Revised Report

Economic Contributions of the E-470 Tollway

The Economics of Land Use

Prepared for:

E-470 Public Highway Authority

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in collaboration with

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1. EXECUTIVE SUMMARY

Economic & Planning Systems (EPS) with subcontractor Felsburg, Holt & Ullevig (FHU) were contracted to complete an economic impact study for the E-470 Public Highway Authority (PHA). The following are the major findings of that analysis within the E-470's context of the 6-County Denver Metropolitan Statistical Area (MSA) for 2015.[1]

1. ***Since 1986, E-470 has catalyzed $38.4 billion in real estate valuation along its corridor.***

   Using boundaries consistent with those drawn in initial 1986 economic forecast documents, EPS determined that E-470 has catalyzed $10.5 billion more in real estate development than originally projected 30 years ago. As a result, this Impact Area contributes $467 million in property taxes annually to regional governments, $290 million more than initially projected.

2. ***The Impact Area is home to 407,000 people and 132,000 jobs.***

   The Impact Area's population represents 15 percent of the MSA's population and is 154,000 higher than projected in 1986 economic forecasts. While those original forecasts projected more jobs by 2015, total employment in the Impact Area accounts for 10 percent of the MSA's wage and salary jobs (i.e. excluding sole proprietors).

3. ***Spending by businesses and households in the E-470 Impact Area accounts for 12 percent of the MSA's annual economic activity.***

   The direct spending associated with labor and business-to-business purchases (i.e. output) in the E-470 Impact Area is $25 billion per year, which accounts for 12 percent of the MSA's direct output. Direct value-added, a metric commonly characterized as Gross Regional Product (GRP), within the Impact Area is $14.2 billion, also 12 percent of the MSA's GRP.

4. ***Average wages and household incomes are higher among workers and households in the Impact Area.***

   Average wages of workers employed in the E-470 Impact Area are $63,860, which is 5 percent higher than average wages in the MSA ($60,720). Average incomes of households living in the Impact Area are $104,250, which is 20 percent higher than the MSA average ($86,550).

5. ***More than 21,000 households and 7,800 workers are dependent on E-470 for their travel needs.***

   Using DRCOG's Compass 4.0 travel demand model, it is estimated that without E-470, this magnitude of additional population and jobs would push surrounding road networks beyond failure points. The economic contributions can be characterized in similar terms. The presence of these households and jobs in the Impact Area account for $5.1 billion of the total Impact Area real estate valuation (13.2 percent of the Impact Area), contribute $1.0 billion in total business-to-business spending, and contribute $608 million GRP (both approximately four percent of the Impact Area).

[1] The Denver MSA in this analysis is defined as the collection of Adams, Arapahoe, Broomfield, Denver, Douglas, and Jefferson counties.

6. ***E-470 saves MSA residents from an additional 14.8 million hours of driving per year, translating to $26.1 million in annual travel time savings.***

   More time spent driving translates to lost productivity and lower quality of life. In this analysis, which also used travel demand modeling, the study estimated that without E-470, MSA residents would spend 14.8 million more hours driving per year (and 20 million more hours in congestion). Using standard USDOT metrics for the value of travel time savings, E-470 saves MSA drivers $199.1 million per year. Because such a scenario means that drivers would not be paying tolls, the net economic value of travel time savings is $26.1 million per year, less 2015 toll revenues of $173.0 million.

7. ***E-470 also provides unseen economic benefit in terms of avoided traffic incidents.***

   Because it moves traffic to a safer roadway type (i.e. a divided highway), E-470 is also responsible for the avoidance of an estimated $24 million in accidents, injuries, and fatalities per year.

8. ***The operation of E-470 also ripples through the regional economy.***

   E-470 employs or contracts 272 full- and part-time workers. Annually, its operations contribute approximately $25.1 million in GRP to the MSA, inducing an additional $23.8 million in GRP contributions. Its operations also support the purchase of $41.6 million in goods and services in the process of its own service delivery, inducing an additional $39.0 million in spending in the MSA.

The technical methodologies, data sources, and detailed descriptions of E-470's economic contributions follow in the report. An appendix provides more detailed results from the input-output modeling used to estimate standard economic impact metrics such as direct, indirect, and induced employment, total spending, and Gross Regional Product (GRP).

2. TECHNICAL METHODOLOGY

This chapter details the technical methodologies used in the process of characterizing the different metrics of E-470's economic contributions and impacts to the 6-County Denver MSA.

Data Sources

The following data sources were used either directly in the analytical process described in this chapter or in previously-developed data utilized in this analysis. Concerning previously-developed data, EPS utilized geo-spatial socio-economic data (population, households by income, and employment by industry) generated specifically for E-470's most recent *Investment Grade Traffic and Revenue Study* report (October 2014). These geo-spatial data are utilized in aggregate format at the traffic analysis zone (TAZ) level, but were aggregations of data analyzed at either the Census tract, block group, or block level. As such, the data supporting this analysis are:

- U.S. Census Longitudinal Employer-Household Dynamics: This data source enables users to collect and analyze block data on employment magnitudes by industry. The data source is, however, more commonly used to document and analyze in- and out-flow of workers and residents from a select region, i.e. in- and out-commuting patterns. In this analysis, block-level data were used to identify and verify magnitudes of employment at sub-municipal levels in the 2014 T&R Study.
- U.S. Census: As with the Census LEHD data, general demographic data from the American Community Survey, as well as block level data were used to document geo-spatial distributions of population and household throughout the MSA.
- Bureau of Labor Statistics: At the county level, wage and salary employment data was used from the BLS to recalibrate job levels by county throughout the MSA.
- County Assessor Parcel Data: Parcel data was used to determine property values and tax revenues generated from the areas dependent on E-470. Data was acquired for Denver, Douglas, Arapahoe, Adams, and Broomfield counties, all of which represented the year 2015, except Denver which represented 2014. Where necessary, additional information such as land use, property values, and mill levies was acquired separately and joined to the parcel data. Respective assessed value and mill levy data were used to calculate taxes paid. Depending on the original data, all parcel data was assimilated to uniform classifications, such as residential and commercial, whereas input data may have had more disaggregations of type.
- Colorado Department of Transportation: Primary data used in this analysis came from CDOT's 2012 Accidents and Rates Book. That report describes the number of incidents and rates of traffic crashes, such as property damage, injuries, and fatalities for the calendar year 2012. CDOT's data sources include computerized traffic volume data from CDOT's Division of Transportation Development, and computerized crash data gathered and maintained by the Traffic Records Unit of the Safety and Traffic Engineering Branch.

- U.S. Department of Transportation: The USDOT provides guidance to analysts conducting cost-benefit analyses that relate to roadway improvements and usage. Data from USDOT informed the statistical value of property damage, injuries, and fatalities used in the analysis of E-470's safety impacts, as well as the analysis of E-470's time travel savings.
- Original E-470 Land Use and Revenue Forecast Studies (1986): EPS researched multiple original documents pertaining to the current and projected (i.e. 2015) valuation of land and property taxes, population, households, and jobs. These data points were used where possible as points of comparison to illustrate the degree to which the actual values and impacts of E-470 have been exceeded.

E-470 Travel Dependency Methodology

EPS and FHU developed a unique and original analytical framework to quantify the extent to which surrounding land uses along the E-470 Corridor are *dependent* on E-470 for their travel needs, i.e. without which the surrounding roadway network would be pushed to quantifiable failure points.

Objective

The intent of the analysis was to quantify the degree of dependency without entering into the argument over causality between E-470 as a catalytic development and resulting developments solely attributable to E-470. EPS and FHU approached the task with the following understanding:

- Attempting to attribute all surrounding land uses to E-470 would present analytical risk and arguably overstate the economic contributions of E-470.
- The existing road network, whether or not at, below, or beyond capacity or a failure point, is operating sufficiently to serve the existing levels of land uses along the E-470 Corridor.
- The daily traffic volume created by some portion (but not all) of the existing land uses surrounding E-470 could not be handled by the existing roadway network (excluding E-470) without pushing some roadway networks to failure points.
- It would be too difficult to assume that sufficient rights-of-way exist for all surrounding roadway networks that might be pushed to failure points, such that they could be expanded or widened to accommodate the greater daily traffic volumes in a hypothetical network scenario without E-470. (The objective of such an approach might have been to quantify the economic "costs" saved by respective municipalities and counties through the presence of E-470.)

With this understanding, the primary objective of the analytical process was to reduce land use inputs (population, households, and employment) in specific areas along the E-470 Corridor such that the daily traffic volumes in the roadway network (excluding E-470) returned to levels in alignment with *existing* daily traffic volumes for the same roadway network. In order to accomplish this, a process was coordinated between EPS and FHU to repeatedly test varied reductions in land uses with the impact on the roadway network.

