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Arizona State Freight Plan

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Phase 3 Working Paper Wholesalers and Retailers Sector Profile and Transportation Performance Needs

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Working Paper

This working paper is one of 10 focusing on key Arizona economic sectors. Its purpose is to document the economic profile, outlook and transportation performance needs of Arizona's wholesalers and retailers sector. This working paper will later inform system improvement needs to increase Arizona's economic competitiveness and growth. This working paper is provided for comment and discussion and should not be interpreted as final.

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Opinions

Unless otherwise indicated, the opinions herein are those of the author and do not necessarily reflect the views of ADOT or the State of Arizona.

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Executive Summary

The purpose of this working paper is to provide a focused assessment of the performance transportation needs, outlooks and economic contribution of the wholesalers and retailers sector in Arizona. Specifically, it describes the sector's economic and traffic profile; its supply chain structure and transportation performance needs: and its key transportation barriers and related priority improvements.

Economic and Traffic Profile

The wholesalers and retailers sector in Arizona contributed \$38.5 billion to the state's gross domestic product (GDP) in 2012. This represents 14.2 percent of

	Measure	Wholesalers and Retail Sector	Arizona (Statewide)	
Economy	GDP (2012, \$ million)	\$38,462	\$271,503	
	GDP Annualized Growth (1997-2012)	5.1%	4.9%	
Jobs	Employment (2013)	401,994	2,619,055	
	Compensation per Employee (2013)	\$46,381	\$57,393	
Transportation	Total Commodity Flows (2012, Mt)	28.2	138.2	
	Top Origin (2012, Mt)	California (3.3 Mt)	California (9.6 Mt)	
	Top Domestic Destination (2012, Mt)	California (1.4 Mt)	Mexico (5.6 Mt)	
	Intrastate Flows (2012, Mt)	20.3	101.8	
	% Truck (2012)	97.3%	87.2%	
Source: CPCS Analysis of data from Bureau of Economic Analysis and 2012				

the state's total economic output. Meanwhile, the sector employed 401,994 people, representing 15.3 percent of total employment in the state. The largest sub-sector generating employment in the sector is grocery stores followed by other general merchandise stores, comprised mostly of large warehouse superstores that sell a combination of grocery and general merchandise (non-grocery) items.

The sector generates 28 million tons (Mt) of freight annually in Arizona, which is over 20 percent of the total freight tonnage in the state. Most of this (20 Mt or 72 percent) is transported within the state. Much of this intrastate volume reflects the pattern of goods being transported from regional distribution centers (DCs) to retail storefronts in the state.



Arizona Wholesale and Retail Sector Volume ('000 Tons)



Source: CPCS analysis of Commodity Flow Survey, 2012.

A large portion (60 percent) of inbound freight originates in California. This largely reflects the use of the Ports of Los Angeles/Long Beach (POLA/POLB) to import products from overseas.

Supply Chain Structure and Transportation Performance Needs

The wholesale and retail landscape in Arizona is very competitive. Managing their transportation and logistics supply chains efficiently is one way that retailers (either on their own or through their logistics partners) attempt to maintain a competitive advantage. The sector relies heavily on state highway infrastructure both to move inbound products to their DCs and to deliver products to local stores from those DCs.

External factors, especially congestion, serve to increase direct transportation costs, lower fleet utilization (for those who have in-house fleets) and increase extended logistics costs (such as inventory carrying costs and product obsolescence). Retail food (grocery stores) face additional challenges of managing the cold chain, where many products have to be kept at specific (and different) temperatures and humidity levels while in transit or in storage. Longer and more variable travel times increase the risk of product spoilage.

For retailers of other products, such as fuel delivered to gas stations, on-site storage is limited. As a consequence, these retailers have to coordinate deliveries for times where inventories are low (so they are able to accept the delivery of products), but not too low (which would risk "stock-outs", or not having product on hand when customers wish to make a purchase). Road congestion makes such coordination more difficult.

In short, a combination of freight cost, travel time and travel time reliability inform the sector's transportation decisions. Perishable products (such as fresh foods) will gravitate towards travel time and travel time reliability as being the most important factors.



Notable Barriers and Related Priority Improvements

Stakeholders cited more transportation challenges on the outbound journey (from the DCs) than on the inbound journey. This is partly because the inventory that can be held at retail stores is relatively limited and shelves have to be restocked on an ongoing basis. This often leaves little choice but to conduct deliveries during peak traffic hours where major highways and arteries are congested. This has the effect of increasing travel time to stores, which in turn ties up more equipment and labor (fewer deliveries per truck, trailer and driver hour). This is especially a factor in the Phoenix Metropolitan Area for retail locations that are located on the other side of downtown relative to the DC (forcing the delivery route through the downtown core).

City ordinances related to noise were cited as issues in certain areas of Tucson and Phoenix, particularly where there are strong neighborhood associations that oppose deliveries at offpeak hours. This limits the ability of certain grocery stores to be replenished outside of congested hours.

Stakeholders also noted that in some cases, where stores are located in large shopping centers, there are challenges related to manoeuvring large trucks to and from delivery docks.

