

I-70 Mountain Corridor Transit Cost Estimates

Included Elements and Assumptions

Operating Plan Assumptions

For AGS

- Hybrid alignment with high speed Maglev technology
- 120-mile Full system termini at C-470/I-70/US 6 in Golden and at Eagle County Regional Airport
- 59-mile MOS with termini at C-470/I-70/US 6 in Golden and at Breckenridge, plus stations at Idaho Springs and Keystone
- AGS costs do not include bus shuttle between Breckenridge AGS station and Silverthorne
- 365 days of operation per year
- 18-hours of operation per day including 6 peak hours with 30-minute headways and 12 off-peak hours with 60-minute headways Thursday through Sunday (208 peak days)
- 18-hours of operation per day including 6 peak hours with 60-minute headways and 12 off-peak hours with 60-minute headways Monday through Wednesday (157 off-peak days)
- Five, 5-car Maglev train consists plus 5 spare vehicles; 82 seats per car or 410 seats per train
- MOS forecast ridership of 1,541,176 passengers per year; equates to 24% seat occupancy
- MOS farebox revenue of \$20,851,174
- All AGS costs provided by CDOT's AGS Feasibility Study

For BRT

- I-70 alignment from Golden to Vail, operating in managed lanes (peak direction) to Silverthorne and in general purpose travel lanes from Silverthorne to Vail
- 53-mile MOS with termini at C-470/I-70/US 6 in Golden and at Silverthorne
- 12 stations including Silverthorne Multimodal facility
- 365 days of operation per year
- Original proposal: 20-hours of operation per day including 9 peak hours with 30-minute headways and 11 off-peak hours with 60-minute headways, 7 days per week
- Equivalent Capacity to AGS: 20-hours of operation per day including 9 peak hours with 15-minute headways and 11 off-peak hours with 30-minute headways, 7 days per week; this is the basis for the capital and O&M cost estimates
- 18 peak buses plus 4 spare vehicles; 56 seats per bus
- Ridership forecast of 1,522,371 passengers per year equivalent to AGS MOS; equates to 65% seat occupancy, with shorter headways and more operating hours
- O&M cost of \$250 per vehicle revenue hour is conservative; more than double the current O&M cost per hour of Summit Stage (\$105.00/hour) and RFTA (\$118.37/hour)
- Estimated farebox revenue of \$20,420,582

Transit Capital Costs – AGS MOS capital costs are 51% of full buildout costs

- Vehicles – 22 BRT vehicles (to provide equivalent capacity to AGS) are heavy duty, over-the-road coaches such as MCI model D @ \$600,000; AGS vehicles are high speed Maglev vehicles @ \$8 million (5 trains of 5-car consists plus spare vehicles for a total of 30 vehicles).
- Infrastructure – includes AGS guideway, bridges, tunnels and power/control systems.
- Stations (Major) – includes Silverthorne Multimodal facility for BRT @ \$8.0 million– 3 times area and cost of basic/standard station plus 10,000 sf building with restrooms/amenities @ \$250/sf for a total of \$8.0 million; for AGS, Eagle County Airport and Golden stations @\$25 million.
- Stations (Basic/standard) – includes 6 stations for AGS estimated @\$15 million in CDOT Feasibility Study, and 11 stations for BRT @ \$1.85 million, including platforms, structures, shelters/canopies, bus pads, fare collection equipment, benches, bike racks/lockers, signs, security systems, passenger information systems, map/schedule displays, lighting, trash receptacles, including all installation costs.
- Maintenance barn – includes storage and maintenance facility for AGS (\$49 million) and for BRT (\$15 million), including equipment, parts inventory, fuel/wash, fixtures, and furnishings.

BRT Stations (Basic/standard)

Driveway, Bus Pads, Circulation area, curb-and-gutter, incl. clearing/grading, installation	Bus staging/turnaround (reinforced concrete) 25,000 sf; \$300/cu yd	LS	\$186,000
Station Platform	Boarding Area (reinforced concrete) 6,000 sf (150' x 40'); \$300/cu yd	LS	\$45,000
Standard Station Signage	3 per station	Ea.	\$500
Shelter	Upgraded shelter with wind screen (3 per station)	Ea.	\$150,000
Benches	Standard bench with accessible seating area (2 per shelter; 6 total)	Ea.	\$4,500
Map Display	3 per station	Ea.	\$4,500
Trash receptacles	3 per station	Ea.	\$650
Bike Racks	3 per station	Ea.	\$2,500
Variable Message Sign for real-time passenger information system	3 per station	Ea.	\$25,000
Lighting	LED Platform Lights; street/bus area lighting; park-n-ride area lighting; 50 lights @\$1,500	LS	\$75,000
Fare collection	Ticket vending machines (2 per station)	Ea.	\$70,000
Landscaping	Station area and park-n-ride lot	LS	\$75,000
Park-n-ride lot incl. clearing/grading, installation, curb-and-gutter	200 spaces (asphalt/striped) 76,000 sf @\$4.00	LS	\$304,000
Electrical, fiber optic cable, conduit	To serve the station site	LS	\$200,000
CCTV security, emergency phone	To serve the station site	LS	\$250,000

Total per Station \$ 1,851,450

Transit Allowances – applied to BRT alternatives only; these are already included in the AGS total cost estimates