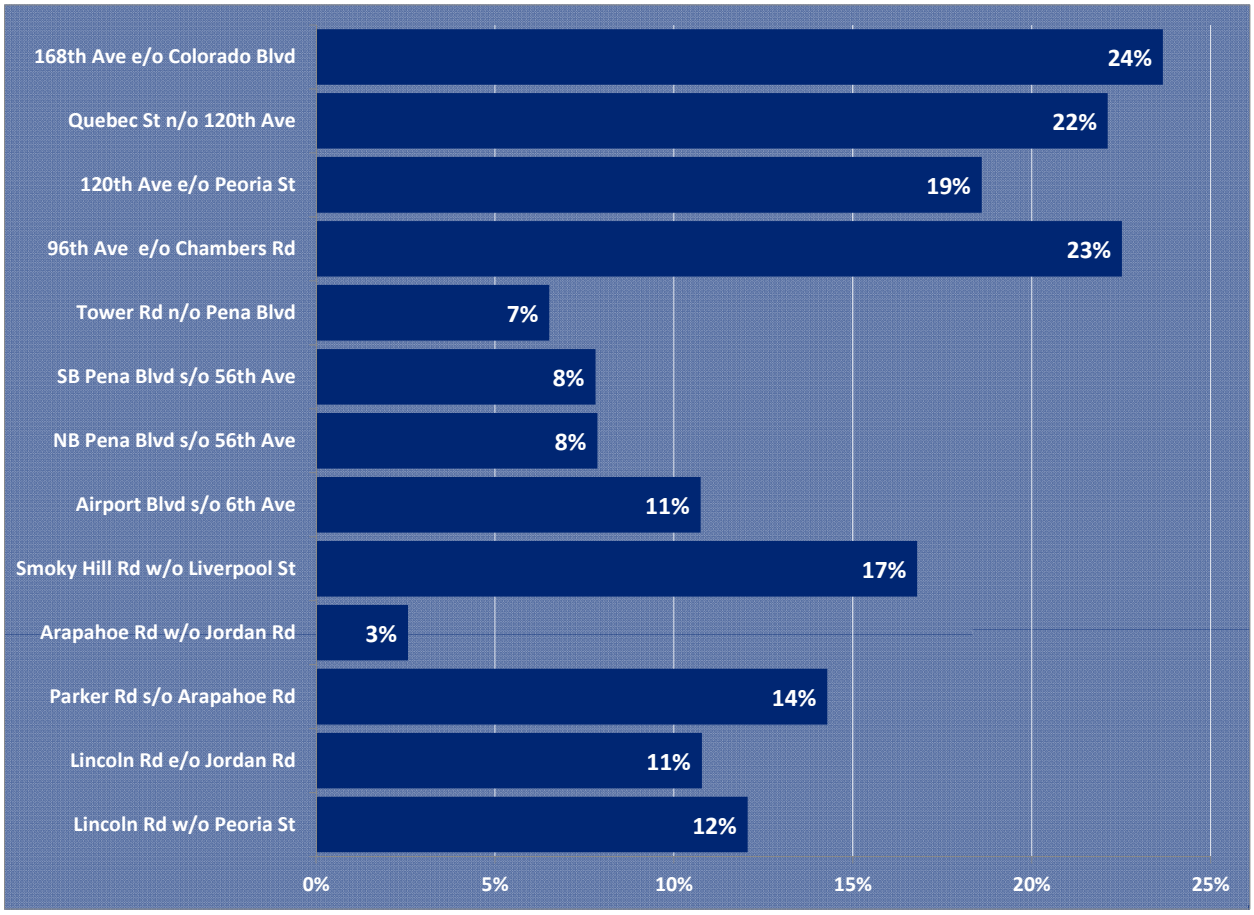
Process

EPS and FHU's technical modeling incorporated the travel demand models and associated socio-economic and land use inputs utilized for E-470's *Investment Grade Traffic and Revenue Study* (completed in October 2014) with amendments to quantify land use impacts on the transportation system. The Denver Regional Council of Governments' (DRCOG) Compass 4.0 Travel Demand Model (TDM) was used as the basis for all evaluation with adjustments and refinements to travel characteristics along the E-470 corridor. The primary output metric used from the TDM was daily traffic volumes on adjacent and parallel roadway facilities for the base year (2015).

- The first iteration of the TDM involved quantifying daily traffic volumes on all roadway segments through the model with *as-is* roadway facilities (i.e. including E-470).
- The second iteration of the TDM involved quantifying the daily traffic volumes on all roadway segments throughout the model *without* E-470.

A comparison of the primary output metric from these first two iterations served as a gauge for the extent to which land use reductions needed to occur in various sectors of the E-470 Corridor. Shown in **Figure 1** are the degrees to which daily traffic volumes along selected roadway segments throughout the Corridor increased above existing daily traffic volumes when E-470 was removed from the network. These magnitudes served as guideposts to orient the following geographically targeted reductions of population, households, and employment.

Figure 1
Traffic Volume Increases in Selected Roadway Segments without E-470



Critical Development Nodes

Instead of making arbitrary or wholesale reductions to land uses throughout the Corridor (which would not have produced appropriate results), Critical Development Nodes (CDN) adjacent to E-470 and with significant access to E-470 were identified using a variety of metrics. The intent was that such reductions to specific CDN land uses would produce targeted daily traffic volume reductions on related roadway segments, whereby those CDNs and their land uses could be characterized as measurably dependent on E-470 for their travel needs. This process involved the following:

- Express Toll Customer (ETC) accounts and License Plate Toll (LPT) records from the E-470 PHA were geocoded and analyzed by zip code.
- Household and employment data was also geocoded by TAZ for the base year 2015.
- Toll transaction data was also used in this process to understand, to the extent possible, where E-470 users were entering and exiting the highway.
- An overlay of the previous four data sources was used to identify CDNs for land use reduction.

The outcome of this effort was to isolate specific areas where a portion of land uses was likely contributing to higher daily traffic volumes (as illustrated in **Figure 1**) in the TDM scenario *without* E-470 such that the down-network (in the direction of travel) was pushed to failure points.

Iterative Reductions in Land Use

Once CDNs were identified and tested (to ensure that reductions to their land uses influenced primarily those roadway segments pushed to failure points), multiple degrees and combinations of household and employment reductions were made and fed through the TDM to measure daily traffic volumes along not only those identified roadway segments but the general roadway network surrounding E-470. In the process, two metrics using daily traffic volumes were considered as volumes were calibrated back to existing levels:

- The ratio of traffic volume over capacity (V/C). It was assumed that V/C gave an indication of which roads were at or over capacity. For this analysis, a V/C ratio of 1.25 was highlighted to be the point at which a roadway segment could fail.
- The absolute difference in volume between the first and second iterations of the TDM (i.e. with and without E-470). In the analysis, an increase greater than 2,000 daily traffic counts was highlighted in the results of the TDM.

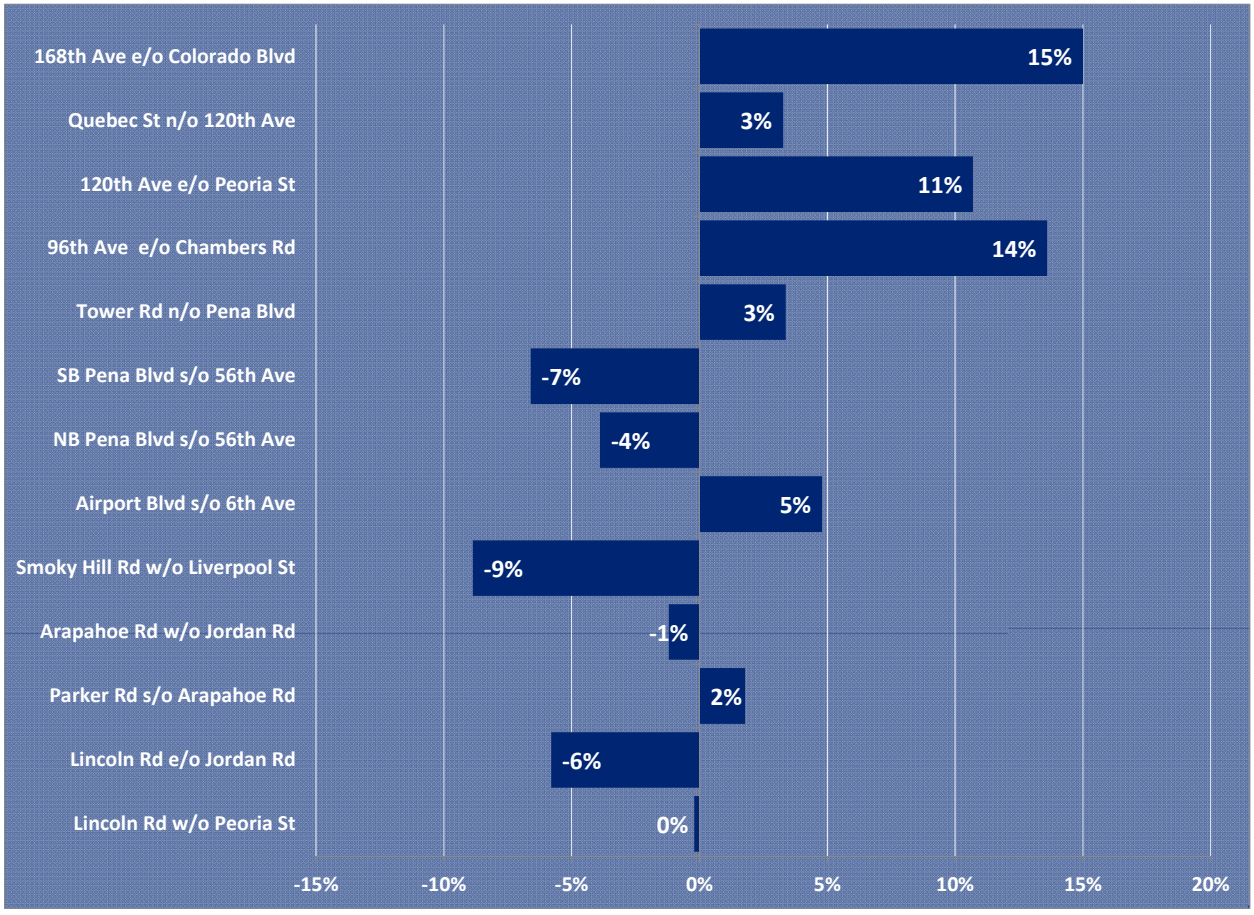
These two measures were interpreted in combination to identify where and to what extent land use reductions made the appropriate locational magnitude of daily traffic volume reductions. After multiple iterations of land use reductions run through the TDM, it was determined that approximately 21,000 households (population of approximately 62,000) and 7,800 jobs were dependent on E-470 for their travel needs.

