



Colorado Statewide Intercity and Regional Bus Network Study

Appendix C: Demand Estimation





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OVERVIEW

This appendix examines regional demand in three corridors where CDOT has proposed establishing regional commuter bus services: the North I-25, South I-25, and I-70 corridors. Different methods were used in the I-70 corridor from the north and south I-25 corridors because of different conditions and different availability of data.

This appendix addresses both demand and ridership estimates. Often, the two terms are used interchangeably. As much of the information comes from different sources, note that the context in which the terms are used is important. The term “demand” is used in a general sense to identify the overall level of demand that would be expected to occur if transit services are operated with a high enough level of service so that riders find the service to be convenient for the trips they make. The term “Ridership” is used to reflect the anticipated use of a service based on the quality of service that is provided.

The quality of service is commonly measured by frequency of service, the days and hours when service is available, travel time, directness of travel, and fares. The more complete the service network, with direct service or easy transfers, the more viable it is for travelers. The service that is being considered for these corridors is essentially new service, so in the development of the service will need to balance the quality of service and development of ridership. While a base level of service is needed to garner ridership, the development of transit service in a corridor is then generally incremental with service increases provided as warranted by ridership. It can take up to two years for ridership to develop on a route as people learn about the option, test it, and then a portion become regular riders

Several studies have identified overall demand for transit service in these corridors including major environmental analyses in the Mountain I-70 Corridor and the North I-25 corridor. In this appendix information will be presented on overall demand from models, and where data is available the estimates will be grounded in experience within the corridors. The appendix begins with information on the Mountain I-70 corridor and then describes demand and potential ridership in the I-25 corridors.



MOUNTAIN I-70 CORRIDOR

Demand in the I-70- corridor is complex, serving varied markets and travel patterns. There are complex trip purpose and peaking characteristics that reflect the unique mix of recreational, employee, and general travel markets. In those parts of the corridor where there is strong travel demand for employees, comprehensive transit systems have developed.

INFORMATION AVAILABLE

There are three basic types of information available: Census Journey-to-Work data, the *“I-70 Mountain Corridor Programmatic Environmental Impact Statement”* (PEIS), and ridership data from the systems in the corridor.

- The Census information is high level and specific to one market, employment trips. It helps provide an understanding of the use of transit for employment trips.
- The PEIS provides a high level analysis of travel markets in the mountain corridor, with detailed information on how the markets vary by time of day, day of the week, and season of the year. This information is helpful in understanding the magnitude of the various markets and when service will be needed to serve these markets.
- Ridership data, schedule information, and planning studies from Summit Stage, ECO Transit, and Roaring Fork Transportation Authority (RFTA) provide actual information on the level of use of these transit systems and the role they serve in transporting employees. In addition, their historical development will be useful in understanding the growth and development of transit services in the I-70 mountain corridor.

Together, this information presents a picture of the overall demand for service in the corridor and can be used to inform decisions on service development. The corridor is a long one, and most of this information only covers segments of the corridor. The focus of the available information is on the 160-mile stretch between Denver and Glenwood Springs. The available information is, however, fairly high level and best for conceptual planning. As noted above, when the knowledge gained from this information is combined with detailed service plans, then ridership can be estimated on specific segments.

Mode of Transportation to Work

The mode of transportation to work for the counties in the I-70 corridor, as reported in the American Community Survey, is presented in Table 1 on pages C-4 and C-5. Rows illustrate the mode of transportation for residents living in the county and for employees working in the county. In counties where a significant number of workers live elsewhere, this is an important distinction.

This data illustrates the completeness of the transit networks in various counties. Those counties where either 5% or more of riders use transit are highlighted. This occurs in in Gilpin, Summit, Eagle, and Pitkin counties in the I-70 corridor.



- In Gilpin County over 26% of workers arrive by transit, riding the many casino shuttles that serve Black Hawk and Central City. Four percent of residents in the County use transit for their work trip. Most of these are workers coming from the Metro area counties.
- The strength of the transit networks in Summit, Eagle, and Pitkin counties are reflected in the high use of transit for commute trips. Parking costs in the Vail and Aspen area also is an important factor.
 - Summit County has a 7.5% transit mode share for both residents and workers;
 - Eagle County has a 6.9% transit mode share among residents and 4.8% among workers;
 - Pitkin County has a 10.9% transit mode share among residents and 13.6% transit mode share among workers.
- Note that in Pitkin and Garfield counties the carpool mode share is extraordinarily high as well.

The journey-to-work data also illustrates the propensity of residents to use transit. First, it shows that where there are good transit connections, people do use transit services. A 5% transit mode share shows the transit network is strong, providing effective connections between home and work, but many of these regions far exceed that level.

It is worth noting that ridership in ECO Transit and RFTA both declined significantly in the recession years, reflecting how closely system ridership is tied to commuter transportation. With job reductions, ridership declined and then service was cut. Ridership and service is only now starting to build up again. For example, ECO Transit carried 3,300 riders daily in 2008 and 1,900 riders daily in 2011, over a 40% reduction in ridership.