Priorities for transportation performance measurement all relate to the objective of reducing road congestion. Some of the specific suggestions that have been put forward by stakeholders include:

- expediting the completion of the Highway 202 extension
- relaxing city ordinances where they exist in order to allow more off-peak deliveries
- offering specific guidelines to developers when building new shopping centers in order to ensure efficient truck access
- reviewing truck weight and dimension limits in some circumstances
- reviewing truck driver hours of service regulations



Acronyms / Abbreviations

ACA	ARIZONA COMMERCE AUTHORITY
ADOT	ARIZONA DEPARTMENT OF TRANSPORTATION
DC	DISTRIBUTION CENTER
FC	FULFILLMENT CENTER
GDP	GROSS DOMESTIC PRODUCT
MPD	MULIMODAL PLANNING DIVISION
POLA	PORT OF LOS ANGELES
POLB	PORT OF LONG BEACH
SC	SORTATION CENTER
USPS	UNITED STATES POSTAL SERVICE



Introduction

Key Messages

The Arizona Department of Transportation, Multimodal Planning Division retained a team led by CPCS Transcom, Inc. to assist in the development of Arizona's State Freight Plan.

The aim of this working paper is to establish the freight transportation performance needs, outlooks, and economic contribution of Arizona's wholesalers and retailers sector (defined here as NAICS Codes 42, 44, 45). This will later inform the analysis of broader transportation system based needs and priorities.

This working paper was developed in large part through stakeholder consultations and analysis of wholesalers and retailers sector data.



1.1 Introduction: Why an Arizona State Freight Plan?

Arizona's economic potential is supported by the state's transportation infrastructure, which connects sources of production to markets.

When transportation infrastructure and related services are efficiently designed and competitively positioned, businesses benefit from lower transportation costs, faster and better transportation services, and increased reliability, which in turn contribute to their own competitiveness and growth, and that of the broader region.

Jurisdictions with access to competitive transportation infrastructure and services are at a competitive advantage in attracting investment, creating jobs and realizing economic growth. Arizona's State Freight Plan can help enable this outcome.

To this end, the ADOT's Multimodal Planning Division (MPD), is developing Arizona's State Freight Plan which will provide strategic guidance to enhance Arizona's economic competitiveness and facilitate economic growth.

1.2 Project Objectives

The State Freight Plan will define immediate and long-range investment priorities and policies that will generate the greatest return for Arizona's economy, while also advancing other key transportation system goals, including national goals outlined in MAP-21. It will identify freight transportation facilities in Arizona that are critical to the state's economic growth and give appropriate priority to investments in such facilities.

The State Freight Plan will ultimately provide Arizona with a guide for assessing and making sound investment and policy decisions that will yield outcomes consistent with the state's visions, goals, and objectives, and notably, promote regional competitiveness and economic growth.

1.3 Purpose of this Working Paper

Since it is economic activity – particularly from goods movement sectors - that drives demand for freight transportation infrastructure and services, optimization of the state's freight transportation system, and related strategies, goals and investments, must start by addressing the transportation performance needs of the sectors moving freight. Yet, the transportation performance needs of freight can differ by sector and commodity group, locations and even company.



For this reason, the team identified 10 key freight sectors in Arizona for specific focus: wholesalers and retailers, food and beverage, high-tech manufacturing, general manufacturing, transportation equipment manufacturing, transportation and logistics, mining (except oil and gas), energy (oil and gas), agriculture, and forestry.

The purpose of this working paper is to provide a focused assessment of the transportation performance needs, outlooks and economic contribution of the wholesalers and retailers sector (defined here as NAICS Codes 42, 44, 45 (includes some retail related to other sectors such as gas stations, food retail, etc).

Specifically, it addresses the following key questions:

- At a high level, what is the profile and economic contribution of wholesalers and retailers sector to Arizona's economy?
- How do the supply chains of Arizona's wholesalers and retailers sector utilize the transportation system and what are the major origins, destinations, intermediate points, and final products of these chains?
- How are wholesalers and retailers sectors' supply chains structured, managed, and what are the primary drivers of transportation decisions and related performance needs?
- What are the key trends in the wholesalers and retailers sector, how are these influencing freight flows, and what are the implications, opportunities and challenges for the competitiveness of Arizona's freight system going forward?

1.4 Methodology

This working paper is informed by a combination of literature review, data collection and analysis, and extensive consultation with wholesalers and retailers sector stakeholders. Documents reviewed are footnoted throughout the working paper, as appropriate. Stakeholders consulted have been listed in Appendix A, unless non-attribution was requested.

1.5 Limitations

This working paper is in many cases informed by data and input provided by third parties. CPCS has verified this information to the extent possible through analysis and cross-checking with other sources but cannot guarantee the accuracy of data received from third parties.



Working Paper | Wholesalers and Retailers Sector

Wholesalers and Retailers Sector Profile

Key Messages

The wholesalers and retailers sector in Arizona contributed \$38.5 billion to the state's GDP in 2012, representing 14.2 percent of the State's total economic output. Meanwhile, the sector employed 404,227 people, representing 16.4 percent of total employment in the state. The largest sub-sector generating employment in the sector is grocery stores followed by other general merchandise stores, comprised mostly of large warehouse superstores that sell a combination of grocery and general non-grocery items.