Result

Overall, this methodology resulted in successful traffic volume reductions along the E-470 corridor both in aggregate and by individual selected roadway segment. Where **Figure 1** illustrated the degree to which roadway segment volumes increased without E-470 and the same level of land use, **Figure 2** illustrates the how the daily traffic volumes are brought in closer alignment with existing network levels with the land use reductions.

It should be noted that because of the nature of how DRCOG's TDM assigns trips, it was neither possible to fully reduce traffic volumes for many of the northern segments or return all segments of the network to precisely their current volume levels. Specifically, areas north of Pena Boulevard along the E-470 corridor did not reach existing volumes through land use reductions. This difficulty was attributed to an overall lack of local development along the corridor for targeted removal and the fact that a majority of long distance trips accessing Denver International Airport could not re-route to routes with acceptable available capacity (noted alternative routes include I-270 and I-70 which are congested facilities with no available capacity). As a result, while the final land use reductions in the northern segments produced limited results, the overall result of this modeling effort identified a magnitude of land use reductions in CDNs directly benefitting E-470, such that aggregate daily traffic volumes in were brought into alignment with existing volumes within 0.1 percent.

Figure 2
Selected Roadway Segment Volumes in Network with Land Use Reductions



Economic Contributions Analysis

Economic contributions can be expressed in a variety ways. Impact analysis, using input-output modeling such as is included in this study, often characterizes an array of standard measurements: employment (jobs); output (i.e., total spending), earnings (salaries plus employer-paid benefits); and value-added (equivalent to Gross Domestic Product or Gross Regional Product). This study goes further in that the economic contributions of E-470 measured are more characteristic of the unique attributes of a roadway facility.

Contribution Metrics

Including the standard impact metrics, the following characterizations of E-470's economic contributions to the 6-County Denver Metropolitan Statistical Area are estimated.

- Employment and Earnings: Employment includes the number of full- and part-time jobs, measured in terms of wage and salary position, not including sole proprietor employment. Earnings are the wages and salaries of full- and part-time workers including salaried and contract labor and including benefits paid by the employer.
- Output: This is the sum of all value-added and intermediate inputs, which are goods and services from producer-supplier relationships (business-to-business sales) used by a final demand industry to produce respective products or services. For example, the operation of the E-470 PHA involves purchasing intermediate inputs, i.e. goods and services from outside vendors or contractors, as well as value-added, i.e. the labor costs, profit margins, taxes, etc. The E-470 PHA purchases goods such as office and cleaning supplies and contracts for services such as legal, accounting, and janitorial services. It also "purchases" full- and part-time labor, either salaried or contract, and pays a variety of taxes. The purchase of all these goods and services is necessary to provide the service and operation of the E-470 tollway itself. The sum of all spending associated with this service is called "output" or "total spending". In an analysis, however, that looks at economic activity across all industries, the measurement of output is larger than GRP, because it reflects the sum of all "purchases" made to produce all goods and services. For this reason, GDP or GRP are the preferred metrics of economic impact because they characterize the value-added alone.
- Value-Added: This is comparable to Gross Domestic Product (GDP) or Gross Regional Product (GRP), which is used in this analysis of a regional economy. It includes the total value of income generated from production, employee compensation, payments to government (taxes), and measures of profit or return on investment. GDP and GRP are the most frequently cited economic contribution metrics in this type of analysis, because they characterize the amount of additional "value" created by the regional economic activity. As mentioned previously, this is the preferred metric of economic impact analysis.
- Travel Dependency: This metric, as described in detail above, characterizes the magnitude of jobs, population, and households within the E-470 Corridor who are *dependent* on E-470 for their travel needs. The economic contributions of the resulting magnitude of population, households, and employment are estimated in this analysis.

- Property Valuation and Annual Property Tax Contributions: Using parcel-level county assessor data from all six counties within the 6-County Denver MSA, EPS estimated the total residential and non-residential market valuation, as well as property tax contributions (estimating property tax liabilities according to exemption status and respective county, city, and district millage rates).
- Travel Time Savings: This metric quantifies the economic value that E-470 brings to all MS drivers on an annual basis. Using DRCOG's TDM, it was possible to quantify the vehicle miles traveled (VMT), vehicle hours traveled (VHT), and congested VHT under each land use scenario. Because the presence of E-470 saves MSA drivers from millions of additional hours in traffic each year, a portion of this analysis is devoted to estimating the net value of travel time savings associated with the presence of E-470. The U.S. Department of Transportation (USDOT), for such efforts, recommends that analysts use hourly value of travel time developed with annual person-miles of travel (PMT) data from the 2001 National Household Travel Survey (see http://nhts.ornl.gov/). Factors are provided for local and intercity travel, as well as broken down by personal, business, or all purposes. For this analysis, EPS has used the recommended hourly value of travel time for all purposes of local trips. The factor itself is a measure of the value of time travelers place on each hour spent in on all surface modes of transportation, including vehicle and mass transit except high-speed rail.
- Safety Impacts: This metric quantifies the economic value of traffic incidents, such as accidents, property damage, injuries, and fatalities that are avoided each year because of the presence of E-470. According to research at federal and state levels, incidents of accidents, property damage, and fatality are lower on divided roadways, such as highways, freeways, and expressways, than they are on collectors, arterials, and local roads. Using the TDM, it was also possible to calculate total annual VMT on the roadway network under current conditions and without E-470 disaggregated by roadway type, such as freeways, expressways, principal arterials, minor arterials, and collectors. Traffic incident data from the CDOT is used to estimate the number of traffic incidents occurring under each network scenario. Statistical values associated with each incident type from the USDOT were then used to estimate the total difference in costs associate with incidents under the different network scenarios.
- Administrative: As described above under "output", E-470's service is produced through the purchase goods and services, including its own salaried and contracted labor, supplies and vendor services, as well as the payment of government taxes, etc. Quantifying the impact of the E-470 PHA's operations implies estimating the extent to which its operations ripple through the surrounding regional economy.

Economic Impact Analysis

In terms of quantifiable economic contributions, most of the metrics described above were run through IMPLAN input-output modeling software.[2] IMPLAN's modeling software is structured to account for trade flows and industry profiles within the defined economic unit, in this case, of the 6-County Denver Metropolitan Statistical Area (MSA), including Adams, Arapahoe, Broomfield, Denver, Douglas, and Jefferson counties. The analysis provides an estimate of the multiplier effects, or the "ripple effect", of an initial "impact" or "demand" from industries within the study area economy. There are three main components to the characterization of the economic impacts that accompany the quantification of impacts in this analysis:

- **Direct Impacts** are the economic activities carried out by a specific industry, such as the labor it employs; wages; property and sales taxes paid; and the goods, services and real estate it purchases or leases in its operations.
- **Indirect Impacts** derive primarily from business-to-business activities, such as the lease and purchase of equipment for operations, and the legal, financial and administrative services that may be procured in the process of conducting direct activities. In an industry, indirect impacts most often include manufacturers of equipment, the legal profession, professional and technical services, and finance and insurance. These impacts will quantify the extent of that integration in terms of jobs, contribution to gross regional product (GRP), and wages.
- **Induced Impacts** are the ripple effects of the direct and indirect impacts on the larger economy. They include the local expenditures made by households of the direct and indirect industry jobs. These effects are the increases in employment and expenditure created by successive rounds of local spending and hiring, as individuals or firms associated with the Industry buy goods and services in the local economy.

