

Tech Memo 4. The Economic Role of Air Cargo in Colorado

4.1 Introduction

Beyond creating impacts of their own as a matter of their operation, Colorado airports play an additional critical role in the state economy by enabling manufacturers and agricultural producers to transport commodities and finished goods to customers located in both long-distance domestic and international markets. The value of shipped commodities is the equivalent of sales of goods from businesses in Colorado to customers in long-distance markets. Without support provided by air cargo services, the markets available to Colorado companies that produce and ship products would be limited and market shares curtailed, leading to an overall reduction in economic activity in the state. The following sections describe how airports support economic development and impact by enabling Colorado firms to sell products out of state, across the U.S. and throughout the world, thereby maximizing their market share of national and international trade and bringing revenues from those sales into Colorado.

This analysis is based on industry-specific data from the U.S. Census Bureau's Foreign Trade Division (collected by WISERTrade) and the Freight Analysis Framework (FAF), jointly produced by the Bureau of Transportation Statistics (BTS) and Federal Highway Administration (FHWA), and county-level economic output (business revenue) data by industry sectors assembled by IMPLAN from federal sources (primarily the U.S. Bureau of Economic Analysis or BEA). Using these data allow for estimates of commodities produced by Colorado industries and sold out of state, and avoids counting tonnage flown within Colorado.

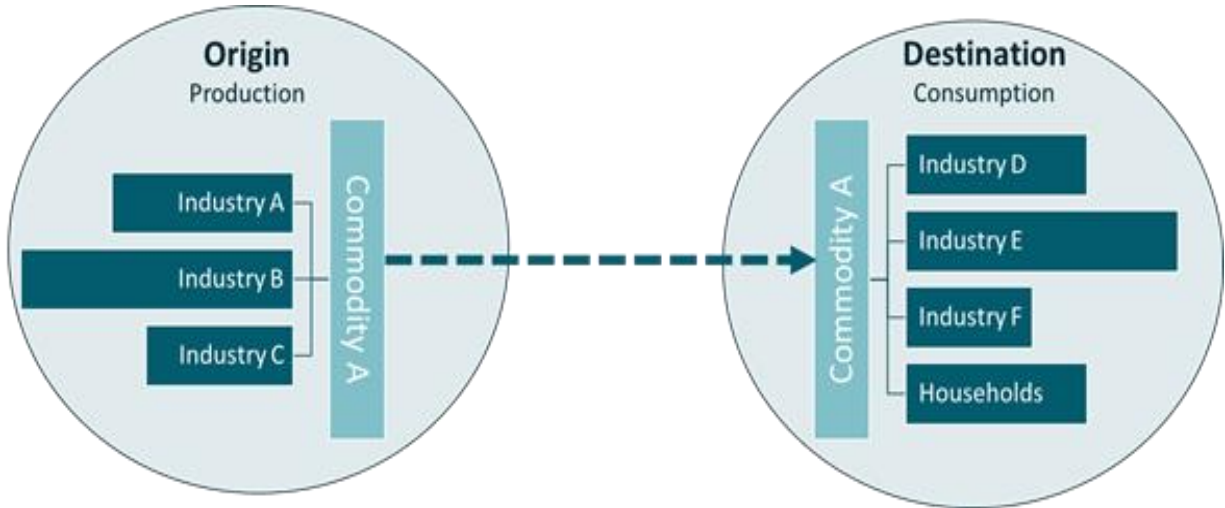
The Colorado Aviation Economic Impact Study (CEIS) is primarily focused on activities that occur on the airport or are related to the operation of the airport system. These include airfield activities that support aircraft operations and terminal activities that support passenger traffic, including visitors who arrive by air. The economic impact of air cargo documents the off-airport activities that are supported by air cargo services at airports. Air cargo's "off-airport related impacts" are the business revenues earned due to these long-distance sales, and the subsequent jobs, payroll, and value added attributable to those sales. These impacts are earned by a wide range of manufacturing and agriculture companies that rely on Colorado's airports to ship products out of state. The 2013 Economic Impact Study for Colorado Airports included a similar off-airport air cargo related economic impact analysis, which provided an economic snapshot of conditions that characterized Colorado in 2012.

