ECONOMIC AND FINANCIAL ANALYSIS

A. Background

1. Economic analysis of the proposed upgrading of the 58.27 kilometer (km.) Baucau to Viquqeue Highway was conducted in accordance with the Asian Development Bank's (ADB) *Guidelines for Economic Analysis of Projects*.[1] The project will support the development of a more reliable and safer road network in Timor-Leste, particularly cross-island connections between the potential south coast economic hubs of Viqueque and Lautem with population centers in Baucau and the national capital, Dili. The project aims to (i) reduce travel times and associated costs; (ii) establish sustainable maintenance arrangements for the project road; (iii) improve maintenance planning and asset management; and (iv) draft legislation to establish a Land Transportation Authority. The succeeding sections detail assumptions, methodologies, and results that demonstrate the economic viability of the proposed Project.

2. **Macroeconomic context**. Timor-Leste has the third-largest economy among ADB's 14 Pacific developing member countries, with gross domestic product (GDP)—excluding offshore petroleum operations—at about $1.5 billion as of 2016.[2] High public spending, backed by large incomes from petroleum taxes and royalties, provided sustained fiscal stimulus that supported average economic growth of 10.5% from 2007 to 2012. Growth eased to an average of 4.4% since, amid fiscal sustainability concerns with the impending depletion the current petroleum production area, and uncertainty regarding further development of other oil fields. Timor-Leste's Petroleum Fund has accumulated $16 billion in asset value, or over $13,000 per capita. Largely because of its petroleum wealth, the country has attained lower middle-income and medium human development status. However, about 70% of the 1.2 million population still live in rural areas and rely on subsistence agriculture. Formal employment opportunities are mostly found in the public sector, with very little manufacturing and production for export in the private sector. The government is planning the development of a downstream petrochemical industrial hub in the south coast through its *Tasi Mane* project. The project will support not only this government initiative but also the broader economic development of agriculture-rich and high tourism potential districts in Timor-Leste's southern coast.

3. **Sector context.** A 25-year period of conflict suppressed any significant investment in maintenance and rehabilitation of the Timor-Leste road network prior to independence in 2002. Progressive deterioration leading to poorer road conditions continued over most of the first decade of independence. To help address road connectivity and safety in Timor-Leste, ADB has financed a series of transport sector projects including the Road Network Development Sector Project, the Road Network Upgrading Project, and the Road Network Upgrading Sector Project.[3] In combination with other development partner-supported projects, about 560 km or 39% of the most important sections of the national road network are expected to be upgraded by the end of 2019.[4] The project targets a crucial north–south component of the land transport network, and involves important synergies with past and ongoing road projects.

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[1] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.
[2] Although the Government of Timor-Leste receives substantial taxes and royalties from offshore oil and gas production, the preferred measure of economic activity excludes the petroleum sector as this has almost no direct linkages with the domestic economy. Economic monitoring therefore focuses on the non-oil economy and non-oil GDP.
[3] ADB. 2009. *Report and Recommendation of the President to the Board of Directors: Proposed Asian Development Fund Grant to the Democratic Republic of Timor-Leste for the Road Network Development Sector Project*. Manila; and ADB. 2012. *Report and Recommendation of the President to the Board of Directors: Proposed Loans for the Road Network Upgrading Project.* Manila.
[4] For example, ADB is co-financing the upgrading of the Dili–Baucau road together with the Japan International Cooperation Agency (JICA) while the World Bank is financing upgrading of the Dili–Ainaro road.

B. The Project

4. The existing road between Baucau and Viqueque is about 4.5 meters (m) wide, unsealed, and in generally poor condition. The first 23.38 km section between Baucau and Venilale serves an estimated population of over 24,000. About 63% of the carriageway is in "fair" condition, with the remainder classified as "poor". Average roughness is about 8 m/km. The second 34.89 km section from Venilale to Viqueque that serves a population of over 16,000 is in a more deteriorated condition, with less than half of the carriageway classified as "fair" and the rest as "poor". Average roughness is 26 m/km. and the road is passable only by 4-wheel drive (4WD) vehicles, trucks, and buses. Except for the first few kilometers, the Baucau–Viqueque road is generally on a hilly to mountainous terrain.

