2020 – 2045
Oklahoma Long-Range Transportation Plan

Existing and Future Trends Report

November 5, 2019

Prepared by

HIGH STREET

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1. INTRODUCTION

An assessment of existing and future trends in topics such as demographics, socioeconomics, the environment (both natural and built), and technology helps provide proper context in the development of a long range transportation plan (LRTP). This report highlights critical trends, both historical and projected, to inform discussions around the future of Oklahoma's transportation system.

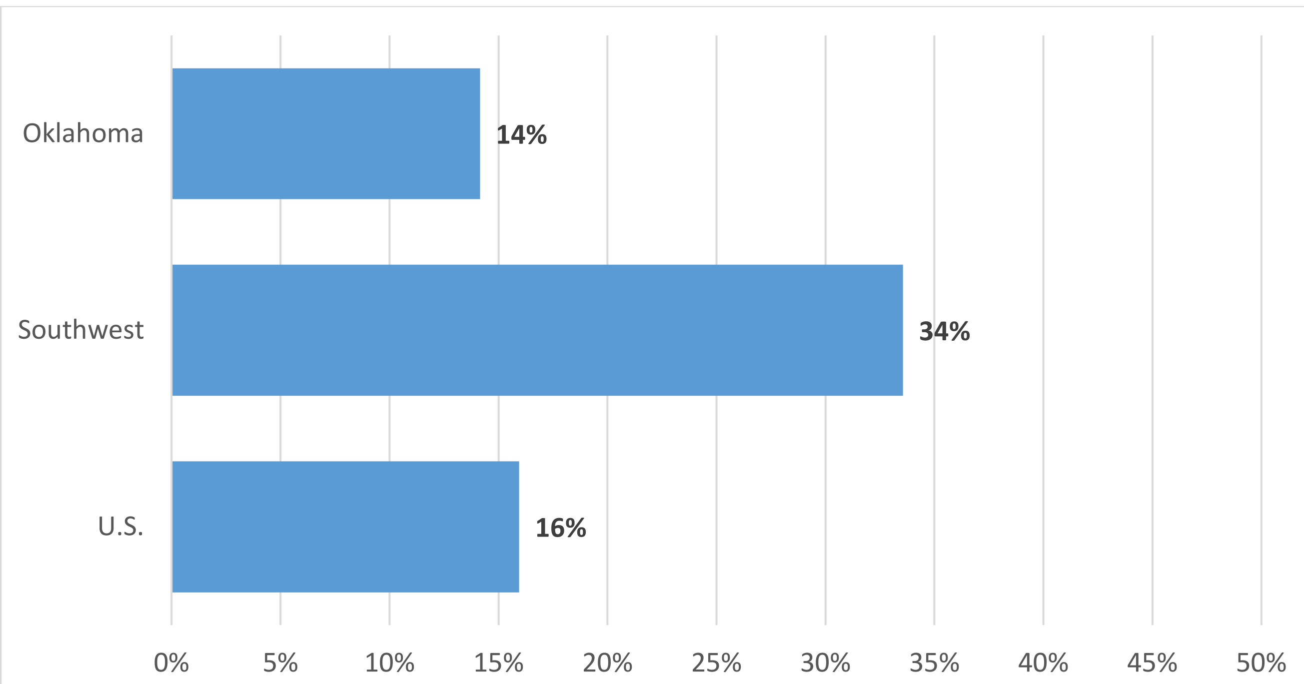
2. DEMOGRAPHICS

This section highlights population trends that will impact the demands of Oklahoma's transportation system.

2.1. POPULATION TRENDS

According to the US Census Bureau, the population of Oklahoma in 2000 was 3.45 million and is estimated to have increased to 3.94 million in 2018; a 14 percent overall growth rate. As shown in **Figure 2-1** that rate is slightly less than the US as a whole, and less than half of the overall growth rate for the Southwest region, which includes Arizona, New Mexico, Oklahoma, and Texas.

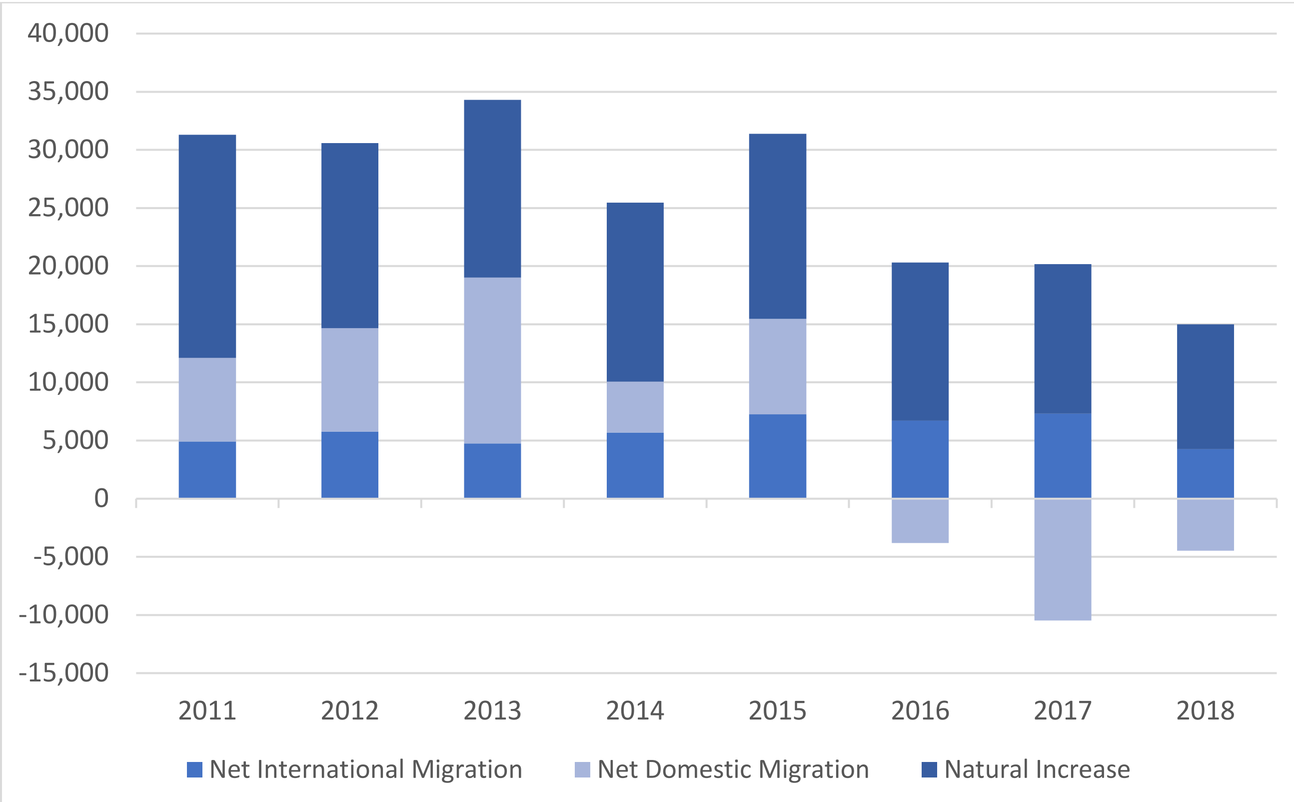
Figure 2-1: Overall Population Growth, 2000-2018



Source: US Census Bureau

The Federal Reserve Bank of Kansas City found that the primary factor for the state's lag in population growth has been domestic migration. As shown in **Figure 2-2**, the years 2016 to 2018 had net negative domestic migration (more US residents move out of state than move in). Total migration loss was partially offset by net positive international migration. The negative domestic migration in 2016 followed the 2014-2015 drop in oil prices and the subsequent downturn in the State's economy. The analysis presumes that while overall migration trends for the state should improve as Oklahoma's economy strengthens, longer term out migration trends for those in the western part of the state and for college graduates could continue despite a good economy (Wilkerson & Shupert, Who has been leaving Oklahoma, and will the trend continue?, 2019).

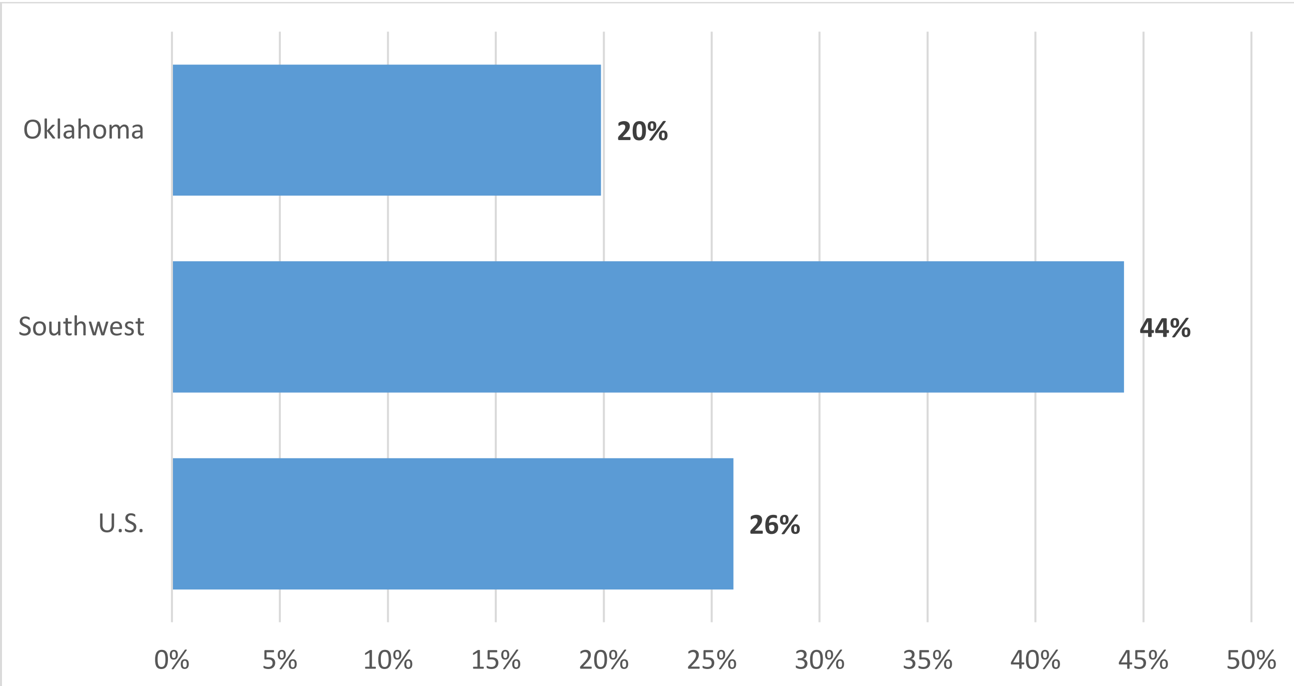
Figure 2-2: Oklahoma Population Change by Component, 2011-2018



Source: US Census Bureau

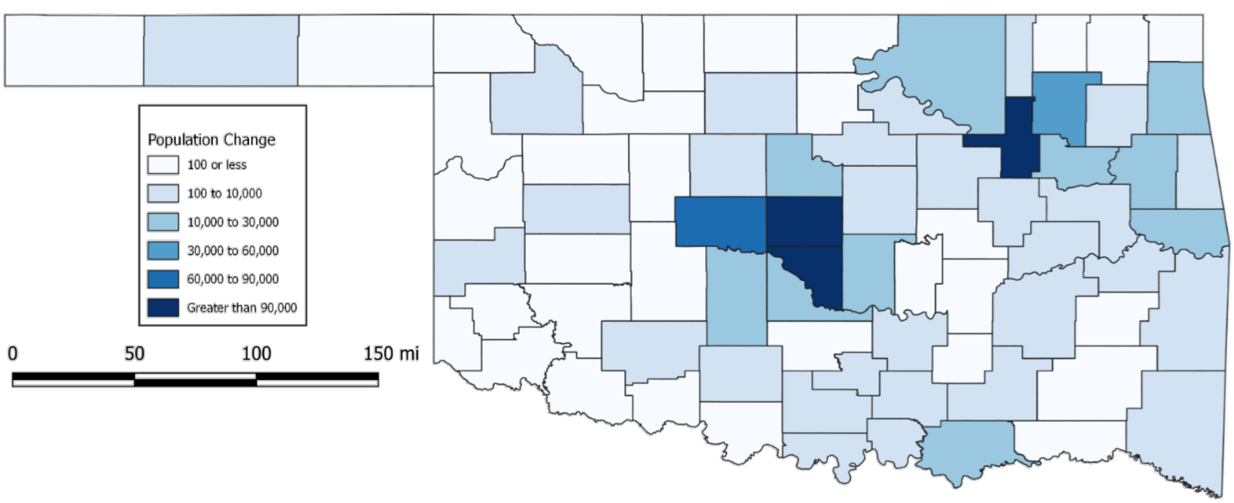
By 2045, population in Oklahoma is projected to grow by 20 percent, a growth rate that again is less than that of the projected rates for the US and the Southwest region, (**Figure 2-3**). However, there is much variability between projected population growth by Oklahoma counties as shown in **Figure 2-4**. The majority of the future population growth will be concentrated in the urban areas of Oklahoma City and Tulsa.

Figure 2-3: Projected Overall Population Growth, 2018-2045



Source: US Census Bureau and Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018.

Figure 2-4: Projected Population Change by County, 2018-2045

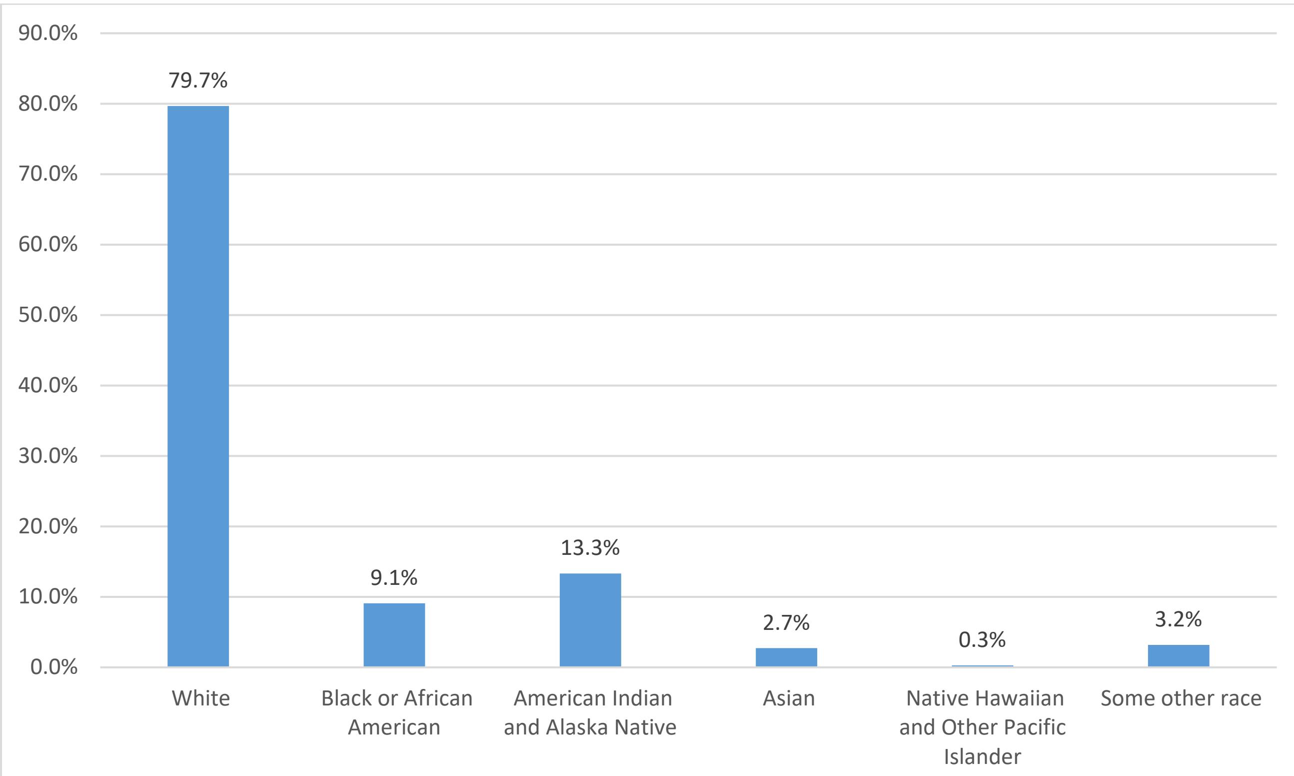


Source: Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018.

2.2. RACE & ETHNICITY

The Census Bureau uses six categories to distinguish race; namely White, Black or African American, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, and Some Other Race. However, Census survey respondents are allowed to report multiple races. **Figure 2-5** shows the percentage of Oklahoma's population by race, including those that identify with more than one race. Due to the overlap among races (e.g. those that identify as both White and American Indian and Alaska Native), *the sum of the percentages do not equal to 100 percent*; however, **Figure 2-5** does allow for a more robust representation of overall racial diversity.