4.2 Allocating Air Cargo to Industries of Production

Figure 4.1 illustrates the relationship between (1) industries and commodities; and (2) the process of shipping commodities for sale to points of purchase. Commodities produced in Colorado by one or more industries are shipped to subsequent ultimate destinations. Once they reach those destinations, the commodities are consumed by one or more (potentially different) industries as inputs to their production (usually referred to as "intermediate inputs"), or as final demand for households. An example of an intermediate input may be plastic produced in Colorado and flown to Michigan where it is used as part of automobile production. An example of a product shipped for "final demand" is a pharmaceutical product manufactured in Colorado and flown to Florida; the product itself may be

handled by wholesalers and retailers, but it is purchased directly by consumers at drug stores without any further production required.

Figure 4.1. Schematic Presentation of Inter-industry Commodity Flows (Cargo Flows) Between Regions



Source: EBP, 2020

4.3 Data Sources

WISERTrade and FAF data provided the base data used to develop a detailed profile of air shipments from Colorado, by commodity and origin of movement. WISERTrade is port-specific and provides the point of origin by state. WISERTrade reports commodities and value or air cargo shipped to international destinations from Colorado airports that have point of origins in the state. On the other hand, FAF is not port-specific. Rather, FAF data are provided on commodity origin that is broken out by the Denver metropolitan statistical area (MSA) and the “rest of state.” FAF reports commodities produced in Colorado by MSA or in the rest of the state that are shipped by air. Neither source, however, provides county-level data on where shipped commodities are produced. Therefore, to determine point-of-origin data at the commodity level, U.S. Department of Commerce data assembled by IMPLAN were used to calculate the ratios of business revenue by commodity for Colorado counties compared to the total revenues produced in the state. This calculation provides an estimate of the “share” of Colorado-produced air shipments with an approximate point of origin by county.

The FAF integrates data from a variety of sources to create a comprehensive picture of cargo movement between geographic zones - major metropolitan areas and remaining nonmetropolitan areas of each state. FAF provides this data by all modes of transportation, including aviation. The latest version of FAF (FAF4) provides estimates for tonnage value (and ton-miles) by regions of origin and destination, commodity type, and mode.

FAF classifies commodities according to the 2-digit level of the Standard Classification of Transported Goods (SCTG) codes, and WISERTrade classifies commodity data in terms of value and weight according

to the Harmonized System.¹ IMPLAN, meanwhile, tracks commodity flows between industries using a different set of 536 sectors. A crosswalk between WISERTrade, FAF, and IMPLAN made it possible to estimate the value of air cargo commodities produced by county and shipped from Colorado airports.

WISERTrade provides commodity flow data in terms of value and weight according to commodity type and was used to estimate the weight and value of goods produced in Colorado and exported from Denver International Airport (DEN) to international markets.² The Foreign Trade Division, through WISERTrade, provides data on total exports by commodity and state of origin, and the total value of exports shipped. WISERTrade aggregates total value and weight by commodity for all shipments from DEN, including at a commodity level by state point of origin.³