Table 1: Mode of Transportation to Work

| | | | Total Workers | Drove alone | 2-person Carpool | 3-or-more-person Carpool | Public Transportation | Bike | Walked | Taxi, Motorcycle and Other | Worked at Home |
|-------------|-----------|---------|---------------|-------------|------------------|--------------------------|-----------------------|------|--------|----------------------------|----------------|
| Gilpin | Residents | Number | 3,053 | 2,194.0 | 352 | 6.0 | 125 | 11.0 | 40 | 17.0 | 308 |
| | | Percent | 100 | 71.9 | 12 | 0.2 | 4 | 0.4 | 1 | 0.6 | 10 |
| | Workers | Number | 5,373 | 2,888 | 452 | 130 | 1,416 | 0 | 33 | 146 | 308 |
| | | Percent | 100.0 | 53.8 | 8.4 | 2.4 | 26.4 | 0.0 | 0.6 | 2.7 | 5.7 |
| Clear Creek | Residents | Number | 5,217 | 3,897 | 426 | 41 | 69 | 78 | 223 | 97 | 386 |
| | | Percent | 100.0 | 74.7 | 8.2 | 0.8 | 1.3 | 1.5 | 4.3 | 1.9 | 7.4 |
| | Workers | Number | 3,392 | 2,111 | 482 | 98 | 22 | 39 | 193 | 61 | 386 |
| | | Percent | 100.0 | 62.2 | 14.2 | 2.9 | 0.6 | 1.1 | 5.7 | 1.8 | 11.4 |
| Summit | Residents | Number | 17,430 | 10,904 | 1,579 | 357 | 1,311 | 275 | 1,128 | 223 | 1,653 |
| | | Percent | 100.0 | 62.6 | 9.1 | 2.0 | 7.5 | 1.6 | 6.5 | 1.3 | 9.5 |
| | Workers | Number | 19,172 | 12,283 | 1,747 | 535 | 1,433 | 255 | 1,148 | 118 | 1,653 |
| | | Percent | 100.0 | 64.1 | 9.1 | 2.8 | 7.5 | 1.3 | 6.0 | 0.6 | 8.6 |
| Eagle | Residents | Number | 30,238 | 21,815 | 2,024 | 435 | 2,084 | 248 | 1,341 | 65 | 2,226 |
| | | Percent | 100.0 | 72.1 | 6.7 | 1.4 | 6.9 | 0.8 | 4.4 | 0.2 | 7.4 |
| | Workers | Number | 30,271 | 21,739 | 2,368 | 801 | 1,454 | 228 | 1,376 | 79 | 2,226 |
| | | Percent | 100.0 | 71.8 | 7.8 | 2.6 | 4.8 | 0.8 | 4.5 | 0.3 | 7.4 |



| | | | | | | | | | | | |
|-----------------|---|---------|--------|--------|-------|-------|-------|-----|-------|-----|-------|
| Garfield | Residents | Number | 29,204 | 18,706 | 3,375 | 1,954 | 1,354 | 483 | 1,332 | 158 | 1,842 |
| | | Percent | 100.0 | 64.1 | 11.6 | 6.7 | 4.6 | 1.7 | 4.6 | 0.5 | 6.3 |
| | Workers | Number | 27,945 | 18,902 | 2,889 | 1,570 | 756 | 477 | 1,332 | 177 | 1,842 |
| | | Percent | 100.0 | 67.6 | 10.3 | 5.6 | 2.7 | 1.7 | 4.8 | 0.6 | 6.6 |
| Pitkin | Residents | Number | 10,238 | 5,290 | 622 | 269 | 1,114 | 288 | 1,330 | 195 | 1,130 |
| | | Percent | 100.0 | 51.7 | 6.1 | 2.6 | 10.9 | 2.8 | 13.0 | 1.9 | 11.0 |
| | Workers | Number | 17,917 | 9,144 | 1,878 | 1,394 | 2,437 | 320 | 1,395 | 219 | 1,130 |
| | | Percent | 100.0 | 51.0 | 10.5 | 7.8 | 13.6 | 1.8 | 7.8 | 1.2 | 6.3 |
| Source/Note | US Census Bureau, ACS 2006-2008 3yr est., Special Tabs for CTPP | | | | | | | | | | |



PEIS Data

For the PEIS a comprehensive travel demand modeling effort was undertaken. The effort was focused on solving congestion problems, so the days modeled were related to the days on which congestion occurs and it was structured to build an understanding of the components congestion.

This provides a great deal of useful information and is an important component of the analysis. However, it is important to keep the information in context. The modeling effort was geared to the magnitude of the congestion issues and used a bus alternative with the capacity to handle peak volumes. This is illustrated in the I-70 Corridor Analysis, Appendix A. In the model, buses traveling in mixed traffic were not considered effective because of poor travel times in peak periods and limited capacity. However, they were retained in the Record of Decision as an initial start-up system or to augment a rail or Advanced Guideway system. Buses operating in a guideway performed well, but there were concerns about icing and snow build-up in the guideway.

This study is considering development of an initial start-up system, and considering the conditions that exist in 2013. The PEIS information provides an important understanding of the markets for transit services and when the travel occurs by direction. It also provides an understanding of the magnitude of both service and park-and-ride infrastructure that will be required to address recreational travel even as an initial system is developed. The PEIS work is not geared to evaluate trade-offs that need to be considered in various start-up bus operating scenarios.

On the following pages charts and data are presented that illustrate key information from the PEIS. The first two graphs illustrate the daily person trips, by purpose, that the model estimated would be carried in 2025 by a bus in mixed traffic. This is illustrated for a Winter Saturday and a Summer Thursday to show peak and base travel days. Following this is a table illustrating the projected mode share of person trips carried by buses operating in mixed traffic with notes on the trip purposes by segment.

Definitions:

CDR – Colorado day recreation (not from Front Range)

CNW – Colorado non-work trips

Stay Over – Stay-over recreation trips

FRDR – Front Range day recreation trips

LNW – Local non-work

A key finding is that even in mixed traffic the model estimates around 5% of trips would be made by bus.



