ECONOMIC AND FINANCIAL ANALYSIS

A. Project Background

1. The city of Peshawar, which has a population of 1.8 million, currently lacks a formal public transport system. Instead, an informal network of minibuses, wagons, vans, and other vehicles provide public transport. This lack of formalization has created inefficiencies as well as safety and environmental issues. While several modes of transport have consistent routes, they lack designated schedules, stops, or stations. Consequently, service frequency is irregular. Drivers pull over to pick up passengers at will, and sometimes wait in place until the vehicles fill. Passengers must hail vehicles from the side of the road, creating a safety hazard. Boarding the vehicles can be challenging—especially for the elderly, children, and the physically disabled—and all the more so on the side of a busy road. During peak commute times, it is also common for passengers to sit on the roof, or hang from the side of moving vehicles. Finally, vehicles in this informal network tend to be poorly maintained, leading to inefficient fuel consumption, increased emissions, and higher operating costs.

2. As in many growing cities in Asia, traffic congestion plagues Peshawar, limiting traffic speeds to less than 10 kilometers (km) per hour along certain popular routes. Steady population and economic growth has exacerbated the problem as residents increasingly purchase private cars and motorcycles, and the informal transit network expands to meet demand. In addition to the challenges outlined above, the informal system contributes to urban congestion as vehicles stopping for passengers block traffic lanes.

3. The proposed Peshawar Sustainable Bus Rapid Transit (BRT) Corridor Project aims to provide high frequency service with multiple routes. BRT vehicles will travel a designated corridor in the busiest parts of the city and will also be able to travel off-corridor. This approach, known as the “direct service” model, expands the system’s reach and lessens passenger transfers. The BRT lane will be physically separated from mixed traffic along the corridor, and stations are designed to accommodate up to four buses in each direction at a time. Most of the corridor will be at-grade, and the design also includes bicycle lanes and pedestrian facilities intended to streamline BRT station access.

4. The economic analysis described herein focuses on measurable changes in transport costs, specifically vehicle operating cost (VOC) savings, and travel time savings. Additional public benefits to safety and the environment were also considered. The costs and benefits of the with-project scenario were assessed against a base-case scenario that assumed the informal transport system’s continued dominance. A financial analysis assessed whether or not the revenue generated by BRT operations would sufficiently cover the system’s operation and maintenance (O&M) costs.

B. Demand Estimate

5. The analysis assumed that most passengers will come from the existing informal public transport system that operates along the proposed BRT routes, with 50%–100% of bus, station wagon, and pickup truck passengers transferring to BRT. Based on observed examples from past projects, a moderate 7% modal shift from private vehicles was also assumed. Current and projected passenger demand on routes covered by the project is shown in Table 1, based on data collected by the Asian Development Bank (ADB) project preparatory technical assistance (PPTA) team. It is estimated that 476,838 of passengers from different modes will shift to BRT if the project is implemented.

Table 1: Passenger Demand by Mode Before and After the Project

Mode	Daily passenger demand (base case)	Modal shift (% to BRT)	Daily passenger demand (with project)
Motorcycle	26,915	7%	25,031
Bicycle	1,165	0%	1,165
Car	87,923	7%	81,768
Suzuki pickup truck	203,639	50%	101,820
Large bus	44,601	50%	22,301
Rickshaw	82,211	50%	41,106
Taxi	49,902	25%	37,427
Minibus	236,483	100%	0
Station wagon	50,006	100%	0
Datsun pickup truck	9,219	50%	4,610
Mixed Traffic Total	**792,064**		**315,226**
Bus Rapid Transit	**0**		**476,838**

Source: Asian Development Bank estimates.

6. Future BRT trip growth was estimated at 3.5% per year after considering population growth forecasts, historical trends in travel growth, and the evolution of car ownership and trip rates by mode. The projected annual BRT ridership is in Table 2.

Table 2: Projected Annual Ridership in the Proposed Bus Rapid Transit Network

	2020	2025	2030	2035
Annual bus rapid transit ridership	158,870,438	188,688,244	224,102,443	266,163,403

Source: Asian Development Bank estimates.

C. Analysis of Alternatives

7. Alternative mobility solutions for Peshawar considered in the decision-making process included formalizing the existing informal system, a first generation “trunk-only” BRT system, and light rail transit. Although an in-depth cost–benefit analysis was not conducted for these alternatives, they were ruled out for other reasons. Formalizing the informal system appeared to have little impact with regard to improving travel speeds or VOCs. A trunk-only BRT service would serve only a fraction of Peshawar’s transit demand and require passengers to make multiple transfers; therefore, this was considered unlikely to be financially sustainable. Light rail was ruled out due to its long implementation time and comparatively high capital costs.

