7 Cost Evaluation

The cost evaluation criteria used in the evaluation of the transit modes are:

- Capital cost.
- Annual operating costs.
- Fare revenue.
- Net cost per passenger/passenger-mile.
- Travel-time benefits.

7.1 Capital Cost

A capital cost estimate was developed for each alternative/option and escalated to 2012 dollars. The estimates include the following three categories of costs:

- Cost of construction.
- Equipment costs.
- Allowances for other project costs (e.g. design, insurance, and construction management).

7.1.1 Description of Criterion

7.1.1.1 Construction Costs

This subchapter presents details of the capital costs for each of the alternatives/options. Details of the methodology used are as follows:

- The capital costs encompass all works across the full corridor extending from Suffern to Port Chester.
- The methodology used in the development of the cost estimates for each alternative/option was as follows:
  - Determine individual construction activities and related quantities from data sheets (300 scale drawings).
  - Combine construction activities into compound activities. For example, all activities required for a particular type of road construction would be considered a composite activity.
  - Develop unit rates corresponding to the combined construction activities. This would include forecasts of all material, labor and equipment costs, as well as factors to account for location, market escalation, contractors' or subcontractors' methods of determining prices, competitive bidding, and market conditions.
  - Schedule all compound activities. These activities have been ordered per Construction Specifications Institute (CSI) format, which organizes all tasks by trade.
  - Include mark-up for contractors' general conditions, insurance and overhead and profit.
  - Include mark-up cost for escalation, design and construction contingencies, insurance, general conditions, and soft costs such as design, permitting, construction management, program management and agency staff.
  - The capital costs were produced in 2007 dollars and escalated to 2012, the mid-point of construction, using a 4.5 percent yearly inflation rate.
- All options assume a replacement bridge (for cost estimating purposes).
- The capital cost estimates do not include allowances for:
  - ROW acquisition.
  - Third-party mitigation works.
  - Hazardous materials handling.

7.1.1.2 Vehicle Equipment Costs

The cost of vehicles for each alternative/option was estimated based on the fleet size required to provide the level of service shown in the service plans in Appendix A and, in the case of rail alternatives/options, the length of train needed, to adequately serve the ridership levels projected for that alternative/option. The level of service refers to the headways used, which is the time between buses or trains at any given point on a route.

To determine the number of buses needed in the BRT alternatives/options, as well as those buses planned to operate as part of the rail alternatives/options, the following steps were followed:

- Each bus route was evaluated in terms of its end-to-end run time at speeds appropriate to the roadways that would be used by the route. Speeds were adjusted for each route for peak-period operations (congested speeds) and off-peak operations (uncongested speeds).
- The end-to-end run times were then summed for both directions with an allowance for turn-around times, schedule slippage, and layover times, resulting in a cycle time – the total time it would take for a bus to return to a given point on its route after departing from that point. This was used to determine the number of buses that would be needed to achieve the desired headway on each route in the AM peak, midday, PM peak, and off-peak periods. For example, a route that takes two hours to cycle (the bus takes two hours to complete a round trip) and has a headway target of 30 minutes would require four buses to maintain that 30-minute headway.
- The number of buses needed was then estimated using the most demanding service period (usually the AM or PM peak) with an allowance for spares.

Depending on the peak link demand level, the type of bus required was then assigned, with a choice of standard 40-foot buses, express coach buses (for express routes only), articulated 60-foot standard buses, or articulated 60-foot BRT-specific buses. The unit cost for each bus type was based on published figures or recent experience in the New York Metropolitan area. The number of buses was then multiplied by the appropriate unit price to arrive at the fleet cost. This was done for each route of every alternative/option. Table 7-1 summarizes the vehicle equipment costs used.

