ASIAN INFRASTRUCTURE INVESTMENT BANK

PD000357-CHN
June 24, 2021

Project Document
of the Asian Infrastructure Investment Bank

Sovereign-backed Financing

The People's Republic of China
Guangxi Chongzuo Border Connectivity Improvement Project

Currency Equivalents
(As of Jan. 27, 2021)

Currency Unit – Chinese Yuan (RMB)
RMB1.00 = USD0.15
USD1.00 = RMB6.48

Borrower's Fiscal year
Jan. 1 – Dec. 31

Abbreviations

AIIB	Asian Infrastructure Investment Bank
ADB	Asian Development Bank
CDB	China Development Bank
GCUCIDG	Guangxi Chongzuo Urban Construction Investment Development Group Co., Ltd.
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESP	Environmental and Social Policy
ESS	Environmental and Social Standard
FM	Financial Management
GDP	Gross Domestic Product
GRM	Grievance Redress Mechanism
IA	Implementing Agency
IE	Implementing Entity
IU	Implementing Unit
km	Kilometer
m	Meter
MDB	Multilateral Development Bank
MOU	Memorandum of Understanding
NDB	New Development Bank
PDS	Project Delivery Strategy
PIO	Project Implementing Office
PLG	Project Leading Group
PMO	Project Management Office
PP	Procurement Plan
WB	World Bank

Contents

1. Summary Sheet

The People's Republic of China
Guangxi Chongzuo Border Connectivity Improvement Project

Project No.	000357
Project Name	Guangxi Chongzuo Border Connectivity Improvement Project
AIIB Member	China
Borrower	The People's Republic of China
Project Implementing Entity	Guangxi Zhuang Autonomous Region
Sector	Transport
Subsector	Roads
Project Objective	To improve the cross border connectivity around Shuolong port and expand economic and trade activities between China and Vietnam.
Project Description	The project will comprise four components: • Component A: Construction of the last section of the Wuzhou - Shuolong Expressway with a total length of 17.679 km. • Component B: Improvement of an existing border road with a length of 13.632 km connecting Shuolong Port to the Detian (Pan Gioc) Waterfall scenic spot. • Component C: Construction of the Shuolong Port (Shuolong Main Gate-Phase 2). • Component D: Technical support and project management.
Implementation Period	Indicative Start Date: Oct. 2021 Indicative End Date: Oct. 2026
Expected Loan Closing Date	April 2027
Cost and Financing Plan	The estimated project cost: USD457.5 million Financing Plan: AIIB Loan: USD300 million Government's Counterpart Funds: USD 157.5 million
Size and Terms of AIIB Loan	EUR 249 million[1] (approximately USD 300 million equivalent) The loan will have a maturity of 30 years, including a grace period of five years, with standard terms for AIIB sovereign-backed loans.
Environmental and Social Category	A
Risk (Low/Medium/High)	High

[1] The Loan amount is denominated in EUR, however, the costs and funding in this report will still be presented in USD with the exchange rate applied of USD 1=EUR 0.83, the exchange rate as of April 21, 2021, when the project obtained IC appraisal approval.

Conditions for Effectiveness	A Subsidiary Agreement has been executed by and between the Implementing Agencies and the Implementing Unit, under terms and conditions acceptable to the Bank.
Key Covenants	Selection of a consultancy for resettlement monitoring before commencement of any land acquisition or resettlement work. Selection of a consultancy for environmental and social monitoring before awarding the first civil contract
Retroactive Financing (Loan % and dates)	Up to 20 percent of the loan amount, for expenditures incurred within 12 months prior to the loan signing date.
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that the Bank is in compliance with the policies applicable to the Project.

President	Jin Liqun
Vice President	Konstantin Limitovskiy, Investment Operations Region 2
Director General, Department	Supee Teravaninthorn, Infrastructure Investment Department, Region 2
Manager	Gregory Liu, Infrastructure Investment Department, Region 2
Team Leader	Anzheng Wei, Investment Officer
Team Members	Bernardita Saez, Sr. Counsel Chongwu Sun, Sr. Environmental Consultant Geng Yi, Sr. Financial Management Specialist Matthew Smith, Digital Technology Consultant Mengmeng He, Financial Associate Susrutha Goonasekera, Sr. Social Development Specialist Wenlai Zhang, Transport Consultant Yasuhiro Kawabata, Highway Consultant Youxuan Zhu, Social Development Consultant Yunlong Liu, Sr. Procurement Specialist Yuyou Guo, Project Assistant

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2. Project Description

A. Project Overview

1. **Project Objective.** The objective of the project is to improve the cross border connectivity around Shuolong port and expand economic and trade activities between China and Vietnam.

2. **Project Description**. The project will comprise four components:

- Component A: Construction of the last section of the Wuzhou - Shuolong Expressway with a total length of 17.679 km, starting from the Neitun Interchange, which is the crossing point with the existing Chongzuo-Jingxi Expressway, and ending at the Shuolong Port bordering with Vietnam.

- Component B: Improvement of an existing border road with a length of 13.632 km connecting Shuolong Port to the Detian (Pan Gioc) Waterfall scenic spot, which is a Cross-border Tourism Cooperation Zone.

- Component C: Construction of the Shuolong Port[1] (Shuolong Main Gate-Phase 2), including the approaching road, parking space, inspection service buildings and relevant facilities, and landscaping at the Shuolong Main Gate.

- Component D: Technical support and project management, including the pilot based Infrastructure Technology (Infratech) application in the project to improve the asset management across the infrastructure lifecycle, and the required consulting service and capacity building to enhance the project implementation.

3. **Expected Results.** Expanded economic activities, including trade and tourism, would be measured by: (a) reduction in heavy trucks travel time between Neitun Interchange and Shuolong Port (Yanying Gate); (b) increase in the annual volume of cross-border trade between China and Vietnam at Shuolong Port; (c) increased number of in/out travelers at Shuolong Port; (d) reduced passenger customs passing time at Shuolong Port (Main Gate); (e) reduced passenger travel time between Neitun Interchange and Detian Waterfall scenic spot; and (f) increased number of tourists to the Detian (Pan Gioc) Cross-border Tourism Cooperation Zone. The results will be monitored through indicators shown in *Annex 1: Results Monitoring Framework***.**

4. **Expected Beneficiaries**. The project will provide faster and safer roads for domestic and international freight transport and passengers using the road network around the Shuolong Port areas. The main beneficiaries will be the road users and haulage operators, who will travel through the Shuolong Port, and the local road users and bus-passengers, who will travel through the expressway section connected to the highway from Shuolong to Detian with improved connectivity, reduced travel time, less operating and maintenance costs, and improved road safety. The firms and entities in mineral and tourism related industries will also benefit from the investment in the infrastructure financed by the project.

[1] Shuolong Port is a dry port at the border between China and Vietnam.

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B. Rationale

5. **Strategic fit for AIIB.** The project is well aligned with the Connectivity and Regional Cooperation thematic priority in AIIB's Corporate Strategy. It is also aligned with AIIB Transport Sector Strategy, particularly regarding promotion of major transportation linkages and cross-border connectivity. The main component of the proposed project will connect the provincial/national expressway network of China via an upgraded Class I bilateral cross border port with the highway network in Vietnam. It will enhance the cross-border connectivity and promote the economic and trade cooperation of two countries by means of construction of the missing link in the western China - the last section of the expressway connecting the eastern part of Guangxi (Wuzhou City) to the border (Shuolong) in its west. The improvement of the relevant infrastructure and facilities at the Shuolong Port will further enhance the traffic mobility and the processing efficiency at customs of the border port. The project will also improve the accessibility of a cross border International Tourism Cooperation Zone across the border line, which is designed to allow the tourists from both countries to enter into the zone easily and promote the cooperation and connectivity. The project also includes the Infratech component, which is application of technologies that will positively impact throughout the project cycle. This is highly aligned with Bank's thematic priority of technology-enabled infrastructure.

6. **Value addition by AIIB.** The Bank's participation contributes to adopting the international standards and practices, especially in the contract management, procurement, and social and environmental standards by the Implementing Unit in preparation and implementation of its first expressway project. In addition, the Bank's participation has enhanced the quality of the feasibility studies, including the cost estimates and implementation plans, which will strengthen the economic viability and the long-term sustainability of the infrastructure to be invested. Regarding Infratech application in the project, AIIB has worked closely with the client in knowledge sharing and development of the appropriate scope, procurement and financing structure. The Bank will also support the client to achieve the target stated in the China's long-term plan[2], in which the digital technology application in the transport infrastructure is to be increased by 2035.

7. **Value addition to AIIB.** The project would be the Bank's first financing in the transport sector in China. It will enhance the Bank's position to be a strong and reliable partner in transport infrastructure development in the Country. Investment in the road infrastructure and the border port infrastructure under one project could be a learning experience for the Bank to further explore innovative design of the cross-border connectivity projects. It would exert a demonstration effect to other cross-border connectivity investments in China and other countries in the region. As a pilot project adopting Infratech in transportation, the Bank could learn from this project and replicate it in other Bank's financed projects..

8. **Lessons learned**. Guangxi is one of provinces in China that have received significant MDB's financing, including support from ADB, WB and NDB. The Government of Guangxi Zhuang Autonomous Region is very experienced in preparing and implementing MDBs' projects.

[2] In February 2021, Ministry of Transport of China, together with 20 ministries and many experts, compiled China's Plan of National Integrated Transport Network (NITN), which is the first long-term plan including various modes of transport in China. The NITN indicates that by 2035, the digital technology application in the transport infrastructure should be more than 95% in China.

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One of the experience taken into account in this project is the need for the Bank to involve in the project design, starting from the feasibility study stage. Although it may take a bit longer time for project preparation, the benefit outweighs the cost. It allows the client to incorporate Bank's standards and requirement in the initial design of the project which would enhance the quality and the soundness of the project in technical design, cost estimation, and environmental and social compliance. Bank's early involvement would also provide confidence to the client in terms of Bank's commitment to the investment, which would enable the government to streamline their internal process, particularly regarding the government approval procedure of the feasibility study reports. As a Bank's first cross-border connectivity project in China, it was also a good opportunity for Bank to better understand the demand and issues in the border area. The experience gained would be shared with future projects of similar nature in China.

C. Components

9. The project comprises four components：

10. **Component A: Construction of the last section of Wuzhou – Shuolong Expressway (WSE), including design, construction and supervision.** The project section is the last section of the Wuzhou - Shuolong Expressway, from Wuzhou City in the east of Guangxi, through Nanning City, the capital of Guangxi, to Shuolong Port. Upon completion, it will be the shortest route from Nanning to border ports. The section starts from the Neitun Interchange, the intersection of Wuzhou - Shuolong Expressway (S40) and the Chongzuo-Jingxi Expressway (S60) and ends at Shuolong Town. The total length of the project section is 17.679 km, including a 12.263 km expressway (fully access controlled) section and a 5.416 km Class 1 highway (partially access controlled) section.

11. **Component B: Improvement of Detian – Shuolong Road (DSR) including design, construction and supervision.** The proposed work to be undertaken for Detian – Shuolong Road (DSR) is basically improvement and/or rehabilitation of the existing road, with few realignment and new construction of a 395m long tunnel. DSR will adopt flexible design standards to cope with the various road conditions, particularly under the principles of avoiding/minimizing side slope excavations, focusing on treatment of defects and water drainage systems, improving traffic safety and environmental-friendly features. The DSR, with a total length of 13.632km, would consist of: (i) 2-lane section for 9.362 km, from the Detian (Pan Gioc) Cross Border Tourism Cooperation Zone entrance to the Tourism Center; and (ii) a 4-lane section for 4.270 km, from the Tourism Center to Shuolong Port area, intersecting with the connection highway under Component A.

12. **Component C**. **Construction of the Shuolong Port (Shuolong Main Gate-Phase 2) including design, construction and supervision.** The Phase 1[3] of the Shuolong Main Gate has been completed with the government's own funds, and ready for operation. The Phase 2 includes construction of the approaching road, parking spaces, related inspection service buildings and

[3] The Phase 1 of the Shuolong Main Gate has been assessed as not being an associated facility according to the ESF, since construction of Phase 1 is not materially related to the project and is deemed not necessary for the project to be viable.

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relevant facilities, and landscaping at the Shuolong Main Gate. The approaching road under Phase 2 will connect with the road funded under Component A. The main purpose of Phase 2 is to enhance the mobility of the cross-border traffic and reduce the customs processing time at the Shuolong Main Gate.

13. **Component D. Technical Support and Project Management.** This component includes the following: (i) the application of Infratech within the project allows integration of digital technologies such as building information modelling, enabling data analytics to optimize asset management across the infrastructure lifecycle; (ii) engagement of individual consultants or consulting firms to enhance the quality of implementation capacity in order to meet the Bank's standards and requirements, particularly, in bridge and tunnel engineering, environmental and social (ES) implementation and monitoring, digital technology, reporting and language translation etc., and (iii) institutional capacity building, including consulting service, trainings and study tours as needed to enhance the Implementing Agencies' capacity.

D. Cost Estimates and Financing Plan

14. Based on the approved feasibility study reports[4], the total project cost is estimated at USD 457.5 million. It will be further updated[5] incorporating the results from the preliminary/engineering designs, which are currently underway. The project cost estimation and the financing plan are shown in the Table 1 below.

Table 1. Project Cost and Financing Plan

Item	Project Cost (USD million)	Financing Plan (USD million and %)			
		AIIB		Gov.	
Component A: Construction of the last section of the WSE	392.2	260.3	66%	131.9	34%
Component B: Improvement of DSR section	40.8	23.9	59%	16.9	41%
Component C: Construction of Shuolong Main Gate-Phase 2	16.2	10.4	64%	5.8	36%
Component D: Technical support and Project Management	8.3	5.4	65%	2.9	35%
Total Project Cost (Inclusive of VAT and Import Duties):	**457.5**	**300.0**	66%	**157.5**	34%

E. Implementation Arrangements

15. **Implementation period.** The proposed project implementation period is five years, starting in October 2021 and ending in October 2026.

[4] The Feasibility Study Reports (FSR) of three components under the project have been approved by the relevant government authorities (Guangxi Development and Reform Commission). The only difference between costs in FSRs and the PD is the 'interest costs', which are included in FSR costs but not in the PD cost.

[5] Any cost overrun will be fully supported by the additional financing from the government counterpart fund, which was agreed and committed by the government during the appraisal.

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16. **Implementation Management**. The Guangxi Zhuang Autonomous Region will be the **Implementing Entity**. The Chongzuo Municipality and the Daxin County [6] will be the **Implementing Agencies** of the project. The Chongzuo Municipality is responsible for the implementation of Component A and Component D, while the Daxin County is responsible for the implementation of Component B and Component C. The Chongzuo Municipality and the Daxin County will designate Guangxi Chongzuo Urban Construction Investment Development Group Co., Ltd. (GCUCIDG) as the **Implementing Unit (IU)**.

17. The GCUCIDG was created in December 2008 as the only platform representing the Municipality of Chongzuo in the infrastructure development and urban assets management, tourism industry development, trading and other sectors. GCUCIDG is 100 percent owned by the Municipality of Chongzuo. As the IU, GCUCIDG will be responsible for the day-to-day implementation of the project, including procurement, financial management and contract management. The IU will also represent the Implementing Agencies to provide the government counterpart fund for the project. After completion of this project, GCUCIDG will be authorized to represent the Chongzuo Municipality to own the road assets of the last section of WSE, the assets under Component B and Component C will be transferred to Daxin County.

