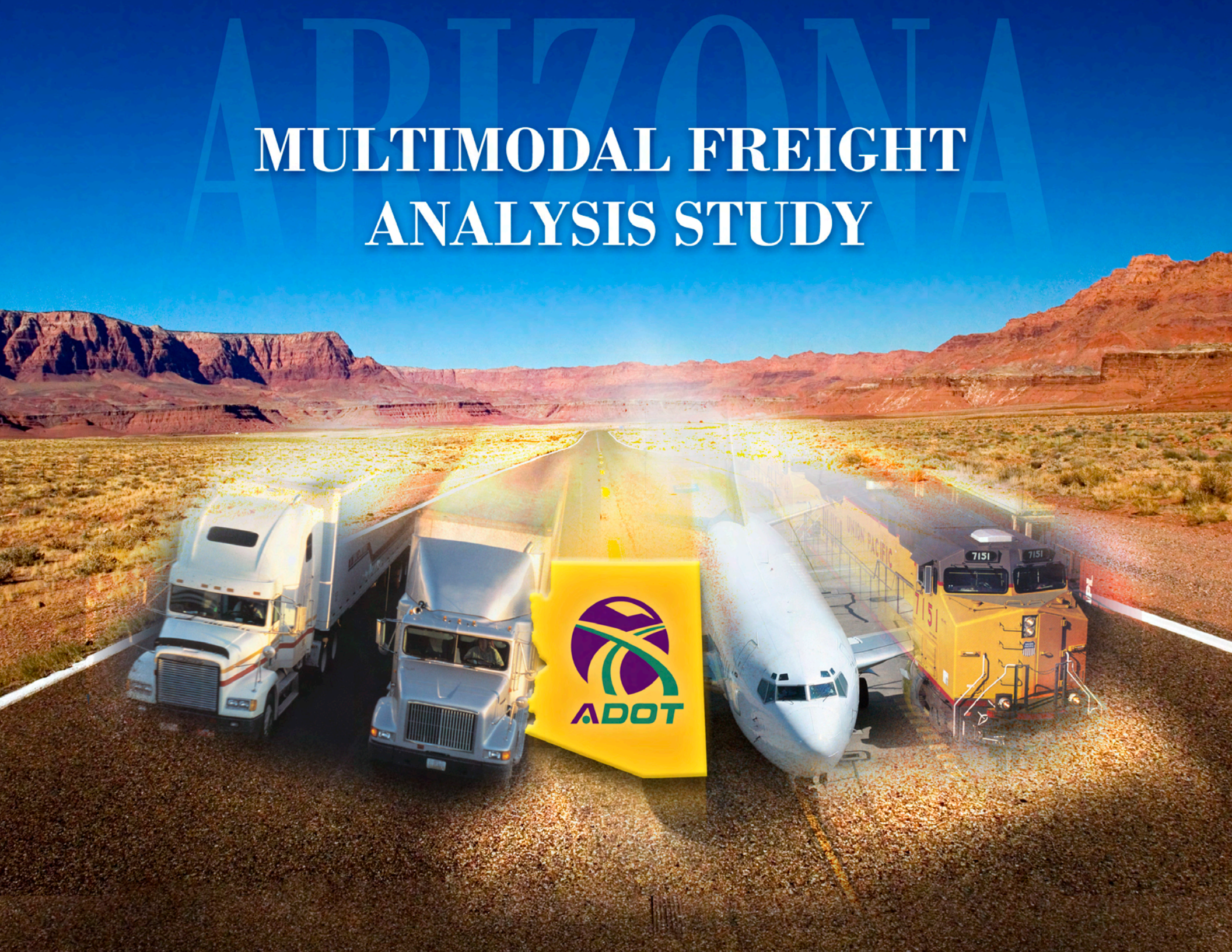
MULTIMODAL FREIGHT ANALYSIS STUDY



Arizona Multimodal Freight Study

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executive summary

"a strategy for establishing freight analysis as an integral part of Arizona's long-range planning process."

A key outcome of the Arizona Multimodal Freight Analysis Study is "a strategy for establishing freight analysis as an integral part of Arizona's long-range planning process."* This study was directed to include the following as part of the strategy development:

- Broad themes to guide future freight planning
- A description of how multimodal transportation networks impact the freight industry
- Potential impacts of freight strategies on economic development in Arizona
- A strategy for freight data collection, analysis, and planning
- Measurable indicators describing the impact of freight traffic on the performance of Arizona's multimodal freight transportation network

The study process for the Arizona Multimodal Freight Study involved three analysis steps and three interim study Technical Memoranda:

1. Analysis of Arizona's Freight-Dependent Industries (Tech Memo #1) examined the demands placed on Arizona's multimodal transportation infrastructure as a result of freight/commodity movements in and through the state.

2. Freight Infrastructure Analysis (Tech Memo #2) is a supply-side analysis that provides an inventory of Arizona's modal freight networks and key nodes.

3. Strategic Directions for Freight Planning (Tech Memo #3) presents key information from the analysis tasks and proposes a freight planning agenda for the Arizona Department of Transportation (ADOT) designed to offer a menu of options for integrating freight considerations into department planning functions.

* State of Arizona, Notice of Request for Proposals for a Multimodal Freight Analysis Study, December 2006.

In addition to recommending freight planning strategy options, the report also provides examples, guidance for implementation, and suggestions for performance metrics. The three Technical Memoranda are available on the ADOT web site at:
http://tpd.azdot.gov/planning/freightstudy.php.

BROAD THEMES TO GUIDE FUTURE FREIGHT PLANNING

The key trends and themes likely to impact freight transportation in the State of Arizona are based on data, analysis, research and stakeholder outreach conducted for the Arizona Multimodal Freight Analysis Study. These key trends are examined with regard to specific implications for freight transport issues in Arizona and provide the basis for freight policy and planning recommendations presented in the report. It is likely to take years to ultimately determine whether recent fuel price volatility or the current economic recession will result in additional shifts to U.S. trade patterns. However, nothing at this time suggests current economic conditions will reverse the underlying macro-economic, demographic or industry trends discussed.

Arizona's Population Growth

Between 1990 and 2000, Arizona's population growth ranked second among all states with a 40 percent increase in population over the decade. Long-term forecasts for population growth in Arizona predict population increases of 74 percent between 2006 and 2030, growing from approximately 6.2 million people in 2006 to 10.7 million in 2030. The forecasted growth in Arizona's population will have major impacts on Arizona's demand for freight transportation services.

Population growth drives the demand for freight related services required to bring goods to Arizona consumers. Economic output drives the future demand for freight services required to move Arizona products to market. Projected growth in employment and worker productivity serves as a proxy for estimating future economic output in the state. From 2005 to 2030 both total employment and productivity per employee are estimated to each increase at an annual rate of 2.1 percent.[1,2] When combined these two factors suggest an average annual growth rate for economic output of 4.2 percent, or more than 180 percent over the period. If freight movements increase in direct proportion Arizona's estimated economic

growth, the volume of commodities generated by Arizona production facilities will increase nearly three fold.

In 2005, approximately 557 million tons of freight valued at $2.3 billion moved in, out, within, and through the state of Arizona. On a weight basis, roughly three-quarters of this freight moved on the state's highway system by truck. Railroads moved most of the remaining tonnage, while air cargo accounted for just one-tenth of one percent by weight (**Exhibit ES-1**).

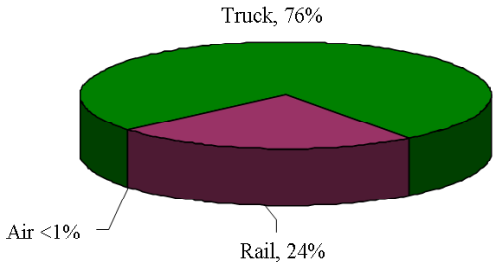
Globalization and Macro-Economic Shifts

Over the last several decades the U.S. economy has undergone fundamental changes due to an aging workforce, improvements to and greater dependence on technology, and low cost transportation. The U.S. economy, once based on manufacturing is today based on service industries, and U.S. manufacturing continues to become more focused on high-value/value-added production. Advances in technology and supply chain management practices have enabled firms to develop customized products for mass-market distribution. In the current environment, cost-effective, time-sensitive transportation services are increasingly a strategy for competitive advantage. Businesses today shop the world for raw materials, parts and labor, managing widely dispersed supply chains, using real-time information to manage integrated multimodal transportation services.

For Arizona, the new economy and logistics revolution have several implications:

1. Growing Arizona population centers will drive increasingly higher levels of freight activity and truck traffic, as consumer consumption drives the need for freight movements.
2. Southern California will continue to be a primary gateway for Trans-Pacific container traffic. While expansion of the Panama Canal currently underway (scheduled for completion in 2014) will draw more Asian containerships

Arizona's Commodity Movements by Tonnage



Source: WSA Analysis of 2005 TRANSEARCH data

Exhibit ES-1:
Modal Shares of Arizona Freight by Weight

directly to east coast ports, Arizona will continue to see high volumes of "land-bridge" rail and truck traffic from the San Pedro Ports.

3. Increasing highway congestion will drive supply chain strategies like transloading that will impact commercial development and regional land use in Arizona.
4. To remain competitive in the new economy, businesses will seek environments where public and private infrastructure supports integrated supply chain strategies; namely transportation networks that are reliable, agile, dependable, and to some extent redundant.
5. The freight transportation sector is a significant contributor to airborne emissions and air quality issues. As citizens and communities become increasingly sensitive to environmental quality, companies are recognizing the need to respond with transport options that reduce carbon emissions.

The impact of multimodal transportation networks on the freight industry

The generic supply chain for imported goods depicted in **Exhibit ES-2** illustrates the multiple parties and close coordination required to make multimodal supply chains flow smoothly and efficiently. As globalization of the U.S. economy has grown, Arizona as a border state to Mexico and neighbor to Southern California, home of the largest North American container port, is in the middle of the globalization trend.

One emerging practice in response to capacity constraints and congestion at deep water coastal ports like the San Pedro Ports of Southern California is transloading. Transloading includes the practice of moving imported goods received at a port in 40 foot international containers by rail to an inland facility where they are reloaded into 53 foot domestic containers. Domestic containers are then moved by truck to manufacturers, retailers or other receivers. Arizona is becoming a popular location for transloading containers moving through the San Pedro Ports.

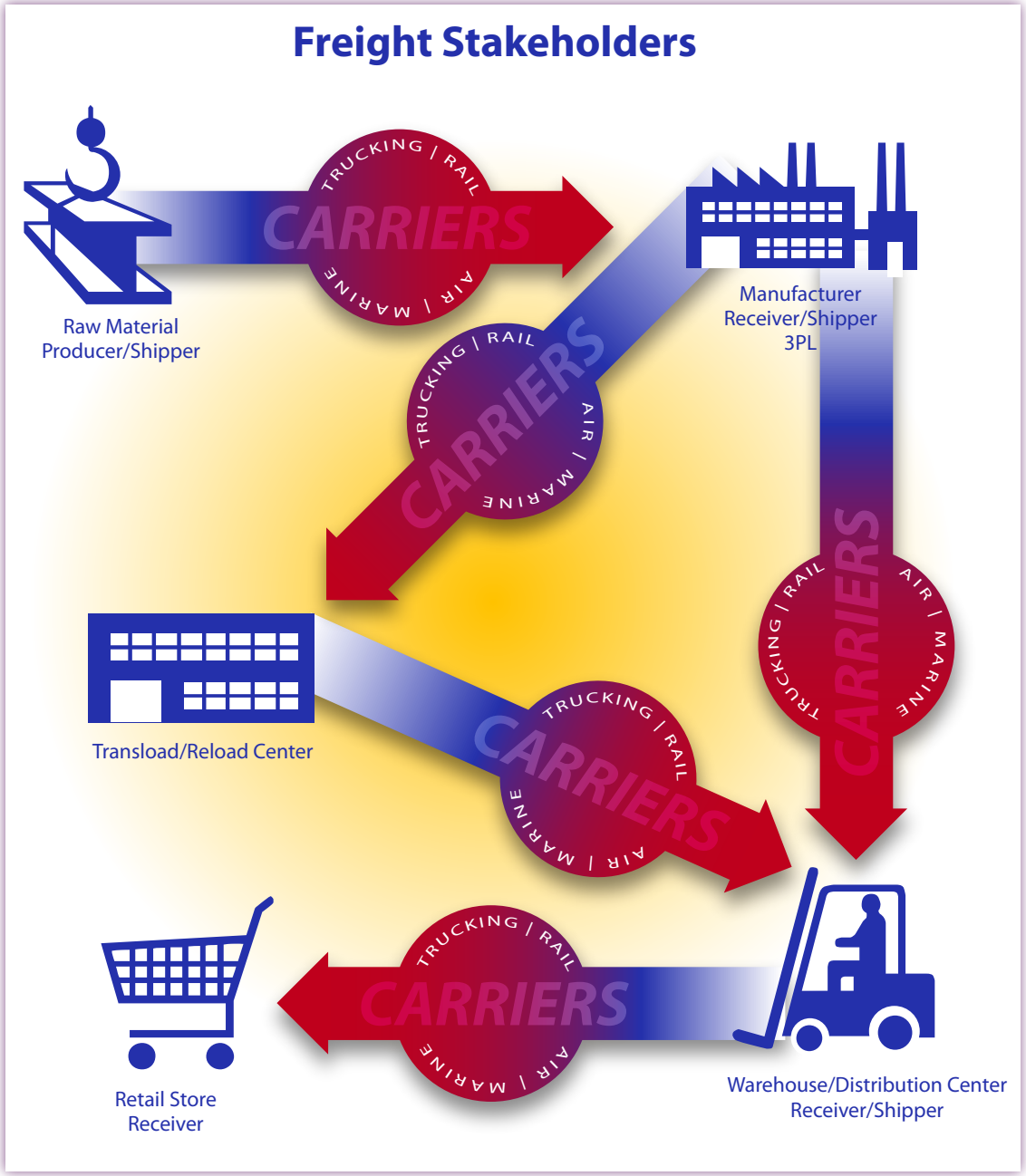


Exhibit ES-2: Illustrative Supply Chain Network for Imported Goods

While rail transport will likely play a major role in transporting regional and bridge traffic to, from, and through Arizona, truck transportation will remain the dominant mode for distributing the population- driven freight transportation growth within the state's mega-urban area that includes Tucson and Phoenix. Freight transport patterns within the urban areas consist predominantly of shorter trips (relative to regional and long-haul trips) with a scattered distributed pattern across a widespread market.

The pressure from Arizona's population growth, the tension between commercial development, and the service sensitivity of modern supply chains for reliable transportation services suggests a need to identify a priority regional highway-freight network. The high volumes of landbridge traffic moving by road and rail through Arizona should not overshadow the need to plan for regional truck networks supporting local and regional economies in the state. While regional road networks may experience significantly lower truck volumes than high volume interstate corridors, regional truck networks are often essential to the economic vitality of regional trade centers. Many regional highway segments already experience relatively high levels of truck traffic in excess of 20 percent on some segments. Intra-regional commercial corridors would be the primary conduits for freight from Phoenix, the urban center of Arizona, to regional trade centers such as Tucson, Yuma, and Flagstaff.

While Arizona has historically been viewed as a bridge state serving large volumes of through traffic, carriers will increasingly view Arizona as a destination due to its growing population. Increasingly, trucking, railroads and third party logistics providers will build whole loads (trucks, rail cars, unit trains) specifically for Arizona traffic. The combined Phoenix and Tucson market by 2030 will be on the same scale and size as the greater Los Angeles market today, which by itself consumes around 20 percent of all containers through the ports of Los Angeles and Long Beach

(LA/LB). This represents a significant market for carriers to serve the Arizona market as a set aside destination market.

Potential impacts of freight strategies on economic development in Arizona

The dramatic shift in the U.S. economy has greatly increased the demand for freight transport services. Arizona's transportation and warehousing industry plays a vital role in the state's economy. The transportation industry supports many other industry sectors by facilitating the movement of goods and services, and is also a significant direct contributor of jobs and earnings in the state. In 2006, Arizona's transportation and warehousing industry directly accounted for 3 percent of the state's workforce, and 5.3 percent of gross state product. When economic multiplier effects from transportation and warehousing are considered, it is estimated that the sector supported jobs for 237,600 Arizona citizens, providing earnings of $12.5 billion. When multiplier effects of the industry are considered, transportation and warehousing contributed $27.7 billion in gross state product in 2006. Economic forecasts of transportation and warehousing activity in Arizona estimate that by the year 2014, the industry will support 271,600 jobs, earning of $12.5 billion, and produce $31.7 billion in total economic activity (measured in 2006 dollars).

Over the next 25 years, commodity volumes in Arizona are expected to increase by an average of 78 percent on a weight basis. Some commodity groups are expected to experience tremendous growth. For instance, Electrical Equipment is forecasted to grow by more than 400 percent over the next 25 years. *Machinery; Miscellaneous Manufacturing; and Instruments, Photography Equipment, and Optical Equipment* commodity groups are each expected to grow by more than 200 percent during the forecast period. Over the next 25 years, commodity volumes moving by truck are projected to increase from 421.5 million tons to 712.7 million tons, an increase of 69 percent. The forecast equates to a 2.1 percent annual growth rate for trucking volumes.

Strategies for Freight Data Collection, Analysis, and Planning

In response to Arizona's tremendous population growth over the past several decades and the need to invest in the state's future, ADOT is currently pursuing an aggressive statewide transportation investment strategy. To support the investment strategy, ADOT has undertaken a series of regional and issue-specific framework studies. The themes developed to guide ADOT's freight planning efforts are intended to respond directly to the issues facing Arizona, while providing opportunities to integrate freight planning with emerging statewide policy. **Exhibit ES-3** introduces six proposed freight planning strategy themes and suggests how these themes integrate with the Transportation Planning Framework Principles.