Table 7-1

Vehicle Equipment Capital Costs

Vehicles	Cost 2012 $
BRT Vehicles	
Standard 40-foot Bus	$422,500
Express Coach Bus	$552,500
Articulated 60-foot Bus (Standard)	$780,000
Articulated 60-foot Bus (BRT-Specific)	$988,000
CRT Vehicles	
Diesel-Electric Locomotive	$4,587,700
Coach Car (gallery)	$1,977,300
Cab Car (gallery)	$2,284,100
LRT Vehicle	$2,730,000

In the case of rail alternatives/options, the same methodology as was used for estimating bus equipment was applied, but in the case of rail alternatives/options the basic unit being calculated was trains. Each train's capacity was adjusted by the number of cars in the train to provide adequate service to meet ridership needs. A minimum train consist of four coach cars was used for the CRT alternatives/options. The CRT alternatives/options were assumed to use trains consisting of conventional push-pull diesel-electric locomotives with coaches (gallery) and a cab car (gallery) – the end car used to remotely operate the train when the locomotive is on the trailing end of a train in push mode. As with the buses, the individual pieces of equipment were estimated based on recent experience, and the number of each type of vehicle was then multiplied by the appropriate unit price to arrive at a fleet cost. This included allowances for spares.

The LRT vehicles estimate varied from the CRT estimate only in that there is but one type of LRT vehicle – a self-propelled and -operated car. So the number of cars per train was multiplied by the number of trains needed to operate the planned service, and that was multiplied by a spare factor, the result of which was multiplied by the unit price of each LRT vehicle.

The number and cost of the respective vehicles were used to establish the vehicle and equipment costs in Figure 7-2.

7.1.2 Comparison of Transit Modes

The capital cost estimate results for each alternative/option are summarized in Figures 7-1 and 7-2 as total and transit costs respectively. The total capital cost across all alternatives/options ranges from $8 billion to $22 billion, with the highest costs for those alternatives/options that include CRT ($16 billion to $22 billion) and the lowest for those alternatives/options that include only BRT ($8 billion to $10 billion). The estimated costs for the transit-only parts of the alternatives/options range from $1 billion to $2.5 billion for BRT, $9 billion to $15 billion for CRT, and $5 billion to $6 billion for LRT.

Overall, the estimated costs for BRT transit are notably less than the costs for LRT and significantly less than the costs for CRT. The primary differences in costs result from:

- The ability of the BRT system to utilize the HOV lanes included in the highway component of each alternative/option, particularly in Rockland County, which substantially reduces the transit cost for BRT.
- The ability of the BRT system to stay largely at-grade and within the existing highway infrastructure, which substantially reduces costs compared to CRT and LRT. For CRT and LRT, there are substantial sections that are not at-grade (either elevated or in tunnel), and these sections increase the estimated capital cost.

BRT Alternatives/Options

The estimated capital transit cost for BRT is $0.9 billion for Option 3A and $2.5 billion for Option 3B. Both options have the same cost in Rockland County ($263 million). This cost is primarily for stations and ramps, as the cost of the travel way for BRT in Rockland County (and on a possible replacement TZB) is not included in the transit cost estimate, as the BRT system will utilize the HOV lanes, the cost of which was included in the highway apportioning.

Across Westchester County, the estimated capital cost is $560 million for Option 3A to $2.2 billion for Option 3B. The higher cost for Option 3B results from the extensive use of viaducts to provide mostly elevated BRT along I-287, compared to generally at-grade BRT in Option 3A.

LRT Alternatives/Options

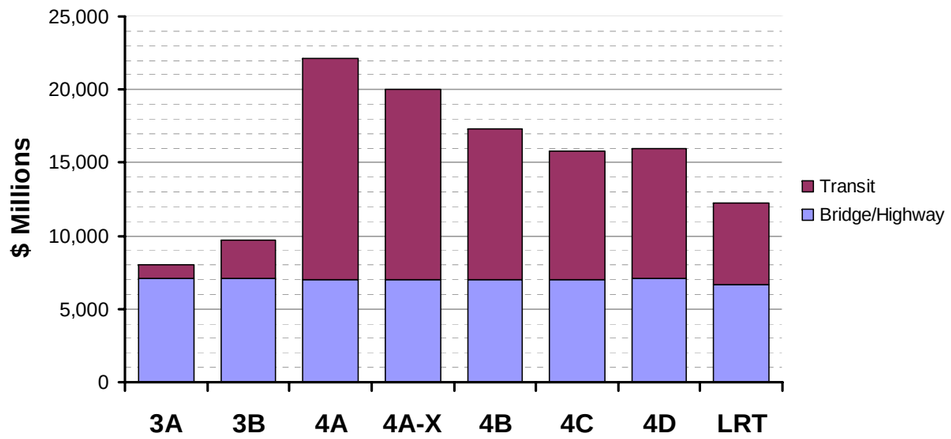
At $5.5 billion, the transit cost for full-corridor LRT is six times the cost of full-corridor BRT as presented in Option 3A ($0.9 billion). The larger costs are attributable to the more extensive requirement for elevated structures to pass over the constraints of the built environment, particularly in Westchester County. In Rockland County, the costs associated with a new travel way for LRT is the primary source of difference – travel way costs are not included in the BRT costs, as BRT can utilize the HOV lanes.