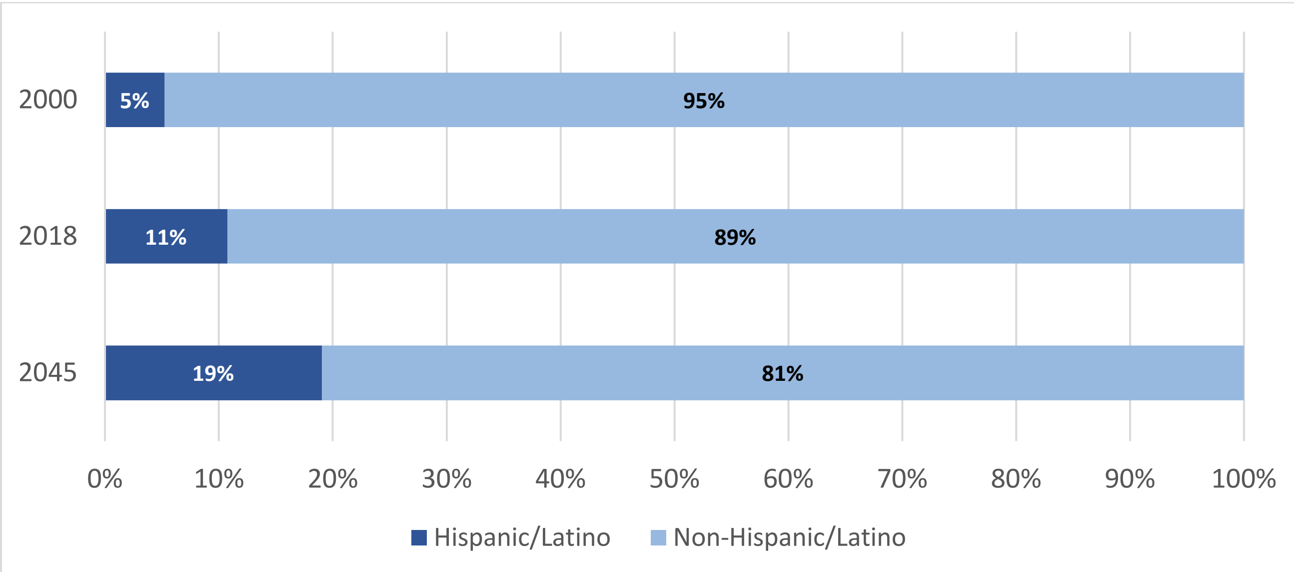
Figure 2-5: Oklahoma Population, Race Alone or in Combination with One or More Other Races



Source: US Census Bureau

Figure 2-5 does not account for Oklahoma's Hispanic / Latino population as the term "Hispanic / Latino" does not represent a race group, but rather a description of ethnic origin. According to Woods and Poole ethnicity projections, the Hispanic/Latino population in Oklahoma is expected to continue its trend of becoming an increasing share of overall population, reaching a projected share of 19 percent by 2045 (**Figure 2-6**).

Figure 2-6: Oklahoma Population by Race/Ethnicity

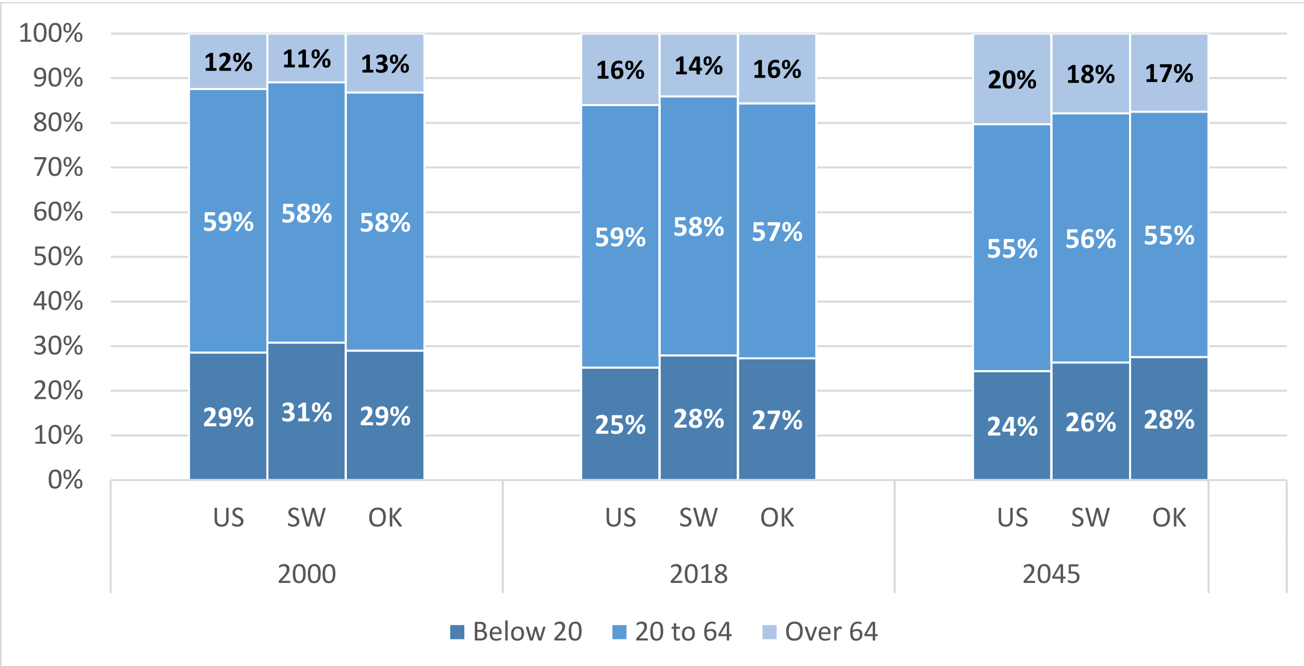


Source: Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018.

2.3. AGE DISTRIBUTION

Overall, the age distribution of Oklahoma's residents has not differed greatly from that of the US and the Southwest region (**Figure 2-7**). While the trend of an increase in the aging population as share of overall population is projected to continue, compared to the US and the Southwest region, Oklahoma is projected to have a lower percentage of those aged 64 years and older in 2045, than the Southwest region or the US as a whole.

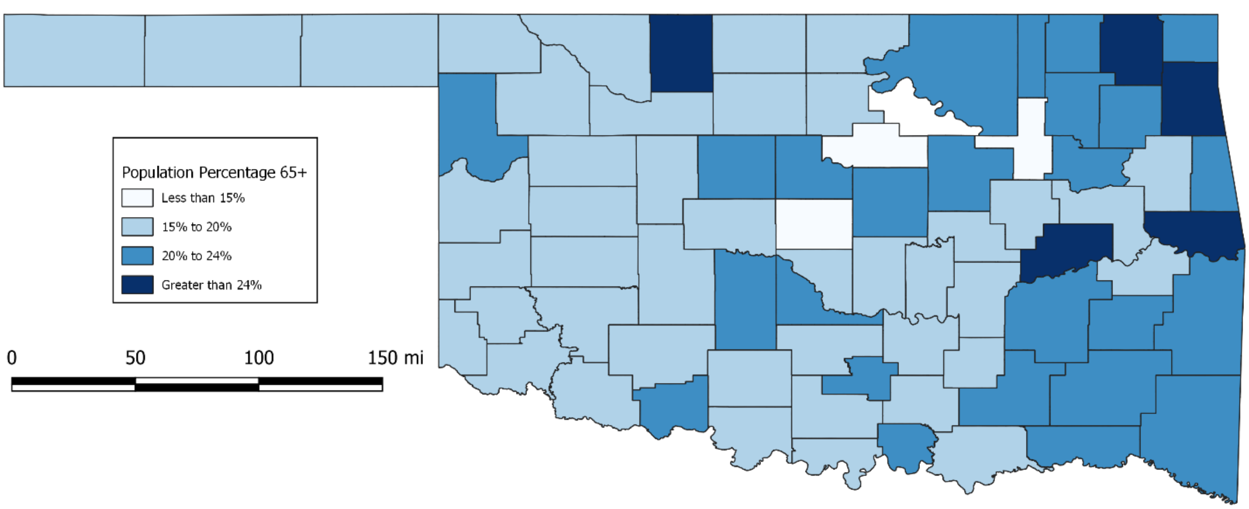
Figure 2-7: Population by Age Group



Source: US Census Bureau and Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018.

Projected age distribution in 2045 among Oklahoma counties is quite varied. Those aged 65 years and older represent less than 15 percent of the population in some of the state's more urbanized areas, but account for over 24 percent in other parts of the state (**Figure 2-8**).

Figure 2-8: Oklahoma Projected Population Percentage Aged 65+ by County, 2045

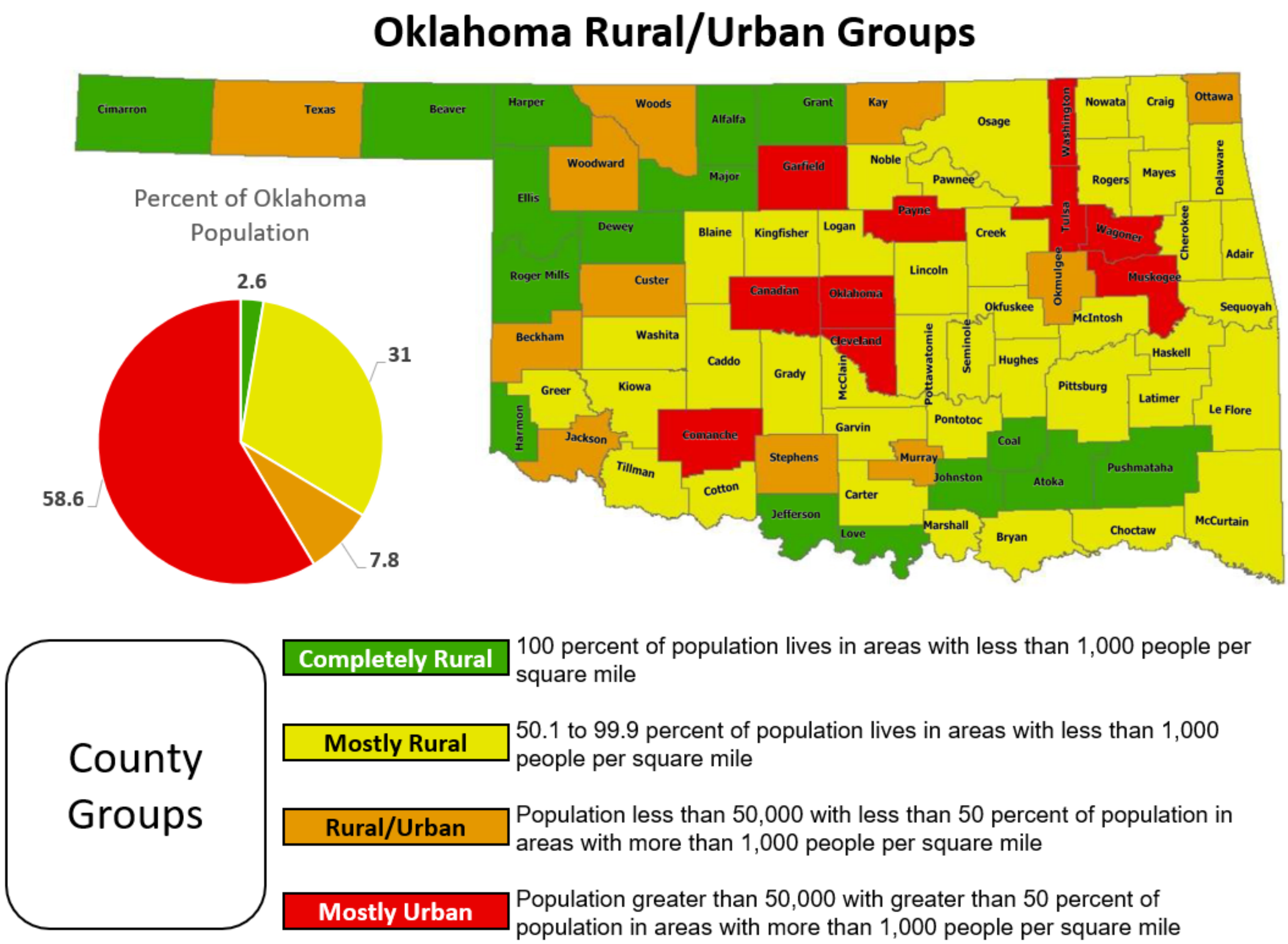


Source: Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018.

2.4. URBAN VS. RURAL POPULATIONS

The maps in **Figure 2-4** and **Figure 2-8** highlight differences in projected trends between urban and rural areas; namely total population growth will be centered around urban areas and older adults will represent a greater percentage of the population in rural areas. This urban/rural population disparity is not a new phenomenon and is acutely apparent when looking at population density throughout the State. **Figure 2-9** shows that almost 60 percent of Oklahoma residents live in counties whose total land area accounts for less than 11 percent of the state's geographic area.

Figure 2-9: Rural and Urban Populations in Oklahoma, 2010



Source: US Census for Oklahoma Rural Development Conference and Workshop (2017)

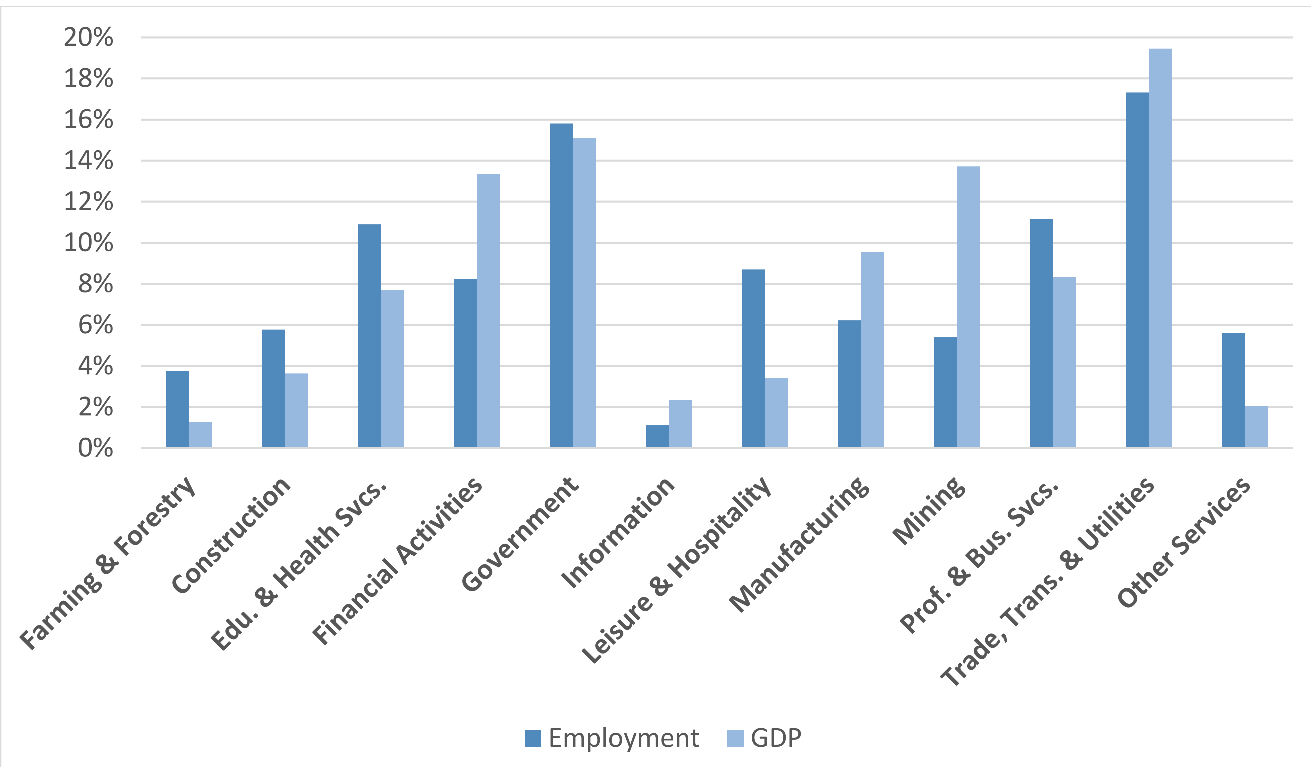
3. SOCIOECONOMIC FACTORS

The socioeconomic section focuses on both the economic (e.g., employment, income) and social (e.g., commuting trends) factors that can influence future demands on the transportation system.

3.1. OKLAHOMA BY INDUSTRY

Evaluating economic factors by industry provides a future economic outlook for Oklahoma. **Figure 3-1** shows the percentage share of employment and gross domestic product (GDP) in Oklahoma by industry for 2018. Trade, Transportation and Utilities is the top industry in terms of both GDP and employment. It is followed by Government and Mining in terms of GDP (the latter industry including extraction of oil and natural gas), however Mining ranks tenth as a share of overall employment in Oklahoma.

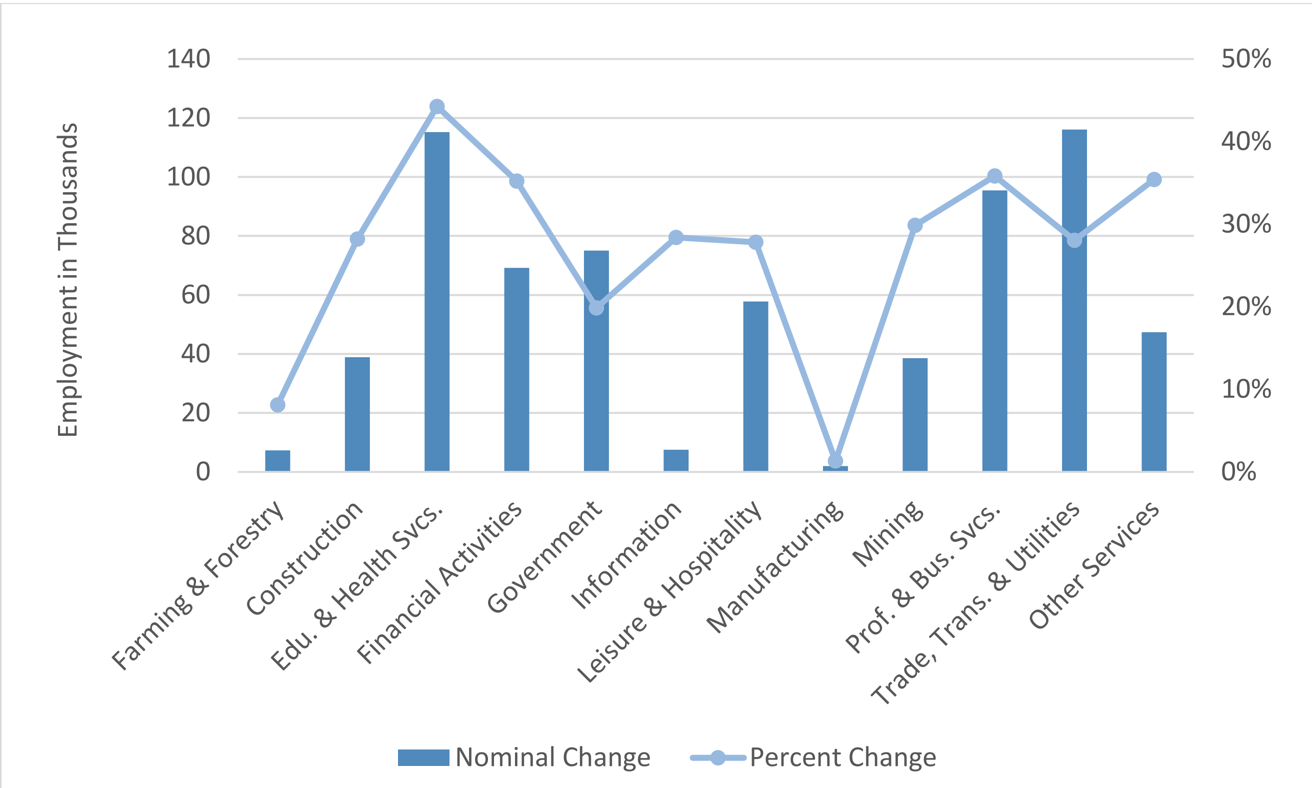
Figure 3-1: Share of Oklahoma Employment and GDP by Industry, 2018



Source: Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018; US Bureau of Economic Analysis, 2019.

