore holes were drilled every 25 meters (m) along the proposed project alignment. Since the proposed site is in seismic zone III, the structure design adopts seismic measures.

6. The substructure will be constructed using mainly pile foundations with pier caps at the top of the columns. The construction will use a single line of piers with portals where a single pier is not possible or cannot take the load. The superstructure is planned as segmental using U-girders and I-girders. Incorporating a lesson learned from Chennai Metro Rail phase 1 and other metro projects, the U-girders will be launched using launching girders instead of road cranes. The pier arms are designed as precast elements that require only launching time at the site, thus avoiding in-situ works that cause heavy traffic. All these measures will result in less disruption to traffic, thus speeding up the work.

7. **Elevated Stations.** The project includes 23 elevated stations. The interstation distance varies from 676 m to 1,280 m. Most of the stations will be constructed using the cantilever method. A typically elevated station consists of three levels: entry and exit structure at ground level on either side of the road, a concourse at the middle level and platforms at the top. Passenger facilities and operational and commercial areas are at the concourse level. Besides staircases, elevators and escalators will be installed to connect the levels. Platforms will be 12-15 m high and the concourse floor about 8 m above the road, with a minimum of 5.5 m of vertical clearance under the concourse for road traffic. The stations will include gender-sensitive and socially inclusive features to provide universal accessibility, which will benefit women and people with disabilities. The cross section of a typical elevated station is shown in Figure A2.3. Generally, elevated stations are divided into seven types (Table A2.2).

Figure A2.3: Typical Elevated Station



Source: Chennai Metro Rail Limited.

**Table A2.2: Typology of Elevated Stations(meter)**

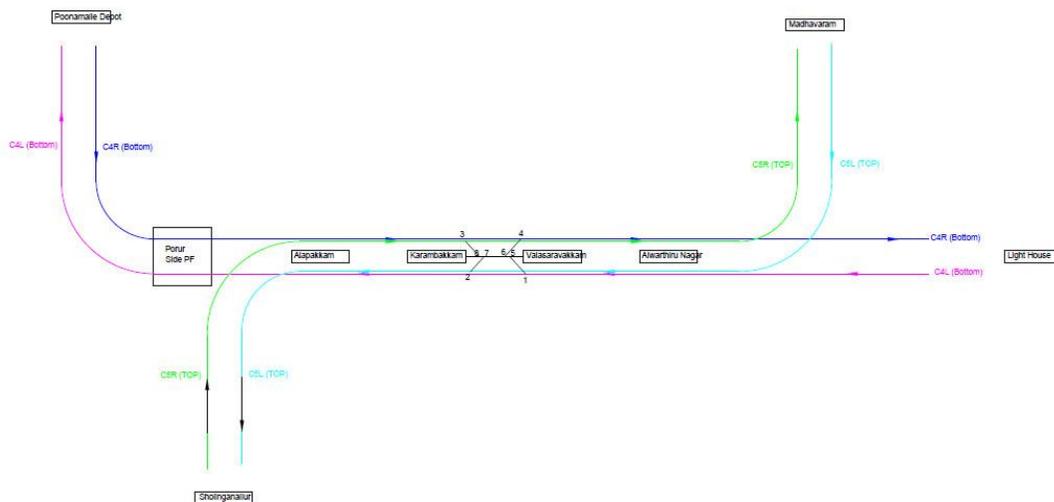
	<b>Station Type</b>	<b>Box Size (m)</b>	<b>Walkway/ Concourse Level (m)</b>	<b>Min. Rail Level (m)</b>	<b>Platform Level (m)</b>
1.	Type 1- Typical Island Platform with Full Concourse	138.0 x 17.0	+8.24	+13.90	+14.99
2.	Type 1A- Typical Island Platform with Link Bridge	198.0 x 17.0	+7.59	+11.0	+12.09
3.	Type 2 – Typical Island Platform Double Decker with Full Concourse	141.0 x 18.1	+9.40	+15.06 (lower) +22.11 (upper)	+16.15 (lower) +23.20 (upper)
4.	Type 2A – Typical Island Platform Double Decker with Link Bridge	141.0 x 18.1	+7.59	+11.0 (lower) +18.05 (upper)	+12.09 (lower) +19.14 (upper)
5.	Type 3- High Rail Level Island Platform	141.0 x 17.0	+7.50 (PD) +12.90 (CL)	+18.41	+19.50
6.	Type 4 -Typical Side Platform with Part Concourse	138.0 x 22.5	+7.94	+13.60	+14.69
7.	Type 5 - High Rail Level Side Platform	137.0 x 22.5	+9.68 (lower) +16.28 (upper)	+21.94	+23.03

Source: Chennai Metro Rail Limited.

8. **Interchanges with Other Metro Corridors and Other Transport Modes.** Chennai Metro Rail phase 2 will interconnect with existing and proposed metro corridors, the airport, bus terminals, the mass rapid transit system (MRTS) and rail terminals. Since the right of way was limited in central Chennai and having duplicate stations close to each other was considered less feasible technologically and economically, CMRL decided to have common stations for corridors 4 and 5 with the same structure but at different levels. Corridor 5 is proposed to run above corridor 4.

9. The corridors between Valsaravakkam and Karabakkam will have a cross-over arrangement to transfer trains from one line to the other for service during nonrevenue hours. The service cross-over will be signaled. The schematic arrangement of the common path is in Figure A2.4. The four common stations are Alwathirunagar, Valasaravakkam, Karabakkam and Alapakkam. The common section, including the elevated viaducts and elevated stations, is proposed for corridor 4 project financing.

**Figure A2.4: Schematic of Common Alignment of Corridors 4 and 5**



Source: Chennai Metro Rail Limited.

10. **Intermodal Connectivity.** Besides having interchanges with other metro corridors, corridor 5 is well connected with other modes of public transport, including bus and suburban railway. Corridor 5 connects with four bus terminals and depots through metro stations at Madhavaram Mofussil Bus Terminus, Vilivakkam Bus Terminus, Anna Nagar West Bus Depot and Chennai Mofussil Bus Terminus. Corridor 5 is also connected with railway stations at Villivakkam railway station and St. Thomas Mount MRTS station. Seamless connectivity at these locations will be ensured by strategic placement of station entry and exit structures, link bridges, foot over-bridges and walkways. Furthermore, corridor 5 users will benefit from integrated ticketing system, which is planned to be introduced in mid-2022. This is being initiated as part of the National Common Mobility Card scheme. The CMRL is also currently working to provide real time train information system and plans to expand these facilities further, which are expected to benefit the corridor 5 users.

11. **Environmental Sustainability.** The project will be environment friendly as it will conserve water and energy and promote clean energy. Water conservation measures will include the use of water-efficient fixtures such as aerators in water taps, rainwater harvesting and reuse of water.

12. CMRL has installed rooftop solar panels at phase 1 stations. On the same lines, solar panels will be installed at the project stations. Maximum use will be made of natural lighting for illumination. The platform level of elevated stations will have an open configuration so that maximum illumination during daytime is through natural lighting. The lighting fixtures will make use of LED-based technology to reduce energy consumption. Measures to promote the use of clean energy will include facilities for electric vehicles and free parking for electric vehicles at all the stations where parking is available. All these provisions will help reduce the project's carbon footprint.

## **B. Other Metro Components not Funded by the Bank**

13. **Track.** The elevated section track will adopt a ballast-less structure with standard gauge of 1,435 millimeters (mm), a minimum track center distance of 4,000 mm, 16-ton maximum axle load capacity and a design speed of 80 km per hour. For the main lines, UIC60 kilograms (kg)

head hardened rails of grade 1,080 are proposed to reduce maintenance and renewal efforts. For other lines and the depot, 60 kg rails of grade 880 (without head hardening) are proposed. The rails will conform to Indian Railways standards, with a cant of one in 20. The rolling stock will be compatible with this rail profile. The main line will have one in nine types of turnouts and the depot will have one in seven.

14. **Power Supply.** Corridor 5 will run on 25 kV AC overhead traction and will be fully integrated with the phase 1 power supply system running. The 25 kV AC overhead catenary system allows for energy efficiency through lower losses and higher regeneration. Four receiving substations—Mugalivakkam, Saint Thomas Mount, Medavakkam and Perubakkam—will supply power for traction and auxiliary services from Tamil Nadu Transmission Corporation Limited. The entire power supply and traction network will be controlled through a supervisory control and data acquisition (SCADA) system. Solar panels will be installed on elevated stations' and depot buildings' rooftops. Surplus solar power will be fed into the grid.

15. **Systems and Communications.** To ensure a high level of safety and reliability, the planned signaling and train control system for corridor 5 is a communication-based train control system with unattended train operation functions and platform screen doors. Telecommunications are planned to be done through an integrated system with optical fiber transmission, SCADA, closed-circuit television, central voice recording system, among others. Stations are planned to be equipped with an automated fare collection system that allows contactless payment methods (token, smart card) and includes station and central servers, ticket vending machines and uninterrupted power supply.