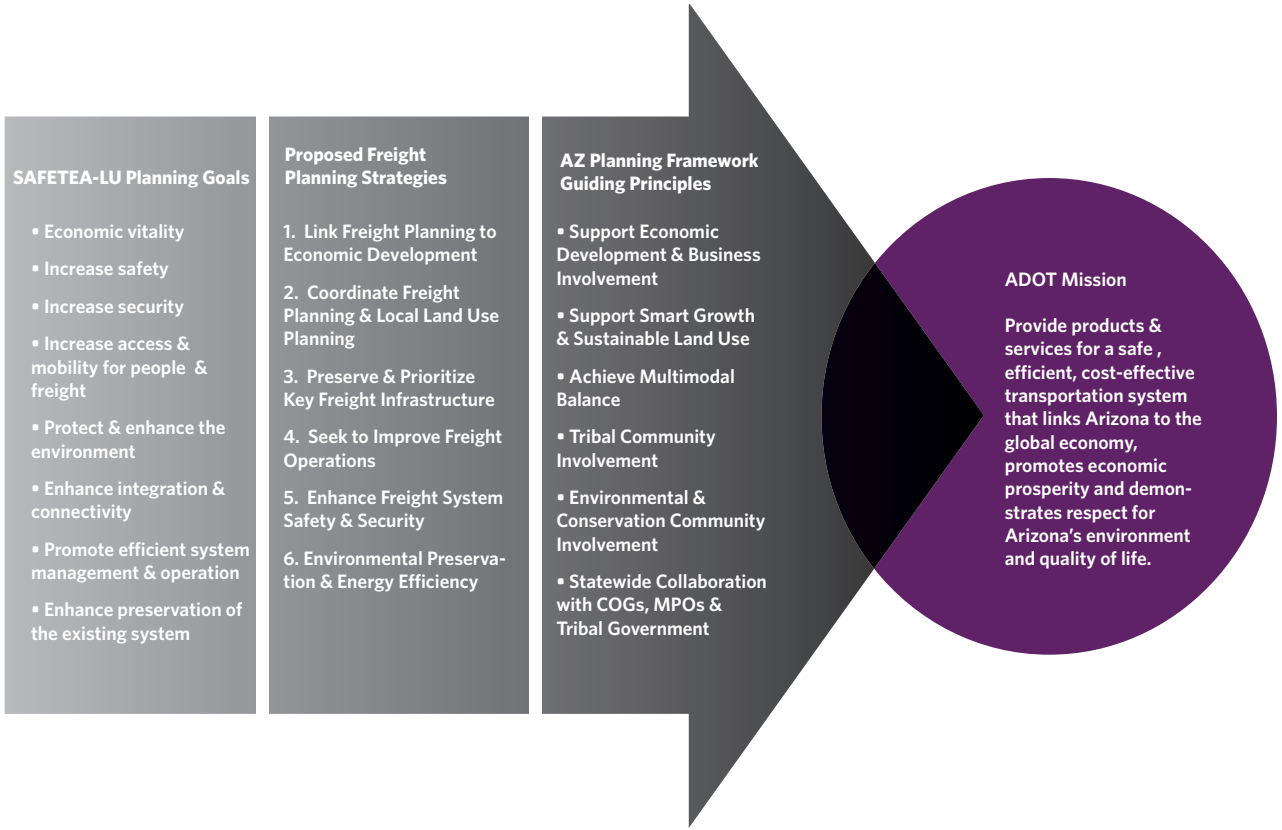


Exhibit ES-3: Recommended ADOT Freight Planning Strategies

A key outcome of the Arizona Multimodal Freight Analysis Study is *"a strategy for establishing freight analysis as an integral part of Arizona's long-range planning process."*[†] The strategy is intended to provide themes for guiding future freight planning at ADOT, examine the relationship between freight activity and economic development in Arizona, and provide strategies for related data collection and analysis about the impacts of freight on the performance of Arizona's multimodal freight transportation networks. To meet these objects a freight planning agenda is recommended for ADOT that provides a menu of strategies and tactics that ADOT can use to begin the process of integrating freight into the existing planning process. The freight planning agenda summarized in **Exhibit ES-4** is intended to start ADOT down this cooperative freight planning path. The agenda is designed to integrate freight considerations into ADOT's existing planning initiatives while remaining consistent with other state and national freight policy themes. The summary table also provides suggestions for performance measures that can be use to track the effectiveness of implemented strategies.

[†] State of Arizona, Notice of Request for Proposals for a Multimodal Freight Analysis Study, December 2006.

Strategic Response #1: Link Freight Planning to Economic Development	
Tactics	**Performance Measures/Indicator**
1a. Engage the private sector in transportation planning	▪ Number of freight stakeholder outreach activities ▪ Number of private sector attendees at events
1b. Support freight-related training and education for state, regional, and local planning staff.	▪ Number of training sessions or workshops hosted ▪ Number of MPO/COG representatives at training sessions
1c. Market the link between transportation and Arizona's economy.	▪ Public attitudes toward freight in omnibus surveys ▪ Sponsorship of the CAPS Center for Strategic Supply Research or similar organizations

Strategic Response #2: Coordinate Freight Planning and Local Land Use Planning	
Tactics	**Performance Measures/Indicator**
2a. Encourage and support efforts on behalf of local governments to develop land use planning guidelines for freight-intensive development.	▪ Number of Arizona communities that adopt or develop land use guidelines specifically addressing freight developments ▪ Number of in-state university research projects addressing land use and freight
2b. Encourage communities to work closely with the private sector when developing freight logistics centers	▪ Number of communities that develop local freight stakeholder forums or groups

Strategic Response #3: Preserve and Prioritize Key Freight Infrastructure	
Tactics	**Performance Measures/Indicator**
3a. Expand Arizona's participation in high-priority corridor initiatives.	▪ Number of corridor-level agreements with other states ▪ Number of projects funded through or initiated by COF or other corridor-based programs
3b. Support railroad mainline capacity expansions.	▪ The formation of, or participation in, rail corridor coalitions ▪ Rail freight facility access improvements ▪ Number of at-grade crossings removed
3c. Prioritize and protect priority highway corridors for efficient freight movement.	▪ Average truck trip time between trade centers
3d. Establish and maintain a freight data collection program.	▪ The number or percent of planning studies, such as framework studies, that include some element of freight analysis ▪ Average travel time and buffer indices for major truck corridors

Exhibit ES-4: Summary of the Proposed ADOT Freight Planning Agenda

Strategic Response #4: Seek Opportunities to Improve Freight Operations	
Tactics	**Performance Measures/Indicator**
4a. Incorporate heavy truck movements into highway design and reduce bottlenecks	• Percent of priority truck routes meeting ADOT standards for: o pavement condition o bridge condition o WB-67 intersection design o adequate acceleration lanes for trucks • Adequate climbing lanes for trucks on steep grades
4b. Expand Arizona's NHS intermodal connector network for freight.	• Number of Arizona road segments on the FHWA-NHS connector listing that serve freight facilities
4b. Use innovative technology to improve highway operations for commercial vehicles.	• Number of ITS projects on freight-significant corridors in Arizona • Estimated time savings from ITS investments on priority truck corridors

Strategic Response #5: Enhance Freight System Safety and Security	
Tactics	**Performance Measures/Indicator**
5a. Target improvements to truck crash "hot spots."	• Commercial vehicle crash rates by segment • Percent of vehicle and driver attributes for truck crashes for which the response "unknown" is listed in crash reports
5b. Provide safe, secure parking opportunities for commercial vehicle drivers.	• Percent of public truck parking spaces occupied by time of day • Distance (in miles) between public truck parking facilities on major corridors
5c. Monitor/improve the safety of railroad grade crossings that have a crash history.	• Number of crashes by crossing • Number of at-grade improvements
5d. Implement performance-based truck size and weight enforcement policies.	•Annual pavement and bridge infrastructure savings from weight enforcement
5e. Monitor impacts of TSA air cargo screening requirements on businesses.	• Number of meetings with air cargo stakeholders to monitor impacts

Strategic Response #6: Environmental Preservation and Energy Efficiency	
Tactics	**Performance Measures/Indicator**
6a. Promote "green" freight initiatives in Arizona's growing freight transport sector.	• Percentage reduction in mobile source emissions from large trucks • Percentage reduction in energy consumption from large trucks
6b. Study options for moving through trucks out of congested urban corridors.	• Percentage reduction in truck VMT on congested urban corridors

Exhibit ES-4: Summary of the Proposed ADOT Freight Planning Agenda *Continued*

CONCLUSIONS

The forecasted growth in Arizona's population is the leading driver impacting freight transportation policy and development in the state of Arizona. The increase in population will lead to an equivalent increase in demand for goods and services. As population increases, so will traffic volumes, both in terms of passenger travel and freight transportation. The geographic distribution of these population forecasts suggests significant development patterns around the major metropolitan areas of Tucson and Phoenix.

Commodity forecasts suggest that rail will be the fastest growing mode in Arizona, but most of the volume increases will come from bridge traffic through Arizona. Truck transportation will likely be the dominant mode for distributing the population-driven freight demand around Arizona's population centers.

The state of Arizona is at the crossroads of several significant regional, national, and international trade corridors. As bridge traffic along these trade corridors grows, they continue to congest and impact the efficiency and productivity of key regional and national rail and highway corridors that serve Arizona, in terms of both freight transportation and overall commuter transportation.

It is anticipated that the San Pedro Bay ports of Los Angeles and Long Beach (LA/LB) will continue to be the major U.S. gateway for Asian container traffic, with container volumes expected to triple by 2020. The railroads are making major investments in on-dock rail facilities to accommodate an increasing share in rail traffic. Moreover, trucking is likely to continue as the dominant mode for transporting containers to markets other than those on the East Coast. The increase in rail traffic and long-haul truck traffic is likely to impact key corridors feeding through Arizona. While speculation continues about the development of rail and highway corridors from Mexico to serve increasing trade between Mexico and the United States, these plans

are not concrete. If successfully implemented, they could have significant impacts on key corridors that serve the state of Arizona; notwithstanding these trends, the San Pedro Bay ports will continue to be an important gateway with significant impacts on Arizona by virtue of their location.

As Arizona continues to grow, individual communities, stakeholders, and constituent groups are likely to gain the resources as well as the political will and weight to try to address transportation strategies on an autonomous and individual basis. ADOT can be a leader in the area of freight transportation planning. The challenge in taking this leadership role lies in the ability to develop a consistent statewide strategy for addressing freight transportation. The overriding policy implication for the state of Arizona is the need for greater cooperation and proactive planning among agencies at the state and regional level, coordination among cities and counties within major urban areas, and coordination with the private sector specifically.

background

"a strategy for establishing freight analysis as an integral part of Arizona's long-range planning process."

The key outcome from the Arizona Multimodal Freight Analysis Study is *"a strategy for establishing freight analysis as an integral part of Arizona's long-range planning process."*[3] The study was directed to include the following as part of the strategy development:

- Broad themes to guide future freight planning
- A description of how multimodal transportation networks impact the freight industry
- Potential impacts of freight strategies on economic development in Arizona
- A strategy for freight data collection, analysis, and planning
- Measurable indicators describing the impact of freight traffic on the performance of Arizona's multimodal freight transportation network

The Arizona Multimodal Freight Analysis Study is intended to build on previous freight study efforts by ADOT such as the high-level analysis of goods movement completed for the MoveAZ long-range transportation plan and the Arizona Railroad Inventory and Assessment.

The study process for the Arizona Multimodal Freight Study involved three analysis steps and three interim study Technical Memoranda:

1. **Analysis of Arizona's Freight-Dependent Industries** (Tech Memo #1): Examines the demands placed on Arizona's multimodal transportation infrastructure as a result of freight/commodity movements in and through the state. Tech Memo #1 includes an examination of economic and demographic trends in Arizona and the implications for freight movement. The memorandum also presents an extensive analysis of TRANSEARCH commodity flow data acquired for the study, as well as information gathered through stakeholder interviews. The memorandum is organized in four sections:

   a. An Overview of Arizona's Demographic and Economic Foundations
   b. Key Issues and Trends Affecting Freight Movements
   c. A Profile of Major Commodity Movements in Arizona
   d. A Summary of Freight Stakeholder Outreach Activities

The three Tech Memos are available on the ADOT web site at: ***http://tpd.azdot.gov/planning/freightstudy.php.***

2. **Multimodal Freight Infrastructure Analysis** (Tech Memo #2): A supply-side analysis that provides an inventory of Arizona's modal freight networks and key nodes. The memorandum examines how existing infrastructure in Arizona and Southwestern United States impacts the freight industry. This memorandum is also organized in four major sections:

   a. Highway Inventory and Needs Assessment
   b. Railroad Inventory and Needs Assessment
   c. Air Cargo Inventory and Needs Assessment
   d. Public Sector Stakeholder Outreach

3. **Strategic Directions for Freight Planning** (Tech Memo #3): This memorandum presents key information from earlier tasks, as well as new information from analyses of commodity flow forecasts and economic forecasts related to Arizona's Transportation and Warehouse Industry sector. The memorandum presents a proposed freight planning agenda for ADOT designed to offer a menu of options for integrating freight considerations into department planning functions. The strategy recommendations in the memorandum address all freight modes operating in Arizona—air, rail, and trucking—nonetheless an emphasis remains on highways because more than three-quarters of all freight moving in Arizona by volume moves on the highway system. In addition to recommending freight planning strategy options, the report also provides examples of freight issue analysis, guidance for freight planning strategy and tactics implementation, and suggestions for performance metrics.

This final report of the Arizona Multimodal Freight Study represents the culmination of analysis, findings, and recommendations presented in the three Technical Memoranda.

introduction

In the current global trade environment, cost-effective, time-sensitive transportation services are increasingly a strategy for competitive advantage in manufacturing, value-added agriculture and service-based industries. Businesses today shop the world for raw materials, parts and labor, managing widely dispersed supply chains, using real-time information to manage integrated with multimodal transportation services.

Over the last several decades many developed countries have seen fundamental changes to their economic structure. The factors driving economic changes in developed countries include aging populations/workforces, improvements to and greater dependence on technology, and low cost transportation. Developed nations now "off-shoring" low margin, labor intensive industries such as basic manufacturing are transitioning to high value manufacturing and service based economies. Developing nations are, as the name suggests, developing manufacturing based economies to supply basic consumer goods to the world. In general, the U.S. economy remains in transition, continuing the shift from resource-oriented industries like commodity based agriculture, mineral extraction and basic manufacturing, toward a more diverse industry mix including value-added agriculture, service industries and advanced manufacturing such as bio-technology, microelectronics and aerospace.

As the U.S. economy becomes more service oriented and manufacturing focuses more on high-value/value-added production, inventories become more expensive to stock. Advances in technology and supply chain management allow firms to develop customized products for mass-market distribution. To hold down costs associated with inventory companies adopt just-in-time supply chain management practices with the following attributes:

- *Demand-Pull Inventory Management:* Product replenishment orders triggered by the consumer as opposed to the producer (supply-push). For example product inventory requests triggered as products are scanned at a check-out counter.
- *Customer-Focused Logistics:* Tailoring logistics/communication networks that

respond to the unique needs and profitability requirements of each specific customer group.

- *Transportation Effectiveness:* Leveraging the abilities of technology for integrating transportation services to improve customer service and total supply chain performance.

Exhibit 1 depicts a generic supply chain illustrating the multiple parties and close coordination required to make multimodal supply chains flow smoothly and efficiently. As globalization of the U.S. economy has grown, Arizona as a border state to Mexico and neighbor to Southern California, home of the largest North American container port, is in the middle of the globalization trend.

One emerging practice in response to capacity constraints and congestion at deep water coastal ports is transloading. Transloading includes the practice of moving imported goods received at a port in 40 foot international containers by rail to an inland facility where they are reloaded to 53 foot domestic containers. Domestic containers are then moved by truck to manufacturers, retailers, or other receivers. Arizona is becoming a popular location for transloading containers moving through the San Pedro Ports of Southern California.

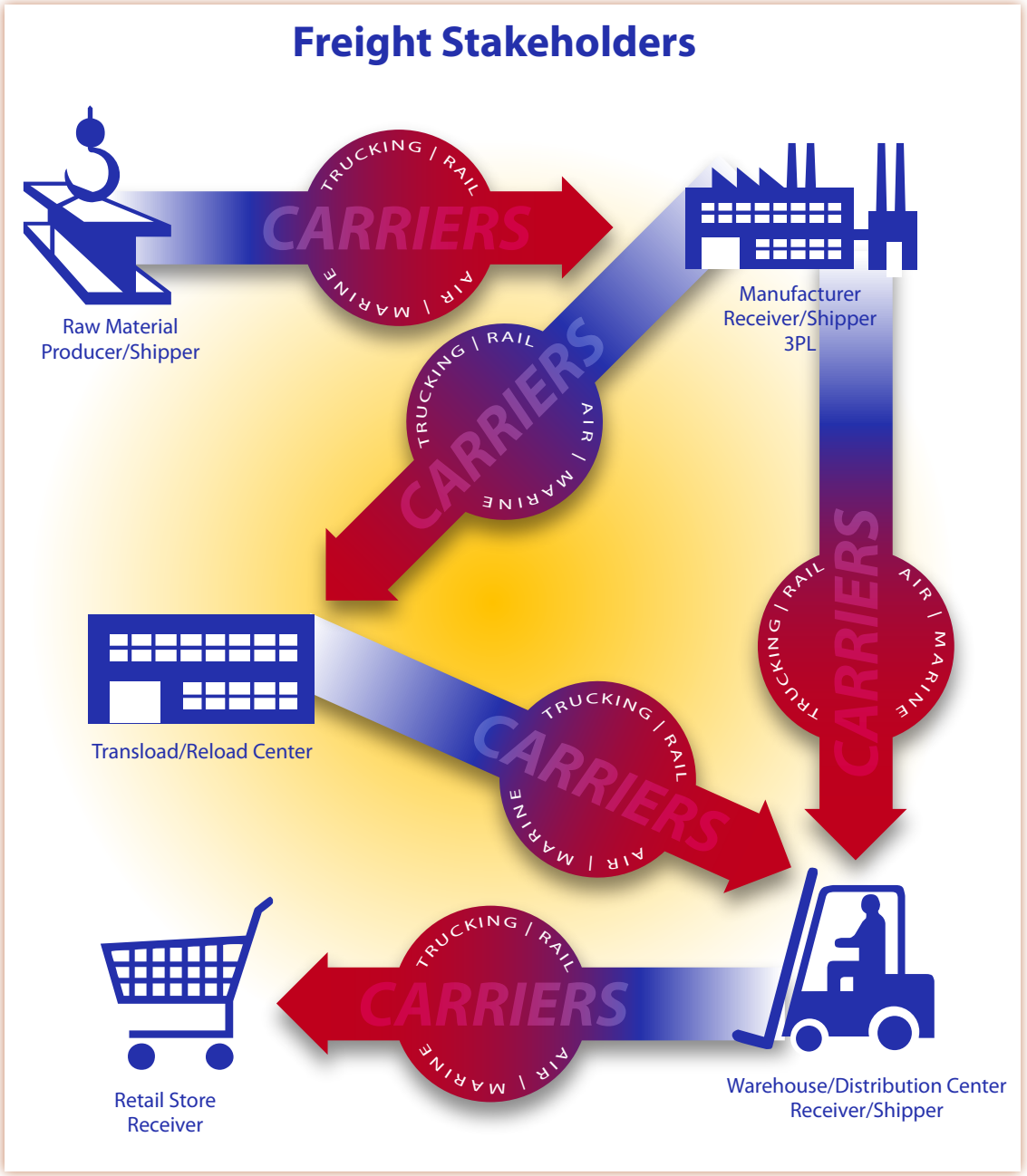


Exhibit 1: Illustrative Supply Chain Network for Imported Goods

For Arizona, the new economy and logistics revolution have several implications:

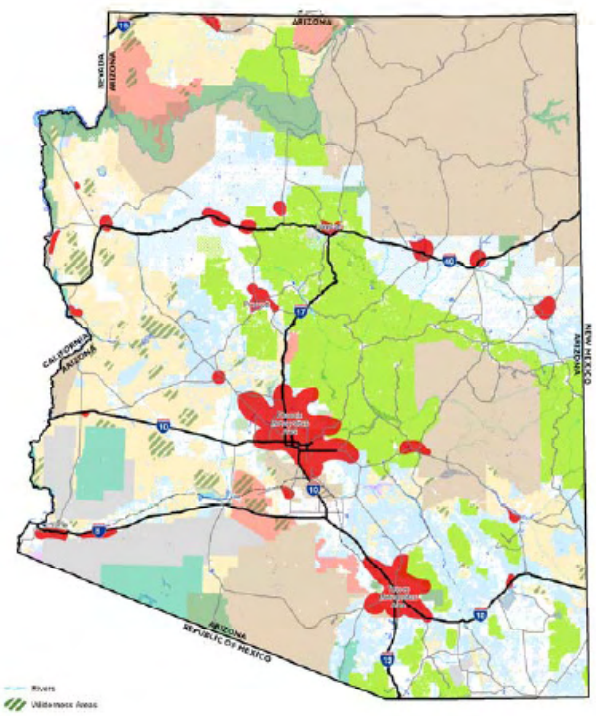
1. Growing Arizona population centers will drive increasingly higher levels of freight activity and truck traffic, as consumer consumption drives the need for freight movements.
2. Southern California will continue to be a primary gateway for Trans-Pacific container traffic. While expansion of the Panama Canal currently underway (scheduled for completion in 2014) will draw more Asian containerships directly to east coast ports, Arizona will continue to see high volumes of "land- bridge" rail and truck traffic from the San Pedro Ports.
3. Increasing highway congestion will drive supply chain strategies like transloading that will impact commercial development and regional land use in Arizona.
4. To remain competitive in the new economy, businesses will seek environments where public and private infrastructure supports integrated supply chain strategies; namely transportation networks that are reliable, agile, dependable, and to some extent redundant.
5. The freight transportation sector is a significant contributor to airborne emissions and air quality issues. As citizens and communities become increasingly sensitive to environmental quality, companies are recognizing the need to respond with transport options that reduce carbon emissions.