The sector generates 28 Mt of freight annually in Arizona, which is over 20 percent of the total freight tonnage in the state. Most of these (20 Mt or 72 percent) are transported within the state. Much of this intrastate volume reflects the pattern of goods being transported from regional distribution centers to retail storefronts in the State.

A large portion (60 percent) of inbound freight originates in California. This largely reflects the use of the Ports of Los Angeles/Long Beach to import products from overseas.



2.1 Overview of Wholesalers and Retailers Sector

The wholesalers and retailers sector in Arizona is comprised of businesses that facilitate the distribution of finished goods to consumers. The wholesaling process is "an intermediate step in the distribution of merchandise."¹ Wholesalers generally source products from goods manufacturers both within and outside of the state and hold inventory in warehouses or DCs. Subsequently they sell and/or distribute goods to retail storefronts, who sell goods to the general public (the final step in the distribution of merchandise). Many businesses are engaged both in wholesale and retail trade, where their wholesale arm distributes goods to their own retail storefronts that are directly owned or operated as franchises, as well as in some cases to other third-party retail businesses.

In Arizona, grocery stores, general retail (including department stores), hardware stores, gas stations, automobile dealerships and pharmacies are among the most significant retail sub-sectors. All of these retail sub-sectors rely at least to some extent on wholesale distributors for the supply of the products that they sell to the general public. By employee count, individual wholesaler and retailer businesses are some of the largest in the state. Walmart Stores is the second largest employer in the state, at 32,000 employees. Other notable employers in the sector that are among the largest 20 employers in the state are: Kroger Co., which operates Fry's Foods (third largest employer at nearly 17,000 employees); Albertsons (over 14,000 employees); Home Depot (nearly 10,000 employees); Bashas' Supermarkets (8,500 employees); and Target (over 8,000 employees).²

These businesses rely heavily on the state highway infrastructure in order to transport goods to DCs (often from outside of the Arizona) and especially from DCs to retail store fronts. Delivery to DCs is often done by trucks hauling trailers or intermodal (domestic or international) containers. Delivery from DCs to retail stores is almost exclusively done by truck (tractor-trailers or straight trucks). The state's highway and arterial road system then is vital for the sector's competitiveness and for supplying Arizonans with essential and leisure goods that contribute to their high quality of life.

2.2 Economic Profile and Importance to Arizona's Economy

2.2.1 GDP

The wholesalers and retailers sector in Arizona contributed \$38.5 billion to the state's GDP in 2012, representing 14.2 percent of the state's total economic output. Since 1997, GDP in the wholesalers and retailers sector has grown at a rate of 5.1 percent per annum, over performing as compared to the overall state average of 4.9 percent GDP growth per annum.³

³ Bureau of Economic Analysis Regional Economic Accounts, GDP by State. GDP in current dollars.



¹ Bureau of Labor Statistics, Industries at a Glance.

² AZ Central, Arizona Republic 100: State's largest employers.

2.2.2 Commodity Flows

Overall, over \$96 billion of goods in the wholesalers and retailers sector traveled into, out of, or within the State of Arizona in 2012. Of this, \$33 billion of goods originated in other states and were destined to Arizona, \$15 billion originated in Arizona and were destined for other states, and \$48 billion in goods traveled within the state of Arizona.



Source: CPCS analysis of Commodity Flow Survey, 2012.

Origins of Inflows to Arizona

The figure below summarizes the origins of wholesale and retail sector products that were shipped to Arizona from other states. California was the largest origin of wholesale and retail goods destined for Arizona with \$13.8 billion in goods shipped to Arizona, followed by Texas and Colorado with 4.2 billion and \$2.3 billion in inflows respectively. Some of these moves may have originated or been destined internationally [e.g. imported through the Ports of Los Angeles/Long Beach (POLA/POLB) and transported through California to Arizona].





Figure 2-2: Value of Top Wholesale and Retail Sector Inflows to Arizona by State or Origin (2012)

Source: CPCS analysis of Commodity Flow Survey, 2012.

Destinations of Outflows From Arizona to Other States

The figure below summarizes the destination of wholesale and retail products originating in Arizona. California was the largest destination of Arizonan products, where \$4.7 billion worth of products originating in Arizona were destined.



Figure 2-3: Value of Top Wholesale and Retail Sector Outflows from Arizona by State of Destination (2012)

Source: CPCS analysis of Commodity Flow Survey, 2012



2.2.3 Employment and Wages

In 2013 the sector employed 401,994 people, representing 15.3 percent of total employment in the state.^{4 5} The total wages and salaries paid to employees in 2013 was \$18.65 billion dollars⁶, making the average annual earnings per employee in 2013 approximately \$46,381 for the sector. Annual earnings per employee were highest in wholesale trade at around \$78,800 per year and lowest in Clothing and Clothing Accessories Stores at \$21,600, likely partially reflecting the higher share of part time work in that industry.





Source: CPCS Analysis of Quarterly Workforce Indicators dataset, United States Census Bureau

The largest sub-sector generating employment in the sector is grocery stores followed by other general merchandise stores, comprised mostly of large warehouse superstores that sell a combination of grocery and general non-grocery items.