CRT Alternatives/Options

The estimated capital transit cost for CRT ranges from approximately $9 billion to $15 billion for alternatives/options 4A, 4A-X, 4B, 4C and 4D. In Alternative 4A, the alternative with the most extensive CRT, the cost to provide CRT is approximately $15 billion. In this alternative the costs for CRT in Rockland and Westchester Counties are approximately $4.5 billion and $7 billion, respectively. The larger costs in Westchester County result from more extensive tunneling and the cost of underground stations. The Hudson Line connection, at $1.5 billion, is a major cost component in this alternative and includes extensive tunneling in the approach to the Hudson Line as well as two-miles of modifications on the Hudson Line itself to merge the necessary trackwork within the existing ROW.

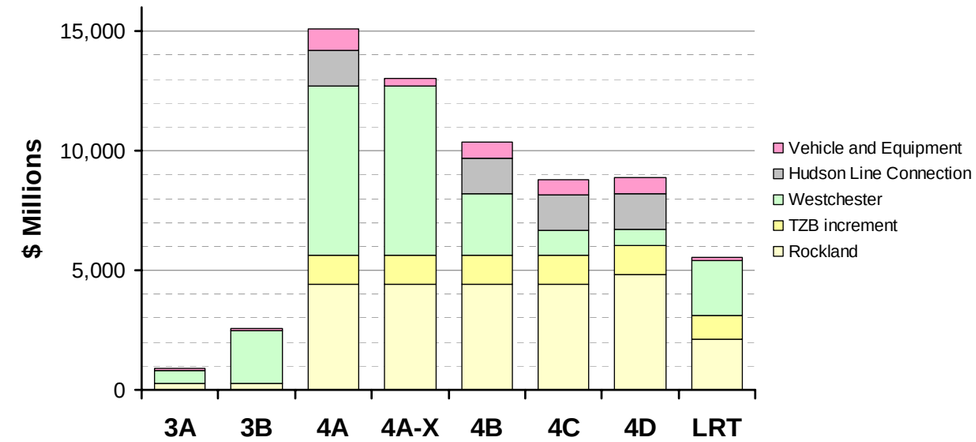
In Option 4A-X, which differs from Alternative 4A only by the exclusion of the Hudson Line connection, the overall capital transit cost estimate is approximately $13 billion. The $2 billion difference in cost between 4A and 4A-X is directly related to the cost of the Hudson Line connection, but there is also a reduction in the number of vehicles and equipment required.

In Alternative 4C, one of the alternatives with the least-extensive CRT system, the cost to provide CRT is $8.2 billion in an overall transit cost of $8.8 billion – the difference being the cost to realize BRT in Westchester. Compared to Alternative 4A, the major cost difference in Alternative 4C is a substantial decrease in the cost of transit across Westchester County, where the transit mode is BRT instead of CRT. Option 4D is similar to Alternative 4C but with a reduction in the number of CRT stations and an increase in the extent of the BRT system across the full corridor. These changes result in a marginal increase in total transit cost ($8.9 billion) but a reduction in the cost of CRT ($7.9 billion).



	Capital Cost Estimate (millions) 2012 dollars							
	3A	3B	4A	4A-X	4B	4C	4D	LRT
Bridge/Highway	$7,130	$7,130	$6,980	$6,980	$6,980	$6,980	$7,130	$6,690
Transit	$897	$2,548	$15,111	$13,022	$10,372	$8,775	$8,869	$5,561
	$8,027	**$9,678**	**$22,091**	**$20,002**	**$17,352**	**$15,755**	**$15,999**	**$12,251**