trends and issues affecting freight movements in arizona

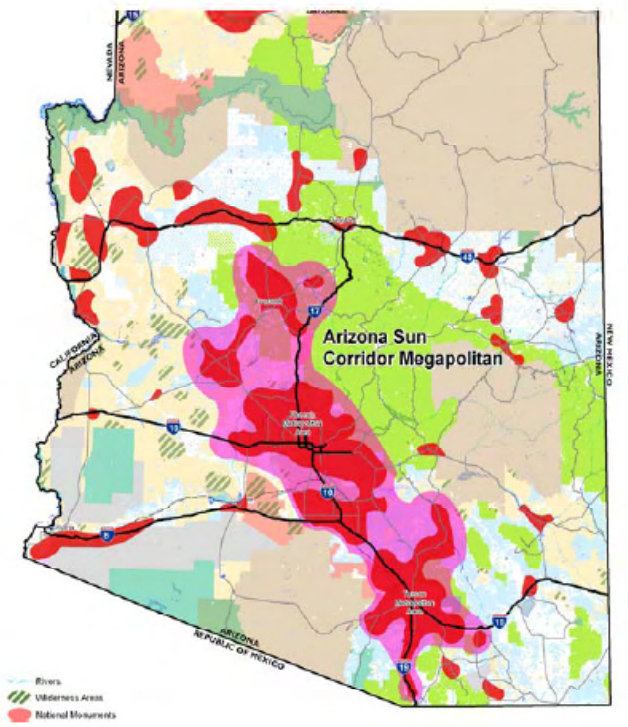
This overview of key trends likely to impact freight transportation in the state of Arizona is based on data, analysis, research, and stakeholder outreach conducted for the Arizona Multimodal Freight Analysis Study. These key trends are examined with regard to specific implications for freight transport issues in Arizona and provide the basis for freight policy and planning recommendations presented later in the report. It is likely to take years to ultimately determine whether recent fuel price volatility or the current economic recession will result in additional shifts to U.S. trade patterns. However, nothing at this time suggests current economic conditions will reverse the underlying macro-economic and industry trends discussed in this section.

More People, More Freight Demands

Between 1990 and 2000 the rate of growth in Arizona's population ranked second among all states - an increase of 40 percent over the decade. Long-term forecasts for Arizona suggest an increase in the state's population of an additional 74 percent between 2006 and 2030, resulting in 10.7 million people by 2030. The red or dark shaded areas shown on the maps in **Exhibit 2** suggest regions of Arizona where population growth will be concentrated over the next several decades. It is important to keep in mind however, that while Arizona is growing fast, the latest population estimates from the U.S. Census Bureau ranks Arizona 14th among all states in total population.[4] Of the top ten states by population only two, California and Texas, lie west of the Mississippi River. Still, Arizona's growing population will have major impacts on future demands for freight transportation services.



2005 Growth Areas
Population: 5.1 million



2050 Growth Areas
Population: 14.1 million

Exhibit 2: Arizona's Future Potential Statewide Growt

Source: "Building a Quality Arizona" Presentation by Victor Mendez, ADOT Director to the State Transportation Board, June 19, 2008

Population growth drives the demand for freight related services required to bring goods to Arizona consumers. Economic output drives the future demand for freight services required to move Arizona products to market. Projected growth in employment and worker productivity serves as a proxy for estimating future economic output in the state. From 2005 to 2030 both total employment and productivity per employee are estimated to each increase at an annual rate of 2.1 percent.[5,6] When combined these two factors suggest an average annual growth rate for economic output of 4.2 percent, or more than 180 percent over the period. If freight movements increase in direct proportion Arizona's estimated economic growth, the volume of commodities generated by Arizona production facilities will increase nearly three fold.

In 2005 approximately 557 million tons of freight valued at $2.3 billion moved in, out, within, and through Arizona (**Exhibit 3**). On a weight basis, roughly three-quarters of this freight moved on the highway system in trucks. Railroads moved most of the remaining tonnage, with air cargo accounting for only one-tenth of one percent by weight.

Exhibit 4 presents the anticipated changes in commodity volumes between 2005 and 2030, in percentage terms. Over the next twenty-five years, commodity volumes in Arizona are expected to increase by 78 percent. The projected fastest growing commodity groups are Electrical Equipment; Instruments, Photographic Equipment, and Optical Equipment; Miscellaneous Manufacturing Products; and, Machinery. Over the twenty-five year period Electrical Equipment is expected to grow by more than 400 percent.

Total freight volumes moving by truck in Arizona are projected to increase from 421.5 million tons to 712.7 million tons, an increase of 69 percent between 2005 and 2030 (an annual growth rate of 2.1 percent). Forecasts of the ten largest commodity

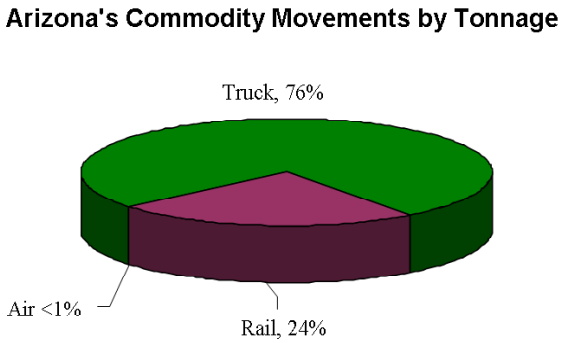


Exhibit 3: Modal Shares of Arizona Freight by Weight
Source: WSA Analysis of 2005 TRANSEARCH data

groups moving by truck suggest that only Food and Kindred Products, and Secondary Traffic will outpace the average growth rate for all truck movements. Secondary Traffic includes truck movements to and from warehouse and distribution centers and intermodal rail or air cargo facilities.

Commodity volumes moving by rail across Arizona are forecast to exceed the growth in commodity volumes transported by truck. The predicted growth in rail traffic for Arizona is a significant departure from national trends that suggest higher growth in trucking volumes, than for either rail shipments or waterborne transportation."[7] Global Insight forecasts that rail volumes moving on Arizona's railroad network will increase 105 percent between 2005 and 2030; an annual growth rate of 2.9 percent, a full percentage point higher than the national average.

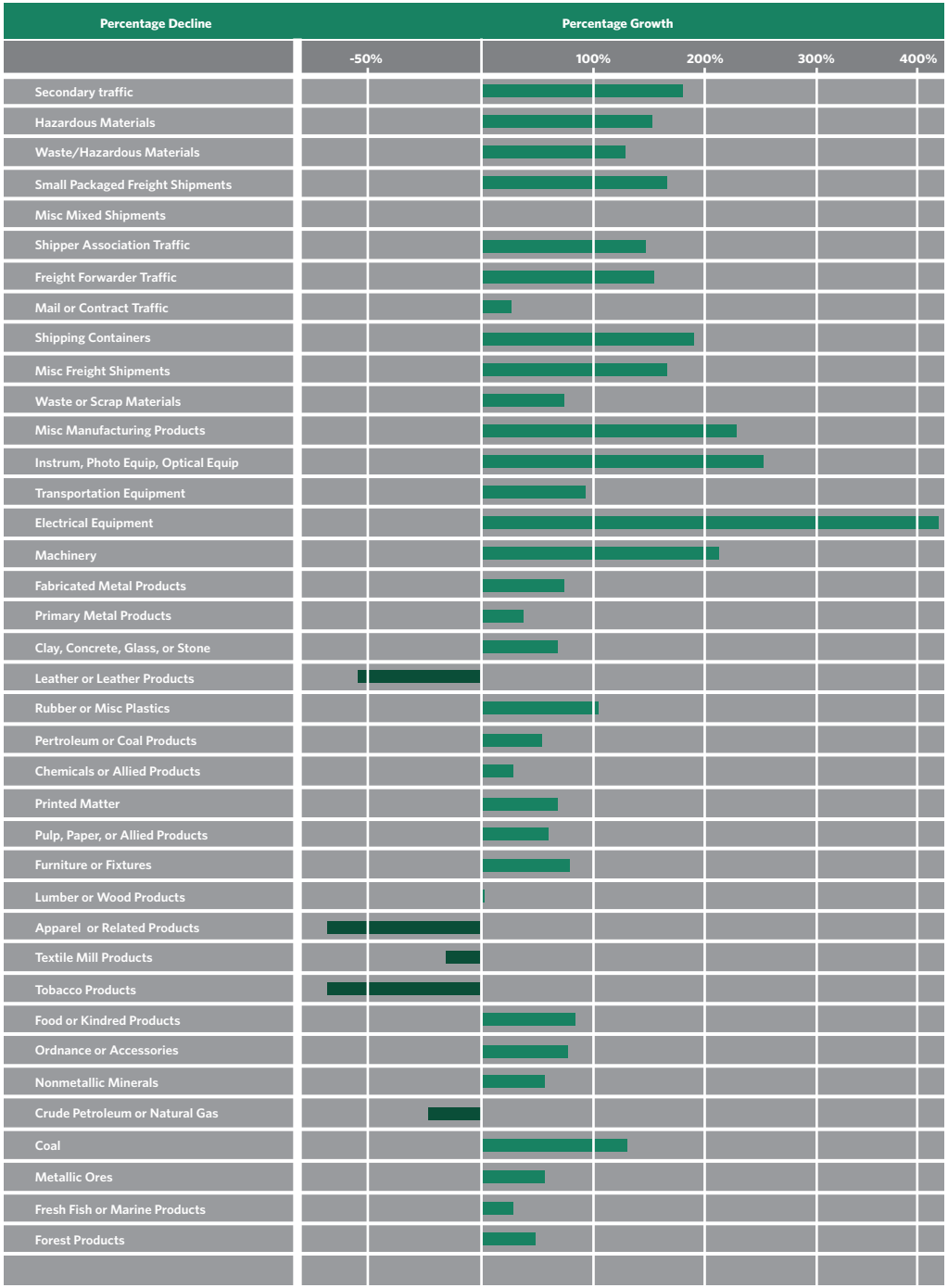


Exhibit 4: Percent Change in Arizona Commodity Movements 2005-2030

Source: Global Insight, Inc. TRANSEARCH Forecast Data.

The economic recession during the last half of 2008 has significantly reduced short-term projections of annual population growth in Arizona to 1.2 or 1.3 percent over the next two years, however long-term implications for freight demand in Arizona driven by population and economic growth include the following:[8]

- *Commodity Movements – Current and Forecast:* Arizona's increasing population will lead to greater demands for goods and services. As population increases, so will traffic volumes – both passenger travel and freight transportation. The sectors likely to experience the highest growth are consumer-driven retail trade and construction materials to support residential and commercial development. History shows that investment in the freight system will not be at pace with growth in demand. The implication is increased congestion on the local roadway system and networks and deteriorated levels of service and reliability.

- *Mode Reliance and Distributive Networks:* While rail transport will likely play a major role in transporting regional and bridge traffic to, from, and through Arizona, truck transportation will remain the dominant mode for distributing the population- driven freight transportation growth within the state's mega-urban area that includes Tucson and Phoenix. Freight transport patterns within the urban areas consist predominantly of shorter trips (relative to regional and long-haul trips) with a scattered distributed pattern across a widespread market.

- *Development Patterns:* The geographic distribution of the population forecasts indicates a specific development pattern around the major metropolitan areas of Tucson and Phoenix. Land use forecasts show a pattern of growth along a linear corridor stretching from the eastern boundaries of Tucson westward

along I-10 through Phoenix and northward along I-17 toward Prescott. The linear growth pattern will dictate the development of specific transportation networks and therefore the local and regional patterns for distributing retail and consumer goods as well as construction materials.

Arizona: A "LandBridge" for North American Freight

Arizona's growing population will drive an increase in demand for freight transportation services, and its location between major international trade gateways in Southern California and population centers in the middle and eastern portions of the United States will intensify the infrastructure demands created by goods movement. As depicted in the supply chain graphic in **Exhibit 1**, large volumes of international trade move between trading countries through international gateways. In 2005, containerized freight volumes between Asian and North America totaled 18 million twenty foot equivalent units (TEU). During the same year container traffic between North American and Europe totaled 5.4 million TEU. In 2005, 14.2 million TEUs moved through the San Pedro Ports in Southern California.[9]

International containers coming to North America through major deep water container ports are then distributed to the interior of the continent primarily by rail to major rail intermodal hubs located in cities such as Chicago, Kansas City, St. Louis, Memphis and Dallas/Fort Worth. Since 1980 intermodal container volumes have increased eight-fold. In 2006, railroad intermodal traffic in the U.S. exceeded 14.2 million units (containers and piggy-back trailers); containerized freight accounted for 11.8 million units. The long-haul rail or truck portion of an international container movement is often referred to as a "landbridge" movement.

"Landbridge as an intermodal freight transport mode seamlessly integrates long-haul rail and short-haul truck services to provide transcontinental delivery of containers..." [10]

Exhibit 5 presents the breakdown of the total tonnage of freight moving on Arizona's multimodal networks by direction and mode. Over three quarters of all the freight moved in the State was shipped by truck, while rail accounted for almost a quarter, and the remaining modes constituted less than one percent. However, 60 percent of all rail and truck movements on Arizona's transportation networks were through movements, with origins and destinations external to Arizona.

Exhibit 5: 2005 Arizona Directional Flows by Mode (figures are in tons)

Source: WSA Analysis of 2005 TRANSEARCH data

Mode	Outbound	Inbound	Internal	Through	Total	% Total
Truck	42,315,696	48,477,815	95,930,448	234,800,988	421,524,946	75.7%
Rail	3,053,004	28,827,987	2,435,101	100,211,677	134,527,768	24.2%
Air	305,723	196,264	3,163	0	505,150	0.1%
TOTAL	45,674,422	77,502,066	98,368,712	335,012,664	556,557,864	100.0%

The state of Arizona is at the crossroads of several significant regional, national and international trade corridors. As bridge traffic along these trade corridors grow, they continue to congest and impact the efficiency and productivity of key regional and national rail and highway corridors that serve Arizona, for both freight and commuter transportation. Trends affecting Arizona as a landbridge state include:

- *Class I Railroads are Moving More Traffic on Southern Main Lines.* As the price of oil continues to increase, so does the demand for coal from the Powder River Basin (PRB) in Southeast Montana and Northeast Wyoming. The growing coal volumes, particularly trains moving east from the PRB, are often routed on the same rail lines that serve the time-sensitive intermodal trains. In order to preserve the reliability of these major coal routes, the railroads use price incentives to encourage intermodal shippers to use mainline routes across the southern portion of the country including those mainlines running through Arizona.

- *The San Pedro Ports of Los Angeles and Long Beach.* The San Pedro Ports in Southern California will continue to be the major U.S. gateway for Asian container traffic. The railroads are making major investments in on-dock rail facilities in the San Pedro Ports to accommodate an increasing share in rail traffic. Moreover, trucking will continue to be the dominant mode for transporting containers to population centers other than those in the Midwest and East Coast. The increase in rail traffic and long-haul truck traffic is likely to impact key west-east corridors traversing Arizona.

- *Corridors from Mexico.* There continues to be speculation on the development of rail and highway corridors from Mexico to serve growing trade between Mexico and the United States. In addition, there are plans for one or more international container ports to be developed on Mexico's west coast, that will be served by rail corridors leading north through Arizona. While these plans are still in flux, if successfully implemented they will have significant impacts on key north/south corridors serving the state of Arizona.
    - The new rail intermodal operation at Port of Lazaro Cardenas will likely have little impact on the volume of traffic moving through the San Pedro Ports in the near term. Currently, the Port of Lazaro Cardenas is seeking to attract cargo that currently moves into the Southeastern US via Southern California. The location of the Port of Lazaro Cardenas and configuration of the U.S. rail network will continue to favor Southern California as a gateway for cargo destined for the U.S. Northeast and Midwest.
    - The establishment of the Port of Lazaro Cardenas as dedicated to Transpacific-U.S. cargo is only one trend affecting Southern California ports. First, the Mexican Government has created a transportation infrastructure plan that identifies three priority corridors for development. Each of the three priority corridors will connect a port on the Pacific Coast.

The priority corridor identified on the Gulf Coast will provide Mexico with the opportunity to become a land-bridge between Asia and other locations in the U.S. Second, the expansion of the Panama Canal will allow larger ships to cross between the Pacific and Atlantic Oceans, avoiding the need to discharge transcontinental cargo in California. A third trend is the increasing reliance on the Suez Canal for passage between Asia and the U.S. Asian cargoes that once were delivered to Southern California and put on trains for the Northeast and Midwest, are being routed through the Suez Canal to the Port of New York or the Port of Norfolk. Notwithstanding these trends, the Southern California ports will always be an important gateway by virtue of their location. Consequently, absent any dramatic decrease in imports from Asia, it is expected that these ports will generate significant volumes of containers moving through Arizona.

- *Corridors from Northern Arizona.* As communities to the north of Phoenix along I-17 continue to grow, so does the level of traffic along this north-south corridor. One area of concern raised by stakeholders is trucks traveling from Southern California through Flagstaff and other Northern Arizona communities. Hours of service regulations that dictate the length of time truck drivers can operate without sleep force truck drivers to stop and park when they reach their drive time limit. As a result, an increasing numbers of trucks are parking and staging along highways and in neighborhoods throughout communities in Northern Arizona.

- *The I-10: Arizona's Highway Link to Global Gateways.* Already, some segments of I-10 through Arizona rank as among the worst highway bottlenecks in the nation. In 2004, the American Highway Users Alliance published the findings of a highway bottleneck study that found two Phoenix area interchanges

ranked among the 25 worst highway bottlenecks in the nation. A section of I-10 where the freeway crosses State Routes (SR) 52 and 202 referred to as "The Mini-Stack" was ranked as the fourth worst interchange bottleneck in the U.S. A segment of I-10 from the interchange with I-17 (The Stack) and Cactus Road was ranked as the 12th worst interchange bottleneck in the nation. A more recent evaluation of U.S. freight bottlenecks conducted for FHWA found The Stack interchange now ranked as the second worst interchange bottleneck accounting for 1,492,100 hours of total annual delay for trucks each year. The Mini-Stack which had dropped to the 24th worst truck bottleneck accounted for an additional 521,600 hours of truck delay annually.[11]

Maintaining Freight Transport Service Levels and Market Priorities

The high volumes of landbridge traffic moving by road and rail through Arizona should not overshadow the need to plan for regional truck networks supporting local and regional economies in the state. While regional road networks may experience significantly low truck volumes than high volume interstate corridors, regional truck networks are often essential to the economic vitality of regional trade centers. Motor carrier surveys conducted for this study asked trucking company officials to identify key routes for regional shipments within, to, or from a location in Arizona. Routes identified included: US-60, US-89, US-93, SR-77 and SR-287. Many of these routes serve as inter-regional corridors between metropolitan Phoenix and regional trade centers around the state. **Exhibit 6** shows annual average daily traffic (AADT), truck average daily traffic (ADT), and percent of trucks in the traffic stream for selected segments along these routes.