- Contingency (unallocated) – assumes 10% applied to total capital costs for BRT; for AGS, total contingencies estimated at 33% or \$4,407,133,581 for full buildout.
- Environmental Mitigation and Basic Landscaping – lump sum for each alternative; includes items to mitigate environmental impacts (landscaping at stations and maintenance barn included in station cost) for BRT; for AGS, environmental mitigation estimated at 1% or \$186,540,000 for full buildout; \$10 million for BRT environmental mitigation.
- Utilities – lump sum for each alternative; includes fiber optic, electric, and water service for BRT Silverthorne station plus fiber optic and electric for basic stations at 5% of station and maintenance barn costs; for AGS utility relocation estimated at \$671,540,000 for full buildout.
- Drainage and Water Quality (permanent) – lump sum for each alternative; 10% of station and maintenance barn costs.
- Water Quality (construction) – lump sum for each alternative; 1% of station and maintenance barn costs.
- Signing and Striping (general) – does not apply to AGS; does not apply to BRT since it's covered in managed lane costs.
- Traffic Control (construction) – 5% of BRT capital costs; for AGS, included in total cost.
- Mobilization and Staging – 4% of BRT capital costs; for AGS, construction support estimated at \$50,000,000 for full buildout.
- Right-of-Way – lump sum for each alternative; for BRT stations, park-n-ride facilities and maintenance barn (conservatively assuming they are outside I-70 ROW). Assumes 31,000 sf per station plus 76,000 sf per park-n-ride @\$2.00 per sf for 11 BRT stations; plus 300,000 sf for Silverthorne Multimodal facility; plus 50,000 sf for BRT storage/maintenance barn; for AGS, ROW and Utilities estimated at \$329,494,912 for full buildout.
- CSS Contingency – set by CDOT at 15% of total capital costs minus vehicles; not added for AGS.

Transit O&M Costs – estimated at \$250 per vehicle revenue hour for BRT; AGS MOS O&M costs are 58% of full buildout cost estimates

- Vehicle and Station Operations – for BRT 55% of total O&M cost; includes drivers/operators, fuel; for AGS 38% of total O&M cost.
- Vehicle Maintenance – for BRT 15% of total O&M cost; includes mechanics, parts; for AGS 14% of total.
- Infrastructure Maintenance – for BRT 12% of total O&M cost; includes maintenance staff, utilities, supplies; for AGS 26% of total.
- General Administration – for BRT 18% of total O&M cost; includes supervisory staff, accounting, purchasing, support; for AGS 22% of total.
- Long Term Capital Replacement (annualized) – includes:

<u>Item</u>	<u>Useful Life (years)*</u>	<u>Times to replace over 50 yrs.</u>
• BRT vehicles	12	4
• AGS vehicles	25	2
• AGS guideway (exclusive ROW)	125	0
• AGS guideway (aerial structure)	80	0
• AGS guideway (tunnel)	125	0
• Train controls and signals	30	1
• Traction power supply: substations	50	1
• Traction power distribution: catenary/3 rd rail	30	1
• Communications	20	2
• Fare collection system and equipment	25	2
• Central control	30	1
• Maintenance facility	50	1
• Stations at-grade and aerial	70	0
• Stations underground	125	0
• Park-n-ride lots	20	2
• 4% discount rate assumption		

*FTA standards

Total replacement costs for AGS = \$567.5 billion; \$31.9 million annualized over 50 years at 4% discount rate

Total replacement costs for BRT = \$94.3 million; \$8.1 million annualized over 50 years at 4% discount rate

Transit Design and Construction Engineering

For BRT

- PE/Final Design – assumes 12% of all transit capital items; \$10.7 million
- Construction engineering – assumes 8% of all transit capital items; \$7.1 million

For AGS

- Professional Services combined estimated at \$1,940,000,000

BRT Capital Costs

BRT service to Vail

Item	Unit	Unit Cost	Quantity	Total Cost	
Vehicles	Each	\$600,000	16	\$9,600,000	48-60 seats; 45' long; underfloor luggage compartment Prevost H Series; X Series
Stations	Each	\$1,850,000	11	\$20,350,000	Volvo 9500, 9700, 9900
Silverthorne Multimodal Facility	Each	\$8,000,000	1	\$8,000,000	MAN Neoplan Tourliner or Starliner
Maintenance and Storage Facility	Each	\$15,000,000	1	\$15,000,000	MCI J4500 or D series
Contingency	Percent of capital costs	10% of vehicles; 30% of other items		\$13,965,000	Van Hool T2145 USA
TOTAL				\$66,915,000	

Golden, Hogback, Evergreen, Idaho Springs, Empire Junction, Georgetown, Loveland Pass, Silverthorne, Frisco, Copper Mountain, Vail Pass, Vail

BRT service to Vail to match AGS ridership with 55 mph in managed lanes

Item	Unit	Unit Cost	Quantity	Total Cost	
Vehicles	Each	\$600,000	63	\$37,800,000	48-60 seats; 45' long; underfloor luggage compartment Prevost H Series; X Series
Stations	Each	\$1,850,000	11	\$20,350,000	Volvo 9500, 9700, 9900
Silverthorne Multimodal Facility	Each	\$8,000,000	1	\$8,000,000	MAN Neoplan Tourliner or Starliner
Maintenance and Storage Facility	Each	\$15,000,000	1	\$15,000,000	MCI J4500 or D series
Contingency	Percent of capital costs	10% of vehicles; 30% of other items		\$16,785,000	Van Hool T2145 USA
TOTAL				\$97,935,000	

BRT service to Vail to match AGS ridership with 65 mph in managed lanes

Item	Unit	Unit Cost	Quantity	Total Cost	
Vehicles	Each	\$600,000	60	\$36,000,000	
Stations	Each	\$1,850,000	11	\$20,350,000	Golden, Hogback, El Rancho, Idaho Springs, Empire Junction, Georgetown, Loveland, Frisco, Copper Mountain, Vail Pass, Vail
Silverthorne Multimodal Facility	Each	\$8,000,000	1	\$8,000,000	
Maintenance and Storage Facility	Each	\$15,000,000	1	\$15,000,000	
Contingency	Percent of capital costs	10% of vehicles; 30% of other items		\$16,605,000	
TOTAL				\$95,955,000	