Figure 7-1 Capital Cost Estimate



	Transit Capital Cost Estimate (millions) 2012 dollars							
	3A	3B	4A	4A-X	4B	4C	4D	LRT
Rockland	263	263	4410	4410	4410	4410	4830	2110
TZB increment	0	0	1220	1220	1220	1220	1220	1000
Westchester	560	2210	7080	7080	2560	1020	660	2295
Hudson Line Connection	0	0	1500	0	1500	1500	1500	0
Vehicle and Equipment	74	75	901	312	682	625	659	156
	$897	**$2,548**	**$15,111**	**$13,022**	**$10,372**	**$8,775**	**$8,869**	**$5,561**

Figure 7-2 Capital Cost Estimate – Transit Split

In Alternative 4B, the total cost for transit, at approximately $10.4 billion, is in the mid-range between the highest- and lowest-cost CRT alternatives/options, with cost differences primarily associated with transit modes in Westchester County. For alternatives 4A, 4B and 4C, with CRT, LRT and BRT modes in Westchester County respectively, the transit cost estimates are $7.0, $2.5, and $1.0 billion. LRT costs are substantially lower than CRT costs, as the greater flexibility in the LRT system capability eliminates the need for expensive tunnels and underground stations. However, extensive elevated lengths are required to cross existing infrastructure, making LRT more expensive than BRT.

All CRT options include an incremental cost ($1.2 billion) for the possible replacement TZB beyond that required for the highway components. Unlike in the BRT-only options, where BRT could be accommodated within the highway envelope on a possible replacement TZB, this is not possible for CRT, and additional width would be required to carry CRT.

7.2 Annual Operating Costs

Annual operating costs for the transit alternatives/options were projected based on the operating plan for each component of the alternative/option, with bus and rail costs estimated separately and then combined for the total operating cost. The measure used was the vehicle hours of operation. This measure was selected because of the ready availability of recent and directly relevant operating costs within the region for existing mature transit services. While no assumptions have been made about what agency might operate a given service, it is reasonable to assume that whatever agency operates the service it will have similar costs to those of the current operators of equivalent services.

Annual operating costs for highway and bridge operations were similarly based on the actual operating cost experience of highways and bridges in the region or the corridor itself. In either case, the observed costs of operations were used to develop the cost per lane mile.

All costs were escalated to 2012 using growth factors that reflect recent experience, with transit costs rising more rapidly in the near future and then leveling to the same growth rate as for highway and bridges.

7.2.1 Description of Criterion

7.2.1.1 Highway and Bridge Operations and Maintenance Costs

Highway operating and maintenance costs were calculated using the unit costs for highway operation and maintenance per lane mile for the New York Division of the New York State Thruway Authority ($47,000/lane mile). These costs do not include State Police costs. They were applied to the existing lane miles and the lane miles in the alternatives/options, and inflated to 2012 dollars using an inflation rate of 4.5 percent.

The cost of maintaining the bridge in this year's budget is $6 million. That cost per lane mile was applied to the new highway bridge, and those numbers were also inflated to 2012 dollars.

7.2.1.2 Operations and Maintenance Cost Estimates

The estimate of operating and maintenance costs was calculated using the same concepts as in the fleet cost estimates in order to determine the number of vehicles needed to provide the planned level of service.

For the calculation of the cost of operations and maintenance, the number of vehicles operating in each service period (AM peak, midday, PM peak, and nighttime) was multiplied by the hours in that period (4 hours in the AM and PM peaks and 5 hours in the midday and nighttime periods) to arrive at the total daily revenue vehicle hours of service. The daily hours of vehicle service were converted to annual figures using an annualization factor of 291. The annualization factor reflects full service each weekday and reduced service levels on weekends and holidays (which is why it is not 365).

The annual vehicle revenue hours of service were then multiplied by the cost per revenue hour based on the actual cost of operations per revenue hour for that type of vehicle for each transit provider. The costs per hour of operation were based on 2005 National Transit Database figures for MTA for express buses, Transport of Rockland, Clarkstown Mini-Trans and Bee-Line System for bus operations in those locales, New Jersey Transit for LRT operations, and Metro-North Railroad for CRT operations. Table 7-2 provides the 2005 cost per revenue vehicle hour.