Exhibit 6: Traffic and Truck Counts for Select Regional Routes in Arizona

RTE	Road Way Segment				AADT 2006	Truck ADT	% of Trucks
	Begin Post	Beginning Intersection	End Mile Post	Finding Intersection			
US-60	180.40	Exit 180 Mesa Dr.	180.41	Exit 181 Stapley Dr.	185,000	33,422	17%
US-60	140.93	Meeker Blvd.	142.76	Bell Rd.	27,565	10,668	28%
US-60	120.13	SR 74 Morristown	138.61	SR 303	11,795	5,469	28%
SR-287	112.03	Florence St.	112.77	Trekell Ave.	23,824	5,024	15%
US-89	418.37	SB 40/Cntry Club Dr.	420.74	Winona Rd.	26,389	3,004	12%
US-60	108.45	Country Club Dr.	110.33	US 93/Center St.	13,894	2,935	20%
US-93	123.67	Chicken Sprgs Rd.	155.23	SR 97	6,746	2,179	34%
US-93	52.76	Chloride Rd.	67.03	SR 68	9,014	2,116	24%
US-89	420.74	Winona Rd.	422.75	Silver Saddle Rd.	16,987	1,981	12%
US-93	155.23	SR 97	182.91	SR 71	6,796	1,934	28%
US-93	0.00	NV State Line	41.84	Pierce Ferry Rd.	6,636	1,791	24%
US-93	91.20	I-40 (Exit 71)	123.67	Chicken Sprgs Rd.	6,227	1,761	34%
US-60	212.23	SR 79 - Florence Jct.	225.82	Main St. - Superior	8,709	1,705	17%
US-93	196.16	Vulture Mine Rd.	199.67	US 60 - Wickenburg	11,213	1,651	20%
US-89	457.11	Gray Mtn Trading Post	465.21	SR 64	5,597	886	12%
SR-287	115.80	I-10 (Exit 194)	117.73	Overfield Rd./Cnt Ave.	9,267	809	15%
US-60	56.53	Buckeye Rd.	61.49	2nd St. - Wenden	2,065	419	20%
US-60	85.81	SR 71 No.	105.66	Airport Rd.	1,875	313	20%
SR-77	115.33	North Main St.	134.81	SR 177 - Winkleman	3,650	291	18%
US-60	31.26	I-10 (Exit 31)	45.85	Vicksburg Rd.	1,578	237	20%

As traffic volumes grow in Arizona, the threat emerges that freight transport service levels may decline as highways become more congested. There is also the threat of rail carriers focusing investment on existing larger markets and trade lanes that are more profitable today. Issues related to maintaining freight transport service levels include:

- The pressure from Arizona's population growth, the tension between commercial development, and the service sensitivity of modern supply chains for reliable transportation services suggests a need to identify a priority regional highway-freight network. Many regional highway segments already experience relatively high levels of truck traffic in excess of 20 percent on some segments. Intra-regional commercial corridors would be the primary conduits for freight from Phoenix, the urban center of Arizona, to regional trade centers such as Tucson, Yuma, and Flagstaff.
    - From a design standpoint commercial corridors would be built to accommodate large trucks including acceleration lanes, climbing lanes for trucks, wide shoulders, sufficient pavement strength and adequate turning radii.
    - Operationally, commerce corridors are managed for freight. Where these routes pass through urban commercial or community business districts, access management rules are implemented to preserve truck mobility in and out of key facilities and traffic signals are timed for truck movements from known freight generators and receivers. Construction activity does not disrupt a route and its relief simultaneously, and construction as far as practical is coordinated with industry, avoiding commercially sensitive time periods (like month-end) and understanding the time patterns of line-haul and city freight schedules.

- *The Class I Railroad Business Model is Changing.* The Class I railroads are shifting their business focus to market opportunities that increase "hook and

haul" traffic, specifically traffic with significant and concentrated volumes to generate unit trains at a single load center. Transcontinental intermodal container traffic and coal traffic are examples of such market sectors. As unit train volumes increase and rail line capacity becomes scarce, railroads "de-market" traditional business lines that generate incremental carload and boxcar shipments from a dispersed market area. The implications for the state of Arizona include; land use for larger staging facilities to build long unit trains, deteriorating transportation capacity along key corridors that service the transcontinental intermodal and coal unit trains, and declining market access for smaller markets which are increasingly ignored. There are two specific sectors that stand to be impacted by the latter implication – the mining and fresh produce sectors.

- *The Class I Railroads are De-Marketing the Smaller Domestic Car-Load Markets Such as Mining and Fresh Produce*. Railroads are using pricing to turn aside lower-profit carload freight in favor of intermodal and coal traffic, which can be handled cost-effectively and profitably in bulk unit trains. One example is the mining sector, which is somewhat volatile in Arizona. Production, output, and employment fluctuates with global commodity prices. While employment declined between 2000 and 2005, trends indicate that employment is increasing as the global demand for natural resources increases and prices strengthen, particularly for copper. Rail is an important mode used to transport copper anodes in boxcars as well as powder and ore in open hopper cars. The key issue for the industry is whether the railroads can supply enough equipment to handle increases in mining production particularly now that the railroads have a long-term focus on coal and intermodal traffic. Another example impacted by the changing rail business model is the fresh produce. Although Arizona has historically been a leading U.S. producer of fresh produce, the sector has seen a decline as an increasing amount of agricultural

acreage has been converted to residential and commercial development. This is particularly the case for citrus production. While railroads penetrated the produce market on a national scale, particularly for shipments from the San Joaquin Valley in California to markets in the east, the opposite has happened in Arizona. In the past, railroads invested in facilities for handling and shipping produce by rail (such as icing facilities and packing sheds). However, Arizona based growers are increasingly upset that these facilities are in decline, the issue is whether the trend can be reversed.

- *Changes in the Class I Railroad Market may present opportunities for Short-line Railroads:* As the major railroads rationalized their rail networks and have focused on corridors with higher traffic densities, the role of short-line railroads has become increasingly important. With a cost structure that is different from the Class I railroads, the short-line and regional railroads have the ability to serve smaller customers more cost-effectively. Short-line railroads gather (and distribute) freight cars that are loaded by shippers on their lines and deliver them as small trains to the Class I railroads for movement on to ultimate destination. The operation is analogous to the role of commuter airlines in that industry, whereby passengers are collected at less populous locations and delivered to primary hubs. Over time, the small railroads have established themselves as the retail arm of the larger railroads in many markets.

Freight Nodes: The Next Big Thing in Freight Related Land-Use Planning

The data used in freight planning is typically categorized as 1) Flows, 2) Nodes, and 3) Networks. In layman's terms, freight nodes are major truck traffic generators like intermodal yards, transload facilities, distribution centers, air cargo ramps, and warehousing facilities. As traditional ports and other gateways to the burgeoning global trade have become increasingly congested, a new type of inland freight node has emerged in recent years; the inland port:

"An Inland Port is a site located away from traditional land, air and coastal borders with the vision to facilitate and process international trade through strategic investment in multi-modal transportation assets and by promoting value-added services as goods move through the supply chain." [12]

Inland port developments to date has been most prevalent along Interstate corridors where road and air freight is consolidated; "Consequently, warehousing, trucking, freight forwarding and air cargo activities are major indicators and drivers of this new distribution economy.[13] Several regional planning organizations in Arizona have initiated examinations of developing in-land port facilities. Other communities in Arizona are also seeking support for proposals to develop intermodal railroad facilities.

Railroads operate most efficiently using dedicated point-to-point trains between major market hubs, thus avoiding high cost local pick-up and delivery of rail cars. Logistics centers benefit the railroads as they provide locations to consolidate or deconsolidate rail shipments moving on point-to-point trains. They also benefit shippers whose existing local rail service does not meet their requirements by providing a location to transfer freight between truck and railroad, thus, obtaining the benefits of fast, reliable motor carrier transport for the local move and the economies of lower cost rail transportation for the intercity segment.

Recent freight intermodal facility/logistics center developments suggest several common factors that contribute to their success:

- *Significant base load market:* Access to a large industrial, commercial, or agricultural market is essential to the success of a logistics facility. Freight density, a balance between outbound and inbound freight, and consistent year-round availability are the most important factor when considering the

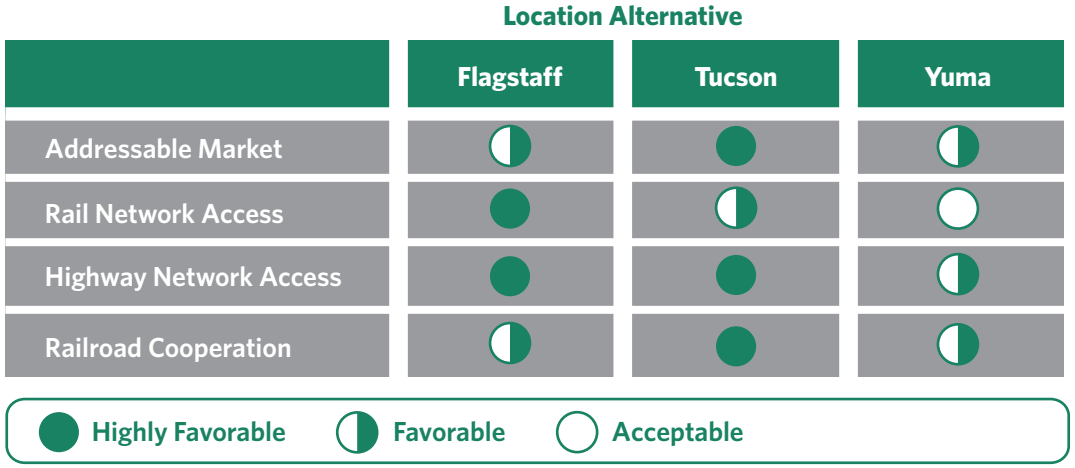
financial feasibility of a facility. Because of the land required and supporting infrastructure, logistics facilities are capital intensive, and consequently, volume is critical in amortizing the costs of the facility through acceptable user fees.

- *Network access:* Access to a Class I railroad mainline track is another critical success factor as facilities benefit from more frequent train service and expedited transit times. Connections to a mainline either through a Class I branch line, or a short-line railroad are acceptable alternatives under certain circumstances. Branch line connections should have frequent service with no delays on the mainline train operation. Likewise, short-line interchanges with a Class I railroad must be fluid.

- *Primary highway system access:* Proximity to the highway network and ability to easily connect to the network is imperative to the success of a logistics facility. Motor carrier travel times and low trucking costs are required to make the facility attractive as a modal transfer center. In addition, locating on interstate highways makes it easier to divert intercity traffic passing through.

- *Railroad cooperation:* In addition to top location in proximity, the cooperation of the Class I railroad is also important. The railroad must offer the service required by the facility users to the location that users ship to or receive traffic from. The railroad must also offer freight rates that are competitive with motor carrier freight rates. Railroad interest is based on the traffic volumes generated by the facility, the ability to accommodate service to the facility into its operating plan, and reduced operating costs. The latter are attributable to avoiding serving individual shippers and operating point-to-point dedicated trains.

Exhibit 7: Sketch-level Analysis of Potential Freight Logistics Center Locations



When the potential for future railroad terminal development is evaluated on these success factor criteria, a number of locations in Arizona offer the potential for rail served logistics centers (**Exhibit 7**). This sketch level analysis slightly favors Tucson over the other locations. However, both Flagstaff and Yuma have features that make them candidate locations for future railroad developments.

Freight logistics centers should benefit both shippers and the railroads:

- Railroads can run efficient point-to-point merchandise trains between the logistics centers and major markets without completely abdicating local service.
- Shippers benefit from improved lower transit times and improved service reliability for non-intermodal, carload traffic by avoiding local train operation and yard classification where local truck transportation was advantageous.
- Shippers who do not have rail access or who ship by truck because of less than acceptable rail service gain a multimodal alternative to all-truck transportation.

- Value added services can be provided more cost-effectively than at individual shipper sites.

In most instances, major freight terminal facilities built in the U.S. have been funded by private enterprises with local assistance. ADOT can play a role in the development of the facilities by supporting the development of intermodal highway connections through initiatives like the National Highway System Intermodal Connectors Program. As traffic volumes grow, the rationale for developing at least one or perhaps two distribution centers to serve the growing metropolitan areas of Phoenix and Tucson is gaining strength. The following factors support this rationale:

- *Large Regional Consumption Center.* While Arizona has historically been viewed as a bridge state to serve through traffic, carriers will increasingly view this market as a destination on its own due to its growing size. In other words, carriers in the trucking and rail industry, as well as third party logistics providers, will likely shift away from practices of combining Arizona loads with loads for other markets. Instead, they will increasingly build whole loads (trucks, rail cars, unit trains) specifically with Arizona traffic. The combined Phoenix and Tucson market by 2030 will be on the same scale and size as the greater Los Angeles market today, which by itself consumes around 20 percent of all containers through the ports of LA/LB. In the future, Arizona represents a market large enough for carriers to serve as a destination market.

- *Longer Trains.* The Class I railroads are responding to growing volumes and demand by increasing train "velocity" to gain greater throughput capacity. One of the ways to increase velocity is to build longer trains, thereby increasing volumes without increasing the number of trains. The railroads are now mandating international intermodal shipments be handled in 40-foot well cars on trains that are at least 8,000 feet in length. The implications for Arizona

are that longer sidings would be needed to permit trains to meet and pass, as well as the need for corresponding intermodal yard capacity. The latter issue has specific implications for the communities where such yards are to be built, particularly in light of growing demand for real estate development.

- *Internal (within the state) Distribution Patterns.* In addition to staging areas and load centers related to the regional and bridge traffic, it is likely that warehouse and distribution centers to support the local distribution of increased retail consumption will also become an issue. While internal distribution patterns are largely dictated by the highway network and system, the location of warehouse and distribution centers will occur in a fragmented pattern, causing further congestion throughout the system. Hence, the need for the development of a series of staging areas and load centers in which warehouse and distribution activity is to be concentrated. Developing truck load centers in conjunction with defined highway network roles will likely isolate the impact of increased highway freight transport.

- *Preserving Freight Service Levels.* As mentioned earlier, some of the traditional domestic market segments are increasingly being de-emphasized by the carriers. The main reason is that these domestic market segments typically require consolidation by the railroads in order to satisfy their need for building unit trains between key markets. Consolidation represents a cost penalty for the railroads thereby cutting into their profit margin, encouraging them to focus on segments that do not require consolidation over local distribution networks. The development of load centers and staging areas for market segments that are in danger of being de-emphasized presents an opportunity for maintaining service levels by the railroads.

A Changing Perception of "Green" and the Growing Field of Stakeholders

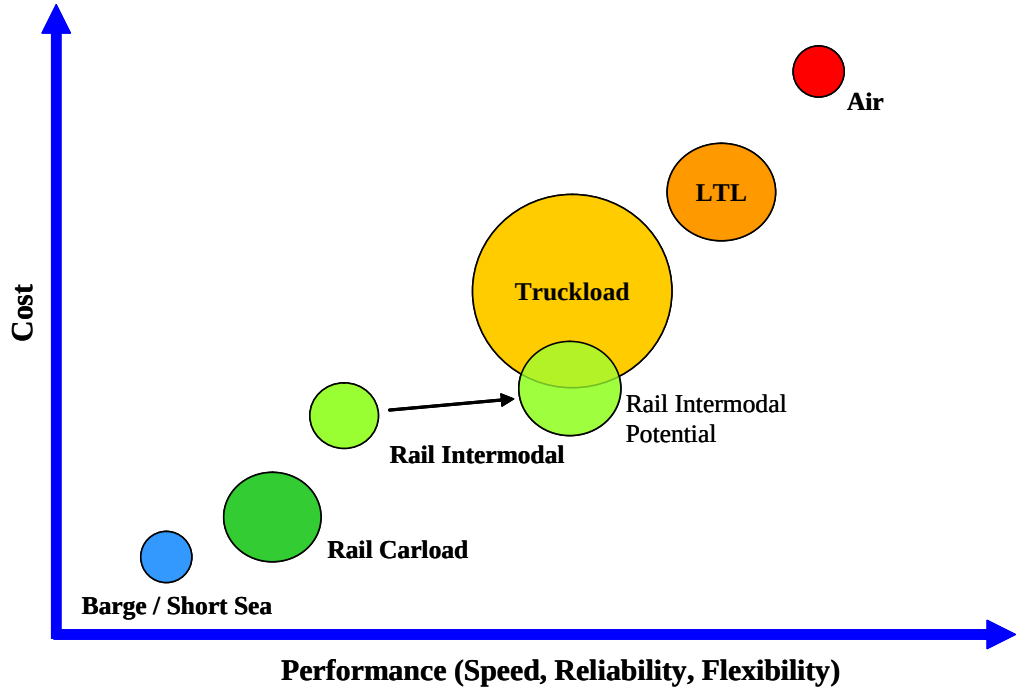
There is popular public sentiment supporting the idea that anytime freight can be diverted from trucks to rail (or barge) it will be less costly and more environmentally friendly. However, this simplistic, but popular view ignores two key issues: 1) the transportation time and service sensitivities of many new economy business supply chains; and, 2) the operating models that have returned Class 1 railroads to profitability.

The success of intermodal freight transportation results from economic synergies gained by integrating the best attributes of each individual mode. Working together each mode performs most efficiently the task it does best. Typically, railroad line-haul costs are less than those for motor carriers, while motor carriers have greater flexibility and universal access to industrial and commercial locations. Joint services take advantage of these strengths but are much more complicated than single mode movements, due to the specialized equipment, terminals and coordination among firms. The additional cost and complexity creates important prerequisites for the success of intermodal rail facilities such as the availability of willing firms skilled in providing intermodal services.

In order for intermodal rail services to produce a rate advantage, shipments typically must move a sufficient distance (500 miles or more) to allow rail's line-haul economies to outweigh higher terminal and transaction costs. Other requirements usually include sufficient volume to operate daily trains with on-time reliability competitive with trucking. As a result, rail intermodal services are ordinarily provided only in high volume corridors between major population centers. **Exhibit 8** expands on the notion of cost and service levels associated with a variety of freight transport modes. The graphic also suggests that efficiency improvements in port operations, modal transfers, and network operations have the potential to improve rail intermodal service performance.

"'Greenness' has become a code-word for a range of environmental concerns, and is usually considered positively. It is employed to suggest compatibility with the environment, and thus like 'logistics' is something that is beneficial."[14]

Exhibit 8: Modal Service versus Cost Continuum [15]



With forecasts suggesting strong long-term growth in truck traffic and increasing market share for the trucking industry, support for modal diversion has traditionally been strong. In particular, environmental groups have typically supported projects that result in diversions away from the truck mode. A dominant body of research in the industry points to significant environmental impacts from successful diversion strategies, particularly through lower emissions, as well as lower congestion along key corridors and within major urban areas.

However, recent history shows that intermodal projects do not necessarily get a free pass in communities. Environmental groups and community groups are increasingly skeptical about plans to improve rail intermodal access and increase rail volumes.