⁶ Bureau of Economic Analysis Regional Economic Accounts, Personal Income and Employment by State. SA6N Wages and Salaries by NAICS Industry



⁴ Excludes self-employment

⁵ Bureau of Economic Analysis Regional Economic Accounts, Personal Income and Employment by State. SA27N Wages and Salaries by NAICS Industry

2.3 Locations and Traffic Profile

The wholesalers and retailers sector generates 28 Mt of freight annually in Arizona, which is over 20 percent of the total freight tonnage in the state. Most of these (20 Mt or 72 percent) are transported within the state, while about 5.4 Mt (19 percent) come in from other states, some of which likely to include imports and 2.5 Mt (9 percent) goes outbound to other states, some of which likely get exported.

The numbers presented here are obtained from Commodity Flow Survey (CFS), 2012. CFS accounts for only domestic movements. These include domestic shipments as well as the domestic components of international supply chains⁷.



Figure 2-5: Arizona Wholesale and Retail Sector Volume ('000 Tons)

Source: CPCS analysis of Commodity Flow Survey, 2012.

2.3.1 Activity Clusters

The activity clusters of wholesalers and retailers are illustrated by the geographic distribution of employment in the sector. The most significant clusters are in large urban areas like Phoenix, Tucson as well as in cities like Flagstaff, Bullhead City, Lake Havasu City, Yuma City and the border crossing of Nogales. Locations such as food stores, gas stations and other retails are spread across the clusters. Wholesalers are concentrated more in the southern parts of Phoenix and at the border town of Nogales.

⁷ In CFS, the sum of individual state volumes is slightly lower than the national volume which is due to data suppression and rounding in individual state-to-state movements. For consistency across all the graphics (maps and charts), this paper presents the total of state level volumes.





Figure 2-6: Arizona Wholesale and Retail Sector Employment Clusters

Source: CPCS analysis of County Business Pattern Data, 2013 by US Census Bureau.



The figure below illustrates wholesale and retail clusters based on estimated tonnage production. The clusters were identified from kernel density estimation in ArcGIS using Global Insight's Freight Finder dataset. Freight Finder has estimated outbound tons based for wholesale and retail business establishments in Arizona. Wholesale and retail locations are concentrated in all major urban areas, specifically in southern part of Phoenix, Tucson, Yuma and Flagstaff, Prescott Valley, Lake Havasu City and Nogales. In Phoenix, the major concentrations are at Tolleson and Sky Harbor.





Source: CPCS Analysis of Freight Finder 2013









Source: CPCS









2.3.2 Major Origins and Destinations

Most of the wholesale and retail movements take place within the state, representing "last mile" shipments. In terms of both inbound and outbound movements, California is Arizona's biggest domestic freight flow partner, reflecting in large part the importance of POLA and POLB. More than 60 percent of all inbound tonnages originate in California and 56 percent of all outbound tonnages are destined for California. Other notable sources of inbound freight are Texas, New Jersey, Washington, Oregon. Major destinations, other than California, are nearby states such as New Mexico and Nevada.





Source: CPCS analysis of Commodity Flow Survey, 2012.

Note: The map above does not include import/export data. The import/export data was extracted for all of top 10 sectors, except wholesale and retail. The data was obtained from FAF3 estimates for 2012. CPCS did a crosswalk between 2-digit SCTG codes used in FAF3 and top 10 sectors used in this study. Since wholesale and retail sector is related to commodities produced in almost all the sectors, CPCS did not establish a commodity crosswalk for this sector. This means that the import/export numbers in other sectors would have some wholesale and retail commodities included.



2.3.3 Modal Breakdown

Trucking is the primary mode of transportation for all types of shipments – inbound, outbound and intrastate.⁸ However, some of the long-distance, inbound shipments are handled by rail and a combination of truck and rail. Rail transport is a small share of intrastate tonnage.



Source: CPCS analysis of Commodity Flow Survey, 2012.

⁸ Please note that in CFS dataset, the individual mode volumes do not add up to the aggregate "All Mode" which is due to the data suppression and rounding at detailed mode level.



Working Paper | Wholesalers and Retailers Sector

Supply Chain Structure and Transportation Performance Parameters

Key Messages

The wholesale and retail landscape in Arizona is very competitive. Managing their transportation and logistics supply chains efficiently is one way that retailers attempt to maintain a competitive advantage.

The sector relies heavily on state highway infrastructure both for moving inbound products to their distribution centers and to deliver products to local stores from those distribution centers.

External factors, especially congestion, serve to increase direct transportation costs, lower fleet utilization (for those who have in-house fleets) and increase extended logistics costs (such as inventory carrying costs and product obsolescence). Retail food (grocery stores) face additional challenges of managing the cold chain, where many products have to be kept at specific (and different) temperatures and humidity levels while in transit or in storage. Longer and more variable transit times increase the chance of product spoilage.



3.1 Supply Chain Structure

Because wholesale and retail supply chains in the state provide a wide variety of products to consumers, their specific supply chains and transportation needs are variable. However, there are common themes that permeate through most wholesale and retail supply chains.

This chapter places a particular emphasis on grocery supply chains for a couple of reasons. For one, grocery stores are omnipresent in the state simply due to the fact that consumers place a lot of value in having immediate and convenient access to their food supply. Grocery supply chains are also generally similar to other retail "big-box" supply chains, where products are sourced from a large number of locations and suppliers to DCs before being delivered to store fronts.