As shown in **Figure 3-2**, Trade, Transportation and Utilities is also projected to be the top industry in terms of nominal employment growth, adding approximately 116,000 jobs from 2018 to 2045. It is followed by Education and Health services, which is projected to represent the largest increase in employment as a percentage of those currently employed in that industry.

Figure 3-2: Projected Change in Oklahoma Employment by Industry, 2018-2045



Source: Woods & Poole Economics, Inc. Washington, D.C. Copyright 2018.

3.2. ENERGY SECTOR

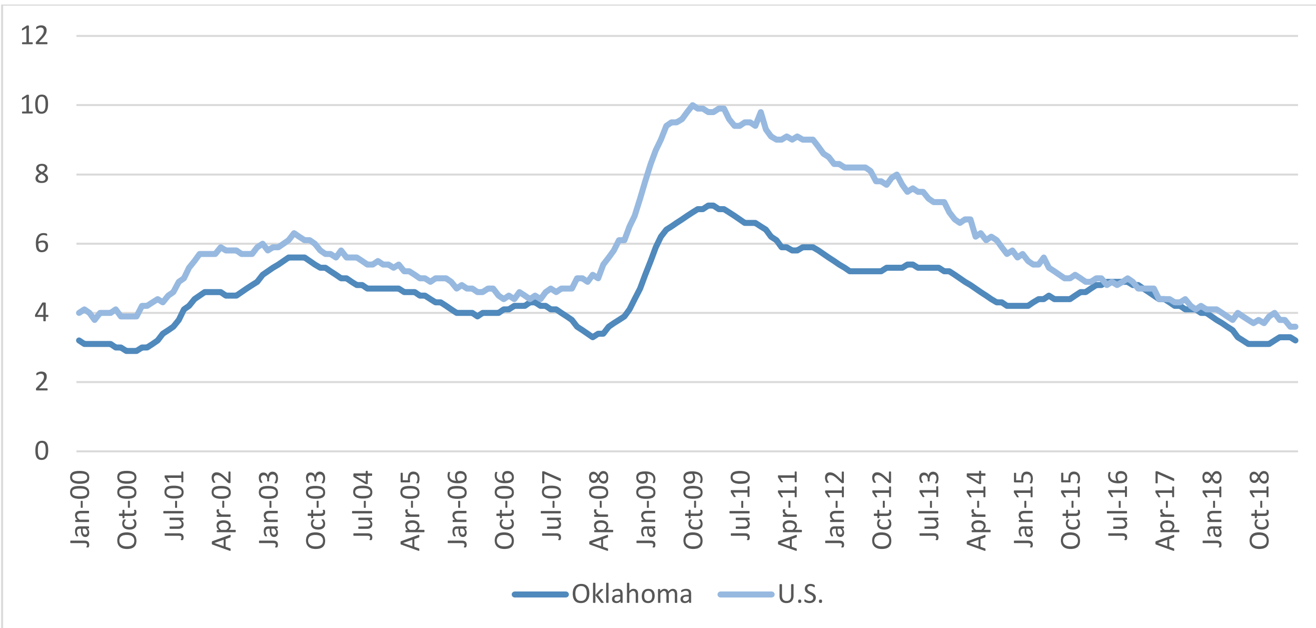
The energy sector plays a significant role in Oklahoma's economy. According to a 2014 Oklahoma State Chamber Research Foundation report, the energy industry was the largest contributor to state revenues, accounting for approximately 22 percent of statewide tax collections. Between 2014 and 2015, 10,000 energy sector jobs were lost in Oklahoma, resulting in a decrease of taxable income of more than $13 billion. (Oklahoman Editorial Board, 2018).

The rebound in energy sector employment after the drop in employment which resulted from the decline in oil prices in 2015 and 2016, helped turn the overall Oklahoma economy around. For the first time since 2013, Oklahoma's nonfarm employment grew as fast as or faster than the national rate at times between 2017 and 2018. According to Oklahoma State University Center for Applied Economic Research, this growth is anticipated to slow through 2020. (Rickman, 2019)

3.3. UNEMPLOYMENT RATE

The current unemployment rate in Oklahoma is 3.2 percent, slightly higher than the lowest recorded rate of 2.9 percent in 2000 (**Figure 3-3**). During the time period from 2000 to 2018, in all but nine months, Oklahoma had lower unemployment rates than that of the US.

Figure 3-3: Unemployment Rates for US and Oklahoma (Seasonally Adjusted)

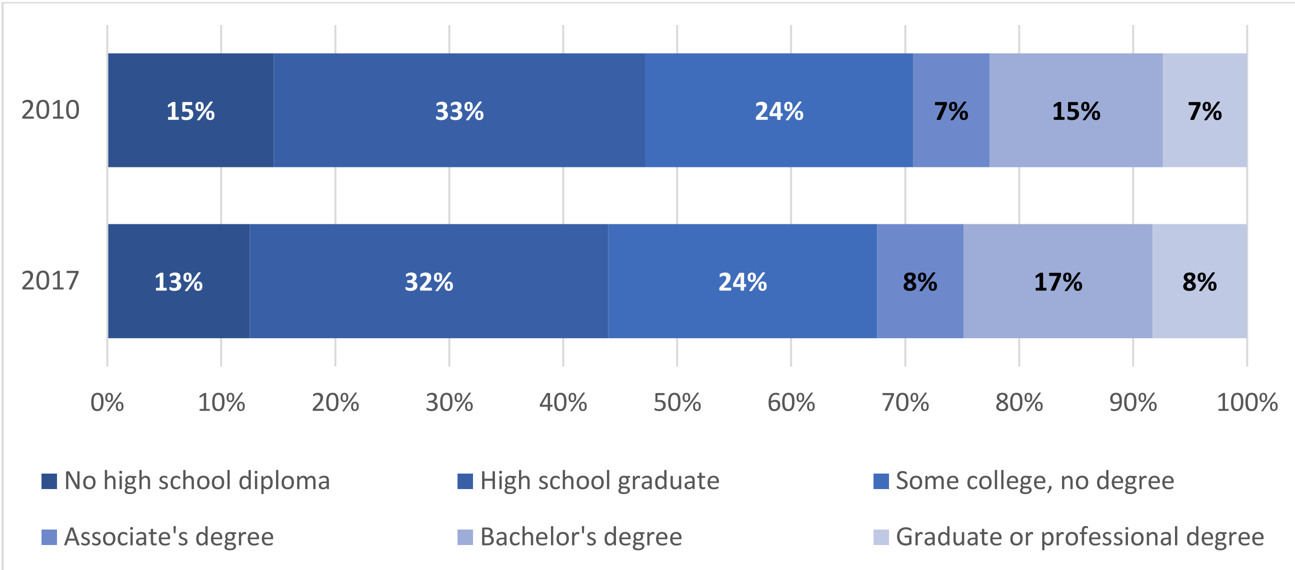


Source: US Dept. of Labor, Bureau of Labor Statistics.

3.4. EDUCATION

Between 2010 and 2017, the percent of Oklahoma residents with a degree higher than a high school diploma increased while the percent with no high school diploma dropped by 2 percent (**Figure 3-4**). In 2017, over 32 percent of those aged 25 years or older had an associate degree or higher; in 2010, that segment of the state's population accounted for just over 29 percent.

Figure 3-4: Percent Oklahoma Population Aged 25+ by Educational Attainment

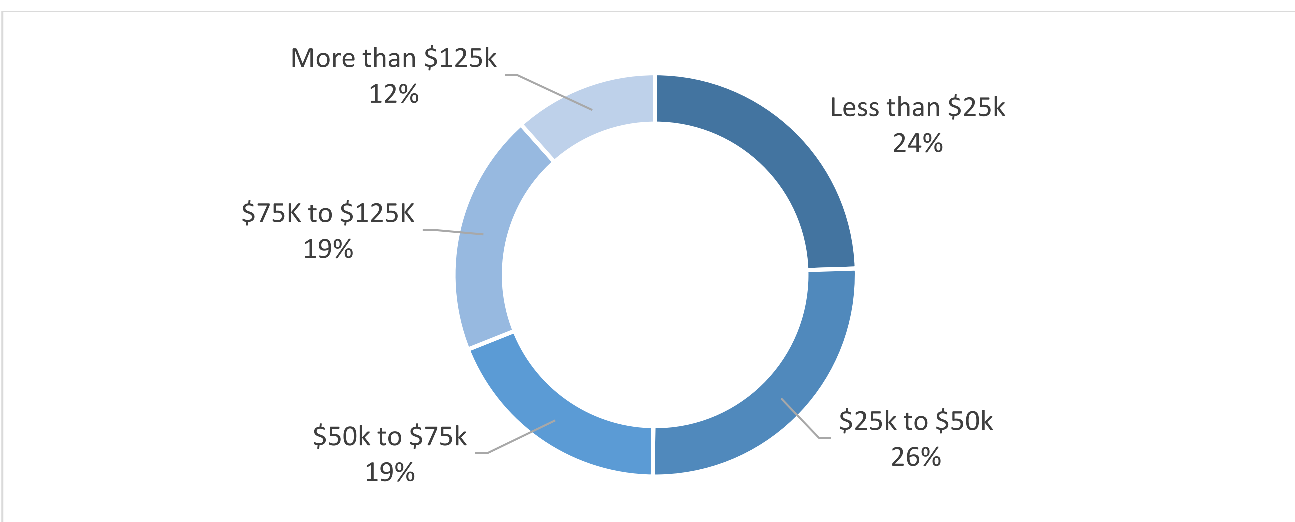


Source: US Census Bureau, 2006-2010 ACS and 2013-2017 ACS 5-Year Estimates

3.5. INCOME AND POVERTY STATUS

According to the US Census Bureau's American Community Survey (ACS) 5-Year Estimates, the median household income in Oklahoma for 2017 was $49,767. The breakdown of Oklahoma households by annual income level is shown in **Figure 3-5**. Just over half of Oklahoma households make less than $50,000 per year.

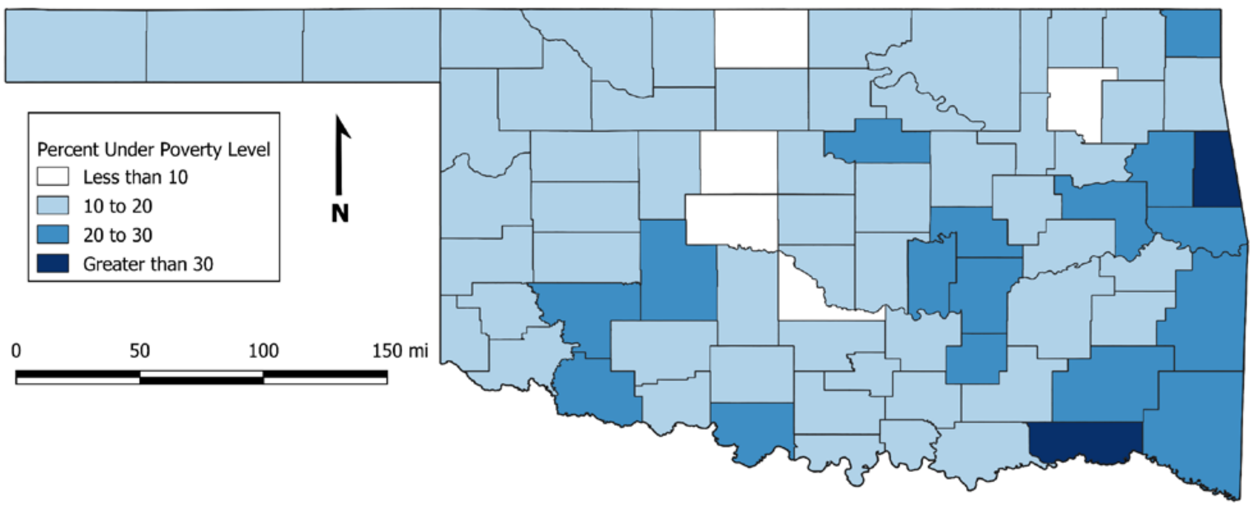
Figure 3-5: Percentage of Oklahoma Households by Annual Income Level, 2017



Source: US Census Bureau, 2013-2017 ACS 5-Year Estimates

Figure 3-6 shows the percent of population below the poverty level [i] by county. The majority of Oklahoma counties are in the 10 to 20 percent range, however there are many counties in the southern and eastern parts of the state where over 20 percent of the population is below the poverty line.

Figure 3-6: Percent of Oklahoma Population below Poverty Level, 2017



Source: US Census Bureau, 2013-2017 ACS 5-Year Estimates

3.6. COMMUTING PATTERNS

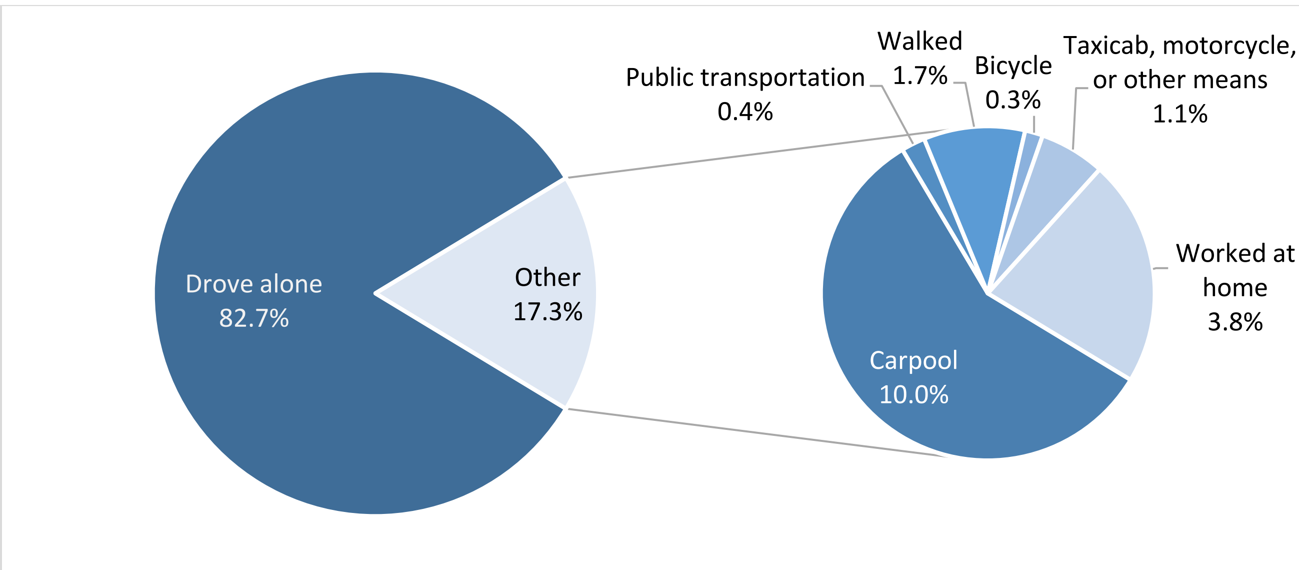
The vast majority of the working population in Oklahoma drive alone for their commutes to work, while carpooling was the second most common (**Figure 3-7**). Combined, those two modes equate to over 92 percent of commutes in Oklahoma. In terms of travel time to work, except for the Oklahoma City and Tulsa metropolitan areas – Divisions 4 and 8 respectively, more than half of workers in all have travel times of less than 20 minutes (**Figure 3-8** and **Figure 3-9**). In terms of commutes between metropolitan areas, the Oklahoma City and Tulsa metropolitan areas (Table 3-1) also have the largest number of commuters.