This has been the case for large urban areas that play host to major intermodal facilities and rail corridors as well as small rural communities located along major rail freight corridors. One of the reasons is the large land use footprint typically required to support intermodal networks:

"...The hub structures of logistical systems result in a land take that is exceptional. Airports, seaports and rail terminals are among the largest consumers of land in urban areas." [16]

The debate has shifted away from determining the best and most efficient mode for addressing freight growth, toward a more skeptical view of freight growth as a whole. Nationwide, some communities and environmental groups are questioning the need for increasing freight capacity, regardless of the mode. The implication is significant for the future of freight transportation and freight systems development throughout Arizona.

With the tremendous growth in freight volumes and the concentration of goods movements in urban areas freight has become a major source of national and regional nitrogen oxide (NOx) emissions. While new regulations on heavy duty truck engines is likely to mitigate NOx emissions in years to come, it will likely take close to a decade to substantially turnover the U.S. commercial truck fleet:

"U.S. companies and organizations use nearly 7 million trucks and 20,000 Class 1 locomotives to transport over 9 billion tons of goods each year, worth nearly 7 trillion dollars. The ground freight transport system is invaluable to businesses, consumers and the economy. However, these economic benefits are not without costs. Moving freight accounts for 20% of all energy consumed in transportation sector. Trucks carry about 66% of all freight shipped in the US, while rail carries about 16% (water, pipeline, and air

transport account for the rest). Together, truck and rail transport now consume over 35 billion gallons of diesel fuel each year. [17]

Approximately 30 states, including Arizona, have now adopted anti-idling regulations for parked trucks.[18] Arizona regulates smoke emissions and limits idling for large trucks to five minutes statewide, but exemptions are provided for traffic conditions and certain types of special equipment such as trucks with refrigeration units. Targeting congestion, highway freight bottlenecks and helping communities make good land use decisions with regard to freight transportation can further advance Arizona's efforts to reduce truck emissions.

The Environmental Protection Agency has also initiated the SmartWay Program to provide guidance for the reduction of freight related emissions:

SmartWay Transport is a voluntary partnership between various freight industry sectors and EPA that establishes incentives for fuel efficiency improvements and greenhouse gas emissions reductions. By 2012, this initiative aims to reduce between 33 - 66 million metric tons of carbon dioxide (CO2) emissions and up to 200,000 tons of nitrogen oxide (NOx) emissions per year. At the same time, the initiative will result in fuel savings of up to 150 million barrels of oil annually. There are three primary components of the program: creating partnerships, reducing all unnecessary engine idling, and increasing the efficiency and use of rail and intermodal operations. [19]

Given the continued growth in population within Arizona and throughout the nation, it is inconceivable that freight transport demand will remain flat or even decline. More population equates to more buyers demanding more goods and services in local stores and retail centers, as well as more bridge traffic through the state. A multimodal approach under well planned land use conditions for freight

transportation systems development will become increasingly paramount into the future. The flexibility to develop intermodal systems to transport and stage freight transportation throughout the state is critical. A shift away from supporting intermodal transportation development translates to negative implications for freight transportation and the economy in Arizona.

As Arizona continues to grow, individual communities, stakeholders, and constituent groups are likely to gain the resources as well as the political will and weight to try to address transportation strategies on an autonomous and individual basis. For example, the state's metropolitan planning organizations (MPO) have significant weight in influencing transportation planning, policy, and funding. The business community as a whole is driving a specific transportation agenda within the state. The rural communities have their own specific transportation concerns. Environmental and community groups have a strategy for transportation development in the State. Of course, the state Department of Transportation has its own responsibilities for statewide transportation development. The result is a growing field of stakeholders and players with an influence on transportation systems planning and development, transportation policy and transportation funding. The challenge lies in the ability to develop a consistent statewide strategy for addressing freight transportation. The implications of a fragmented approach to transportation development could be disastrous for the state's economy, its residents, the environment and its communities.

key policy implication and responses

In response to Arizona's tremendous population growth over the past several decades, as well as the need to invest in the state's future, ADOT is currently pursuing an aggressive statewide transportation investment strategy. To support the investment strategy, ADOT has undertaken a series of regional and issue-specific framework studies. The Statewide Transportation Planning Framework was constructed with broad input from regional transportation planning entities, transit organizations, tribal governments, land management agencies, conservation groups, business and community leaders, and the governor's Growth Cabinet. The framework planning program is guided by the following principles:

- Achieving multimodal balance (e.g., an appropriate balance among modes of transportation)
- Supporting smart growth and sustainable land use
- Tribal community involvement
- Supporting economic development and business community involvement
- Environmental and conservation community involvement
- Statewide collaboration with councils of governments (COGs), metropolitan planning organizations (MPOs), and tribal governments

The themes developed to guide ADOT's freight planning efforts are intended to respond directly to the issues facing Arizona, while providing opportunit ies to integrate freight planning with emerging statewide policy. **Exhibit 9** introduces the proposed six major freight planning strategy themes and suggests how these themes integrate with the Transportation Planning Framework Principles.

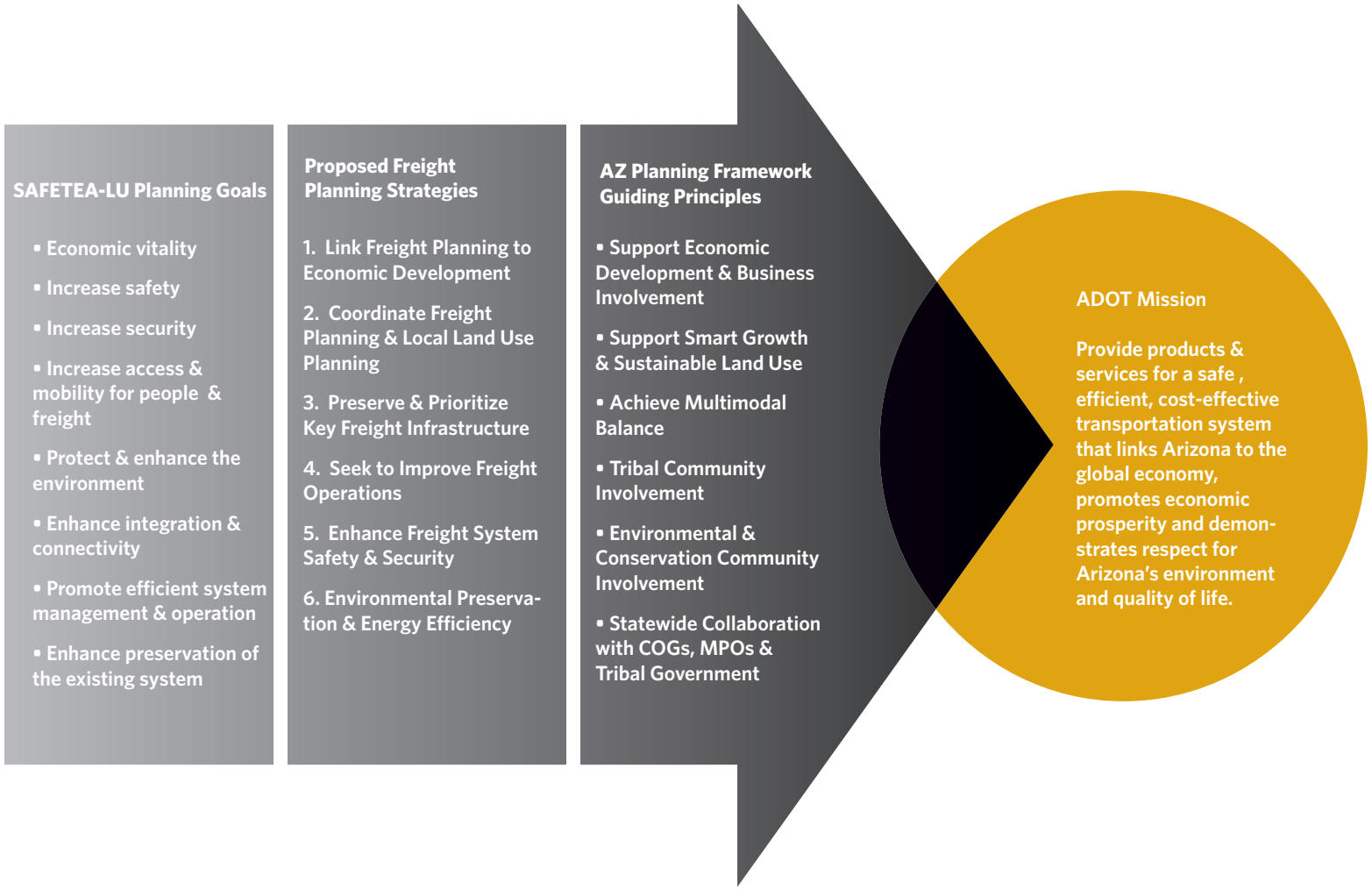


Exhibit 9: Recommended ADOT Freight Planning Strategies

Strategic Response #1: Coordinate Freight and Local Land Use Planning

An overriding policy implication for the state of Arizona is the need for greater cooperation and proactive planning among planning agencies at the state and regional level, coordination among cities and counties within major urban areas, and coordination with the private sector specifically.

Many of the freight impacts stemming from increased population growth in the urban areas are essentially local such as roadway network impacts and traffic congestion. The land use conflicts between freight and residential development are local. One of the tools for addressing these local impacts is through a coordinated land use strategy for the entire State of Arizona and in particular for major urbanized areas. Land use policy is largely a local tool and a large number of local communities will be impacted by freight transportation. Priorities vary from community to community. While some communities weigh economic development heavily and welcome increased freight volumes, others are more resistant. Moreover, the degree to which land use policies are enforced varies across communities. It is not uncommon for fragmented land use approaches towards freight transportation to evolve within the major urban areas. It is critical that policymakers across the state work together towards coordinated freight transportation land uses.

Planning research today is only beginning to examine the conflicts that arise from heightened demands for freight and goods movement needs in urban areas. Public planning efforts to harmonize freight and people movement are only just beginning, but progress is being made. For example, some urban areas in North America and in Europe are working jointly with freight haulers and shippers to revise local ordinances or adopt new development regulations to improve the efficiency of freight and goods movements in and through their urban areas. Discussions and research are also underway to look at how local ordinances and regulations impact congestion, productivity, the costs of goods and services, lost opportunities, the environment, and global competitiveness.

This body of land use research is sometimes referred to as *City Logistics*, defined as "the process for totally optimizing the logistics and transport activities by private companies in urban areas while considering the traffic environment, traffic congestion, and energy consumption within the framework of a market economy."[20] The diagram in **Exhibit 10** expresses the overarching strategy for responding to increasing truck traffic in urban areas, as well as tactics ADOT may wish to pursue. ADOT may wish to seek partnerships to implement this strategy by encouraging in-state research universities with geography or planning schools to engage in city logistics research, as urban freight movements will have huge impacts on Arizona's communities in the future.

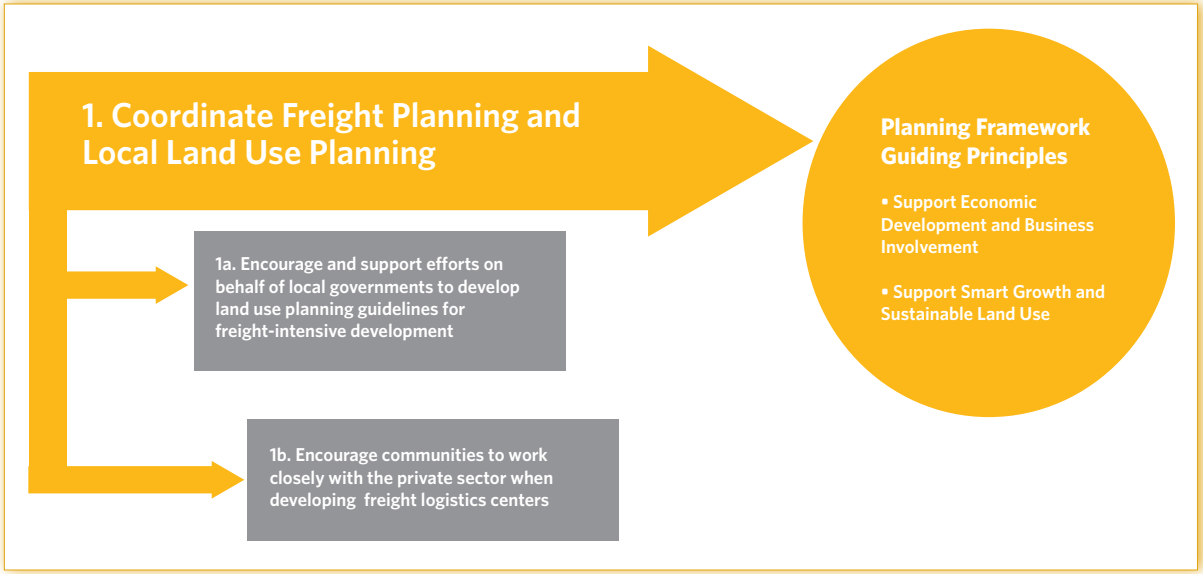


Exhibit 10: Strategic Response: Coordinate Freight Planning and Local Land Use Planning

Arizona's current planning process calls upon ADOT to work closely with MPOs, COGs, and other local planning agencies to address transportation planning needs. Rapid population growth and increasing demands for freight transportation services are driving transportation- related commercial development in communities across the state. ADOT may wish to consider the following strategies and tactics aimed at raising local government knowledge about freight-related industries and fostering broader private sector involvement in freight-related planning:

1a. Encourage and support efforts on behalf of local governments to develop land use planning guidelines for freight-intensive development: Experience has shown that without proper coordination and land use considerations, conflicts often arise between commercial transportation development and residential neighborhoods. Any efforts that ADOT can take to educate local planners about how freight industries work and any guidance ADOT can provide related to freight and land use issues is likely to reduce future conflicts. For instance, ADOT may wish to consider sponsoring in-state university research related to freight and land use conflicts.

1b. Encourage communities to work closely with the private sector when developing freight logistics centers: Intermodal freight services are complex business relationships with many interrelated parties and large diverse networks. Without proper planning and evaluations of service demand, experience has shown that communities may develop publicly supported facilities that go unused or underused. There are several good examples of local planning agencies in Arizona that are working closely with private sector stakeholders on freight-related development issues. ADOT may wish to consider ways to encourage this type of collaboration as a means of developing freight-related developments that are supported by the communities where they reside. ADOT may also wish to encourage and support local government efforts to work closely with shippers, carriers, and other parties when seeking to develop intermodal transportation facilities such as inland ports and multimodal logistics centers.

Strategic Response #2: Link Freight Planning to Economic Development

Arizona's economic future; the ability to create high-paying jobs, produce product exports, and support consumer demands—depends on the safe, efficient transportation of goods. Stephen Blank, professor at Arizona State University, recently summed up the transformation of the U.S. economy that raised our dependence on efficient freight transportation:

In the 1980s and 1990s, the structure of North America's economies changed. In the face of increasing international competition and falling profit margins, many American firms rationalized their Canadian (and Mexican) branch plants into integrated North American production, supply, and distribution operations... Flows of goods across North America's international borders grew rapidly in this period, and an increasing share of these products consisted not of final products, but of components and parts moving within company supply chains... Increasingly elaborate supply chains depended on efficient transportation systems. Transportation providers met increasing demands of users because excess capacity existed in many systems, because of available new technology (unit trains, double-stack containers, larger trucks), and because consolidation in the trucking and rail industries enabled suppliers to work more efficiently. [21]

This dramatic shift in the U.S. economy has greatly increased the demand for freight transport services. Arizona's transportation and warehousing industry plays a vital role in the state's economy. The transportation industry supports many other industry sectors by facilitating the movement of goods and services, and is also a significant direct contributor of jobs and earnings in the state. In 2006, Arizona's transportation and warehousing industry directly accounted for 3 percent of the state's workforce, and 5.3 percent of gross state product. When economic multiplier effects from transportation and warehousing are considered, it is estimated that the sector supported jobs for 237,600 Arizona citizens, providing earnings of $12.5

billion. When multiplier effects of the industry are considered, transportation and warehousing contributed $27.7 billion in gross state product in 2006. Economic forecasts of transportation and warehousing activity in Arizona estimate that by the year 2014, the industry will support 271,600 jobs, earning of $12.5 billion, and produce $31.7 billion in total economic activity (measured in 2006 dollars).

Location quotient is a relative measure of industrial concentration within a specific geographic or economic area in comparison to a broader area, like the entire United States. Here, the location quotient ratio is calculated as an Arizona industry's share of the state's economy to the respective national industry's share of the U.S. economy. An industry with a location quotient less than one (<1.0) has a share of the state's economy proportionally smaller than the same industry share of the U.S. economy. A location quotient greater than one, indicates that the state production from an industry generally exceeds regional demand for the goods and services of that industry, allowing excess production to be exported.

In Arizona, concentrated industry sectors heavily dependent on freight services include *Waste Services, Construction, Food Services, and Retail Trade.* Freight-dependent industry sectors with lower relative industry concentrations in Arizona include *Wholesale Trade, Transportation and Warehousing, Mining, and Manufacturing*. (**Exhibit 11**).

Exhibit 11: Select AZ Industry Location Quotients
Source: Regional Economic Info System, BEA, USDOC.

Location Quotient Industry	2005
Administrative and Waste Services	1.39
Construction	1.34
Utilities	1.14
Accomodation and Food Services	1.09
Forestry, Fishing, and Related Activity	1.08
Retail Trade	1.07
Wholesale Trade	0.95
Transportation and Warehousing	0.85
Mining	0.77

Arizona's high-tech industries are also considered to be a vital component of the state's economic future. In 2004, high-tech firms in the *Manufacturing* industry sector comprised 18 percent of the state's total manufacturing firms and represented 44 percent of the state's total manufacturing jobs.[22]

High-tech industries are characterized by their proportion of R&D employment, advanced technology product production, and use of high-tech production methods. **Exhibit 12** shows high-tech industries with concentrations in Arizona based on location quotients.[23]

Location Quotient High-Tech Industry	2004
Aerospace product and parts manufacturing	3.30
Semiconductor and component manufacturing	3.27
Navigational measuring and other manufacturing	1.65
Other pipeline transportation	1.50
Electric power generation, transmission/distribution	1.14

Exhibit 12: Select AZ High-Tech Location Quotients
Source: Bureau of Labor Statistics.

In addition to creating high-paying jobs, high technology also fuels a significant portion of the state's manufacturing exports. In 2006, Arizona's manufacturing exports topped $18 billion with 22 percent of the state's jobs dependent upon foreign trade.[24] Approximately 40 percent of Arizona's international manufacturing exports go to NAFTA countries; however, China has also become a significant trade partner for the state. Arizona's exports to key trade partners such as China, Singapore, and Germany include computers and electronic components; transportation equipment; and electrical equipment, appliances, and parts.[25] Since 1997, Arizona's exports to China have grown by 70 percent. The table in **Exhibit 13** displays Arizona's top export trade partners by value, as well as the recent growth in trade values.