16. **Depots.** The major maintenance depot for corridors 3 and 5 is proposed at Madhavaram Milk Colony. Since a combination of circular and linear train operations is proposed between corridors 3 and 5, inspection and maintenance of the rakes of the two corridors are proposed to be done at Madhavaram Depot. The maintenance facilities at Madhavaram Depot will have capacity for 37 trains of 6 cars for maintenance and repairs of the operational rolling stock. The depot facilities should include stabling lines, scheduled inspection lines, a workshop for overhaul, unscheduled maintenance for major repairs, wheel reprofiling and heavy interior, under frame, roof cleaning, among others for the rolling stock, and maintenance facilities for track, buildings, water supply, traction, signaling and telecommunications, automatic fare collection, among others. When possible, automation with state-of-the-art machinery will ensure quality and reliability. Madhavaram Depot is financed under phase 2 of the JICA-financed portion of the project.

17. **Rolling Stock (Financed by the Tamil Nadu Government).** The rolling stock specifications include 2.9 m wide coaches with three- and six-car configurations like those of Chennai Metro Rail Phase 1. The rolling stock will be equipped with an onboard communications-based train control signaling system, automated doors, computerized control and facilities for females and people with disabilities. All these systems will be designed by the contractors or original manufacturers and reviewed and supervised by the general consultant.

18. **General Consultant (Financed by the Tamil Nadu Government).** Component 4 will finance the general consultant, which will provide overall support to CMRL in project management, construction supervision and quality control. Since CMRL will implement in parallel the entire Chennai Metro Rail Phase 2, the consultant, along with the general consultant for Phase 2 of the

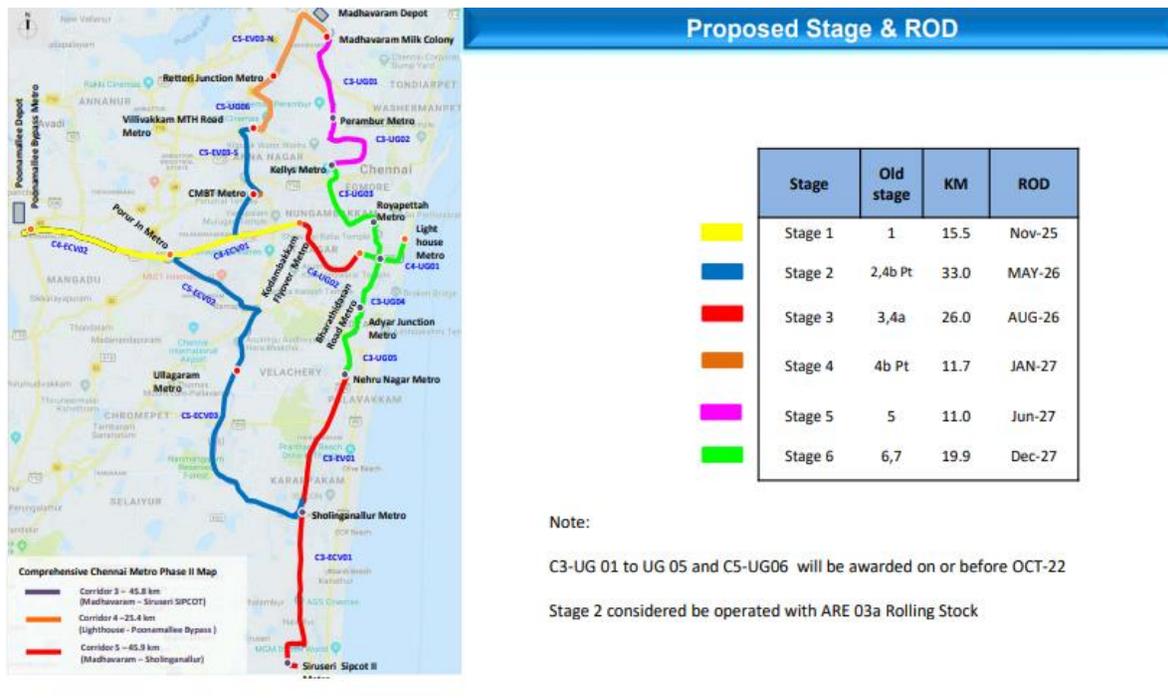


supporting maintenance and other ancillary activities will be outsourced to ensure cost efficiencies: (a) housekeeping services of stations, administration offices and depots; (b) ticketing services at stations, parking and crowd control; (c) train operation services; (d) security services; (e) regulation of mainline traffic at the operation control center and of train movement at the depot control office; (f) maintenance of signaling; telecommunications; traction and power systems; mechanical, electrical, and plumbing; lifts and escalators; automatic fare collection systems; among others; and rolling stock preventive maintenance. To ensure quality control, key performance indicators are proposed and will be linked with payment to the private contractors.

86. **Operation Plan.** Chennai Metro Rail Phase 2 is planned to start operating in stages:

- (a) Corridors 5 and 3 will run circular operation with the Madhavaram depot catering to both the lines. Target headway after final commissioning is 2.5 minutes.
- (b) The JICA-financed portion of corridors 5 is planned to be commissioned by Jan 2027, hence, CMRL is planning to start BC5 operations in May 2026 by using Poonamallee depot of corridor 4 (stage 2). Poonamallee depot and elevated corridor 4 will have been constructed by that time in stage 1..
- (c) For stage 2, CMRL is planning to run 12 trains with reversals at temporary terminals—Grain Market and Elcot stations—with 10 minutes' headway. About five trains can be stabled every day after revenue hours at the terminals, and the rest will be taken to corridor 4 (Poonamallee depot) through the crossover link at Karambakkam station. The depot is designed for 56 three-car trains and will easily accommodate the 12 trains (five in stage 1 and seven in stage 2) planned to be stabled daily at the depot. Headway will be improved to five minutes in future stages.
- (d) CMRL is planning a single package for signaling and train control in phase 2, thus the movement of corridor 5 trains over corridor 4 will be under automatic train protection. Other systems will be in different packages for each corridor. Rolling stock is being procured as three packages.

Figure A2.6: Phase 2 Operation Plan



Source: Chennai Metro Rail Limited.

22. The metro will have a maximum design speed of 80 km per hour and a scheduled speed of 32 km per hour. Revenue operations will be from 5:00 AM to 12:00 AM. No services are proposed between 12:00 AM and 5:00 AM, which is reserved for maintenance of infrastructure and rolling stock. Key features of the estimated train operation plan are in Table A2.3. With eight passengers per square meter, the carrying capacity will be optimal and more than peak hour, peak direction traffic. Trains are selected based on projected ridership. In the first decade, three-car trains are planned, and six-cars trains will be introduced in subsequent decades as demand increases.

**Table A2.3: Estimated Peak Headway and Capacity**

Items	2026	2035	2045	2055
Cars per train	3	3&6	3&6	6
Headway in seconds	277	277	257	240
Trains/hour	13	13	14	15
Three-car trains	13	6	3	0
Six-car trains	0	7	11	15
Capacity (@ six pax/m <sup>2</sup> )	9,958	15,628	19,634	23,640
Capacity (@ eight pax/m <sup>2</sup> )	12,675	19,878	24,969	30,060
PHPDT	11,707	18,944	23,816	29,940

m<sup>2</sup> = square meter, PHPDT = peak hour peak direction traffic.

Source: Chennai Metro Rail Limited.

23. **Transit-Oriented Development.** The project envisages maximizing non-fare revenue by transit-oriented development, guided by the National Transit Oriented Development Policy. It focuses on developing high-density mixed land use in stations' influence areas and advocates pedestrian access to facilities such as shopping, entertainment and work. Non-fare revenue will include revenue from shops and kiosks at the stations, station naming rights and advertisements at stations and in trains, among others. The increase in ridership is envisaged to result in an increase in non-farebox revenue, while such facilities at stations will attract more ridership.

24. **Last-Mile Connectivity.** The project will have last-mile connectivity through nonmotorized transport options and feeder bus services. Currently, the CMRL is looking into the possibility, in coordination with the Metropolitan Transport Corporation, of introducing minibus feeder services to Metro Corridor 5 stations. Project feeder services are envisaged as being booked through the CMRL mobile app, which enables payment for such services using the same travel card for the metro, creating an integrated ticketing system across metro and feeder services. Also, free electric buggy pickup and drop services from nearest CMRL metro stations to Airport terminals, Central railway station, Wimco Nagar Suburban railway station are available. Other planned services include shared taxis, rented bicycles and electric auto rickshaws. For instance, CMRL has already introduced free bicycle rental (with refundable security deposits) for metro users. Furthermore, rental bicycle services, operated by a private sector operator (Smartbike Mobility Limited), are available at CMRL metro stations. The CMRL also plans to include designated bicycle parking areas in major stations of Corridor 5 including St.Thomas Mount, Alandur, Elcot/Shollinganallur). All these initiatives will help the potential Metro Corridor 5 users.

## **Annex 3: Strategic and Operational Alignment with Chennai's Development Strategy**

### **A. Preamble**

1. CMA is developing fast and forecasted to have a population of over 12.6 million in 2026. With increasing population, the city is experiencing rapid motorization (Chennai district vehicle number increased at an annual rate of 6.3 percent in the last 10 years), leading to increased congestion and pollution. The CMP for CMA<sup>1</sup> has identified several challenges including lack of land use transport integration, absence of intermodal integration. Routes, services and operations, as well as institutional and technological aspects, of public transport modes require more integration for their optimal operation, suggested the plan.