Figure 1: 2025 Bus-in-Mixed-Traffic Person Trips (Winter)

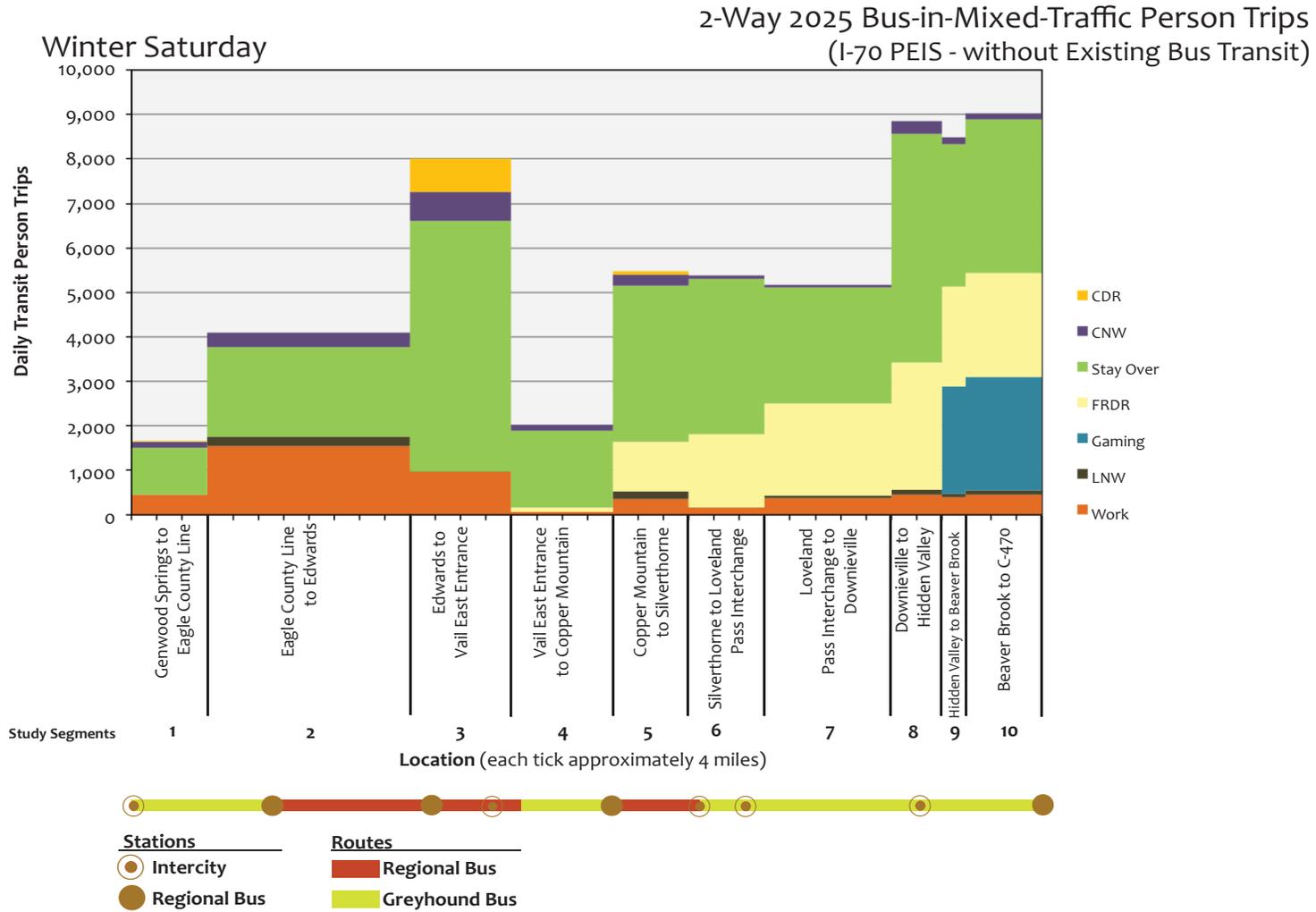




Table 2: I-70 Travel Demand Bus-in-Mixed Traffic (Winter)

| Bus-in Mixed Traffic Projected Mode Share | | | | Notes on Trip Purposes |
|--|------------------|-----------------------------|--------------------------------|---|
| Winter Saturday | 2025 Highway PTs | 2025 Transit (all BIMT) PTs | PEIS Transit as % of Total PTs | 2025 Winter Saturday Corridor Trip Purpose Patterns (% of Total 2025 PTs) |
| Winter Saturday e/o Genesee | | | | <p>Overview</p> <p>On Winter weekends, Day Recreation, Stay Over and Colorado Non-work trips dominate trip purposes</p> <p>Work Trips</p> <ul style="list-style-type: none"> • 24% of PTs from Eagle Co line to Edwards • 7 – 11% for the rest of the Corridor <p>Local non-work trips</p> <ul style="list-style-type: none"> • 15 – 20 % of PTs in Eagle Co • 9% in Summit Co • 2% in Clear Ck Co <p>Day Recreation</p> <ul style="list-style-type: none"> • 30% of all PTs from Edwards to Vail • 31% in Summit Co • 46 – 48% in Clear Creek Co • 25% in Jefferson Co <p>Stay over and Colorado non-work PTs</p> <ul style="list-style-type: none"> • 38% from Edwards to Vail • 60% at Vail Pass • 38% in Clear Ck Co • 22% in Jefferson Co. |
| | 258,400 | 11,500 | 4% | |
| Winter Saturday at Floyd Hill | | | | |
| Minimal Action | 242,500 | 10,900 | 4% | |
| Winter Saturday at Twin Tunnels | | | | |
| Minimal Action | 153,600 | 7,600 | 5% | |
| Winter Saturday e/o Empire Jct | | | | |
| Minimal Action | 69,700 | 7,500 | 5% | |
| Winter Saturday at EJMT | | | | |
| Minimal Action | 111,000 | 6,200 | 5% | |
| Winter Saturday between Frisco and Silverthorne | | | | |
| Minimal Action | 109,300 | 6,100 | 5% | |
| Winter Saturday at Vail Pass | | | | |
| Minimal Action | 70,500 | 2,200 | 3% | |
| Winter Saturday at Dowd Canyon | | | | |
| Minimal Action | 111,300 | 9,000 | 7% | |
| Winter Saturday e/o Eagle | | | | |
| Minimal Action | 84,700 | 4,400 | 5% | |
| Winter Saturday w/o No Name | | | | |
| Minimal Action | 50,900 | 1,800 | 4% | |