BRT service to Vail to match AGS MOS ridership with 55 mph in managed lanes

Item	Unit	Unit Cost	Quantity	Total Cost	
Vehicles	Each	\$600,000	22	\$13,200,000	48-60 seats; 45' long; underfloor luggage compartment Prevost H Series; X Series
Stations	Each	\$1,850,000	11	\$20,350,000	Volvo 9500, 9700, 9900
Silverthorne Multimodal Facility	Each	\$8,000,000	1	\$8,000,000	MAN Neoplan Tourliner or Starliner
Maintenance and Storage Facility	Each	\$15,000,000	1	\$15,000,000	MCI J4500 or D series
Contingency	Percent of capital costs	10% of vehicles; 30% of other items		\$14,325,000	Van Hool T2145 USA
TOTAL				\$70,875,000	

BRT service to Vail to match AGS MOS ridership with 65 mph in managed lanes

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$600,000	22	\$13,200,000
Stations	Each	\$1,850,000	11	\$20,350,000
Silverthorne Multimodal Facility	Each	\$8,000,000	1	\$8,000,000
Maintenance and Storage Facility	Each	\$15,000,000	1	\$15,000,000
Contingency	Percent of capital costs	10% of vehicles; 30% of other items		\$14,325,000
TOTAL				\$70,875,000

Golden, Hogback, El Rancho, Idaho Springs, Empire Junction, Georgetown, Loveland, Frisco, Copper Mountain, Vail Pass, Vail

Original BRT Estimate to Vail (Duncan Allen)

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$1,200,000	12	\$14,400,000
Stations	Each	\$2,500,000	10	\$25,000,000
Silverthorne Multimodal Facility	Each	\$15,000,000	1	\$15,000,000
Maintenance and Storage Facility	Each	\$7,000,000	1	\$7,000,000
Third Managed Lane	Mile	\$1,000,000	47	\$47,000,000
Contingency	Percent of capital costs	20% of vehicles and lanes; 30% of other items	N/A	\$26,380,000
TOTAL	N/A	N/A	N/A	\$134,780,000

Original BRT Estimate to Vail w/o managed lanes

Vehicles	Each	\$1,200,000	12	\$14,400,000
Stations	Each	\$2,500,000	10	\$25,000,000
Silverthorne Multimodal Facility	Each	\$15,000,000	1	\$15,000,000
Maintenance and Storage Facility	Each	\$7,000,000	1	\$7,000,000
Contingency	Percent of capital costs	20% of vehicles; 30% of other items	N/A	\$16,980,000
TOTAL	N/A	N/A	N/A	\$78,380,000

BRT service Golden to Silverthorne

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$600,000	16	\$9,600,000
Stations	Each	\$1,850,000	6	\$11,100,000
Silverthorne Multimodal Facility	Each	\$8,000,000	1	\$8,000,000
Maintenance and Storage Facility	Each	\$15,000,000	1	\$15,000,000
Contingency	Percent of capital costs	10% of vehicles; 30% of other items		\$11,190,000
TOTAL				\$54,890,000

Golden, Hogback, Evergreen, Idaho Springs, Empire Junction, Georgetown, Loveland Pass

82% of full Vail service cost; 65% of the distance

Breckenridge to Silverthorne Shuttle Connector for AGS

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$500,000	3	\$1,500,000
Stations	Each	\$1,000,000	3	\$3,000,000
TOTAL				\$4,500,000

Frisco, Breckenridge, Silverthorne

Keystone to Silverthorne Shuttle Connector for AGS

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$500,000	3	\$1,500,000
Stations	Each	\$1,000,000	2	\$2,000,000
TOTAL				\$3,500,000

Keystone, Silverthorne

Idaho Springs/Downieville-Lawson-Dumont Circulator/Feeder Service

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$350,000	4	\$1,400,000
Bus stops	Each	\$125,000	9	\$1,125,000
TOTAL				\$2,525,000

9 local plus connector to BRT near I-70 incl. under BRT costs

Idaho Springs/Central City-Blackhawk Circulator/Feeder Service

Item	Unit	Unit Cost	Quantity	Total Cost
Vehicles	Each	\$350,000	4	\$1,400,000
Bus stops	Each	\$125,000	4	\$500,000
TOTAL				\$1,900,000

2 in Central City and 2 in Blackhawk

BRT Replacement costs

Item	Useful Life	Times to replace over 50 yrs.	Unit Capital Cost	Number Required	Total Replacement Capital Cost	4% discount rate	Total Annualized Cost
Vehicles	12	4	\$ 600,000	22	\$ 52,800,000	0.106552	\$ 5,625,955
Communications	20	2	\$ 325,000	12	\$ 7,800,000	0.073582	\$ 573,938
Fare collection system and equipment	25	2	\$ 140,000	12	\$ 3,360,000	0.064012	\$ 215,080
Central control	30	1	\$ 8,000,000	1	\$ 8,000,000	0.057830	\$ 462,641
Maintenance facility	50	1	\$ 15,000,000	1	\$ 15,000,000	0.046550	\$ 698,253
Stations at-grade	70	0			\$ -	0.042745	\$ -
BRT Park-n-ride lots	20	2	\$ 304,000	12	\$ 7,296,000	0.073582	\$ 536,852
					<u>\$ 94,256,000</u>		<u>\$ 8,112,719</u>

AGS Replacement costs

Item	Useful Life	Times to replace over 50 yrs.	Unit Capital Cost	Number Required	Total Replacement Capital Cost	4% discount rate	Total Annualized Cost
AGS vehicles	25	2	\$ 8,000,000	15	\$ 240,000,000	0.064012	\$ 15,362,871
AGS guideway (exclusive ROW)	125	0			\$ -	0.040299	\$ -
AGS guideway (aerial structure)	80	0			\$ -	0.041814	\$ -
AGS guideway (tunnel)	125	0			\$ -	0.040299	\$ -
Train controls and signals	30	1	\$ 50,000,000	1	\$ 50,000,000	0.057830	\$ 2,891,505
Traction power supply: substations	50	1	\$ 187,600,000	1	\$ 187,600,000	0.046550	\$ 8,732,818
Traction power distribution: catenary/3 rd rail	30	1	\$ 16,900,000	1	\$ 16,900,000	0.057830	\$ 977,329
Communications	20	2	\$ 8,429,000	1	\$ 16,858,000	0.073582	\$ 1,240,441
Fare collection system and equipment	25	2	\$ 140,000	8	\$ 2,240,000	0.064012	\$ 143,387
AGS Maintenance facility	50	1	\$ 49,000,000	1	\$ 49,000,000	0.046550	\$ 2,280,960
Stations at-grade and aerial	70	0			\$ -	0.042745	\$ -
Stations underground	125	0			\$ -	0.040299	\$ -
AGS Park-n-ride lots	20	2	\$ 304,000	8	\$ 4,864,000	0.073582	\$ 357,902
					<u>\$ 567,462,000</u>		<u>\$ 31,987,212</u>