2. One of the disturbing trends of Chennai transport characteristics is the increasing share of private vehicles (cars and two-wheelers) at the cost of on-motorized transport (NMT) and bus trips, although NMT and buses are still responsible for the majority of trips in Chennai (roughly 53 percent in 2018). In this context, the main objective of CMP which was prepared in 2019 is to provide a long-term strategy for the desirable mobility pattern of Chennai's population. One of the main focuses of the CMP is to develop a public transit system in conformity with the land use that is accessible, efficient and effective. The plan target is to increase the public transport mode share to over a half, currently at 38 percent. The CMP contains an investment program (until 2048) that focuses on mobility of people rather than on vehicles. The mobility goals for Chennai have been addressed through a multipronged approach. The plan has eight specific strategies ranging from land use and transport strategy to public transit improvement strategy to freight management strategy.

### **B. Strategic Alignment**

3. The proposed project aligns with the CMP strategies and plans. One of the two focuses of the CMP land use and transport strategy is the transit-oriented development. The CMP has identified a total of 12 corridors for such a development approach, seven of them being road corridors and remainder five being metro corridors. Metro Corridor – 5 (Madhavaram to Sholinganallur Road) is one of the five metro corridors.

4. Apart from the proposed project, AIB's current and proposed support to Chennai include three other projects: (a) Chennai City Partnership: Sustainable Urban Services Program, PD000477 (under implementation; co-financed with the World Bank); (b) Chennai Metro Rail Phase 2 Project - Corridor 4, P000301 (under implementation); and (c) Chennai Peripheral Ring Road Sections II & III - P00036 (under implementation). All these projects are interlinked, and they are included in the CMP proposals, barring the Sustainable Urban Services Program, which has cross-cutting transport components. While Chennai Metro Corridor 4 and Chennai Metro Corridor 5 are proposed as a part of the transit-oriented development strategy, the Peripheral Ring Road is a part of the freight management strategy, as identified in the CMP.

5. Sustainable Urban Services Program activities will benefit all these three ongoing and potential AIB projects. The Program has two distinct transport indicators, which are linked to the

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<sup>1</sup> [www.cmdachennai.gov.in/pdfs/ComprehensiveMobilityPlan-CMA.pdf](http://www.cmdachennai.gov.in/pdfs/ComprehensiveMobilityPlan-CMA.pdf)

disbursement of program funds. They are: (a) operationalization of the Chennai Unified Metropolitan Transport Authority (CUMTA)<sup>2</sup> with enhanced capacity and control over sector budget allocation; and (b) introducing performance-based contracts for bus service delivery to enhance quantity and quality of services. The first indicator will help in overseeing, coordinating, promoting and monitoring of implementation of various traffic and transportation measures by different agencies in the Chennai. The latter one will help, in the improvement of performance of buses and potential enhanced modal integration.

### **C. Operational Alignment**

6. The proposed project aligns operationally with other modes and systems that enhances inter-modal integration and synergies. The Balance Metro Corridor 5 (a portion of the Red Line) will run initially north-south, parallel to the Metro Corridor 3 (under construction Purple Line), finally meeting it again at Okkiyam Thoraipakkam metro station. In this process, it meets four interchange metro stations of Corridor 4 (Orange Line): Alwarthirunagar, Valasaravakkam, Karabakkam and Alapakkam. Further south, the Red Line (Corridor 5) meets an interchange station (Alandur) located on bosuth Corridor 1 (Blue Line) and Corridor 2 (Green Line). This means that the Balance Corridor 5 will have seven metro interchange stations: two on Corridor 3, four on Corridor 4 and one on both Corridor 1 and 2. It is to be noted that Corridor 1 (Blue Line) terminates at Chennai Airport, which is south of the Alandur interchange station.

7. Furthermore, the construction of the proposed Balance Corridor 5 will help enhancing modal integration of other public transport modes including buses. Once completed, the Red Line will connect four bus terminals/depots (Madhavaram Mofussil Bus Terminus, Vilivakkam Bus Terminus, Anna Nagar West Bus Depot and Chennai Mofussil Bus Terminus). The proposed Balance Corridor 5 will also connect Chennai Suburban Rail system (third busiest suburban rail system in India - after Mumbai and Kolkata - and carries approximately 2.5 million passengers per day) at Villivakkam (West Line) and St. Thomas Mount (South Line) stations. The project design will help seamless connectivity at these locations by strategically placing station entry and exit points, and by providing appropriate access structures including link bridges, foot over-bridges and walkways.

8. Metro Corridor 5 users benefit from integrated ticketing system, which was introduced in November 2022. This is being initiated as part of the National Common Mobility Card scheme. The CMRL is also currently working to provide real time train information system. Dynamic train timing displays, and passenger Information Kiosks are provided to facilitate passengers between Chennai central railway station and Egmore. The CMRL plans to expand these facilities further, which are expected to benefit the Metro Corridor 5 users.

9. Some ongoing and planned initiatives by CMRL will also help in the last mile connectivity of the Metro Corridor 5 passengers. For instance, CMRL has already introduced free bicycle rental (with refundable security deposits) for metro users. Furthermore, rental bicycle services, operated

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<sup>2</sup> CUMTA is established by the State Government in November 2010 (through ACT No. 44 OF 2010) as a coordinating authority in the area of Transport. The overwhelming objective of the creation of the authority is to properly coordinate and streamline activities among different agencies, responsible for the planning, operating and managing transportation system in Chennai Metropolitan Planning Area.

by a private sector operator (Smartbike Mobility Limited), are available at CMRL metro stations. The CMRL also plans to include designated bicycle parking areas in major stations of Corridor 5 including St.Thomas Mount, Alandur, Elcot/Shollinganallur).

10. Currently, the CMRL is looking into the possibility, in coordination with the with Metropolitan Transport Corporation, of introducing minibus feeder services to Metro Corridor 5 stations. Also, free electric buggy pickup and drop services from nearest CMRL metro stations to Airport terminals, Central railway station, Wimco Nagar Suburban railway station are available. All these initiatives will help the potential Metro Corridor 5 users.

## Annex 4: Economic and Financial Analysis

### A. Introduction

1. The project will support the construction of a section of the corridor 5, which, along with corridors 3 and 4, comprises Chennai Metro Rail phase 2. The three corridors together will cover 118.9 kilometers (km) and include a mix of underground and elevated stations. While corridors 3 and 5 will improve the connectivity of northwestern and southern Chennai along with phase 1 corridors, corridor 4 will enhance east-west connectivity. The project's key beneficiaries are passengers who will gain from transport services that are faster, more reliable and of better-quality than other modes of transport. By diverting traffic from congested roads, the project will speed up remaining traffic.

2. The project's economic viability was assessed using a cost-benefit analysis by comparing with- and without-project scenarios. The economic internal rate of return (EIRR) was calculated by comparing the project's economic and societal benefits with the project's cost over 36 years, including six years of construction. The analysis indicates that the project is economically viable, with an EIRR of 19.41 percent and a net present value (NPV) of INR134.34 billion. A similar analysis of phase 2 substantiates its economic viability, with an EIRR of 14.45 percent and an NPV of INR246.84 billion, comparable to the 12.86 percent EIRR computed for phase 2 in the economic analysis of Chennai metro corridor 4. The project's key benefits are vehicle operating cost (VOC) savings, value of time savings (VOT) of passengers, reduction in greenhouse gas (GHG) emissions, improved road safety and road maintenance cost savings.

### B. Demand Analysis

3. The traffic demand estimates are derived from the DPR based on growth in income and population and modal shift from other vehicle categories. Table A3.1 outlines the daily ridership for the project and phase 2 for key years. The ridership for intermittent years is based on the compound annual growth rate between these years.

**Table A3.1: Daily Metro Passenger Ridership**

(million)

Line	2025	2035	2045	2055
Corridor 5	0.66	1.24	1.41	1.61
Phase 2 (corridors 3, 4 and 5)	1.77	2.97	3.41	3.85

Source: Comprehensive Detailed Project Report for Chennai Metro Rail Phase II, Rail India Technical and Economic Services, March 2020.

### C. Economic Costs

4. The economic costs cover civil, electrical, signaling and telecommunications works, along with operation and maintenance (O&M). Cost on account of contingencies, taxes and resettlement and rehabilitation have been excluded from the costs while costs borne for land acquisition have been included. All the costs have been escalated to 2020 prices using a five percent escalation factor. A standard conversion factor of 0.83, as prescribed by the Ministry of

Housing and Urban Affairs (MoHUA) Appraisal Guidelines for Metro Rail Project Proposals, has been used to convert financial costs into economic prices. The economic costs comprise the following:

- (a) **Capital expenditure.** The construction period for Chennai Metro Rail corridor 5 is assumed to be six years, from 2021 to 2027. The upfront capital expenditure on construction is assumed to follow the following: five percent in 2021, 15 percent in 2022, 20 percent in 2023, 20 percent in 2024, 20 percent in 2025, 15 percent in 2026 and five percent in 2027. As per the DPR, the upfront capital expenditure for corridor 5 is INR152.18 billion in 2020 prices, from which we exclude taxes, contingencies and resettlement and rehabilitation. The economic value of the cost is obtained by using standard conversion factors. Incremental capital expenditure is required for replacement of equipment due to wear and tear during the project's lifetime. The expenditure includes additional investment to add coaches to the system to cater to increasing demand and is estimated at INR4.08 billion in the 10th year of operation and INR16.04 billion in the 20th. Total capital expenditure is estimated at INR127.87 billion. Total capital expenditure for phase 2 is INR485.19 billion.
- (b) **O&M.** O&M costs include staff wages, energy and repair and maintenance costs. O&M costs under various categories have been estimated as per the costs incurred in Chennai Metro Rail phase 1 and other metro projects in India. For corridor 5, these costs add up to INR100.88 billion and for the entire phase 2 about INR306.25 billion.
- (c) **Salvage value.** Salvage value is considered 20 percent of economic cost at the end of analysis period and is treated as a negative cost.<sup>3</sup>

#### D. Economic Benefits

5. The project will yield numerous tangible and intangible benefits. The key quantifiable benefits include VOT savings of people switching from other modes to corridor 5, lower road congestion, higher VOC savings, reduced GHG emissions and reduced accidents and road maintenance costs:

- (a) **VOC savings.** Such savings occur as passengers shift from buses, cars, two-wheelers and three-wheelers to the metro, lessening road congestion and reducing vehicle demand. VOC is a function of vehicle type, speed, road roughness and other road characteristics. The number of various vehicles required with and without corridor 5 was calculated based on the number of trips and carrying capacity, average lead and vehicle-kilometers per day. VOC unit cost per kilometer was derived from the Indian Road Congress Manual on Economic Evaluation of Highway Projects and adjusted for 2020 by escalating it by five percent per year.<sup>4</sup> VOC savings were converted to economic savings by using a standard conversion

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<sup>1</sup> Based on the Chennai Peripheral Ring Road Project.