4.4 Cargo Activity

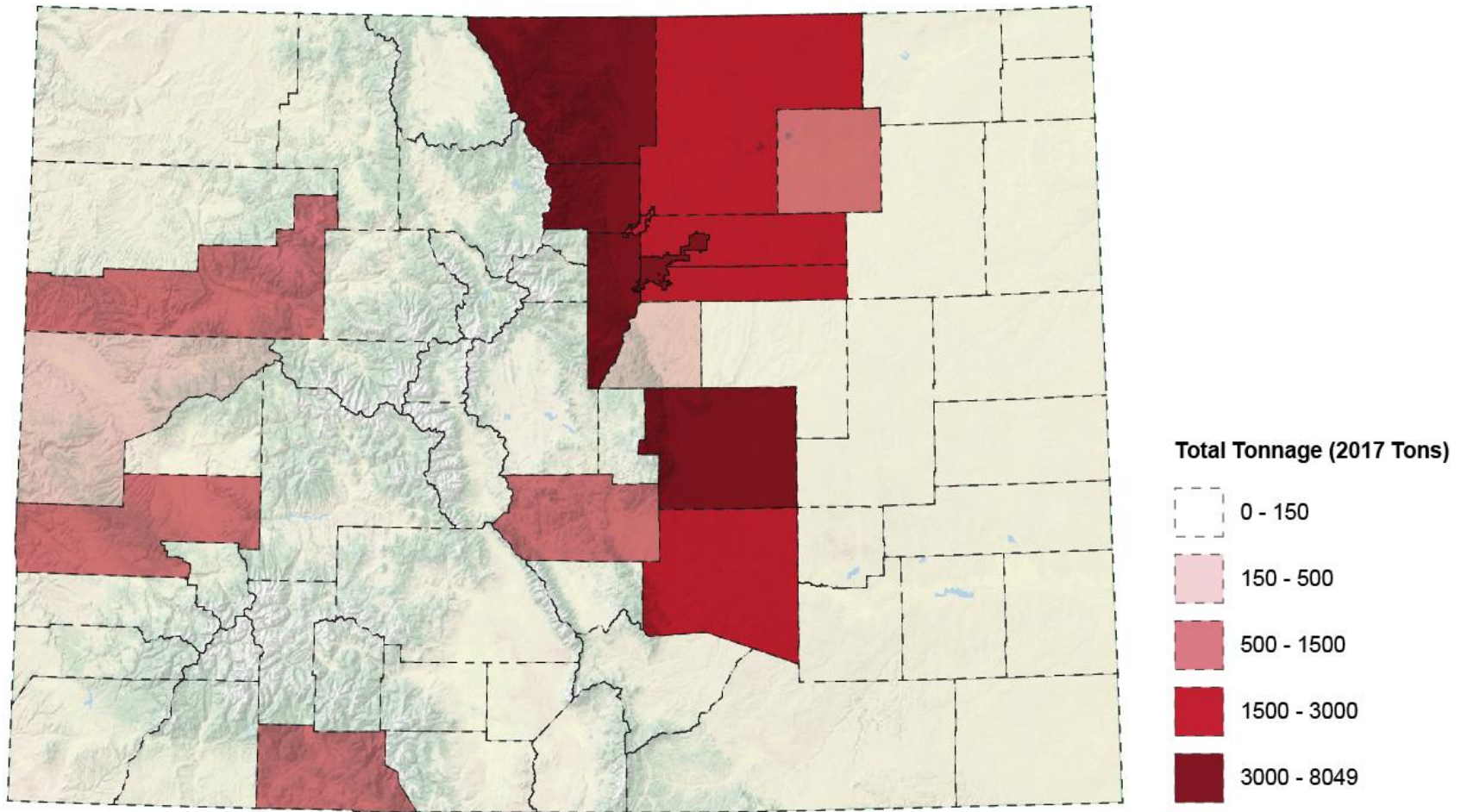
Using the FAF and WISERTrade data described above, **Figure 4.2** shows the location by county of industries in Colorado that produce goods shipped through Colorado airports to out-of-state domestic and international destinations, with darker red counties indicating greater tonnage of air cargo flowing out of that county.

¹ The Harmonized System is the predominant international commodity classification usage for international trade and is used by over 200 countries for assessing tariffs. EBP has developed a crosswalk between the two commodity codes for cohesive reporting and analysis.

² DEN is the only Colorado airport showing 2018 international trade shipments.

³ EBP has entered into a special data agreement with WISERTrade to be able to trace commodities by state of origin and port of export.

Figure 4.2. Tonnage Produced by County and Flown to Markets



Sources: WISERTrade data from the U.S. Census Bureau Foreign Trade Division, FAFData from the Bureau of Transportation Statistics and Federal Highway Administration, 2017 and the IMPLAN modeling system, and Calculations by EBP, 2020



Table 4.1 compares domestic cargo activity produced and shipped from Colorado to international cargo in terms of value and tonnage by commodity group. Domestic cargo exceeds international cargo in both value and weight and comprises a similar set of commodity types. The top value commodity is the same for both domestic and international cargo (precision instruments) as is the third highest value commodity (electronics). Beyond these two commodity types, however, domestic and international cargo differs, with transport equipment, printed products, and base metal articles comprising the other most valuable domestic commodity flows, as opposed to machinery, pharmaceuticals, and basic chemicals for international cargo in terms of high-value commodities.