Rapid O&M costs

	52,020 revenue hours(due to all mixed flow, requires one more bus than BRT with dediaded lanes)	updated 8/6/13	56,100
\$	93.00 base FR cost	\$	90.00
\$	4,837,860.00 base cost	\$	5,049,000.00
\$	250,000.00 extra security	\$	250,000.00
\$	190,000.00 COM software	\$	190,000.00
\$	120,000.00 extra maintenance	\$	120,000.00
\$	5,397,860.00 total	\$	5,609,000.00
\$	103.77 per hour	\$	99.98
\$	105.00 round up cost per revenue vehicle hour	\$	105.00

BRT O&M costs

	49,980 revenue hours		45,000
\$	93.00 base FR cost	\$	150.00
\$	4,648,140.00 base cost	\$	6,750,000.00
\$	500,000.00 extra security	\$	500,000.00
\$	380,000.00 COM software	\$	380,000.00
\$	300,000.00 extra maintenance	\$500/mo/station =	\$ 48,000 8 stations
\$	150,000.00 station spare parts	\$500/mile dedicated lanes/mo.=	\$ 318,000 6.5 miles
\$	200,000.00 extra utilities (stations)	\$300/artic. bus/mo.=	\$ 43,200
\$	6,178,140.00 total	\$	409,200
\$	123.61 per hour	\$	179.00
\$	125.00 round up cost per revenue vehicle hour	\$	125.00

O&M cost	2011
Eugene, OR	\$ 104.91 BRT
Spokane, WA	\$ 94.17
Fairfax, VA	\$ 119.14
Hampton Roads, VA	\$ 74.07
Jacksonville, FL	\$ 94.02
Las Vegas, NV	\$ 85.79 BRT
Reno, NV	\$ 93.52 BRT
Hartford, CT	\$ 119.82 BRT
Tacoma, WA	\$ 115.25
average	\$ 100.08
LA Metro Orange Line	\$ 234.13 BRT
	\$ 113.48 new average

I-70 Mountain Corridor BRT O&M Costs per Alternative
2/7/2014

Option	No Build - Silverthorne				No Build - Vail				Alternative A				Alternative B								
	53 miles general purpose lanes to Silverthorne @40 mph in peak direction; 45 mph in non-peak direction				82 miles general purpose lanes to Vail @40 mph in peak direction; 45 mph in non-peak direction				53 miles managed lanes to Silverthorne @55 mph in peak direction; 45 mph in non-peak direction				53 miles managed lanes to Silverthorne @65 mph in peak direction; 45 mph in non-peak direction				29 miles Silverthorne to Vail mixed flow lanes @40 mph in peak direction; 45 mph in non-peak direction				
Year	2015		2015		2015		2015		2015		2015		2015		2015		2015		2015		
Travel time Each Way (Peak/non-peak direction)	80	71	80	71	123	98	123	98	58	71	58	71	49	71	49	71	44	39	44	39	
Round Trip (Peak)	150.2		150.2		221.4		221.4		128.5		128.5		119.6		119.6		82.2		82.2		
Schedule Recovery and Driver's Break	25		25		25		25		25		25		25		25		25		25		
5-min. dwell time at 6 (+3 to Vail) intermediate stations each direction	60		60		60		60		60		60		60		60		30		30		
Cycle (Peak)	235.2		235.2		306.4		306.4		213.5		213.5		204.6		204.6		137.2		137.2		
Faster Factor (Base)	20%		20%		20%		20%		20%		20%		20%		20%		20%		20%		
Cycle (Base)	188.1		188.1		245.1		245.1		170.8		170.8		163.7		163.7		109.7		109.7		
Annual Hours (Peak speed)	Cycle	235.2		235.2		306.4		306.4		213.5		213.5		204.6		204.6		137.2		137.2	
	Headway	20		20		20		20		20		20		20		20		20		20	
	Vehicles	12		12		16		16		11		11		11		11		7		7	
	Span	9		9		9		9		9		9		9		9		9		9	
	Daily Vehicle Hours	108		108		144		144		99		99		99		99		63		63	
	Days	365		365		365		365		365		365		365		365		365		365	
	Annual Hours	39,420		39,420		52,560		52,560		36,135		36,135		36,135		36,135		22,995		22,995	
Annual Hours (Off-peak speed)	Cycle	188.1		188.1		245.1		245.1		170.8		170.8		163.7		163.7		109.7		109.7	
	Headway	60		60		60		60		60		60		60		60		60		60	
	Vehicles	4		4		5		5		3		3		3		3		2		2	
	Span	11		11		11		11		11		11		11		11		11		11	
	Daily Vehicle Hours	44		44		55		55		33		33		33		33		22		22	
	Days	365		365		365		365		365		365		365		365		365		365	
	Annual Hours	16,060		16,060		20,075		20,075		12,045		12,045		12,045		12,045		8,030		8,030	
total daily vehicle hours	152		152		199		199		132		132		132		132		85		85		
Total Annual Vehicle Hours	55,480		55,480		72,635		72,635		48,180		48,180		48,180		48,180		31,025		31,025		
O&M Cost/Vehicle Hour	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	\$ 200.00	\$ 250.00	
TOTAL ANNUAL O&M COST	\$11,096,000		\$13,870,000		\$14,527,000		\$18,158,750		\$9,636,000		\$12,045,000		\$9,636,000		\$12,045,000		\$6,205,000		\$7,756,250		
20% spare peak vehicles	3		3		4		4		3		3		3		3		2		2		
total vehicles required	15		15		20		20		14		14		14		14		9		9		