<sup>4</sup> As per MoHUA guidelines on Economic Appraisal of Metro Projects.

factor of 0.9 as prescribed by MoHUA. VOC savings estimated in this analysis are conservative and do not consider savings in VOC arising from the remaining vehicles on the road becoming faster and more efficient because of reduced congestion after the introduction of corridor 5.

- (b) **Travel time savings (VOT savings).** Chennai Metro Rail Limited (CMRL) will be significantly faster than alternate road-based transport modes and will result in travel time savings for passengers who shift from slower modes to the metro. The scheduled operating speed of the metro is 32 km per hour, while the average running speed on roads in Chennai Metropolitan Area is 20 km per hour. In line with recent transport projects in Chennai, VOT is based on Tamil Nadu's per capita income of INR218,599 in 2020,<sup>5</sup> working population ratio of 45 percent and an assumption of 23 working days per month, yielding an average VOT of INR220 per hour. In this analysis a more conservative value of INR190 per hour is considered. The figures are further adjusted to account for different transport modes. The analysis assumes a 20 percent higher-than-average VOT for car passengers. VOT for bus and three-wheeler passengers is assumed to be 31 percent that of car passengers, while VOT for two-wheeler passengers is assumed to be 58 percent. The nonworking time of passengers is valued at 40 percent of the above figures.

An additional benefit accruing to passengers shifting to the metro emanates from reduced road congestion, which allows the remaining vehicles on the road to travel faster. According to the DPR, the speed for various vehicle categories will increase by five to 11 km per hour with the introduction of metro services.<sup>6</sup> As separate data for corridor 5 on the increase in speed are not available, we conservatively estimate that the increase in speed due to reduced congestion will be 90 percent of the increase in speed observed for the entire phase 2. We assume that, owing to congestion, vehicle speed will slow by one km per hour every year due to the addition of new vehicles. After the initial 10 years, the difference in speed between the with- and without-project scenarios is assumed to be negligible.

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<sup>5</sup> Reserve Bank of India. 2020. Handbook of Statistics on Indian Economy.

<sup>6</sup> In the absence of a similar comparison of speeds for corridor 5, we conservatively assume that the introduction of corridor 5 will result only in an increase in speed of remaining vehicles to 33 percent of the increase in speed assumed in the with-phase 2 scenario.

**Table A3.2: Average Speed with and without Phase 2**

	Average Speed (kilometer per hour)	
	Without Phase 1	With Phase 2
Bus	13	18
Car	18	29
Two-wheelers	18	29
Three-wheelers	16	25

Source: Comprehensive Detailed Project Report for Chennai Metro Rail Phase II, Rail India Technical and Economic Services, December 2018.

- (c) **Benefits of emission savings.** As a result of fewer vehicles on the road due to modal shift and an increase in speed of the remaining vehicles resulting from lower congestion, the project will significantly reduce GHG emissions. The DPR assumes that the emission rate for buses is 787.72 grams per km (g/km), cars 139.52 g/km, two-wheelers 28.58 g/km and three-wheelers 77.89 g/km. For carbon pricing, the midpoint of the Stiglitz-Stern recommendation was used until 2035, after which the price of carbon is estimated to grow at 2.25 percent per year. These benefits are conservatively estimated as they ignore the benefits from reduction of other gases.
- (d) **Savings on road maintenance.** In the absence of adequate data, savings on road maintenance are assumed at a flat rate of INR713 million for corridor 5, which is a third of INR2,140 million per year for phase 2, as per the DPR.
- (e) **Savings on cost of accidents.** The modal shift to the CMRL system is expected to reduce accidents in the catchment area by reducing the number of vehicles. The assumptions for accident savings are based on cost of fatal and major accidents and cost of damage to vehicles, as prescribed by MoHUA. The number of accidents per 100,000 vehicles was computed using data from CEIC and Road Accidents and Road Safety Measures in Tamil Nadu.

6. Several other benefits have not been quantified due to lack of data, including (a) increased economic activity in the catchment area because of improved connectivity, (b) empowerment of vulnerable segments of the population resulting from availability of safe public transport and (c) increased access to health and education facilities for people in nearby areas.

## **E. Economic Viability**

7. Based on the above costs and benefits, the economic internal rate of return (EIRR) for corridor 5 is computed as 19.41 percent while the NPV is estimated at INR134.34 billion at a nine percent discount rate. The EIRR and NPV of the entire phase 2 is computed as 14.45 percent and INR246.84 billion. Thus, corridor 5 and phase 2 are deemed economically viable. Estimates are on the conservative side because of the various assumptions made in the analysis, including

(a) excluding VOC savings arising from lower road congestion, (b) using a more conservative average VOT and (c) excluding the savings in reduced GHG emissions other than CO<sub>2</sub>.

**Table A3.3: Economic Evaluation Base Case Scenario**

<b>Chennai Metro Rail Corridor</b>	<b>EIRR Base Case (percent)</b>	<b>ENPV at 9 percent (INR billion)</b>
Phase 2	14.45	246.84
Corridor 5	19.41	134.34

EIRR = economic internal rate of return, ENPV = economic net present value.

Source: AIIB.

8. The details of the economic analysis with the annual benefits and costs are outlined in Table A3.4.

**Table A3.4: Annual Benefits and Costs  
(INR million)**

	<b>Construction Costs</b>	<b>Operations Costs</b>	<b>Large CAPEX Costs</b>	<b>VOT Savings</b>	<b>VOC Savings</b>	<b>GHG Benefits</b>	<b>Accident and Road Savings Benefits</b>	<b>Net Benefit</b>
<b>2021</b>	5,387.18	-	-	-	-	-	-	(5,387.18)
<b>2022</b>	16,161.55	-	-	-	-	-	-	(16,161.55)
<b>2023</b>	21,548.74	-	-	-	-	-	-	(21,548.74)
<b>2024</b>	21,548.74	-	-	-	-	-	-	(21,548.74)
<b>2025</b>	21,548.74	-	-	-	-	-	-	(21,548.74)
<b>2026</b>	16,161.55	-	-	-	-	-	-	(16,161.55)
<b>2027</b>	5,387.18	2,628.36	-	27,737.01	3,546.43	60.55	747.87	24,076.32
<b>2028</b>	-	2,682.02	-	27,723.11	3,858.45	66.95	751.53	29,718.03
<b>2029</b>	-	2,736.78	-	27,667.23	4,173.52	72.67	755.05	29,931.68
<b>2030</b>	-	2,792.66	-	27,564.57	4,492.10	79.63	758.42	30,102.06
<b>2031</b>	-	2,849.68	-	27,409.94	4,814.64	86.93	761.66	30,223.48
<b>2032</b>	-	2,907.87	-	27,197.71	5,141.61	93.36	764.78	30,289.60
<b>2033</b>	-	2,967.24	-	26,921.80	5,473.48	101.29	767.78	30,297.11
<b>2034</b>	-	3,027.82	-	26,575.61	5,810.72	109.58	770.68	30,238.77
<b>2035</b>	-	3,089.64	-	26,152.03	6,153.80	118.26	773.47	30,107.92
<b>2036</b>	-	3,152.72	-	25,643.35	6,503.22	127.17	776.17	29,897.18
<b>2037</b>	-	3,217.10	4,085.13	27,220.32	6,859.45	136.56	778.77	27,692.88
<b>2038</b>	-	3,237.63	-	28,265.44	7,033.50	144.16	780.25	32,985.73
<b>2039</b>	-	3,258.29	-	29,348.33	7,207.06	152.06	781.71	34,230.87

2040	-	3,279.08	-	30,470.12	7,380.06	160.24	783.15	35,514.49
2041	-	3,300.01	-	31,631.97	7,552.41	168.73	784.58	36,837.68
2042	-	3,321.07	-	32,835.03	7,724.03	177.52	785.99	38,201.50
2043	-	3,342.27	-	34,080.47	7,894.82	186.64	787.38	39,607.04
2044	-	3,363.60	-	35,369.47	8,064.67	196.09	788.75	41,055.38
2045	-	3,385.06	-	36,703.19	8,233.48	205.87	790.11	42,547.59
2046	-	3,406.67	-	38,082.81	8,401.13	216.00	791.45	44,084.73
2047	-	3,428.41	16,042.85	39,509.49	8,567.49	226.49	792.78	29,625.00
2048	-	3,450.29	-	41,080.36	8,760.67	237.88	794.21	47,422.83
2049	-	3,472.31	-	42,711.14	8,953.58	249.68	795.63	49,237.72
2050	-	3,494.47	-	44,403.85	9,146.13	261.91	797.03	51,114.45
2051	-	3,516.77	-	46,160.53	9,338.22	274.58	798.42	53,054.99
2052	-	3,539.21	-	47,983.28	9,529.76	287.71	799.79	55,061.33
2053	-	3,561.80	-	49,874.23	9,720.63	301.31	801.15	57,135.52
2054	-	3,584.53	-	51,835.52	9,910.72	315.39	802.50	59,279.60
2055	-	3,607.41	-	53,869.34	10,099.91	329.98	803.83	61,495.65
2056	-	3,630.43	-	55,977.92	10,288.05	-	805.15	63,440.69
2057	-	3,653.60	(21,548.74)	58,163.48	10,475.02	-	806.46	87,340.10

CAPEX = capital expenditures GHG = greenhouse gas, VOC = vehicle operating cost, VOT = value of time.