18. The **Project Implementation Office (PIO)**, established in GCUCIDG consisting of a dedicated professional team, will be responsible for the day-to-day implementation of the project. PIO will manage engineering aspect, digital technology application, procurement, contract management, financial management (FM), reporting, and implementation of the environment and social action plans of the project. The PIO is headed by the General Manager of GCUCIDG, and consists of five divisions, namely: technical division, procurement division, ES division, FM division, digital Infratech division and administration division. Each division is staffed with qualified in-house specialists from GCUCIDG together with the support from experienced consultants to be engaged on assignment basis. Engaged consultants are also expected to transfer their knowledge and experience to the junior specialists in GCUCIDG during the day-to-day works in order to enhance the institutional capacity throughout the project implementation. The organization chart for project implementation is shown as below, which has been confirmed and finalized during the project appraisal.

19. The **Project Leading Group (PLG)** was established under the Municipality of Chongzuo in October 2020. The PLG is headed by the Executive Vice Mayor of Chongzuo and comprises heads from the relevant government agencies and institutions of Chongzuo, including Development and Reform Commission (DRC), Financial Bureau, Transport Bureau, National Resources Bureau, Ecological Environment Bureau, Commerce and Port Bureau, Water Conservancy Bureau, Forestry Bureau, GCUCIDG, and the governments of Daxin County and Tiandeng County. The PLG will provide high-level guidance and oversight to the project implementation, specifically in policy and strategy instructions, cross-sector communication and coordination, consultation and resolution of critical issues in order to ensure the smooth implementation and successful completion of the project.

[6] Daxin County is under the administration of the Chongzuo Municipality.

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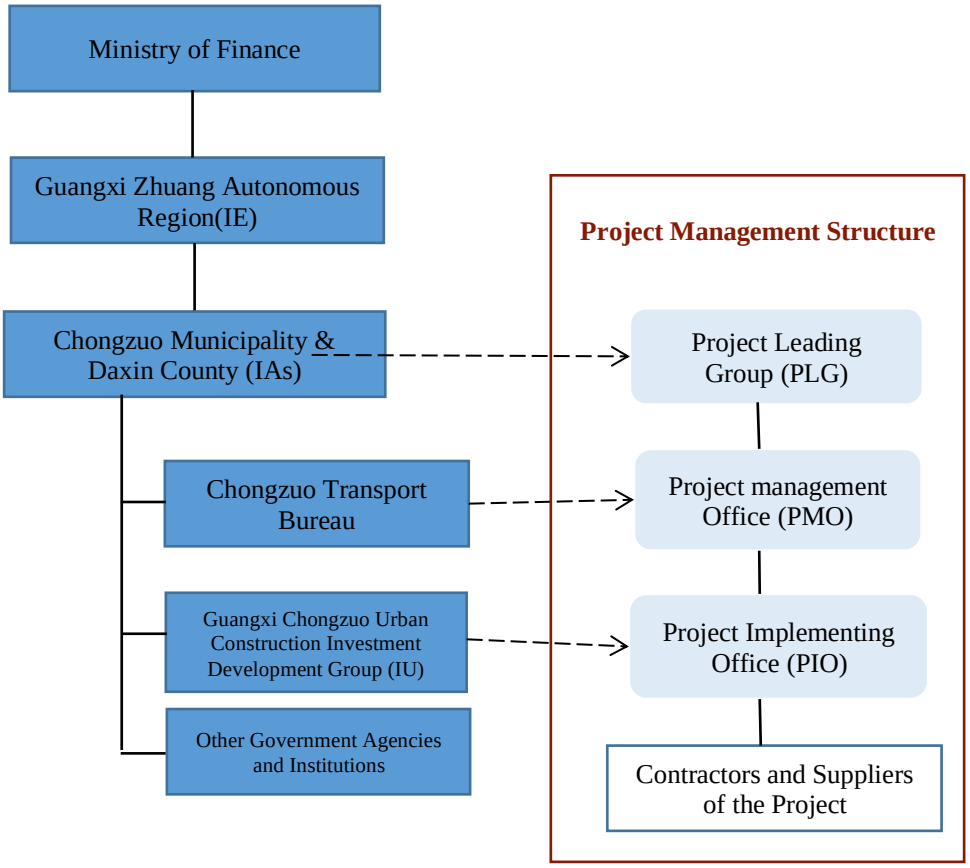
20. Under the PLG, a **Project Management Office (PMO)** has been established. The PMO, headed by Director of the Transport Bureau, is responsible for overall management, monitoring and supervision of the implementation of the Project and ensure that the project implementation is in compliance with national laws, Bank policies and legal agreements of the Project.

Chart 1. Organization Chart for Project Implementation



21. **Operation and Maintenance Arrangements**. Upon completion of the project, as the owner of the road assets, GCUCIDG plans to entrust a professional company to carry out the operation (including toll collection) and maintenance of the road under Component A. Since the road section is relatively short, it is considered not economically viable to establish a full in-house team for the expressway operation and maintenance. Entrusting the professional service to the external entity is deemed as the most suitable option. The maintenance of the road under Component B will be undertaken and funded by two government agencies of Daxin County. The 9.0 km 2-lane section, starting from the Detian Waterfall Scenic Spot to the Tourism Center, will be maintained by Detian Scenic Zone Management Commission, while the 4.6 km 4-lane section from Tourism Center to Shuolong Port, will be by Daxin Transport Bureau. The Component C after its completion will be operated and maintained by Commerce and Port Bureau of Daxin County.

22. **Procurement.** Procurement of goods, works and services financed by the AIIB loan shall be carried out according to AIIB's Procurement Policy (January 2016) as well as the Interim Operational Directive on Procurement Instructions for Recipients (June 2, 2016) (PIR). Given that

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the Implementing Agencies and the Implementing Unit are public entities as defined per AIIB Procurement Policy, the specific procurement provisions under Section II Procurement of Goods, Works and Services by Public Entities under PIR shall apply to procurement of the project.

23. GCUCIDG, as the project IU, has established the PIO to manage the project implementation, including procurement and contract management. The Municipality of Chongzuo (IE) has appointed design institutes to carry out the pre-construction preparation for the project using its own fund. A professional procurement agent familiar with MDB financed projects has been employed to support the PIO in preparation of a project delivery strategy (PDS), procurement plan (PP) and tender documents, as well as the whole procurement process schedule. Contract management capacity would be further strengthened through on-the-job training by construction supervision consultants.

24. IU has prepared a draft Project Delivery Strategy (PDS) and Procurement Plan (PP) for AIIB review, covering specific procurement arrangements, including contract packaging, cost estimates, selection of tender documents, procurement methods, review methods, and procurement timelines, which will constitute the basis for PIO to carry out the project procurement. The draft PDS and PP has been finalized during the project appraisal, and any update of the PDS and PP, regularly or as whenever it is needed, will be submitted to the Bank for review and no objection during the project implementation.

25. Given its large value and technical complexity, the procurement of the major civil works under Component A: the last section of WSE Works contract/s will be carried out through International Open Competitive Tendering (IOCT) method and using AIIB Standard Procurement Document – Procurement of Works (Trial Version). Other goods and works contracts with less value will be procured through National Competitive Tendering (NCT). Under NCT, the client's tender document and national procedures, subject to proper modifications to meet the conditions of National Competitive Tendering and comply with the Core Procurement Principles of AIIB Procurement Policy, will be applied. The procurement of large value consulting services contracts will be carried out through International Open Competitive Selection (IOCS) and Quality & Cost Based Section (QCBS) procedures by using AIIB Standard Procurement Document: Request for Proposals Consulting Services.

26. During the implementation, the Bank team will carry out the procurement oversight of all contracts to be funded by the loan through procurement prior review for large value and complex contracts, and post review for all other contracts on a regular basis. The client will establish a document record management system to keep all procurement related documents in its office for Bank's future review and auditing by the government authority.

27. Retroactive financing will be allowed, subject to the limit of 20 percent of the total amount of the loan and for expenditure incurred not earlier than 12 months prior to the expected signing date of the loan. Any project activities that are considered for retroactive financing will have to be implemented in accordance with the Bank's procurement and its social and environmental policies and requirements. According to the envisaged progress of the project and processing timeline, procurement of some consulting services might start before the expected loan signing date.

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28. **Financial Management.** The project designated financial staff have been assigned in the PIO and IU, and their capacities has been assessed as acceptable. The project financial management system including funds flow arrangements will ensure project funds are properly used. The interim project financial report in the format agreed with the Bank will be prepared and submitted within 60 days following the end of each semester to reflect project implementation status and financial position. The project annual audit report issued by Guangxi Autonomous Regional Audit Office will be submitted to the Bank within six months after the end of the year.

29. **Counterpart Funding.** Counterpart funds comprise earmarked bonds issued by the Financial Department of Guangxi Zhuang Autonomous Region (Guangxi Financial Department) on behalf of GCUCIDG, policy debt provided by China Development Bank–Nanning Branch and special subsidies provided by Guangxi Transport Department. The earmarked bonds will be issued in two batches and the first batch will be issued and provided to GCUCIDG in later part of 2021. The debt from China Development Bank (Nanning Branch) is in a total loan amount of about 15 percent of the total project cost. It was agreed that AIIB policies and standards particularly in the procurement and ES aspects would be strictly followed during the project implementation. The internal approval processing of CDB is underway and it is expected that the final approval of the CDB loan would be secured in July 2021. During the project preparation, the Bank team had good communication with CDB project team and based on the information received, CDB has committed to its support to this project and expressed its willingness to cooperate with AIIB.

3. Project Assessment

A. Technical

30. **Alignment Alternatives Analysis.** For the WSE under Component A, a comprehensive alternative analysis has been conducted to optimize the alignment design, taking into account the topographical, geological, hydrological conditions, as well as the main controlling factors along the route of the Project, such as the start/end locations, planning of towns along the route, environmentally sensitive points, tourism areas and regional road network, etc. The main analysis was conducted on 2 alternatives on the main route corridors, local alignment alternatives at 7 sections, and 2 layout alternatives on Neitun Interchange. The recommended alignment scheme in the feasibility study has been optimized and refined to the depth of preliminary design.

31. **Unfavorable Geological and Topographic Conditions.** The project is located in the southwest of Guangxi. The topographic features of the terrain where the route passes through are mainly limestone mountains, peak cluster valleys and peak forest valleys, with a large rolling topography. Unfavorable geology along the route is dominated by karst, talus, hanging rocks and soft soil. The karst features as karst caves, karst depressions, funnels, sinkholes and underground rivers. Soft soil disperses over the river valley depressions, and water-rich farm fields along the route. These unfavorable conditions were well taken into consideration in determining the alignment scheme, cross and vertical sections, side-slope height of roadbed and treatment measures.

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32. **Excavated rocks utilization.** The volume of excavated rocks under this project, including tunnel ballast and subgrade cuttings, is relatively large. In order to reduce spoils and control the project cost, the rocks have been properly balanced for utilization to the project, as crushed aggregates, structural stones, subgrade fillings and soft soil treatment materials. The volume of rocks will be further calculated at the preliminary and detailed design stage, and any redundant rocks will be used as crushed artificial sand.

33. The function of DSR under Component B is mainly to serve the development of tourism-related industry for the Detian Cross-border Tourism Cooperation Zone and the townships along the route. The existing route lies along the border and passes through the scenic zone and water source protection zone. Given the traffic forecast and its composition, and the environmentally sensitive conditions, the design of DSR has adopted flexible technical standards, particularly under the principles of avoiding/minimizing side slope excavations, focusing on treatment of defects and water drainage system, improving traffic safety and environmental-friendly features.

34. The DSR is to be improved to Class-II/III standard, with various design speeds and subgrade widths. The design speeds are 40 km/h for most of the 2-lane sections and 30 km/h for the constrained section. The subgrade widths are 10m for most of this section, 16m for the sections passing through villages, and 7.5m for constrained sections. The design speed is 40 km/h for the 4-lane section with subgrade width of 16m for most of this section and 17.5m for the section passing through Shuolong Township.

35. In the feasibility study, the local alignment alternatives analysis was undertaken at two sections, including 3 alternatives on Longtun village section and 2 alternatives on Shuolong Township section. At the preliminary design stage, the alignment scheme on Longtun village section proposed in the feasibility study has been further optimized and one more alternative analysis has been added on the ‘Lv-Dao-Xing-Yun’ Scenic Spot.

36. To follow the environmental-friendly and tourism-served design principle, tourism facilities are provided along the road, such as scenic view spots, public rest areas and toilets, bus bays, greening and lightings, etc. The existing asphalt pavement and the base layer will be reutilized by being removed, reprocessed and repaved.

37. For the Phase 2 of Shuolong Main Gate under Component C, the design has considered the limited space in the location of the port (between two mountains as well as a river passing by) and the consistency with design of Phase 1, which has been completed and plans are to pass the State inspection in the 2nd half of 2021. A total of 283 parking lots will be constructed under Phase 2, including 257 underground parking lots for cars and the other 26 for buses on the ground. The designed capacity is consistent with the forecast traffic volume in the port area and the customs passing time at the port. The design of the buildings and landscape will be further refined during the preliminary design stage. The completion of Phase 2 of the Shuolong main Gate will not affect the function of the Phase 1 of the port. The construction of Component C is expected to start in late 2022.

38. **Climate-resilient design**. The design of the proejct has properly taken into account the influence of extreme climate and flooding. A disaster and climate risk assessment prepared for

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the project reveals that the potential most significant hazards to the project components in the border area is flooding. Flooding poses a high risk to the infrastructure throughout the entire project cycle, from the construction to the operation and maintenance. The design standards and parameters were so determined as to strengthen the road capacity for withstanding extreme climate and flood events. According to the Technical Standard of Highway Engineering (JTGB01-2014), the design flood frequency for the subgrade of an expressway and Class-I highway should be 1/100yrs[7], and that of Class-II highway should be 1/50yrs[8]. The subgrade design flood frequency of the Component A of the project is 1/100yrs, and the designed elevation of the route is above the hundred-year flood level. The main sections along the project that are controlled by flood level are the toll station section of the mainline, the entrance section of Longchanglang Tunnel and the exit section of Longdong No.1 Tunnel. For the flood-controlled sections with a subgrade design flood frequency of 1/100yrs; i) the designed elevation of the subgrade needs to be properly raised, ii) the bridge height and length should be properly increased, iii) the culvert is required to be extended, iv) the key subgrade protection design should be strengthened, in order to improve the flood control, discharge and interception capacities of the tunnel.

39. **Digital Technology Application**. The project will pioneer the focused use of technologies in infrastructure ("Infratech") as a strategic and competitive differentiator within AIIB's funding of large-scale infrastructure projects. The project is designed to be a 'Lighthouse' example project for technology implementation. The goal is to create alignment to AIIB's corporate strategy to facilitate adoption of Infratech to deliver better value, quality, productivity, efficiency, resilience, sustainability, inclusion, transparency or better governance along the full project life cycle. Full details of the technology portion of the project are set out in *Annex 4 Digital Technology Section.*

B. Economic and Financial Analysis

40. **Economic Analysis**. A detailed cost-benefit analysis (CBA) has been carried out using the discounted cash flow (DCF) technique to obtain the economic internal rate of return (EIRR) and net present value (ENPV) for the proposed investments of Component A and Component B, which accounts for about 95% of the total project cost. A standard CBA model for the road project has been prepared based on traffic volume forecast, with the comparison of the "with- "and "without-"project cases, using 2020 economic prices as the baseline year. The traffic intensity forecast is based on the Origin and Destination (OD) Survey, projection of the traffic growth and traffic distribution simulations through TransCAD. The Average Annual Daily Traffic (AADT) of the expressway section under Component A is estimated at 5,397 pcus (passenger car unit) in the first operational year (2025) and will increase to 25,259 pcus in the twentieth year (2044) after completion. The estimated traffic volume of the highway section under Component B is 4,602 pcus in 2024 after the construction completion, and will increase to 8,141 pcus in 2043.