5. Overall, the road requires upgrading to a sealed standard, and widening to 6.0 m with 1.0 m shoulders. Climate change and climate resilience measures, including drainage designed for increased rainfall intensity, resilient asphalt pavement surfacing, and raising of the road in flood-prone areas is included in the detailed engineering design. With the Project, the Baucau–Viqueque highway will be upgraded to an average roughness of 4 m/km., and will provide reliable all-weather, all-vehicle, cross-island road connectivity.

C. Methodologies and assumptions

6. This analysis updates a previous economic appraisal conducted in 2013 through project preparatory technical assistance (PPTA). Results from a detailed traffic study and site surveys were used as inputs in conducting the economic analysis using the World Bank's Road Economic Decision (RED) Model. Economic values are derived on a world price numeraire basis. Costs of traded goods and services are assumed to reflect economic prices, while non-traded goods and services costs are adjusted using a standard conversion factor of 0.86 (implying a shadow exchange rate factor of 1.16). Unskilled labor costs are adjusted further by a shadow wage rate factor (SWRF) of 0.50.[5] All costs and benefits are expressed in constant 2017 prices. The analysis is conducted assuming a 3-year construction period (i.e., about 2.5 years for Baucau–Venilale, and 3 years for Venilale–Viqueque), and an economic lifespan of 25 years.

7. **Economic costs**. Financial capital costs, including engineering, procurement, and construction for the total of 58.27 km roads to be upgraded amount to about $57.7 million. All costs exclude taxes, duties, and price contingencies, but include physical contingencies. Annual operations and maintenance (O&M) costs are assumed to remain constant at $0.8 million per annum in real terms, covering regular upkeep and periodic minor road rehabilitation and repair works. Periodic resealing is expected to be required every 7 years, at a cost of $3 million. Financial costs are adjusted to economic values by applying appropriate conversion factors to respective non-traded and unskilled labor cost components.

8. **Economic benefits**. Quantified road user benefits include reductions in: (a) vehicle operating costs (VOC); and (b) passenger time savings from travelling on an upgraded highway. The relatively strong growth of the Timor-Leste economy is expected to continue to generate high future traffic growth. In particular, truck traffic—which has been growing at over 20% per annum (from a very low base) in recent years—is expected to continue to grow rapidly. Table 1 summarizes the results of a traffic survey that is based on annualized data on historical traffic growth by vehicle type from 2005–2013, and projects traffic growth per vehicle type on the Project

[5] Conversion factors are consistent with the economic analysis for ADB. 2015. *Report and Recommendation of the President to the Board of Directors: Road Network Upgrading Sector Project (additional financing). Manila*.

road. To be on the conservative side, potentially induced traffic is not included in the analysis. Therefore, traffic projections in the with- and without project scenarios are the same, and only includes non-incremental traffic growth that is in line with population and economic growth trends.[6]

Table 1: Historical traffic counts and projected traffic

	Motor-cycles	Car (med.)	Jeep / 4WD	Pick-up/van	Mini bus	Larger bus	Light truck	Med. truck	Heavy truck
Baucau–Venilale									
2013	654	17	67	81	199	60	74	22	21
2014-20	975	23	90	109	269	81	164	49	46
2021-24	1,532	34	134	162	397	120	381	113	108
2024-29	1,975	47	185	224	551	166	623	185	177
2029-45	2,697	106	416	503	1,237	373	1,846	549	524
Venilale–Viqueque									
2013	261	7	18	52	24	38	32	47	17
2014-20	389	9	24	70	32	51	71	104	38
2021-24	611	14	36	104	48	76	165	242	87
2024-29	788	19	50	144	66	105	269	396	143
2029-45	1,076	43	112	323	149	236	798	1,172	424

4WD = four-wheel drive.

a. **Lower VOC.** Use of an upgraded highway with low average roughness is expected to result in substantial reductions in VOC, including lower annual expenditures on fuel, replacement of tires and other spare parts, and maintenance labor. VOC benefits are considered mostly tradable (e.g., imported replacement vehicles and vehicle parts, fuel and oil), plus a small labor component. Estimates of with- and without Project VOCs from the 2013 survey are updated to 2017 prices using the operation of personal transport equipment component of Timor-Leste's consumer price index (Table 2). On average, VOCs are seen to decline by about 36%:

Table 2: Vehicle Operating Costs, with- vs. without Project ($ per vehicle km.)

