4. Cost Estimates

Operating and capital costs were assessed for each of the eight corridors.

Operating costs were estimated by estimating the length and operating speed of each corridor. Bus rapid transit (BRT) and light rail transit (LRT) corridors were estimated to operate at 15 mph (including stops) while commuter rail corridors were estimated to operate at 20 mph.

The operating time required to make a complete trip was estimated based on length and assumed operating speed of the corridor. The required number of vehicles was estimated based on the cycle time for a single trip and the proposed frequency of service. A frequency of every ten minutes during the peak and every 20 minutes during the off-peak was used for BRT and LRT service, while commuter rail was estimated at every 30 minutes during peak hours only.

The number of revenue hours required was calculated by multiplying the number of required vehicles and the number of service hours. Operating costs were estimated by converting the daily revenue hours to annual revenue hours by multiplying 254 days (for weekdays) and 110 days (for weekends).

The annual operating cost was estimated by multiplying the number of required revenue hours by a cost per revenue hour. For BRT, the cost per revenue hour was estimated to be $56.64 (the cost per KAT revenue hour from 2007 NTD data) plus an additional $75,000 per track mile in maintenance costs. For LRT, the cost per revenue hour used was $200.00, based on light rail operating costs for various systems in the eastern part of the United States. The commuter rail cost estimate used $636.70 per revenue hour, which is the reported cost per revenue hour for the Music City Star in Nashville.

The capital cost estimate took into account three components: required vehicle cost, station construction cost, and guideway construction cost.

The required vehicle cost was based on the number of peak vehicles required to run each service based on the frequencies described above. These were multiplied by the cost per vehicle, which was estimated at $800,000 per articulated BRT vehicle, $4.14 million per articulated LRT vehicle, and $5.0 million per diesel multiple unit for commuter rail.

The station construction cost estimated the number of required stations based on the length of each corridor. No station locations were assessed for each corridor, so the cost estimate is a general number. For BRT and light rail corridors, stations were estimated to be 0.5 miles apart. Thus, a corridor of 7.0 miles would have 14 stations. The cost used for a BRT station was $250,000 and the cost used for a light rail station was $500,000.

For commuter rail the stations were estimated to be 1.0 miles apart, which is based on the scale and speed of commuter rail service. Stations were estimated to cost approximately $250,000.

Guideway construction costs were estimated on a per-mile basis. Guideway miles are essentially double the corridor length, since it was assumed that each corridor would be double-tracked. For BRT the guideway cost was estimated to be $5 million per mile for low-end BRT and $25 million per mile for high-end BRT. The difference provides a high and low boundary of costs based on the level of right of way improvements that are required. The LRT guideway cost was estimated at $45 million per mile.

For the two commuter rail corridors there were no assumed guideway costs, since rail presently exists on each of these corridors. However, in some places the commuter rail is single tracked. Thus, the guideway costs for commuter rail do not take into account the cost of double tracking the corridor. Additionally, no costs were assigned to lease each corridor from their respective owners.

Tables 4-1 and 4-2 summarize the estimated operating costs and capital costs, respectively, for implementing high capacity transit in each of the eight corridors. For the two rail corridors, Norfolk Southern and Alcoa-Knoxville, operating and capital cost estimates were performed only for the commuter rail option. For the remaining six corridors, operating cost estimates were calculated for both a BRT and LRT option. Capital cost estimates were calculated for three different options, low-end BRT, high-end BRT, and LRT.

Considering only capital costs, implementing commuter rail in either the Norfolk Southern or Alcoa-Knoxville rail corridors would be the least expensive options. Because these corridors already exist as active freight rail lines, the only capital costs for implementing commuter rail service would be the purchase of vehicles and construction of stations. Furthermore, because commuter rail stations are located at greater intervals than either BRT or LRT stations, total station costs are lower than for many of the BRT/LRT corridors. In the remaining six corridors, the capital costs of implementing low or high-end BRT or LRT are directly related to the length of the corridor. Therefore the MLK Jr. corridor, at 4.2 miles, would be the least expensive option, while the Chapman Highway/James White Parkway, at 8.5 miles, would have the highest capital costs. In all cases, the most expensive low-BRT option would still be less costly to implement than the least expensive high-BRT option. The same holds true for high-BRT versus LRT, with the exception of the Chapman Highway high-BRT option, which is estimated to have slightly higher capital costs than a light rail line on the MLK Jr. corridor.

Operating costs are also closely related to the length of the corridor, but the number of vehicles in service and number of service hours are also significant factors in determining operating costs. Of the six corridors with a BRT option, the MLK Jr. corridor is estimated to have the lowest operating costs, due to the short distance of the corridor and low number of vehicles operating during peak and off-peak periods. The Magnolia Avenue and Cumberland Avenue/Kingston Pike Corridors are also estimated to have annual operating costs below $2 million for BRT. The Chapman Highway/James White Parkway Corridor has the highest estimated BRT operating costs. For LRT, the MLK Jr. and Magnolia corridors are estimated to have the lowest operating costs, while the Western Ave. and Chapman Highway corridors have the highest estimated operating costs. The cost of operating commuter rail in the Norfolk Southern rail corridor is estimated to be more expensive than operating BRT in any of the non-rail corridors, but less expensive than operating a light rail line. However, the cost of operating commuter rail in either of the rail corridors is likely to be much more expensive than has been estimated, due to the omission of leasing costs from the estimates.