41. The economic benefits, including reduction of vehicle operating cost (VOC), saving of passengers' travel time, saving of travel time for goods, reduction of traffic accidents and reduction of carbon emission, were measured against the economic costs, including the construction and associated design and supervision costs, maintenance and major repair costs

[7] One hundred-year flood level.
[8] 50-year flood level.

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and the residual value. The analysis has covered 20 years from the first full year of operation. The EIRR obtained for the 'base case' for the project is 12.4%, which is much above the minimum required economic opportunity cost capital (EOCC) of 9%, as well as above the threshold of 8%[9] set up by the government. Additionally, a sensitivity analysis was carried out by assuming some extreme scenarios. The results show the robustness of the economic feasibility indicators under normal and the adverse sensitivity scenarios. The EIRR for the project in all scenarios is more than the EOCC of 9%. Detailed economic analysis is presented in the *Annex 3: Economic and Financial Analysis*.

42. **Carbon Emission Reduction**. Construction of the new expressway and improvement of the existing highway section will result in increased travel speed and higer fuel efficiency for all types of vehicles travelling on these roads. This reduction in the fuel consumption will lead to reduction in carbon emission into the atmosphere and will be a benefit of the project. Resultant carbon emission is estimated to decrease by 927 tons for the project operation starting year (2025) and in total 159,477 tonnes reduction is estimated during the 20 years analysis period (2025-2044). This 159,477 tonnes carbon emission reduction is valued at USD14.87 million savings or its NPV value at USD 2.87 million as a project benefit. This is mainly due to the reduced carbon emission rate for the improved road condition with optimized travel speed. More detailes of the calculation is presented in *Annex 3*.

43. **Financial Analysis.** The expressway section under Component A will be a toll road. The financial analysis has been carried out for Compinent A by using the estimation of the toll revenue against the capital investment, and the operation and maintanance cost of the expressway in the 20 years analysis perid (2025-2044). The result shows that the estimated toll revenue will be more than sufficient to cover the operation and maintannance of the expressway. However, after taking into account of the capital investment of the road construction, the FIRR of the invetment of Component A is negative (FIRR is -0.73%, without considering the financing cost/interests).

44. The assets created under Component B and Component C will be the typical public goods that will not generate revenues in its operation and will be financed by the Daxin Country. The fiscal analysis has been carried out. Considering the importance of the assets invested under Component B and C to the economic growth, particularly the development of tourism industry of the Daxin county and comparing with the average budget allocation to road sector of Daxin county in the past 5 years, it is assessed as affordable to the government to maintain the sustainability of the assets after its completion. More detailes could be found in the *Annex 3*.

C. Institutional Capacity Assessment, Fiduciary and Governance

45. **Institutional Capacity Assessment.** Assessment on the PMO/PIO's professional knowledge and capability for project implementation was performed. The results are summarized as follows: (i) in general, the Implementing Agencies have experience in implementation of projects funded by MDBs; (ii) the IU has the capacity to manage the national road projects under national standards and procedures, however, its experience in implementing an expressway project applying international standards is limited; and (iii) the guidance and support from Bank is

[9] The threshold for the public goods investments set up by the National Development and Reform Commission.

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essential during the project implementation and the PMO/PIO's capacity would be further enhanced by engaging qualified and experienced individual consultants or consulting firms to support its in-house expertise, particularly in the technical aspects (bridge and tunnel), contractual management, environmental and social, and digital technology supported under the Component D.

46. **Procurement.** The PIO has mobilized four procurement staff, some of them have previous experience with projects financed by ADB and all of them have rich experiences in procurement processes of highway projects funded by the government budget and are familiar with the domestic procurement laws and regulations. With proper capacity strengthening, including using the services of a professional tendering agent to support the procurement process, as well as on-site construction supervision companies to carry out construction supervisions of expressway/highway works contracts, the PIO will have adequate procurement capacity to implement the project satisfactorily.

47. A procurement capacity and risk assessment of the project was carried out during project preparation to identify procurement related risks, and to ensure that pertinent risk mitigation measures are put in place, including measures to strengthen the procurement capacity of the PIO, and the appropriate arrangements for the project procurement. Based on the above assessment, the project procurement risk is rated as "Medium".

48. **Financial Management (FM).** GCUCIDG as the designated project IU, through its dedicated team-PIO, will be responsible for project financial management of all the four project components. Designated staff have been appointed from its various subsidies and divisions to form the PIO. Separate project financial management system and bank account will be established for this project. Project financial statements will be prepared in the format required by MOF to reflect the overall sources and usage of project funds and project implementation status.

49. The Loan Agreement will be signed between AIIB and the People's Republic of China, then MOF will on lend to the Guangxi Zhuang Autonomous Region, who will further on lend to the Municipality of Chongzuo (for Component A and D) and the Daxin County (for Component B and C). The Municipality of Chongzuo will enter into a Subsidiary Agreement with GCUCIDG. A Project Agreement will be signed between AIIB and Guangxi Zhuang Autonomous Region.

50. **Disbursement.** Advance method will be the primary disbursement method for payment of eligible expenditures. Following the above on-lending arrangement, disbursement applications will be prepared by GCUCIDG, and submitted to Chongzuo City Finance Bureau (for Component A and D) or Daxin County Finance Bureau (for Component B and C). After these finance bureaus' review, the applications will be further processed by the Financial Department of Guangxi Zhuang Autonomous Region (Guangxi Financial Department). A Designated Account (DA) will be opened in a financial institution acceptable to the Bank and managed by Guangxi Financial Department. Guangxi Financial Department will manage the Project Designated Account in signed loan currency and will make foreign exchange and release required Bank loan proceeds in RMB to GCUCIDG directly. The use of advances to DA will be reported on a quarterly basis. It was agreed that disbursement documentation would be Summary of Statements. Such funds flow

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arrangement is adequate but not excessive to ensure loan proceeds are properly used with due efficiency and effectiveness. The disbursement letter will detail out the documents requested for each disbursement claim, authorized signatory letter and disbursement process, which will be discussed and finalized during the Loan Negotiation.

51. GCUCIDG closely monitors the process of all counterpart funds and proactively coordinates with related agencies, so as to ensure sufficient counterpart funds are timely available to support project implementation, especially for making due payments in the initial stage of land acquisition and resettlement work. The Municipality of Chongzuo commits to provide additional counterpart funds if any cost overrun occurs during the project implementation considering the engineering complexity of the project.

52. Since most of the project financial staff are new to MDB operations, the Bank provided basic financial management and disbursement training during the appraisal. Additionally, a project Financial Management Manual will be prepared by GCUCIDG to standardize project financial management and disbursement work, which will be reviewed by concerned finance bureaus and submitted to the Bank for review before the loan negotiation, and then be finalized before the project starts. GCUCIDG will also engage an experienced financial management consultant during implementation to strengthen its capacity and train the financial staff. The Bank's team will closely monitor the financial management performance from initial system setup throughout implementation and provide necessary guidance and support. Based on the FM capacity and risk assessment conducted, the project FM risk is rated as "Medium".

53. **Governance and Integrity**. AIIB is committed to preventing fraud and corruption in the projects it finances and will ensure strict compliance with AIIB's Policy on Prohibited Practices (2016). 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 the project and to take necessary measures to prevent and redress any issues in a timely manner, as appropriate.

D. Environmental and Social

54. **Environmental and Social Policy and Categorization.** The Bank's Environmental and Social Policy (ESP), including the Environment and Social Standards (ESSs) and the Environmental and Social Exclusion List applies to this project. ESS 1 (Environmental and Social Assessment and Management) and ESS 2 (Involuntary Resettlement) will apply to the project. ESS 3 (Indigenous Peoples) will not apply to this project based on the social assessment carried out during project preparation. The project has been identified as Category A, based on the available information, particularly considering the project environmental and social impacts and risks, and their scale that may be substantial, significant, cumulative, diverse, and partially permanent in nature, as well as due to land acquisition, potential physical displacements and resettlement.

55. **Instruments.** An Environmental and Social Impact Assessment (ESIA) and Environmental and Social Management Plan (ESMP), and Resettlement Action Plan (RAP) have been prepared. ESIA and ESMP will assess the environmental and social impacts and then

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propose mitigation measures to address project related environmental and social issues during the project implementation and operational phases, including identification of such measures, and the requirements for monitoring, and supervision. The RAP addresses the physical and economic displacement of a temporary or permanent nature. An Entitlement Matrix has also been prepared, including an approximate budget and schedule for Resettlement and Rehabilitation.

56. **Environmental Aspects.** During the ESIA process, a baseline survey, screening and scoping of environmental impacts/risks, alternative analysis, and impact assessment and mitigation measures have been undertaken. At the same time, the environmental sensitive receptors/locations for acoustic, air, water, and ecological environment, have been identified and assessed. There are two ecologically sensitive locations along the project road alignments, however, there is no national and local protected species and no endangered flora and fauna in the project areas. The ESIA process has resulted in the conclusion that though the environmental and social impacts and risks are substantial, they will be reduced, limited and controlled through adequate mitigation measures, management and monitoring. The ESMP addresses adverse impacts related to ecosystem, water environment, noise, vibration, atmospheric environment, solid wastes, occupational health and safety, and labor management. As part of the ESIA preparation, public/stakeholder consultation and information disclosure have been carried out at various stages to share the project information and to obtain opinions from stakeholders.

57. The results of the assessment indicate that it is important to ensure appropriate incorporation of environmental considerations into the project feasibility study and designs, using alternative analysis as a tool, so that the environmental impact and risks can be avoided or limited to possible extent. Most potential negative environmental impacts and risks during construction phase are localized, and are associated with soil erosion, construction noise, fugitive dust, disruption of traffic and community services, and risks to worker's health and safety. These can be effectively mitigated through good construction and health/safety management and measures implemented by contractors. There will be standard procedures for the control and mitigation of emissions, such as dust, noise and wastewater discharges from the construction sites and work camps. Potential impacts during operation and maintenance (O&M) phase of the project are associated with noise emissions and exhaust gas emission, solid waste, and occupational health and safety risks to workers. These risks have been minimized to the extent possible through the designs, including the use of low-noise equipment, work safety procedures, and routine health checks for workers. These can be effectively mitigated through good operation of the equipment, and health and safety practices implementation.

58. An ESMP has been prepared as a separate document, in which institutional arrangements respective responsibilities and budgets are clearly identified for its implementation, monitoring, and reporting. The objective of the ESMP is to ensure (i) implementation of identified mitigation and management measures to avoid, reduce, mitigate, and compensate for anticipated adverse environmental and social impacts; (ii) implementation of monitoring and reporting against the performance indicators; and (iii) compliance with the government's relevant environmental laws, standards, and regulations and the AIIB's ESP. Furthermore, the ESMP includes an environmental monitoring plan to monitor the relevant environmental parameters and assess the effectiveness of mitigation measures, and a capacity building and training program focused on

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health, safety, and environmental management. Monitoring reports will be provided on a semi-annual basis.

59. **Social Aspects.** Key social risks associated with the project are related to land acquisition and physical and/or economic displacements. According to surveys carried out, construction activities will involve 1597.87 mu of permanent land acquisition and 677 mu of temporary occupation of land with over 80 percent of acquired land belonging to farmland. The land acquisition and temporary occupation will directly affect 967 households from eight villages in Tiandeng and Daxin Counties in the Municipality of Chongzuo. For such impacts, adequate compensation and rehabilitation will be provided based on established national laws, local regulations and AIIB's ESP. A detailed RAP has been prepared based on the magnitude of impact, social economic survey, and extensive consultations among affected people and communities. Other adverse social impacts and risks during the operation and maintenance phase are mostly associated with noise and possibility of road accidents. The ESMP, mentioned earlier, includes measures to address the above impacts, including a chance finds procedure for archaeological, historical, and sacred sites.

60. The ethnic groups in Daxin and Tiandeng Counties that fall within the project area are mainly Zhuang, accounting for 96.89% and 98.9%, respectively, of the total population. The other ethnic groups are Yao, Han, Miao and Dong, etc., but their folk customs and culture are not different from that of the Zhuang. Although the Zhuang has its own language, it is not the only language used by the Zhuang population in the project area. The lifestyle of the local Zhuang people are roughly the same as those of the Han people and have diversified sources of livelihood. Last but not least, the Zhuang has no political, economic or cultural systems independent of the mainstream society and, as a result, is not considered as falling into the category of indigenous peoples under ESS 3.

61. **Gender Aspects.** Women and the elder people in the project area will benefit from the improved transport facilities. A gender and vulnerable assessment has been conducted as part of the environmental and social assessment of the Project. In consultation with relevant stakeholders, including communities along the proposed corridor, measures have been identified to prevent potential adverse impacts caused by the influx of migrant workers in the community and the risk of gender-based violence, and included in the ESMP. A Gender and Vulnerable Peoples Action Plan for the Project will be prepared in accordance with the ESP.

62. **Occupational Health and Safety, Labor and Employment Conditions.** The Implementing Agencies shall ensure that adequate health and safety measures are taken for workers, and that the bidding documents include clauses on how contractors will address health and safety requirements. The Implementing Agencies shall also ensure that civil works contractors comply with applicable labor laws and regulations and adopt and enforce codes of conduct (including guidelines for prevention and management of Gender Based Violence) aiming to mitigate possible issues related to labor influx. The relevant information is included in the ESIA and ESMP.

63. **Stakeholder Engagement, Consultation and Information Disclosure.** Engagement with concerned stakeholders especially the project affected peoples (PAPs) is an essential part

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of the project preparation and implementation. During project preparation, consultations have been held during the preparation of ESIA and RAP, which was two-way communication, mainly carried out in two stages, e.g., at the early preparation stage with project scope and preliminary environmental and social issues identified and then at a later stage of preparation with available draft environmental and social documents. During awareness raising focused discussions with Party leaders, village leaders and women's representatives have also taken place in different locations by various means. According to the questionnaire survey, 84.6% of the villagers supported the construction of the project; 1.9% of the villagers did not support the construction of the project because they did not know about the project; and 98.1% of the villagers agreed to occupy part of their land under the condition that the compensation standard was legal, and the compensation fee could be paid in time. Nearly 70% of the villagers knew more about the local policies and standards for compensation for permanent and temporary land occupation, and 57.7% of the villagers knew the complaint ways and means. It is realized that it is even more important during construction, the Municipality of Chongzuo should regularly conduct consultations with the local communities throughout the project life cycle, and report on these consultations on a monthly basis.

64. The draft English and Chinese versions of the ES documentation have been posted on the Implementing Unit's and Bank's webpages[10] as below and will be made available in hard copies in the project area.

65. **Project Grievance Redress Mechanism.** Building on existing complaints handling systems, a multi-tier Project Grievance Redress Mechanism (GRM) has been established in accordance with the requirements of AIIB's ESP. Locally appropriate public consultation and disclosure process have been used to disseminate information about the GRM. A separate GRM will be established to address workplace complaints and concerns.