8. As demonstrated below, the BRT design employed for the project serves Peshawar’s demand needs more effectively than do the alternatives and with greater economic viability.

D. Cost–Benefit Analysis

9. Introducing BRT as a new transport mode will generate direct and indirect benefits for Peshawar. The direct benefits of the proposed BRT system include a lower operating cost for the city’s public transit system, reduced travel time for transit riders who switch from existing modes to BRT, and reduced travel time for users of other transport modes due to the decongestion of the road network. Indirect benefits include the reduction of costs related to greenhouse gas emissions and traffic accidents.

10. All costs and benefits of the proposed BRT system were estimated based on a comparison with a base-case ("do-nothing") scenario, in which private vehicle ownership continues to increase unabated, and informal transport operators continue to provide most public transit services.

11. Based on ADB's Guidelines,[1] the project's economic viability was assessed by examining the project's economic internal rate of return (EIRR) and net present value with a discount rate of 9%. The assessment assumed a 2-year project implementation period starting in 2017, and a 20-year economic life thereafter (2019–2039). The cost information used in the analysis was based on 2017 constant prices. The analysis was conducted based on the domestic price numeraire.

E. Project Costs

12. **Capital costs.** The economic assessment included the following capital costs: (i) investment costs, including civil works, rolling stock, and equipment; (ii) environmental and social impact mitigation costs, including compensation for resettlement and costs to fund a fleet scrapping program for informal providers; (iii) construction supervision services costs; and (iv) physical contingencies.

13. **Operating costs.** The analysis included the following operating costs: (i) costs to be borne by TransPeshawar, a public company newly established to manage the BRT system and maintain the BRT infrastructure (infrastructure maintenance estimated at 2% of civil works per year); [2] (ii) the vehicle operating companies' costs, including driver, mechanic, and vehicle O&M expenses; (iii) costs of fare system operations, station services (e.g., cleaning, landscaping, and fare collecting), an intelligent transportation system, and revenue distribution services; and (iv) vehicle renewal and replacement costs (estimated based on the vehicle design life).

14. Taxes and duties, financial charges during construction, and price contingencies were excluded from the calculation of economic costs. Financial costs were converted to economic costs in line with ADB's Guidelines (footnote 1). A distinction was made between traded and non-traded goods, and a shadow exchange rate factor of 1.039 was applied to traded goods. A shadow wage rate factor of 0.85 was estimated and applied to unskilled labor.

F. Vehicle Operating Cost

15. The PPTA team determined the average VOC/km travelled for existing modes to be PRs71.7/km, including fuel, maintenance, and driver costs. Operating costs for BRT vehicles was assumed to be PRs46.98/km, calculated based on known fuel consumption (per km travelled) of the proposed vehicles; the cost of replacement materials (lubricant, filters, and tires, estimated at PRs3.7/km); miscellaneous vehicle maintenance costs (PRs3.5/km); driver and mechanic costs.[3]

16. Vehicle kilometers travelled (VKT) in the base case were estimated based on surveying and transport modeling conducted by the PPTA team in 2016. VKT for public transit operations along the proposed BRT corridor is estimated to reach 33,306,284 per year in 2020. Estimated VKT for the proposed BRT fleet is 28,736,264 per year in 2020. Both VKT figures were assumed to increase by 3.5% per year on average, in line with ridership growth. Annual VKT estimates in the base and project case are shown in Table 3. The lower VKT in the project case is due to the higher capacity of BRT vehicles, and the efficiency gains yielded by transporting the same number of passengers on the project corridor.

[1] ADB. 2017. *Guidelines for the Economic Analysis of Projects.* Manila.
[2] Estimated based on the experience of the design team under the project preparatory technical assistance (PPTA).
[3] Estimated from: Cities Development Initiative for Asia. 2014. *Peshawar Urban Transport Pre-Feasibility Study*. Manila.

Table 3: Projected Vehicle Kilometers Travelled for Public Transit along the Proposed Bus Rapid Transit Corridor

	2020	2025	2030	2035
VKT Base Case	33,306,284	39,557,417	46,981,803	55,799,644
VKT Project Case	28,736,264	34,129,668	40,535,339	48,143,267

VKT = vehicle kilometers travelled.
Source: Asian Development Bank estimates.