Table 7-2

Cost per Revenue Vehicle Hour

Operation	Cost per Revenue Hour of Service (2005)
Bus Operations	
MTA New York City Transit	$139.72
Transport of Rockland	$118.72
Clarkstown Mini-Trans	$78.20
Westchester County Bee-Line System	$142.21
Rail Operations	
New Jersey Transit Corporation Light Rail	$349.79
Metro-North Commuter Railroad	$480.58

The main trunk route in BRT was assumed to use articulated buses. The cost per hour of operation (not necessarily per mile) of articulated buses was increased by 25 percent over standard buses based on industry experience. In addition, for the portion of all BRT routes running in the BRT ROW, a factor of 1.1 was used to escalate per-hour costs. This is due to the higher operating speeds of BRT, which result in more miles traveled per hour of operation but lower fuel efficiency, and to the higher operating costs associated with fare collection and the operation of stations.

The 2005 CRT and LRT operating costs were escalated to 2007 levels, based on Metro-North data showing a 12 percent increase over those two years. BRT costs were escalated by 10.8 percent over that time[1]. From 2007 to 2012, a 4.5 percent inflation rate was assumed for all modes.

7.2.2 Comparison of Transit Modes

Table 7-3 provides the annual operating cost of each transit alternative/option. Alternative 4A has the highest transit annual operating cost – $347 million – followed by Option 4D and Alternative 4C, $309 and $306 million, respectively. The alternative/option with the lowest transit annual operating cost is Option 3A, at $75 million, followed closely by Option 3B and Full-Corridor LRT, each with an annual operating cost of $81 million.

[1] This represents a combination of 4.5% percent inflation for 2005-2006, and 6.1 percent for 2006-2007. In determining an inflation factor from 2006 to 2007, it was found that fuel costs rose 30 percent. Fuel costs made up 6 percent of the overall cost of bus operations. Using the same 4.5 percent inflation originally assumed for all non-fuel costs, this led to an overall inflation rate of 6.1 percent.

Table 7-3

Annual Operating Costs (2012)

Criterion	Alternative/Option							
	3A Full-Corridor BRT Enhanced	**3B** Full-Corridor BRT HOT Lanes in Rockland, Busway in Westchester	**4A** Full-Corridor CRT with Hudson Line (HL) Connection	**4A-X** Full-Corridor CRT without HL Connection	**4B** CRT in Rockland, HL Connection, LRT in Westchester	**4C** CRT in Rockland, HL Connection, BRT in Westchester	**4D** CRT in Rockland, HL Connection, Full-Corridor BRT (3A)	Full-Corridor LRT
Transit Annual Operating Costs ($ Millions)	75	81	294	161	223	265	268	80
Bridge and Highway ($ Millions)	23	23	23	23	23	23	23	23

7.3 Fare Revenue

The revenue projections developed in this study, as well as the operating cost projections used, were intended solely to permit the comparison among alternatives/options. Before any alternative/option would advance into implementation, a complete operations and maintenance cost model would be developed, as would a more detailed analysis of the farebox potential for the chosen alternative/option. The recovery rates which the current estimates imply are not intended for, nor should they be used for, financial planning. They are unbiased and provide a reasonable basis to compare the alternatives/options, and that is their sole intent. The fare revenue estimate for each alternative/option used the existing fare levels escalated to 2012 for each service, and the appropriate fare based on the distance traveled for the CRT alternative/option and the boarding and alighting points for the LRT and BRT alternatives/options.

7.3.1 Description of Criterion

Fare revenue was calculated for each alternative/option based on the following assumptions:

- Fares used in the BPM analysis (BPM was 1996 dollars), which are assumed monthly pass costs per ride in 1996 dollars, were applied to 2035 forecast ridership for all new services.
- Fares for rail services were assumed to be 95 percent of fare to GCT for Manhattan-bound services, and 95 percent of fare to White Plains for cross-corridor services, to approximate the number of passengers taking shorter trips.
- AM Peak-period ridership was factored to daily ridership using a multiplier of 2.86.
- Daily ridership was factored to annual ridership using a multiplier of 291, reflecting weekday and weekend ridership.
- Revenues in 1996 dollars (BPM uses 1996 dollars) were inflated to current dollars using a factor of 1.33, based on the CPI, then further inflated by 4.5 percent annually to 2012, so that dollars are comparable to cost dollars.

7.3.2 Comparison of Transit Modes

Fare revenues vary from $27 million to $127 million (Table 7-4), with those alternatives/options carrying more people on commuter rail generating the higher fare revenues. Rail alternatives/options with service to Manhattan vary from $98 million to $127 million. The option without the Hudson Line connection generates only $34 million, among the lowest. Bus-only alternatives/options and cross-corridor LRT generate less revenue from flat fares (i.e., fares that are not distance-based).