66. **Project-Affected People's Mechanism.** The Project-affected People's Mechanism (PPM) has been established by the Bank to provide an opportunity for the independent and impartial review of submissions from Project-affected people who believe they have been or are likely to be adversely affected by the Bank's failure to implement its ESP in case when their concerns cannot be addressed satisfactorily through the Project-level GRM or the processes of the Bank's Management. Information on the Project-affected People's Mechanism, is available at https://www.aiib.org/en/policies-strategies/operational-policies/policy-on-the-project-affected-mechanism.html

E. Risks and Mitigation Measures

67. According to the preliminary assessment, the Project has been given a "High" risk rating, mainly because it is a Category A project. Risks have been identified and analyzed and the related mitigation measures have been proposed, as summarized in Table 2.

[10] Implementing Unit's webpage: http://www.czcjjt.com.cn/c600.html
AIIB webpage: https://www.aiib.org/en/projects/details/2020/proposed/China-Guangxi-Chongzuo-Border-Connectivity-Improvement-Project.html

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Table 2: Summary of Risks and Mitigating Measures

Risk Description	Assessment Ratings (High, Medium, Low)	Mitigation Measures
Technical Risk: The design and construction could face challenges due to unfavorable geological conditions such as Karst features and soft grounds. Construction of tunnels and bridges under constrained mountain topography could also be a challenge.	Medium	1. The PMO/PIO has engaged capable and experienced design institutes to carry out the feasibility study and designs. 2. Contractors will be selected through a good competition and well-designed procurement process. 3. Adoption of the digital technology will enhance the design, construction and asset management during the project implementation.
Institutional Risk: The Implementing Unit has limited experience in MDB financed project.	Medium	1. The Bank will continue providing guidance and support during the project implementation. 2. The PMO/PIO's capacity will be enhanced through engaging experienced consultants in order to support the implementation of the project and provide training to their in-house staff in specific aspects to strengthen the overall institutional capacity.
Procurement Risk: The procurement capacity of the PIO could be challenging, particularly in managing the large value contract following MDB's standards and procedures. Uncertainty of the impact of COVID-19 to the international tendering of the major infrastructure contracts.	Medium	1. The PIO has employed a professional procurement agent to support the procurement process. 2. During project implementation, construction supervision consultants will also be employed to carry out contract management and construction supervision. Design firms have been put in place to carry out the project designs. 3. The Bank will provide continuous procurement training and guidance to the PIO during procurement and contract management. 4. All major value contracts will be subject to procurement prior reviewed by the Bank.
Financial Management: Project financial staff may not have experience in fiduciary management. Risk of counterpart	Medium	1. Necessary training has been provided during the appraisal mission. 2. Guangxi Financial Department's involvement in the management of loan

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funds not available in a timely manner or sufficiently provided.		proceeds and extensive review on disbursement applications will mitigate the potential risk of misuse of funds. 3. Project Financial Management Manual has been prepared to standardize the project FM and disbursement works. 4. Project financing plan is finalized with all concerned parties with full commitment during the appraisal.
Environmental and Social Risks: The project is in a mountainous area passing through some eco-system sensitive locations such as natural reserves, and involves land acquisition and resettlement. Therefore, some of the anticipated project environmental and social risks and impacts may be substantial, significant, cumulative, diverse, and permanent in nature.	High	1. Based on the technical features and the location of the project, the Bank conducted E&S screening and due diligence. As a result, a Category A is proposed for the Project. ESIA, ESMP, and RAP have been prepared under Bank team's guidance. 2. During preparation, public consultation, especially with project-affected peoples, have been conducted. 3. The ES monitoring and evaluation by a third party has been budgeted in the project cost and will be supported by Component D.

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Annex 1: Results Monitoring Framework

Project Objective:	To improve the cross border connectivity around Shuolong port and expand economic and trade activities between China and Vietnam.												
Indicator Name	**Unit of measure**	**Base-line** Data 2020	**Target Values**									**End Target**	**Frequency (F) and Methodology (M)**	**Respon sibility**
			YR1	**YR2**	**YR3**	**YR4**	**YR5**	**YR6**	**YR7**	**YR8**	**YR9**			
Project Objective Indicators:														
Heavy trucks travel time between Neitun Interchange and Shuolong Port (Yanying Gate)	minutes	>55	NA	NA	NA	NA	≤40	≤40	≤40	≤40	≤40	**≤40**	**F:** Every year after compleltion of Component A. **M:** Carrying out a survey/test twice every quarter during the monitoring period, calculate the average of the testing result each year.	IU[1]
Increase in the annual volume of cross-border trade between China and Vietnam at Shuolong Port	1,000 tons	19[2]	NA	NA	NA	NA	>15% average YOY growth					**⩾250**	**F:** Every year after compleltion of Component A. **M:**The data will be provided by the Commerce and Port Bureau of Daxin County.	IU
Number of In /Out travelers at Shuolong Port	1,000 persons	90[3]	NA	NA	NA	NA	>15% average YOY growth					**≥250**	**F:** Every year after compleltion of Component A, B &C. **M:** The data will be mornitored and provided by the Commerce and Port Bureau of Daxin County.	IU
Passenger customs passing time at Shuolong Port (Main Gate)	minutes	NA	NA	NA	NA	NA	≤20	≤20	≤20	≤20	≤20	≤20	**F:** Every year after compleltion of Component C. **M:** Commerce and Port Bureau of Daxin County will carry out the survey every quarter during the mornitoring period and calculate the average of the result for each year.	IU
Passengers travel time between Neitun Interchange and Detian	minutes	>60	NA	NA	NA	NA	≤37	≤37	≤37	≤37	≤37	≤37	**F:** Every year after compleltion of Component A and B. **M:** Carrying out a survey/test once every quarter during the monitoring	IU

[1] IU refers to Implementation Unit.
[2] The port was closed in 2020 due to the COVID impact. The baseline data is the average of the past three years before 2020 (from 2017 to 2019), provided by the Commerce and Port Bureau of Daxin County.
[3] The port was closed in 2020 due to the COVID impact. The baseline data is the average of the past three years before 2020 (from 2017 to 2019), provided by the Commerce and Port Bureau of Daxin County.

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Project Objective:	To improve the cross border connectivity around Shuolong port and expand economic and trade activities between China and Vietnam.												
Indicator Name	**Unit of measure**	**Base-line** Data 2020	**Target Values**									**End Target**	**Frequency (F) and Methodology (M)**	**Respon sibility**
			YR1	**YR2**	**YR3**	**YR4**	**YR5**	**YR6**	**YR7**	**YR8**	**YR9**			
Waterfall Scenic Spot													period, calculate the average of the testing result for each year.	
Number of the tourists[4] to the Detian (Pan Gioc) Cross-border Tourism Cooperation Zone	Million persons	1.34	NA	NA	NA	NA	>10% average YOY growth					>3.00	**F :** Every year after compleltion of Component A and B. **M:** Culture and Tourism Bureau of Daxin County will carry out the mornitoring and provide the data.	IU
Reduction in the average IRI for Component B	IRI	6.2	NA	NA	NA	≤4.2	≤4.2	≤4.2	≤4.2	≤4.2	≤4.2	≤4.2	**F :** Every year after compleltion of Component B. **M:** Carrying out the IRI test twice a year during the monitoring period, calculate the average IRI every year.	IU
Intermediate Results Indicators:														
Kilometers newly-constructed expressway/Class-1 highway connecting to Shuolong Port	Kilo-meters	0	0	0	0	0	12.2 /5.4	12.2 /5.4	12.2 /5.4	12.2 /5.4	12.2 /5.4	12.2/ 5.4	Annually after the construction completion of Component A	IU
Kilometers improved national road connecting Shuolong to Detain Water Fall	Kilo-meters	0	0	0	0	13.6	13.6	13.6	13.6	13.6	13.6	13.6	Annually after the construction completion of Component B	IU
Parking lots in the Shuolong Main Gate	Number	0	0	0	0	0	283	283	283	283	283	283	Annually after the construction completion of Component C	IU

[4] Not including the tourists who are not required to buy the tickets for entering the Science Zone, which accounted for around 30% of the total number of tourists in 2019.

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Project Objective:	To improve the cross border connectivity around Shuolong port and expand economic and trade activities between China and Vietnam.												
Indicator Name	**Unit of measure**	**Base-line** Data 2020	**Target Values**									**End Target**	**Frequency (F) and Methodology (M)**	**Respon sibility**
			YR1	**YR2**	**YR3**	**YR4**	**YR5**	**YR6**	**YR7**	**YR8**	**YR9**			
Application of the Digital Platform system in the project implementation	Yes/No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Annually	IU

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Annex 2: Detailed Project Description

A. Background

1. Guangxi is one of the major international gateways of China towards ASEAN (Association of Southern Asian Nations) countries. Vietnam, bordering Guangxi, is China's largest trade partner in the ASEAN region. At present, the trade between China and Vietnam is dominated by electronic products and equipment, fruits, cotton, and textile products. It's worth noting that the volume of minerals and commodities, while still making up a small portion, has rapidly expanded in recent years. China is one of largest producers of various metal materials in the world, including alumina and manganese. However, China's deposits of raw materials, such as bauxite and manganese ores, is extremely low compared to its established production capacity. The imbalance of demand and the domestic supply results in China's heavy dependence on the import of bauxite and manganese ores, whose import volume has been continuously increasing over the past few years, reaching 54% and 70% of the total demand volumes, respectively in 2018. Vietnam has large deposits of bauxite and manganese. For instance, the deposit of bauxite reserves in Vietnam accounts for 12% of the total exploitable reserves in the world, ranking third place after Guinea and Australia. Most of these deposits are located in the Cao Bang and Lang Son provinces in the northern Vietnam, which are very close to Guangxi.

2. While Vietnam has the supply of raw mineral ores, China, specifically, the city of Chongzuo, has well established production capacities for processing these materials. It is essential for both countries to exploit the potential of their own competitive advantages, and collaborate in the development of the whole value chain of metal industries. The mining products and minerals could be potential items to increase the bilateral trade in the near future. In 2017, the total volume of bauxite exported from Vietnam to China was nearly 350,000 tons, accounting for 51.4% of Vietnam's total value of the exported minerals. According to market analysis, it is expected to increase to 1.5 million tons by 2030. Road transportation is still the major mode supporting the export of mineral ores from Vietnam, making up more than 50% of the total trade values. To support the potential increase of trade of minerals, it will require further improvement of the cross-border infrastructure, including ports and roads, which will enhance the transport capacity to accommodate the demand of mineral freights crossing the border.

3. In 2017, the China and Vietnam governments agreed to upgrade Shuolong (Ly Van) port to Class I Bilateral Port. Given its geographic location, Shuolong Port is one of the best locations for the import of minerals from Vietnam to China. The Port has two Gates: Shuolong Main Gate for passengers and the Yanying Gate for freight. The physical upgrading and construction of Shuolong Port is now under implementation and expected to be completed by 2024. After completion, it will become one of the major ports for import/export, particularly minerals and related products, with the designed custom clearance capacity of 3.5 million tons per year. The major investment component of this Project is construction of the missing link connecting the Shuolong Port to the existing expressway network. The Project will also include improvement of the Shuolong Main Gate, and will finance construction of an approaching road, parking spaces, related inspection buildings and relevant facilities, and landscaping, which will enhance the mobility of the cross-border traffics and reduce the border crossing and customs/immigration processing time at the Shuolong Main Gate.

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4. There is a well-established communication and coordination mechanism between the government of Guangxi and the governments of the four border provinces (Ha Giang, Cao Bang, Lang Son, and Quang Ninh) in Vietnam. The main purpose of this coordination is to promote the development of the infrastructure to support the cross-border connectivity, and economic and trade activities in the border area. In the MOU of the 10th Coordination Conference (2019) among the Five Provinces, there was an agreed plan to enhance the road connectivity in the border areas on both sides. The Plan indicates that in the short to medium term (between 2025-2030), Vietnam would concentrate on construction of the trunk expressway from Tong Deng to Cha Ling, while in Guangxi, priority would be given to completion of the missing links connecting the expressway network to border ports. In the medium to long term (by 2030 and beyond), Vietnam will upgrade the road links connecting the border ports to trunk expressways. After that, the expressway/highway network connecting two countries in the border crossing areas will be established. Once completed, it will significantly improve the connectivity and promote the economic development in the border areas of both countries. The expressway section under the proposed Project connecting to Shuolong (Ly Van) Port is included in the Plan and stated in the MOU of the 10th Coordination Conference (2019) among the Five Provinces as one of the priority projects in China.

5. Ly Van (Shuolong) Port in Vietnam is in Cao Bang province and is connected by two existing cement paved roads (equivalent to Class-4 in Chinese standards). According to the letter (dated November 22, 2019) from the government of Cao Bang province of Vietnam, the government of Vietnam has already started upgrading and rehabilitation of the selected sections of existing cement roads connected to Ly Van (Shuolong) Port. In the medium-term plan, the upgrading of the entire roads to Class-3 Highway is to be completed by 2030. In the long-term, the entire roads are to be upgraded to the expressway standard and connected to the trunk expressway from Tong Deng to Cha Ling, which is one of the priority projects in Vietnam as stated in the MOU of the 10th Coordination Conference.

6. Completion of the “last mile” section of the expressway in Shuolong, China is also an important complement to the highway/road network in the border areas around Shuolong Port, including expressways, highways and local roads in the Daxing county and Tiandeng county. It will improve the mobility and efficiency of the local traffic in the area. In addition, Guangxi possesses numerous tourism resources with natural beauties and landscapes, and these are mostly to be further developed. Among them, Detian (Pan Gioc) Waterfall along Guichun River is a unique scenic spot that sits on the border line. From both China and Vietnam sides, people can access the scenic spot for sightseeing, visits and carry out other economic activities. In 2015, Chinese and Vietnamese governments agreed to establish the Detian (Pan Gioc) Cross-border Tourism Cooperation Zone to jointly develop the natural resource. It was agreed that both countries would provide 200 hectares of land around the waterfall scenic spot to build the Cross-border Tourism Cooperation Zone. It is envisaged that within the Cooperation Zone, the people can cross the border freely to the other side. This will significantly facilitate the connectivity, and promote economic activities related to the tourism industry and border trade in the area. The Project also includes the improvement of the road infrastructure connecting Shuolong Port to Detian (Pan Gioc) Cross-border Tourism Cooperation Zone. The improvement of the road will directly support the development of Tourism Cooperation Zone and further enhance the connectivity and economic integration of two countries in the border areas.

B. Project Components

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7. The Project includes three civil works components (Components A, B and C) and a soft component, which includes the Technical Support and Project Management support (Component D).

8. **Component A: Construction of the last Section of Wuzhou – Shuolong Expressway (WSE)**

9. The project section is the last end section of the Wuzhou - Shuolong Expressway, from Wuzhou City in the east of Guangxi, through Nanning City, the capital of Guangxi, to Shuolong Port. This project route starts from the Neitun Interchange, the intersection of Wuzhou - Shuolong Expressway (S40) and the Chongzuo-Jingxi Expressway (S60), and ends at Shuolong Town.

10. The total length of the project section is 17.679 km, including a 12.263 km long expressway (fully-access-controlled) section, and a 5.416 km long Class 1 (partially-access-controlled) connection highway section. The design speed of the four-lane expressway is 100 km/h, with subgrade width of 26m; and the design speed of the four-lane Class 1 highway is 80 km/h, with subgrade width of 25.5m.

11. The expressway section comprises of 6 bridges and one interchange for a total length of 5.1125 km, and 6 tunnels for a total length of 3.6455 km, resulting in a high bridge-tunnel ratio of 71.42%. The Class 1 highway section comprises of a 98.5 m long bridge and a 1.43 km long tunnel, with a bridge-tunnel ratio of 28.22%. The project section also includes construction of a maintenance yard, an expressway toll station, and a monitoring and communication sub-center.