## F. Sensitivity Analysis

9. The robustness of the EIRR is evaluated by making alternate assumptions about the costs and benefits. The project is found to be economically viable if (a) costs increase by 10 percent, (b) benefits decline by 10 percent and (c) both (a) and (b) occur (Table A3.4).

**Table A3.5: Sensitivity Analysis**

	Corridor 5		Phase 2	
	EIRR (percent)	NPV (INR billion)	EIRR (percent)	NPV (INR billion)
Baseline	19.41	134.3	14.45	246.8
Increase costs by 15 percent	17.45	119.2	12.87	192.33

Decrease benefits by 15 percent	17.14	99.5	12.62	155.30
Increase costs by 15 percent and decrease benefits by 15 percent	15.31	84.91	11.14	100.8

EIRR = economic internal rate of return, NPV = net present value.

Source: AIIB.

10. In all scenarios, the EIRRs for corridor 5 and phase 2 are well above the social discount rate of 9 percent, indicating that the project remains viable even under these adverse conditions.

11. **Scope of the Financial Analysis.** The financial analysis was undertaken to assess the financial viability of corridor 5, part of Chennai Metro Rail phase 2 and an alignment of 47.01 km from Madhavaram in the north to Okkiyam Thoraipakkam in the south. Corridor 5 takes an orbital route connecting the central areas of the city with the existing mofussil bus terminal and has interchanges with the phase 1 alignment. The financial evaluation defines costs and revenues that would accrue over a 36-year projection period (comprising six years of implementation and 30 years of operations, beginning from 2021). The post-tax financial rate of return and net present value were used as the value measures for the analysis of financial sustainability and profitability.

12. **Capital Costs.** The capital costs have been obtained from the Updated Detailed Project Report (March 2020, DPR) for Phase 2 of Chennai Metro Rail prepared by M/s RITES (a Government of India enterprise). According to the DPR, the costs were estimated at December 2018 price levels. The DPR consultants referenced the cost workings to [the Report on Benchmarking of Costs for Metro Rail Projects](#) by the Ministry of Housing and Urban Affairs MoHUA, brought out in February 2019), the apex authority under GoI for metro rail projects, among others. The costs were also referenced to contracts awarded for the first phase of the Chennai Metro Rail and its extension, as well as other metro projects in India. The assumed methodology for the capital cost estimation is aligned with the current industry practice. The costs were escalated to 2021, the base date assumed for financial analysis.

13. **Implementation Schedule.** Based on the DPR, the cost of constructing corridor 5 was assumed to be spread over six years, starting from 2021. Expense phasing, however, assumed a small spillover into the seventh year; five percent of the total cost is expected to be incurred in the first and seventh years, 15 percent in the second and sixth and 20 percent in the mid-third, fourth and fifth.

14. **Post-Commissioning Capital Expenses.** The capital cost provided for post-construction outlay, towards capacity augmentation (including rolling stock additions as per design considerations) and replacement needs (as per wear and tear of signaling, telecommunications, tracks and electrical assets). Financial analysis assumed that (a) senior debt would be serviced before spending on these outlays and (b) internal generation would cater to these requirements, with sponsors making up any deficiencies.

15. **Operation and Maintenance Costs.** O&M costs include staff wages, energy and repair and maintenance costs. O&M costs under various categories were estimated as per the unit cost (per unit of network track length) incurred in Phase 1 after adjusting the unit measures to bring them to the base date assumed for financial analysis. Energy costs were escalated in the 10th

and, thereafter, the 20th year of operations to reflect increased energy consumption from enhanced metro operations. Maintenance costs were estimated based on phase 1 operations, after adjusting for the underlying route length of corridor 5. The variable portions of the O&M costs were profiled to reflect a gradual ramp up of operations, with the full O&M costs shown to be incurred only from the sixth year of operations, in line with the guidance provided in the DPR.

16. **Traffic Demand and Farebox Revenue.** Ridership numbers were handled as per the DPR estimates. Traffic for the first year of operations (2027) was assumed conservatively to be at 25 percent of the DPR forecasts, and the same was increased linearly to the forecast level by the fourth year of operations. DPR estimated traffic to be 661,000 in the first year of operations, increasing to 1,242,000 in the 10th, 1,415,000 in the 20th and 1,611,000 in the 30th year.

17. Farebox revenue is the main revenue source for the corridor, and the existing ticket fare system of CMRL is distance based. An annual escalation of 7.5 percent to the base fare structure is conservatively assumed for the analysis.<sup>7</sup> Like other metro projects in India, the ticket fare will subsequently be fixed by the Fare Fixation Committee. The travel distance matrix as estimated in the DPR was used to calculate trip length behind the farebox revenues.

**Table A3.5: Fare Structure**

Trip Length (kilometer)	Fare (INR)	Trip Length (kilometer)	Fare (INR)
0-2	10.00	12-15	50.00
2-4	20.00	15-18	50.00
4-6	30.00	18-21	60.00
6-9	40.00	21-24	60.00
9-12	40.00	>24	70.00

Source: Comprehensive Detailed Project Report for Chennai Metro Rail Phase II, Rail India Technical and Economic Services, March 2020.

18. **Non-fare Revenue.** Non-fare revenue generally varies from 20 percent to 35 percent of the fare revenue of similar projects in India. Non-fare revenue has been cautiously assumed at 20 percent of the farebox revenue in the analysis. Non-farebox revenue resources include advertising revenue, automatic teller machine fees, automated vending machines and income from property development, as per CMRL's non-fare strategy and operations in Chennai Metro Rail phase 1. CMRL has generated non-fare revenue of about 39 percent of the fare revenue in 2019.<sup>8</sup>

19. **Outcome of the Financial Analysis.** Post-tax financial rate of return (FIRR) was calculated based on the above assumptions. The analysis was done in real (or constant) terms, without factoring escalations for costs. Although the revenue assumed an annual escalation factor

<sup>7</sup> Delhi Metro, the oldest metro operating in India, has experienced four fare fixations by the Fare Fixation Committee. Over the past 15 years, the fare for a 12 km trip grew from INR8.0 to INR40.0, as proposed by the committee and accepted by Delhi Metro, implying a compound annual growth rate (CAGR) of 11.33 percent per year (nominal value). As regards the annual increase in nominal fares, for the Mumbai Metro Rail Systems Project, the Asian Development Bank considered a CAGR of 7.5 percent (nominal value) in metro ride fares, the same as that assumed by the project team in the financial rate of return analysis.

<sup>8</sup> CMRL. 2019. [Annual Report 2018-2019](#). Chennai.

(7.5 percent per annum), the same was deflated at an assumed domestic inflation rate to the base year that was reckoned for financial analysis. The evaluation results show that the post-tax real FIRR is 6.13 percent for corridor 5, including consideration of salvage value behind initial and operational life additions to the capital assets.<sup>9</sup>

20. NPV was worked out at negative USD33.9 million. Albeit marginal, negative NPV indicates a loss to CMRL from corridor 5 under a discount rate assumption that equaled the benchmark rate of return to the opportunity cost: i.e., if the capital invested in the project was invested elsewhere by the sponsors of corridor 5. The current yield on a 10-year Government of India security was used as the hurdle rate for NPV calculations and, at 6.24 percent,<sup>10</sup> it worked out marginally higher than FIRR, at 6.13 percent, resulting in a slight negative NPV. The average of the operating ratio at 17 percent over the study period indicates financial viability.<sup>11</sup> Given that farebox revenue is the main benefit stream from the project investment, fare escalation and ridership projections will have a crucial impact on FIRR and NPV (Table A3.6).

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<sup>9</sup> The FIRR was calculated on an after-tax basis, assuming a tax rate of 26 percent, as per CMRL. 2019. [Annual Report 2018-2019](#). Chennai.

<sup>10</sup> Trading Economics. [India Government Bond 10Y](#). (Accessed Aug. 20, 2021.)

<sup>11</sup> Calculated as operating expenses over total operating revenue (farebox and non-farebox) revenue.