Table 3: I-70 Travel Demand Bus-in-Mixed Traffic (Thursday - Summer)

| Summer Thursday | 2025 Highway PTs | 2025 Transit (all BIMT) PTs | PEIS Transit as % of Total PTs | 2025 Summer Thursday Corridor Trip Purpose Patterns (% of Total 2025 PTs) |
|--|------------------|-----------------------------|--------------------------------|--|
| Summer Thursday e/o Genesee | | | | <p>Overview Eagle Co is expected to be the most urbanized. In 2025, Work and Local non-work trips dominant east of Eagle (over 100% increase); and Stay Over and Colorado Non-Work trips are more dominate west of Eagle. The growth in Local Non-Work trips and Stay Over and Colorado Non-Work trips reflect the urbanization patterns projected in Eagle Co west of Vail.</p> <p>Work Trips</p> <ul style="list-style-type: none"> • Work Trip % increase from west to east: • 28% at Glenwood Canyon • 27 – 30 % from Eagle Co line to Vail • 33 -37% from Vail to Copper Mountain • 36% to 48% in Summit Co • 46% in Clear Creek Co • 34% from Beaver Brook to C-470 <p>Local Non-Work Trips</p> <ul style="list-style-type: none"> • 40% from Eagle County Line to Edwards • 36% from Edwards to Vail • 13% in Vail pass • 24% in Summit Co • 12% in Clear Ck Co <p>Day Recreation Trips</p> <ul style="list-style-type: none"> • Less than 10% in Corridor west of Copper Mountain • 5 - 6% east of Copper Mountain <p>Stay Over and Colorado Non-Work</p> <ul style="list-style-type: none"> • 28% in Glenwood Springs area • 25% in the Eagle Co line to Edwards area • 41% at Vail Pass • 25% in Summit C |
| Minimal Action | 195,700 | 4,000 | 2% | |
| Summer Thursday at Floyd Hill | | | | |
| Minimal Action | 170,400 | 3,500 | 2% | |
| Summer Thursday at Twin Tunnels | | | | |
| Baseline | 115,000 | 300 | 0% | |
| Minimal Action | 113,000 | 2,300 | 2% | |
| Summer Thursday e/o Empire Jct | | | | |
| Minimal Action | 103,400 | 2,200 | 2% | |
| Summer Thursday at EJMT | | | | |
| Minimal Action | 94,700 | 1,900 | 2% | |
| Summer Thursday between Frisco and Silverthorne | | | | |
| Minimal Action | 108,300 | 2,000 | 2% | |
| Summer Thursday at Vail Pass | | | | |
| Minimal Action | 72,100 | 1,500 | 2% | |
| Summer Thursday at Dowd Canyon | | | | |
| Minimal Action | 121,100 | 3,200 | 3% | |
| Summer Thursday e/o Eagle | | | | |
| Minimal Action | 98,200 | 1,400 | 1% | |
| Summer Thursday w/o No Name | | | | |
| Minimal Action | 48,700 | 700 | 1% | |



Table 4: I-70 Travel Demand Bus-in-Mixed Traffic (Sunday - Summer)

| Summer Sunday | 2025 Highway PTs | 2025 Transit (all BIMT) PTs | PEIS Transit as % of Total PTs | 2025 Summer Sunday Corridor Trip Purpose Patterns (% of Total 2025 PTs) |
|--|------------------|-----------------------------|--------------------------------|--|
| Summer Sunday at Genesee | | | | <p>Overview</p> <p>The total eastbound (peak direction) demand is constant between the Eagle County Line and Copper Mountain. Summer Sunday volumes are projected to exceed Winter Saturday across the Corridor, however peak hourly winter Saturday volumes may exceed those of summer weekends. In contrast, summer weekends tend to have several consecutive hours of similarly heavy travel demand. Local Non-Work and Work trips make up a greater percentage of Eagle Co (especially Eagle Co line to Edwards), triggered by projected population and employment growth. Recreational travel dominates throughout the Corridor.</p> <p>Work Trips</p> <ul style="list-style-type: none"> • 5% Eagle Co line to Edwards • 3 – 5 % for remainder of Corridor <p>Local Non Work Trips</p> <ul style="list-style-type: none"> • 5% Eagle Co Line to Edwards • 3 – 5% for remainder of Corridor <p>Day Recreation</p> <ul style="list-style-type: none"> • Drops off west of Copper Mountain • 5 - 7% Eagle Co Line to Edwards • 10% at Dowd Canyon • 4-5% at Vail Pass • 15% Summit Co <p>Stay Over and Colorado Non-Work Trips</p> <ul style="list-style-type: none"> • 75 – 90% in Eagle, Summit and Clear Ck Counties • 40% in Jefferson Co |
| Minimal Action | 358,400 | 9,800 | 3% | |
| Summer Sunday at Floyd Hill | | | | |
| Minimal Action | 301,500 | 8,700 | 3% | |
| Summer Sunday at Twin Tunnels | | | | |
| Minimal Action | 196,800 | 6,700 | 3% | |
| Summer Sunday e/o Empire Jct | | | | |
| Minimal Action | 193,900 | 6,600 | 3% | |
| Summer Sunday at EJMT | | | | |
| Minimal Action | 151,700 | 5,000 | 3% | |
| Summer Sunday between Frisco and Silverthorne | | | | |
| Minimal Action | 151,600 | 5,000 | 3% | |
| Summer Sunday at Vail Pass | | | | |
| Minimal Action | 117,200 | 2,500 | 2% | |
| Summer Sunday at Dowd Canyon | | | | |
| Minimal Action | 132,200 | 3,300 | 2% | |
| Summer Sunday e/o Eagle | | | | |
| Minimal Action | 117,600 | 1,900 | 2% | |
| Summer Sunday w/o No Name | | | | |
| Minimal Action | 86,500 | 1,800 | 2% | |