Table 7-4

Fare Revenue*

Criterion	Alternative/Option							
	3A Full-Corridor BRT Enhanced	**3B** Full-Corridor BRT HOT Lanes in Rockland, Busway in Westchester	**4A** Full-Corridor CRT with Hudson Line (HL) Connection	**4A-X** Full-Corridor CRT without HL Connection	**4B** CRT in Rockland, HL Connection, LRT in Westchester	**4C** CRT in Rockland, HL Connection, BRT in Westchester	**4D** CRT in Rockland, HL Connection, Full-Corridor BRT (3A)	Full-Corridor LRT
Fare Revenue ($ Millions)	40	39	105	34	98	113	127	27

Note:
* The revenue projections used in this study are intended solely to permit the comparison among alternatives/options, and are not intended to be used for financial planning purposes.

7.4 Cost/Net Cost Per Passenger and Passenger-Mile

7.4.1 Description of Criteria

Cost/net cost per passenger and net cost per passenger-mile are measures of the cost effectiveness of the alternatives/options. The value of such measures is that they combine the costs of the alternatives/options and their benefits, so that alternatives/options can be compared despite having significantly different costs or benefits. Another way of expressing the value of this type of measure is to say that it provides a way of assessing whether a particular investment provides sufficient return to warrant the investment. For public transit systems, these measures are roughly equivalent to the private market measures of Return on Investment (ROI) used to evaluate private-sector projects. Cost per passenger or passenger-mile does not factor in revenue. Net cost is the total 'subsidy' for the alternative/option, on a per-passenger or per-passenger-mile basis.

7.4.1.1 Cost and Net Cost Per Passenger

The cost or net cost per passenger has two inputs – the cost or net cost of the alternative/option and the total number of passengers (Table 7-5). The cost measure is the sum of the annualized capital costs and annual operating cost; net cost deducts the annual fare revenues. Annualized capital costs are calculated using a discount rate (7 percent) applied to the expected economic life of the facilities needed to create the alternative/option. It is analogous to an amortization rate, representing the annual level of investment needed to finance the alternative/option over its economic life. While transit systems are not privately financed, this allows comparison of alternatives/options having different economic lives to be equitably compared. For example, some alternatives/options have longer economic lives than do others. The economic life expectancy of buses is far shorter than trains, so over the life of a project the bus fleet may need to be entirely replaced once or even twice for every time the rail vehicles need to be replaced. The annualized capital cost measure accounts for this difference by reflecting such differences.

Table 7-5

Cost/Net Cost per Passenger and Passenger-Mile

Criterion	Alternative/Option							
	3A Full-Corridor BRT Enhanced	**3B** Full-Corridor BRT HOT Lanes in Rockland, Busway in Westchester	**4A** Full-Corridor CRT with Hudson Line (HL) Connection	**4A-X** Full-Corridor CRT without HL Connection	**4B** CRT in Rockland, HL Connection, LRT in Westchester	**4C** CRT in Rockland, HL Connection, BRT in Westchester	**4D** CRT in Rockland, HL Connection, Full-Corridor BRT (3A)	Full-Corridor LRT
Cost per Passenger	$8.92	$17.03	$77.16	$103.23	$62.87	$46.68	$39.08	$43.51
Net Cost per Passenger	$6.39	$14.55	$71.36	$100.13	$56.52	$40.81	$33.66	$41.13
Cost per Passenger-Mile	$1.00	$1.77	$2.53	$5.52	$1.95	$1.73	$1.69	$2.54
Net Cost per Passenger-Mile	$0.72	$1.51	$2.34	$5.36	$1.75	$1.51	$1.45	$2.40

The annual ridership of each alternative/option is based on the daily ridership projected for that alternative/option expanded to an annual figure. The process of adjusting from daily to annual estimates uses an annualization factor that reflects how many days each year full service will be provided versus those days when less than full service will be provided. The days when less than full service is likely to be provided are holidays and weekends. The annualization factor weights those days and adds them to the full-service days to arrive at the equivalent factor to provide annual ridership. In the case of this project, the annualization factor used is 291, so daily ridership was multiplied by 291 to arrive at an annual ridership figure.