17. To calculate VOC savings, the average VOC for the existing fleet (PRs71.7/km) was multiplied by the base-case VKT. Operating costs for the BRT system (PRs46.98/km) were multiplied by the projected VKT for the proposed system. Costs for the proposed system were subtracted from those of the existing system to yield total VOC savings. The results are summarized in Table 4.

Table 4: Vehicle Operating Cost Savings Summary
(million)

	2020		2025		2030		2035	
	PRs	$	PRs	$	PRs	$	PRs	$
VOC without BRT	2,388	22.8	2,837	27.1	3,369	32.1	4,001	38.2
VOC with BRT	1,350	12.9	1,603	15.3	1,904	18.2	2,262	21.6
VOC savings	**1,038**	**9.9**	**1,233**	**11.8**	**1,465**	**14.0**	**1,740**	**16.6**

BRT = bus rapid transit, PRs = Pakistan rupees, VOC = vehicle operating cost.
Source: Asian Development Bank estimates.

G. Travel Time

18. Traffic congestion and operational inefficiencies in Peshawar's existing transport system result in long and uncomfortable trips for the city's residents. The project offers a rapid and direct service that will yield travel time savings for riders of the new BRT system. Segregated bus lanes on the BRT corridor will ensure traffic-free travel and, although traffic may still affect buses outside the corridor, bus lanes will be implemented in the city's major arterial roads where most of the congestion occurs. Furthermore, by helping to streamline other traffic, the project will also yield travel time savings for non-BRT users.

19. Reductions in travel time were determined by first conducting origin–destination surveys to understand current travel times, and then using a demand model to estimate the anticipated time savings resulting from the project. For those shifting to BRT, average time savings are estimated at 9.3 minutes per passenger trip. Due to the decongestion effect (para. 18), road users not using the BRT are expected to save 2.6 minutes per passenger trip for private transport users, and 5.8 minutes per passenger trip for public transit users.

Table 5: Mixed Traffic and Bus Rapid Transit Passenger Travel Time Savings

	Travel time without BRT (minutes)	Travel time with BRT (minutes)	Travel time savings (total minutes)	Travel time savings (%)
BRT passenger	43.3	34.0	9.3	21
Private passenger (mixed traffic)	28.6	26.0	2.6	9
Public passenger (mixed traffic)	43.3	37.6	5.8	13

BRT = bus rapid transit.
Source: Asian Development Bank estimates.

20. To convert these physical time savings into economic values, the value of time (VOT) for the average road user was estimated. Based on Pakistan's average per capita income of approximately $1,600 per year (in early 2017), and adjusting for the fact that incomes are higher in urban areas, the VOT for working time was estimated at PRs84/hour. For higher income taxi and car users, the VOT was calculated at PRs227/hour.[4] The VOT for non-working time was estimated as half that of working time. Furthermore, it was assumed that 50% of journeys on the corridor would be for work, and 50% for non-work travel.

21. Travel time cost savings were calculated for both expected BRT passengers and non-BRT users who would benefit from decongestion by multiplying the physical time savings summarized in Table 5 by the VOT explained in para. 20. The value of travel time savings from mixed traffic and BRT passengers is shown in Table 6 below.

Table 6: Travel Time Cost Savings for Bus Rapid Transit Passengers and Mixed Traffic
(million)

	2020		2025		2030		2035	
	PRs	**$**	**PRs**	**$**	**PRs**	**$**	**PRs**	**$**
BRT passenger travel time savings	1,551	14.8	1,843	17.6	2,188	20.9	2,599	24.8
Mixed traffic travel time savings	8,296	79.2	8,296	79.2	8,296	79.2	8,296	79.2
Total Travel Time Cost Savings	**9,847**	**94.0**	**10,139**	**96.7**	**10,484**	**100.0**	**10,895**	**104.0**

BRT = bus rapid transit, PRs = Pakistan rupees.
Source: Asian Development Bank estimates.

H. Road Safety

22. Traffic collisions inflict significant costs on society, including lost economic productivity for those involved. Studies show that the average annual number of collisions is positively related to the VKT. Thus, the number and social cost of traffic collisions decrease when the VKT is lower.