SYSTEM DEVELOPMENT AMONG I-70 CORRIDOR PUBLIC PROVIDERS

Several public transit systems operate in the mountain I-70 corridor, each operating some combination of local feeder services or regional employee transportation. The municipal systems (Black Hawk/Central City, Vail Transit, Avon-Beaver Creek, Glenwood Ride!) primarily offer local circulating transit services. The countywide systems have a stronger focus on employee transportation, although they also provide circulation within the communities in each county. While the municipal systems provide important feeder services, the countywide systems (Summit Stage, ECO Transit, and Roaring Fork Transportation Authority) and the service on the I-70 corridor are the focus here. RFTA service on Highway 82 is identified as well, as it has a high level of transit service and it serves as an extension of the I-70 corridor.



Table 5: I-70 Corridor LOS

| Operator | Segment/Route | Service Level* | Annual Riders | Daily Riders |
|---------------------|-----------------------|--|---------------|---|
| Summit Stage | Frisco-Copper Mtn. | 15-30 minute peak; 60-minute base frequency | 185,000 | 260 - summer and 860 - winter |
| ECO Transit | Gypsum-Vail (I-70) | Express w/ 15-30 min in peak; up to 120 in base | 144,000 | 400 |
| | Edwards-Vail (6 & 70) | 30 min | 533,000 | 1,461 overall, with 780 in summer & 2,300 in winter |
| RFTA | Glenwood-Rifle | Peak only, with 60 min. frequency most often. | 164,000 | 450 |
| | Hwy 82 | 30 min; will increase to 15 peak with opening of BRT | 2,204,000 | 4,160 |

* Service levels vary considerably, both by season and by time of day, as the systems match service with demand. These approximations are what commonly occur.

** ECO's highest ridership months are December through March with an average of 3,200 trips provided per day (total ridership was 391,373). In the summer, the ridership was about 335,000 with an average daily ridership of 1,400 trips.

The ridership numbers in Table * generally reflect annual ridership and are for either 2011 or 2012, depending on availability of data. Winter and summer differentials are provided where available. The ridership does not relate directly to potential I-70 service as routes serve multiple purposes and different purposes than the proposed services. These routes operate on a mix of local roadways, State Highways, and I-70. For example, the ECO Highway 6 route operates on both Highway 6 and I-70, carrying local passengers and workers traveling from Edwards to Vail. The existing ridership does, however, provide a reality check and shows that the projections from the PEIS are in a realistic range.

RFTA Highway 82 service will transition to Bus Rapid Transit in September of 2013. ECO Transit is in the initial stages of restructuring their service to operate an I-70 spine augmented by continued local services operating on Highway 6. This will allow them to provide the highest capacity service with the quickest travel times and lowest costs.



NORTH AND SOUTH I-25 CORRIDORS

These corridors are different in character than the Mountain I-70 Corridor in that the focus of service development is primarily peak hour regional employment trips.

One can consider a simple mode share estimate (e.g. 2% of trips generally will use the transit mode when adequate services are provided) and consideration of the mode share of only the work trips that travel in the market. In Colorado, workers have generally shown a propensity to use transit when it is available, with mode shares of 4-10% of work trips fairly common and higher numbers in some corridors. While mode shares provide an important guide to what might be expected, qualitative factors are also important, including:

- Quality of service as measured by travel time, frequency of service, span of service, and availability of parking
- Location of employment (central core vs. dispersed locations)
- Availability of car and van pools

INFORMATION AVAILABLE

There are three basic types of information available for these corridors: Census Journey-to-Work data, historical ridership data from FREX, and planning studies for north I-25, including the North I-25 EIS and North Front Range Regional Transit Element.

- The Census information provides an understanding of the flow of employment trips between Denver and the other counties along the I-25 corridor.
- Prior FREX ridership data provides a wealth of information about ridership levels by trip.
- The planning studies provide a conceptual understanding of the level of demand in the northern corridor. Both the EIS and Regional Transit Element considered total trips rather than only employment trips, but this information is useful in understanding the potential growth of services and overall demand in the North I-25 corridor.

Again, the demand estimation only provides a conceptual understanding of ridership. Service levels, and particularly in the North I-25 corridor, the availability of park-and-ride lots, are major determinants in developing successful services.

METHODOLOGY

As employment transportation is a key reason for the development of regional services, it is useful to examine the proportion of workers who use transit for the commute trip. This provides a context for understanding the likelihood of residents to use transit for their commute trip and the degree to which existing services are meeting this need.

A several-step methodology was used to determine the demand for regional transit services in the north and south I-25 corridors. These general steps were:

- A. Review historic ridership and service trends



- B. Estimate mode share from journey-to-work data and consider qualitative and market factors in estimating mode share for proposed services.
- C. Identify population and employment forecasts to determine how ridership might grow through 2040
- D. Apply factors to estimate ridership for specific service plans

MODE OF TRANSPORTATION TO WORK

The mode of transportation to work, as reported in the American Community Survey, is presented in Table 6. The destination counties of the Denver Metropolitan Area are listed first, followed by counties that would be served by the proposed I-25 regional commuter bus services, and then the counties in the I-70 corridor. Rows illustrate the mode of transportation for residents living in the county and for employees working in the county. In counties where a significant number of workers live elsewhere, this is an important distinction.