I-70 Mountain Corridor BRT O&M Costs per Alternative
2/7/2014

Option	AGS				BRT				BRT to match AGS ridership				BRT to match AGS ridership				BRT to match AGS MOS ridership				BRT to match AGS MOS ridership			
	MOS 74 miles to Breckenridge @100 mph average = 44 min.; 71 min. from AGS study to Eagle Co. airport				53 miles to Silverthorne @55 mph in peak direction plus 29 miles Silverthorne to Vail mixed flow lanes; 45 mph in non-peak direction				53 miles to Silverthorne @55 mph in peak direction plus 29 miles Silverthorne to Vail mixed flow lanes; 45 mph in non-peak direction				53 miles to Silverthorne @65 mph in peak direction plus 29 miles Silverthorne to Vail mixed flow lanes; 45 mph in non-peak direction				53 miles to Silverthorne @55 mph in peak direction plus 29 miles Silverthorne to Vail mixed flow lanes; 45 mph in non-peak direction				53 miles to Silverthorne @65 mph in peak direction plus 29 miles Silverthorne to Vail mixed flow lanes; 45 mph in non-peak direction			
Year	2015		2015		2015		2015		2015		2015		2015		2015		2015		2015		2015			
Travel time Each Way (Peak/non-peak direction)	44	44	71	71	101	109	101	109	101	109	101	109	92	109	92	109	101	109	101	109	92	109	92	109
Round Trip (Peak)	88.8		142.0		210.7		210.7		210.7		210.7		201.8		201.8		210.7		210.7		201.8		201.8	
Schedule Recovery and Driver's Break	20		20		25		25		25		25		25		25		25		25		25		25	
5-min. dwell time at 6 (+3 to Vail) intermediate stations each direction	0		32		30		30		30		30		30		30		30		30		30		30	
Cycle (Peak)	108.8		194.0		265.7		265.7		265.7		265.7		256.8		256.8		265.7		265.7		256.8		256.8	
Faster Factor (Base)					20%		20%		20%		20%		20%		20%		20%		20%		20%		20%	
Cycle (Base)	108.8		194.0		212.5		212.5		212.5		212.5		205.4		205.4		212.5		212.5		205.4		205.4	
Cycle	108.8		194.0		265.7		265.7		265.7		265.7		256.8		256.8		265.7		265.7		256.8		256.8	
Headway	30		30		20		20		5		5		5		5		15		15		15		15	
Vehicles	4		7		14		14		54		54		52		52		18		18		18		18	
Span	6		6		9		9		9		9		9		9		9		9		9		9	
Daily Vehicle Hours	24		42		126		126		486		486		468		468		162		162		162		162	
Days	365		365		365		365		365		365		365		365		365		365		365		365	
Annual Hours	8,760		15,330		45,990		45,990		177,390		177,390		170,820		170,820		59,130		59,130		59,130		59,130	
Cycle	108.8		194.0		212.5		212.5		212.5		212.5		205.4		205.4		212.5		212.5		205.4		205.4	
Headway	60		60		60		60		15		15		15		15		30		30		30		30	
Vehicles	2		4		4		4		15		15		14		14		8		8		7		7	
Span	12		12		11		11		11		11		11		11		11		11		11		11	
Daily Vehicle Hours	24		48		44		44		165		165		154		154		88		88		77		77	
Days	365		365		365		365		365		365		365		365		365		365		365		365	
Annual Hours	8,760		17,520		16,060		16,060		60,225		60,225		56,210		56,210		32,120		32,120		28,105		28,105	
total daily vehicle hours	48 train hrs		192 veh. hrs		170				651				622				250				239			
Total Annual Vehicle Hours	17,520		32,850		62,050		62,050		237,615		237,615		227,030		227,030		91,250		91,250		87,235		87,235	
O&M Cost/Vehicle Hour	\$ 1,500.00		\$ 1,500.00		\$ 200.00		\$ 250.00		\$ 200.00		\$ 250.00		\$ 200.00		\$ 250.00		\$ 200.00		\$ 250.00		\$ 200.00		\$ 250.00	
TOTAL ANNUAL O&M COST	\$26,280,000		\$49,275,000		\$12,410,000		\$15,512,500		\$47,523,000		\$59,403,750		\$45,406,000		\$56,757,500		\$18,250,000		\$22,812,500		\$17,447,000		\$21,808,750	
20% spare peak vehicles	1		2		3		3		11		11		11		11		4		4		4		4	
total vehicles required	5		9		17		17		65		65		63		63		22		22		22		22	