12. **Component B: Improvement of Detian – Shuolong Road (DSR)**

13. The proposed work to be undertaken for Detian – Shuolong Road (DSR) is basically improvement and/or rehabilitation of the existing roadway, with new construction of a 395 m long tunnel. The total length of DSR is 13.632 km, including a 9.362 km 2-lane section, from the Detian (Pan Gioc) Scenic Zone entrance to the Tourism Center, and a 4.270 km 4-lane section from the Tourism Center to Shuolong Port area, intersecting with the Class 1 highway under Component A. DSR will adopt flexible design standards to cope with the various road conditions, particularly in the principles of avoiding/minimizing side slope excavations, focusing on treatment of defects and water drainage system, improving traffic safety and environmentally friendly features.

14. **Component C. Construction of the Shuolong Port (Shuolong Main Gate-Phase 2)**

15. Shuolong Port is a land port consisting of two gates including Shuolong Main Gate near the WSE ending point and Yanying Gate, which is located about 7 km south of the WSE ending point, connecting with Shuolong Main Gate by G359/G219. The road is to be upgraded to a 4 lanes Class-1 Highway supported by the government's own funds. The rehabilitation has commenced and is expected to be completed in 2022. The Shuolong Main Gate will serve for the In/Out travelers from China, while the Yanying Gate will be mainly used for cargo transportation by trucks. As the freight transportation and associated logistic and industries have high possibility to make the infrastructure investment commercially viable, the Chongzuo Municipality plans to attract private sector to carry out the design, construction and operation of the infrastructure and facilities in Yanying Gate. The public funds will be used to support the Shuolong Main Gate. There are two phases of the Shuolong Main Gate: Phase 1 has completed its construction supported by the government's own funds, and ready for operation and Phase 2 includes construction of the

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approaching road, parking spaces, related inspection buildings and relevant facilities, and landscaping at the Shuolong Main Gate. The approaching road under Phase 2 will connect with the road funded under Component A. The main purpose of Phase 2 is to enhance the mobility of the cross-border traffics and reduce the border crossing and processing time at the Shuolong Main Gate.

16. According to the design of the Shuolong Main Gate, the forecast peak time slots are 8 - 10 in the morning and 4 - 6 in the afternoon (4 hours per day). The four hours period will account for almost 100% of the average daily traffic. The target waiting time for each passenger passing through the customs should be less than 30 minutes during peak hours (according to the government's regulation). From a longer term perspective (in 20 years), the average number of passengers passing through the customs will be around 4,000 per day. The Bank will review the details of the design once preliminary/detailed designs for the Phase 2 of the Shuolong Main Gate are completed.

17. **Component D: Technical Support and Project Management**

18. Technical Support and Project Management program includes: (i) the application of Infratech within the infrastructure invested under the project is designed to integrate digital technologies such as building information modelling, with materials, sensors and industry processes enabling data analytics to drive asset management optimization across the infrastructure lifecycle; (ii) engagement of individual consultants or consulting firms on assignment basis to enhance the implementation capacity quality in order to meet the Bank's standards and requirement, particularly, in the bridge and tunnel engineering, environmental and social (ES) implementation and monitoring, digital technology, reporting and language translation etc., and (iii) Institutional Capacity Building, including, consulting service, trainings and study tours which would be accessed as needed to enhance the Implementing Agencies' capacity in implementing the project.

C. Cost Estimation and Financing Plan

19. The project cost estimate and financing plan is shown in Table 2.1 below.

Table 2.1: Cost Estimate and Financing Plan

(Unit: USD Million)

Component	Project Cost	AIIB	Gov.
A.1. Construction of civil work contract/s of the last new expressway section from Neritun Interchange to Shuolong port.	330.1	254.2	75.9
A.2. Supervision Consultancy on the construction works.	6.1	6.1	-
A.3. Field Investigations, feasibility studies, detailed designs and bidding document preparation and other operation cost during the project preparation and implementation of Component A	18.5	-	18.5
A.4. Land acquisition and compensations for Component A	37.5	-	37.5
Component A Subtotal	**392.2**	**260.3**	**131.9**

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B.1. Construction of civil work contract/s national road from Detain Waterfall Tourism Zone to the Shuolong port.	30.1	23.3	6.8
B.2. Supervision Consultancy on the construction works.	0.6	0.6	-
B.3. Field Investigations, feasibility studies, detailed designs and bidding document preparation and other operation cost during the project preparation and implementation of Component B	3.6	-	3.6
B.4. Land acquisition and compensations for Component B	6.6	-	6.6
Component B Subtotal	**40.8**	**23.9**	**16.9**
C.1. Construction of civil work contract/s of the Phase 2 of Shuolong Main Gate	13.3	10.2	3.2
C.2. Supervision Consultancy on the construction works.	0.2	0.2	-
C.3. Field Investigations, feasibility studies, detailed designs and bidding document preparation and other operation cost during the project preparation and implementation of Component C	2.4	-	2.4
C.4. Land acquisition and compensations for Component C	0.2	-	0.2
Component C Subtotal	**16.2**	**10.4**	**5.8**
D.1. Application of Infratech within the infrastructure invested under the Project is designed to integrate digital technologies such as building information modelling, with materials, sensors and industry processes enabling data analytics to drive asset management optimization across the infrastructure lifecycle.	3.9	3.1	0.8
D.2. Project management/monitoring support, comprising consulting service in engineering, ES implementation and monitoring, reporting and language translation and other required consulting service to enhance the project implementation. This component also includes the Institutional Capacity Building, such as trainings and study tours**.**	4.4	2.3	2.1
Component D Subtotal	**8.3**	**5.4**	**2.9**
PROJECT COST (Inclusive of VAT and Import duties) and FINANCIAL PLAN	**457.5**	**300.0**	**157.5**

D. Additional information of the potential increase of trade of minerals between China and Vietnam.

20. China is the largest alumina producer in the world while its deposit of the bauxite (raw material for alumina) is extremely low comparing to its established capacity of alumina production. The imbalance of demand and the domestic supply results in China's heavy dependence on the import of bauxite. The import volume has continuously increased and reached 54% of the total demand in 2018, rising from 40% of the same in 2014. In 2019, the total import volume climbed above 100 million tons for the first time. Guinea, Australia and Indonesia are the top three countries of origin of China's bauxite imports, accounting for over 94% of the total imports. Vietnam has large deposit of bauxite reserves, accounting for 12% of the total exploitable reserves in the world, ranking the third place after Guinea and Australia. Most of the deposit in Vietnam is located in the Cao Bang and Lang Son provinces in the north, which border with Guangxi in China.

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21. According to the aluminum industry analysis, taking into consideration all the factors, such as geographical location, transport cost, ore grade and others, the importation of bauxite from Vietnam by road to target markets of major aluminum producers in Guangxi and other southwestern provinces, such as Chongqing would be a cost-effective economic model. Guangxi has made several major investments to build its capacity in alumina industry, including a major alumina production line with the capacity of 1 million tons per year, which is under construction and will be operational in 2022. This single production line will demand around 3 million tons of bauxite every year. Furthermore, almost all the imported bauxite to China is currently transported by ship. Imports through the border between Guangxi and Vietnam will diversify the origins and also provide an alternative model of transportation of the imported bauxite.

22. A similar situation as mentioned above has been observed in the manganese industry as well. With the rapid development of the steel and electronic battery industries in China, the demand of manganese products has surged. The explored reserves of manganese ore in China are mainly in Guizhou and Guangxi, particularly in Chongzuo city. However, the domestic mining industry of manganese ore is constrained by the low grade of the ore, high mining cost and the increasingly high-standard requirement of the environmental protection. Many small-scale manganese mines have been closed which has further reduced the supply and deepened the gap with the growing demand. China is the largest manganese consumer in the world. China imported 27.64 million tons (dry tons) of manganese ores in 2018, and 34.19 million tons in 2019, an increase of 23.7%. Because of its relatively rich manganese resources, Guangxi has a well-established manganese industry value chain. Due to the closure of the small-scale mining companies and the reduction of manganese ore productions within the province, Guangxi is now turning to the import of the high grade of manganese ores. Guangxi imported 2.335 million tons of manganese ores (8.45% of China's imports) in 2018 and 2.669 million tons (7.80% of China's imports) in 2019. Some enterprises from Guangxi have already proactively explored the supply market in Vietnam and other ASEAN countries through direct investment or participation in the mining industries in these countries with rich, high-grade manganese reserves.

23. Deepening the cooperation between China and Vietnam in aluminum and manganese industries will increase the bilateral trade of mining products and minerals across the border, which will create the additional traffic volume on the border road networks.

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Annex 3: Economic and Financial Analysis

A. Approach and Methodology of Economic Analysis

1. **General.** The objective of the cost benefit analysis is to identify and quantify the main economic benefits and costs associated with the Project in order to evaluate the economic feasibility and viability of the Project. The analysis focuses on the **Component A**- Construction of the last section of the Wuzhou - Shuolong Expressway with a total length of 17.6 km, from the Neitun Interchange to the Shuolong Port; and **Component B**- Improvement of an existing border road with a length of 13.6 km connecting Shuolong Port to the Detian (Pan Gioc) Waterfall scenic spot. These two pysical components account for about 95% of the total proejct cost. Component C is the construction of a border port and Component D is technical assistence. Considering the economic benefits of the Component C and D can be hardly quatified and the investment of these two components is relatively minor, the focus of the cost benefit analysis was on Component A and B.

2. The Cost Benefit Analysis (CBA) was carried out by using the discounted cash flow (DCF) technique to obtain the economic internal rate of return (EIRR) and net present value (NPV) for the proposed investments linked with the Project. This is followed by a 'sensitivity analysis' carried out by adjusting the critical factors affecting the cost and benefit streams of the proposed project, in order to ascertain their effect on the economic feasibility parameters i.e. NPV, and EIRR.

3. **Analysis Framework.** The following scenarios are considered for the economic analysis.

- **"Without the proposed intervention" (Base Case):** This is the 'without project proposal' case in which there will be no construciton of the new expressway under Component A or no improvement to the existing road under Component B, except the regular maintenance to the existing road. The traffic on the existing roads (including the parallel road to the expressway of Component A) will likely continue to grow, with higher vehicle operating costs (VOC), longer traveling time due to reduced service levels and increased conjestion. In the analysis, this is the 'base case' against the case in which the new construction/improvement is undertaken.

- **"With the proposed intervention (new construction/improvement)":** This is the 'with project proposal' case. Traffic diverts to the new road from the existing road network, with lower vehicle operating costs (VOC), shorter traveling time due to the shortened road length and good road conditions. The traffic in the parrallel road will also enjoy the same due to impoved road service levels. Under Component B, where the future traffic volume on the road is assumed to continue in the improved road condition at a lower VOC and shorter travelling time. In the analysis, this alternative is compared against the 'base case'.

4. **Benefits Calculation:** Reduction in vehicle operating costs (VOC), travel time, and accident cost savings together will lead to the economic savings of the Project. The total savings expressed in quantitative terms are the total economic benefits arising from the improvement of the road sections. The total quantitative benefits and costs at economic prices determine the economic feasibility indicators (EIRR and NPV) of the Project.

5. **Approach.** The economic evaluation has been carried out within the broad framework of cost-benefit analysis assuming that the analysis period is construction period (3 or 4 years) plus

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20 years operation period. The economic feasibility of the Project has sought to maximize the economic returns on investment. There will be reduction in road user costs of motorized traffic upon completion of the new road or improvement of the existing road. The signifcant economic savings in the following areas are expected to occur due to investment. We have discussed the potential increase of the benefits from the tourisim industry upon completion of the project. There is an obvious positive impact expected in this area, however, it would also depend on many other factors, including the road infrastrure improvement, and the development of the scenic zone and the associated tourisim services supporting facilities around the scenic area etc. Futhermore, it is not easy to quantify the benefit directly resulting from the improvement of the road. Thus, these benefits have not been taken into calculation of the analysis. The quantiifed benefits includes the following items:

- Savings in VOC
- Savings in travel time of passengers
- Savings in travel time of goods
- Savings in accident cost
- Savings in carbon emissions

6. All costs and benefits are valued in monetary terms and expressed in economic prices. The analysis was made for Component A and B, respectively and the results were combined and expressed in terms of EIRR and NPV.

7. **Traffic Intensity.** The “four-stage method” has been applied in the prediction of the highway traffic volumes, namely (i) investigation and analysis on current status of regional traffic, (ii) traffic generation forecast, (iii) regional traffic distribution forecast, and (iv) traffic volume distribution forecast. The current status of regional traffic was investigated and analysed mainly based on the observation data on traffic volumes of existing roads and OD survey results. The general growth of traffic volume is closely related to economic development[1]. At the same time, the improvement of transportation infrastructures will promote the development of regional economy and induce additional traffic. The forecast of traffic volume distribution is based on the forecast results of the traffic generation and concentration and the current traffic distribution status (current OD status). The road network distribution of traffic volume is based on the planned future regional road networks and achieved by the stochastic user equilibrium distribution method in TransCAD with the travel time, distance and charge as the impedance factors.

8. **Construction Program.** Construction of both Component A and B is assumed to start in October 2021. The construction schedule for Component A and B is summarized below (Table 1). For the analysis purpose, it is assumed that the highway/road will open for traffic upon completion of all construction activities.

Table 1: Planned Consturction Timetable

Activities	Component A: WSE section	Component B: DSR section
Construction	2021 - 2024	2021-2023
Operation	2025 - 2044	2024-2043

[1] Refer to research results in the *China Study of Prioritization of Highway Investments and Improving Feasibility Study Methodologies* (The World Bank, 1995) coedited by CCCC Highway Consultants Co., Ltd. and PPK.

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9. **Key Assumptions and model.** The following assumptions and model were used to estimate the aforesaid benefits.

- Forecast traffic volume (Average Annual Daily Traffic - AADT) on the identified highway/road sections according to the Feasibility Study Reports (FSR) of Component A and B.
- Year 2020 is considered as 'base year', and the construction will start in 2021.
- Currency conversion rate: USD 1 = RMB 6.48
- Usual maintenance work and costs in 'with' and 'without' project conditions are considered.
- Estimation of maintenance costs refers to the recent experience of the actual practices and cost of the similar type of roads in Guangxi.
- The GDP growth rate and population growth rate are taken from the macroeconomic sections in Feasibility Study Reports of Component A and B.
- The average shadow price conversion rate is 0.94, which is a weighted average value taking into consideration all the cost elements.
- Road user benefits considered include:
  - VOC savings
  - Time savings for passengers
  - Time savings for goods
  - Accident cost savings
  - Carbon emission reduction
- Economic opportunity cost of capital considered for analysis is 9%, following Bank's relevant guidance on the Economic CBA.
- The salvage value of the road assets in 20 years after completion is estimated at 25% of the historical Capex value.

10. **Road Condition Data**. The road geometry and pavement data on existing roads and the proposed design parameters were taken from the FSRs and used as input data in CBA model for the analysis.

Table 2: Conditions of the Design Highway/Road and Existing Road

Sections:	Component A		Component B	
Scenarios:	With Project (w P)	Without Project (w/o P)	With Project (w P)	Without Project (w/o P)
Length (km)	17.7	22.3[2]	13.6	13.6
Design Speed (km/hr)	100.0	60.0	40.0	30.0
Roughness	2.0	4.0	4.0	5.0
Vertical degree	4.0%	6.0%	6.0%	7.0%

11. **The Residual Value**. Regarding the remaining life of the construction assets, the residual value (salvage value) was assessed at the end of the project life. For structures, the life is assumed to be 50 years. Values of the selected construction items such as structures, sub-base, social displacement cost etc. are included in the economic analysis as residual values at the end of the project life. These residual values are considered as benefits to the project in the analysis. In the feasibility study reports, 50% is used as the salvage value after 20 years of completion, which follows the guidance in the government' regulation and manuals. In the Bank's analysis,

[2] 'W/o project' scenario refers to the condition of the parallel road.