Table 3-1 Journey to Work metropolitan area commuters

	Fort Smith	Lawton	OKC	Tulsa	Total
Outbound	329	1,112	3,761	1,780	6,982
Inbound	237	1,669	3,902	2,505	8,313
Total	566	2,781	7,663	4,285	15,295

Source: US Census Bureau, 2009-2013 ACS 5-Year Estimates[1]

Figure 3-7: Oklahoma Commute by Mode, 2017



Source: US Census Bureau, 2013-2017 ACS 5-Year Estimates

[1] Note: Commutes between the Oklahoma metropolitan areas were examined as well as commutes to and from Wichita, KS, Dallas-Ft. Worth, TX and Wichita Falls, TX

Figure 3-8: ODOT Divisions

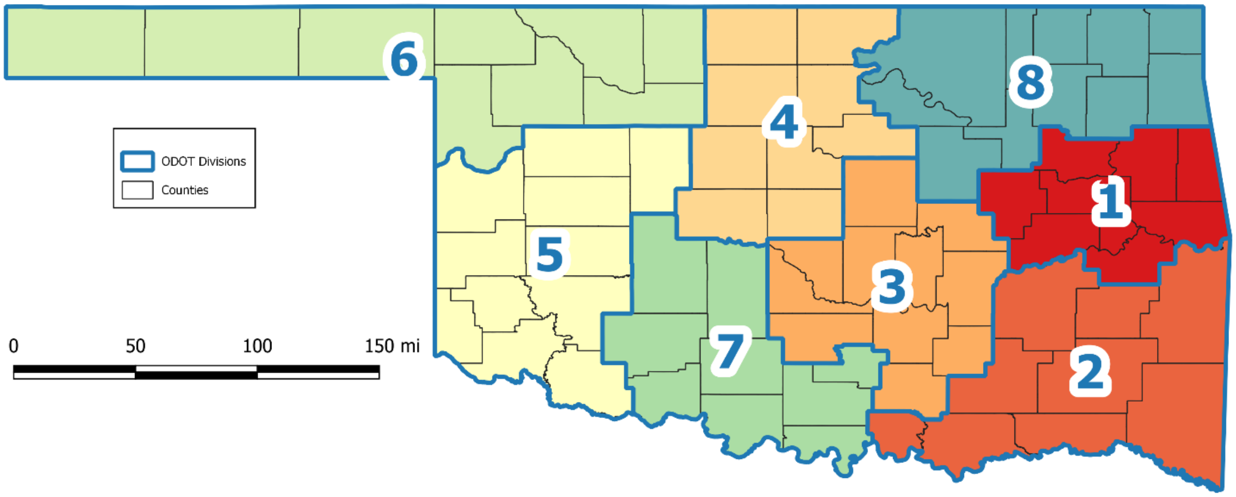
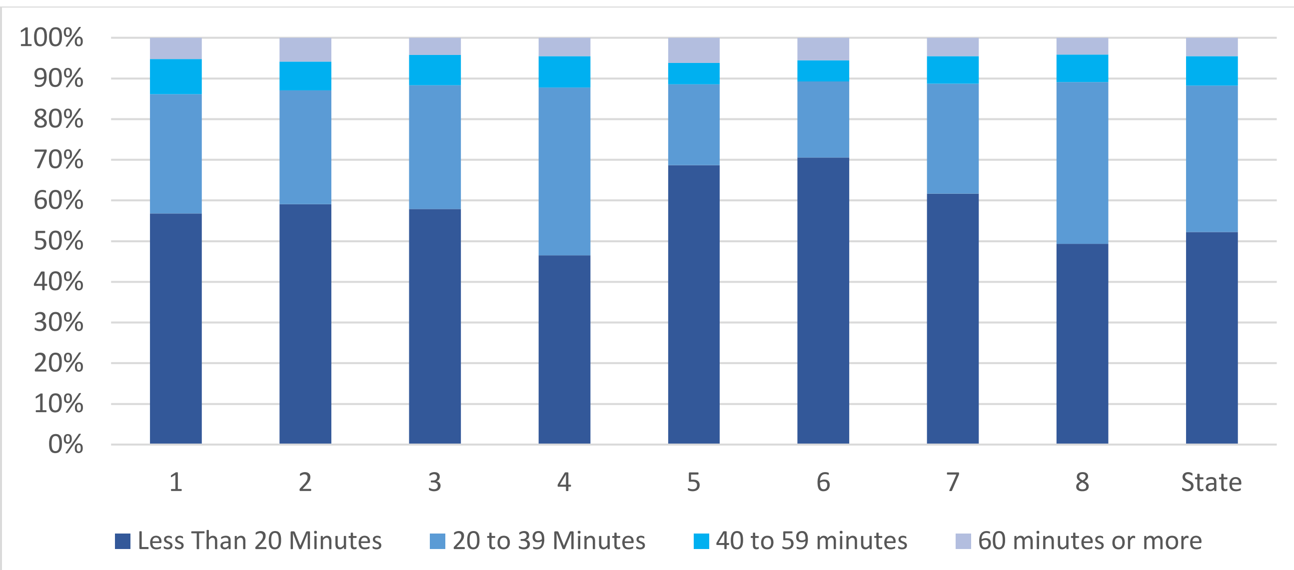


Figure 3-9: Travel Times to Work by Oklahoma DOT Division, 2017

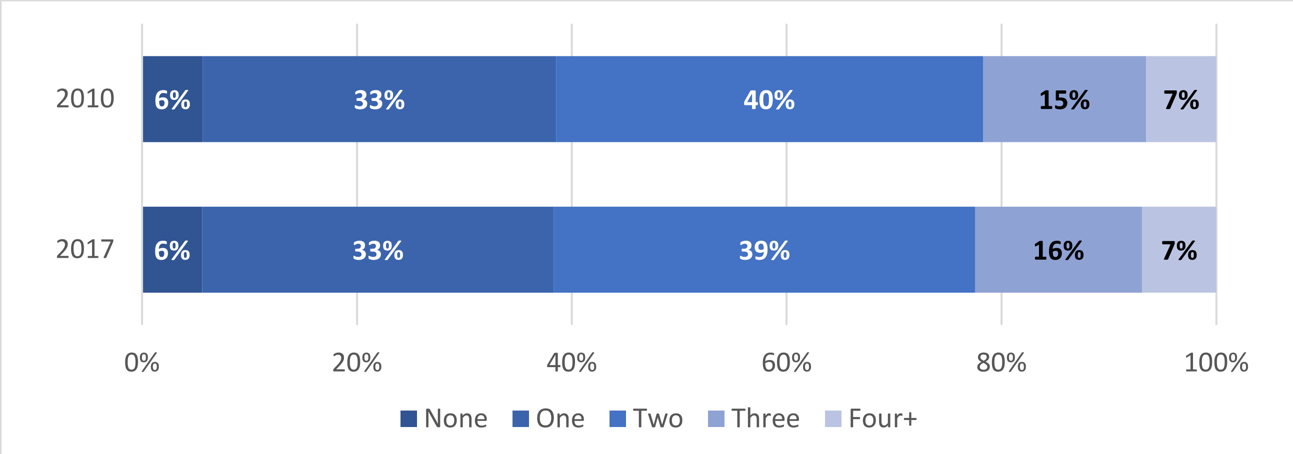


Source: US Census Bureau, 2013-2017 ACS 5-Year Estimates

3.7. VEHICLE AVAILABILITY

Between 2010 to 2017, Oklahoma households have not seen major changes in the number of vehicles available, though a slightly higher percentage now have three vehicles available to them as opposed to two (**Figure 3-10**). In 2018, Oklahoma registered 3,127,423 vehicles (Oklahoma Tax Commission Motor Vehicle Division, 2018) or approximately 2.13 vehicles per household.[ii]

Figure 3-10: Percentage of Oklahoma Households by Vehicles Available



Source: US Census Bureau, 2006-2010 ACS and 2013-2017 ACS 5-Year Estimates

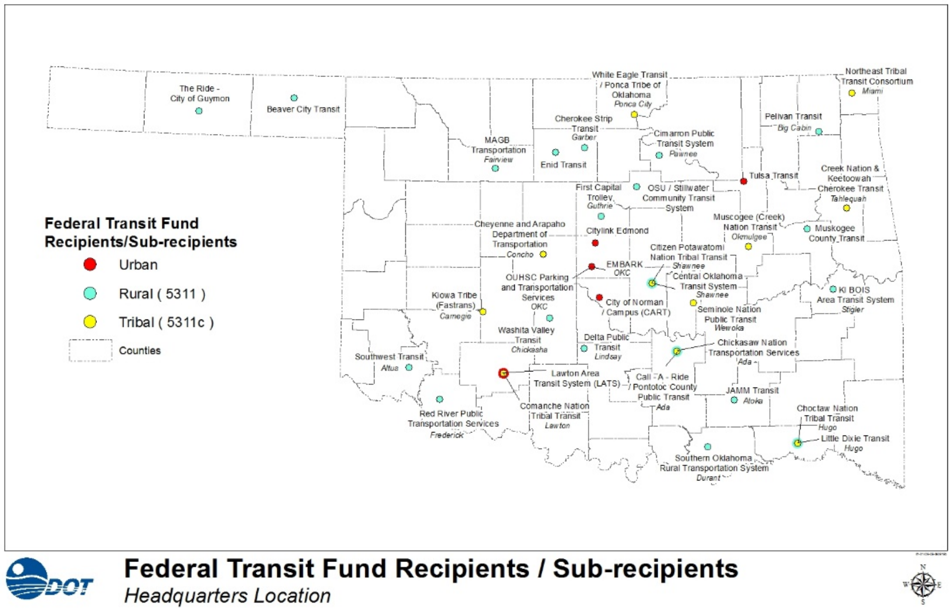
3.8. TRANSIT RIDERHSIP

Transit service in Oklahoma varies based on location within the state, underscoring the differences between urban and rural areas. Urban areas – including Oklahoma City, Tulsa, Norman, Lawton, and Edmond – primarily offer fixed route transit service. Fixed route transit service operates along a designated route on a fixed schedule with passengers boarding and alighting at designated stops. In rural areas of Oklahoma, transit service is provided by regionally located transit agencies primarily providing demand response service. Demand response service provides door-to-door or curb-to-curb transportation for individual passengers. Transit agencies in both urban and rural areas also offer paratransit services which provide transit options to people with disabilities.

Urban, Rural, Tribal Transit

Transit providers rely heavily on federal funding to pay for their operations. Oklahoma City, Tulsa, Norman, Lawton, and Edmond administer their own urban transit services along with the §5307 funding provided to them through the Federal Transit Administration (FTA).[iii] ODOT administers the §5311 funding from the FTA in areas with populations of less than 50,000.[iv] The FTA also provides funding to federally recognized Indian tribes to offer public transportation services on and around Indian reservations or tribal land in rural areas through its §5311c tribal transit program.[v] Oklahoma has 38 recognized tribes that are eligible recipients of federal tribal transit funds. Similar to rural transit, the tribal transit program is instrumental in providing access to work, medical appointments, and shopping. The locations of federal transit fund recipients in Oklahoma are shown in the map in **Figure 3-11**. A detailed listing of the transit service provider headquarters in Oklahoma is shown in **Appendix A**.

Figure 3-11: Federal Transit Fund Recipients / Sub-recipients

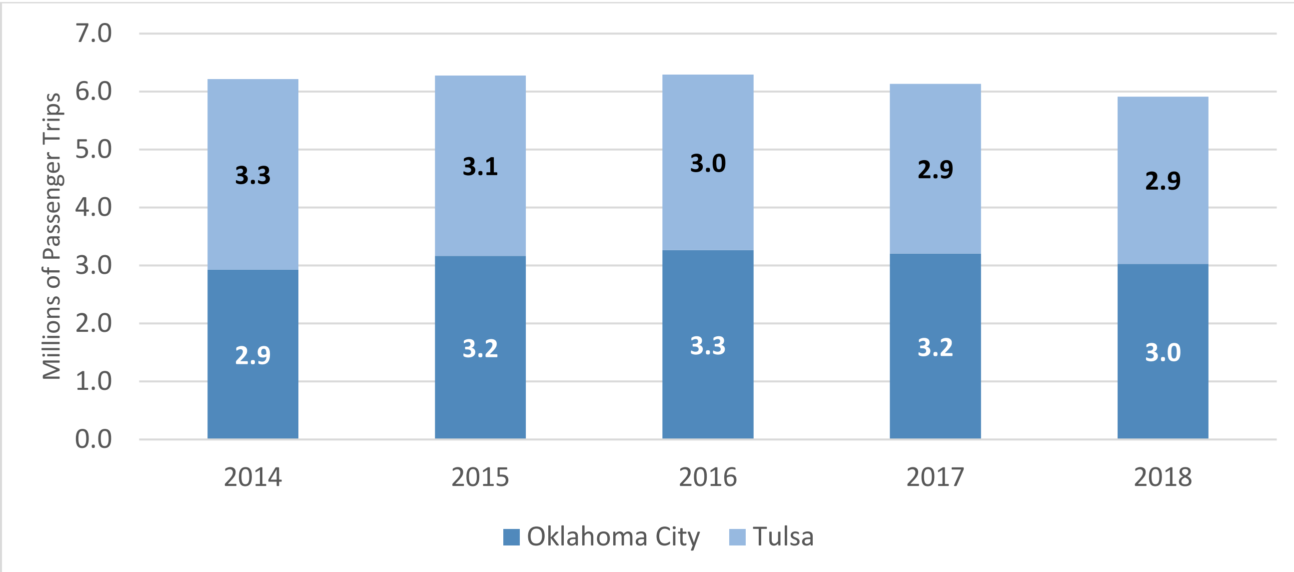


Source: ODOT

Figure 3-12, **Figure 3-13**, **Figure 3-14**, and **Figure 3-15** show transit ridership trends in Oklahoma. While demand for transit impacts ridership, it should be noted that there are many other factors that ultimately influence ridership as well. These include (Mallett, 2018):

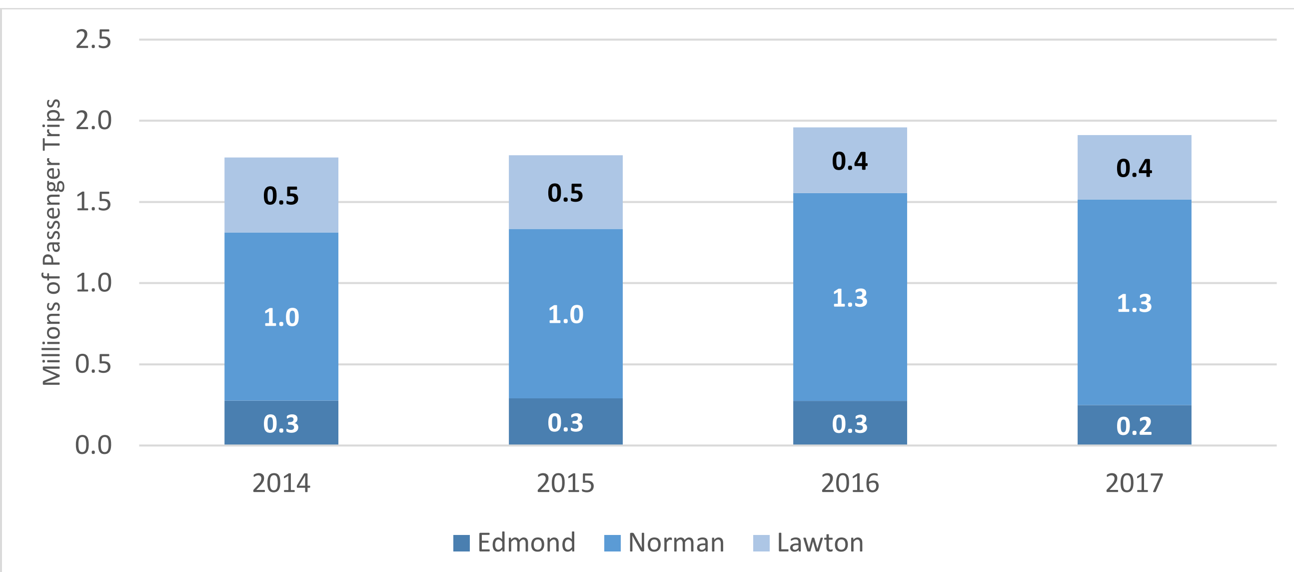
- Transportation options (e.g. private vehicles, ride-sharing such as Uber and Lyft);
- Transit service supply (e.g. hours of service, service frequency, geographic coverage);
- Socioeconomic factors (e.g. income, population density); and
- Funding availability.