The economic impact analysis identifies several measures of economic activity, including output (i.e., total sales or spending), earnings (salaries plus employer-paid benefits including proprietor income), employment (jobs), and value-added (equivalent to GDP). State, local and federal fiscal impacts are also estimated, including payments such as property and sales taxes associated with the economic activity associated with E-470's impacts.

[2] Minnesota IMPLAN Group, Inc. (MIG), Hudson, WI, www.implan.com

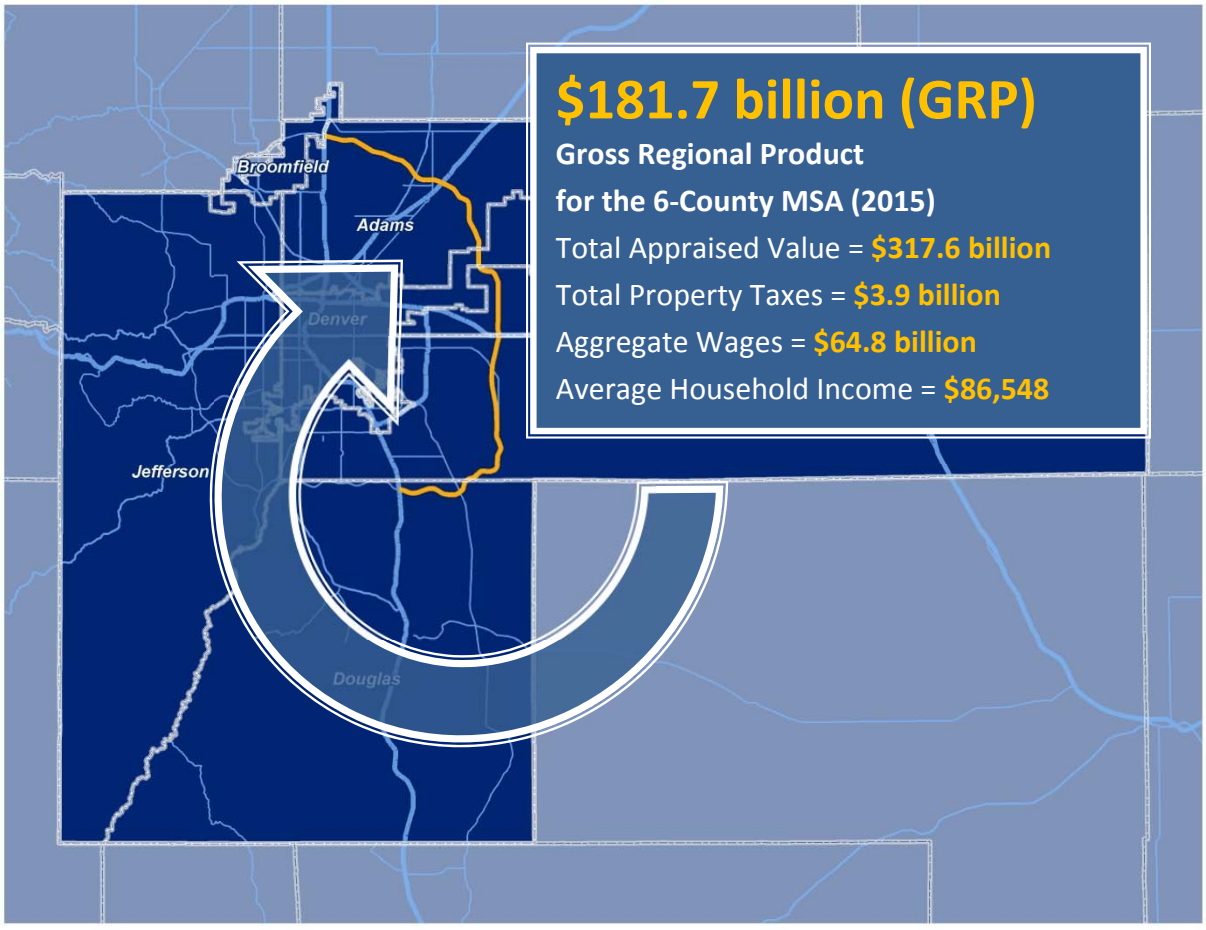
3. E-470's Economic Contributions

This chapter includes the major findings of the economic activity and impact analysis conducted at three specific geographic levels: the 6-County Denver Metropolitan Statistical Area (MSA); the E-470 Corridor Influence Area boundary used in the E-470 Public Highway Authorities current calculations, the original E-470 Impact Area from 1986 for direct comparison to 30-year old projections; and a subset of the impact area geography called Travel Dependency areas.

MSA Economic Activity

Shown in in **Figure 3** below, the economic activity and impacts for the 6-County Denver MSA include Adams, Arapahoe, Broomfield, Denver, Douglas, and Jefferson counties. In 2015, the gross regional product (equivalent to total spending by businesses and households in the MSA) was an estimated $181.7 billion.

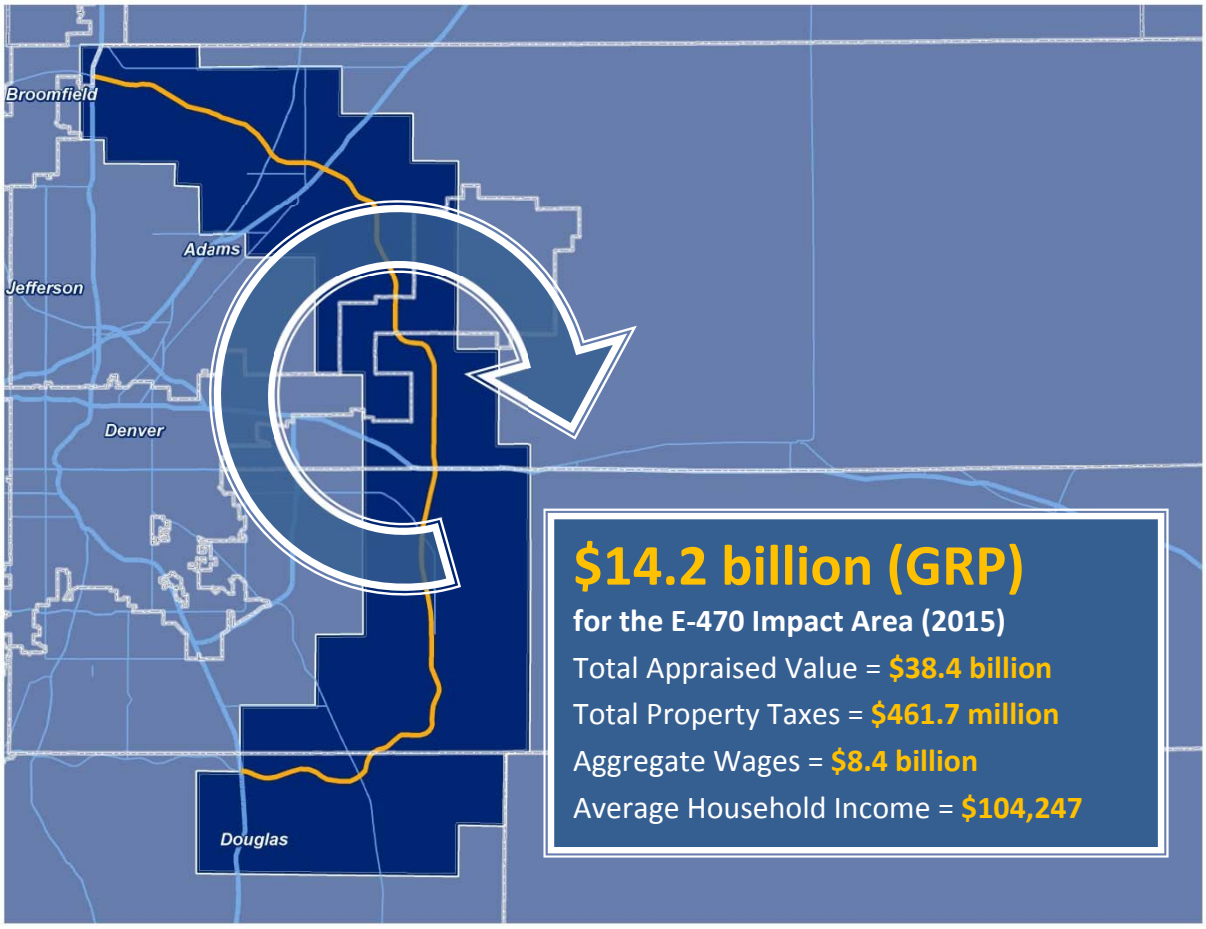
Figure 3
6-County MSA Economic Activity, 2015



E-470 Impact Area

Illustrated in **Figure 4** is the Impact Area as defined by several original 1986 land use and economic forecast documents, which projected increases in population, households, employment, as well as the escalation in total appraised property valuation and property taxes. The land use within these boundaries accounts for 15 percent of the MSA's population and 10 percent of its employment. It contains 12 percent of the MSA's total appraised property valuation and property tax liabilities. Aggregate wages account for 13 percent of the MSA's, and average wages of hourly and salaried workers is approximately 5 percent higher than the MSA average. Aggregate household income accounts for 15 percent of the MSA's, and the average income of households is 20 percent higher than the MSA average. In total, direct output from the Impact Area is $25.0 billion, and direct GRP is $14.2 billion, which both account for 12 percent of the MSA's 2015 economic activity.