23. To calculate the value of reduced traffic collision costs, crash data from Khyber Pakhtunkhwa was obtained from the Bureau of Statistics. The average value during 2004–2013 was calculated to prevent an exceptional event from altering the results. Traffic collisions in Peshawar were estimated proportionally based on the city's population relative to that of the province. The derived number of the expected collisions was multiplied by their value—PRs27.7 million ($264,000) for fatalities and PRs1.4 million ($13,000) for serious injuries.[5] Figures were adjusted to 2017 prices in the analysis.

24. While the collision growth rate varies year-to-year, the average annual number of collisions is expected to increase or decrease along with the VKT. As the project will reduce the public transit VKT by about 3 million km per year and replace hazardous transport modes with safer ones, fatalities and serious injuries are estimated to be 17.5% lower compared to the without project case. The value of safety savings was calculated by establishing the base-case traffic collision costs and subtracting the forecasted project case traffic collision costs therefrom using the data and methodology described above.

[4] Estimated from: Cities Development Initiative for Asia. 2014. *Peshawar Urban Transport Pre-Feasibility Study*. Manila.
[5] M. Rafiq. 2011. Estimating the Value of a Statistical Life in Pakistan. *Sandee Working Paper* No. 63-11. Kathmandu.

I. Carbon Emissions

25. Carbon emission reductions were calculated using the Transport Emissions Evaluation Model for Projects (TEEMP), the industry standard developed by Clean Air Asia, ADB, and other partners. Data on the VKT, ridership, and modal split with and without the project are entered in the model, which then produces an estimate of tons reduced per year. Carbon emission reductions were then multiplied by a social cost of carbon of $36.30, consistent with ADB's Guidelines (footnote 1).

J. Results and Sensitivity

26. As shown in Table 7, the project EIRR was found to be 15.4%, well above the 9.0% minimum economic yield required for an ADB-financed project.

27. **Sensitivity tests.** The analysis included sensitivity tests to ensure a robust result. These tests considered the following scenarios: a 20% capital cost overrun, a 20% reduction in passenger ridership, and a 2-year delay in system opening.

28. As shown in Table 7, all scenarios meet the ADB guidelines.

Table 7: Results of the Economic Analysis (Including Sensitivity Tests)

Test Parameter/Result	Base	Scenario A	Scenario B	Scenario C
EIRR	15.0%	12.0%	14.0%	12.0%
Net Present Value ($ million)[a]	201	120	172	261
Cost–Benefit Ratio	1.29	1.15	1.25	1.39
Switching Value	N/A	55%	–26%	N/A

EIRR = economic internal rate of return, N/A = not applicable.
[a] Net present value discounted at 9%.
Source: Asian Development Bank estimates.

Table 8: Economic Analysis Results
($ million, 2017 prices, undiscounted)

Year	VOC Saving	Time Saving	Safety Saving	Carbon Saving	Total Econ. Benefit	OPEX	CAPEX	Total Econ. Costs	Net Econ. Benefit
2017	-	-	-	-	-	-	240.7	240.7	–240.7
2018	-	-	-	-	-	-	216.1	216.1	–216.1
2019	9.6	93.5	2.5	1.4	106.9	28.1	-	28.1	78.8
2020	9.9	94.0	2.5	1.5	107.9	31.1	-	31.1	76.8
2021	10.3	94.5	2.5	1.6	108.9	31.5	-	31.5	77.4
2022	10.6	95.0	2.5	1.7	109.9	31.9	-	31.9	78.0
2023	11.0	95.6	2.5	1.9	111.0	32.4	-	32.4	78.6
2024	11.4	96.1	2.5	2.0	112.0	32.9	-	32.9	79.2
2025	11.8	96.7	2.6	2.1	113.2	33.4	-	33.4	79.8
2026	12.2	97.3	2.6	2.2	114.3	33.9	-	33.9	80.3
2027	12.6	98.0	2.6	2.2	115.4	34.6	-	34.6	80.8
2028	13.0	98.6	2.8	2.3	116.8	35.2	-	35.2	81.6
2029	13.5	99.3	2.9	2.3	118.0	35.9	-	35.9	82.1
2030	14.0	100.0	2.9	2.4	119.3	36.7	-	36.7	82.6
2031	14.5	100.8	2.9	2.4	120.5	113.0	-	113.0	7.5
2032	15.0	101.5	2.9	2.5	121.9	41.0	-	41.0	80.9
2033	15.5	102.3	2.9	2.6	123.2	42.0	-	42.0	81.2
2034	16.0	103.1	2.9	2.6	124.7	43.1	-	43.1	81.5
2035	16.6	104.0	3.2	2.7	126.4	44.3	-	44.3	82.0
2036	17.2	104.8	3.2	2.7	127.9	45.6	-	45.6	82.3
2037	17.8	105.7	3.2	2.8	129.4	47.0	-	47.0	82.5
2038	18.4	106.6	3.2	2.8	131.1	48.5	-	48.5	82.6
2039	19.0	107.6	3.2	2.9	132.7	50.1	-	50.1	82.7