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25% is used to align with the practice in other similar projects in order to examine the robustness of the project's viability.

Table 3: Details of Salvage Value Adopted for Analysis (US$ Million)

Section	Assets-Financial Value[3] ($million)	Assets-Economic Value ($million)	Value-Economic Salvage Value ($million)	Salvage Value (%)
Component A	354.7	333.4	83.3	25%
Component B	34.3	32.2	8.2	25%
Total	**389.0**	**365.7**	**91.5**	**25%**

B. Traffic Volume and Growth Rates

12. **Component A - Construction of the last section of the Wuzhou - Shuolong Expressway with a total length of 17.6 km.** The forecast traffic volume of the Component A consists of the trend traffic volume, the induced traffic volume and the traffic volume from the in-and-out traffics through the Shuolong Port. The predicted traffic volume (AADT) of the mainline of the Component A is 5,397 pcu/d in 2025, 9,571 pcu/d in 2030, 14,308 pcu/d in 2035, 19,218 pcu/d in 2039 and 25,259 pcu/d in 2044, with an average growth rate of 12.1% in the first 5 years after the project completion, 8.4% in the second 5 years, 7.7% in the third 5 years and 5.6% in the fourth 5 years. Traffic forecast was made taking into account the designed traffic capacity of the border crossing and the business plan of the tourism industry in that area. The traffic intensity in future years with its compositions is predicted as shown below.

Table 4: Forecast Traffic for Component A (AADT-pcu)

Feature Years	2025	2030	2035	2039	2044
Forecast Traffic on the Mainline Road	**5,397**	**9,571**	**14,308**	**19,218**	**25,259**
- Traffic volume by the tourism	2,054	4,250	6,250	7,500	8,750
- In-and-out passenger and freight through Shuolong Port	339	656	1,330	3,454	7,159
- Traffic volume by local residents in the border area.	3,004	4,665	6,728	8,264	9,350

13. **Component B - Improvement of an existing border road with a length of 13.6 km connecting Shuolong Port to the Detian (Pan Gioc) Waterfall scenic spot**. This component is improvement of an exisiting road, which will not significantly change the road structure. However, the improvement of the road condition and the service of a road connecting the Detain Waterfall scenic spot with the Shuolong port, further with the new expressway to be constructed under Component A will support the steady growth of traffic in the entire road network in the border area. The induced traffic was also estimated and considered in the calculation. The predicted weighted average traffic volume of the road under Component B for future years under 'w

14. ith project' and 'without project' senarios are shown in the table below.

[3] Including the design, construction and supervision costs for the implementation of the component

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Table 5: Traffic Forecast of Component B under 'w P' and 'w/o P' Scenarios (AADT-pcu)

Years	2024	2029	2034	2038	2043
With Project Scenario	4,602	5611	6657	7400	8,141
Without Project Scenario	4610	5,337	5,839	6,058	6,226

C. Economic Cost

15. The financial cost of the Capex investment for the Compinent A and B[4] were taken from the respective FSRs. The economic cost was estimated by multiplying 0.94 conversion factor to the financial cost and the predicated capex schedule is presented in the table below.

Table 6: Economic Cost of Component A and B and Predicted Capex Schedule

Sections	Financial Cost (USD million)	Economic Cost (USD million)	Year 1	Year 2	Year 3	Year 4
Component A	354.7	333.4	*8%*	*33%*	*38%*	*23%*
Component B	34.4	32.2	*30%*	*55%*	*15%*	
Capex for each year:	**389.0**	**365.7**	**34.7**	**126.1**	**129.9**	**75.0**

16. **Maintenance Cost.** The following maintenance and operation costs were considered in the analysis based on the empirical data in Guangxi. The financial unit costs estimated below were converted into economic costs by applying the conversion factor in the analysis. More details could be found in the Excel spreadsheet.

- Annual routine maintenance: RMB 150,000 per km per year for the Expressway and RMB 60,000 per km per year for the Class I highway. With deterioration of the road, the unit cost is assumed to increase by 3% every year.
- Medium intervention maintenance (applied to the Expressway section only): The first medium intervention maintenance will be carried out in the fifth year after the road completion. It will then be conducted every 10 years.
- Major intervention maintenance: The first medium intervention maintenance will be carried out in the tenth year after the road completion. It will then be conducted every 10 years.
- Electro/mechanical operations and maintenance: The unit cost is estimated at RMB 400,000 per km per year, with 3% year-of-year (YOY) escalation rate.
- Management cost is estimated at RMB 300,000 per km per year for expressway and RMB 60,000 per km per year for highways, with 3% YOY escalation rate.

D. Economic Benefits

17. **Vehicle Operating Cost Savings.** The model comprehensively predicts the performance and operating costs of motorized vehicles in the selected fleet. Vehicle performance projections include speeds (free flow and congested conditions) and consumptions. Projections for vehicle operating costs include fuel, oil, tire and parts costs, crew and maintenance labor costs, capital depreciation, financing costs, and overhead costs. The CBA model was used to estimate the Vehicle Operating Costs (VOC) for traffic in each vehicle category on each selected road sections with and without improvement taking into account the speed and travel time including surface

[4] Including design, construction and supervision costs for the implementation of the component.

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quality and road congestion. The estimated VOC values for each road can be found in the analysis results.

Table 7: Unit Rates and Saving of VOC for Component A (USD/100 km/vehicle)

Year	2025			2035			2044		
Types of Vehicles	W P.	W/O P.	saving %	W P.	W/O P.	saving %	W P.	W/O P.	saving %
Car	24.5	32.3	24%	24.7	37.4	34%	24.7	51.2	52%
Bus	50.3	65.3	23%	51.0	76.6	33%	51.8	111.3	53%
Small truck	32.6	44.6	27%	32.6	50.2	35%	32.6	68.7	53%
Medium truck	36.6	55.0	33%	37.1	67.3	45%	37.7	104.2	64%
Large truck	47.0	62.6	25%	47.7	70.6	33%	48.6	95.5	49%
Trailer	77.5	105.8	27%	89.7	117.4	24%	101.1	156.0	35%

Source: Feasibility Study report of Component A

Table 8: Unit Rates and Saving of VOC for Component B (USD/100 km/vehicle)

Year	2024			2034			2043		
Types of Vehicles	W P.	W/O P.	saving %	W P.	W/O P.	saving %	W P.	W/O P.	saving %
Car	34.9	40.2	13%	38.4	44.0	13%	42.5	45.5	6%
Bus	73.1	88.7	18%	80.3	95.0	15%	88.1	97.4	10%
Small truck	48.2	56.0	14%	52.0	60.1	14%	56.5	61.8	9%
Medium truck	63.4	79.2	20%	71.2	86.5	18%	79.7	89.3	11%
Large truck	68.3	78.2	13%	73.3	82.8	11%	78.6	84.6	7%
Trailer	115.9	133.1	13%	122.5	139.2	12%	129.0	141.4	9%

Source: Feasibility Study report of Component B

18. **Travel Time Saving for passengers.** The model estimates the Value of Travel Time (VOTT) for passengers in both with- and without-project scenarios taking into account speed and travel time including surface quality, road congestion, and unit time value for different vehicle travelers etc. The main categories of passanger vehicles will be cars and buses. To simplify the caculation, the anaylsis only examines the rate of two vehicle types.

Table 9: Unit Rates and Saving of VOTT for Passengers-Component A (USD/100 km/vehicle)

Year	2025			2035			2044		
Types of Vehicles	W P.	W/O P	saving %	W P.	W/O P	saving %	W P.	W/O P	saving %
Car	10.2	18.7	46%	18.9	50.5	63%	33.3	152.8	78%
Bus	92.9	170.9	46%	171.2	402.1	57%	296.2	1146.0	74%

Source: Feasibility Study report of Component A

Table 10: Unit Rates and Saving of VOTT for Passengers-Component B (USD/100 km/vehicle)

Year	2024			2034			2043		
Types of Vehicles	W P.	W/O P.	Saving%	W P.	W/O P.	saving %	W P.	W/O P.	saving %
Car	22.3	30.7	28%	50.7	66.5	24%	105.8	120.2	12%
Bus	194.8	260.8	25%	410.3	523.6	22%	795.5	922.0	14%

Source: Feability Study report of Component B

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19. **Transport time saving for goods**. Considering that there will be cargo transported through the expressway under Component A, particularly the cross-border cargo is expected to increase significantly after the road completion. The economic benefit from saving of cargo transportation time was estimated[5] according to the time value of money during the time when the cargo is in transit. In this calculation, the shadow price of goods was determined according to the prices of major goods such as cement, mining materials, and steel and ore materials transported by road in the project area through the traffic survey during preparation of the feasibility study. The averaged shadow price of goods per ton in 2020 was estimated at RMB 810/ton, and the annual growth rate was estimated at 3%, taking into account factors such as price increase of some typical types of goods. Based on the calculation, it was found that the cumulative impact from the freight transport time saving from Component A during the period of 2025-2044 is about RMB 1.5million, which would not have significant influence to the viability of the project**.**

20. **Accident Cost Saving.** The saving from the estimated reduction of accidents due to the improvement of the road condition and road services are shown in **Table 11 and 12**.

Table 11: Accident Cost Saving for Component A

Year	2025			2035			2044		
Indicators	W P.	W/O P.	saving %	W P.	W/O P.	saving %	W P.	W/O P.	saving %
No. of Accidents (per 100 million vehicle*km)	0.0	164.1	100%	16.8	189.9	91%	53.9	214.5	75%
Lost per Accident (USD /accident)	11592.0	9838.3	-18%	15578.6	13221.9	-18%	20326.6	17251.6	-18%

Source: Feasibility Study report of Component A

Table 12: Accident Cost Saving for Component B

Year	2024			2034			2043		
Indicators	W P.	W/O P.	saving %	W P.	W/O P.	saving %	W P.	W/O P.	saving %
No. of Accidents (per 100 million vehicle*km)	163.4	270.3	40%	172.2	287.4	40%	175.8	280.1	37%
Lost per Accident (USD /accident)	9259.3	7716.0	-20%	12443.7	10369.7	-20%	16236.2	13530.1	-20%

Source: Feasibility Study report of Component B

21. **Carbon Emission Saving[6].** After completion of the Project, due to the shortening of mileage and the improvement of road conditions, the energy consumption of vehicles will

[5] Referring to the 'Guidelines on Feasibility Study of Investment Projects' issued by National Development and Reform Commission of the People's Republic of China, 2002.

[6] Since the impact to the economic viability is not significant, the calculation of Carbon Emission Saving was carried out only for Component A, the major component of the project.

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decrease, thus reducing carbon emissions and bringing environmental benefits. The carbon emission reduction in the Project is mainly calculated by referring to the HDM-4 calculation model. However, there are certain differences between the classification and characteristics of various vehicle types in the model and the classification and standards implemented in China. In recent years, in order to effectively reduce the fuel consumption of automobiles and reduce carbon emissions, the Chinese government has formulated relevant standards for the fuel consumption limits of commercial vehicle for cargos transportation, commercial vehicle for passenger transportation, and passenger cars. Vehicles whose carbon emissions exceed the limits can no longer be produced. The actual fuel consumption can be accurately reflected by using the prescribed consumption limits. Therefore, the calculation of carbon emissions is adjusted based on the HDM-4 model according to the classification of vehicle types and the fuel consumption standard of each vehicle type in China[7], and then the fuel consumption is converted into carbon dioxide emissions. The annual carbon emission for the Component A under 'without project' and 'with project' scenarios were estimated and compared. The estimation of carbon price follows the recommendation in the draft CBA Guidance of AIIB shared by SPB in 2019.

22. According to the calculation, under Component A in the 20-year operation period (from 2025-2044), compared with the case of "without project", the case of "with project" reduces 159,477 tons of CO2 emission, with an average annual reduction of 7,974 tons of CO2 emission. This 159,477 tonnes carbon emission reduction is valued at USD14.87 million savings or its NPV value at USD 2.87 million as project benefit.

Table 13: Estimates of Carbon Emission Reduction by vehicle type for Component A (2025– 2044)

Unit: Ton CO2/year

Vehicle type / Year	Car	Bus	Small Truck	Medium Truck	Large Truck	Trailer	Total
2025	(123)	266	263	180	252	90	927
2026	(126)	296	289	208	288	127	1,083
2027	(121)	330	319	241	331	175	1,274
2028	(104)	369	353	281	381	232	1,512
2029	(66)	414	393	330	441	304	1,815
2030	5	466	440	390	512	393	2,206
2031	110	507	477	444	575	486	2,598
2032	269	554	519	509	648	596	3,095
2033	504	607	568	588	734	729	3,731
2034	849	670	627	684	836	887	4,554
2035	1,348	744	698	802	959	1,080	5,632
2036	1,776	783	734	883	1,058	1,260	6,495
2037	2,315	826	773	975	1,171	1,470	7,531
2038	2,995	870	813	1,079	1,300	1,711	8,768
2039	3,777	920	854	1,201	1,453	2,004	10,208
2040	4,634	975	895	1,344	1,638	2,373	11,860

[7] Relevant parameters in IPCC Guidelines for National Greenhouse Gas Inventories (2006) and General Principles for Calculation of Total Production Energy Consumption (GB/T 2589-2008) were referred for the conversion of fuel consumption into carbon dioxide emission.

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2041	6,140	1,085	984	1,598	1,937	2,934	14,678
2042	8,159	1,212	1,086	1,919	2,316	3,665	18,358
2043	10,908	1,363	1,197	2,328	2,814	4,637	23,248
2044	14,725	1,547	1,321	2,866	3,484	5,963	29,905
Total							159,477

E. Economic Viability and Conclusion

23. **The economic internal rate of return (EIRR) and the net present value (NPV) was calculated by the model applying a project discount rate of 9 percent[8] (i.e., the economic opportunity cost of capital).** The results of economic analysis are summarised in **Table 14**. The EIRR obtained for the 'base case' for the project (Component A + B) is 12.4%, which is much above the minimum required economic opportunity cost capital (EOCC) of 9%. Hence, the project is economically viable.

Table 14: Summary of the Economic Analysis

Sections	Base Case	
	EIRR	**ENPV @ 9% Discount - USD Million**
Component A	12.4%	145.0
Component B	11.3%	7.1
Combined A and B:	**12.4%**	**154.9**

EIRR = Economic internal rate of return, ENPV = Economic net present value

24. **Sensitivity Analysis**. Additionally, a sensitivity analysis for the following scenarios was carried out and the results are summarised in **Table 15**. The results show the robustness of the economic feasibility of the project under the normal and adverse sensitivity scenarios. The EIRR for the project in different scenarios is more than the EOCC of 9%. This justifies the Project investment with more risk absorption capacity.

- 15% increase in project cost
- 30% reduction in project benefits
- One-year delay in construction
- Combined scenario of 15% increase in project cost, 15% reduction in project benefits and One-year delay in construction (worst case)

Table 15: Results of the Sensitivity Analysis

Scenarios	Component A +B	
	EIRR%	ENPV-USD Million
Base Case	**12.4%**	**154.9**
15% increase in project cost and O&M cost	11.2%	109.1
30% decrease in benefit (worst scenario)	9.5%	20.4
1- year delay in construction	11.7%	103.2

[8] As recommended by the draft Guidance for CBA of AIIB shared by SPB in 2019.