Figure 4
E-470 Impact Area (1986 Boundaries)



As part of this study, EPS reviewed four original economic studies kept in-house at E-470's administrative building. The objective was to document land use projections from 1986 for the original impact area. The following, also illustrated in **Table 1**, are some of the most interesting differences between the 1986 projections for 2015 and 2015 actuals:

- Population and Households: the actual population in the E-470 Impact Area is 61 percent greater than was projected for 2015 back in 1986, and the actual count of households in 2015 is 19 percent higher. The wide variation in percentage differences is due to the fact that the 1986 projection assumed that the average household size would drop from 3.05 persons per household to 2.10 persons per household by 2015. In actuality, the persons per household rate only dropped to 2.84 in 2015 for this geography.
- Employment: the actual employment count is 45 percent lower than the nearly 240,000 projected by 2015. The projection was based on conversion of floor area to supportable jobs, and forecast that the Impact Area would grow from 7.7 million square feet to 77.3 million square feet of commercial/industrial floor area. The 1986 analysis assumed 400 square feet per retail jobs, 250 square feet per office job, and 550 per square feet per industrial job. Using the same overall average of 322 square feet per job, today's inventory of commercial/ industrial floor area is closer to approximately 36.4 million square feet.
- Property Valuation: Based on a number of demographic and employment growth assumptions, the original 1986 study projected total property valuation to increase to approximately $28.0 billion by 2015, nearly $10.5 billion less than actual appraised property valuation in 2015. Interestingly, assessed valuation was projected to reach $5.9 billion by 2015, which is $1.2 billion less than today's actual. One reason for the difference is that in 1986, the residential and commercial assessment rates were held at a constant 21 percent, whereas in actuality, according to the Gallagher Amendment, residential and commercial properties assessment rates are recalibrated so that the 45/55 percent apportionment is maintained – over time the residential assessment rate has dropped to 7.96 percent. Furthermore, because the assessed value was overestimated and because the millage rate from 1986 of 30 mills was not projected to increase over time, the annual property taxes were projected at $176.2 million, approximately $291 million less than today's actuals.

Table 1
1986 Projections and 2015 Actuals for E470 Original Impact Area

	2015 Projection (from 1986)	Recreated Original E-470 Impact Area	Difference
General			
Population	252,950	407,030	154,080
Households	120,450	143,225	22,775
Jobs	239,879	132,146	-107,733
Property Valuation			
Appraised Value	$27,969,000,000	$38,417,204,905	$10,448,204,905
Assessed Value	$5,873,600,000	$4,671,607,400	-$1,201,992,600
Property Taxes	$176,200,000	$467,087,932	$290,887,932

Source: Economic & Planning Systems

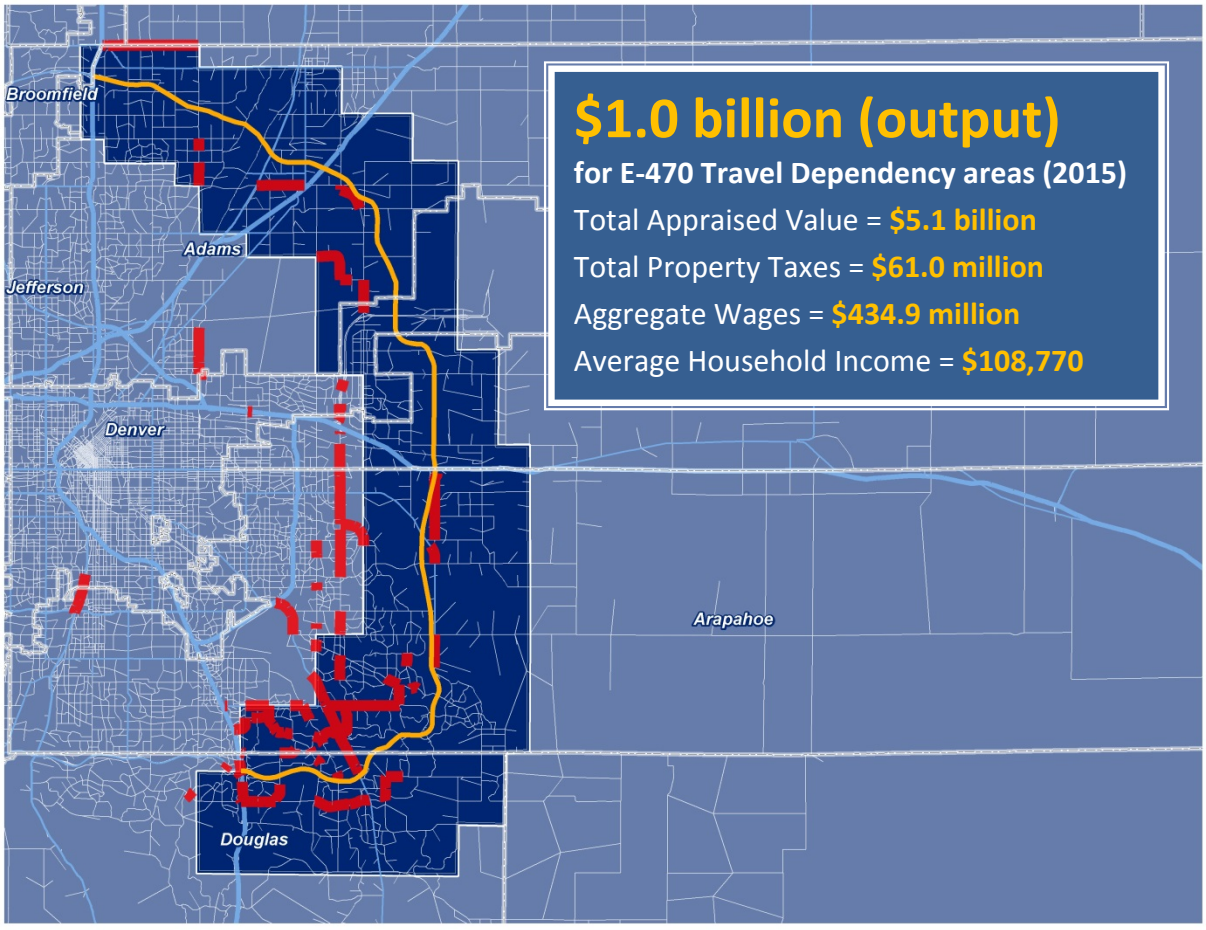
H:\153095-E470 Economic Impact Study\Models\[153095-Economic Impacts-040416.xlsx]TABLE 1.1- Orig Impact Area

Travel Dependency Areas

In the land use development surrounding and within the E-470 Impact Area, it is estimated that approximately 21,000 households and 7,800 jobs are dependent on E-470 for their daily commuting and personal travel needs. **Figure 5** illustrates the basis of this finding, indicating where surrounding roadway network sections are both pushed beyond their current volume of traffic per day by 25 percent and where current volumes are exceeded by at least 2,000 more vehicles per day. EPS and FHU made incremental reductions in the magnitude of households and jobs in selected areas around the E-470 Impact Area, which were identified as the source of trips pushing roadway sections beyond failure points.

This analysis was iterative, testing the effects of these incremental reductions in terms of trip generation and failure points. Ultimately, an appropriate reduction of households and jobs was developed such that travel demand on surrounding roadway segments was reduced to current (i.e. existing) levels. As shown, this magnitude of households and employment accounts for an estimated $1.0 billion in output and $608 million in GRP, both 4 percent of the E-470 Impact Area, 15 percent of its population, households, 6 percent of its employment, and 13 percent of its appraised property valuation and property taxes. Average household incomes are also 4 percent higher than the MSA average.