I-70 Mountain Corridor BRT O&M Costs per Alternative
2/7/2014

Option	Idaho Springs Local Connector				Breckenridge to Silverthorne Connector				Keystone to Silverthorne Connector				Springs/Downieville-Dumont-Lawson Connector				Idaho Springs/Central City-Blackhawk Connector				
	3-mile route with 2-way service at average 12 mph and 8 stops with 20-second dwell				12 miles one-way at average 35 mph and 1 stop in Frisco with 60-second dwell				8 miles one-way at average 35 mph				7.5-mile route one-way with 2-way service at average 28 mph				14-mile route one-way with 2-way service at average 39 mph				
Year	2015		2015		2015		2015		2015		2015		2015		2015		2015		2015		
Travel time Each Way (Peak/non-peak direction)	16.0	16.0	16.0	16.0	20.6	20.6	20.6	20.6	13.7	13.7	13.7	13.7	16.3	16.3	16.3	16.3	21.7	21.7	21.7	21.7	
Round Trip (Peak)	32.0		32.0		41.1		41.1		27.4		27.4		32.5		32.5		43.4		43.4		
Schedule Recovery and Driver's Break	6		6		10		10		10		10		5.0		5.0		5		5		
5-min. dwell time at 6 (+3 to Vail) intermediate stations each direction	5.0		5.0		1		1		0		0		5.7		5.7		4.0		4.0		
Cycle (Peak)	43.0		43.0		52.1		52.1		37.4		37.4		43.2		43.2		52.4		52.4		
Faster Factor (Base)	0%		0%		20%		20%		20%		20%		20%		20%		20%		20%		
Cycle (Base)	43.0		43.0		41.7		41.7		29.9		29.9		34.5		34.5		41.9		41.9		
Annual Hours (Peak speed)	Cycle	43.0		43.0		52.1		52.1		37.4		37.4		43.2		43.2		52.4		52.4	
	Headway	20		20		30		30		30		30		20		20		20		20	
	Vehicles	3		3		2		2		2		2		3		3		3		3	
	Span	9		9		6		6		6		6		9		9		9		9	
	Daily Vehicle Hours	27		27		12		12		12		12		27		27		27		27	
	Days	365		365		365		365		365		365		365		365		365		365	
	Annual Hours	9,855		9,855		4,380		4,380		4,380		4,380		9,855		9,855		9,855		9,855	
Annual Hours (Off-peak speed)	Cycle	43.0		43.0		41.7		41.7		29.9		29.9		34.5		34.5		41.9		41.9	
	Headway	60		60		60		60		60		60		60		60		60		60	
	Vehicles	1		1		1		1		1		1		1		1		1		1	
	Span	11		11		12		12		12		12		11		11		11		11	
	Daily Vehicle Hours	11		11		12		12		12		12		11		11		11		11	
	Days	365		365		365		365		365		365		365		365		365		365	
	Annual Hours	4,015		4,015		4,380		4,380		4,380		4,380		4,015		4,015		4,015		4,015	
total daily vehicle hours		38				24				24				38				38			
Total Annual Vehicle Hours		13,870		13,870		8,760		8,760		8,760		8,760		13,870		13,870		13,870		13,870	
O&M Cost/Vehicle Hour		\$ 105.00		\$ 125.00		\$ 105.00		\$ 125.00		\$ 105.00		\$ 125.00		\$ 105.00		\$ 125.00		\$ 105.00		\$ 125.00	
TOTAL ANNUAL O&M COST		\$1,456,350		\$1,733,750		\$919,800		\$1,095,000		\$919,800		\$1,095,000		\$1,456,350		\$1,733,750		\$1,456,350		\$1,733,750	
20% spare peak vehicles		1		1		1		1		1		1		1		1		1		1	
total vehicles required		4		4		3		3		3		3		4		4		4		4	

I-70 Mountain Corridor BRT O&M Costs per Alternative
2/7/2014

Option	CDOT's IX Service				CDOT's IX Service				CDOT's IX Service			
	Fort Collins to Denver				Colorado Springs to Denver				Glenwood Springs to Denver			
	2015		2015		2015		2015		2015		2015	
Travel time Each Way (Peak/non-peak direction)	72.0	72.0	72.0	72.0	78.0	78.0	78.0	78.0	174.0	174.0	174.0	174.0
Round Trip (Peak)	144.0		144.0		156.0		156.0		348.0		348.0	
Schedule Recovery and Driver's Break	15		15		15		15		15		15	
5-min. dwell time at 6 (+3 to Vail) intermediate stations each direction	2.0		2.0		3.0		3.0		5.0		5.0	
Cycle (Peak)	161.0		161.0		174.0		174.0		368.0		368.0	
Faster Factor (Base)	20%		20%		20%		20%		20%		20%	
Cycle (Base)	128.8		128.8		139.2		139.2		294.4		294.4	
Cycle	161.0		161.0		174.0		174.0		368.0		368.0	
Headway	60		60		60		60		120		120	
Vehicles	3		3		3		3		4		4	
Span	4		4		5		5		1		1	
Daily Vehicle Hours	12		12		15		15		4		4	
Days	365		365		365		365		365		365	
Annual Hours	4,380		4,380		5,475		5,475		1,460		1,460	
Cycle	128.8		128.8		139.2		139.2		294.4		294.4	
Headway	60		60		60		60		60		60	
Vehicles	3		3		3		3		5		5	
Span	1		1		1		1		0		0	
Daily Vehicle Hours	3		3		3		3		0		0	
Days	365		365		365		365		365		365	
Annual Hours	1,095		1,095		1,095		1,095		0		0	
total daily vehicle hours	15				18				4			
Total Annual Vehicle Hours	5,475		5,475		6,570		6,570		1,460		1,460	
O&M Cost/Vehicle Hour	\$ 150.00	\$ 175.00			\$ 150.00	\$ 175.00			\$ 150.00	\$ 175.00		
TOTAL ANNUAL O&M COST	\$821,250		\$958,125		\$985,500		\$1,149,750		\$219,000		\$255,500	
20% spare peak vehicles	1		1		1		1		1		1	
total vehicles required	4		4		4		4		5		5	

General Purpose Lanes

Weekday EB 15 hours at 55mph plus 5 hours at 45 mph
 Weekday WB 16 hours at 55mph plus 4 hours at 45 mph

Weekend EB 16 hours at 55mph plus 4 hours at 45 mph
 Weekend WB 15 hours at 55mph plus 5 hours at 45 mph

Weekly
 217 at 55mph
 63 at 45 mph
 280 140 directional hours per week = 7 days X 20 hours per day

JeffCo to Silverthorne 53 miles 53 miles
 Average speed in managed lane 55 mph 45 mph
 one-way trip time 57.8 minutes 70.7 minutes

JeffCo to Silverthorne 53 miles 53 miles
 Average speed in managed lane 65 mph 45 mph
 one-way trip time 48.9 minutes 70.7 minutes

Silverthorne to Vail 29 miles 29 miles
 Average speed in general purpose lane 45 mph peak 55 mph off-peak
 one-way trip time 38.7 minutes 32 minutes