Table 4.1. Comparison of Domestic and International Cargo in Terms of Current Value and Tonnage

Domestic Commodities				International Commodities			
SCTG	Description	Tons	Value	SCTG	Description	Tons	Value
38	Precision Instruments	4,317	\$842,745,000	38	Precision Instruments	1,180	\$286,220,000
37	Transport Equipment	1,477	\$480,384,000	34	Machinery	1,296	\$114,596,000
35	Electronics	6,660	\$353,662,000	35	Electronics	507	\$66,243,000
29	Printed Products	8,094	\$117,291,000	21	Pharmaceuticals	164	\$62,252,000
33	Articles-Base Metal	6,005	\$108,454,000	20	Basic Chemicals	87	\$34,916,000
21	Pharmaceuticals	2,633	\$45,607,000	37	Transport Equipment	41	\$28,025,000
36	Motorized Vehicles	861	\$33,243,000	40	Misc. Mfg. Products	83	\$17,062,000
34	Machinery	607	\$16,782,000	23	Chemical Products	311	\$15,486,000
24	Plastics/Rubber	361	\$12,289,000	24	Plastics/Rubber	250	\$6,790,000
40	Misc. Mfg. Products	1,387	\$9,600,000	31	Non-Metal Min. Products	86	\$6,104,000
	Rest of Commodities	2,412	\$20,481,000		Rest of Commodities	772	\$20,812,000
TOTAL		34,813	\$2,040,538,000	TOTAL		4,777	\$658,506,000

Sources: WISERTrade data from the U.S. Census Bureau Foreign Trade Division; FAF Data from the Bureau of Transportation Statistics and Federal Highway Administration, 2017; and Calculations by EBP, 2020

4.5 Total Air Cargo Impact

Table 4.2 provides a summary of total air cargo related economic impacts for Colorado. The business revenues shown represent earnings of Colorado businesses from sales of commodities that were shipped out of state by air. These are earnings that are enabled by Colorado airports in support of state

industries. The air cargo impacts shown in **Table 4.2** include both domestic and international air cargo, as well as the two streams of multiplier effects that account for supplier sales and income respending in Colorado as a result of the commodity production and income earned by workers due to the sales.

Table 4.2. Total Statewide Economic Impact of Air Cargo Movement from Colorado

Total Statewide Economic Impact of Air Cargo				
	Jobs	Payroll	Value Added	Business Revenues
Direct	6,079	\$672,030,000	\$1,174,293,000	\$2,699,044,000
Supplier Sales	3,493	\$293,738,000	\$462,488,000	\$809,087,000
Income Respending	4,988	\$248,390,000	\$524,712,000	\$881,530,000
Total	14,560	\$1,214,158,000	\$2,161,493,000	\$4,389,661,000

Columns and rows may not add due to rounding.

Sources: Data from FAF, WISERTrade and IMPLAN assembled and calculated by EBP

DEN and Colorado Springs Municipal (COS) support the overwhelming proportion of air cargo shipped out of state by Colorado producers, and account for 98.6 percent of direct business revenues earned by state businesses from their exports. DEN by itself accounts for almost 94 percent of direct business revenues generated by exports.

Table 4.3 presents the statewide economic impacts of air cargo shipped out of state through DEN, COS, and airports in the rest of Colorado. **Table 4.2** and **Table 4.3** demonstrates the scale of the economic impacts resulting from air cargo in Colorado. Considering direct effects and subsequent supplier sales and income respending, air cargo produced in Colorado and shipped from state airports generates almost \$4.4 billion in business revenues. These revenues support over 14,500 jobs, more than \$1.2 billion in payroll, and almost \$2.2 billion in value added.

Table 4.3. Economic Support to Businesses in Colorado by Airport from Providing Air Cargo Services

State Economic Impact by Airport/Region				
	COS	DEN	Rest of State	Total Impacts
Jobs				
Direct	354	5,603	122	6,079
Supplier Sales	140	3,332	21	3,493
Income Responding	194	4,770	24	4,988
Total	687	13,705	168	14,560
Payroll				
Direct	\$32,041,000	\$632,007,000	\$7,981,000	\$672,030,000
Indirect	\$11,683,000	\$280,331,000	\$1,723,000	\$293,738,000
Induced	\$9,659,000	\$237,554,000	\$1,177,000	\$248,390,000
Total	\$53,382,000	\$1,149,893,000	\$10,882,000	\$1,214,158,000
Value Added				
Direct	\$50,220,000	\$1,112,328,000	\$11,746,000	\$1,174,293,000
Indirect	\$18,185,000	\$441,524,000	\$2,780,000	\$462,488,000
Induced	\$20,404,000	\$501,822,000	\$2,486,000	\$524,712,000
Total	\$88,809,000	\$2,055,674,000	\$17,011,000	\$2,161,493,000
Output				
Direct	\$131,191,000	\$2,530,399,000	\$37,455,000	\$2,699,044,000
Indirect	\$32,790,000	\$771,210,000	\$5,087,000	\$809,087,000
Induced	\$34,279,000	\$843,075,000	\$4,176,000	\$881,530,000
Total	\$198,260,000	\$4,144,684,000	\$46,718,000	\$4,389,661,000

Columns and rows may not add due to rounding.