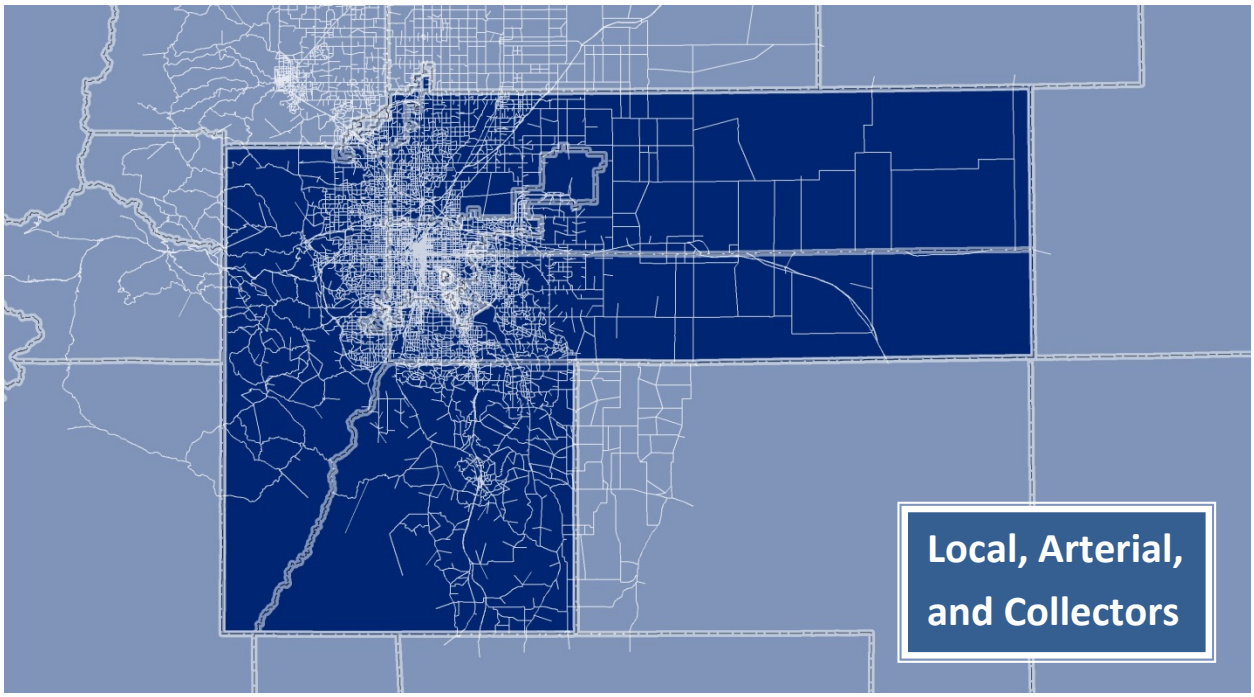
Figure 5
E-470 Travel Dependency and Roadway Failure, 2015

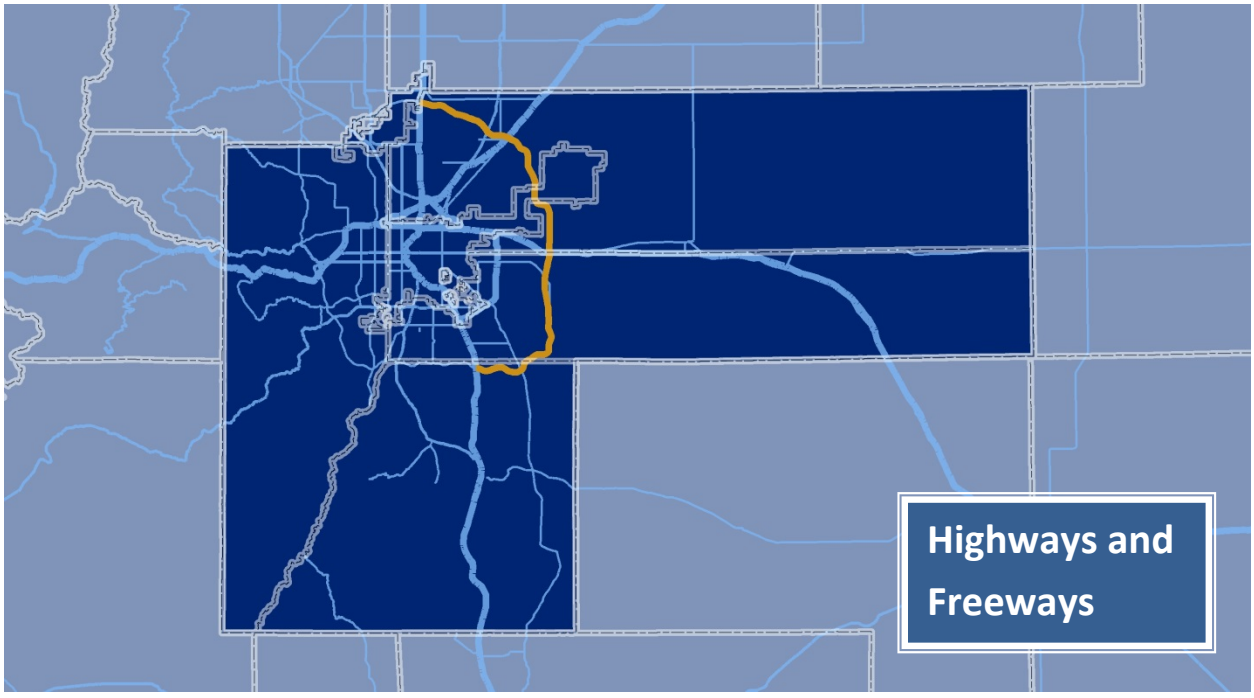


Other Impacts

There are other types of quantifiable economic impacts resulting from E-470 that are characterized in this section, two of which are related to the volume of travel by type of roadway network. **Figure 6** illustrates the network of local and arterial roadways (on top) in the 6-County MSA and (on bottom) the divided highway and freeway network including E-470.

Figure 6
Local and Arterial Roadway Networks vs Highways, 2015





Travel Time Savings

The travel demand analysis completed as a part of this study found that residents and workers of the 6-County MSA generated approximately 800.4 million vehicle hours traveled (VHT) under existing conditions. With E-470 removed from the travel demand model, however, it was estimated that VHT increased by 14.8 million hours, totaling 815.2 million VHT. Using industry standard value of time factors, the 14.8 million hours that E-470 saves drivers translates to a $199.1 million in annual time savings. This calculation uses 2013 factors (adjusted for inflation) recommended by the U.S. Department of Transportation for economic analysis of the value of time spent driving for personal and business travel. Adjusted by the Consumer Price Index, which increased by 4.0 percent between 2013 and 2015, the value of time factor for all purposes is $13.50 per hour in local travel settings.[3]

Because drivers in this scenario without E-470 are shifted from the tollway to un-tolled roadway networks, total toll revenues for 2015 ($173.0 million) are netted out of the gross travel time savings. As a result, the net economic impact to MSA drivers is an estimated $26.1 million in annual time savings.

An additional result of the travel demand modeling found that many of those VHT were spent in congestion. Under existing conditions, drivers in the MSA spend approximately 176.6 million hours in congestion, but without E-470 that amount of time would increase by 20.3 million hours to 196.8 million hours in congestion.

Safety Impacts

According to data collected by the Colorado Department of Transportation (CDOT), rates of property damage, injury (various degrees of severity), and fatality are higher on local roads, collectors and arterials than on interstates, highways, and freeways such as E-470. Data from the National Highway Transportation Safety Administration (NHTSA) confirm this as well. CDOT data specifically shows that, for example, the rate of fatalities on interstates and freeways (such as freeways) ranges from 0.5 to 0.7 fatalities per 100 million vehicle miles traveled compared to 1.4 to 2.2 fatalities per 100 million vehicle miles traveled on local roads, arterials, and collectors.

As mentioned above, the travel demand analysis completed as a part of this study found that *without E-470*, the trips associated with 376 million vehicle miles traveled would be displaced onto local roads, collectors, and arterials. While this would result in an estimated lower distance traveled (124 million fewer vehicle miles traveled) because E-470 is a longer (albeit faster) distance traveled, it would result in a higher frequency of accidents, property damage, injuries, and fatalities. As a result, and based on the most recently-available data from CDOT (2012), this shift in vehicle miles traveled would result in an estimated 176 more incidents of property damage, 27 more serious injuries, and two additional fatalities per year than under today's roadway network *with E-470*. As estimated using the U.S. Department of Transportation's Abbreviated Injury Scale (AIS) statistical values of injury/fatality severity, E-470's presence and utilization is estimated to avoid accident and fatality costs of approximately $24 million per year.