In addition, grocery supply chains are faced with the added complexities of cold chain logistics (which requires maintaining specific temperatures, humidity and ventilation controls through a series of transportation and storage links and nodes). This makes transportation performance even more critical.

Moreover, traditional general merchandise retailers are increasingly offering groceries and competing directly with traditional grocers (most notably Walmart). Finally, unlike general retail which has witnessed a shift towards e-commerce (replacing consumer trips to storefronts with parcel deliveries), grocery supply chains continue to rely heavily on physical retail presence, perhaps more now than ever before.

3.1.1 Grocery Supply Chains

The grocery store market in Arizona is very competitive, with many large chains vying for market share through many retail storefronts across the state. There are over 400 grocery stores in the Phoenix Metropolitan Area alone. Fry's Foods (a division of Kroger Co.), Walmart Supercenters, Bashas' (under its three brands), Safeway and Albertsons and many others compete for market share in the retail market. The new company resulting from the merger of Safeway and Albertsons could result in the second largest grocer (after Fry's) in the area.⁹

The major grocers in the state typically have one or two DCs supplying retail storefronts with their daily product requirements. A typical supply chain structure is depicted in Figure 3-1, where products are sourced internationally through POLB (from where it is trucked), or domestically by truck. The DC supplies retail stores in its catchment area (e.g. the State of Arizona) by truck. Stores may also source certain products directly from local suppliers.

⁹ Corbett, *Phoenix-area market has grocery chains in battle.*





Figure 3-1: Example of Grocery Store Supply Chain



Example of a Retail Grocery Supply Chain - Safeway

Safeway operates a DC in Tempe that supplies 109 retail stores in Arizona and New Mexico. The DC sources products from across the country and internationally. Over 80 percent of the products are sourced domestically, most of which is delivered to the DC by trucks in 53-foot trailers. The vast majority of these trailers are refrigerated units.

International products are mainly sourced via POLB. Products are delivered to the port in international containers, after which they are usually transloaded to 53-foot trailers and delivered to the DC by truck. In this case, the benefit of transloading is that the contents of five 40 foot containers can be stuffed into four 53-foot trailers, thereby reducing the number of truck trips from Long Beach to Arizona by 20%. This comes at the cost of additional transit time and additional costs associated with the transloading itself. A small portion (approximately 700 containers per year) of Safeway backhaul traffic to the port is filled with cardboard bound for China.

Rail plays a small role in the supply chain, as it does for the Sector in general. The Safeway DC in Tempe, for example, used to be served by a rail spur that had been used to inbound empty milk jugs (the location also houses a milk plant which produces milk primarily for its own retail stores). Since the spur has been abandoned milk jugs are now supplied by truck. This has increased truck traffic to the DC; even though the rail spur was lightly-used, it takes approximately 25 trucks to carry the same amount of milk jugs that a single rail car was able to carry.

Outbound flows to the 109 Safeway retail stores are handled by Class 8 semi-trucks, with approximately 40 percent hauling 53-foot trailers and 60 percent hauling 50 foot trailers. As with the inbound flows, the majority of these are refrigerated units. In total, the DC generates approximately 700 outbound trailers per week, covering approximately 140,000 miles (the average length of haul being roughly 200 miles). The state's highway system then is critical for accommodating the steady supply of food products to retail storefronts.

Source: CPCS consultation with Safeway

3.1.2 Other Wholesale and Retail Supply Chains

Big-box retail (general merchandise, electronics, clothing, etc.) supply chains are typically configured similarly to the grocery supply chain noted above, without the added complexity of the cold chain. One exception is in healthcare and pharmaceuticals, where certain products require a high degree of precision with respect to temperature control, although the volumes are much smaller than retail grocery volumes.

One large wholesaler and retailer in the state noted similar supply patterns as the grocery example provided above, where one DC supplies retail stores across the state. Roughly 20 percent of inbound freight to their Tolleson DC was sourced internationally through Long Beach, with the rest being sourced domestically (scattered across virtually all states). A notable difference was that semi-trucks hauled international containers directly from the port to the DC. This particular DC sees approximately 225 inbound truckloads per day. Roughly 700 outbound (less-than-truckload) shipments per day are made by truck from this DC, mostly to retail stores in Arizona (a smaller portion of outbound shipments are destined for Las Vegas and Albuquerque).



One supply chain that is largely distinct from other retail supply chains is the retail fuel supply chain. The key distinctions are: the products are relatively homogenous; the product is sourced from relatively few locations (California and Texas via the "West Line" and the "East Line"¹⁰); and pipeline, rather than trucking, is the key mode of transportation for importing product into the state.

However, the "last mile" of transportation to retail gas stations exhibits some logistical similarities to other retail supply chains. After being imported to the state by pipeline, gasoline is stored at bulk storage plants (underground or aboveground storage tanks) which are effectively the DC that supply retail stores. Compared with other retail supply chains, these storage plants serve smaller geographic areas (there is greater emphasis placed on being closer to the end user).