Sources: Data from FAF, WISERTrade and IMPLAN assembled and calculated by EBP, 2020

4.6 Comparison to Prior Impacts

While the off-airport air cargo related economic impact valuation methodologies used in both the 2013 and the current CEIS are similar, comparing the results of the two studies presents a significant challenge. Relative to the current air cargo data obtained for this study, the 2013 report showed much lower tonnage, but a much higher value per ton for several important commodities.

Table 4.4 depicts the 2017 cargo volumes and value from FAF supporting the economic impacts presented previously in **Table 4.2** and compares them to the volume and value for Colorado according to the 2011 FAF, which was the basis for the prior economic impact report. While the 2017 FAF cargo volumes and values are roughly comparable to those in the 2013 FAF, a major change occurred between 2011 and 2013, as the FAF methodology was revised.

By drawing this comparison, **Table 4.4** demonstrates why it is difficult to compare the current off-airport air cargo related economic impacts to the prior report. Specifically, the total tonnage reported for Colorado increased from 11,000 tons in 2011 FAF to 37,080 tons in 2013 FAF, while the value of those commodities dropped from \$3.5 billion to \$2.0 billion. In other words, the reported tonnage

increased by over three-fold, yet the value of goods produced decreased by more than 40 percent in just a two-year period. The 2017 FAF report for Colorado is consistent with 2013.

FAF data indicates a major change occurred in estimating tonnage and in the value of commodities per ton. For example, from 2011 to 2017, the value per ton of the top commodity in the current report - precision instruments - fell 90 percent, from \$1,975,800 per ton to \$195,200 per ton. Similarly, the second top commodity in the current report, transportation equipment, fell in value from \$2,352,300 per ton to just \$325,300 per ton, a reduction of 86 percent. As a result, the estimated total value of the air cargo in 2017 is much lower than it was in the previous report which used the 2011 FAF, even though reported tonnage has increased. This drop-in value per ton also translates to the lower economic impacts reported for 2018 for off-airport cargo related activity.

It is natural to wonder why a similar dataset might produce such wildly different values in two different years. Understanding this change requires an understanding of FAF. As noted in the introduction, the FAF integrates data from a variety of sources to create a comprehensive national picture of cargo movements among states and major metropolitan areas (by air and by other modes of transportation). The current analysis used FAF4 (the fourth database of its kind), while the 2013 economic impact study used FAF3.

Since FAF2, the database has relied on the U.S. Census Bureau's Commodity Flow Survey (CFS) for much of its commodity and mode detail. The CFS is a survey of business establishments conducted every five years and produces commodity flow data based on samples from the surveys. The CFS collects data on shipments, including commodity type, originating from a wide range of industries. FAF4 relied on the 2012 CFS, while FAF3 relied on the 2007 CFS. The reasons for changes in data from FAF3 to FAF4 are not clearly stated. However, changes in the CFS, such as the redefinition of the minimum weight that constitutes an air shipment, may have changed aspects of FAF4. The BTS itself has noted that changes in geography, commodities, and modes in the 2012 CFS have impacts on FAF4 in comparison to historical FAF data series.⁴

⁴ Bureau of Transportation Statistics (BTS), *Effects of Changes in 2012 Commodity Flow Survey*. Updated: November 2017. https://www.bts.gov/archive/subject_areas/freight_transportation/faf/faf4/effects

Table 4.4. Comparison of Cargo Volumes and Value (Past and Present), Organized by Top Commodities in 2017 FAF