	Motor-cycles	Car (med.)	Jeep / 4WD	Pick-up/van	Mini bus	Larger bus	Light truck	Med. truck	Heavy truck
Without Project									
Baucau–Venilale	0.053	0.252	0.304	0.340	0.296	0.453	0.423	0.572	1.062
Venilale–Viqueque	0.074	0.420	0.531	0.584	0.489	0.736	0.672	0.870	1.699
With Project									
Both sections	0.047	0.221	0.252	0.287	0.256	0.382	0.355	0.496	0.927

4WD = four-wheel drive.

b. **Time savings.** Journey or trip times will also be cut significantly, as an upgraded highway allows for safe travel even at higher vehicle speeds. Estimates of average vehicle speeds based on target road roughness upon completion of the Project suggest an increase in average speeds of about 45% (Table 3). Given 2017 non-oil GDP projected at $1,514 million, 30.6% of the 1.2 million population economically-active, and about 2,000 working hours per year, business time can

[6] As traffic growth in the with- and without Project scenarios are the same, the net effect on carbon emissions is also likely to be small and negligible for the purposes of this analysis.

be valued at about $2.03 per hour. By convention, leisure time is valued at 25% of this rate, at $0.51. Based on the 2013 traffic survey, the proportion of passenger business trips per vehicle type are as follows: motorcycles and cars (35%); jeeps and 4-wheel drives (67%); pick-ups and vans (58%); mini-buses (27%); and larger buses and all trucks (32%). Time savings benefits are considered non-tradable and are adjusted accordingly by the SWRF and SCF, consistent with the use of a world price numeraire.

Table 3: Vehicle speeds, with vs. without Project (km. per hour)

	Motor-cycles	Car (med.)	Jeep / 4WD	Pick-up/van	Mini bus	Larger bus	Light truck	Med. truck	Heavy truck
Without Project									
Baucau–Venilale (IRI = 8)	61.3	61.6	61.4	61.6	61.5	58.4	58.2	60.1	61.1
Venilale–Viqueque (IRI = 25)	25.0	25.0	24.6	25.0	25.0	24.6	24.6	24.6	22.1
With Project									
Both sections (IRI = 4)	63.4	63.8	63.8	63.9	63.7	61.5	61.3	62.6	63.7
Avg. no. of passengers	*1.4*	*3.8*	*3.5*	*3.2*	*13.1*	*18.7*	*6.2*	*4.5*	*4.5*

4WD = four-wheel drive, IRI = international roughness index.

9. In addition to benefits detailed above, unquantified benefits from the Project would include: (i) reduced frequency of, and losses from, vehicular accidents with improved road safety (which could not be quantified given lack of reliable national data on accidents); (ii) large potential gains in induced traffic driven by a decline in VOCs and complementary developments to stimulate industrial (i.e., through the *Tasi Mane* project) and tourism activity; (iii) better health and education outcomes resulting from better access to health and school facilities; (iv) generation of employment opportunities from improved access to markets; and (v) possible boost to agriculture activity given the Project area's importance in achieving basic food supply targets as outlined in the Timor-Leste *Strategic Development Plan 2001–30*, among others.

D. Results of the economic evaluation

10. **Baseline scenario.** Evaluation of annual streams of Project economic costs and associated benefits under a baseline scenario yields an economic internal rate of return (EIRR) of 11.6%, with an economic net present value (ENPV) $20.6 million (Table 4). This confirms the Project's economic viability as its EIRR exceeds ADB's minimum required EIRR for investment projects of 9%, which serves as a proxy for economic opportunity cost of capital in developing member countries. Annual VOC savings build up steadily from the completion of construction in 2020, reflecting strong anticipated growth in traffic volumes. In total, VOC savings over the economic lifespan of the Project amount to $60.7 million in present value terms. The value of passenger time add a further $9.2 million to quantified Project benefits.[7]

[7] During the 3-year construction period, VOC and travel times can be assumed to worsen by 20% for the Baucau–Venilale section, and by 50% for the Venilale–Viqueque—which is in much worse condition to begin with. This is reflected in negative VOC and time savings for 2018–2020 in Table 4.