**Table A3.7: Financial Evaluation and Sensitivity Analysis**

<b>Scenario</b>	<b>FIRR</b>	<b>NPV</b> (USD million)
Base case	6.13 percent	(33.9)
Revenue decreases by 10 percent	5.44 percent	(239.2)
Decrease in annual fare escalation by 100 bps (7.5 percent in base case decreased to 6.5 percent)	5.19 percent	(298.5)
Decrease in annual fare escalation by 200 bps (7.5 percent in base case decreased to 5.5 percent)	4.22 percent	(522.3)
Increase in capital cost by 10 percent	5.60 percent	(209.7)
Increase in capital cost by 25 percent	4.91 percent	(473.4)
Increase in O&M cost by 10 percent	6.04 percent	(63.0)
Increase in capital cost and O&M cost by 10 percent	5.51 percent	(238.8)
Increase in capital cost and O&M cost by 10 percent and reduction in revenue by 10 percent	4.83 percent	(444.1)
Increase in capital cost, O&M cost by 10 percent, reduction in revenue by 10 percent and reduction in annual fare escalation by 100 bps to 6.5 percent (nominal)	3.86 percent	(682.3)

bp = basis point, FIRR = financial rate of return, NPV = net present value, O&M = operation and maintenance.  
Source: AIIB.

## Annex 5: Gender Analysis

### A. Gender Equality in Chennai

1. In India, gender inequality is significant. The World Economic Forum has ranked India 140 (score of 0.625 with parity being 1.0) among 156 countries in the 2021 Global Gender Gap Report. One of the major factors for India's poor performance is the large gender gap in economic opportunities and participation (score of 0.326). Low level women participation in the labor market (22.3 percent) and wage disparity for similar work are the two major attributes for the large economic opportunity and participation gap.

2. The Government of India and State Governments have prioritized Gender, Disability and Social Inclusion in all infrastructure related projects implemented in India. In particular, the Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013 provides protection against sexual harassment of women at workplace and for the prevention and redressal of complaints of sexual harassment.

3. Tamil Nadu is one of the best performing states on gender equality in India. Women's contribution to the state economy is significant. Female labor force participation rate in the state is higher than the national average. The participation rates in rural and urban areas are roughly 15 percent and 8 percent higher than Indian averages. Nonetheless, women's effective participation in the workforce and their transition to formal employment opportunities continues to remain a challenge. With respect to GBV, 42.2 percent of ever married women aged 18-49 experienced spousal violence.<sup>1</sup> Also, National Crime Records Bureau noted rise in crime against women and children during the pandemic.

4. Tamil Nadu has undertaken positive steps in reducing gender inequality and promoting women's empowerment. The State has drafted a new policy for women<sup>2</sup> in end-2021, which is awaiting government approval. The guiding principles of the policy include enhancing access [of women] to all services (e.g., health, education, employment, skills and training) and elimination of violence against women. Core policy objectives comprise increasing women's participation in workforce leading to 40% share of Gross State Domestic Product and providing safe and women friendly public spaces and workspaces.

5. The State's policy for women has envisioned the creation of 10,000 jobs for women and conducting regular third-party gender safety audit to ensure safe workspaces for women and setting up of an Internal Complaints Committee as required by the Law<sup>3</sup>. Government has also launched a "free bus travel for women" scheme which has increased the share of women passengers in town buses from 40 percent to 61 percent. Furthermore, the Greater Chennai Corporation has set up a gender and policy lab, under the Chennai City Partnership project, which is jointly financed by the World Bank and the AIIB. The objective of the lab is to make Chennai

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<sup>1</sup> National Family Health Survey-5 (2019-21), [http://rchiips.org/nfhs/NFHS-5Reports/NFHS-5\\_INDIA\\_REPORT.pdf](http://rchiips.org/nfhs/NFHS-5Reports/NFHS-5_INDIA_REPORT.pdf).

<sup>2</sup> [https://cms.tn.gov.in/sites/default/files/documents/TN\\_Policy\\_Women\\_2021\\_draft.pdf](https://cms.tn.gov.in/sites/default/files/documents/TN_Policy_Women_2021_draft.pdf)

<sup>3</sup> The Prevention of Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013. <https://legislative.gov.in/sites/default/files/A2013-14.pdf>

safer and bring gender inclusivity in projects.

6. According to the Periodic Labor Force Survey 2017-2018, 77.1 percent of employment in India is non-regular, either self-employment or casual, with another 13.7 percent in regular jobs that lack social protection. Thus, between 364 million to 473 million workers risk being adversely affected by external shocks, including the pandemic. In particular, women represent a larger share in informal economy, with increased vulnerabilities due to lack of social safety nets. A high-frequency employment survey indicates a sharp increase in unemployment rate from 7.9 percent in January-March 2020, i.e., the quarter preceding the lockdown, to 18.5 percent in April-June 2020, when the lockdown policy measures were most stringent. With the easing of restrictions, the unemployment rate improved and averaged 7.2 percent from July 2020 to March 2021. Localized restrictions on account of the second wave again pushed up the unemployment rate to 11.9 percent in May 2021. While it has since declined, the unemployment rate remains above pre-pandemic levels.

7. In CMRL, 120 women employees are currently working on a contract out of 504 employees. Women employees are employed in all fields i.e. Systems, Operations, Maintenance, Projects, HR and Finance, etc. The reservation prescribed by the Government for women category is being followed whenever recruitment for Operation & Maintenance on a permanent basis is conducted. Despite efforts, there is room for improvement to strengthen women's leadership in higher leadership/managerial positions.

## **B. Gender Strategy**

8. Gender disparities remains deep and persistent in India, including equitable access to infrastructure and services, work-force participation such as in the construction sector, and GBV in domestic and public areas. In this context, the gender strategy under the project is based on the following principles: (a) project gender interventions will be aligned with the state's policy, strategy and plan; (b) the project will maximize the gender related interventions within its scope and timeframe; (c) interventions will only include those that are practical and implementable within the project timeframe; (d) the use of governments entities in gender related interventions will be given priority in order to ensure intervention sustainability; and (e) indicators to monitor the gender related interventions will be simple and easily monitorable.

9. The Gender Strategy aims to take active steps to integrate gender and inclusion dimension in the design, implementation and operation of the project by constructing gender and universal access features, thereby closing gender gaps as well as advancing gender equality and women's empowerment.

10. The Gender Strategy is aligned with the Chennai Metropolitan Area CMP 2019 of attaining people-centric transport system that provides integrated, safe and convenient mobility to all transport users, especially women, children, and other vulnerable groups. Implementation of GAP ensures effective gender mainstreaming and integration of gender-responsive planning and practices.

11. The project will work closely with Gender Lab, supported by AIIB and World Bank as part of Chennai City Partnership Project. CMRL will form a Gender Equality and Social Inclusion (GESI) committee to amplify gender impacts of the projects as well as address any gender-specific

concerns. A Gender Consultant will also be recruited at the beginning of 2023 on a part time basis to support the implementation of GAP. Additionally, the project will appoint a Gender Focal Person within the CMLR team, supported by the GC's Social and Environmental team to lead the implementation of GAP.

### **C. Gender Action Plan (GAP) and Gender-related indicators**

12. The GAP has been developed in consultation with the key project stakeholders and based on a survey of existing women employed in the metro that was carried out to understand the additional facilities that women want for their safety and comfort of travel.

13. The GAP is compliant with GOI's Acts and Guidelines. Activities included in the GAP can be drivers of change and contribute to positive gender results.

14. The GAP activities are grouped under the following four areas:

- (i) Ensuring gender friendly and accessible infrastructure. The project will develop accessible and gender-friendly infrastructure to vulnerable users including women, persons with disabilities and other vulnerabilities. It is proposed that the metro stations will include the following features: (i) CCTV, (ii) nappy changing facility (only in 5 stations), (iii) accessible toilet for persons with disabilities and (iv) women's helpline number, (v) access ramps and (vi) lifts or escalators.
- (ii) Creating safe public and workspaces. The project will take action to make the working conditions and project constructed public spaces safe, mitigating any GBV/SEA risks. Perception surveys, public consultations with women, local groups and networks affected by the project will be conducted to capture women's voices and any grievances. These activities will allow to identify gender-specific opportunities, gaps, recommendations and learnings to feed into future project design.
- (iii) Enhancing employment opportunities for women. The project will proactively take actions to maximize employment opportunities of women in construction and O&M activities by job-oriented skills training for women such as campaigns, trainings, etc.
- (iv) Enhancing capacity and strengthening institutional capacity on gender. The project will propose gender sensitization training to project staff to help understand the basic concepts related to gender; the ways gender can be integrated into infrastructure planning and implementation; and to improve gender balance in the transport sector. The following activities are expected to be undertaken:
  - Conduct one public consultation on a half yearly basis with women's groups and networks to capture women's voices and any grievances, also reiterated in the Environmental and Social Management Plan.
  - Conduct two awareness raising campaigns and/ or awareness raising workshops on gender and transport related issues per year.

- Organize annual capacity building workshop for at least 50 project staff on gender-responsive project design, management and M&E.
- Based on the field situation, provide livelihood development skills trainings for women, transgenders and vulnerable groups, especially from the vulnerable HHs impacted by the project.

15. Furthermore, throughout the project implementation and operations phase, consultations will continue to be participatory and gender responsive. To enhance women's meaningful representation and capture their voices and grievances, one woman representative of the local community from each station is identified as a member of the Environmental and Social Grievance Redressal Committee. The representative(s) from the location(s) to which the grievance(s) pertain(s) shall be invited to deliberations of the Committee. Increased participation in community-based management of stations will be encouraged. Women shall be invited and trained to contribute to community-based station management as well as secure gainful employment with agencies who are awarded contracts for station facility management.