For example, Western Refining operates three storage plants in Arizona (Phoenix, Tucson and Safford, the latter primarily serving a mine site). Collectively, these three plants generate roughly 1,300 outbound truck trips and over 100,000 truck miles per week. The average length of haul of between 70 to 80 miles is notably shorter than the grocery or general retail examples provided above.

3.2 Transportation Performance Parameters

3.2.1 Grocery Supply Chains

Inbound (to the DCs) transportation decisions are made based on a mix of cost (freight rate), travel time and travel time reliability factors. The relative importance of each factor varies depending on the attributes of the specific products, particularly their perishability. For example, canned and dry foods typically have long shelf lives and often do not require refrigeration. This reduces (but does not eliminate) the emphasis on travel times or travel time reliability. Travel times and reliability remain important for keeping shelves stocked to satisfy customer demand, but larger inventories can be held without fear of spoilage. Certain fruits (such as apples and kiwifruit) may require refrigeration in transit and while in longer term storage, but as long as they are stored at the right temperature and humidity levels their shelf life can extend for between two and seven months.¹¹

On the other hand, certain fresh (as opposed to frozen) fruits and vegetables (such as strawberries and lettuce), dairy products and fresh meats have shelf lives that may be a few days or even less. For those products both travel time and travel time reliability are critical. Because their shelf lives are short even in optimal temperatures, the impacts of unreliable travel times cannot be mitigated by holding higher inventory levels at the DCs or in the store.

¹¹ Hamburg Sud, *Stay Cool, We Care.*



¹⁰ Arizona Attorney General, *Gasoline*. azag.gov.

Furthermore, while these fresh products are in transit the reefer unit on the semitrailer must be set to the correct temperature (which varies by product). Failing to set and maintain the correct temperature or failing to deliver the product within a short period of time results in having to discount the product or dispose of it altogether. For these products, saving a few cents on the freight cost is a distant consideration relative to improving travel time and travel time reliability.

The inbound supply chain is also subject to seasonal factors. Sourcing locally can assist in the process of keeping highly-perishable foods fresh by the time they hit store shelves, but sourcing locations change throughout the year. For example, produce is often sourced locally in colder months but shifts up the east coast as the weather warms. This implies longer lengths of haul and therefore higher freight costs and heavier reliance on reliable travel times in those months. But this is a necessity in order to keep shelves stocked with a wide variety of fresh products year round, as failing to do so results in unsatisfied customers and a loss in market share of the very competitive grocery market.

3.2.2 Other Wholesale and Retail Supply Chains

Other retail supply chains are more likely to place a greater emphasis on cost (the freight rate) over travel time and travel time reliability, as they are generally not moving perishable products. However, some products remain time sensitive for other reasons. High value electronics, for example, have higher opportunity/financing costs while being held in inventory and may also depreciate in value rapidly, given the pace of introduction of new technologies and models. As a result, lower travel times are preferred. High travel time variability also increases the likelihood of stock-outs, resulting in delayed or lost sales.

In addition, while some wholesale and retail interests may emphasize cost over travel time, travel time works its way into costs either implicitly or explicitly. This depends on whether the wholesaler or retailer manages its own fleet. For fleet owners, longer travel times mean lower equipment utilization (and higher associated costs). For shippers who use contract carriers, the longer travel times will ultimately be reflected in higher freight rates (although the reason for the higher freight rate may not be made explicit to the shipper).

For retail fuel supply chains, transportation cost is an important factor. Where possible, storage plants are built on and supplied by pipelines, which are generally far more economical than other modes of transportation. Furthermore, storage plants are built to service smaller geographic areas than other retail DCs in order to maximize the transportation distance by pipeline and minimize the transportation distance by truck.

Retail fuel stations operate very much in a just-in-time environment due to high customer volumes and limited onsite storage capacity. As a consequence, deliveries have to be timed both to avoid stock-outs and to avoid arriving early (in which case there may not be enough storage capacity to take the delivery). For retail fuel stations, a stock-out is almost always a lost sale (rather than a delayed sale), as customers will purchase fuel from another station rather than wait until inventory is replenished at the first station. These factors increase the importance of reliable travel times and factor into the decision to keep storage tanks relatively close to retail outlets.



As noted, travel times lower fleet and labor utilization and increase direct transportation costs as a result. One fuel wholesaler noted that increased travel times due to congestion in the Phoenix Metropolitan Area adds about 15 to 20 percent to their transportation costs due to higher labor and equipment costs.

3.3 Barriers to Transportation Performance

3.3.1 Grocery Supply Chains

Stakeholders cited more transportation challenges on the outbound (from the DCs to retail stores) than on the inbound side. This is due in part because the inventory that can be held at retail stores is relatively limited and shelves have to be restocked on an ongoing basis. This often leaves little choice but to conduct deliveries during peak traffic hours where major highways and arteries are congested. This has the effect of increasing travel time to stores, which in turn ties up more equipment and labor (fewer deliveries per truck, trailer and driver hour). It also has the effect of increasing the variability of delivery times and therefore increasing the chance of stock-outs or spoilage. This is especially a factor in the Phoenix Metropolitan Area for retail locations that are located on the other side of downtown relative to the DC (forcing the route through the downtown core).