CAPEX = capital expenditures, Econ. = economic, OPEX = operational expenditures, VOC = vehicle operating costs.
Source: Asian Development Bank estimates.

K. Financial Analysis

29. The financial analysis of the project was carried out in accordance with ADB's *Financial Management and Analysis of Projects.*[6] The project and its operational plan have been designed to ensure that the revenue generated from the BRT system will adequately cover its O&M costs, which are estimated to reach approximately $32 million in 2020. The ADB loan will cover the civil works, equipment, consultant, and social and environmental mitigation expenses, including the purchase of all vehicles with an expected 12-year lifespan. TransPeshawar, the managing company, is not responsible for repaying the capital cost of the loan.

30. The BRT system generates revenue in four ways: fares, advertising, rent on concessions and storefronts in stations and depots, and revenue from parking plazas. Fare revenue, the largest source, was calculated using an average estimated fare of $0.23 (PRs25) per trip.[7] Advertising revenue is estimated at 3% of fare revenue, while revenue from concessions and parking facilities are calculated based on use. Revenue from these sources is estimated to be $40 million in 2020.

[6] ADB. 2005. *Guidelines for the Financial Management and Analysis of Projects*. Manila.

[7] The current average fare in the existing informal public transport system is PRs20. Only a slight increase is proposed for the BRT system, which will provide a much better transportation experience for a still-affordable average fare. The new BRT system's fare will also be distance-based, and a single ticket will vary between PRs15 for short trips to PRs40 for the longest distance.

31. This revenue will be used to cover all O&M expenses, as well as the procurement of new buses to keep up with projected demand increases and fleet replacement costs. A financial clearinghouse company will collect and distribute fare revenue. Vehicle operation fees will be paid on a per km basis. Station services, including cleaning, security, and staffing, will also be contracted out. ADB consultants are currently supporting the development of a detailed operational and financial plan, including determining the appropriate payment per km for private bus operators.

32. The Government of Khyber Pakhtunkhwa decided to consider the capital cost (including that of the BRT infrastructure and initial fleet) a grant, and does not intend to recover this investment from the system's operational revenues. The government intends to ensure the system's financial sustainability and to limit or even eliminate the need for the operational subsidies troubling other existing BRT systems in Pakistan, such as in Lahore or Islamabad-Rawalpindi. In the absence of a cost recovery tariff, a conventional financial evaluation based on cash flow analysis leading to the computation of a financial internal rate of return is not considered appropriate.

33. Instead, an operating ratio analysis was conducted to ensure that revenues will cover operating costs. The analysis results are in Table 9. In addition to the base case, alternative scenarios were also considered. Scenario A assumes that operating costs are 20% higher than estimated in the base case, while Scenario B assumes that fare revenue is 20% lower than projected. In all cases, the ratio remains under 100%, indicating that the project is financially sustainable.

Table 9: Results of the Operating Ratio Analysis

($ million)

	2020				2025				2030			
	Costs	**Rev.**	**Ratio**	**Net Cash Flow**	**Costs**	**Rev.**	**Ratio**	**Net Cash Flow**	**Costs**	**Rev.**	**Ratio**	**Net Cash Flow**
Base Case	34	49	70%	10	37	76	48%	26	40	118	34%	52
Scenario A	41	49	84%	5	44	76	58%	21	48	118	41%	47
Scenario B	34	40	86%	4	37	61	60%	17	40	95	42%	37

Rev. = revenue.
Source: Asian Development Bank estimates.

34. Net cash flows were calculated by applying the 33% tax on benefits. TransPeshawar's future financial position confirms solid net cash flows and its financial capacity to cover the recurrent costs to sustain the facilities developed under the project. Moreover, as ridership and gross domestic product increase and service coverage improves, the agency may be able to increase fares and charge more for advertising, parking, and concessions space, thus strengthening its ability to finance O&M costs.