16. Following are the gender indicators proposed for the project:

- 2 out of 23 project stations designated to be fully operated by women,
- 30% of staff during project operations stage, including depots, are women,
- 75% percentage of female passengers satisfied with station facilities and services during operations,
- 23 stations incorporate the following gender-friendly and universal accessible features: (i) CCTV, (ii) nappy changing facility (only 5 stations out of 23), (iii) accessible toilet for persons with disabilities, (iv) women's helpline number, (v) access ramps and (vi) lifts or escalators,
- 50 project staff trained on gender-sensitive transport project design and implementation.

## Annex 6: Member and Sector Context

### A. Country Context

1. India's economy grew at a healthy rate of 7.4 percent from FY2014 to FY2018. However, growth had steadily slowed in the years preceding the pandemic owing to disruptions due to the demonetization, teething implementation issues related to the rollout of the goods and services tax, rural sector distress and stresses in corporate and financial sector. COVID-19 pandemic and the associated social-distancing measures significantly impacted growth in FY2020. India's gross domestic product (GDP) contracted by 6.6 percent in FY2020. The economy recovered strongly in FY2021 with the easing of lockdown restrictions and grew by 8.7 percent in FY2021.

2. Economic contraction significantly impacted some of the most vulnerable sectors and reversed many of the impressive socioeconomic gains made over the last two decades. From 2004-2005 to 2011-2012, poverty rates fell from 39.9 percent to 22.5 percent and are estimated to have further fallen to 8.1-11.3 percent by 2017.<sup>1</sup> However, recent household data from the Centre for Monitoring Indian Economy indicate that job losses due to the COVID-19 pandemic are likely to have pushed up poverty rates to levels last seen in 2016, implying about four years of setback in poverty reduction efforts. The World Bank estimates that the COVID-19 pandemic resulted in an increase in the overall poverty rate by about 2.5 percentage points in FY2020.

3. According to the Periodic Labor Force Survey 2017-2018, 77.1 percent of employment in India is non-regular, either self-employment or casual, with another 13.7 percent in regular jobs that lack social protection. Thus, from 364 million to 473 million workers risk being adversely affected by disruptions caused by the pandemic. A high-frequency employment survey indicates a sharp increase in unemployment rate from 7.9 percent in January-March 2020, i.e., the quarter preceding the lockdown, to 18.5 percent in April-June 2020, when the lockdown policy measures were most stringent. With the easing of restrictions, the unemployment rate improved and averaged 7.2 percent from July 2020 to March 2021. Localized restrictions on account of the second wave again pushed up the unemployment rate to 11.9 percent in May 2021. While it has since declined, the unemployment rate remains above pre-pandemic levels.

4. India's economy is expected to recover strongly from the pandemic, growing by about 6.5 percent in the next few years.<sup>2</sup> Growth is expected to be assisted by improvement in the business climate, rapid urbanization, a unified tax regime and favorable demographics. At the same time, achieving a high rate of growth will be contingent on addressing key bottlenecks and emerging challenges, including creating jobs by raising competitiveness, resolving infrastructure bottlenecks, bridging the skill deficit, improving institutional capacities and mitigating environmental degradation.

5. Bridging the infrastructure gap is vital for India to achieve rapid and inclusive growth in a sustainable manner. According to Global Infrastructure Outlook, India needs USD4.5 trillion in

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<sup>1</sup> World Bank. 2020. [South Asia Economic Focus, Fall 2020: Beaten or Broken? Informality and COVID-19](#). Washington, DC.

<sup>2</sup> International Monetary Fund. 2022. World Economic Outlook Database.

investment in infrastructure in 2015-2040, with transport accounting for nearly a quarter of that.<sup>3</sup> The Government of India's Strategy for New India @75 outlines goals to expand the urban road network, improve roads and reduce the number of road accidents by 50 percent by 2022-2023.<sup>4</sup> The government is, therefore, taking a nine-pronged approach involving (a) expanding the road network to improve connectivity, (b) improving road maintenance and safety, (c) streamlining land acquisition processes, (d) developing skills, (e) increasing the emphasis on research and development, (f) enhancing public transport, (g) expanding electronic toll collection, (h) completing rural connectivity targets and (i) increasing the adoption of technology between different modes of transport. The government plans to transform road transport and promote public transport, make more public funding available for public transport and work with subnational bodies to promote technology-enabled bus ports. The Report of the Task Force on National Infrastructure Pipeline projects total infrastructure investment of about USD1.9 trillion in 2020-2025 for India to become a USD5 trillion economy. More than a third of the investment is required in transport, including USD222 billion for urban metros.

6. Despite the ambitious targets, urban transport infrastructure has not kept pace with economic growth, resulting in road congestion, falling road speeds, increasing air pollution, stretched road capacity, reduced road safety and strained public transport systems.<sup>5</sup> Public transport systems often operate in silos and fragments and not as integrated systems. Expansion of public transport fleets has been hampered by the short supply of vehicles as well as the lack of reform of policies, which give preference to private vehicles and road expansion at the cost of strengthening public transport. The lack of designated spaces for public motorized transport systems reduces their time efficiency. Women face significant safety challenges in using public transport, which hampers their access to education and employment.

7. Tamil Nadu is the second-largest contributor to India's economy after Maharashtra and is one of the more developed states in India, with a per capita income of INR225,106 (USD3,000) in FY2020, nearly 50 percent higher than the national average. Tamil Nadu is the most urbanized large state, with an urban population accounting for 48.4 percent of the total population in 2011, which is expected to rise to 63 percent by 2030. Most of the state's GDP is generated in urban areas, as reflected in services and industry accounting for nearly 88 percent of the state's GDP. As in other states, buses are the most common form of public transport. More than 20,000 bus fleets are operating in the state. The public transport system has not been able to keep up with the pace of urbanization. Citizens are forced to use modes of private transport, resulting in greater congestion and more accidents. Estimates indicate that in Chennai, the state's capital city, the average vehicle movement speed fell from 30 kilometers (km) per hour in 1993 to 19 km per hour in 2017. A rise in number of private vehicles caused total accidents to increase from 5,060 in 2009 to 7,257 in 2017, while fatal accidents increased from 582 to 1,264.

8. Chennai is on the shores of the Bay of Bengal and is the fourth-largest city in India. It has grown as a base for the automobile, information technology, hardware manufacturing and health-care industries. Chennai is one of the world's fastest-growing cities and its economy is projected

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3 Oxford Economics and Global Infrastructure Hub, July 2017. [Global Infrastructure Outlook, Infrastructure Investment Needs, 50 countries, 7 sectors to 2040](#)

4 NITI Aayog, 2018 [Strategy for New India @75](#), New Delhi, India

5 Knight Frank Research, 2020 [India Urban Infrastructure Report 2020](#), Mumbai, India

to grow by more than 8 percent annually from 2019 to 2035. However, the city has been vulnerable to climate change, natural disasters and, more recently, the COVID-19 pandemic. The floods of 2016, Cyclone Gaja in 2018, droughts in 2018 and 2019 and the COVID-19 pandemic have caused significant economic and human losses and negatively affected infrastructure and service delivery.

## **B. Sector and Institutional Context**

9. The transport system in Chennai Metropolitan Area (CMA) is marked by high traffic density and carbon emissions and frequent road accidents. In addition to the high volume of vehicles and already congested roads, inadequate parking space and the encroachment of street space by vendors on the major road have exacerbated traffic congestion. The growth in the use of private vehicles has put Chennai in fifth place for transport carbon emissions among 54 South Asian cities.<sup>6</sup> Chennai has the highest number of road incidents in India, with a staggering 7,846 cases recorded in 2016.<sup>7</sup>

10. Chennai offers multiple modes of public transport, including metro rail, suburban rail and buses, although they operate in isolation, with separate ticketing systems and poor integration between the modes. In 2011, the Chennai Unified Metropolitan Transport Authority (CUMTA) Act was passed to integrate the entire network under a single operator. However, the act and CUMTA rules came into force only in 2019. A USD150 million program to improve sustainable urban services approved by the World Bank in 2021 will help CUMTA coordinate transport across different modes and agencies, with emphasis on delivering seamless mobility services.<sup>8</sup>

11. Inadequate transport infrastructure and poor maintenance have resulted in a marked decrease in the share of the use of public transport, from 54 percent in 1970 to 28 percent in 2014.<sup>9</sup> The Chennai Second Master Plan 2026 proposes to increase the public and private mode split to 70:30. Mass transit, especially an integrated metro system, will be essential to achieve the target modality split.

12. Chennai's metro rail system began operations in 2015 with phase 1 spanning 54 km in two corridors linking the city's north and south, including a connection to Chennai Airport. The Chennai metro was financed by the Government of India, the Tamil Nadu government and the Japan International Cooperation Agency. Phase 2, which features three additional corridors, is now under development, with AIIB participating as a potential financier for corridors 4 and 5. The metro rail system is implemented, operated and maintained by Chennai Metro Rail Limited (CMRL).

13. Chennai metro ridership dropped significantly during the COVID-19 lockdown. With economic activity picking up further during the previous year, average daily ridership reached 180,000 in September 2022<sup>10</sup>.