Figure 3-12: Passenger Trips – Urban Full Reporter[vi]



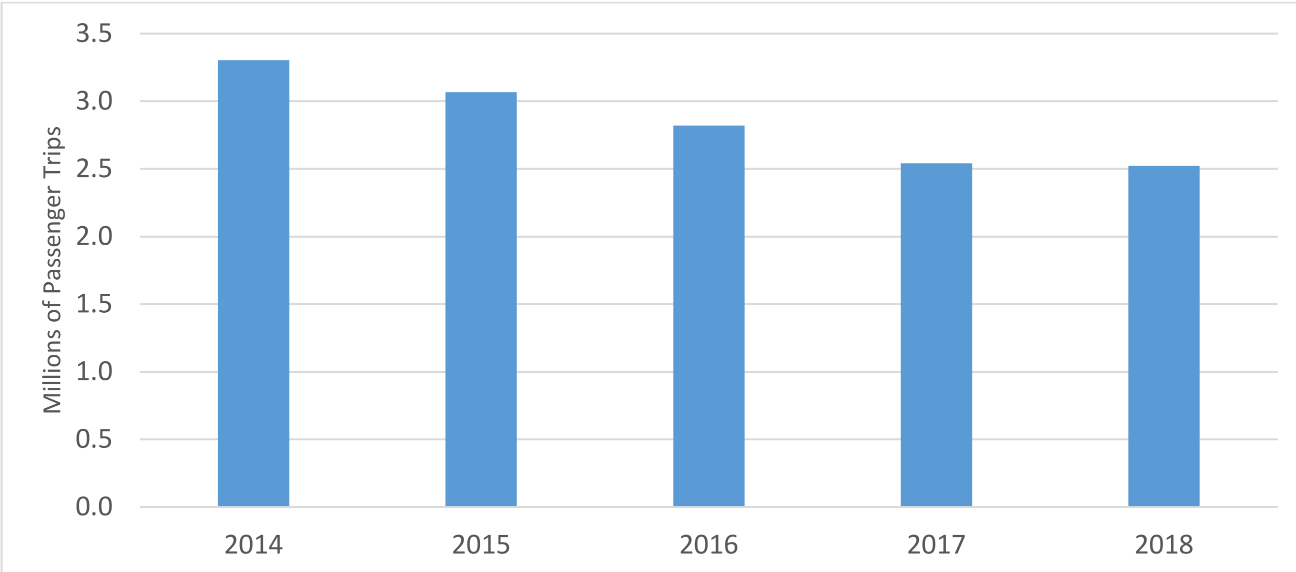
Source: National Transit Database

Figure 3-13: Passenger Trips – Urban Reduced Reporter[vii]



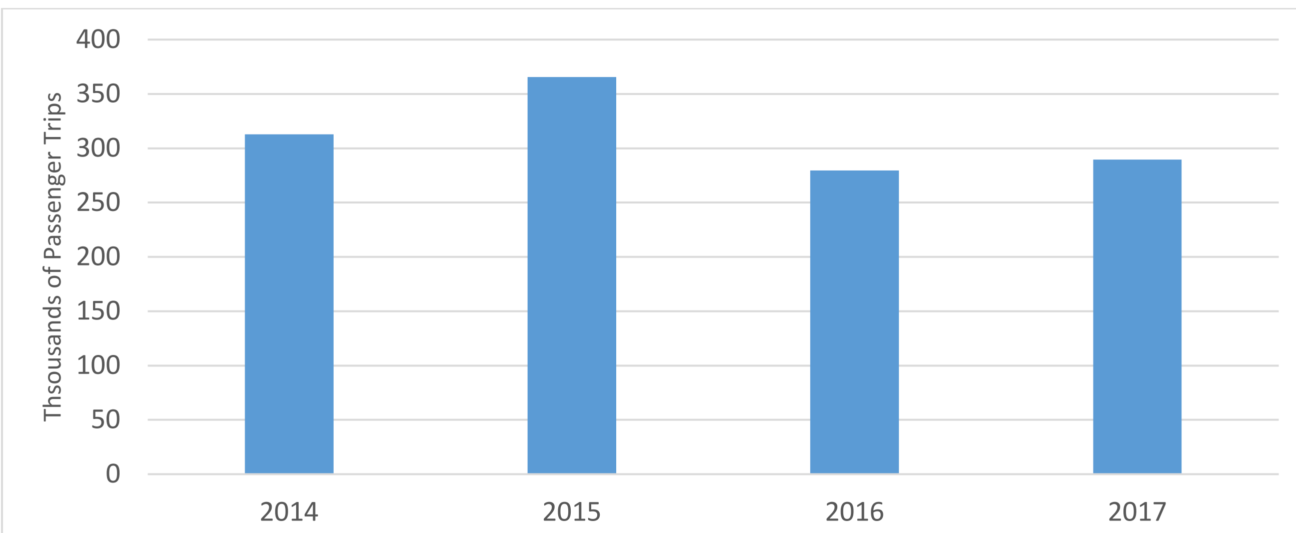
Source: National Transit Database

Figure 3-14: Passenger Trips – Rural Reporters[viii, ix]



Source: National Transit Database, ODOT, and Transit Providers

Figure 3-15: Passenger Trips – Reduced Reporter (Tribe)[x, xi]



Source: National Transit Database, ODOT, and Transit Providers

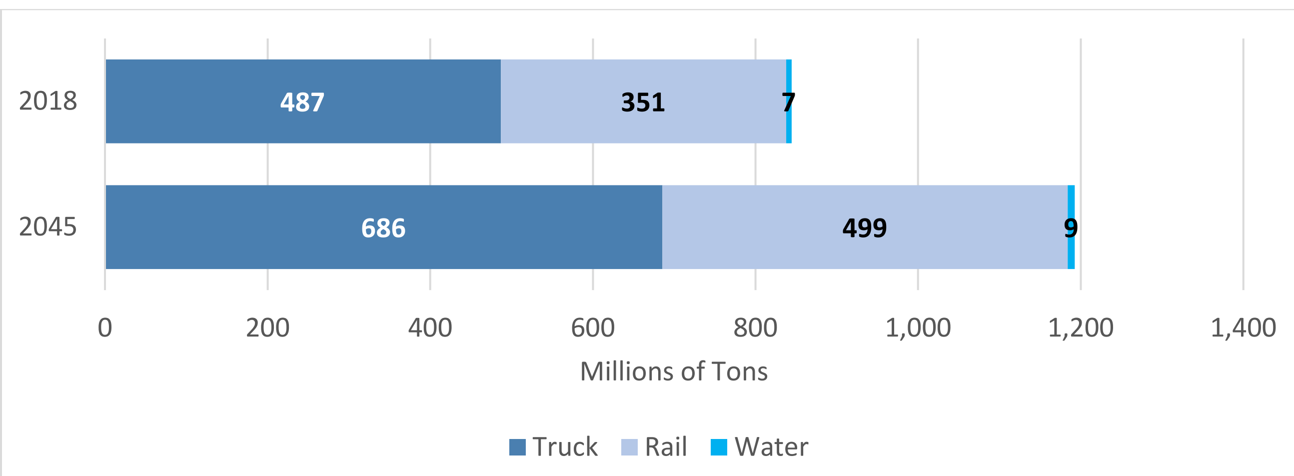
The Tribal Transit data in **Figure 3-15** does not include trips for tribes that contract their transit services to other rural transit providers. For example, from 2014 to 2018, the Cherokee Nation and the Northeast Oklahoma Tribal Transit Consortium (NTTC) reported 479,350 and 81,526 trips, respectively, with those trips being accounted for in the rural transit data in **Figure 3-14**.Also included in **Figure 3-14** are passenger trips provided specifically for elderly and disabled persons; however due to inconsistency in how those trips have been reported in the past, year-over-year historical data is not broken out in this report. In 2018, rural transit operators provided over 810,000 trips for elderly and/or disabled persons, accounting for over 32 percent of passenger trips provided by rural transit services.

In 2019, ODOT announced the formation of the Office of Mobility and Public Transit to develop a statewide public transit policy that will involve all public transit agencies. The new office will also take over the administration of the Section 5310 federal program that helps fund transit services for disabled and elderly persons throughout the state (Tabak, 2019).

3.9. FREIGHT

Freight tonnage in Oklahoma is projected to grow for each mode, with over 40 percent growth in both truck and rail, and just over 30 percent for water from years 2018 to 2045 (**Figure 3-16**).

Figure 3-16: Projected Oklahoma Freight Tonnage by Mode



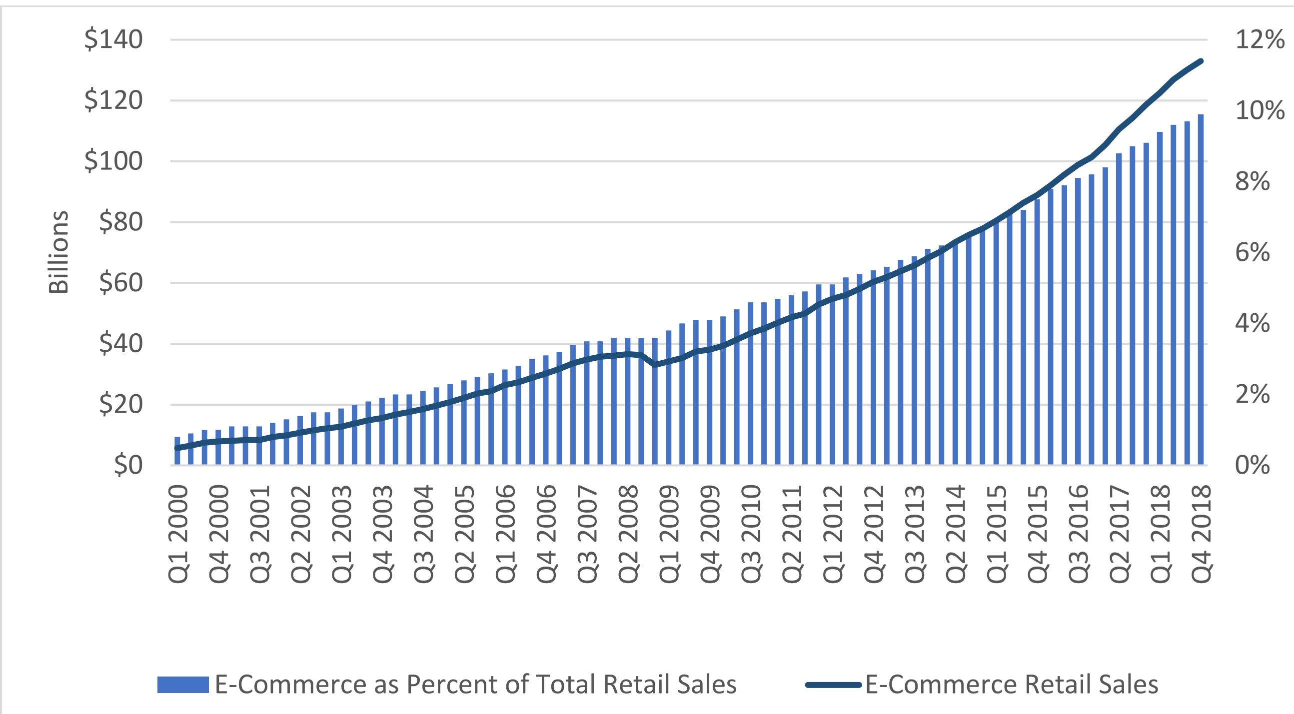
Source: Oklahoma Freight Transportation Plan 2018-2022 (2017)

Coupled with this projected growth in freight is a growing shortage of truck drivers. An American Trucking Associations report states that the industry has been dealing with a driver shortage for the past 15 years and estimates that it needs to hire almost 900,000 more drivers nationally to meet expected demand (Raphelson, 2018).

3.10. E-COMMERCE

E-Commerce retail sales in the US have been steadily increasing both numerically and as a percentage of total retail sales (**Figure 3-17**). Oklahoma's 2018-2022 Freight Plan reports that this trend has resulted in an increase in the average number of distribution centers per supply chain, and a corresponding decrease in the square footage of those centers, as companies desire placement of goods in staging points closer to the points of consumption. This shift will likely cause an increase in the number of distribution centers in Oklahoma, particularly near its cities. (Oklahoma DOT, 2017).

Figure 3-17: Growth in US E-Commerce



Source: US Census Bureau E-Commerce Report

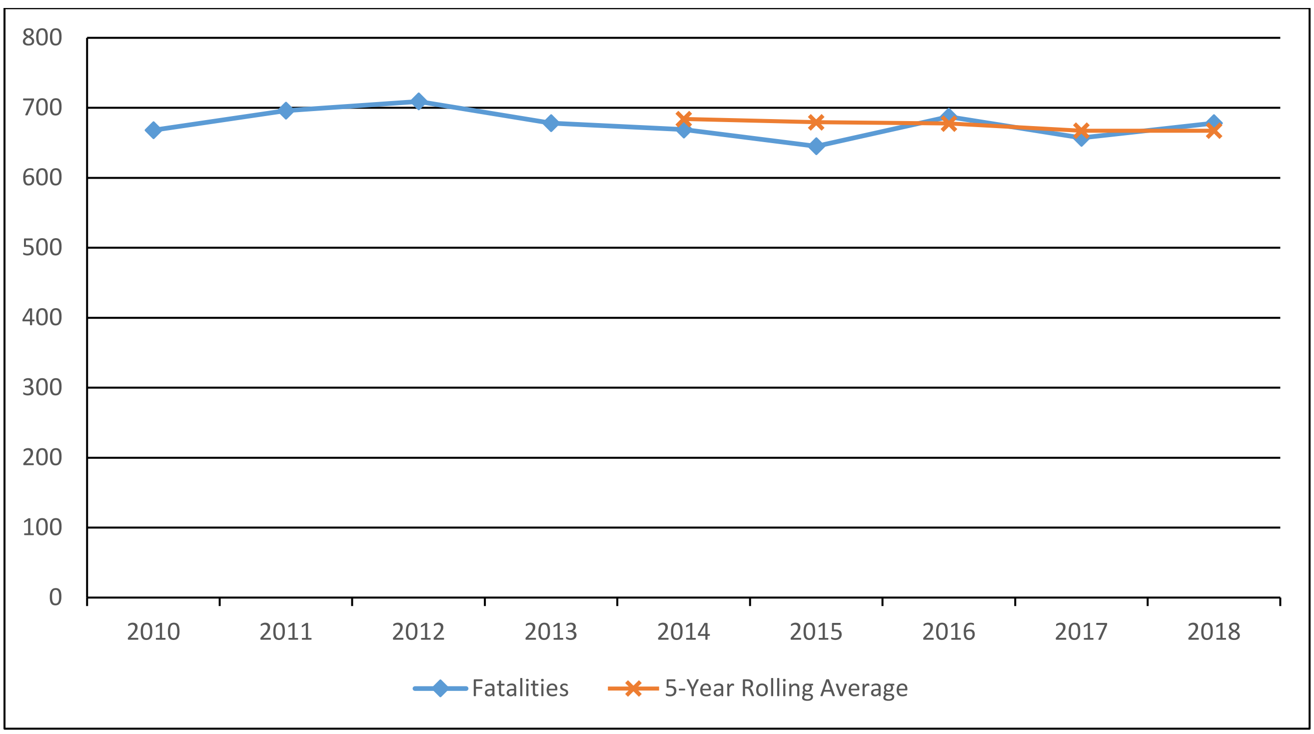
4. SAFETY AND SECURITY

Safety is a primary concern in long-range transportation planning with historical trends informing both progress from, and potential for, transportation strategies. ODOT analysis of safety performance measures to be included in the 2019 Oklahoma Highway Safety Improvement Program (HSIP) serves as a primary reference for this section.[xii] Also covered in this section is the security of the transportation system, particularly as it relates to the introduction of new technology and the resulting risks.

4.1. FATALITIES

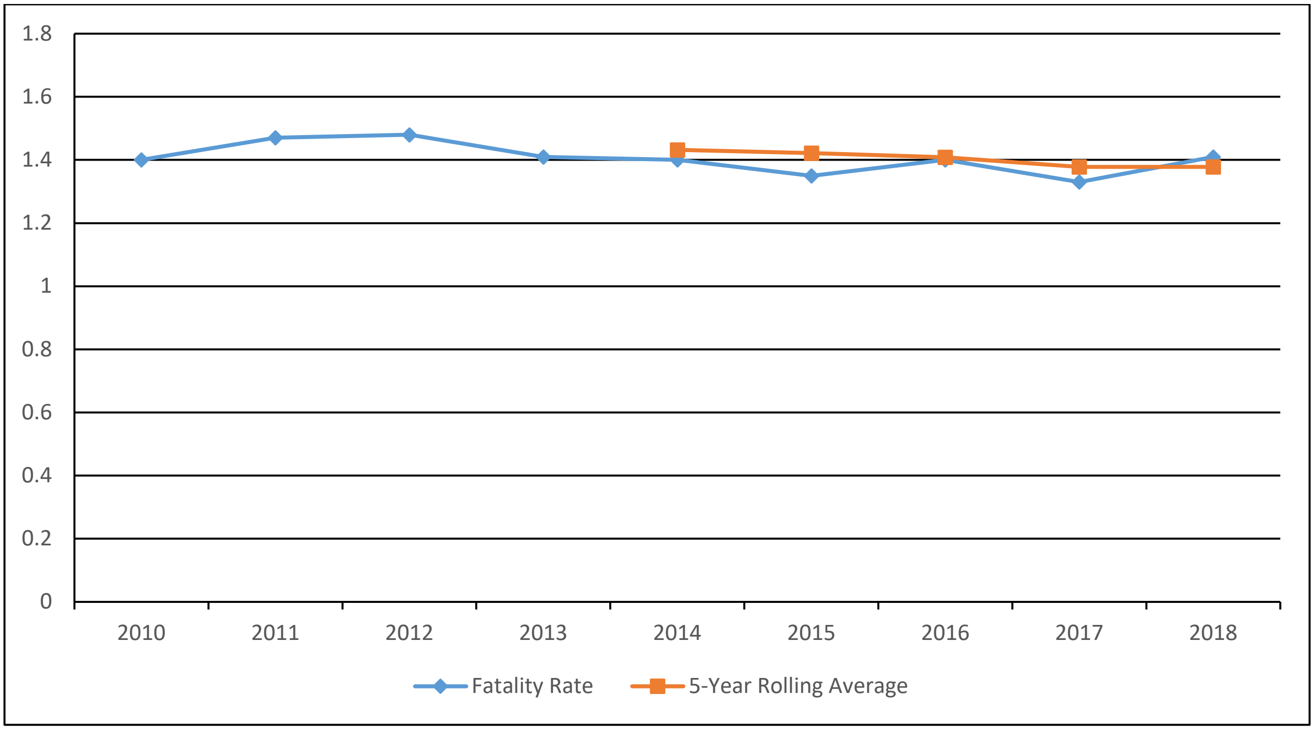
The five-year rolling averages for both total fatalities and fatalities per 100 million vehicle miles traveled (HMVMT) on Oklahoma public roads have been generally trending down since 2014 with both measures coming down from peaks in 2012 (**Figure 4-1** and **Figure 4-2**). However, when stratified by the eight emphasis areas in Oklahoma's Strategic Highway Safety Plan (SHSP), the five-year averages for fatalities in the areas of Pedestrians and Older Drivers have actually increased during the same time period (**Figure 4-3**).