City ordinances related to noise were cited as issues in certain areas of Tucson and Phoenix, particularly where there are strong neighborhood associations that oppose deliveries at offpeak hours. This limits the ability of certain grocery stores to be replenished outside of congested hours.

Stakeholders also noted that in some cases, where stores are located in large shopping centers, there are challenges related to manoeuvring large trucks to and from delivery docks. This is thought to be due to developers thinking primarily of customer traffic needs at the expense of freight needs when designing these centers. This also serves to increase travel time and lower equipment/labor utilization.

Finally, one stakeholder felt that there was a disproportionate number of trucks being pulled over for inspection by ADOT on the I-10 between Phoenix and Tucson. This serves to increase the variability of travel times when travelling on that corridor.

3.3.2 Other Wholesale and Retail Supply Chains

Other wholesale and retail stakeholders noted road congestion as the primary concern as well. Large retailers who manage their own fleets typically pay drivers by the mile (rather than by the hour) and as a result, strive to maximize the use of driver time (in addition to maximizing fleet utilization). As an example, if deliveries take 10 percent longer on average the result is 10 percent higher driver costs per delivery as well as 10 percent higher equipment utilization costs (as a larger fleet is required in order to move the same amount of product). For those who rely on contract carriers, as noted earlier, it is expected that these additional costs ultimately work their way into the freight rate.



One large wholesaler and retailer (contrary to the experience of others), noted no issues with off-peak deliveries at any of their retail locations. In order to avoid driving in congested hours as much as possible, the first set of outbound shipments from their Phoenix area DC start early in the afternoon, while the second set of shipments start at 1am.

Other retailers also noted weight restrictions as being low relative to other states that allow gross vehicles weights in excess of 80,000 lbs. This was noted as generating more truck trips for a given amount of freight both for inbound (to the DCs) and outbound traffic.

Specific infrastructure bottlenecks that were noted include the I-17 northbound from Phoenix. The I-10 in both directions posed a challenge for delivering fuel to retail stations across the Phoenix Metropolitan Area from storage tanks west of downtown.

3.4 Trends and Implications

3.4.1 Grocery Supply Chains

Grocery supply chains are and will continue to rely upon reefer technologies in order to keep food fresh and safe while in transit. As customer demands for variety increase, this reliance will only get stronger. This is particularly important in states with warm climates.

While these technologies have improved over time, they are accompanied by a fuel performance penalty. Larger retail stakeholders often plug reefers into to electric outlets while they are standing in order to preserve fuel. However, the extent to which this is possible is limited by the availability of 480 voltage outlets. As greater emphasis is placed on environmentally-friendly technologies, it is viewed that regulations may ultimately require plugging in reefers while idle. This would reduce operating costs (as electricity rates are lower than fuel rates) at the expense of the capital costs required in order to provide the necessary infrastructure.

3.4.2 Other Wholesale Retail Supply Chains

Both grocery and other general retail supply chains continue to look for opportunities to provide backhaul traffic to overseas destinations in order to reduce their freight transportation rates. For example, there is generally more demand for imports through POLB than there are exports. As noted, Safeway fills some of this backhaul with corrugated cardboard back to China. Other wholesalers and retailers have also noted that they send cardboard as well as shrink wrap bales back to China. As more opportunities are found, this will help to lower the cost of freight transportation to Arizona. Ideally, backhaul traffic would be higher value (which would help to offset the inbound or head haul rate to a greater extent).

A general trend has simply been managing the rapid increase in volumes year after year. In general, the Phoenix Metropolitan Area is seen as a growth area for retail sales. This is due to the diverse and growing population as well as the availability of land for new wholesale and retail locations. One larger wholesaler and retailer, for example, noted that volumes out of



their DC have been growing at 5 percent to 7 percent per year and they expect this growth to continue into the near future. This growth prompted the addition of an in-house trucking fleet in order to manage and deliver their base load volumes, while relying on contract carriers to handle the surges. Managing an in-house fleet increases the visibility that wholesalers and retailers have on external factors that increase transportation costs (such as congestion), as they absorb those costs first-hand.

3.4.3 The Future of E-Commerce

A supply chain that exhibits some key dissimilarities to the aforementioned supply chains is the Electronic Shopping or e-commerce supply chain. Traditional big-box retailers have all increased their e-commerce presence, the implication being more deliveries from DCs directly to customers. This has the effect of tempering the growth of semi-truck deliveries to retail stores but increasing the number of trips directly to customers (usually via courier companies in straight trucks).

But perhaps most notable in terms of e-commerce is the impact the "pure" or native ecommerce companies have had on how consumers purchase their retail goods. Amazon in particular has increased its footprint in the state, where it now operates four "fulfillment centers" (FCs) in Phoenix and Goodyear. These FCs are each 1 - 1.2 million sq. ft. in size and handle items from third-party vendors as well as Amazon's own products (company-wide 40 percent of Amazon's items sold are now from third parties).¹²

¹² Wohlson, A Rare Peak Inside Amazon's Massive Wish-Fulfilling Machine. wired.com.