7.4.1.2 Cost and Net Cost Per Passenger-Mile

The cost/net cost per passenger-mile (Table 7-5) uses the same annualized capital cost as does the cost/net cost per passenger measure. However, annual passenger miles differ from passengers by reflecting the trip lengths projected for those passengers. This gives another measure that is useful in spotting the length of trips being served, so that longer trips are valued appropriately. Passenger-miles were determined by measuring passenger loads along the main transit corridor from Suffern to Port Chester.

The BPM outputs represent the AM-peak period (6-10 AM). A factor of 2.86 was used to derive daily passenger miles. A factor of 291 was then used to convert daily miles to annual miles. Annual costs/net costs were then divided by the total number of passenger-miles for each alternative/option.

The revenue/cost measure developed in this analysis is not a cost/benefit measure nor is it a cost/effectiveness measure. These figures were developed to enable comparison among multiple alternatives/options and are not intended for financial analyses. They are performance measures and not financial measures, since significant additional work will be needed for the selected alternative/option to develop reliable revenue and cost estimates. The Federal Transit Administration (FTA) uses a cost/effectiveness measure that captures the benefits of alternatives/options using "transit system user benefits" – taking the number of hours of commute time saved and monetizing those savings, converting them to dollars. The measures presented in this section on costs/net costs do not purport to monetize those benefits and are, therefore, not comparable to the FTA measure.

7.4.2 Comparison of Transit Modes

Table 7-5 provides the cost/net cost per passenger and per passenger-mile for the alternatives/options. The lowest cost per passenger was achieved by BRT Options 3A and 3B. The highest cost per passenger was recorded by Option 4A-X, followed by Alternative 4A. Option 4A-X has the highest cost per passenger-mile, followed by Full-Corridor LRT. The lowest cost per passenger-mile was achieved by Option 3A.

Net costs range from roughly $6 per passenger to over $100 per passenger, and from less than $1 to over $5 per passenger-mile, with the bus-only alternatives/options having lower unit costs, and the option of full-corridor CRT without a connection to Manhattan having the highest unit cost.

7.5 Travel-Time Benefits

Travel-time benefits place a dollar value on the amount of time saved by commuters under each alternative/option compared to the No Build Alternative. These include direct benefits (time saved by transit users) and indirect benefits (time saved by non-transit commuters due to reduced congestion). The time saved by transit users is determined by direct comparison of travel times in the No Build and in each of the alternatives/options. Travel time saved by non-transit users is calculated as a multiplier, using federal guidelines. These are benefits that accrue to individuals, and are therefore not included in the net-cost calculation.

7.5.1 Description of Criterion

Travel-time benefits were derived by applying a value of time to the aggregate travel-time savings described above. Based on FTA guidance, the value of time was based on a 2007 wage of $12.00 per hour. FTA has established allowances of 100 percent for indirect benefits such as congestion relief and economic development, which leads to a value of time of $24.00 in 2007 dollars, and $29.90 in 2012 dollars (assuming an inflation rate of 4.5 percent per year). It should be noted that this estimate of travel-time benefits is not the same as the user benefits measure used by FTA in New Starts analysis.

7.5.2 Comparison of Transit Modes

Table 7-6 summarizes the travel-time savings of each alternative/option. Unlike some of the other measures, this measure varies by origin and destination. Each origin/destination pair would have different savings for each alternative/option. Therefore, there are three tables nested within the following table.

Table 7-6

Travel-Time Savings

Criterion	Alternative/Option							
	3A Full-Corridor BRT Enhanced	**3B** Full-Corridor BRT HOT Lanes in Rockland, Busway in Westchester	**4A** Full-Corridor CRT with Hudson Line (HL) Connection	**4A-X** Full-Corridor CRT without HL Connection	**4B** CRT in Rockland, HL Connection, LRT in Westchester	**4C** CRT in Rockland, HL Connection, BRT in Westchester	**4D** CRT in Rockland, HL Connection, Full-Corridor BRT (3A)	Full-Corridor LRT
Aggregate Travel-Time Savings (Hours in the Peak Period (6-10 AM)	4,400	4,500	7,400	3,900	6,200	6,000	8,100	3,800
Annual Travel-Time Benefits ($ millions)	110	112	184	97	154	149	202	95

The benefits from most rail alternatives/options are greater than those from the bus-only or LRT alternatives/options, due to the longer trips taken at higher speeds compared to highway speeds. The exception is the variant without the connection to the Hudson Line, where trips to Manhattan are low.