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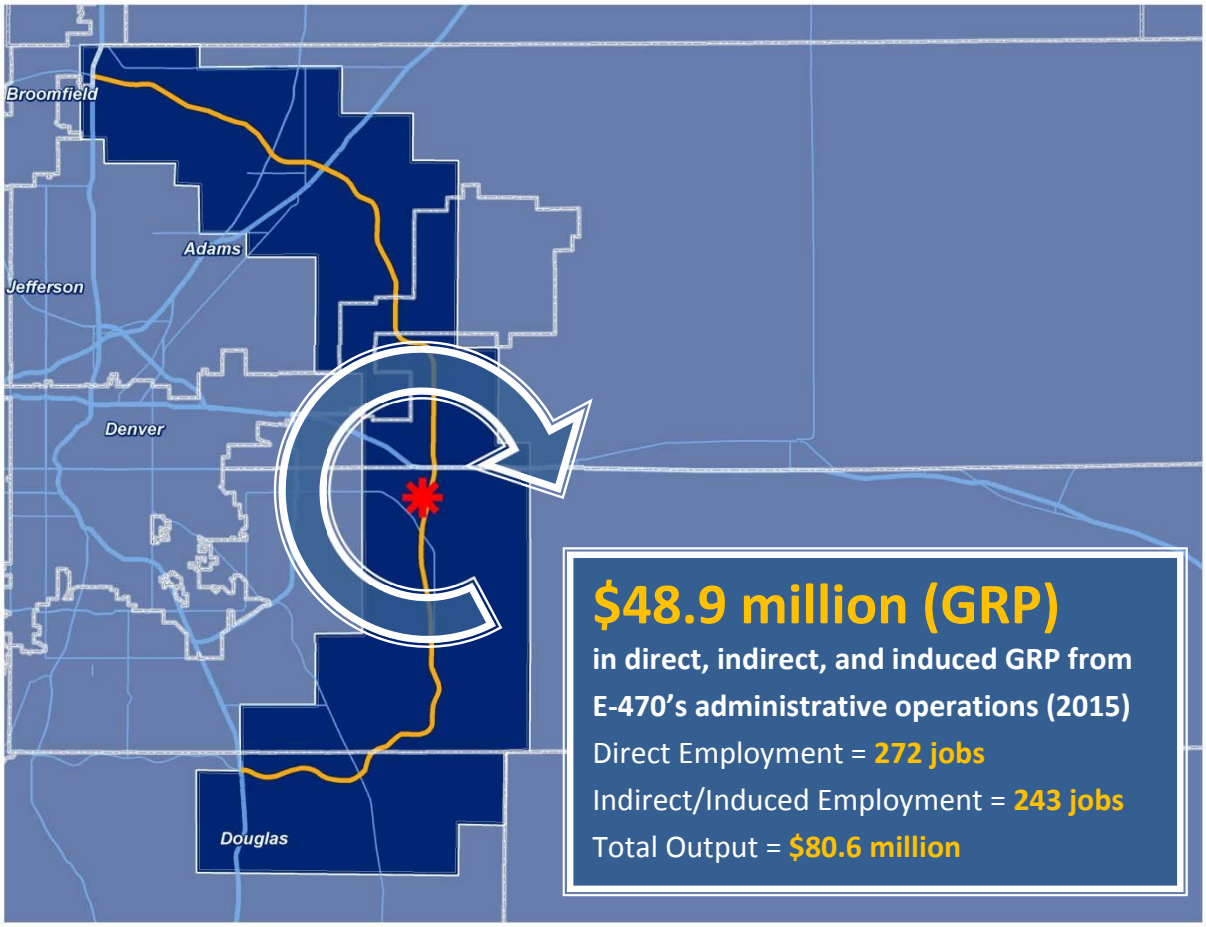
[3] The USDOT provides multiple factors for estimating the value of time savings. For local travel, personal trips are valued at $12.92 per hour, business trips are valued at $26.24 per hour, and "all purposes" trips are value at $13.50 per hour used in this calculation. For intercity travel, however, personal trips are valued at $18.20 per hour, business trips are valued at $25.38 per hour, and "all purposes" trips are value at $19.76 per hour.

Administrative Impacts

According to the E-470 PHA's current counts, 272 full- and part-time workers are employed either directly or through contract for services. Broken down by type, there are 25 jobs in transportation; 31 information technology jobs; 8 jobs in finance and insurance; 9 jobs in management; and 199 in administrative services

EPS used the employment inputs, classified by two-digit North American Industrial Classification System industry codes, to estimate direct, indirect, and induced employment, GRP, and output. As shown in **Figure 7**, E-470's administrative operations contribute a total of $48.9 million to the MSA's GRP, including $25.1 million directly and another $23.8 million indirectly. In addition to the 272 jobs it employs, an additional 243 jobs are supported throughout the MSA. And, as a result of its direct purchases for goods and services, as well as the purchases of its business-to-business relationships in the MSA, the E-470 administrative operations are supportive of a total of $80.6 million in spending in the MSA.

Figure 7
E-470 Operational Impacts, 2015



Appendix A:
Economic Impact Tables

E-470 Original (1986) Impact Area

Table 2
E-470 Original Impact Area Employment, 2015

Industry	Direct	Indirect	Induced	Total
Agriculture, Forestry, Fish & Hunting	252	158	90	500
Mining	1,912	757	135	2,804
Utilities	258	215	175	648
Construction	9,383	1,340	732	11,455
Manufacturing	6,032	1,341	1,052	8,425
Wholesale Trade	8,467	2,315	2,204	12,987
Retail trade	13,729	3,622	10,565	27,916
Transportation & Warehousing	6,241	3,229	1,767	11,237
Information	8,164	2,511	1,334	12,009
Finance & insurance	9,452	7,374	6,490	23,316
Real estate & rental	2,547	3,706	5,842	12,095
Professional- scientific & tech svcs	13,605	10,706	3,386	27,698
Management of companies	3,361	1,595	489	5,445
Administrative & waste services	8,258	10,367	4,520	23,145
Educational svcs	4,872	92	2,758	7,722
Health & social services	12,070	87	14,545	26,703
Arts- entertainment & recreation	3,685	1,391	2,552	7,628
Accommodation & food services	11,516	2,574	9,816	23,907
Other services	4,125	2,812	6,803	13,740
Government & non NAICs	4,217	2,769	3,504	10,490
Total	**132,146**	**58,963**	**78,760**	**269,868**

Source: IMPLAN; Economic & Planning Systems

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Table 3
E-470 Original Impact Area GRP, 2015

Industry	Direct ($ millions)	Indirect ($ millions)	Induced ($ millions)	Total ($ millions)
Agriculture, Forestry, Fish & Hunting	$9.71	$6.08	$3.47	$19.26
Mining	$669.29	$264.99	$47.14	$981.42
Utilities	$150.05	$125.16	$101.67	$376.88
Construction	$709.84	$101.38	$55.34	$866.55
Manufacturing	$899.30	$199.92	$156.87	$1,256.09
Wholesale Trade	$1,416.41	$387.34	$368.75	$2,172.50
Retail trade	$750.15	$197.93	$577.25	$1,525.33
Transportation & Warehousing	$641.70	$332.05	$181.65	$1,155.41
Information	$2,502.47	$769.57	$408.93	$3,680.98
Finance & insurance	$966.95	$754.40	$663.95	$2,385.29
Real estate & rental	$636.18	$925.78	$1,459.14	$3,021.09
Professional- scientific & tech svcs	$1,472.12	$1,158.45	$366.42	$2,996.99
Management of companies	$646.97	$307.02	$94.04	$1,048.04
Administrative & waste services	$435.06	$546.16	$238.15	$1,219.37
Educational svcs	$222.75	$4.19	$126.10	$353.05
Health & social services	$809.94	$5.86	$976.05	$1,791.84
Arts- entertainment & recreation	$184.10	$69.50	$127.50	$381.10
Accommodation & food services	$439.48	$98.24	$374.61	$912.33
Other services	$227.32	$154.97	$374.91	$757.20
Government & non NAICs	$369.95	$242.91	$307.41	$920.27
Total	**$14,159.74**	**$6,651.89**	**$7,009.35**	**$27,820.99**

Source: IMPLAN; Economic & Planning Systems

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Table 4
E-470 Original Impact Area Total Spending, 2015

Industry	Direct ($ millions)	Indirect ($ millions)	Induced ($ millions)	Total ($ millions)
Agriculture, Forestry, Fish & Hunting	$15.81	$9.90	$5.64	$31.35
Mining	$1,017.04	$402.68	$71.63	$1,491.35
Utilities	$360.48	$300.67	$244.25	$905.39
Construction	$1,700.74	$242.89	$132.59	$2,076.23
Manufacturing	$2,720.06	$604.70	$474.46	$3,799.22
Wholesale Trade	$2,120.64	$579.92	$552.09	$3,252.65
Retail trade	$1,111.91	$293.38	$855.63	$2,260.92
Transportation & Warehousing	$1,278.79	$661.72	$362.00	$2,302.51
Information	$4,530.31	$1,393.19	$740.31	$6,663.80
Finance & insurance	$1,961.24	$1,530.13	$1,346.68	$4,838.05
Real estate & rental	$940.53	$1,368.68	$2,157.20	$4,466.41
Professional- scientific & tech svcs	$2,289.29	$1,801.51	$569.82	$4,660.63
Management of companies	$966.88	$458.84	$140.54	$1,566.27
Administrative & waste services	$622.36	$781.28	$340.68	$1,744.32
Educational svcs	$352.49	$6.63	$199.55	$558.67
Health & social services	$1,277.10	$9.24	$1,539.02	$2,825.36
Arts- entertainment & recreation	$304.87	$115.10	$211.14	$631.11
Accommodation & food services	$753.02	$168.33	$641.88	$1,563.23
Other services	$304.82	$207.79	$502.72	$1,015.33
Government & non NAICs	$379.42	$249.13	$315.29	$943.85
Total	**$25,007.83**	**$11,185.71**	**$11,403.13**	**$47,596.66**