This data illustrates the completeness of the transit networks in various counties. Those counties where either 5% or more of riders use transit are highlighted. This occurs in Denver and Boulder counties in the metropolitan area. In the Denver Metro Area, note that 4.4% of residents of Arapahoe County use transit for work trips, many of whom likely travel into Denver. However, only 2.5% of employees use transit, a reflection that it is more difficult to use transit to access jobs in Arapahoe County.

The journey-to-work data also illustrates the propensity of residents to use transit. First, it shows that where there are good transit connections, people do use transit services. More than a 5% transit mode share shows the transit network is strong, providing effective connections between home and work. Second, it points out those counties where the propensity to use transit for the work trip is low. El Paso County had 1.3% of people reporting that they use transit for the work trip. While a low number, it was more than twice the 0.6% rate for Weld County. Larimer County showed 0.8% of residents using transit for their work trip. While not reflective of what people who travel long distances may choose to do, it still provides information on the relative propensity to use transit in various counties.



Table 6: Mode of Transportation to Work

| | | | Total Workers | Drove alone | 2-person Carpool | 3-or-more person Carpool | Public Transportation | Bike | Walked | Taxi, Motorcycle, and Other | Worked at Home |
|----------|-----------|---------|---------------|-------------|------------------|--------------------------|-----------------------|-------|--------|-----------------------------|----------------|
| Denver | Residents | Number | 295,432 | 204,843 | 23,645 | 6,122 | 22,968 | 5,472 | 12,365 | 4,015 | 16,002 |
| | | Percent | 100.0 | 69.3 | 8.0 | 2.1 | 7.8 | 1.9 | 4.2 | 1.4 | 5.4 |
| | Workers | Number | 451,562 | 325,369 | 36,869 | 8,655 | 41,003 | 5,616 | 12,359 | 5,689 | 16,002 |
| | | Percent | 100.0 | 72.1 | 8.2 | 1.9 | 9.1 | 1.2 | 2.7 | 1.3 | 3.5 |
| Adams | Residents | Number | 204,553 | 155,965 | 21,099 | 5,614 | 8,735 | 736 | 3,065 | 2,453 | 6,886 |
| | | Percent | 100.0 | 76.2 | 10.3 | 2.7 | 4.3 | 0.4 | 1.5 | 1.2 | 3.4 |
| | Workers | Number | 157,037 | 123,315 | 14,083 | 3,543 | 3,471 | 793 | 3,070 | 1,876 | 6,886 |
| | | Percent | 100.0 | 78.5 | 9.0 | 2.3 | 2.2 | 0.5 | 2.0 | 1.2 | 4.4 |
| Arapahoe | Residents | Number | 281,253 | 219,450 | 20,739 | 4,935 | 12,336 | 1,255 | 4,897 | 2,999 | 14,642 |
| | | Percent | 100.0 | 78.0 | 7.4 | 1.8 | 4.4 | 0.4 | 1.7 | 1.1 | 5.2 |
| | Workers | Number | 269,772 | 217,198 | 19,596 | 3,743 | 6,729 | 1,193 | 4,567 | 2,104 | 14,642 |
| | | Percent | 100.0 | 80.5 | 7.3 | 1.4 | 2.5 | 0.4 | 1.7 | 0.8 | 5.4 |
| Boulder | Residents | Number | 150,237 | 99,407 | 10,557 | 2,647 | 8,022 | 6,183 | 6,703 | 1,862 | 14,856 |
| | | Percent | 100.0 | 66.2 | 7.0 | 1.8 | 5.3 | 4.1 | 4.5 | 1.2 | 9.9 |
| | Workers | Number | 176,783 | 123,463 | 13,449 | 3,047 | 7,336 | 6,197 | 6,622 | 1,813 | 14,856 |
| | | Percent | 100.0 | 69.8 | 7.6 | 1.7 | 4.1 | 3.5 | 3.7 | 1.0 | 8.4 |
| | | | | | | | | | | | |



| | | | | | | | | | | | |
|---|------------------|---------|---------|---------|--------|-------|-------|-------|--------|-------|--------|
| El Paso | Residents | Number | 293,332 | 226,775 | 22,225 | 6,019 | 3,766 | 1,146 | 13,572 | 3,344 | 16,485 |
| | | Percent | 100.0 | 77.3 | 7.6 | 2.1 | 1.3 | 0.4 | 4.6 | 1.1 | 5.6 |
| | Workers | Number | 292,588 | 227,392 | 22,330 | 5,704 | 3,592 | 1,134 | 13,237 | 2,714 | 16,485 |
| | | Percent | 100.0 | 77.7 | 7.6 | 1.9 | 1.2 | 0.4 | 4.5 | 0.9 | 5.6 |
| Larimer | Residents | Number | 148,674 | 112,454 | 11,267 | 3,011 | 1,157 | 5,583 | 3,639 | 1,892 | 9,671 |
| | | Percent | 100.0 | 75.6 | 7.6 | 2.0 | 0.8 | 3.8 | 2.4 | 1.3 | 6.5 |
| | Workers | Number | 141,534 | 107,298 | 10,088 | 2,636 | 1,047 | 5,550 | 3,757 | 1,487 | 9,671 |
| | | Percent | 100.0 | 75.8 | 7.1 | 1.9 | 0.7 | 3.9 | 2.7 | 1.1 | 6.8 |
| Weld | Residents | Number | 115,789 | 91,550 | 10,056 | 2,930 | 717 | 625 | 2,483 | 1,401 | 6,027 |
| | | Percent | 100.0 | 79.1 | 8.7 | 2.5 | 0.6 | 0.5 | 2.1 | 1.2 | 5.2 |
| | Workers | Number | 91,856 | 70,473 | 8,171 | 2,529 | 529 | 620 | 2,439 | 1,068 | 6,027 |
| | | Percent | 100.0 | 76.7 | 8.9 | 2.8 | 0.6 | 0.7 | 2.7 | 1.2 | 6.6 |
| Source/Note US Census Bureau, ACS 2006-2008 3yr est., Special Tabs for CTPP | | | | | | | | | | | |



HISTORIC RIDERSHIP AND SERVICE LEVELS

Table 3-2 illustrates FREX service characteristics between 2005 and 2012. In 2010 there was a one-third cut in service, and the Castle Rock stop was eliminated. Fares were steadily increased in 2007, 2008, and 2009.