Trading Partner	2002	2004	2006	2007	% Change 2002 - 2007
Mexico	$3,044,185,893	$3,794,137,782	$5,370,625,511	$5,235,838,827	72.0%
Canada	$1,167,335,841	$1,386,488,241	$1,841,227,759	$2,143,461,909	83.6%
China	$380,366,813	$628,996,204	$1,196,306,206	$1,317,122,960	246.3%
Singapore	$343,833,415	$603,822,513	$1,242,507,187	$1,139,044,209	231.2%
Germany	$525,056,891	$687,574,227	$755,396,731	$1,011,225,107	92.6%
U.K.	$927,959,655	$656,815,354	$802,795,397	$959,106,439	3.4%
Japan	$327,841,768	$439,795,914	$685,844,038	$716,624,250	118.6%
Taiwan	$374,394,674	$326,600,102	$380,847,696	$576,981,438	54.1%
Malaysia	$1,211,026,441	$744,014,007	$807,939,654	$539,263,657	-55.5%
France	$442,603,363	$466,208,405	$495,436,676	$512,414,475	15.8%
All Other	$3,126,349,659	$3,688,460,271	$4,708,471,074	$5,034,563,801	61.0%
World Total	**$11,871,004,413**	**$13,422,913,020**	**$18,287,397,929**	**$19,185,647,072**	**61.6%**

Exhibit 13: Arizona's Top Export Trade Partners by Value [26]

Source: TradeStats Express at: http://tse.export.gov/.

Many of Arizona's key industry sectors that support the state's economic growth are highly dependent upon efficient transportation. It is vital that local, state, and federal agencies cooperate to ensure a multimodal freight system that is responsive to industry needs. Active communication is an important role for planning agencies wishing to gain the trust and support of the private sector.

One of the key challenges facing public sector policymakers and the agencies responsible for transportation systems is the difficulty of keeping the attention of the private sector. Not only is getting and holding the private sectors attention critical in terms of developing a coordinated strategy for freight transport system development, it is also critical for maintaining levels of freight service provided by the carriers and supporting freight related economic development.

In addition to communicating with the private sector about their needs, ADOT may also want to actively communicate the important role that freight transportation plays in the modern economy of the state. The diagram in **Exhibit 14** expresses strategic freight planning responses for supporting economic growth in the state through freight planning activities.

Exhibit 14: Strategic Response: Link Freight Planning to Economic Development

2a.Engage the private sector in transportation planning: ADOT has established guidelines for public involvement but has not developed practices or guidelines specifically for engaging the private sector in planning activities. To facilitate greater participation in state and metropolitan transportation planning, federal legislation encourages states and MPOs to provide opportunities for various interested parties to offer input into the development of transportation plans and programs. For example, the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) stipulates that MPOs and states shall give freight shippers and providers of freight transportation services reasonable opportunities to comment on transportation plans and programs.

2b. Support freight-related training and education for state, regional, and local planning staff: ADOT may wish to consider continuing its support of education and training for internal staff and local planning partners on freight issues. Opportunities for providing freight training include FHWA and NHI course offerings, as well as working with regional university systems. In February 2008, ADOT hosted an FHWA Freight Professional Workshop: Engaging the Private Sector in Freight Planning and the following day hosted an FHWA-sponsored Peer-to-Peer (P2P) Exchange on the topic. The workshop was attended by representatives from several COGs and MPOs from across the state. During the P2P Exchange, representatives from Oregon and Colorado shared their experiences with establishing and maintaining freight advisory groups.

2c. Market the link between transportation and Arizona's economy: In 2006, total employment in Arizona amounted to almost 3.37 million jobs[27]. The *T&W Industry*, including governmental postal services, directly employed 102,638 people in Arizona accounting for 3.0 percent of the state's total workforce. Income earned by those employed in the *T&W Industry* amounted to $5.1 billion in 2006, an annual average income of $49,744. The average personal income for all industries in Arizona for 2006 was $58,522[28]. After taking into account multiplier effects from the *T&W Industry*, it is estimated that in 2006 the sector contributed 237,600 jobs and $27.7 billion toward Arizona's gross state product (GSP), i.e., 7.1 percent of statewide employment and 11.9 percent of GSP. Employment in the *T&W Industry* is expected to grow 1.69 percent per year through 2014, resulting in estimated sector employment of 117,300 in 2014[29]. Assuming the economic multiplier effects from the T&W Industry remain constant (2006-2014), total employment in 2014 is estimated at 271,600 jobs with $12.5 billion in earnings and $31.7 billion in total output (2006 dollars).

Strategic Response #3: Preserve and Prioritize Key Freight Infrastructure

The roadway network throughout the state of Arizona, particularly along key regional corridors and within the growing major urban areas, will likely remain the leading mode for freight transportation. It is imperative then, that the key stakeholders involved in freight transportation development, including ADOT, MPOs and COGs, coordinate the definition of freight network roles and delivery systems. It is also critical that a coordinated strategy be developed for intermodal transportation to at least preserve existing modal market shares and, where possible increase the use of rail.

The Interstate Highway network across Arizona, particularly those facilities serving key regional centers and growing major urban areas, are and will remain the state's backbone of commerce. Large volumes of both truck and rail freight movements are landbridge movements through the state, with both origins and destinations beyond the borders of Arizona. In addition, there is a need to understand and plan for regional truck networks that support goods bound for regional trade centers in the state. Involving ADOT's planning partners, such as MPOs and COGs, could help establish a coordinated effort to define key freight network roles and delivery systems. To preserve, prioritize, and monitor the state's key corridors, a consistent freight data program is required. The diagram in **Exhibit 15** suggests strategic actions that can be implemented for planning, preserving, and monitoring the state's key freight corridors.

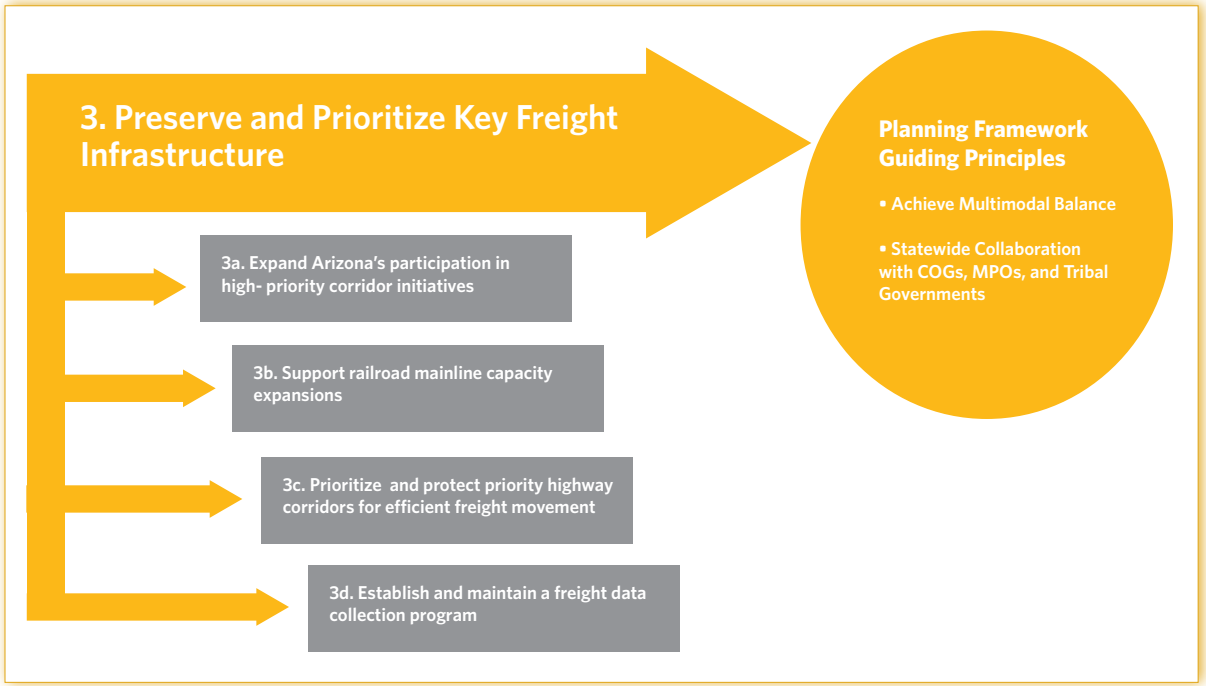


Exhibit 15: Strategic Response: Preserve and Prioritize Key Freight Infrastructure

Arizona's freight network includes nationally significant rail and highway corridors that carry freight from international gateways to Arizona's burgeoning population centers, as well as communities in other states. The interstate/international nature of goods movement is a compelling reason to explore nontraditional planning alliances and partnerships. Strategies and tactics for responding to these issues include the following:

3a.Expand Arizona's participation in high-priority corridor initiatives: Arizona is a bridge state for large volumes of freight. Both trucks and trains originating in the San Pedro Bay ports, destined to points beyond Arizona, contribute significantly to the demands on Arizona's freight networks. Developments in

California and points beyond affect traffic through Arizona. Beginning with the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), corridors have been designated in federal transportation legislation as high-priority corridors on the National Highway System (NHS) for inclusion in the 163,000-mile approved NHS as specific routes or general corridors. These corridor systems designated by Congress are eligible for a variety of funding programs. The planning effort for the CANAMEX corridor, one of three designated high-priority corridors in Arizona, is an excellent example of planning across borders to improve end-to-end goods movement efficiency. The I-10 corridor was recently named one of six Corridors of the Future (COF) under a new program sponsored by the USDOT. Selection as a COF means that the USDOT has committed to work with the eight states of the National I-10 Corridor Coalition to expedite the delivery of corridor improvements.

3b. Support railroad mainline capacity expansions: Rail traffic in and through Arizona is expected to double by 2030, with the rail network transporting an additional 140 million tons. Intermodal commodities will grow by 91.8 million tons. This translates to an estimated additional 63 intermodal trains per day through the state's rail network, primarily on transcontinental corridors. ADOT may want to consider an overarching railroad policy consistent with strategies for encouraging multimodal freight transportation. ADOT's role might be one of evaluating and facilitating what is best for the state as a whole in meeting targeted policies.

i. **The Northern Corridor:** Traffic on the Northern Corridor (BNSF's main east-west trunk line) through Flagstaff is projected to increase significantly by 2035. The Northern Corridor connects the Midwest to the San Pedro ports. The short rail-distance from Flagstaff to the San Pedro ports is a hurdle for competitive intermodal rail service, but ADOT may wish to explore opportunities in the Flagstaff area for supporting expanded rail service offerings through actions such as rail facility access improvements, the elimination of at-grade crossings,

or railroad bed realignments that improve rail operations and efficiency to support both intermodal and carload service initiatives.

ii. **The Southern Corridor:** The high-density Union Pacific (UP) rail line traverses the state between Yuma and San Simon through Tucson. This important route is UP's primary line between the San Pedro ports and the Southeast/Midwest. The line also links to Mexico through either El Paso or Laredo. The Southern Corridor also offers access to Phoenix. Without more capacity on the Sunset Route, future rail use by shippers and receivers within Arizona will be constrained by competition for capacity with the transcontinental shippers. ADOT should support private sector initiatives that expand capacity if consistent with increasing freight rail-related public benefits.

iii. **The North-South Corridor:** The North-South Corridor includes the BNSF line connecting the Northern Corridor with Phoenix. Unlike the east-west corridors, this line has limited capacity. If significant development materializes on the Ennis subdivision including the branch line connecting to the Williams-Phoenix line north of Phoenix, the capacity of the Williams-Phoenix line could be reached in short order. BNSF is encouraging multimodal terminal development along this branch to avoid congestion problems within Phoenix that inhibit the growth of rail traffic. The available land parcels along the Ennis branch are suitable for industrial development as well as for multimodal transfer facilities. ADOT may wish to consider working with BNSF to encourage additional railroad development along the Ennis subdivision. To this end, ADOT may support planning studies to ensure that infrastructure is in place to facilitate multimodal transportation connectivity, such as required access roads. While local land use planning falls outside of ADOT's responsibilities, the agency can act as a facilitator between local governments and the railroad by promoting the economic benefits of rail-related development, as well the favorable environmental impacts.

3c. Prioritize and protect priority highway corridors for efficient freight movement: Through truck and rail movements are a significant element of the overall freight volumes in Arizona. However, the volume of interstate "bridge" movements should not eclipse the importance of understanding and planning for regional truck networks that support goods bound for regional trade centers in the state.

i. **Access management:** Access management is an important way to improve the safety and performance of roadways. Often, however, the benefits of access management are undervalued and ignored as a highway design element because the authority for access decisions are fragmented across many functions and levels of government. Over several decades, a large body of research has evolved demonstrating the safety, mobility, and productivity benefits of good access management.

ii. **Designate in-state trade corridors:** A potential freight enhancement to ADOT's current access management program and corridor-focused planning process is the recognition of in-state priority trade corridors. By recognizing and designating the network roles of infrastructure constituting the core system of freightways, commercial traffic can be channeled in natural ways. Public resources for infrastructure development can be devoted to priority freight routes where investments will yield the greatest returns and overall system performance can be raised.

3d. Establish and maintain a freight data collection program: ADOT may wish to consider developing a freight data collection program to support performance monitoring of Arizona's freight network. This and other strategic directions of the freight planning agenda are integral to the overall success of freight planning efforts at ADOT.

i. **Build upon existing freight data resources:** At a basic level, freight planning efforts are typically supported by data that can be broadly grouped into three primary types: flows, nodes, and networks. In conducting the Arizona Multimodal Freight Analysis Study, ADOT made a significant investment in both flow and node data that is widely considered the premier source of commodity information in the United States. ADOT may benefit from continuing to manage this data investment and promoting its use by local planning partners.

ii. **Develop data partnerships (internal and external):** Historically, the public planning focus on people movement has encouraged data collection and traffic monitoring systems closely tied to commuting patterns/trips within defined geopolitical boundaries (e.g., metropolitan regions, states). Also, the focus of vehicle count programs is to support bridge and pavement design functions, so data programs generate number and type of vehicles by roadway segment. However, from the standpoint of managing a "freight network," it is useful to understand throughput across an entire corridor or between major nodes. It is also useful to understand what commodities (and the industries that produce them) consume the infrastructure most rapidly or are most sensitive to shipment reliability.

iii. **Use existing and new data for measuring freight network performance:** During the analysis conducted for the Arizona Multimodal Freight Study, sources of existing ADOT traffic data were analyzed such as traffic counts, percent of trucks in traffic flows, and level of service (LOS). Using existing traffic and LOS data, several corridor profiles of truck traffic were developed to help visualize conditions across two major interstate corridors. FHWA has also been working with the U.S. trucking industry to develop new sources of travel time reliability and congestion on major interstate corridors. ADOT may wish to leverage these existing programs where possible and seek to work with Arizona's trucking industry to expand the availability of truck travel information.

Strategic Response #4: Seek Opportunities to Improve Freight Operations

ADOT is directly charged with managing the state highway system. Maintaining good physical condition (i.e., grade, curves, pavement, and bridges) as well as adequate lane capacity will allow road networks to serve as both a primary transport mode and a collection and distribution network for air, rail, and water modes. Several factors pertaining to the physical condition of the highway system itself affect the movement of truck freight. These are the number of lanes, the areas of traffic congestion, and the location of steep grades.

One of the key challenges facing public sector policymakers and the agencies responsible for transportation systems is the difficulty of keeping the attention of the private sector. This report identifies several reasons why it is critical to continue to engage the private sector moving forward. Not only is this critical in terms of developing a coordinated strategy for freight transport system development, it is also critical for maintaining levels of freight service provided by the carriers and responding to evolving infrastructure needs.

As part of the Arizona Multimodal Freight Analysis Study, an inventory and high-level analysis was conducted of Arizona's modal networks supporting freight movements. The analysis found that generally Arizona's public infrastructure is in good shape, most pavements are good, and condition ratings have gone up in the past decade. Arizona bridges are rated as among the best in the nation. However, maintaining the condition of the system will be challenging due to the expected growth in both population and freight movements.

The greatest needs identified in the study analysis regarding the condition and performance of public infrastructure pointed to key congestion bottlenecks on some of Arizona's primary freight corridors. Other issues identified concerned access management, as well as the design and condition of local roads supporting

key freight nodes such as rail facilities, air cargo facilities, and other major truck traffic generators. The diagram in **Exhibit 16** suggests strategic actions that can be implemented for this policy/strategic area. This strategic response recognizes the importance of highways for enabling the efficient operation of the other modes. A balanced multimodal or intermodal freight transportation system requires efficient connections between modes, a high level of reliability to support competitive supply chain practices, and access to expanding markets in the global economy.

Exhibit 16: Strategic Response: Seek Opportunities to Improve Freight Operations

4a. Incorporate heavy truck movements into highway design and reduce bottlenecks: The volume of trucks that is being experienced on some of Arizona's highway segments suggests that special design and operating considerations may be warranted for some roadways to improve safety and relieve congestion bottlenecks. Considerable research has been conducted about the interaction of commercial vehicles and the highway environment to ensure safe operations. In addition to safety aspects of highway design to accommodate large trucks, truck-accommodating design features can also improve traffic flow and reduce bottlenecks. Bottlenecks that cause delays or reduce trip time reliability for truck drivers are many times relatively low-cost maintenance or operational changes that create valuable goodwill between public sector planning agencies and the freight community. Some planning agencies have developed programs to alleviate some bottlenecks with low-cost or "quick-fix" solutions designed specifically to address commercial vehicle or freight service industries. Examples of quick fix solutions include better signage, filling pot holes or restriping turn lanes. While some freight bottlenecks may have relatively low-cost solutions, others require higher levels of capital investment. Other potential bottlenecks coming to light during the course of this study include truck climbing lanes, urban freeway interchanges, at-grade railroad crossings, and congested ports of entry (POE) at international border crossings.

i. **Truck climbing lanes:** In 2003, ADOT conducted a prioritization of climbing lanes on interstate highways for ADOT[30]. The study identified a total of 34 potential candidate locations for climbing lanes on Arizona's multilane highways.

ii. **Congested interchanges:** In 2005, the FHWA assessed potential truck traffic bottlenecks nationwide[31]. The study identified 14 types of highway truck bottlenecks and found the four types that caused the most prevalent delays:

interchanges, steep grades, signalized intersections, and lane drops. In the study, FHWA identified "The Stack" interchange on I-17 in Phoenix as the third-worst bottleneck in the nation for trucks based on annual hours of delay. Other Phoenix-area interchange bottlenecks include Loop 202 between Dobson and I-10; U.S. 60 between Loop 101 and I-10; and Loop 101 between 67th Avenue and I-17.

iii. **At-grade railroad crossing bottlenecks:** Arizona has 805 public at-grade crossings with 41 public at-grade crossings on ADOT frontage, state routes, or U.S. routes. As train traffic increases due to high volumes of freight moving through the state by rail, the frequency of delays will increase. In 2007, ADOT completed a Railroad Inventory and Assessment which drew the following conclusions regarding at-grade railroad crossings in the state: "Arizona has an organized, functioning grade crossing safety program. Improvements are being considered and effected. Additional improvements may require changes at the federal level. Faster action by railroads and municipalities are encouraged."32 Currently, there is no comprehensive, timely information available regarding highway traffic levels, train frequency, grate down time, and motor vehicle delay that will allow an analysis and ranking of at-grade crossing by level of traffic delay. Developing this type of information will help planners deal with rail crossings that may be affecting the efficiency of passenger and freight movements by highway.

iv. **Border crossing bottlenecks:** As Arizona's trade with Mexico increases, so do the number of trucks crossing the U.S./Mexico border. Since 1994 when NAFTA went into effect, there are 30,000 additional truck crossings per day in the four Southwestern states of Arizona, California, New Mexico, and Texas[33]. In 2007, truck shipments from Mexico to the United States jumped 8.4 percent to $137 billion, while trucking shipments from the United States to Mexico

rose 0.1 percent to $93 billion[34]. Arizona has six crossings on the U.S./Mexico border. Trucks entering Arizona from Mexico are heavily concentrated around Nogales and the Mariposa POE. The Mariposa POE in Nogales was built to handle about 250 trucks per day and during 2006 experienced nearly 800 trucks per day. As a result of this demand on the Mariposa POE, trucks often experience significant delays. Due to growing congestion at the Mariposa POE, ADOT contracted with the Advanced Traffic and Logistics Algorithms and Systems (ATLAS) Center at the University of Arizona to analyze bottlenecks at the POE. Preliminary results confirm areas of congestion on routes in and leading to the Mariposa POE complex. More recently, ADOT awarded a $43.2 million contract for the construction of a four-lane roadway that will allow commercial vehicles to bypass San Luis, Arizona. San Luis is Arizona's second-busiest border POE. The new facility, Arizona Highway 195, will link Interstate 8 in Yuma, Arizona to the new border crossing en route to Sonora State Highway 2 across the border at a point east of San Luis Rio Colorado in Mexico. It is hoped that the expanded facility will be ready by fall 2009[35].