Source: IMPLAN; Economic & Planning Systems

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E-470 Travel Dependency

Table 5
Impact Area Travel Dependency Employment, 2015

Industry	Direct	Indirect	Induced	Total
Agriculture, Forestry, Fish & Hunting	4	5	4	13
Mining	14	25	6	44
Utilities	21	13	7	41
Construction	561	55	31	647
Manufacturing	154	52	45	251
Wholesale Trade	279	95	94	467
Retail trade	2,040	205	449	2,694
Transportation & Warehousing	77	131	75	284
Information	145	75	57	276
Finance & insurance	207	257	276	740
Real estate & rental	120	179	248	548
Professional- scientific & tech svcs	576	409	144	1,129
Management of companies	35	72	21	128
Administrative & waste services	461	427	192	1,080
Educational svcs	216	6	117	339
Health & social services	923	7	619	1,548
Arts- entertainment & recreation	347	53	108	509
Accommodation & food services	1,350	103	417	1,869
Other services	359	121	289	770
Government & non NAICs	117	92	149	358
Total	**8,005**	**2,383**	**3,348**	**13,735**

Source: IMPLAN; Economic & Planning Systems

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Table 6
Impact Area Travel Dependency GRP, 2015

Industry	Direct ($ millions)	Indirect ($ millions)	Induced ($ millions)	Total ($ millions)
Agriculture, Forestry, Fish & Hunting	$0.16	$0.20	$0.15	$0.50
Mining	$4.83	$8.64	$2.00	$15.48
Utilities	$12.30	$7.28	$4.32	$23.91
Construction	$42.45	$4.18	$2.35	$48.98
Manufacturing	$22.91	$7.77	$6.67	$37.35
Wholesale Trade	$46.68	$15.82	$15.67	$78.18
Retail trade	$111.45	$11.22	$24.53	$147.21
Transportation & Warehousing	$7.95	$13.49	$7.72	$29.16
Information	$44.29	$23.01	$17.39	$84.69
Finance & insurance	$21.22	$26.29	$28.22	$75.72
Real estate & rental	$30.04	$44.69	$62.03	$136.76
Professional- scientific & tech svcs	$62.33	$44.27	$15.57	$122.18
Management of companies	$6.68	$13.91	$4.00	$24.58
Administrative & waste services	$24.28	$22.51	$10.12	$56.91
Educational svcs	$9.87	$0.29	$5.35	$15.52
Health & social services	$61.90	$0.44	$41.50	$103.85
Arts- entertainment & recreation	$17.34	$2.66	$5.42	$25.41
Accommodation & food services	$51.50	$3.92	$15.92	$71.34
Other services	$19.79	$6.69	$15.93	$42.41
Government & non NAICs	$10.30	$8.05	$13.07	$31.42
Total	**$608.27**	**$265.33**	**$297.95**	**$1,171.55**

Source: IMPLAN; Economic & Planning Systems

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Table 7
Impact Area Travel Dependency Total Spending, 2015

Industry	Direct ($ millions)	Indirect ($ millions)	Induced ($ millions)	Total ($ millions)
Agriculture, Forestry, Fish & Hunting	$0.25	$0.32	$0.24	$0.82
Mining	$7.34	$13.13	$3.05	$23.52
Utilities	$29.55	$17.49	$10.39	$57.43
Construction	$101.71	$10.01	$5.64	$117.36
Manufacturing	$69.31	$23.49	$20.17	$112.97
Wholesale Trade	$69.89	$23.69	$23.46	$117.04
Retail trade	$165.20	$16.64	$36.36	$218.20
Transportation & Warehousing	$15.84	$26.89	$15.38	$58.10
Information	$80.18	$41.66	$31.48	$153.32
Finance & insurance	$43.03	$53.32	$57.23	$153.59
Real estate & rental	$44.40	$66.07	$91.71	$202.19
Professional- scientific & tech svcs	$96.93	$68.85	$24.22	$190.00
Management of companies	$9.98	$20.78	$5.97	$36.74
Administrative & waste services	$34.73	$32.20	$14.48	$81.41
Educational svcs	$15.62	$0.46	$8.47	$24.55
Health & social services	$97.61	$0.70	$65.44	$163.75
Arts- entertainment & recreation	$28.71	$4.40	$8.97	$42.08
Accommodation & food services	$88.25	$6.71	$27.28	$122.24
Other services	$26.53	$8.97	$21.37	$56.87
Government & non NAICs	$10.57	$8.26	$13.40	$32.23
Total	**$1,035.65**	**$444.04**	**$484.72**	**$1,964.41**

Source: IMPLAN; Economic & Planning Systems

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E-470 Administrative Operations

Table 8
E-470 Administrative Operation Employment Impact, 2015

Industry	Direct	Indirect	Induced	Total
Agriculture, Forestry, Fish & Hunting	0	0	0	0
Mining	0	0	0	0
Utilities	0	0	0	0
Construction	0	2	1	3
Manufacturing	0	2	2	4
Wholesale Trade	0	2	4	6
Retail trade	0	2	19	21
Transportation & Warehousing	25	6	3	34
Information	31	7	2	40
Finance & insurance	8	9	12	29
Real estate & rental	0	6	11	16
Professional- scientific & tech svcs	0	20	6	26
Management of companies	9	2	1	12
Administrative & waste services	199	22	8	229
Educational svcs	0	0	5	5
Health & social services	0	0	26	26
Arts- entertainment & recreation	0	4	5	8
Accommodation & food services	0	6	18	23
Other services	0	6	12	18
Government & non NAICs	0	6	6	13
Total	**272**	**101**	**142**	**515**

Source: IMPLAN; Economic & Planning Systems

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Table 9
E-470 Administrative Operations GRP, 2015

Industry	Direct ($ millions)	Indirect ($ millions)	Induced ($ millions)	Total ($ millions)
Agriculture, Forestry, Fish & Hunting	$0.00	$0.00	$0.01	$0.01
Mining	$0.00	$0.08	$0.08	$0.16
Utilities	$0.00	$0.10	$0.18	$0.28
Construction	$0.00	$0.12	$0.10	$0.22
Manufacturing	$0.00	$0.24	$0.28	$0.52
Wholesale Trade	$0.00	$0.42	$0.66	$1.08
Retail trade	$0.00	$0.11	$1.04	$1.15
Transportation & Warehousing	$2.57	$0.59	$0.33	$3.49
Information	$9.50	$2.14	$0.74	$12.38
Finance & insurance	$0.82	$0.95	$1.20	$2.96
Real estate & rental	$0.00	$1.43	$2.63	$4.06
Professional- scientific & tech svcs	$0.00	$2.18	$0.66	$2.84
Management of companies	$1.73	$0.34	$0.17	$2.24
Administrative & waste services	$10.48	$1.17	$0.43	$12.09
Educational svcs	$0.00	$0.00	$0.23	$0.23
Health & social services	$0.00	$0.00	$1.76	$1.76
Arts- entertainment & recreation	$0.00	$0.18	$0.23	$0.41
Accommodation & food services	$0.00	$0.22	$0.67	$0.89
Other services	$0.00	$0.31	$0.68	$0.98
Government & non NAICs	$0.00	$0.55	$0.55	$1.10
Total	**$25.11**	**$11.12**	**$12.63**	**$48.86**

Source: IMPLAN; Economic & Planning Systems

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Table 10
E-470 Administrative Operations Total Spending, 2015

Industry	Direct ($ millions)	Indirect ($ millions)	Induced ($ millions)	Total ($ millions)
Agriculture, Forestry, Fish & Hunting	$0.00	$0.00	$0.01	$0.01
Mining	$0.00	$0.12	$0.13	$0.25
Utilities	$0.00	$0.23	$0.44	$0.67
Construction	$0.00	$0.29	$0.24	$0.53
Manufacturing	$0.00	$0.72	$0.85	$1.58
Wholesale Trade	$0.00	$0.62	$0.99	$1.62
Retail trade	$0.00	$0.17	$1.54	$1.71
Transportation & Warehousing	$5.12	$1.17	$0.65	$6.95
Information	$17.20	$3.88	$1.33	$22.42
Finance & insurance	$1.66	$1.92	$2.43	$6.01
Real estate & rental	$0.00	$2.11	$3.89	$6.00
Professional- scientific & tech svcs	$0.00	$3.39	$1.03	$4.41
Management of companies	$2.59	$0.51	$0.25	$3.35
Administrative & waste services	$15.00	$1.68	$0.61	$17.29
Educational svcs	$0.00	$0.01	$0.36	$0.36
Health & social services	$0.00	$0.00	$2.77	$2.77
Arts- entertainment & recreation	$0.00	$0.29	$0.38	$0.68
Accommodation & food services	$0.00	$0.37	$1.16	$1.53
Other services	$0.00	$0.41	$0.91	$1.32
Government & non NAICs	$0.00	$0.56	$0.57	$1.13
Total	**$41.57**	**$18.47**	**$20.54**	**$80.59**

Source: IMPLAN; Economic & Planning Systems

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