Table 4: Economic costs and benefits of the Baucau–Viqueque Highway Project ($ million, baseline scenario)

Year	Capital costs	O&M costs	VOC savings	Passenger time	Net benefits
2018	(14.9)		(2.7)	(0.9)	(18.4)
2019	(17.3)		(3.1)	(1.0)	(21.4)
2020	(17.3)		(3.6)	(1.1)	(22.0)
2021		(0.7)	3.5	0.7	3.4
2022		(0.7)	3.9	0.7	3.9
2023		(0.7)	4.4	0.8	4.4
2024		(0.7)	4.9	0.9	5.1
2025		(0.7)	5.4	1.0	5.6
2026	(2.6)	(0.7)	5.9	1.0	3.6
2027		(0.7)	6.4	1.1	6.8
2028		(0.7)	7.0	1.2	7.5
2029		(0.7)	7.7	1.3	8.3
2030		(0.7)	8.4	1.5	9.1
2031		(0.7)	9.1	1.6	10.0
2032		(0.7)	10.0	1.7	11.0
2033	(2.6)	(0.7)	10.9	1.9	9.5
2034		(0.7)	11.9	2.0	13.2
2035		(0.7)	13.0	2.2	14.5
2036		(0.7)	14.2	2.4	15.9
2037		(0.7)	15.6	2.6	17.4
2038		(0.7)	17.0	2.8	19.1
2039		(0.7)	18.6	3.1	21.0
2040	(2.6)	(0.7)	20.4	3.3	20.4
2041		(0.7)	22.3	3.6	25.2
2042		(0.7)	24.4	3.9	27.6
2043		(0.7)	26.7	4.3	30.2
2044		(0.7)	29.2	4.7	33.1
				EIRR	**11.6%**
				ENPV	**$20.6 million**

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operations and maintenance, VOC = vehicle operating costs.

11. **Sensitivity analyses**. To gauge the impact of unfavorable developments, and to test the robustness of the Project's economic viability, sensitivity was tested for each of the following scenarios: (i) 20% increase in capital costs; (ii) 20% increase in O&M costs; (iii) 20% lower-than-anticipated traffic growth; (iv) a 1-year delay in operation; (v) combination of a 20% capital cost overrun and 20% lower traffic growth; and (vi) insufficient road maintenance. Results show that the Project's EIRR remains above the minimum required EIRR of 9% in 4 of the 6 adverse scenarios considered (Table 5).

12. A scenario where improved roads receive insufficient maintenance (i.e., about half of annual requirements) could reduce the Project's EIRR to below 9%. Under such a scenario, it is expected that VOC and time savings for the Bacau–Venilale segment will deteriorate by 10% per year and the road will revert to without project conditions after 10 years. For the Venilale–Viqueque segment, VOC and time savings deteriorate by 5% and the road reverts back to base conditions after 20 years (recall that without project conditions are much worse). A full

rehabilitation, estimated at 30% of the initial capital costs will then have to be undertaken after roads are completely deteriorated. This demonstrates the importance of adequate maintenance provisions for improved roads over their full life cycle.

Table 5: Sensitivity analyses results

Variables	Change	ENPV ($ million)	EIRR (%)	Switching value
Base case		20.5	11.6%	
Capital cost overrun	+20%	11.8	10.4%	46.9%
O&M costs increase	+20%	19.4	11.5%	372.4%
Lower traffic growth	–20%	$6.6	9.9%	–29.4%
1-year delay in operation		18.2	11.3%	
Capital cost overrun + lower traffic growth		–2.2	8.7%	
Insufficient maintenance		–9.6	7.2%	

EIRR = economic internal rate of return, ENPV = economic net present value, O&M = operations and maintenance.