Table 4-1
Operating Cost Estimates

1. Cumberland Avenue/Kingston Pike																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	7.5	15	30	66	10	7	4	20	4	11	20	4	12	23,568	$56.64	$1,334,892	$562,500	$1,897,392
LRT	7.5	15	30	66	10	7	4	20	4	11	20	4	12	23,568	$200.00	$4,713,600		$4,713,600

2. Norfolk Southern Rail Corridor																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
Commuter Rail	7.3	20	22	48	30	2	6		1	2				3,556	$636.70	$2,264,105		$2,264,105

3. Western Avenue																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	8.3	15	33	73	10	8	4	20	4	11	20	4	12	24,584	$56.64	$1,392,438	$622,500	$2,014,938
LRT	8.3	15	33	73	10	8	4	20	4	11	20	4	12	24,584	$200.00	$4,916,800		$4,916,800

4. North Broadway Street																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	7.7	15	31	68	10	7	4	20	4	11	20	4	12	23,568	$56.64	$1,334,892	$577,500	$1,912,392
LRT	7.7	15	31	68	10	7	4	20	4	11	20	4	12	23,568	$200.00	$4,713,600		$4,713,600

5. Martin Luther King Jr. Avenue																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	4.2	15	17	37	10	4	4	20	2	11	20	2	12	12,292	$56.64	$696,219	$315,000	$1,011,219
LRT	4.2	15	17	37	10	4	4	20	2	11	20	2	12	12,292	$200.00	$2,458,400		$2,458,400

6. Magnolia Avenue																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	4.5	15	18	40	10	4	4	20	2	11	20	2	12	12,292	$56.64	$696,219	$337,500	$1,033,719
LRT	4.5	15	18	40	10	4	4	20	2	11	20	2	12	12,292	$200.00	$2,458,400		$2,458,400

7. Chapman Highway/James White Parkway																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
BRT	8.5	15	34	75	10	8	4	20	4	11	20	4	12	24,584	$56.64	$1,392,438	$637,500	$2,029,938
LRT	8.5	15	34	75	10	8	4	20	4	11	20	4	12	24,584	$200.00	$4,916,800		$4,916,800

8. Alcoa-Knoxville Rail Corridor																		
	length (miles)	speed (mph)	one-way running time (min)	cycle time (min)	peak frequency (min)	peak vehicles	peak service hours	offpeak frequency (min)	offpeak vehicles	offpeak service hours	weekend frequency (min)	weekend vehicles	weekend service hours	annual hours	cost per revenue hour	operating costs	maintenance costs	total annual costs
Commuter Rail	16.1	20	48	106	30	4	6		1	2				6,604	$636.70	$4,204,767		$4,204,767

Table 4-2
Capital Cost Estimates

1. Cumberland Avenue/Kingston Pike	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	7.5	15	$5,000,000	$75,000,000	7	$800,000	$5,600,000	15	$250,000	$3,750,000	$84,350,000
BRT High	7.5	15	$25,000,000	$375,000,000	7	$800,000	$5,600,000	15	$250,000	$3,750,000	$384,350,000
LRT	7.5	15	$45,000,000	$675,000,000	7	$4,140,000	$28,980,000	15	$500,000	$7,500,000	$711,480,000

2. Norfolk Southern Rail Corridor	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
Commuter Rail	7.3	N/A	N/A	N/A	2	$5,000,000	$10,000,000	8	$250,000	$2,000,000	$12,000,000

3. Western Avenue	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	8.3	16.6	$5,000,000	$83,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$93,650,000
BRT High	8.3	16.6	$25,000,000	$415,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$425,650,000
LRT	8.3	16.6	$45,000,000	$747,000,000	8	$4,140,000	$33,120,000	17	$500,000	$8,500,000	$788,620,000

4. North Broadway Street	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	7.7	15.4	$5,000,000	$77,000,000	7	$800,000	$5,600,000	16	$250,000	$4,000,000	$86,600,000
BRT High	7.7	15.4	$25,000,000	$385,000,000	7	$800,000	$5,600,000	16	250000	$4,000,000	$394,600,000
LRT	7.7	15.4	$45,000,000	$693,000,000	7	$4,140,000	$28,980,000	16	$500,000	$8,000,000	$729,980,000

5. Martin Luther King Jr. Avenue	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	4.2	8.4	$5,000,000	$42,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$47,450,000
BRT High	4.2	8.4	$25,000,000	$210,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$215,450,000
LRT	4.2	8.4	$45,000,000	$378,000,000	4	$4,140,000	$16,560,000	9	$500,000	$4,500,000	$399,060,000

6. Magnolia Avenue	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	4.5	9	$5,000,000	$45,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$50,450,000
BRT High	4.5	9	$25,000,000	$225,000,000	4	$800,000	$3,200,000	9	$250,000	$2,250,000	$230,450,000
LRT	4.5	9	$45,000,000	$405,000,000	4	$4,140,000	$16,560,000	9	$500,000	$4,500,000	$426,060,000

7. Chapman Highway/James White Parkway	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
BRT	8.5	17	$5,000,000	$85,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$95,650,000
BRT High	8.5	17	$25,000,000	$425,000,000	8	$800,000	$6,400,000	17	$250,000	$4,250,000	$435,650,000
LRT	8.5	17	$45,000,000	$765,000,000	8	$4,140,000	$33,120,000	17	$500,000	$8,500,000	$806,620,000

8. Alcoa-Knoxville Rail Corridor	corridor length (miles)	guideway miles	cost per guideway mile	guideway cost	vehicles required	cost per vehicle	vehicle cost	stations	cost per station	station cost	total cost
Commuter Rail	16.1	N/A	N/A	N/A	4	$5,000,000	$20,000,000	17	$250,000	$4,250,000	$24,250,000