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<sup>6</sup> ICLEI, 2012, 2012. [Creating Carbon Neutral Chennai: Planning for Integrated Freight Movement](#), New Delhi, India

<sup>7</sup> NCRB, 2016 [Accidental Death and Suicides in India \(ADSI\)](#), National Crime Records Bureau, New Delhi, India

<sup>8</sup> World Bank. 2021. [New World Bank Project to support southern Indian city of Chennai deliver better services to its people](#). Sep. 30.

<sup>9</sup> Comprehensive Detailed Project Report for Chennai Metro Phase-II, Chennai Metro Rail Limited, December 2018.

<sup>10</sup> The Times of India, September 13, 2022. [Chennai Metro Rail records highest single day footfall post Covid-19](#)

14. **Institutional Context.** CMRL is a joint venture of the Government of India and the Tamil Nadu government with equal equity ownership. In 2015, CMRL developed the comprehensive mobility plan for CMA based on present and future mobility patterns and identified three corridors (3, 4 and 5) for Chennai Metro Rail phase 2 to alleviate growing transport capacity constraints.

15. Separately, the elevated metro railway in Chennai is operated by the Mass Rapid Transit System (MRTS), a state-owned subsidiary of Indian Railways. MRTS is operated by Southern Railway, which also operates Chennai Suburban Railway as part of a broader urban rail network. The public bus network is operated by the Metropolitan Transport Corporation. These agencies coordinate with the Chennai Metropolitan Development Authority on activities such as land acquisition for expansion purposes.

16. CUMTA should serve as the unified transport authority, the basis for which was introduced by the central government in 2006 in the National Urban Transport Policy to build sustainable urban transport in cities, among other objectives. The policy recommended that a unified metropolitan transport authority be established in every city with a population of more than one million. Subsequently, the Tamil Nadu government passed the CUMTA Act in 2011. However, a decade later, CUMTA has yet to be operationalized, with agencies continuing to operate different modes of transport separately.<sup>11</sup> CUMTA has many benefits, including physical, network, fare, information, geographical and institutional integration across urban transport.

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<sup>11</sup> The News Minute. 2020. [Why Chennai's dream of a single transport authority remains unfulfilled](#). Jan. 29.

## Annex 7: Sovereign Credit Fact Sheet

### A. Recent Economic Development

1. India is a lower-middle-income country, with a GDP per capita at USD 2277.4 and a population of 1.39 billion in 2021.<sup>1</sup> India's economy grew at an average annual rate of 7.4 percent between FY2014 and FY2018 but slowed down in the years before the pandemic following disruptions due to demonetization, rollout of goods and services tax, rural distress and stress in the financial sector.<sup>23</sup> India's GDP contracted by 6.6% in FY2020 (year ending March 2021) on account of stringent lockdown restrictions imposed during the first half of the year. Even though the second wave (April-June 2021) of the pandemic was more severe than the first wave (April-June 2020), the government opted for localized restrictions. With increased mobility and favorable base effect, the Indian economy grew by 8.7% in FY2021 even with the Omicron wave happening in January 2021. GDP grew by 13.5 percent in the first quarter of FY2022 on account of pent up demand and a favorable base effect but is expected to slowdown in subsequent quarters due to monetary tightening and weak global demand.
2. Inflation averaged 6.2 percent in FY2020, primarily driven by food inflation due to supply side disruptions. As a response to the pandemic, the Reserve Bank of India (RBI) reduced key policy rates and introduced measures to reduce the borrowing cost, bolster liquidity, and improve credit flow to the productive sectors. Policy rates remained unchanged with the RBI maintaining an accommodative stance between August 2020 and April 2022. With inflation rising since the last quarter of FY2021, the RBI raised the repo rate by a cumulative 150 basis points since March 2022. Inflation averaged 7.2% in the first half of FY2022 and is likely to gradually ease in the second half. The currency depreciated by 10 percent between January and October 2022, primarily due to capital outflows as a response to monetary tightening in advanced economies.
3. A downturn in revenue due to economic slowdown and higher spending on the stimulus package resulted in the fiscal deficit widening significantly to 12.8 percent of GDP in FY2020. Overall deficit moderated to 9.9 percent in FY2021. Revenue collection grew at 32 percent in FY2021, at a pace higher than expected pace due to buoyant tax revenues. This allowed capital expenditure to increase by 39.3 percent in FY2021, well above the initial target of 30 percent. Fiscal deficit during April to August 2022 accounted for 32.6 percent of the annual targeted deficit with both revenue and expenditure being on course to reach targeted levels. High fiscal deficit in FY2020 and FY2021 resulted in the public debt rising to close to 90 percent of GDP but is expected to remain stable in the medium term.
4. After posting a surplus in FY2020, the current account reverted to a deficit of 1.2 percent of GDP in FY2021 as merchandise imports surged while services exports remained stagnant. Private transfer, including remittances, remained strong with net inflow of USD 81.2 billion in FY2021. Net FDI inflows remained robust at USD 38.5 billion. During Q1 of FY2022, the current account deficit widened to 2.8 percent of GDP mainly due to the widening of trade deficit. Although remittances and net FDI inflows remained robust, foreign portfolio investment recorded net outflows. External debt stood at USD 617.1 billion in June 2022. India's reserve holdings declined

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<sup>1</sup> The income group classification for fiscal year 2020 is based on World Bank criteria.

<sup>2</sup> Data are based on fiscal years. Fiscal year 2021 (FY2021) begins on 1 April 2021 and ends on 31 March 2022.

<sup>3</sup> On Nov. 8, 2016, India's government announced withdrawal of the legal tender of INR500 and INR1,000 notes, which accounted for 86 percent of the value of currency in circulation, and introduction of new INR500 and INR2,000 notes.

by 16.5 percent since January 2022 to USD 528.4 billion as the central bank aimed to reduce currency volatility. Reserves remain adequate according to conventional measures.

5. In June 2022, Fitch revised India's outlook to stable in line with Moody's and S&P, while retaining the BBB- rating. In June 2020, Moody's downgraded India's rating to Baa3 with a negative outlook but revised the outlook to stable in October 2021 while retaining the Baa3 rating. In July 2021, S&P retained India's rating at BBB- with a stable outlook.

## B. Economic Indicators

### Selected Macroeconomic indicators (2019-2022)

Economic Indicators	FY2019	FY2020	FY2021	FY2022*	FY2023*
Real GDP growth	3.7	-6.6	8.7	6.8	6.1
CPI Inflation (average, % change)	4.8	6.2	5.5	6.9	5.1
Current account balance (% of GDP)	-0.9	0.9	-1.2	-3.5	-2.9
General government overall balance (% of GDP)	-7.5	-12.8	-9.9	-9.8	-9.0
General government gross debt (% of GDP)	75.1	89.2	84.2	83.4	83.8
Public gross financing needs (% of GDP)	11.6	17.2	16.5	15.2	14.4
External debt (% of GDP)	19.5	21.4	21.8	21.7	
Gross international reserves (USD billions) 2/	475.6	579.3	617.6	528.4	
Exchange rate (INR/USD, EOP) 2/	75.4	73.5	75.8	82.4	

Note: FY 2021 ran from April 1, 2021 to March 31, 2022

\* denotes projected figures

1/Data for 2021-22 are AIIB Staff Projections based on IMF

2/Reserves and exchange rate are sourced from RBI and pertain to mid-October 2022.

Source: IMF World Economic Outlook October 2022, Reserve Bank of India, and IMF Country Report 21/230.

## C. Economic Outlook and Risks

6. The economy is expected to grow at 6.8% and 6.1% in FY2022 and FY2023 respectively, according to IMF. The severity of the COVID-19 pandemic is expected to subside with a pickup in vaccination rate. However, an expected global recession and further monetary tightening as a response to fighting domestic inflation would curb demand. Private consumption will be affected as higher inflation erodes away purchasing power. The government's subsidized food, fertilizer and gas distribution will help offset some of the effects of high inflation. High policy rates may constrain investment spending. Agriculture growth may be subdued due to uneven monsoon and lower sown area while higher borrowing cost and commodity prices may impact manufacturing sector.

7. Overall inflation is expected to remain elevated at around 6.9 percent in FY2022 before moderating to 5.1 percent from FY2023 onwards due to easing of commodity prices. In May 2022, the RBI indicated withdrawal of its accommodative stance in response to sustained inflation. Persistent domestic inflation and the fear of imported inflation through strengthening of the dollar may push the RBI to further raise interest rates.

8. General government fiscal deficit in FY2022 is expected to moderate to 9.8 percent of GDP as tax revenues increase on the back of improved economic activity. Fiscal pressures could strengthen due to rising subsidy burden and as an hikes in policy rate increase the cost of borrowing.

9. Public debt, which rose sharply to 89.2 percent of GDP in FY2020, levels last witnessed in early 2000s, moderated to 84.2 percent of GDP in FY2021 and is expected to remain stable in the medium term. Despite being high, India's public debt remains sustainable given favorable debt dynamics and the projected economic growth trend in the medium term. Furthermore, with public debt having a long and medium maturity, being denominated in domestic currency, and primarily held by residents, the debt profile is favorable. India's external debt is expected to remain stable.

10. The current account deficit is projected at 3.5 percent of GDP for FY2022 owing to a slower than expected export growth due to the global slowdown and a higher import bill. Remittances may remain strong as a depreciating rupee makes remittances more lucrative.