This table shows that the FREX service carried between 300 and nearly 700 one-way passenger trips per day, showing the level of demand that exists. The highest ridership was when gas first went over \$4.00 per gallon in 2008. The lowest ridership was in 2010 after service was reduced and after the future of the service was threatened; it appears many riders found other means of traveling. Ridership did climb again to nearly 400 a day in 2011 and 2012.

The ridership appears to be directly related to the level of services operated. When service was reduced to 26 trips per day, riders did not condense onto the remaining available trips. Rather, boardings per trip remained in the same range as previously. This indicates the importance of having a broad schedule so people have flexible travel time.

Table 7: Historical FREX Service Characteristics

| | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|------------------------------------|---------|---------|---------|---------|---------|--------|---------|----------|
| | | | | | | | | 8 months |
| Revenue Hrs. | 23,607 | 24,614 | 23,056 | 24,920 | 24,819 | 16,280 | 16,100 | 10,773 |
| One-way trips per day | 42 | 42 | 42 | 42 | 42 | 26 | 32 | 32 |
| Boardings | 118,387 | 154,861 | 136,765 | 175,935 | 141,316 | 79,444 | 101,282 | 66,685 |
| Boardings/ Hour | 5.0 | 6.3 | 5.9 | 7.1 | 5.7 | 4.9 | 6.3 | 6.2 |
| Boardings / Trip | 10.9 | 14.2 | 12.6 | 16.2 | 13.0 | 11.8 | 15.0 | 10.7 |
| 1-way daily passenger trips | 457 | 598 | 528 | 679 | 546 | 307 | 391 | 397 |

Source: 2011 FREX Business Plan, detailed ridership records

Transit planners use the concept of “elasticity” to describe how ridership changes when there are service changes or fare changes. This tool provides a way to quantify the percentage change in ridership for every percentage change in service. In an ideal situation, one would be able to see a clear relationship between a change in service or fares and the change in



ridership. This occurs when there is a fare increase but no changes in service or if headways are changed (such as from 60 to 30 minutes) with no other changes.

In the real world, many things happen together so the challenge becomes how to measure the impact of changes and tease out meaningful data. Often, gross measures are used. An example is comparing total revenue miles or overall frequency changes to ridership changes. In the case of FREX there were many influences each year between 2008 and 2011. Ridership peaked in 2008 when gas prices were high and before the recession hit. By 2010, there were substantial service cuts. At the same time, ridership grew with the perception that service was stable or dropped with the perception that it was not stable.

The historical data was examined to see if patterns would emerge that had both internal consistency and consistency with national patterns. The analysis showed that it is important to look at a finer level – for example not just the difference in total trips operated but the difference in peak hour peak direction trips. It also showed that it is important to look at longer periods than one year, to allow changes to settle in.

The proposed I-25 regional commuter bus service is substantially less than that operated by FREX, even on the reduced schedule of 16 round trips (32 one-way trips). There are three important differences:

1. The buses are proposed to remain in Denver, so the peak hour trips will operate in the peak direction. FREX return trips served some reverse commute travel but in the peak hours did not carry many riders.
2. The proposed service is scheduled to operate on the most heavily used peak-hour trips.
3. Each bus will have 20% more capacity.

To understand how this will impact ridership, a detailed look was taken at ridership by trip, by direction and on the number of trips in the peak direction and peak hour, during mid-day, and early and late trips. Table 3-3 shows how the overall level of service changed by time of day.

Table 8: Changes in FREX Service Levels

| Time of Day | 2008-2009 | 2010 | 2011 - 2012 | Proposed |
|---------------------------------|------------------|------------------|------------------|------------|
| Peak hour, peak direction trips | 8 NB; 8 SB | 6 NB; 6 SB | 6 NB; 6 SB | 5 NB; 5 SB |
| Mid-day trips | 5+ NB; 4 SB | 3 NB; 4 SB | 4 NB; 4 SB | 1 NB; 1 SB |
| Early & late trips | 2 NB AM; 3 SB PM | 1 NB AM; 0 SB PM | 2 NB AM; 0 SB PM | 0 |
| TOTAL | 30 | 20 | 22 | 12 |
| % Change by Period | --- | -33% | +10% | -45% |
| % Change 2009-2011 | --- | --- | -27% | --- |



Comparing the information on the level of service reductions from Table 3-3 to the change in ridership in Table 3-2, one sees that the reduction in ridership from 2009 (141,316) to 2011 (101,282) was 28%. 2009 was chosen because the impact of the gas prices was not as apparent and the employment market is closer to that in 2011. 2011 was chosen because the ridership had a chance to settle in after the reductions that occurred in 2010 and it was a full year of service. A one percent reduction in ridership for each one percent reduction in service is in the expected range. The same exercise for the period from 2008 to 2011 results in an elasticity of 1.25%, which is high for the transit industry. The demand estimation tables use a range from 1% to 1.25% to estimate high and low ridership levels.