Silverthorne to Vail 29 miles 29 miles
 Average speed in general purpose lane 40 mph peak 45 mph off-peak
 one-way trip time 43.5 minutes 38.7 minutes

JeffCo to Silverthorne 53 miles 53 miles
 Average speed in general purpose lane 40 mph peak 45 mph off-peak
 one-way trip time 79.5 minutes 71 minutes 13% faster in off-peak

JeffCo to Vail 82 miles 82 miles
 Average speed in general purpose lane 45 mph peak 55 mph off-peak
 one-way trip time 109.3 minutes 89 minutes 22% faster in off-peak

JeffCo to Vail 82 miles 82 miles
 Average speed in general purpose lane 40 mph peak 50 mph
 one-way trip time 123.0 minutes 98.4 minutes

Idaho Springs Local 4 mile route
 Average speed in general purpose lane 15 mph peak
 one-way trip time 16.0 minutes
 8 stops @20 second dwell 5.0 minutes

Breckenridge to Silverthorne Connector 12 miles
 Average speed in general purpose lane 35 mph peak
 one-way trip time 20.6 minutes
 1 stop at Frisco @60 second dwell 1 minute

Keystone to Silverthorne Connector 8 miles
 Average speed in general purpose lane 35 mph peak
 one-way trip time 13.7 minutes

AGS JeffCo to Vail 82 miles
 Average speed in managed lane 120 mph
 one-way trip time 41.0 minutes
 16 4 stations @ 4 minutes dwell
 57.0

		minutes	miles	
Idaho Springs Local plus Downieville, Lawson, Dumont	7.5 mile route	8.25	5.5 @40mph	to Downieville (Mountain Street interchange)
	Average speed in general purpose lane 27.7 mph peak	8	2 @15mph	in Idaho Springs
	one-way trip time 16.3 minutes	16.3	7.5	
14 stops @20 second dwell plus BRT/AGS twice at 30 sec	5.7 minutes		27.7 average speed	

		minutes	miles	
Blackhawk/Central City to Idaho Springs	14 mile route	15.3	10.2 @40mph	to Central City/Blackhawk
average speed	38.7 mph peak	8.8	2.2 @15mph	in Central City/Blackhawk
one-way trip time	21.7 minutes	6.4	1.6 @15mph	in Idaho Springs
9 stops @20 second dwell plus BRT/AGS and EOL at 30 sec.	4.0 minutes	21.7	14	
			38.7 average speed	

CDOT's IX Bus Program

Fort Collins to Denver 60 mile route 2 stops @1 min. dwell=2.0
 50.0 mph
 72.0 minutes

Colorado Springs to Denver 65 mile route 3 stops @1 min. dwell=3.0
 50.0 mph
 78.0 minutes

Glenwood Springs to Denver 145 mile route 5 stops @1 min. dwell=5.0
 50.0 mph
 174.0 minutes

AGS JeffCo to Breckenridge 74 miles 74 miles
 Average speed in managed lane 100 mph 100 mph
 one-way trip time 44.4 minutes 44.4 minutes

5:00 to 10:00 AM EB peak direction at 45 mph
 5:00 to 10:00 AM WB off-peak direction at 55 mph
 10:00 AM to 3:00 PM EB off-peak direction at 55 mph
 10:00 AM to 3:00 PM WB off-peak direction at 55 mph
 3:00 to 7:00 PM EB off-peak direction at 55 mph
 3:00 to 7:00 PM WB peak direction at 45 mph
 7:00 PM to 1:00 AM EB off-peak direction at 55 mph
 7:00 PM to 1:00 AM WB off-peak direction at 55 mph

217 off-peak bus hours per week
 189 peak bus hours per week

Hours		Bus Hours		
@45 mph	@55 mph	@45 mph	@55 mph	
5		15		
	5		15	
	5		5	
	5		5	
	4		12	
4		12		
	6		6	6 bus hours
	6		6	6 per day
<hr/>		<hr/>		
9	31	27	49	76
	per week	189	343	
	per year	9,828	17,836	27,664

406 total bus hours per week
 21112 per year
 8030 peak bus hours per year (3 buses X 2 directions X 9 hours per day X 365 days per year)
 19710 off-peak bus hours per year

 27740

Bus miles	
82	96.5 peak one-way time
164	265.7 RT trip peak time w/layover, recovery
	212.5 RT trip off-peak time w/layover, recovery
	540 9 peak hours
	660 11 off-peak hours
	2 peak runs per day
	3 Off-peak runs per day
	5 runs per bus per day
	820 miles per bus per day
	299,300 miles per bus per year

General Purpose Lanes

Weekday EB 15 hours at 55mph plus 5 hours at 45 mph
 Weekday WB 16 hours at 55mph plus 4 hours at 45 mph

Weekend EB 16 hours at 55mph plus 4 hours at 45 mph
 Weekend WB 15 hours at 55mph plus 5 hours at 45 mph

Weekly	217 at 55mph	217 off-peak bus hours per week
	<u>63 at 45 mph</u>	189 peak bus hours per week
	280	140 directional hours per week = 7 days X 20 hours per day
		406 total bus hours per week
	14560 per year	21,112 per year
		8,030 peak bus hours per year (3 buses X 2 directions X 9 hours per day X 365 days per year)
		<u>19,710</u> off-peak bus hours per year
		27,740 bus trips per