Figure 3-2: An Amazon Fulfillment Center in the Phoenix Metropolitan Area

These FCs have similar inbound transportation and logistics requirements as traditional retail DCs. Outbound transportation, however, is currently undergoing a significant transformation. Historically, Amazon has relied on courier and parcel companies to deliver products directly to customers from FCs meaning that, as opposed to traditional retailers, it had little control over its outbound logistics. Recently, the company has developed a strategy of building a network of "sortation centers" (SCs). These SCs sort products from (usually nearby) FCs into common destinations (by zip code), after which they are delivered to customers via USPS. Effectively, they are taking part of the outbound process that was previously handled by the courier companies in-house, allowing Amazon to take greater control of its outbound logistics.¹³

Although Amazons still relies on USPS for its last mile delivery, eventually this may change as well as they invest in their own "Amazon Prime Air" technology, a delivery system that is "designed to safely get packages into customers' hands in 30 minutes or less using small unmanned aerial vehicles."¹⁴ This technology and the general strategy of enabling same-day delivery may also eventually disrupt the grocery retail market (Amazon already offers

¹⁴ Amazon, *Amazon Prime Air*. amazon.com.



¹³ MWPVL International, *Amazon Global Fulfillment Center Network*. mwpvl.com.

"AmazonFresh" which offers home delivery of groceries in Seattle, Los Angeles and San Francisco¹⁵).

Depending on the development and acceptance of new technologies the implications for transportation infrastructure in the state can be significant. For now, Amazon's growing footprint in the state will certainly mean more inbound semi-trucks to FCs and more outbound medium trucks operating on truck tours in urban areas. In the longer-term, last mile delivery could be at least partially supplanted by Prime Air or similar technology.

¹⁵ MWPVL International, *Amazon Global Fulfillment Center Network*. mwpvl.com.



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Sector Priorities for Transportation System Performance Improvement

Key Messages

Priorities for transportation performance measurement all relate to the objective of reducing road congestion. Some of the specific suggestions that have been put forward by stakeholders include:

- expediting the completion of the Highway 202 extension
- relaxing city ordinances where they exist in order to allow more off-peak deliveries
- offering specific guidelines to developers when building new shopping centers in order to ensure efficient truck access
- reviewing weight and dimension limits in some circumstances,
- reviewing truck driver hours of service regulations



4.1 **Priority Improvements Needs**

The top transportation system improvements identified by stakeholders during consultations are described below. All of the improvements that would improve the competitiveness of the sector relate to congestion mitigation.

- The completion of the Highway 202 extension through Ahwatukee as quickly as possible. This would be particularly beneficial for retail stores that are located west of Phoenix where their DC is located east of Phoenix (or vice-versa). The completion of Highway 202 would allow these deliveries to bypass downtown Phoenix, resulting in lower and more reliable travel times and better asset utilization. Longer term, construction of the I-11 corridor would help to increase sourcing and trade opportunities with Canada and Mexico.
- Where they exist in Phoenix and Tucson, relaxation of ordinances that restrict the delivery of products at certain (off-peak) hours. This would allow traffic to shift from peak hours to off-peak hours (benefiting both retail supply chains and commuter traffic). Some stakeholders may even be able to live with restricting truck traffic in certain corridors at peak hours if this is accompanied by greater latitude to deliver at off-peak times (a "carrot and stick" approach), although others expressed some desire for truckonly lanes in certain corridors (such as on the I-17 through Phoenix).
- More specific guidelines for developers when designing shopping malls in order to assure that they can efficiently handle the flow of freight deliveries. In general, stakeholders find that major highways, arteries and local access roads in Arizona are very friendly for truck access from a design perspective (relative to the experience in many other states). However, access to delivery docks at some shopping malls is sometimes a challenge. Providing some guidelines for developers when new malls are built or encouraging municipalities to develop consistent guidelines could help to remind them of the importance of freight deliveries for keeping shelves stocked. Stakeholders are aware that this is a local rather than a state issue.
- Reviewing weight and dimension limits in some circumstances. In particular, the use of turnpike doubles on certain corridors would help make sourcing from Mexico more viable. In the case of lighter products (such as lettuce) this would not necessitate an increase in gross vehicle weight limits (since lettuce cubes out before it weighs out). Other products (watermelons, for example) do weigh out and as a result could benefit from higher gross weight limits (greater than 80,000 lbs.) similar to what is found in some other states (Alaska, Florida and Washington were noted as some examples).
- Hours of service regulations. Federal regulations regarding driver hours of service were
 noted as having an impact on delivery times and scheduling particularly when operating
 through congested urban areas. These regulations not only affect driver supply but have
 the impact of reducing fleet utilization if drivers are unable to complete their deliveries
 within the windows provided by the regulations.



4.2 Implications and Conclusion

The implications of these improvements would be lower direct transportation costs, lower non-transportation logistics costs (such as inventory carrying costs) and ultimately, lower prices of consumer goods. As the retail market in Arizona is highly competitive, it is expected that any or most transportation and logistics costs savings will ultimately be passed on to consumers in the prices that they pay.

Despite the challenges related to moving goods to and from DCs and to retail stores, stakeholders have generally noted that Arizona is a relatively friendly state to operate in and ADOT is responsive to needs when issues do arise.



Appendix A: Stakeholder Consultation List

All of the stakeholders consulted in this sector requested anonymity as a condition of participation in the study.