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15% increase of Cost + 15% decrease in benefit +1-year delay (combined scenario)	9.2%	5.8

F. Financial Analysis.

25. The expressway section under Component A will be toll charged after opening to traffic. The basic information of the road sections to be toll charged is shown in the Table 16 below. Using the traffic volume forecast for Component A, multiplied by the 'tolling scheme' by different types of vehicles, which follows the government tolling fee regulation[9] executed in Guangxi, the estimated tolling revenue for each year has been calculated. The special tolling free policy for a few of special vehicles and for cars during public holidays has also been considered in the calculation. The tolling fee standard was assumed to be increased every 5 years for the next 20 years taking into account steady economy growth. Over the life span of the project, the estimated toll revenue will be more than sufficient to cover the operation and maintannance of the expressway. However, as a capital investment project, the FIRR of Component A is negative (-0.73% without considering the financing cost/loan interests).

Table 16: Basic Information of the tolling section of the Expressway (Component A)

Sections	Length	Numbers
Total Expressway section (Road +Bridges + Tunnels)	12,263m	NA
Bridge and Tunnels-Class I (500m-1000m)	2,083 m	3
Bridge and Tunnels-Class II (1000m-3000m)	2,470.5 m	2

26. There will be no revenue directly generated from the road under Component B. The maintenance of Component B after completion of the project will be under responsibility of the relevant government agencies of Daxin Country and is to be funded by the fiscal budget of the government. Given the condition of this road will directly affect the development of the tourism industry in Daxin County, which is one of the most important contributors of its GDP (accounting for around 40-50% every year from 2016 to 2020), the maintenance plan of roads in the tourism area would be on top priority in the budget allocation to road sector and will receive the full support from the local government. The total fund required for road maintenance is about RMB 650,000 per year, which only makes up about 1.3% of the average budget allocation to road sector of Daxin County in the past 5 years, which is assessed as affordable to Daxin County for their public financing.

[9] The Tolling Scheme refers to the following three policies which are currently applicable: 'Working plan for Expressway Accessing to Every County [Gui Zheng Fa 2014-No.51]', 'Notice on Adjustment of Guangxi Expressway Toll Standard [Gui Jia Fei 2014-No. 87]', and 'Notice on Adjustment of Guangxi Toll Charging Method for Trucks according to Vehicle (Axle) Type [Gui Jiao CaiWu Fa 2019-No.86]'.

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Table 17: Details of Economic Analysis for Base Case

Unit: $USD million

Years	CAPEX	OPEX	**Total Cost**	Savings in VOC	Savings in Time cost	Savings from reduction of	Saving from CO2 Emmission	**Total Benefits**	Residual Value	**Net Benefits**
2020	-	-	**-**	-	-	-	-	**-**	-	**-**
2021	34.8	-	**34.8**	-	-	-	-	**-**	-	**(34.8)**
2022	126.4	-	**126.4**	-	-	-	-	**-**	-	**(126.4)**
2023	129.9	-	**129.9**	-	-	-	-	**-**	-	**(129.9)**
2024	75.0	0.1	**75.1**	1.0	1.6	0.1	0.0	**2.8**	-	**(72.3)**
2025	-	1.2	**1.2**	7.5	7.2	0.9	0.1	**15.7**	-	**14.5**
2026	-	1.2	**1.2**	7.6	8.6	1.0	0.1	**17.4**	-	**16.1**
2027	-	1.3	**1.3**	9.7	10.4	1.2	0.1	**21.5**	-	**20.2**
2028	-	1.3	**1.3**	11.1	12.7	1.4	0.2	**25.4**	-	**24.0**
2029	-	3.1	**3.1**	12.7	15.5	1.7	0.2	**30.1**	-	**26.9**
2030	-	1.4	**1.4**	14.6	19.0	1.9	0.2	**35.9**	-	**34.5**
2031	-	1.4	**1.4**	16.3	22.7	2.2	0.3	**41.5**	-	**40.1**
2032	-	1.5	**1.5**	18.3	27.3	2.4	0.3	**48.4**	-	**46.9**
2033	-	2.2	**2.2**	20.7	33.0	2.7	0.4	**56.8**	-	**54.6**
2034	-	6.6	**6.6**	23.6	40.3	3.0	0.5	**67.3**	-	**60.7**
2035	-	1.6	**1.6**	27.0	49.5	3.4	0.6	**80.5**	-	**78.9**
2036	-	1.7	**1.7**	29.6	57.8	3.7	0.7	**91.7**	-	**90.0**
2037	-	1.7	**1.7**	32.5	67.6	4.0	0.8	**104.9**	-	**103.2**
2038	-	1.8	**1.8**	35.9	79.5	4.3	0.9	**120.6**	-	**118.9**
2039	-	4.2	**4.2**	39.7	93.3	4.7	1.0	**138.7**	-	**134.5**
2040	-	1.9	**1.9**	43.8	108.8	5.1	1.2	**158.9**	-	**157.1**
2041	-	1.9	**1.9**	50.7	133.3	5.6	1.5	**191.1**	-	**189.2**
2042	-	2.0	**2.0**	59.4	165.0	6.2	1.9	**232.5**	-	**230.6**
2043	-	2.9	**2.9**	70.6	207.0	6.8	2.4	**286.8**	8.2	**292.1**
2044	-	8.7	**8.7**	84.1	258.3	7.1	3.1	**352.6**	83.3	**427.2**
Total	366.1	49.7	**415.7**	616.6	1,418.5	69.5	16.6	**2,121.2**	91.5	**1,797.0**
ENPV@9%	291.7	13.6	**305.4**	142.8	285.5	16.9	3.4	**448.7**	11.7	**154.9**
EIRR %	-	-	**-**	-	-	-	-	-	-	**12.4%**

Table 18: Details of Sensitivity Analysis for Economic Viability

Unit: $USD million

Year	Base Case			15% Cost Increase			30% Benefit Decrease			1 Year Delay in Construction			Combined Scenario (15%+15%+1 Y)		
	Total Cost	Total Benefits	Net Benefits	Total Cost	Total Benefits	Net Benefits	Total Cost	Total Benefits	Net Benefits	Total Cost	Total Benefits	Net Benefits	Total Cost	Total Benefits	Net Benefits
2020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2021	34.8	0.0	(34.8)	40.1	0.0	(40.1)	34.8	0.0	(34.8)	0.0	0.0	0.0	0.0	0.0	0.0
2022	126.4	0.0	(126.4)	145.3	0.0	(145.3)	126.4	0.0	(126.4)	34.8	0.0	(34.8)	40.1	0.0	(40.1)
2023	129.9	0.0	(129.9)	149.4	0.0	(149.4)	129.9	0.0	(129.9)	126.4	0.0	(126.4)	145.3	0.0	(145.3)
2024	75.1	2.8	(72.3)	86.3	2.8	(83.6)	75.1	1.9	(73.1)	129.9	0.0	(129.9)	149.4	0.0	(149.4)
2025	1.2	15.7	14.5	1.4	15.7	14.3	1.2	11.0	9.8	75.1	2.8	(72.3)	86.3	2.4	(84.0)
2026	1.2	17.4	16.1	1.4	17.4	16.0	1.2	12.2	10.9	1.2	15.7	14.5	1.4	13.4	12.0
2027	1.3	21.5	20.2	1.5	21.5	20.0	1.3	15.1	13.8	1.2	17.4	16.1	1.4	14.8	13.4
2028	1.3	25.4	24.0	1.5	25.4	23.8	1.3	17.7	16.4	1.3	21.5	20.2	1.5	18.3	16.8
2029	3.1	30.1	26.9	3.6	30.1	26.4	3.1	21.0	17.9	1.3	25.4	24.0	1.5	21.6	20.0
2030	1.4	35.9	34.5	1.6	35.9	34.3	1.4	25.1	23.7	3.1	30.1	26.9	3.6	25.5	21.9
2031	1.4	41.5	40.1	1.7	41.5	39.9	1.4	29.1	27.6	1.4	35.9	34.5	1.6	30.5	28.9
2032	1.5	48.4	46.9	1.7	48.4	46.7	1.5	33.9	32.4	1.4	41.5	40.1	1.7	35.3	33.6
2033	2.2	56.8	54.6	2.5	56.8	54.3	2.2	39.8	37.6	1.5	48.4	46.9	1.7	41.1	39.4
2034	6.6	67.3	60.7	7.6	67.3	59.7	6.6	47.1	40.5	2.2	56.8	54.6	2.5	48.3	45.8
2035	1.6	80.5	78.9	1.8	80.5	78.6	1.6	56.3	54.7	6.6	67.3	60.7	7.6	57.2	49.6
2036	1.7	91.7	90.0	1.9	91.7	89.8	1.7	64.2	62.5	1.6	80.5	78.9	1.8	68.4	66.6
2037	1.7	104.9	103.2	2.0	104.9	103.0	1.7	73.5	71.8	1.7	91.7	90.0	1.9	77.9	76.0
2038	1.8	120.6	118.9	2.0	120.6	118.6	1.8	84.4	82.7	1.7	104.9	103.2	2.0	89.2	87.2
2039	4.2	138.7	134.5	4.8	138.7	133.8	4.2	97.1	92.9	1.8	120.6	118.9	2.0	102.5	100.5
2040	1.9	158.9	157.1	2.1	158.9	156.8	1.9	111.3	109.4	4.2	138.7	134.5	4.8	117.9	113.0
2041	1.9	191.1	189.2	2.2	191.1	188.9	1.9	133.8	131.9	1.9	158.9	157.1	2.1	135.1	133.0
2042	2.0	232.5	230.6	2.3	232.5	230.3	2.0	162.8	160.8	1.9	191.1	189.2	2.2	162.5	160.3
2043	2.9	286.8	292.1	3.4	286.8	291.7	2.9	200.8	206.1	2.0	232.5	238.8	2.3	197.6	203.6
2044	8.7	352.6	427.2	10.0	352.6	425.9	8.7	246.8	321.4	2.9	286.8	367.2	3.4	243.8	323.8
Total	415.7	2121.2	**1797.0**	478.1	2121.2	**1734.6**	415.7	1484.8	**1160.6**	407.0	1768.6	**1453.1**	468.1	1503.3	**1126.7**
ENPV@9%	305.4	448.7	154.9	351.2	448.7	109.1	305.4	314.1	20.3	279.2	370.7	103.2	349.9	444.8	5.8
EIRR %			**12.36%**			**11.18%**			**9.51%**			**11.68%**			**9.15%**

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Table 19: Details of Financial Analysis for Component A

Unit: $USD million

Years	CAPEX	OPEX	**Total Cost**	Passanger Vehicles (road)	Passanger Vehicles (T&B)	Freight Vehicles (road)	Freight Vehicles (T&B)	**Total Benefits**	**Net Benefits**
2020	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	**0.0**	**0.0**
2021	26.6	0.0	**26.6**	0.0	0.0	0.0	0.0	**0.0**	**(26.6)**
2022	115.3	0.0	**115.3**	0.0	0.0	0.0	0.0	**0.0**	**(115.3)**
2023	133.0	0.0	**133.0**	0.0	0.0	0.0	0.0	**0.0**	**(133.0)**
2024	79.8	0.0	**79.8**	0.0	0.0	0.0	0.0	**0.0**	**(79.8)**
2025	0.0	1.2	**1.2**	1.8	2.2	1.3	0.6	**5.8**	**4.6**
2026	0.0	1.2	**1.2**	2.0	2.4	1.3	0.7	**6.4**	**5.1**
2027	0.0	1.3	**1.3**	2.2	2.7	1.4	0.7	**7.1**	**5.8**
2028	0.0	1.3	**1.3**	2.5	3.0	1.6	0.8	**7.9**	**6.6**
2029	0.0	3.2	**3.2**	2.7	3.4	1.8	0.9	**8.8**	**5.6**
2030	0.0	1.4	**1.4**	3.5	4.3	2.0	1.1	**11.0**	**9.7**
2031	0.0	1.4	**1.4**	3.8	4.7	2.5	1.2	**12.2**	**10.8**
2032	0.0	1.5	**1.5**	4.1	5.0	2.7	1.3	**13.2**	**11.7**
2033	0.0	1.5	**1.5**	4.4	5.4	2.9	1.5	**14.2**	**12.7**
2034	0.0	6.9	**6.9**	4.7	5.8	3.2	1.6	**15.3**	**8.4**
2035	0.0	1.6	**1.6**	5.9	7.3	3.4	1.9	**18.5**	**16.9**
2036	0.0	1.6	**1.6**	6.2	7.6	4.1	2.0	**19.9**	**18.3**
2037	0.0	1.7	**1.7**	6.6	8.0	4.3	2.1	**21.0**	**19.4**
2038	0.0	1.7	**1.7**	6.9	8.5	4.6	2.2	**22.2**	**20.5**
2039	0.0	4.3	**4.3**	7.3	8.9	4.8	2.4	**23.4**	**19.1**
2040	0.0	1.8	**1.8**	8.9	10.9	5.1	2.8	**27.7**	**25.8**
2041	0.0	1.9	**1.9**	9.4	11.6	6.0	3.0	**29.9**	**28.1**
2042	0.0	1.9	**1.9**	10.0	12.3	6.4	3.2	**31.9**	**29.9**
2043	0.0	2.0	**2.0**	10.7	13.0	6.9	3.4	**33.9**	**31.9**
2044	0.0	9.3	**9.3**	11.3	13.8	7.3	3.6	**36.1**	**26.9**
FIRR %									**-0.73%**

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Annex 4: Digital Technology Section

A. The context of Infratech

1. Infratech can be broadly defined as technologies that impacts the design, construction, financing, operation, or any other aspects along the project cycle or value chain of infrastructure. The specific application of Infratech within this project is designed to integrate digital technologies such as building information modelling, with materials, sensors and industry processes, enabling data analytics to drive asset management optimization across the infrastructure lifecycle.

B. AIIB's Approach to engage in Infratech

2. **AIIB's role in Infratech adoption is a threefold approach.** Firstly, to identify and communicate the benefits of Infratech within large scale infrastructure projects. These include the impact Infratech can deliver, including better value, quality, productivity, efficiency, resilience, sustainability, inclusion, transparency or better governance along the full project life cycle. This is aligned with AIIB Corporate Strategy's definition of technology-enabled infrastructure.

3. Secondly, to understand and address the barriers to adoption for our clients and potential investors. These include restrictive procurement and other policies; insufficient awareness of technology opportunities; cross-industry dialogues and partnership; split incentives of sponsors and users; mismatch of talent pool and culture and Infrastructure stakeholders who are risk averse and need to see success first.

4. Thirdly, to work with infrastructure sponsors to create 'Lighthouse Projects' which demonstrates how to overcome difficulties and barriers of adopting Infratech. This project will play a key role as one of the first 'Lighthouse Projects' in transportation sector..

- These Lighthouse Projects will provide insight and information to improve awareness, promoting collaboration to reduce frictions for partnerships and create living projects that can be used as demonstrations of best practices. These examples will help share the right financing and procurement structure and facilitate financing while coordinating policies and regulation dialogues.

- An additional strategic outcome is the potential to support the creation of a fertile innovation ecosystem and conducive platform for Infratech, where these examples and practice can be shared across different stakeholders. In doing this AIIB will be able to leverage the existing portfolios and network to lead and facilitate more collaborations and adoptions of Infratech in the long term, that will benefit more infrastructure projects and AIIB members.