4b.Expand Arizona's NHS intermodal connector network for freight: Freight connectors are roadways that tie together all the elements of an intermodal freight transportation system. Connectors link freight activity nodes to arterial highway systems and enable end-to-end efficiency of the intermodal networks serving rail yards, airports, and other freight-intensive nodes. When designed, maintained, and operated with freight in mind, connector routes facilitate the best use of individual modes, as well as improving the overall efficiency of regional highway networks. The purpose of the NHS is to "provide an interconnected system of principal arterial routes which will serve major population centers, international border crossings, ports, airports, public transportation facilities, and other intermodal transportation facilities and other major travel destinations; meet defense requirements; and serve interstate and interregional travel."

In 1995, the FHWA issued criteria for states and MPOs to identify the NHS connectors to major intermodal terminals. In total, Arizona has designated 19 roadway segments as NHS intermodal connectors; however, only five of these segments serve freight locations. Data collection and stakeholder outreach activities to give information about and receive input on the potential consequences of NHS connector designation could be incorporated into other localized planning activities such as Transportation Improvement Program (TIP) and the Build a Quality Arizona (BQAZ) framework study processes.

4c. Use innovative technology to improve highway operations for commercial vehicles: Intelligent transportation systems (ITS) have proven to be a relatively low-cost means to improve highway operations for commercial vehicles, increasing safety and efficiently collecting traffic data. ITS technologies provide the additional benefit of producing data streams that are often very useful for freight-related transportation planning efforts. Based upon study efforts of the National I-10 Freight Corridor Coalition, departments of transportation in the eight states supporting the corridor are now focusing efforts to implement ITS technologies and integrate communication systems across the entire corridor. Electronic transactions supporting intermodal interchanges among trucks, railroads, ships, and air-freight lines can reduce wait times at terminals and staging areas. Demonstration projects for these types of technology applications could also present opportunities for Arizona communities seeking intermodal projects to support economic development.

Strategic Response #5: Enhance Freight System Safety and Security

Though not explicitly stated as a guiding principle, it is clear that one of the underlying objectives of the BQAZ initiative is to enhance transportation mobility and safety for residents statewide. Enhancing the safety and security of Arizona's multimodal freight networks are "win-win" strategies. While crashes involving commercial vehicles or trains can often have devastating effects on health and

families, crashes also often create significant delays that impact personal mobility and economic productivity. As Arizona's population continues to grow and the volume of freight movement increases, it is likely that the social costs associated with freight movements will also increase.

Social costs resulting from higher levels of freight activity affect citizens of Arizona in a variety of ways:

- Longer commute times due to congestion
- Higher exposure to trucks and truck crashes
- Higher exposure to trains and at-grade rail crossing incidents
- Rougher roads due to premature pavement consumption
- Roadside hazards from trucks parking on shoulders

In addition to the effects on citizens, greater freight activity is also likely to impact businesses and workers using or operating Arizona's freight delivery systems in the following ways:

- Longer transit times, lost productivity
- Less reliable delivery windows, higher inventory levels
- Extended hours of operation to accommodate off-peak deliveries
- Lack of commercial truck parking for rest or delivery staging

One of the challenges for freight planners is the ability to market positive aspects associated with freight activity (as discussed in *Strategic Response #2: Link Freight Planning to Economic Development*), while also addressing negative social costs associated with freight transportation. This strategic area suggests possible strategic responses to mitigate some of the most prominent external social costs related to health, infrastructure preservation, and economic productivity. Tactics under this strategy area are presented in **Exhibit 17**.

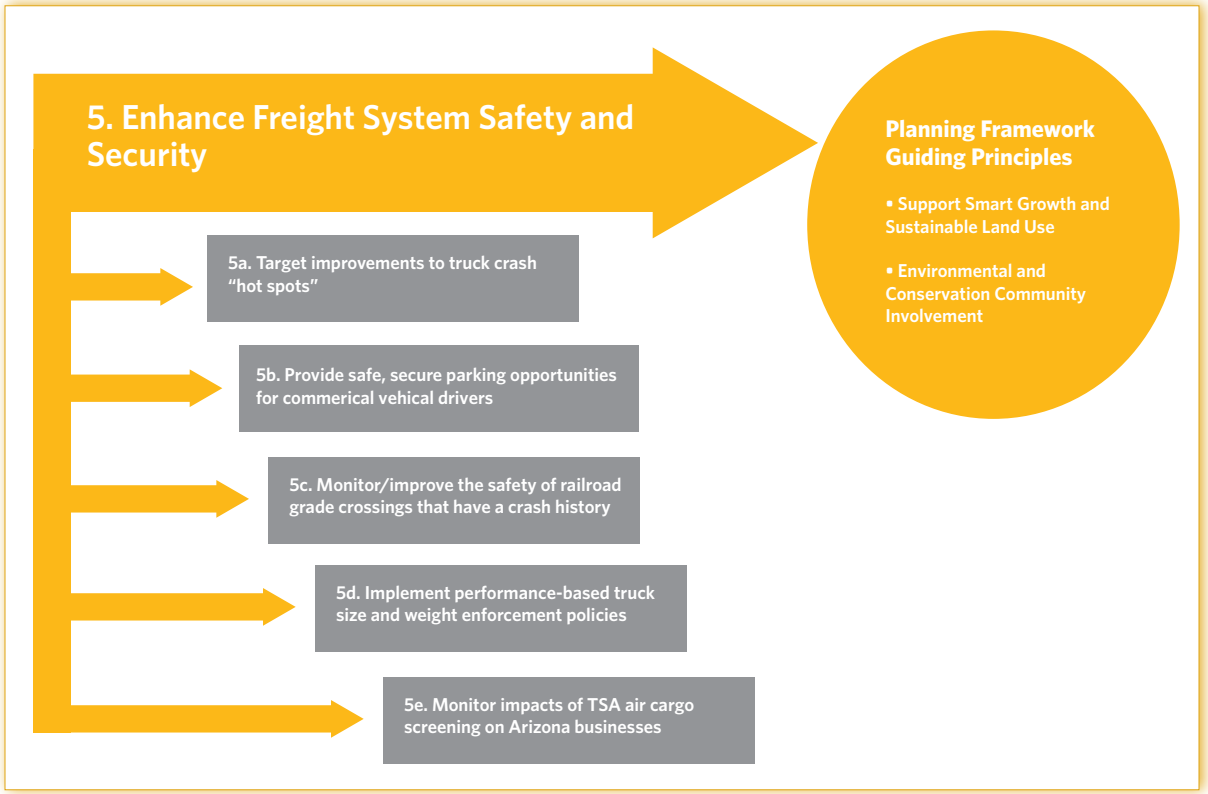


Exhibit 17: Strategic Response: Enhance Freight System Safety and Security

5a. Target improvements to truck crash "hot spots": Safety, and in particular the safety performance of commercial vehicles, has become a focus for many transportation planning agencies in the United States. Fatal crashes involving commercial vehicles are overrepresented in relation to their vehicle population and, although crash rates continue to decline, the total number of fatalities resulting from crashes involving commercial vehicles has remained relatively unchanged. Death by accident is now the fifth leading cause of death in the United States, with nearly one-half of all accidents attributed to motor vehicle crashes. To analyze the

location of truck crashes in Arizona, five years of data from the Arizona Accident Location Information Surveillance System (ALISS) and the Highway Performance Management System (HPMS) were joined in a GIS application. For each highway segment, a truck crash rate was computed based on truck crashes per million vehicle miles of travel (VMT).[‡] The table in **Exhibit 18** shows the highest average truck crash rates for the five-year period. Two segments with high average crash rates are located in central Tucson (the junctions of I-10 with I-19 and S.R. 77). Exit and entrance ramps in this area were recently reconstructed and new frontage roads were also established.

Exhibit 18: Highest Five-Year Average Truck Crash Rates by Highway Segment

Road	From	To	5 Year Avg. Truck Crash Rate (Per Million VMT)[§]
I-19	I-10 East Ramp	I-10 West Merge	11.38
SR 260	Granite Dells Rd	Granite Dells Rd +0.05	10.76
US 60	99th Ave	M148+0.60	9.67
SR 77	I-10 Front	I-10 Front	9.53
SR 347	I-10 Exit 163 G-ramp	Queen Creek Rd	9.41
SR 587	I-10 Exit 175 J-ramp	I-10 Exit 175 G-ramp	8.90
SR 89	M316+0.27	Beg. H618701C	8.74
SR 260	US 60 -0.14	US 60	8.44
SR 95	SR 68	M250+0.00	7.40
US 60	163rd Ave	SR 303	7.37
US 60	Deer Valley Rd	163rd Ave	6.91
US 60	SR 101	91st Ave	6.20
SR 77	Giaconda Way	Ina Rd	5.76
I-17	Sta. 86+50.00 -0.07	Buckeye Rd	5.68
US 60	M129+0.57	M130+0.64	5.60
US 60	SR 303	M138+0.87	5.48
I-19	K011+0.90	SR 289	5.10
I-17	Jefferson St	Adams St	4.87
SR 84	M177+0.61	M177+0.77	4.67
SR 95	I-40 Exit 9 G-ramp	I-40 Exit 9 C-ramp	4.54

[‡§] Note: The denominator in the crash rate is based on total vehicle traffic.

5b. Provide safe, secure parking opportunities for commercial vehicle drivers: The demand for truck parking continues to grow, driven by increasing truck traffic and the time sensitivity of modern supply chain management. Many states are exploring innovative ways to expand truck parking. For example, some states now allow trucks to park at weight and safety inspection facilities. Other states have built rest areas with additional truck parking. California, New York, and other states have developed master plans for the development of rest areas to provide safe off-road parking for trucks. Other initiatives are attempting to make more efficient use of existing parking through ITS technology. In 2002, the FHWA analyzed the availability of truck parking nationwide. **Exhibit 19** summarizes the inventory and analysis of truck parking for Arizona and surrounding states. Generally, truck parking at public rest areas is free with minimal amenities. Privately owned and operated truck stops may charge a fee for parking and typically offer a host of other amenities from food to showers. In Arizona, spaces in public rest areas make up just 6 percent of the existing truck parking supply. By pursuing efforts to work with the trucking industry, ADOT could pursue funding under existing federal programs to expand truck parking in remote areas of the state.

Commercial Truck Parking Inventory Along Interstate and other NHS Routes Carrying More Than 1,000 Trucks Per Day

	Public Rest Areas			Truck Stops and Travel			
State	# of Facilities	# of Spaces	% of Total	# of Facilities	# of Spaces	% of Total	Total # of Spaces
Arizona	38	559	6%	58	8,140	94%	8,699
California	88	1,106	13%	122	7,496	87%	8,602
Colorado	31	167	6%	57	2,710	94%	2,877
Nevada	36	260	5%	31	4,979	95%	5,239
New Mexico	11	78	1%	49	6,322	99%	6,400
Utah	24	238	9%	43	2,488	91%	2,726

Evaluation of Parking Shortage State-By-State Analysis

	Public Spaces		Commercial Spaces		Total Spaces	
State	Ratio	Category	Ratio	Category	Ratio	Category
Arizona	1.88	Shortage	1.88	Surplus	0.53	Surplus
California	4.1	Shortage	4.1	Shortage	2.29	Shortage
Colorado	4.55	Shortage	4.55	Sufficient	1.15	Shortage
Nevada	2.62	Shortage	2.62	Surplus	0.57	Surplus
New Mexico	15.62	Shortage	15.62	Surplus	0.83	Surplus
Utah	1.64	Shortage	1.64	Surplus	0.62	Surplus

Exhibit 19: Summary of Truck Parking Supply/Demand – SW United States[36]

5c. Monitor/improve the safety of railroad grade crossings that have a crash history: In a 2007 study conducted by Citizens for Rail Safety, Inc. and the Center for Hazards Research and Policy Development at the University of Louisville, several at-grade railroad crossings in Phoenix were identified as among the "nation's most dangerous."[37] The 27th Avenue crossing of the UPRR in Phoenix was ranked the number one "most dangerous" crossing in the United States due to the number of car/train crashes that had occurred at the location over several years. Two other Phoenix-area crossings were ranked in the top 20: the BNSF Railroad crossing of 27th Avenue at Thomas Road and the BNSF crossing of 35th Avenue at Indian School Road.

5d. Implement performance-based truck size and weight enforcement policies: The cost to replace or rehabilitate highway pavement is expensive and overweight commercial vehicles directly contribute to premature pavement and bridge deterioration. Studies have shown that replacing prematurely damaged pavement is likely to exceed the cost of an effective vehicle size and weight enforcement program. Arizona completed a study in 2006 that relied heavily on noncompliance rates from a variety of sources and estimated that the cost of overweight commercial traffic in Arizona ranged from $12 million to $53 million. Nonetheless, studies in other states have found similar results. The Motor Vehicle Enforcement Division (MVED) of ADOT currently staffs 21 fixed enforcement facilities: six international border POEs, six interstate POEs, and nine secondary route fixed POEs. Going forward, the MVED believes its effectiveness is being challenged due to increasing numbers of trucks, insufficient staff, and aging facilities. The MVED is proposing to implement "virtual weight enforcement" facilities over the next several years. Given research findings that overweight vehicles contribute $12 million to $53 million of infrastructure damage each year, ADOT may wish to support expanded technology applications and additional enforcement resources to promote the protection of the state's infrastructure.

ADOT might also consider an education and marketing campaign targeted at heavy haul industries, such as mining, to raise the level of understanding about overweight vehicles and the cost to infrastructure.

5e. Monitor impacts of TSA air cargo screening on Arizona businesses: According to the Transportation Security Administration (TSA), aircraft in the United States transport 50,000 tons of cargo each day with 7,500 tons of that cargo loaded into the belly space of passenger aircraft. In August 2007, Congress passed the Implementing Recommendations of the 9/11 Commission Act of 2007 (Public Law 110-53). The law requires TSA to implement a program that accomplishes 100 percent screening of air cargo in the belly of passenger planes within three years of enactment. TSA is developing a Certified Cargo Screening Program (CCSP) to meet the mandate of the new law and prevent delays. The success of the screening requirement depends on harmonized collaboration with key stakeholders (U.S.-based passenger carriers, IACs/freight forwarders, and shippers). Currently, aircraft operators alone do not have the capacity to screen the volume of cargo that is now transported on passenger aircraft daily. Requiring passenger aircraft operators to screen 100 percent of air cargo could result in carrier delays, congestion at airport cargo facilities, backlogs of unscreened cargo, and missed flights. The new requirement for screening cargo equal to passenger baggage will have the biggest impact on cargo that is carried on wide-body aircraft, mainly international flights. IACs/freight forwarders will be affected the most (majority of shippers work through an IAC/freight forwarder and do not negotiate directly with carriers). This is done not only for efficiency, but also because it enables better rates when cargo is tendered "loose" (because less handling by the carrier is required).** ADOT may want to consider monitoring TSA's implementation of the 100 percent air cargo screening requirement to help ensure the continued efficiency of air cargo operations. The following are some suggested steps that ADOT could take:

** Statement of John Sammon Assistant Administrator before the Subcommittee on Transportation Security and Infrastructure Protection Committee on Homeland Security, July 15, 2008

- Work with air cargo stakeholders (carrier, IACs/freight forwarders, shippers) to ensure screening is conducted at earliest stage
- Since IACs/freight forwarders will be mostly impacted by the new law, support the development and funding of technology to effectively and efficiently screen cargo prior to the carrier acceptance
- Monitor the screening mandate for changes in the screening requirements, aircraft type, etc. and communicate these changes to the industry in the state

Strategic Response #6: Environmental Preservation and Energy Efficiency

The increasing volatility of weather during the past decade has raised the national and international consciousness regarding climate change and greenhouse gases. The debate continues as to just how climate change may affect our planet in the future. Nonetheless, in 2006, the Environmental Protection Agency (EPA) estimated that in the United States, approximately one-third of all human-based carbon dioxide (CO_2) emissions can be attributed to the transportation sector.[39] More than half of the nitrogen oxide (NOx) emissions produced in the United States result from "mobile fossil fuel combustion."[40]

Possible strategic responses to mitigate some of the environmental costs associated with freight activity are summarized in **Exhibit 20**. The purpose of this strategy response is to promote actions and policies to protect our natural environment while recognizing the needs and concerns of the freight community.