13. The traffic growth shock scenario's switching value confirms that the Project's economic viability can be maintained even with traffic growth that is up to 29% lower than the baseline. The risk of traffic growth falling far lower than projected can also be considered low because: (a) current traffic projections are already on the conservative side including an assumed gradual easing in truck traffic growth, from which the bulk of VOC savings is derived; (b) growth of the Timor-Leste economy is expected to remain relatively strong and steady as it matures over the medium- to longer-term, with additional economic activity providing a corresponding boost to traffic growth; and (c) truck traffic volumes are likely to rise significantly with construction of the government's planned *Tasi Mane* project expected to proceed in earnest shortly after the upgrading of the Baucau–Viqueque Highway Project.

14. For the capital cost overrun scenario, the switching value shows that capital costs would have to be over 46% higher-than-estimated for the Project to lose economic viability. The risk of capital cost overrun is low, because the unit rates used to determine the estimated cost of the project are conservative when compared to actual bid prices received on recent projects. A one-year delay in realizing Project benefits, as well as a scenario where annual O&M costs are 20% higher than in the baseline only result in marginal reductions in the Project's EIRR. Even under an extreme scenario where a 20% capital cost overrun coincides with 20% lower-than-anticipated traffic growth, the Project's EIRR only falls slightly below 9%. Given mitigating factors outlined above, the risk of such twin shocks being realized, however, can be considered very low. In view of the results of the sensitivity analyses, and considering potentially substantial unquantified economic benefits (as outlined above), the Project is considered economically viable and generally resilient to the impacts of adverse scenarios.

15. **Financial sustainability.** Project roads are non-revenue-earning, constructed and maintained through the Directorate of Roads, Bridges, and Flood Control (DBRFC), under the Ministry of Public Works, Transport and Communication (MPWTC). DRBFC established its Maintenance Division in 2015 with 17 full-time staff supported by an ongoing three-year capacity development program for road maintenance by JICA. Institutional setup and responsibilities for road network operation and maintenance (O&M) are still evolving and weak. DRBFC has no presence and workforce to manage O&M activities at the regional level. Although responsibilities for rural roads have been decentralized to regional municipalities, capacity at the municipal levels

does not exist and it is not clear to what extent municipalities have taken full ownership in terms of planning, budgeting and execution. Therefore, DRBFC continues to respond to any emergency and urgent maintenance needs.

16. DRBFC scopes and plans road projects and presents them in budget submissions that involve MPS, ADN and CAFI for projects over $1 million. With considerable lengths of new and rehabilitated roads being developed, DBRFC's road maintenance capacity and systems need to be rapidly developed and advanced. Against their maintenance budget requests of $25 million, DBRFC has received two cycles of road maintenance budget so far, first in 2015 for $4 million and second for $3.8 in 2016. They are unable to utilize allocations timely as institutional setup remain unclear and weak, and procurement activities to outsource to private domestic contractors is lengthy. DRBFC outsources emergency works on a direct contracting basis. DRBFC primarily relies on external assistance to develop its O&M needs. In addition to JICA's maintenance support program, the Government of Australia have engaged ILO for rehabilitation and maintenance of some 1,600 km of rural roads through the Roads for Development program. The program engages domestic contractors for initial road improvement and rehabilitation works and subcontracting basic routine maintenance operations through community maintenance groups.

17. Through the proposed project, support will be provided to DRBFC maintenance unit to develop a comprehensive national road maintenance strategy and plan, that will focus on: (i) organizational reform to implement a 20 year road maintenance strategy; (ii) defining the levels of service expected from the national road network; (iii) formulating an asset management plan linked to an appropriate asset management system; and (iv) developing an operational manual focusing on planning, budgeting, procurement, supervision, and monitoring and evaluation for the division. This output will complement road maintenance initiatives by the JICA, and Roads for Development program financed by the Government of Australia. It will prepare a programmatic approach for road maintenance in coordination with other development partners, with a 10-year horizon for the government to take full ownership of financing for routine and periodic maintenance and emergency works.