Figure 4-1: Fatalities on Oklahoma Public Roads



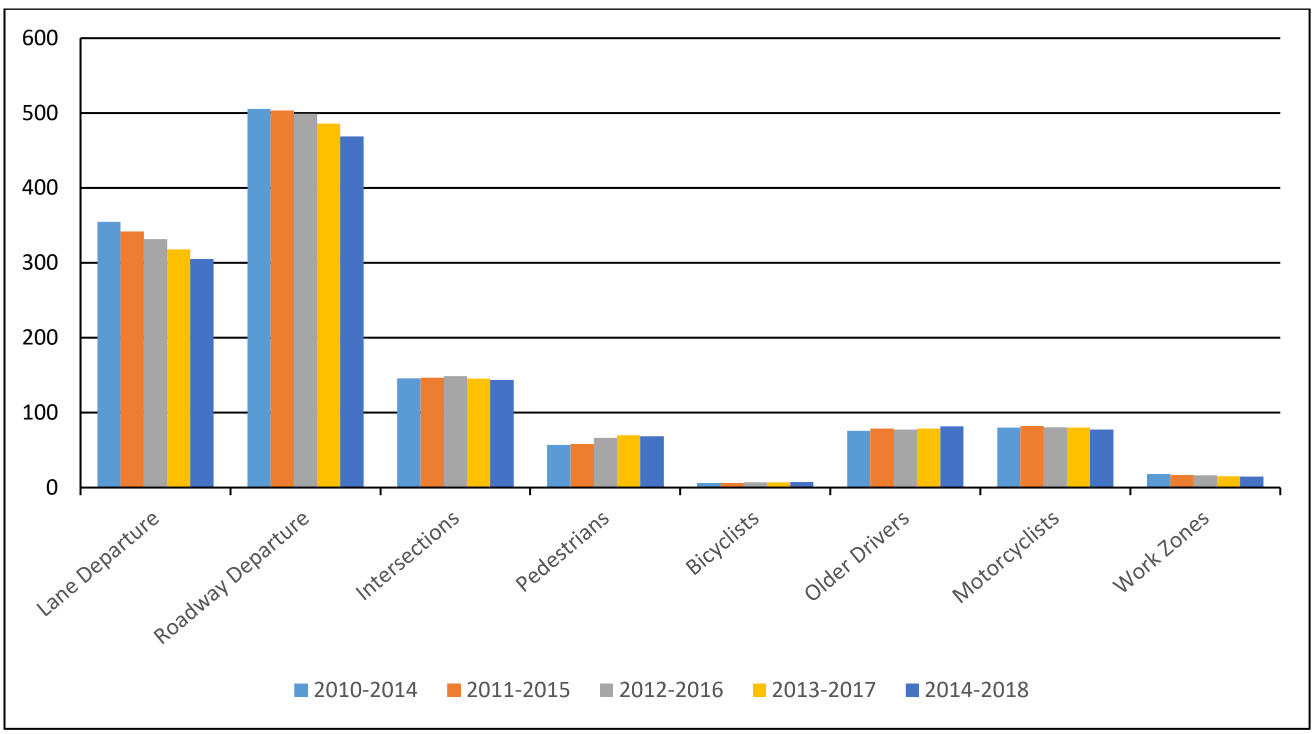
Source: ODOT Analysis, August 2019

Figure 4-2: Fatalities per HMVMT on Oklahoma Public Roads



Source: ODOT Analysis, August 2019

Figure 4-3: 5-Year Average for Fatalities by SHSP Emphasis Area

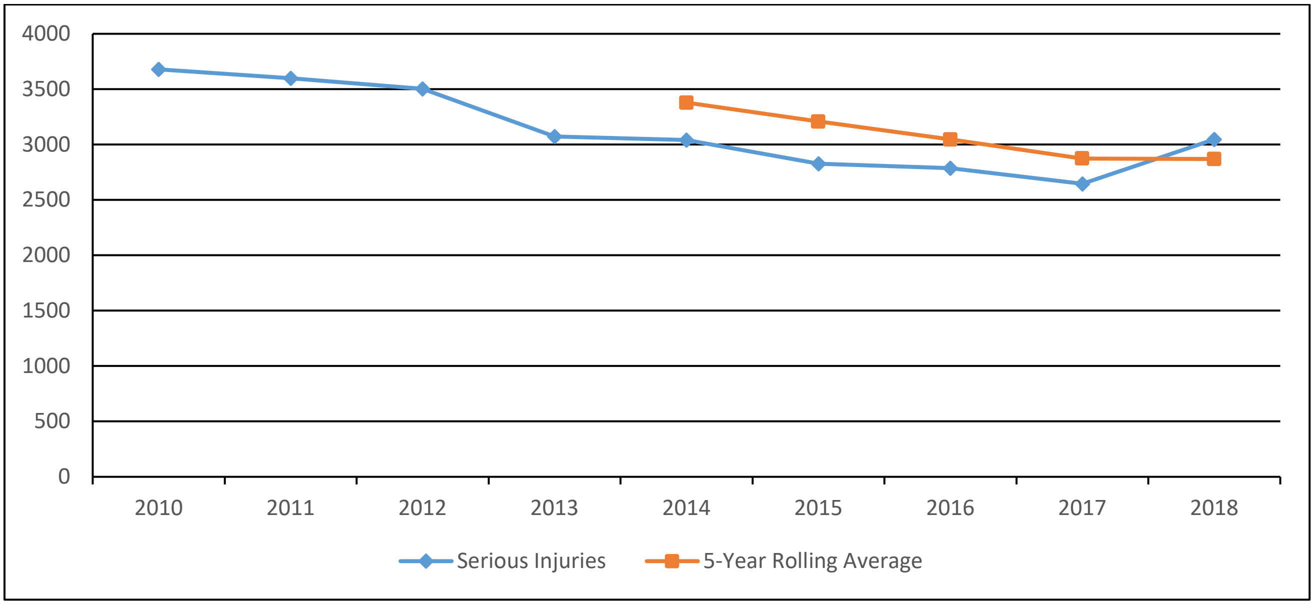


Source: ODOT Analysis, August 2019

4.2. SERIOUS INJURIES

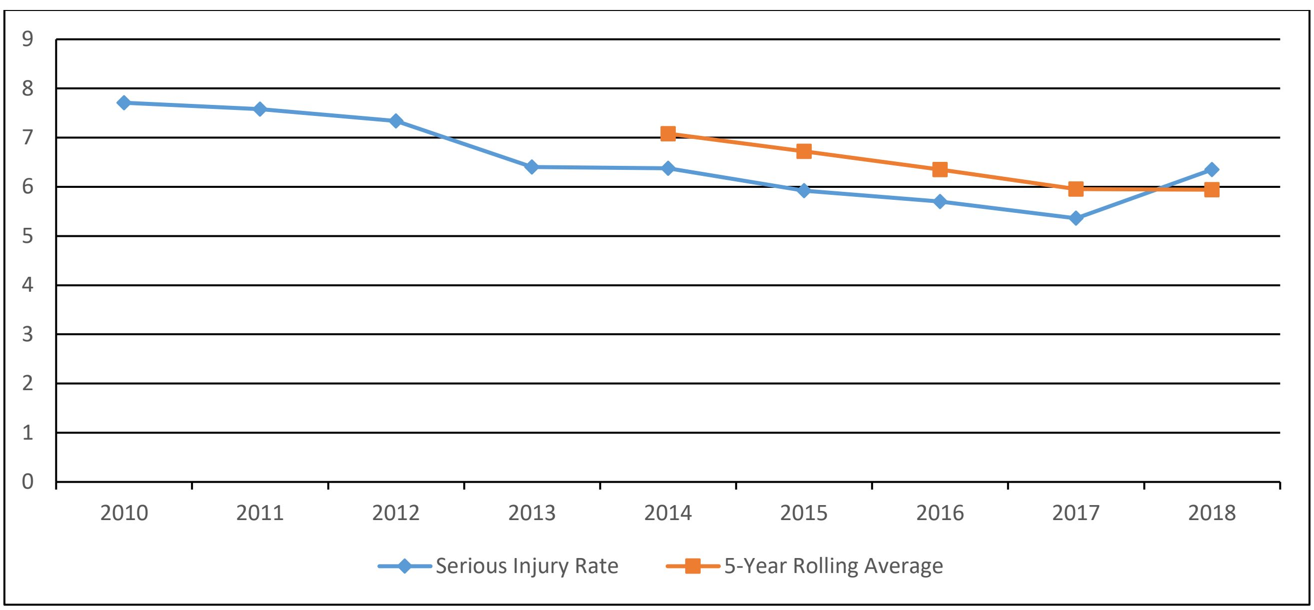
Similar to fatalities, the five-year rolling averages for serious injuries, both total and per HMVMT, have decreased since 2014, despite increases in both measures in 2018 (**Figure 4-4** and **Figure 4-5**). The 2018 five-year averages for serious injuries have decreased in all SHSP emphasis areas compared to 2014 (**Figure 4-6**).

Figure 4-4: Serious Injuries on Oklahoma Public Roads



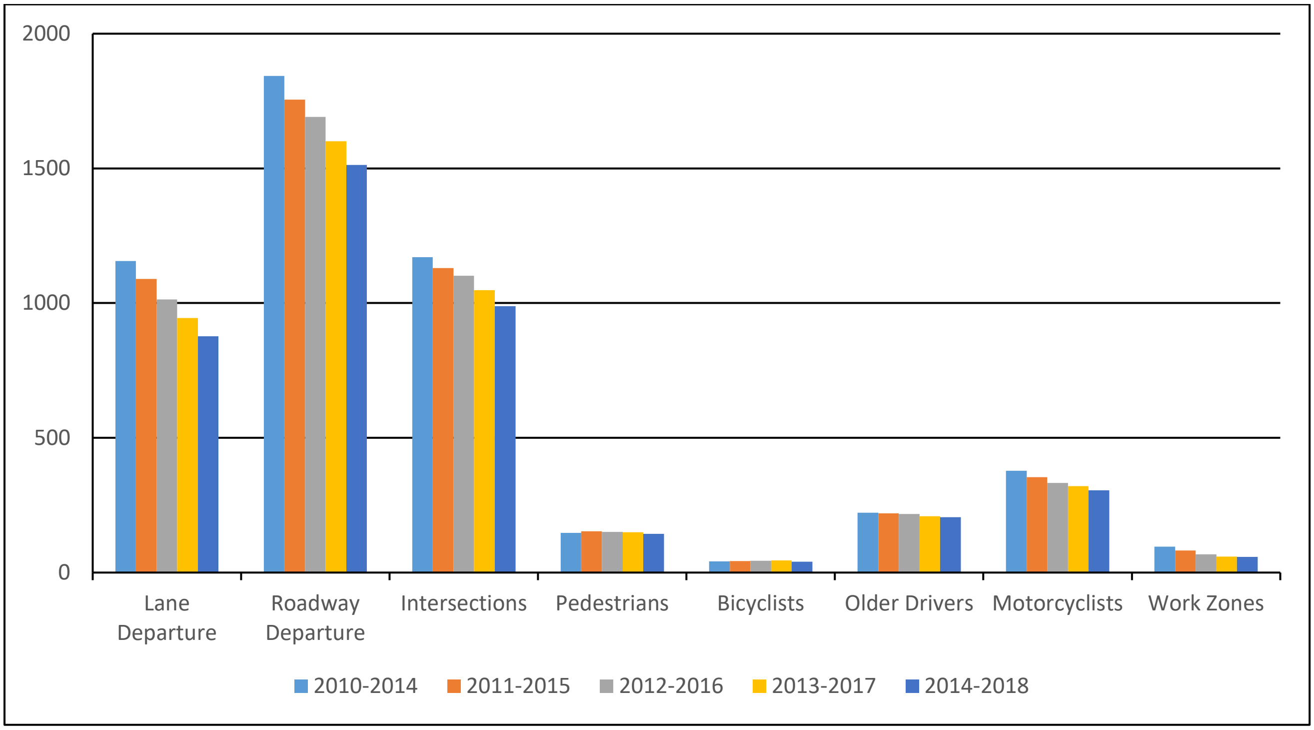
Source: ODOT Analysis, August 2019

Figure 4-5: Serious Injuries per HMVMT on Oklahoma Public Roads



Source: ODOT Analysis, August 2019

Figure 4-6: 5-Year Average for Serious Injuries by SHSP Emphasis Area

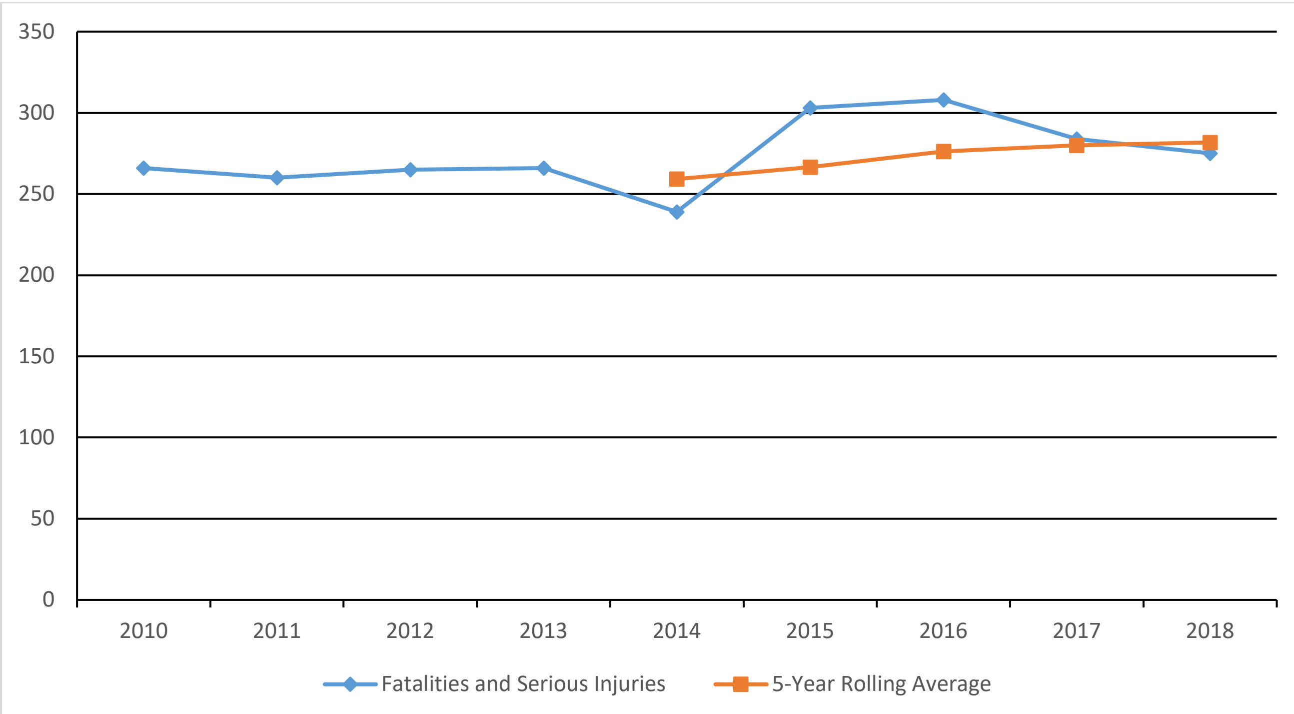


Source: ODOT Analysis, August 2019

4.3. PEDESTRIAN AND BICYCLE SAFETY

In reporting safety data, incidents involving both pedestrian and cyclists are covered under non-motorized fatalities and non-motorized serious injuries as defined by the Fatality Analysis Reporting System (FARS)[xiii] and the American National Standard Institute (ANSI) D16.1-2007,[xiv] respectively. **Figure 4-7** shows that the five-year average in total incidents for non-motorized fatalities and non-motorized serious injuries has increased slightly from 2014, though total incidents is down from a peak in 2016.

Figure 4-7: Total Non-Motorized Fatalities and Non-Motorized Serious Injuries

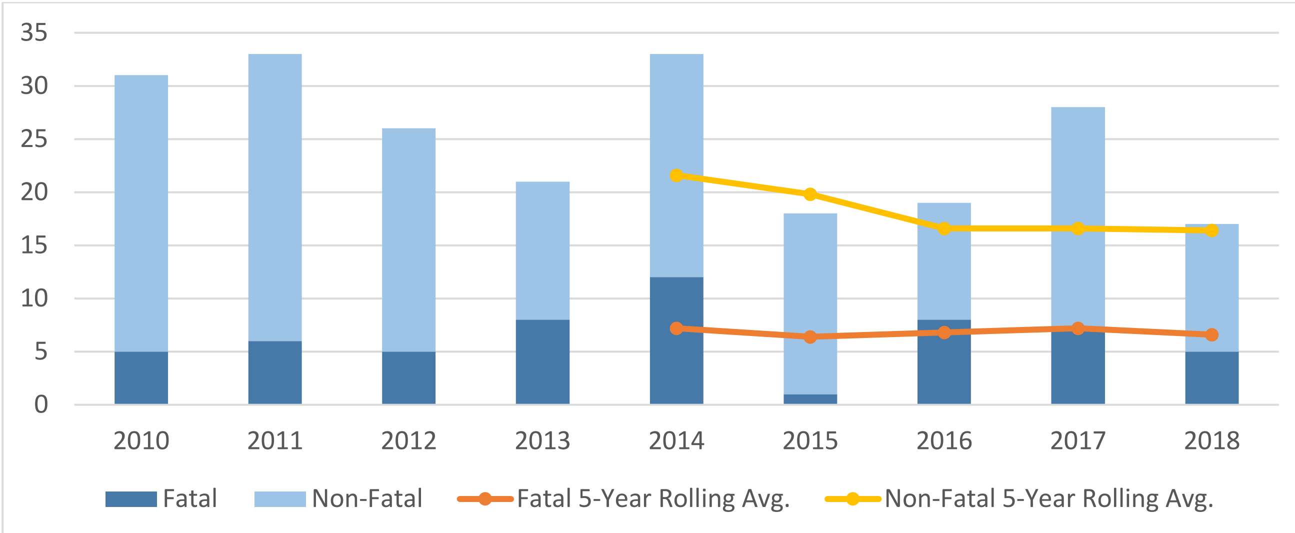


Source: ODOT Analysis, August 2019

4.4. AT HIGHWAY-RAIL GRADE CROSSING INCIDENTS

At–grade rail crossings are another central focus in terms of highway safety. **Figure 4-8** shows that while total highway-rail casualties (fatal and non-fatal) for 2018 are at their lowest point since 2010, the five-year rolling average for fatalities has been nearly flat since 2014, and the five-year rolling average for non-fatal casualties has remained nearly unchanged for the past three years.