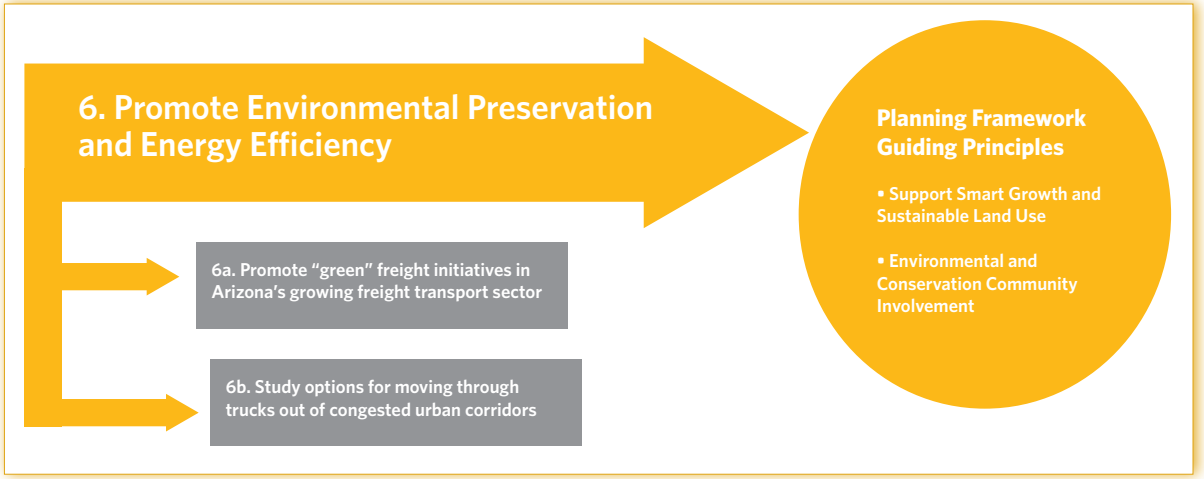


Exhibit 20: Strategic Response: Environmental Preservation and Energy Efficiency

6a.Promote "green" freight initiatives in Arizona's growing freight transport sector: Some emissions, such as NOx, do not have a direct global warming effect but act to influence the formation or destruction of greenhouse gases. With the tremendous growth of freight volumes anticipated in Arizona over the next two decades, freight activities are likely to be major contributors to NOx emissions. Recently implemented regulations requiring clean diesel engines in heavy duty trucks will dramatically lower NOx emissions resulting from commercial fleets in years to come. However, it will likely take a decade or more to substantially turn over the U.S. commercial truck fleet. Following are some steps that ADOT could consider for addressing vehicle emission issues:

i. **Explore opportunities to adopt clean trucks:** It is not atypical for retired over-the-road trucks to continue their service as local delivery trucks or for maquiladoras operations: *"Maquiladoras, also known as maquilas, are factories*

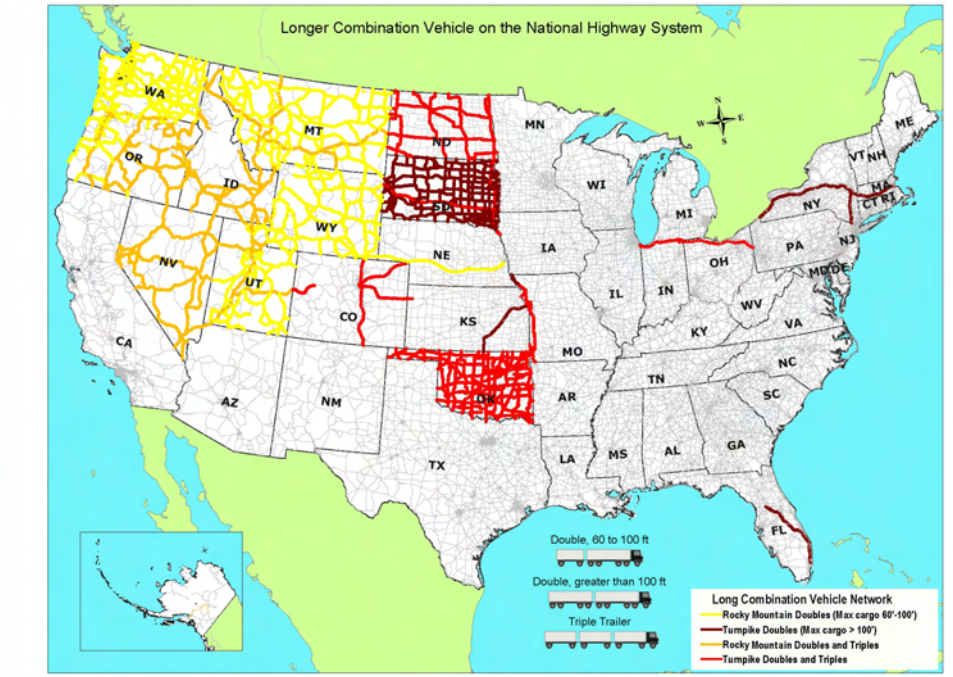
that produce for export, primarily on the basis of assembly or conversion of components and raw materials imported from abroad."[41] Some other international gateways, especially port complexes like the San Pedro Bay ports, and ports of New York/New Jersey have been seeking ways to accelerate the introduction of new, clean diesel engine technologies into local truck drayage operations. By monitoring programs like the Port of Los Angeles' "Clean Truck Program," ADOT may identify opportunities for similar incentive programs for border drayage operations.

ii. **Involve planning partners and the private sector in addressing environmental issues affecting freight:** Approximately 30 states, including Arizona, have now adopted anti-idling regulations for parked trucks.[42] Arizona regulates smoke emissions and limits idling for large trucks to five minutes statewide, but exemptions are provided for traffic conditions and certain types of special equipment such as trucks with refrigeration units. Targeting congestion, highway freight bottlenecks, and helping communities make good land use decisions with regard to freight transportation can further advance Arizona's efforts to reduce truck emissions. The EPA has also initiated the SmartWay Program to provide guidance for the reduction of freight-related emissions. By working with its planning partners, ADOT could develop "green transport" guidelines for land use and commercial development. EPA's web-based "Green Communities Program" may provide a starting point. ADOT might also consider working with MPOs, COGs, and private industry stakeholders to examine potential consequences of climate change, such as hotter days and longer heat waves. Examining the potential consequences of climate change may provide a vehicle for coalescing diverse interests in the transportation planning, economic development, and private sectors to work toward common goals for environmental sustainability.

iii. **Explore opportunities to increase highway productivity:** Many states in the western United States allow longer combination vehicle (LCV) operations. The current extent of LCV operations in the United States is shown in **Exhibit 21.** LCVs have operated on all or portions of the National Network in some western states for many years under the grandfather provisions in federal law. Until 1991, states could determine the weights and dimensions allowed under their grandfather rights. However, concerns over modal competition and safety prompted Congress to "freeze" the existing LCV network under the ISTEA legislation of 1991. Arizona currently allows double- and triple-trailer LCVs on I-15 and short sections of U.S. routes 89, 160, and 163. A recent study conducted by the ATRI and Western Transportation Institute, in cooperation with Cummins, Inc., found that greater

Exhibit 21: Existing LCV Network in the United States

Source: FHWA



adoption of higher productivity vehicles (HPV) in the United States could lead to significant energy savings and transport emissions in the trucking sector. Arizona may wish to consider joining a number of other western states who have petitioned Congress through the Western Governor's Association to re-examine the ISTEA and allow changes to create greater truck size and weight uniformity and allow higher productivity where traffic conditions allow the safe operation of LCVs.

6b.Study options for moving through trucks out of congested urban corridors

i. **Truck Bypasses:** Another strategy for alleviating the contributions to congestion from through truck traffic in urban areas is the construction of truck bypass routes. Bypass routes move traffic out of urban areas, where most through trucks have no need or desire to be during peak traffic periods. Such routes also serve to dilute urban area emissions by dissipating them through a larger geographic zone and reducing emissions associated with congestion. Related to bypasses are methods of encouraging their use. Simple steps like route designation and signage can be effective, or traveler information channels can be applied to advertise the advantage of preferred routes to unfamiliar drivers. Some metropolitan areas have posted advisory signs upstream from bypass exits, encouraging through trucks to use them. Freight support services like fueling stations, rest areas and fully equipped truck stops affect routing choices, especially if they are available on the core network and not on the bypass. Distance, time, and their cost implications are the principle criteria for motor carrier route selection. Since most bypass routes are likely to be longer, having variable message signs with the time implications of route choices may be one way to encourage use under heavily congested conditions.

Currently, bypass systems are employed on major elements of the Phoenix arterial system, such as Loop 101 and Loop 202. However, with projected increases in freight traffic over the next 20 years, Arizona may also wish to consider an expanded bypass routing as part of the response to through truck traffic. For instance, SR-85 from the intersection with I-10 in Buckeye, to its intersection with I-8 in Gila Bend already carries in excess of 4,000 trucks per day, as it has become a popular truck bypass of urban Phoenix. Traffic forecasts also indicate that the traffic volume on I-10 will exceed the capacity of the roadway before 2030.[43] The I-10 Phoenix/Tucson Bypass study narrowed the consideration of many potential routes down to several based on environmental constraints, route distance, travel time savings, and the potential for traffic diversion. A follow-on study further narrowed the list of viable corridors down to one, referred to as "Route 4." Heading east, the Route 4 corridor for the proposed western bypass alternative would break from I-10 near the current junction of I-10 and I-8 in Pinal County. Continuing southeast, the southern end of the corridor would re-connect with I-10, east of Tucson in Casa Grande. The Route 4 corridor alternative is shown in **Exhibit 22.**

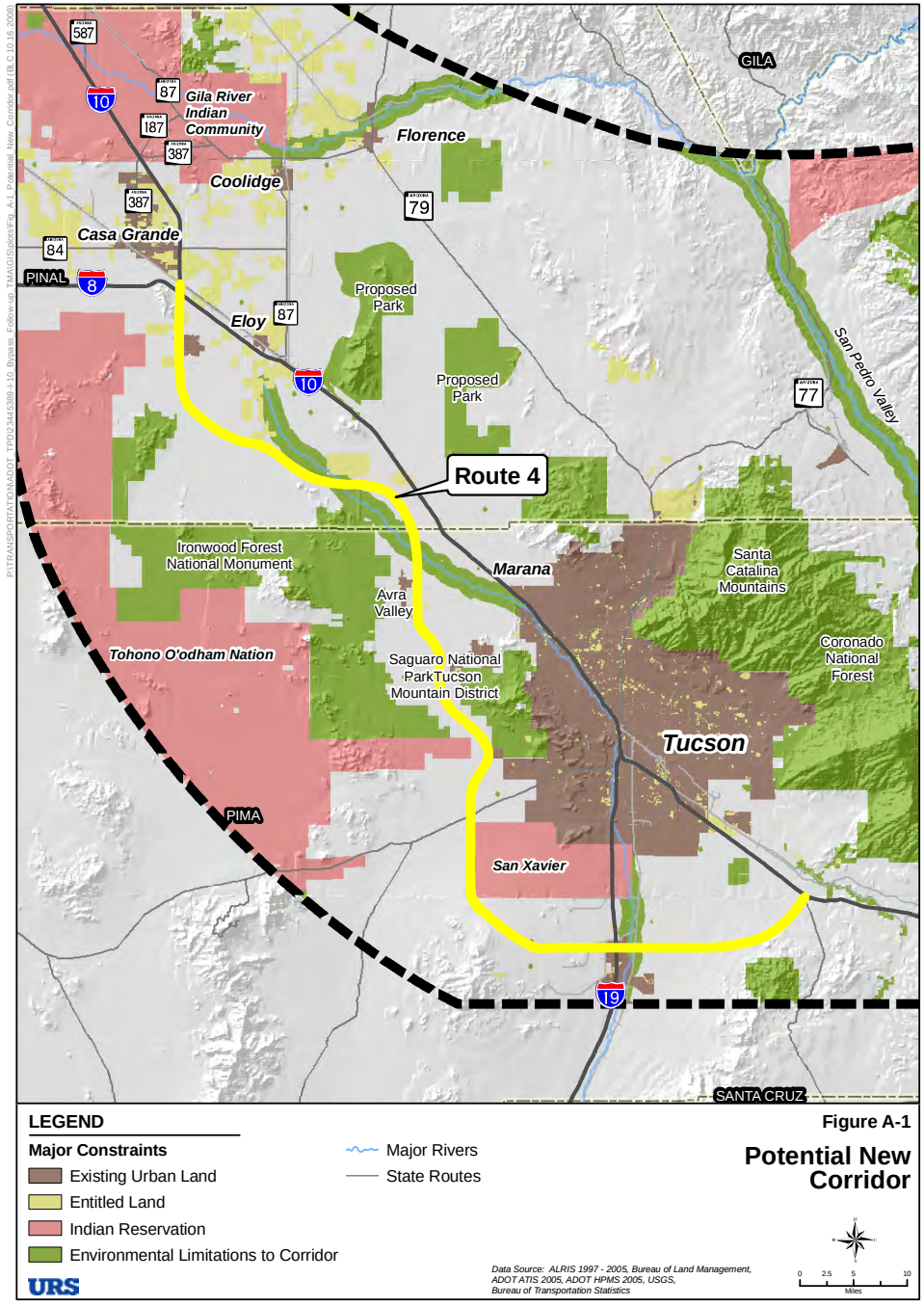


Exhibit 22: Proposed I-10 Corridor Alternative "Route 4"

ii. **Truck separation/tolling:** Toll roads currently are under investigation around the nation as a means of generating partial financing of infrastructure and influencing travel behavior. Several of these investigations are directed primarily at commercial traffic. Studies are examining the feasibility for separating freight and passenger/commuter traffic along several major interstate corridors such as I-70 and I-80. The graphic in **Exhibit 23** shows the truck only lane (TOL) concept being studied in Missouri on I-70. The proposal suggests two lanes in each direction exclusively for commercial vehicles on the inside of the general purpose lanes. Several interchanges that experience high volumes of truck traffic would also have on- and off-ramps exclusively for trucks. However, the majority of interchanges will serve both trucks and other vehicles. These common interchanges will be accessed from the middle truck-only lanes via "slip ramps." One of the "selling points" of the dedicated TOLs is the potential for accommodating larger, heavier loads, traveling at higher speeds than current standards permit. Taking an even more futuristic look at TOLs suggests the possibility of highly automated corridors that could support driverless truck platoons between distinct terminal points. As discussed previously, highway freight movement productivity has lagged in comparison to the operating productivity experienced in other modes, largely due to safety concerns associated with larger, heavier trucks traveling in the same environment as passenger vehicles. TOLs may provide a means to overcome many of the most serious safety concerns. Due to the geographic proximity of Arizona's major population centers to the major international gateways of Southern California, TOLs may provide an opportunity to lower overall freight transportation costs for Arizona shippers while providing timely, reliable services.

Exhibit 23: Proposed I-70 Truck Only Lane (TOL) Configuration

CONCLUSIONS

The forecasted growth in Arizona's population is the leading driver impacting freight transportation policy and development in the state of Arizona. The increase in population will lead to an equivalent increase in demand for goods and services. As population increases, so will traffic volumes, both in terms of passenger travel and freight transportation. The geographic distribution of these population forecasts suggests significant development patterns around the major metropolitan areas of Tucson and Phoenix.

Commodity forecasts suggest that rail will be the fastest growing mode in Arizona, but most of the volume increases will come from bridge traffic through Arizona. Truck transportation will likely be the dominant mode for distributing the population-driven freight demand around Arizona's population centers.

The state of Arizona is at the crossroads of several significant regional, national, and international trade corridors. As bridge traffic along these trade corridors grows, they continue to congest and impact the efficiency and productivity of key regional and national rail and highway corridors that serve Arizona, in terms of both freight transportation and overall commuter transportation.

It is anticipated that the San Pedro Bay ports of Los Angeles and Long Beach (LA/LB) will continue to be the major U.S. gateway for Asian container traffic, with container volumes expected to triple by 2020. The railroads are making major investments in on-dock rail facilities to accommodate an increasing share in rail traffic. Moreover, trucking is likely to continue as the dominant mode for transporting containers to markets other than those on the East Coast. The increase in rail traffic and long-haul truck traffic is likely to impact key corridors feeding through Arizona. While speculation continues about the development of rail and

highway corridors from Mexico to serve increasing trade between Mexico and the United States, these plans are not concrete. If successfully implemented, they could have significant impacts on key corridors that serve the state of Arizona; notwithstanding these trends, the San Pedro Bay ports will continue to be an important gateway with significant impacts on Arizona by virtue of their location.

As Arizona continues to grow, individual communities, stakeholders, and constituent groups are likely to gain the resources as well as the political will and weight to try to address transportation strategies on an autonomous and individual basis. ADOT can be a leader in the area of freight transportation planning. The challenge in taking this leadership role lies in the ability to develop a consistent statewide strategy for addressing freight transportation. The overriding policy implication for the state of Arizona is the need for greater cooperation and proactive planning among agencies at the state and regional level, coordination among cities and counties within major urban areas, and coordination with the private sector specifically.

The freight planning agenda summarized in **Exhibit 24** is intended to start ADOT down this cooperative freight planning path. The agenda is designed to integrate freight considerations into ADOT's existing planning initiatives while remaining consistent with other state and national freight policy themes.

Strategic Response #1: Link Freight Planning to Economic Development	
Tactics	**Performance Measures/Indicator**
1a. Engage the private sector in transportation planning	• Number of freight stakeholder outreach activities • Number of private sector attendees at events
1b. Support freight-related training and education for state, regional, and local planning staff.	• Number of training sessions or workshops hosted • Number of MPO/COG representatives at training sessions
1c. Market the link between transportation and Arizona's economy.	• Public attitudes toward freight in omnibus surveys • Sponsorship of the CAPS Center for Strategic Supply Research or similar organizations
Strategic Response #2: Coordinate Freight Planning and Local Land Use Planning	
Tactics	**Performance Measures/Indicator**
2a. Encourage and support efforts on behalf of local governments to develop land use planning guidelines for freight-intensive development.	• Number of Arizona communities that adopt or develop land use guidelines specifically addressing freight developments • Number of in-state university research projects addressing land use and freight
2b. Encourage communities to work closely with the private sector when developing freight logistics centers	• Number of communities that develop local freight stakeholder forums or groups
Strategic Response #3: Preserve and Prioritize Key Freight Infrastructure	
Tactics	**Performance Measures/Indicator**
3a. Expand Arizona's participation in high-priority corridor initiatives.	• Number of corridor-level agreements with other states • Number of projects funded through or initiated by COF or other corridor-based programs
3b. Support railroad mainline capacity expansions.	• The formation of, or participation in, rail corridor coalitions • Rail freight facility access improvements • Number of at-grade crossings removed
3c. Prioritize and protect priority highway corridors for efficient freight movement.	• Average truck trip time between trade centers
3d. Establish and maintain a freight data collection program.	• The number or percent of planning studies, such as framework studies, that include some element of freight analysis • Average travel time and buffer indices for major truck corridors

Exhibit 24: Summary of the Proposed ADOT Freight Planning Agenda

Strategic Response #4: Seek Opportunities to Improve Freight Operations

Tactics	Performance Measures/Indicator
4a. Incorporate heavy truck movements into highway design and reduce bottlenecks	• Percent of priority truck routes meeting ADOT standards for: o pavement condition o bridge condition o WB-67 intersection design o adequate acceleration lanes for trucks • Adequate climbing lanes for trucks on steep grades
4b. Expand Arizona's NHS intermodal connector network for freight.	• Number of Arizona road segments on the FHWA-NHS connector listing that serve freight facilities
4b. Use innovative technology to improve highway operations for commercial vehicles.	• Number of ITS projects on freight-significant corridors in Arizona • Estimated time savings from ITS investments on priority truck corridors

Strategic Response #5: Enhance Freight System Safety and Security

Tactics	Performance Measures/Indicator
5a. Target improvements to truck crash "hot spots."	• Commercial vehicle crash rates by segment • Percent of vehicle and driver attributes for truck crashes for which the response "unknown" is listed in crash reports
5b. Provide safe, secure parking opportunities for commercial vehicle drivers.	• Percent of public truck parking spaces occupied by time of day • Distance (in miles) between public truck parking facilities on major corridors
5c. Monitor/improve the safety of railroad grade crossings that have a crash history.	• Number of crashes by crossing • Number of at-grade improvements
5d. Implement performance-based truck size and weight enforcement policies.	•Annual pavement and bridge infrastructure savings from weight enforcement
5e. Monitor impacts of TSA air cargo screening requirements on businesses.	• Number of meetings with air cargo stakeholders to monitor impacts

Strategic Response #6: Environmental Preservation and Energy Efficiency

Tactics	Performance Measures/Indicator
6a. Promote "green" freight initiatives in Arizona's growing freight transport sector.	• Percentage reduction in mobile source emissions from large trucks • Percentage reduction in energy consumption from large trucks
6b. Study options for moving through trucks out of congested urban corridors.	• Percentage reduction in truck VMT on congested urban corridors

Exhibit 24: Summary of the Proposed ADOT Freight Planning Agenda *Continued*

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[1]Source: Woods & Poole Economics, Inc. Washington D.C. Copyright 2006. Woods & Poole does not guarantee the accuracy of this data. The use of this data and the conclusions drawn from it are solely the responsibility of Wilbur Smith Associates, Inc.

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[42]Pennsylvania Regulation Limits Truck Idling: Environmental Leader web site: http://www.environmentalleader.com/2007/10/19/pennsylvania-regulation-limits-truck-idling.

[43]ADOT, Draft Report. I-10 Bypass Follow-up Report: Tucson Metropolitan Area, October 2008, pg. iii.