Comparison of Underlying Freight Volumes and Value (Past & Present)														
2017 FAF					2013 FAF					2011 FAF (Used in Prior Report)				
SCTG	Description	Tons (1,000s)	Value	Value/Ton	SCTG	Description	Tons (1,000s)	Value	Value/Ton	SCTG	Description	Tons (1,000s)	Value	Value/Ton
38	Precision Instruments	4.32	\$842,744,900	\$195,215	38	Precision Instruments	4.40	\$817,353,400	\$185,703	38	Precision Instruments	0.21	\$424,606,000	\$1,975,831
37	Transport Equipment	1.48	\$480,383,600	\$325,265	37	Transport Equipment	1.50	\$458,110,400	\$305,672	37	Transport Equipment	1.01	\$2,377,223,900	\$2,352,290
35	Electronics	6.66	\$353,662,200	\$53,104	35	Electronics	6.73	\$362,518,600	\$53,856	35	Electronics	1.85	\$228,446,600	\$123,732
29	Printed Products	8.09	\$117,291,200	\$14,491	29	Printed Products	10.37	\$149,158,700	\$14,390	29	Printed Products	1.52	\$22,601,600	\$14,918
33	Articles-Base Metal	6.01	\$108,453,500	\$18,061	33	Articles-Base Metal	5.86	\$104,917,700	\$17,911	33	Articles-Base Metal	0.08	\$28,413,300	\$359,662
21	Pharmaceuticals	2.63	\$45,607,400	\$17,319	21	Pharmaceuticals	2.65	\$34,137,100	\$12,879	21	Pharmaceuticals	0.98	\$194,164,200	\$198,026
36	Motorized Vehicles	0.86	\$33,243,400	\$38,597	36	Motorized Vehicles	0.75	\$27,736,900	\$36,752	36	Motorized Vehicles	1.37	\$34,948,400	\$25,454
34	Machinery	0.61	\$16,781,700	\$27,661	34	Machinery	0.67	\$17,622,100	\$26,365	34	Machinery	0.00	\$11,107,400	\$3,966,929
24	Plastics/Rubber	0.36	\$12,288,600	\$34,012	24	Plastics/Rubber	0.35	\$11,726,900	\$33,922	24	Plastics/Rubber	0.71	\$14,249,400	\$20,195
40	Misc. Mfg. Prods.	1.39	\$9,600,000	\$6,924	40	Misc. Mfg. Prods.	1.34	\$8,782,900	\$6,574	40	Misc. Mfg. Products	0.55	\$105,269,300	\$191,992
39	Furniture	0.16	\$6,651,800	\$41,316	20	Basic Chemicals	1.02	\$8,305,100	\$8,176	39	Furniture	0.01	\$3,329,000	\$252,197
20	Basic Chemicals	0.86	\$6,217,100	\$7,256	39	Furniture	0.15	\$5,933,200	\$39,060	30	Textiles/Leather	0.30	\$2,369,500	\$7,930
30	Textiles/Leather	0.53	\$3,749,100	\$7,124	30	Textiles/Leather	0.55	\$3,782,700	\$6,928	31	Non-Metal Min. Products	0.56	\$1,120,500	\$1,985
7	Other Foodstuffs	0.03	\$1,175,100	\$43,044	7	Other Foodstuffs	0.02	\$1,028,400	\$42,496	23	Chemical Prods.	0.02	\$18,905,200	\$964,551
31	Non-Metal Min. Products	0.56	\$1,175,100	\$2,089	31	Non-Metal Min. Products	0.45	\$818,500	\$1,839	43	Mixed Freight	1.29	\$21,661,000	\$16,799
23	Chemical Prods.	0.08	\$861,700	\$11,383	23	Chemical Prods.	0.08	\$922,800	\$11,323	32	Base Metals	0.01	\$2,709,100	\$371,110
43	Mixed Freight	0.18	\$357,500	\$2,043	43	Mixed Freight	0.17	\$346,200	\$2,010	28	Paper Articles	0.00	\$1,585,700	\$880,944
32	Base Metals	0.03	\$178,700	\$7,008	32	Base Metals	0.03	\$223,900	\$7,668	26	Wood Prods.	0.03	\$457,100	\$15,654
28	Paper Articles	0.00	\$114,700	\$104,273	28	Paper Articles	0.00	\$108,300	\$98,455	13	Nonmetallic Minerals	0.51	\$49,200	\$97
19	Coal-N.E.C.	0.00	\$100	\$333	19	Coal-N.E.C.	0.00	\$100	\$250	99	Unknown	0.00	\$21,500	\$7,963
Total		34.81	\$2,040,537,400	\$58,614	Total		37.08	\$2,013,533,900	\$54,306	Total		11.01	\$3,493,237,900	\$317,310

Sources: Freight Analysis Framework for Domestic Shipments from Colorado using Air Mode, 2011, 2013 and 2017