7.6 Summary of Cost Evaluation

A summary of all the cost analyses is presented in Tables 7-7 and 7-8. The data have all been described above. The rail options have higher capital costs, which result in higher unit costs, but have advantages in travel-time savings and revenue generation. While total ridership is similar, the rail options attract more riders diverted from other modes, which removes vehicles from the roadways.

Table 7-7

Cost Criteria – Project Costs

Criterion	Alternative/Option							
	3A Full-Corridor BRT Enhanced	**3B** Full-Corridor BRT HOT Lanes in Rockland, Busway in Westchester	**4A** Full-Corridor CRT with Hudson Line (HL) Connection	**4A-X** Full-Corridor CRT without HL Connection	**4B** CRT in Rockland, HL Connection, LRT in Westchester	**4C** CRT in Rockland, HL Connection, BRT in Westchester	**4D** CRT in Rockland, HL Connection, Full-Corridor BRT (3A)	Full-Corridor LRT
Project Capital Cost ($ Millions)	8,027	9,678	22,091	20,002	17,352	15,755	15,999	12,251
Transit Capital Cost ($ Millions)	897	2,548	15,111	13,022	10,372	8,775	8,869	5,561
Project Capital Cost Annualized ($ Millions)	582	701	1,601	1,449	1,257	1,142	1,159	888
Transit Capital Cost Annualized ($ Millions)	65	185	1,095	944	752	636	643	403
Project Annual Operating Costs ($ Millions)	98	104	317	184	245	288	291	103
Transit Annual Operating Costs ($ Millions)	75	81	294	161	223	265	268	80
Project Annual Total Costs ($ Millions)	679	805	1,918	1,633	1,503	1,429	1,450	991
Transit Annual Total Costs ($ Millions)	140	266	1,389	1,105	974	901	911	483

Notes: Based on Year 2012 dollars. Project costs include transit, highway, and bridge costs. Cost estimate was prepared October 25, 2007. Note that value planning for all alternatives/options will be studied and developed in the future.

Table 7-8

Cost Criteria – Transit Costs

Criterion	Alternative/Option							
	3A Full-Corridor BRT Enhanced	**3B** Full-Corridor BRT HOT Lanes in Rockland, Busway in Westchester	**4A** Full-Corridor CRT with Hudson Line (HL) Connection	**4A-X** Full-Corridor CRT without HL Connection	**4B** CRT in Rockland, HL Connection, LRT in Westchester	**4C** CRT in Rockland, HL Connection, BRT in Westchester	**4D** CRT in Rockland, HL Connection, Full-Corridor BRT (3A)	Full-Corridor LRT
Annual Transit Costs ($ Millions)	140	266	1,389	1,105	974	901	911	483
Fare Revenue ($ Millions)	40	39	105	34	98	113	127	27
Net Annual Transit Costs ($ Millions)	100	227	1,284	1,071	876	788	784	456
Travel-Time Benefits ($ Millions)	110	112	184	97	154	149	202	95
Weekday Daily Ridership								
New	23,400	23,800	21,800	13,800	21,000	21,400	31,200	16,900
Diverted From Other Transit Routes	30,600	29,800	40,100	23,100	32,200	44,800	48,700	21,400
Total	54,000	53,600	61,900	36,900	53,200	66,200	79,900	38,300
Annual Passenger-Miles (Millions)								
In Corridor	100	90	190	80	160	176	207	90
On Existing Facilities Beyond Corridor	40	60	360	120	340	346	332	100
Total	140	150	550	200	500	522	539	190
Cost per Passenger	$8.92	$17.03	$77.16	$103.23	$62.87	$46.68	$39.08	$43.51
Net Cost per Passenger	$6.39	$14.55	$71.36	$100.13	$56.52	$40.81	$33.66	$41.13
Cost per Passenger-Mile	$1.00	$1.77	$2.53	$5.52	$1.95	$1.73	$1.69	$2.54
Net Cost per Passenger-Mile	$0.72	$1.51	$2.34	$5.36	$1.75	$1.51	$1.45	$2.40

Notes: Based on Year 2012 dollars. Net cost per passenger-mile is based on total passenger-miles.