2011 Cost per veh. rev. Bus Fare LRT Fare | Bus O&M LRT O&M

Transit Agency	Bus O&M	LRT O&M	Pass. Mil	Pass. Mil	Cost/Pass. Trip	Cost/Pass. Trip	BRT O&M
Denver	\$105.44	\$141.62	\$0.20	\$0.16	\$3.79	\$3.06	
Salt Lake City	\$124.46	\$112.29	\$0.17	\$0.18	\$5.00	\$2.27	
Las Vegas	\$94.52		\$0.31		2.28		
Phoenix	\$104.77		\$0.25		3.66		
LA Metro	\$135.06	\$381.64	\$0.18	\$0.11	\$2.68	\$3.55	
San Diego	\$84.05	\$142.85	\$0.28	\$0.18	\$2.55	\$1.91	higher than fixed route
Sacramento	\$134.24	\$229.30	\$0.32	\$0.19	\$4.94	\$3.49	
San Francisco	\$176.46	\$267.16	\$0.35	\$0.30	\$2.78	\$3.31	
AC Transit (Oakland)	\$169.01		\$0.27		\$4.97		
Seattle	\$148.75	\$208.26	\$0.24	\$0.64	\$4.39	\$3.35	streetcar \$159.24 \$4.04 per BRT pass. Trip
Portland	\$136.19	\$175.18	\$0.24	\$0.19	\$3.83	\$2.27	
Houston	\$115.44	\$235.77	\$0.14	\$0.23	\$4.95	\$1.65	
Dallas	\$121.12	\$401.39	\$0.20	\$0.09	\$6.40	\$6.27	
St. Louis	\$99.55	\$225.92	\$0.21	\$0.12	\$5.05	\$3.66	
Averages	\$124.93	\$229.22	\$0.24	\$0.22	\$4.09	\$3.16	
increase to 2013 @3% per year	\$132.54	\$243.18	\$0.25	\$0.23	\$4.34	\$3.36	\$168.94

* source: FTA transit database, 2011 (latest available)

** only BRT O&M cost included in database

2012 Data Transit Agency	O&M Cost/Veh. Rev. Hour		O&M Cost/Pass. Trip		O&M Cost/Veh. Rev. Mile		Revenue/Pass. Mile		O&M Cost/Veh. Rev. Hour
	Bus	LRT	Bus	LRT	Bus	LRT	Bus	LRT	BRT
Denver	\$113.49	\$152.45	\$3.93	\$3.32	\$9.00	\$8.10	\$0.21	\$0.16	
Salt Lake City	\$128.23	\$90.46	\$5.30	\$2.42	\$7.68	\$7.11	\$0.36	\$0.21	
Las Vegas	\$96.74		\$2.08		\$8.22		\$0.30		
Phoenix	\$113.68		\$3.78		\$8.58		\$0.24		
LA Metro	\$134.46	\$388.27	\$2.56	\$3.75	\$12.06	\$18.07	\$0.18	\$0.11	\$234.13
San Diego	\$88.97	\$148.06	\$2.58	\$1.94	\$8.30	\$8.39	\$0.28	\$0.18	
Sacramento	\$136.00	\$232.56	\$5.23	\$3.45	\$12.25	\$11.91	\$0.31	\$0.19	
San Francisco	\$169.76	\$304.05	\$2.58	\$3.79	\$20.43	\$31.70	\$0.34	\$0.31	
AC Transit (Oakland)	\$182.30		\$5.49		\$16.13		\$0.30		
San Jose	\$181.04	\$316.83	\$6.75	5.95	\$14.98	\$20.00	\$0.17	\$0.16	
Seattle	\$155.38	\$377.34	\$4.50	\$5.90	\$12.91	\$20.12	\$0.26	\$0.21	\$185.98
Portland	\$141.93	\$188.42	\$3.88	\$2.36	\$12.04	\$12.88	\$0.24	\$0.19	
Houston	\$114.63	\$226.72	\$4.99	\$1.54	\$8.71	\$19.17	\$0.11	\$0.15	\$147.48
Dallas	\$120.68	\$355.94	\$6.32	\$4.92	\$8.94	\$17.98	\$0.20	\$0.08	
St. Louis	\$102.66	\$233.65	\$4.79	\$3.65	\$7.49	\$9.82	\$0.20	\$0.12	
Averages	\$132.00	\$251.23	\$4.32	\$3.58	\$11.18	\$15.44	\$0.25	\$0.17	\$189.20
increase to 2013 @3%	\$135.96	\$258.77	\$4.45	\$3.69	\$11.52	\$15.90	\$0.25	\$0.18	\$191.56

\$2.88 per pass. trip

\$6.42 per commuter bus pass. trip

\$5.99 per commuter bus pass. trip

Source: FTA transit database, 2012 (latest available)

Various I-70 Corridor Studies	Annual O&M Cost	Annual Ridership	Annual Fares	Farebox Recovery	fare per rider
2001 CIFGA	\$ 47,000,000	5,900,000	na	na	
2004 Draft PEIS (AGS)	\$ 180,000,000	4,160,000	\$ 85,000,000	47%	\$ 20.43
2010 RMRA (rail) 150 mph	\$ 79,586,000	4,850,000	\$ 101,074,000	127%	\$ 20.84 \$0.35/mile with both I-70 and I-25 HSR in place
June 2013 AGS 150 mph	\$ 63-89,000,000	3,320,000	\$ 76,604,000	86-122%	\$ 23.07 \$0.35/mile with both I-70 and I-25 HSR in place
December 2013 AGS 150 mph	\$ 45-60,000,000	3,580,000	\$ 79,040,000	132-176%	\$ 22.08 \$0.35/mile with both I-70 and I-25 HSR in place

Various I-70 Corridor Studies	Annual O&M Cost	Cost in 2013 Dollars*
2001 CIFGA	\$ 47,000,000	\$ 61,650,000
2004 Draft PEIS (AGS)	\$ 180,000,000	\$ 221,500,000
2010 RMRA (rail) 150 mph	\$ 79,586,000	\$ 85,260,000
June 2013 AGS 150 mph (CDOT)	\$ 63-89,000,000	\$ 63-89,000,000
December 2013 AGS full corridor (CDOT)	\$ 45-60,400,000	\$ 45-60,400,000
December 2013 AGS MOS (CDOT)	\$ 26-35,103,000	\$ 26-35,103,000

* based on Consumer Price Index escalation 2.3% per year

1	2001
1.0230	2002
1.0465	2003
1.0706	2004
1.0952	2005
1.1204	2006
1.1462	2007
1.1725	2008
1.1995	2009
1.2271	2010
1.2553	2011
1.2842	2012
1.3137	2013