Figure 4-8: Highway-Rail Casualties in Oklahoma

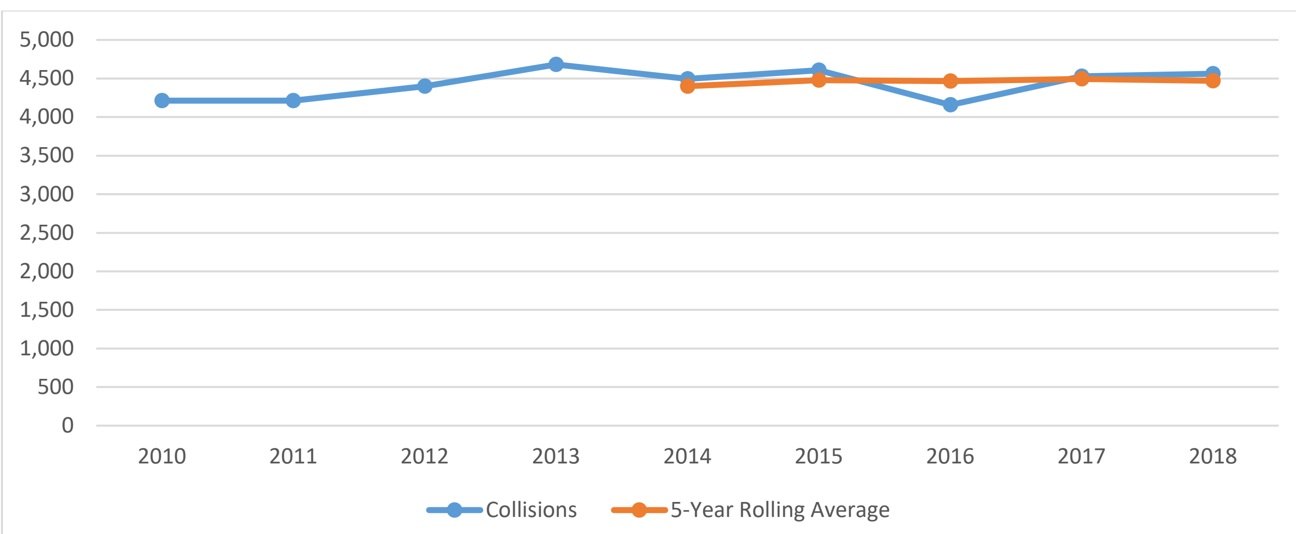


Source: Federal Railroad Administration, Office of Safety Analysis

4.5. LARGE TRUCK COLLISIONS

A further safety measure to highlight are collisions involving large trucks.[xv] Increases in collisions in 2017 and 2018 have resulted in a slight increase in the five-year rolling average since 2014, though the number of collisions involving large trucks is down from a 2013 peak.

Figure 4-9 Total Collisions involving Large Trucks



Source: ODOT Analysis, August 2019

4.6. CYBERSECURITY

When introducing technology into much of the transportation infrastructure, both with the emerging trends listed later in this report, as well as in the advancement in intelligent transportation systems (ITS), cybersecurity increasingly becomes an issue. A 2017 report by Cisco based on responses from transportation security professionals found that (Rocque, 2017):

- Almost half have dealt with public scrutiny due to data breaches.
- 29 percent found that lack of trained personnel is a significant hindrance in adopting advanced technologies and processes.
- Almost half outsource some or all security tasks due to a lack of internal expertise.
- Almost 60 percent listed cloud infrastructure and mobile devices as the most challenging to defend against cyberattacks.

ODOT works with the Oklahoma Department of Emergency Management to respond to emergencies and natural disasters in the state. ODOT's Intelligent Transportation System plays a critical role in supporting safety and security during disasters.

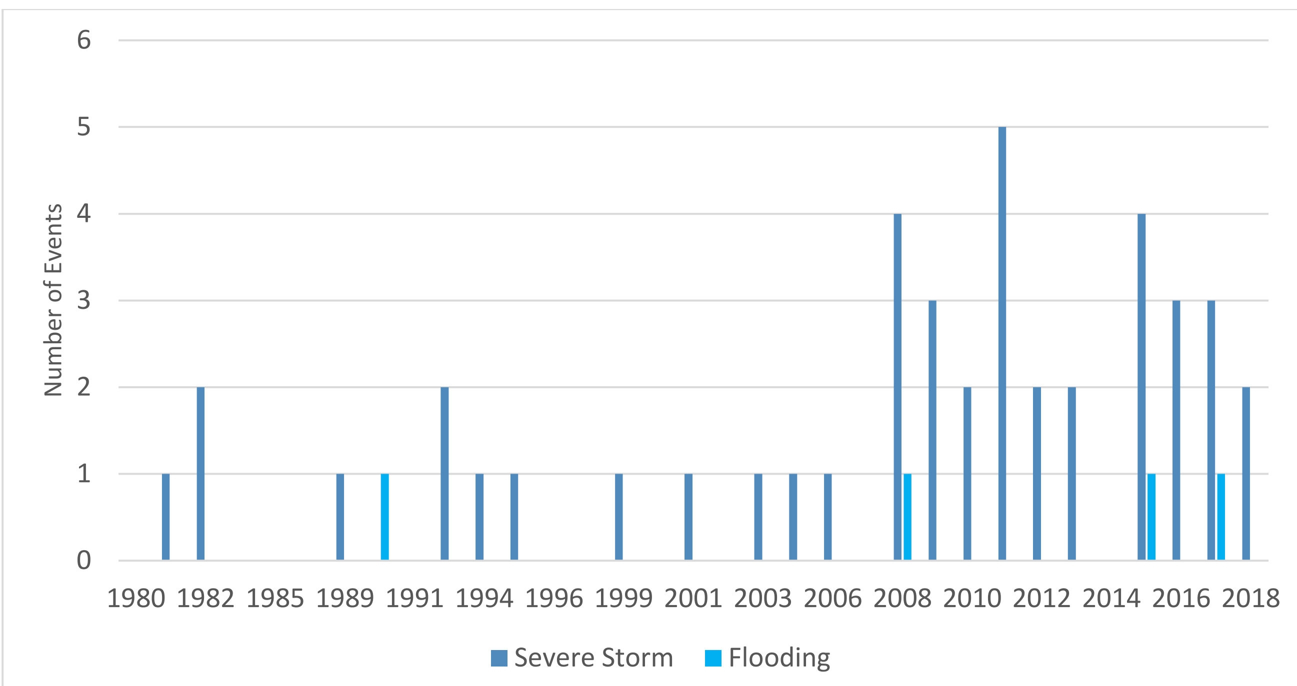
5. RISK AND RESILIENCY

Frequency and intensity of severe weather-related events and other hazards can greatly impact Oklahoma's transportation system. Understanding the risks associated with these hazards is key in planning for resilient systems.

5.1. SEVERE WEATHER EVENTS

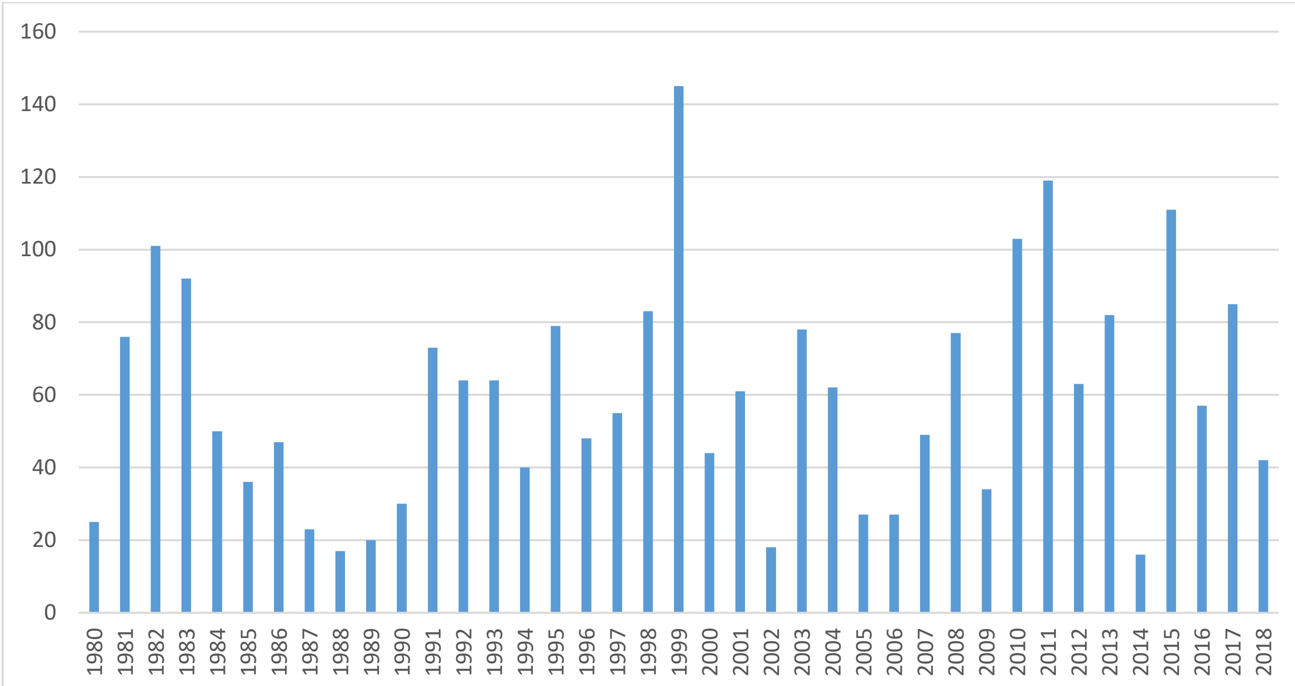
Since 1980, the US has experienced increasing billion-dollar disasters, mostly related to severe weather-related events. Of those events, Oklahoma has been impacted by 75 of the 250 total. **Figure 5-1** focuses specifically on the events from severe storms and flooding showing a trend of increasing frequency. The available data covers 1980 through April 2019; therefore, the chart does not include the recent severe weather event that resulted in parts of Oklahoma seeing historic flooding caused by heavy rains that began in May 2019. Those floods have resulted in damages to roadway infrastructure that is estimated to take months to assess (Stanish, 2019). In addition to storms and floods, Oklahoma is susceptible to tornadoes as shown in **Figure 5-2**.

Figure 5-1: Billion-Dollar Disaster Events in Oklahoma from Flooding and Severe Storms, 1980 to April 9, 2019 (Inflation Adjusted)



Source: National Oceanic and Atmospheric Administration (NOAA)

Figure 5-2: Tornadoes in Oklahoma, 1980 to 2018



Source: National Oceanic and Atmospheric Administration (NOAA)

5.2. SEISMIC ACTIVITY

In addition to the weather-related events, Oklahoma also faces the risks of earthquakes. **Figure 5-3** shows areas in the state with potential seismic activity along with chances for damage caused by shaking. In 2017, ODOT began using the US Geological Survey's (USGS) ShakeCast program to assist in its efforts to prioritize bridge inspections immediately following an earthquake.

Figure 5-3: Oklahoma Area Seismicity and Chance of Damaging Shaking

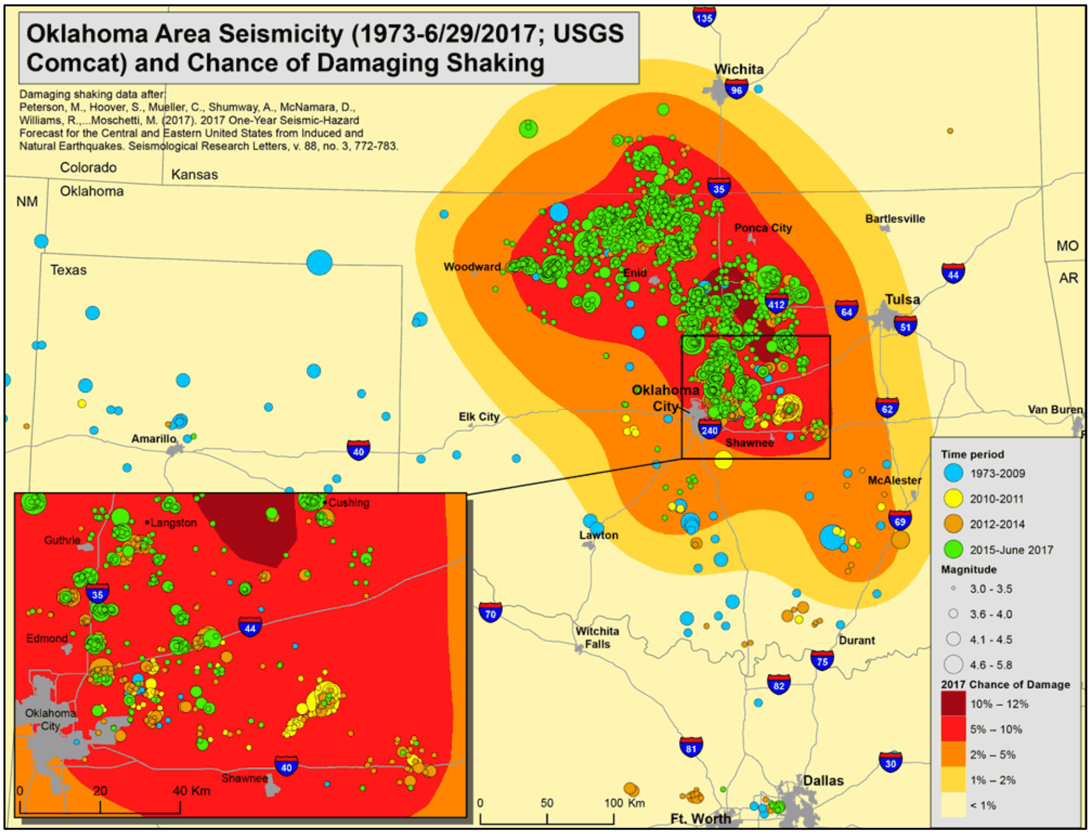


Image Source: US Geological Survey (2017)

6. ENVIRONMENTAL MITIGATION

ODOT strives to constantly improve upon compliance with environmental rules and regulations, using a stewardship approach towards the environment. Environmental impacts are a consideration in delivering the Eight Year Construction Work Plan as part of operating and maintaining an efficient statewide transportation system.

6.1. PROTECTION OF NATURAL, CULTURAL & HISTORIC RESOURCES

In order to facilitate meeting the transportation needs of a growing population and to maintain and improve existing infrastructure, impacts to the natural and cultural environment are often unavoidable. ODOT strives to continue advancement of proven innovations to reduce environmental impacts, improve the life of transportation assets, lower costs, save lives and improve efficiencies for Oklahoma's transportation system. As such, ODOT's transportation programs and operations continue to evolve to integrate environmental considerations and regulatory requirements.

To streamline and minimize potential delays in the environmental process portion of project development efforts, ODOT has instituted a series of programmatic agreements with various entities and resource agencies to define the expectations and roles related to addressing transportation project-associated environmental impacts. Chief among the agreements is a Programmatic Agreement for Processing Categorical Exclusion Actions between the Federal Highway Administration (FHWA) and ODOT. Another primary achievement for streamlining processes for ODOT projects is the Programmatic Agreement for Section 106 reviews between ODOT, FHWA, The Oklahoma State Historic Preservation Officer (SHPO), and the Advisory Council on Historic Preservation (ACHP) for projects involving bridges constructed under federal relief programs during the depression era. In addition, ODOT and FHWA have streamlined the Section 106 review of emergency undertakings by signing on to a Programmatic Agreement that Federal Emergency Management Agency (FEMA) has with SHPO and ACHP. While far from the only other Programmatic Agreement, a final example of these efforts is the ODOT American Burying Beetle (ABB) Programmatic Biological Opinion that applies to counties in eastern Oklahoma which potentially have ABB presence and impacts.

ODOT seeks to minimize impacts to endangered and threatened species using environmentally friendly construction methods to deliver projects that limit the impact of our transportation system on the natural and cultural environment. ODOT routinely holds training, and provides assistance as needed, for construction personnel to ensure compliance with environmental commitments during construction.

ODOT has sought to and developed partnerships with the federal resource agencies such as ACHP, US Fish and Wildlife Services, and US Army Corps of Engineers as well as state resource agencies such as SHPO. This type of collaboration among federal and state agencies has the potential to further streamline and expedite the Department's environmental processes and ensure efficient delivery of the Eight Year Construction Work Plan.

6.2. STORMWATER MANAGEMENT

In most transportation infrastructure projects, impacts to wetlands and streams are unavoidable. ODOT has relied on an array of mitigation strategies as an effective way to preserve, enhance and restore environmental resources. As a best practice, avoidance is the first alternative explored in developing transportation solutions. If impacts to these resources cannot be avoided, the next step is to develop mitigation strategies. These mitigation strategies typically include the acquisition of credits from commercially operated mitigation banks or in lieu fee programs, and consideration of partnership with other state or nonprofit agencies for offsite mitigation. The determination of need and the identification of appropriate mitigation—as early as possible in the transportation planning process—is critical to ensuring that the project can be completed on schedule.

ODOT is committed to protecting the environment through implementation of best management practices to maintain water quality and has a Storm Water Action Team (SWAT) working on the design and implementation of these practices.

Moving forward, ODOT will continue to research and implement new techniques, products, agreements and technologies that will streamline project delivery and constructability, while considering and minimizing effects to the natural and cultural environment. ODOT will continue to collaborate with municipalities in meeting their Municipal Separate Storm Sewer Systems (MS4) requirements while developing their own MS4 permit.