The proposed services are reduced from services provided in 2011 with a shorter span of service, fewer trips in the peak periods, and significantly less service in the mid-day. These reductions in service quality will affect ridership; the assumption is that the impact will be similar to previous service reductions. Partially offsetting this is that fact that the buses will have more capacity, with 50 seats rather than 40, a 20% increase. Capacity was a constant issue for FREX. Although the average trip load, over the course of the month, shows there is available capacity, the reality is that ridership varied significantly throughout the week. On a Wednesday there might be people who could not get a seat while on a Friday there would be empty seats. When people could not regularly obtain a seat they looked for other options for travel.

DEMAND MODEL

At the end of this section you will find demand worksheets that go through each of the following steps:

- Step 1: Existing and Historic Ridership and Service Trends
- Step 2: Journey-to-Work Data
- Step 3: Qualitative Observations
- Step 4: Mode Share: Relation to Ridership
- Step 5: Population and Employment Forecasts
- Step 6: Application – Potential Markets and Service Levels

Separate worksheets are provided for South and North I-25 corridors. The model projects ridership between 2015 and 2040; two service levels are identified in each corridor. It is based on 2008 data as that is the year in which an on-board survey was conducted of FREX riders and this data allowed the modeler to link origins and destinations in order to more accurately assess ridership.

The first three steps have been covered above and is augmented by the corridor-specific information in the tables. Some additional explanation of the mode share and application of the model to alternative scenarios may be useful.



MODE SHARE FOR REGIONAL SERVICE IN THE I-25 CORRIDOR

Journey-to Work data was used to identify the overall market for regional trips in Step 2. The data is limited to county-level analysis, but provides a sense of the overall market share between the major markets.

Comparing the ridership between markets to the size of the employment markets, the mode share can be identified. The FREX experience indicates that 2% to 8% of commuters from El Paso County to Metro Denver counties used the FREX service at its service peak in 2008. In the opposite direction, 1% of commuters used the service. For the North I-25 corridor, a lower mode share was used because (a) previous analysis in the NFR Regional Transit Element showed the diversity and distance from I-25 of origin trips and the diversity of destinations in Denver County and (b) with county-level data it was necessary to use data from all of Larimer and Weld County, including those trips that would use other travel sheds such as Highway 287 or Highway 85.

Based on the service levels provided by FREX, the riders served, and the other factors as listed above, the mode shares for various county markets in the south I-25 corridors are estimated in Step 4 of the demand worksheets found in Attachment 1 at the end of this appendix. Attachment 1 provides numbers for South Front Range and Attachment 2 covers North Front Range. Note that the mode shares for North Front Range are found only in Step 6 of Attachment 2 as no previous service existed for the comparison used in Step 4.

One surprising finding from the Census data on Mode of Transportation to Work is that despite the strong van pool program in the North Front Range, the percentage of people who carpool is similar for Larimer and El Paso counties; Weld County is slightly higher than the other two. Currently the Van Go program has 18 vanpools that operate in the North I-25 corridor and have a destination of downtown Denver. At an average occupancy of 6 per van, this represents 108 individuals¹. If service was in place, a portion of these may have chosen fixed route transit instead of a vanpool. It is important to note that once people are in a vanpool, few leave to use fixed route transit.

¹ Looking at Larimer County to Denver workflows, a 5% capture rate would be 98 employees; for Weld County to Denver work flows, a 5% capture rate would be 324 employees. Only a portion of them are in the path of travel served by van pools, but this suggests that this corridor is one with more people in 3-person carpools than the Journey-to-Work average data suggests.



APPLICATION OF FACTORS TO PROPOSED I-25 CORRIDOR SERVICES

Step 6 applies the various factors to population levels from 2008 to 2040. In each corridor, two alternative levels of service are modeled. For this exercise, it is assumed fares remain at a level comparable to those charged by FREX.

Table 9 identifies ridership for proposed north and south I-25 services using the low (elasticity of 1.25%) and high (elasticity of 1%) ridership levels for each alternative. Projections for this same service level, carried out to 2040, can be found in Appendix B. To the extent that service levels or fares change, the projections would also need to be adjusted.

Table 9: Projected Ridership for Proposed Regional

| | Daily One-way Rides | | | |
|------------------------------|---------------------|-------------|-----------------|-------------|
| | 2008 Baseline | | 2015 Projection | |
| | Low Riders | High Riders | Low Riders | High Riders |
| South I-25 Service | | | | |
| Alternative A: 5 round trips | 335 | 418 | 371 | 463 |
| Alternative B: 6 round trips | 402 | 502 | 445 | 556 |
| North I-25 Service | 2008 Baseline | | 2015 Projection | |
| | Low Riders | High Riders | Low Riders | High Riders |
| Alternative A: 4 round trips | 116 | 145 | 171 | 214 |
| Alternative B: 5 round trips | 140 | 175 | 206 | 257 |

SUMMARY OF REGIONAL DEMAND

The demand for regional services on the I-25 corridor is well documented, and the corridors are well suited to commuter services. Projected ridership levels are constrained by the proposed service quality. The provision of more trips operating over a greater span of service would result in higher ridership. It is important to give consideration to the balance between expenses, fare revenues, and ridership. It will also be important to develop plans to address demands that are greater than the service can carry.

Demands for transit services in the I-70 corridor are not primarily for employment trips as RFTA, ECO, and Summit Stage services cover that market well. The exception is between Frisco and Vail where employee-oriented services presently do not operate. Rather, there are two primary areas of demand. One is for service to connect the existing operators, filling the gaps in services between Glenwood Springs and Eagle and between Vail and Frisco. The other primary transit demand is for recreational trips between Denver and Eagle. It will require significant infrastructure and service levels to address adequately.