C. Infratech applications within the project

5. The initial goal within the project was to communicate the advantages of Infratech and its benefits across the lifecycle of the project to the client. Traditionally any technologies within Infrastructure projects have been the domain of the construction partner and fall into a lowest bidder, siloed approach to technology.

6. AIIB team and the PMO/PIO have worked closely together to discuss the changing role of Infratech within large scale Infrastructure projects and the need to engage with these technologies

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in a more direct manner across the project lifecycle. Adoption of Infratech in the project is consistent with the Ministry of Transport of China' guidance in the plan of National Integrated Transport Network (NITN), which indicates that by 2035, the digital technology application in the transport infrastructure should be above 95% in China. It also strongly aligns with the Ministry of Finance longer term objectives to create the demonstration effect of AIIB's operation in China. It was also agreed on the importance of creating replicable solutions, not just for China, but one that might be applied across AIIB's members.

7. It was agreed that the most appropriate approach would be to engage a "Master Technology Partner ('MTP')" who would have an equal footing and status as all the other main project partners and have the potential to engage throughout the lifecycle of the project. The role of the MTP will be to take a holistic view of the project in selecting the appropriate technologies to directly deploy. The MTP will also create the standards for all the other project participants. This will be accomplished insofar as any technologies procured should meet a set of agreed level of functionality with the ability to ensure that all data generated can be collected and stored centrally in a unified and accessible format. The approach will be further developed together with the client to customize their demand and concerns.

D. Examples of solutions that could be deployed across the project:

- **Design/Construction/Operation & Maintenance** – 'Digital Twin / Building Information Modelling ('BIM')'. This technology takes the project plans and designs and creates a digital 'Twin' overlayed on a real world virtual map of the project. This enables all plans to be agreed and signed off prior to construction, enabling significant savings in change orders. The Digital Twin can be employed across the full lifecycle and act as the single source of truth for data and provide analytics to support efficiencies in all aspects of the project.
- **Construction / Maintenance** – 'Material Science – Smart Concrete'. This technology enables quality control of all concrete operations from production to delivery and deployment. Using Predictive analytics it can ensure that the correct mix of concrete and water is used in the production phase combined with smart scheduling to ensure that the concrete arrives at the site at the optimum point for pouring, utilizing sensors in the concrete area on site to monitor consistency. This technology will have a direct impact on increasing the life of the asset, reducing CO2 in the production process and reducing cost of the concrete.
- **Full Lifecycle** – 'Smart Contract Management'. This technology ensures that all aspects of contracting throughout the project can be captured and stored. Traditionally up to 90% of documentation can be lost between the construction and maintenance phases. Utilising smart contracting can ensure that any future considerations for the asset can be underpinned by a fully transparent set of documents.

8. The MTP will be responsible for the selection and delivery of these solutions either directly or through an eco-system of partners. The eco-system approach also aligns strongly with AIIB's stated technology strategy in this area. All partners will be added to the AIIB database and ultimately future MTP's will have access to this database to better facilitate the selection of qualified partners.

9. The procurement phase for the MTP is intended to be run in advance of the construction phase to ensure that a Digital Twin/BIM is available at the earliest possible stage. It has been included in the agreed Procurement Plan of the project. It is envisaged that the MTP will act as a

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service partner, procured through a service contract. The goal will be to have the terms of reference complete and ready to distribute after the initial project commit to determine the level of interest and solutions capabilities of the potential MTP's. An RFP will follow with the goal to have the partner selection and the build of the digital twin complete in advance of negotiations with construction partners.

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Annex 5: Member and Sector Context

1. **Country Priority.** Guangxi Zhuang Autonomous Region (Guangxi) is located in the southern part of China. Guangxi is bordered by Yunnan Province to the west, Guizhou Province to the north, Hunan Province to the northeast, and Guangdong Province to its east and southeast. It is bordered by Vietnam in the southwest. Its location, in the mountain terrain, has placed it on the frontier of China in history. Guangxi contains the largest population of China's ethnic minorities, in particular, the Zhuang ethnic group which makes up 32% of Guangxi's population.

2. Guangxi has a coastal line of about 1,629 km along the Beibu Gulf (Gulf of Tonkin) and has the only seaport in the west of China. In the past 20 years, Guangxi has experienced steadily growth in its economy as well as infrastructure development. In 2019, the total GDP of Guangxi reached RMB2,123.7 billion and GDP per capita increased to RMB42,964. The GDP of 2019 was ranked 19th among thirty-one provinces/municipalities of the mainland China.

3. Guangxi is one of the major international gateways of China towards ASEAN (Association of Southern Asian Nations) countries. Amid the global growth slowdown and uncertainties of the external environment, the trade between China and ASEAN continues to grow. China has been the ASEAN region's largest trading partner continuously since 2009 and ASEAN became China's second-largest trading partner in 2019. In the context of the pandemic, the ASEAN region overtook the European Union and became the first-largest trading partner in the first quarter of 2020. Given the geographic proximity and strategic partnership between two economies, further enhancement of the trade connectivity between China and ASEAN countries, as well as the promotion of economic and trade cooperation becomes even more important in the current global environment and will contribute to the recovery and stabilization of the regional and global economy.

4. Vietnam, bordering Guangxi, is China's largest trade partner in the ASEAN region. According to the 2018 Report of China's Ministry of Commerce, China was the fifth FDI (Foreign Direct Investment) source for Vietnam. With the continuous enhancement of cooperation between China and Vietnam, it becomes essential for Guangxi to further develop its connectivity infrastructure in the border area with Vietnam. This requires continuous development in the road infrastructure, particularly, construction of the missing link connecting the ports at the border to the provincial and the national expressway network. In addition, it requires the planning and upgrading of the infrastructure and facilities of border ports. This infrastructure investment in the border area will further enhance the opening-up policy, enable the vital ports along the border line to become fully functional in expanding the trade, direct investment, and other economic activities and cooperation between two countries.

5. **Sectoral and Institutional Context.** Guangxi's location makes it an important transport hub connecting provinces in the western, central and southern China and bordering with Vietnam. Guangxi has various transport modes, including highway, railway, waterway, civil aviation and sea transports. Highway transportation is the dominant mode, accounting for about 79 percent of the passengers' transportation and 80% of freight transportation in 2019. In the same year, the total length of roads in Guangxi was around 125,500 kilometers including 6,000 km of expressways, 20,000 km of Class-2 or above highways and 100,000 km of rural roads. Almost one hundred percent (100 percent) of villages are accessed by paved roads and 91 percent of counties are connected by expressways. In 2019, the fixed assets investment in transport sector

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was more than USD17 billion, and about 80 percent was invested in road sectors. After about 20 years development and continuous investment in the road infrastructure, Guangxi has a well-established road network consisting of all categories of roads from trunk expressways to rural roads.

6. Next steps for the development priority of the road sector in Guangxi will be: (i) continuous increase in the accessibility to the people in rural and remote areas; (ii) enhancing the quality and efficiency of the trunk road network; and (iii) improving the road network in the border areas, including construction of the missing links connecting expressway to important ports on the border. The development of comprehensive transport infrastructure in the border areas is still lagging. The majority of the existing roads in the border areas are of low standards with no up-to-standard quality and low transport capacity, which are not sufficient to accommodate the fast-growing demands for the trade, tourism and other economic activities in the area. Only five ports out of 10 ports are at present connected to expressways and others are all connected by low-level roads. In order to further upgrade its expressway network and promote the connectivity with Vietnam, the government of Guangxi has approved the *Expressway Network Planning (2018-2030)*, in which one objective aims at connecting major border ports to the expressway network.

7. Current roads connected to Shuolong Port are of low-standard, such as Class-three roads or below. These roads have narrow lanes, steep slopes, insufficient road safety furniture and are exposed to high risks of geological disasters such as floods and slope failures. It is urgently needed to build a new expressway to connect the newly upgraded Shuolong Port with the expressway network as well as the improvement of the roads and relevant infrastructure in the border area around the Shuolong Port.

8. The Guangxi Provincial Department of Transport oversees policy, regulation, planning and development of major road infrastructure at the provincial level. The Provincial Department of Transport is also responsible for reviewing, commenting and providing clearance of the investment of the road infrastructure projects in Guangxi. City Transport Bureaus and public authorities or entities will be responsible for planning, investment and development of the road infrastructure at the city level. The development of the border road network could be implemented by either provincial level entities/authorities or city level entities/authorities, which will be subject to the decision made by the provincial government with the consultation with the relevant city government. The development model of the road projects could be various, either through Direct Public Procurement or through the Public-Private-Partnership (PPP) and similar contractual arrangements involving the private sector. After completion of the road, under the Direct Public Procurement model, the local government, or through its authorized state-owned entity, will be responsible for the operation and maintenance of the road. Under the PPP model or the similar contractual arrangement involving private sector, the Special Project Vehicle (SPV) or the concessioner will be responsible for the operation and maintenance of the road assets. Chongzuo, the main city of Guangxi bordering with Vietnam, owns 7 ports along its border line, and usually represents Guangxi to manage business and affaires in the border areas, including coordination and negotiation with the government of the border provinces in Vietnam. According to the decision made by the government of Guangxi, the Chongzuo Municipality and Daxin County will be the Implementing Agencies for this project.

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Annex 6: Sovereign Credit Fact Sheet

A. Recent Economic Developments

1. China is an upper-middle-income country with income per capita of about USD10,400 and population of about 1.4 billion, as of 2019.[10] China has weathered the pandemic remarkably well. In 2020, economic growth remained positive as the country contained the virus outbreak, implemented an effective stimulus and reopened the economy ahead of others, benefiting from a booming export demand as other regions were still mired in the pandemic-related lockdowns, while global consumers switched consumption from services to manufactured goods. According to the National Bureau of Statistics (NBS), in Q1 2021, the economy grew by 18.3 percent, compared with Q1 2020, due to the base effect but also reflecting strong growth momentum.

2. Overall, China's economic growth has been trending down recently, declining from above 10 percent in 2010 to 6.0 percent in 2019.[11] This is related to the efforts to "rebalance" the economy more towards consumptions, which are showing some early results. On the demand side, before the pandemic, domestic consumption contributed 58 percent to the GDP growth, as of 2019, according to the NBS. However, in the aftermath of the COVID-19 crisis, private consumption recovery has been lagging, which has led to concerns about sluggish household income and insufficient incentives to consume. On the supply side, services accounted for more than a half of 2020 GDP, whereas manufacturing for about 38 percent.[12]

3. Inflation in 2020 was stable, at 2.4 percent. Expansionary fiscal policy to support the economy through the pandemic and a carryover from the 2019 tax reforms led to a deterioration of the fiscal balance to a 11.4 percent of GDP deficit (IMF's definition), while public debt increased to 44.7 percent of GDP.[13]

Selected Economic Indicators 1/	2017	2018	2019	2020	2021	2022
GDP growth 2/ 7/	6.9	6.7	6.0	2.3	8.4	5.6
Inflation 2/	1.6	2.1	2.9	2.4	1.2	1.9
Current account balance 2/	1.6	0.2	1.0	2.0	1.6	1.3
Fiscal balance 2/ 5/	-3.8	-4.7	-6.3	-11.4	-9.6	-8.7
Public debt 3/ 6/	36.2	36.5	38.1	44.7	47.2	49.5
External debt 3/	14.3	14.3	14.3	15.3	15.2	15.5
Gross official reserves (USD billions) 3/	3,236	3,168	3,223	3,579	3,842	4,127
Exchange rate (CNY/USD, end of period) 4/	6.53	6.86	6.98	6.52	6.38	..

Notes: 1/ in percent of GDP; except growth rates which are in percentage changes, average year-on-year; or as indicated otherwise; 2017-20 are actuals (or estimates), 2021-22 are projections, unless noted otherwise
2/ Source is IMF World Economic Outlook April 2021; 3/ Source is IMF Country Report No. 2021/006; 4/ Source is State Administration of Foreign Exchange, for 2021: as of June 2, 2021; 5/ General budgetary balance (IMF definition), measured by net lending/borrowing; 6/ General budgetary debt (official definition); 7/ Actuals for 2017-20 from National Bureau of Statistics database.

4. The current account has been broadly stable. It increased to a surplus of 1 percent of GDP in 2019 due to a decline in imports and a reduction in the primary income deficit. In 2020, current account surplus is likely to have increased further, to around 2 percent of GDP, due to lower

[10] Income classification and data form the World Bank.
[11] See the table for figures. This applies to all other numbers in the document if the source is not specified.
[12] National Bureau of Statistics
[13] Fiscal balance as measured by net lending/borrowing using IMF's definition, which is based on official statistics, but broadens the fiscal coverage to include all four independent components of China's fiscal accounts, namely: general public budget, government funds, SOE budget, and social security (see IMF Country Report No. 2021/006, for more details). On the other hand, according to the narrower official budgetary approach (which includes only general public revenue and expenditure, adjusted for transfers) the deficit was 3.7 percent of GDP. Public debt measured by the general budgetary debt (official definition).

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commodity prices, the collapse in outbound tourism expenditure, and an unexpected surge of demand for Chinese exports, including pandemic-related goods.

5. Foreign direct investment into China reached record high levels in 2020, making China the biggest FDI destination in the world. Trade surplus combined with strong capital inflows led to a fast exchange rate appreciation. Since early 2020 the RMB has appreciated from around 7.0 to below 6.4 per USD, as of June 2021, which has raised some concerns among policymakers. International reserves have been broadly stable or growing. According to the IMF, reserves are estimated to cover about 16 months of imports, as of 2020, which is more than adequate.

B. Economic Outlook

6. According to IMF projections, China's GDP growth is expected to rebound to 8.4 percent in 2021. In the longer term, the GDP growth rate should continue the smooth and gradual downward trend, along the rebalancing policy. Meanwhile, the pandemic has also revealed risks in the economy, including lagging private consumption, rising financial vulnerabilities as debts have climbed up, and the still uncertain external environment.

7. Regarding external environment, there have been positive signs recently, including the signing of EU-China Comprehensive Agreement as well as the Regional Comprehensive Economic Partnership (ratification is pending). However, uncertainty remains about potential further escalation in trade and geo-political tensions that could lead to higher tariffs and supply chain disruptions. Continued technology decoupling could potentially add to risks.

8. On the domestic side, there are concerns about increasing financial stability risks related to rising vulnerabilities in the nonfinancial corporate sector (e.g., a significantly increase in debt), the highly leveraged property sector, the likely deterioration of credit quality in the banking sector and about the delay of further progress on financial de-risking.

9. Risks to debt sustainability are relatively contained, as economic growth is robust while debt levels remain manageable. External debt is projected to remain stable in the medium term, at around 15 percent of GDP. As the budget deficit is expected to remain higher than before the pandemic, public debt may continue increasing gradually, to almost 50 percent of GDP in the near term.

10. However, off-budget public investment activities are a source of risk. According to IMF's "augmented" debt definition—that is, including debt of local government financing vehicles likely to be recognized, which amount to almost 40 percent of GDP—public debt in 2020 increased from 80.5 to 91.7 percent of GDP, and is expected to rise further to over 110 percent of GDP in 2025.[14]

11. Still, China's sovereign credit remains strong, at A+/A1 with a stable outlook. This is thanks to the large and diversified economy, positive growth prospects, high degree of government's control over the financial sector (and the economy in general), as well as to debts being almost entirely in the local currency, refinanced at low costs. China's future debt profile will depend on continued economic growth, implementation of fiscal consolidation measures and on the gradual reduction of off-budget activities.

[14] See IMF Country Report No. 2021/006 for more discussion on the "augmented debt" and the related risks.

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