7. EMERGING TRENDS

This section focuses on trends that are still evolving, particularly in the technology area, that are highly likely to have significant impacts in the future of transportation. The topics discussed in this section include electric vehicles (EVs), compressed natural gas (CNG) vehicles, Oklahoma's alternative fuel corridors, connected and autonomous vehicles (CAVs), and truck platooning,

7.1. ELECTRIC VEHICLES (EV)

There are four main types of electric vehicles (EVs) as shown in **Figure 7-1**. For the purposes of this report, the focus will be on battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) as those can operate solely by utilizing electric charging stations.[xvi]

Figure 7-1: Types of EVs

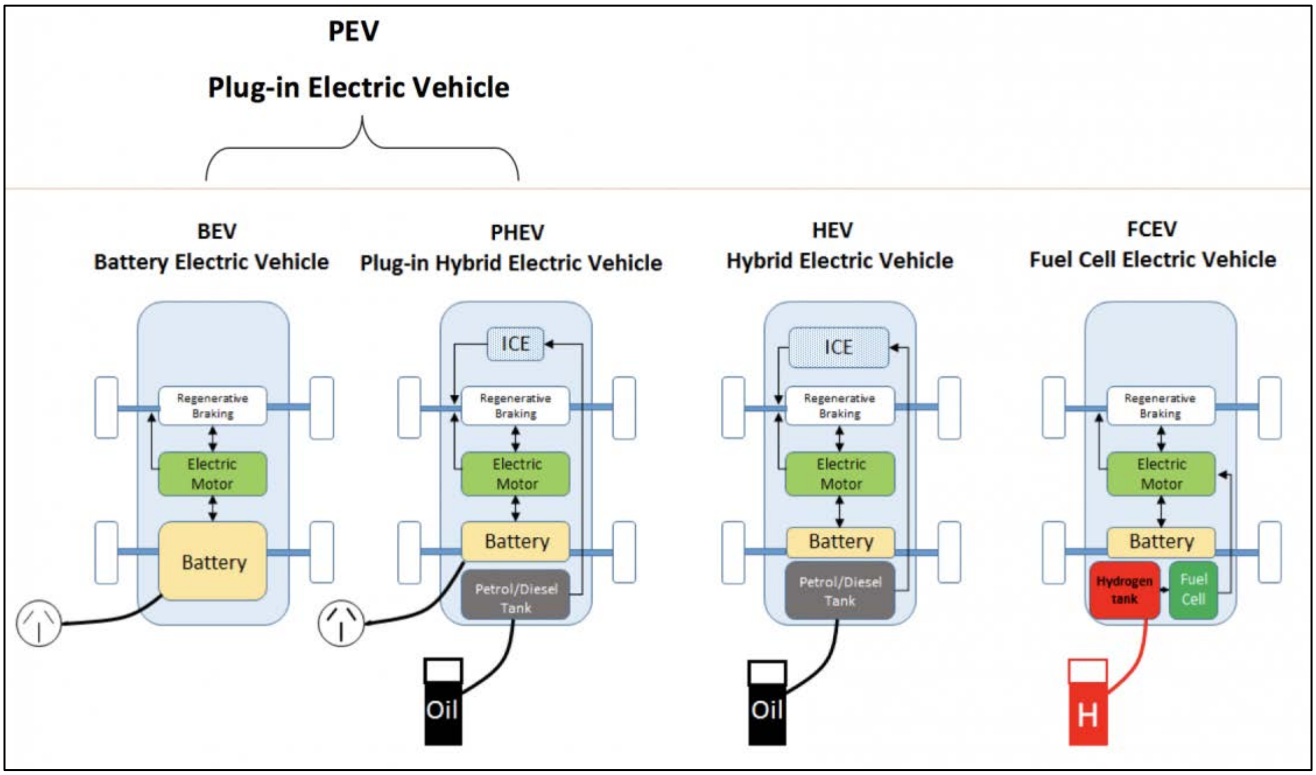


Image Source: The Driven (https://thedriven.io)

7.1.1. CURRENT ADOPTION

EV adoption varies significantly across the country and the world. While international adoption does not directly affect local transportation systems, increasing global investments are improving the technology and reducing pricing. In 2018, EVs accounted for only 0.35 percent of vehicle sales in Oklahoma, with 2,683 vehicles sold. Since the first year of EV sales, a total of less than 5,000 EVs have been sold in Oklahoma placing the state 28th in the country for total EV sales. **Table 7-1** lists the sales of EVs in 2018 in number of units, as well as percentage of light-duty vehicles sold.

Table 7-1 Electric Vehicle Sales 2018

Location / Vehicle Type	Oklahoma		United States		Global	
	Sales	Percent of Sales	Sales	Percent of Sales	Sales (mil)	Percent of Sales
BEV	2,402	0.31%	203,625	1.21%	1.45	1.5%
PHEV	281	0.04%	124,493	0.74%	0.65	0.7%
Total	**2,683**	**0.35%**	**328,118**	**1.95%**	**2.1**	**2.2%**

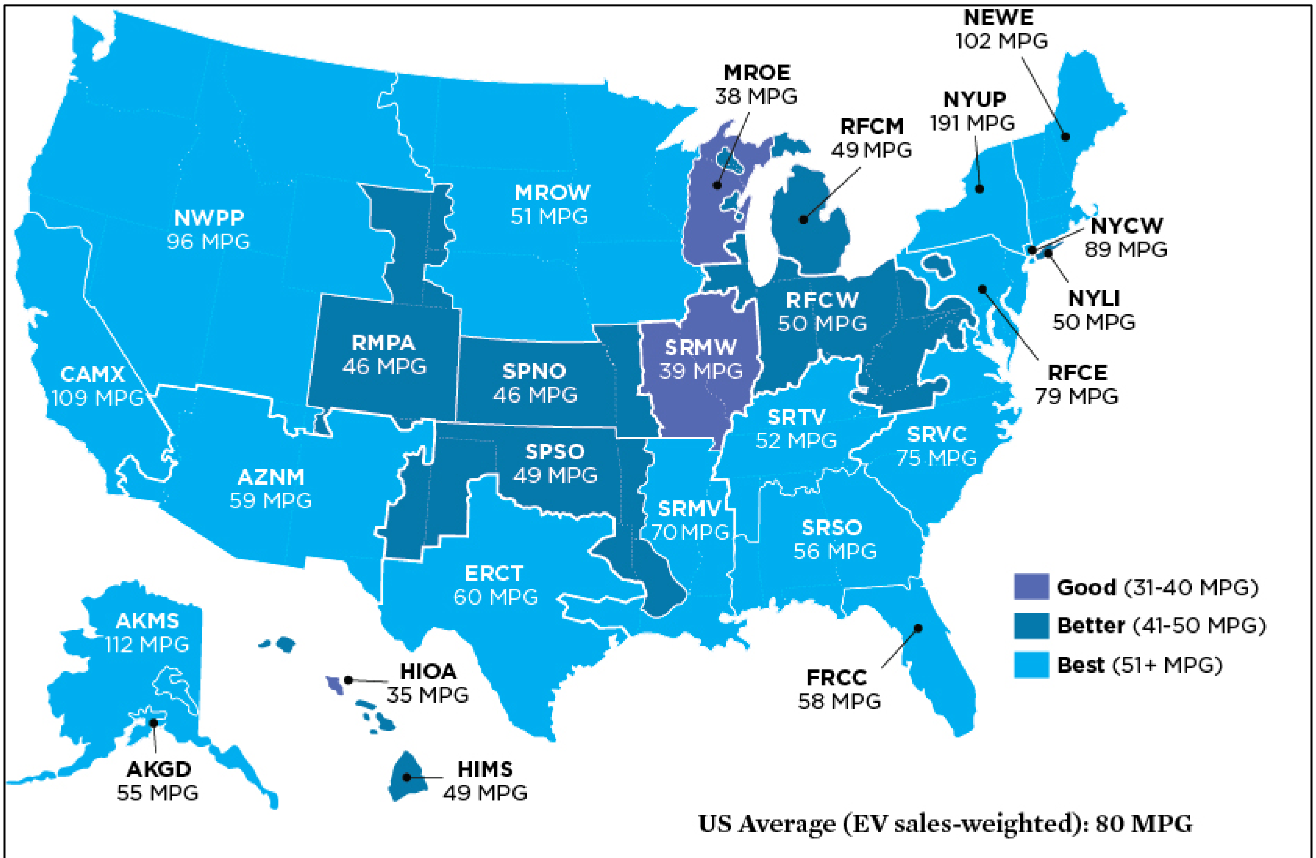
Sources: Auto Alliance 2019, EV-volumes.com 2019

7.1.2. PROJECTED ADOPTION

Because EVs are a relatively new technology, past adoption rates provide limited insight into its potential for adoption in the future. Other major factors that will likely impact EV adoption include state and federal policies, disruptions in supply chains, and changes in social behavior. The overall rate of EV adoption is increasing, which is typical in the early years of a technology. Oklahoma experienced the largest percent increase in sales of EVs of any state in the nation from 2017 to 2018, with sales increasing by 250 percent, but this was still less than half a percent of all vehicle sales in the state.

Reductions in emissions is a key selling point for EVs. While EVs are generally cleaner than vehicles that use traditional fuels, exactly how much cleaner varies by location, specifically being determined by how an area sources its electricity. The current miles per gallon (MPG) equivalent for EVs for areas around the US is shown in **Figure 7-2**. Driving an EV in Oklahoma is equivalent to driving a 49 MPG vehicle running on gasoline in terms of emissions produced.

Figure 7-2 MPG Equivalent for Electric Vehicles



Note: The MPG (miles per gallon) value listed for each region is the combined city/highway fuel economy rating of a gasoline vehicle that would have global warming emissions equivalent to driving an EV. Regional global warming emissions ratings are based on 2016 power plant data in the EPA's eGRID 2016 database (the most recent version). Comparisons include gasoline and electricity fuel production emissions estimates using Argonne National Laboratory's GREET 2017 model. The 80 MPG US average is a sales-weighted average based on where EVs were sold in 2011-2017.

Image Source: Bloomberg New Energy Finance (2019)

7.1.3. EV INCENTIVES AND PROGRAMS

There are various incentives and programs regarding EVs and EV infrastructure from both state and federal sources. The following is a list of some of the more prominent programs, which are described in more detail in **Appendix B**.

- Federal EV tax credit[xvii]
- Oklahoma tax credit for alternative fueling infrastructure[xviii]
- Oklahoma owned/operated alternative fueling infrastructure[xix]
- CLEAN AIR Grants for Public fleets
- ChargeOK Electric Vehicle Supply Equipment Grants

In addition to the incentives, Oklahoma offers another benefit to EVs in the form of a law declaring that an entity that is not currently a regulated utility providing retail plug-in electric vehicle (PEV) charging services will not be defined as a public utility and may sell electricity if it is used for the purpose of fueling a PEV.[xx] This simplifies the EV charging business model by allowing companies to sell electricity for EV charging without being regulated by the framework that governs utilities.

EV Infrastructure

EVs require electric charging stations to refuel their batteries. The current lack of available charging stations is considered a significant hindrance to the further adoption of EVs. **Figure 7-3** shows the three levels of EV charging stations. Oklahoma has 75 publicly available EV charging stations offering 197 charging outlets, primarily concentrated in Oklahoma City, Tulsa, and along I-40 and I-44 (**Figure 7-4**). These stations feature primarily level 2 chargers, with some DC fast chargers along the interstates. Oklahoma Gas and Electric (OG&E) has partnered with OnCue on a pilot installation of a level 3, DC fast-charging station at their Yukon location.

Figure 7-3: EV Charging Station Levels

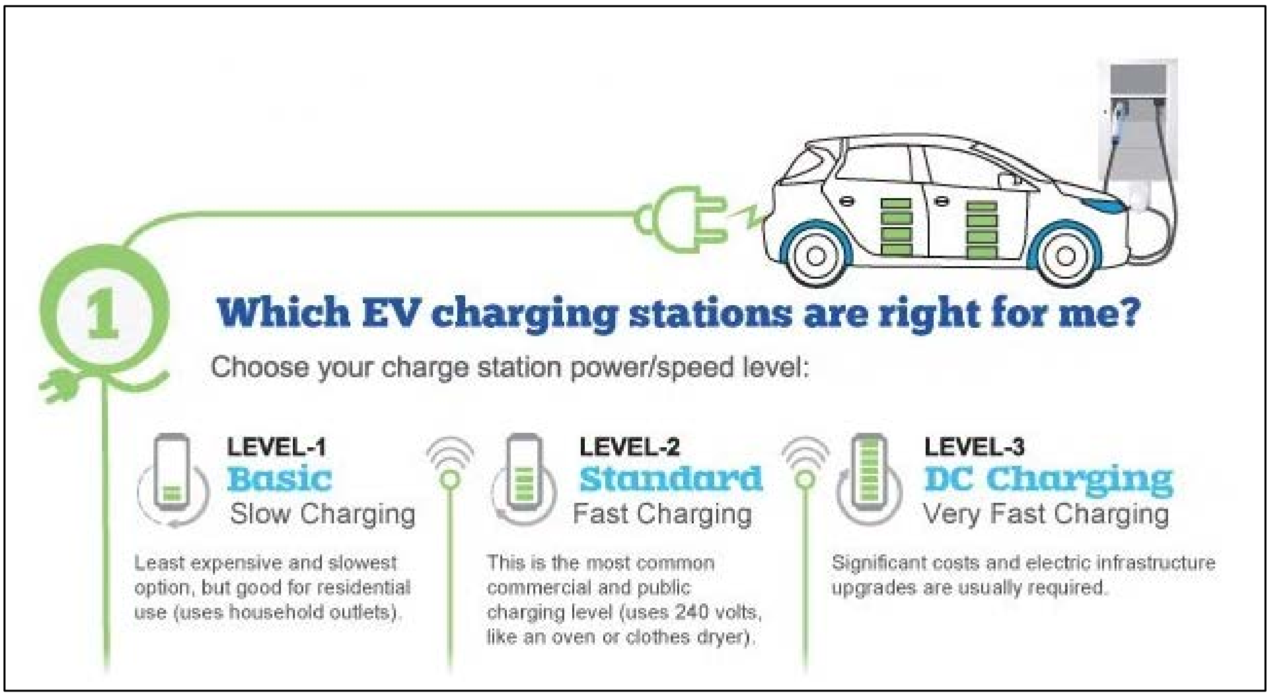


Image Source: Bloomberg New Energy Finance (2019)

Figure 7-4: Public EV Charging Stations in Oklahoma

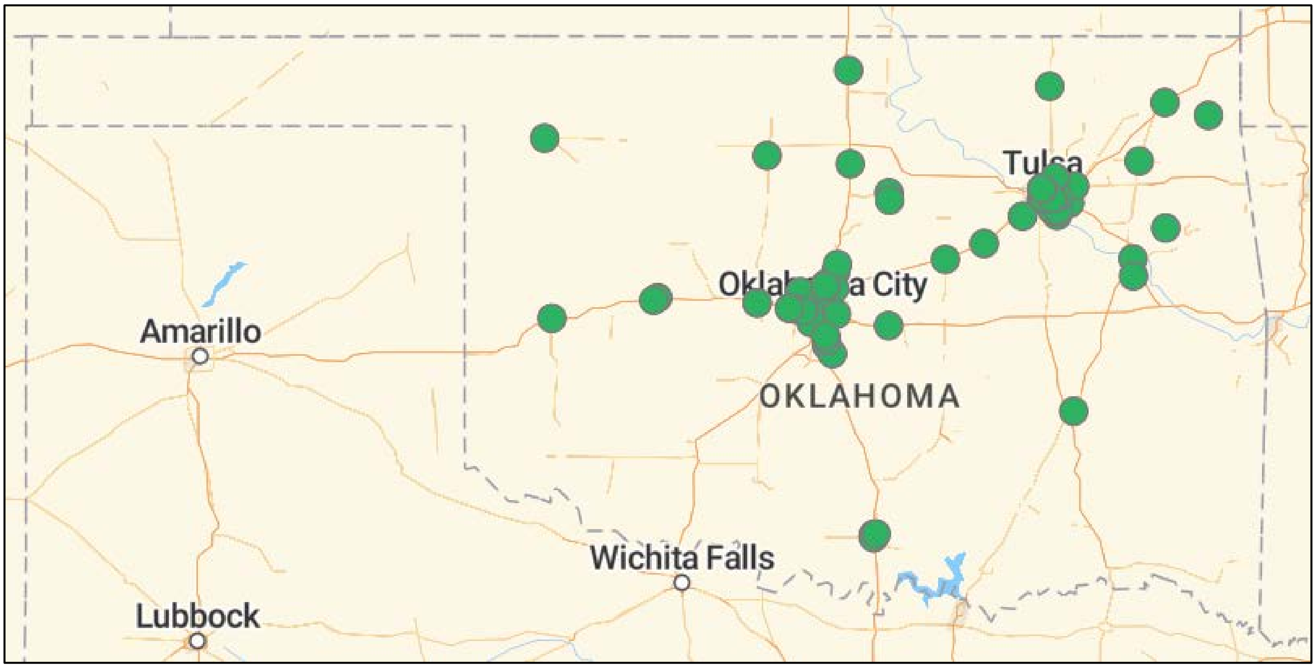


Image Source: Alternative Fuels Data Center (2019)

As EVs become more prevalent, so do the concerns regarding their impact on the electric grid. For context, plugging in an EV can roughly double the energy use of an average house. This challenge can be mitigated by incentivizing people to charge off-peak or at times when the cost of power is lower. This can be accomplished by offering lower prices during the night and/or implementing charge controlling options for the consumer.

Significant EV adoption for an entire city or region will impact larger infrastructure such as transmission lines and substations. If these assets need to be upgraded and the cost of operating the chargers is more than the revenue they generate, the utility will pass the costs on to the customer. However, even under a high EV market penetration scenario, most problems can be mitigated by spreading out the times when people charge their vehicles.

7.1.4. POTENTIAL IMPACT ON REVENUE

There is concern that EVs will reduce revenues dependent on the gas tax. The two most common funding methods currently being considered to offset this reduction in revenue are (1) a flat vehicle registration fee for EVs, and (2) a road use charge (RUC), also known as a mileage-based user fee (MBUF), that determines taxes owed based on miles driven. The RUC is meant to replace the gas tax as the latter is becoming a less dependable proxy for road use given gains in fuel efficiencies and difficulties in raising gas tax rates[xxi].

A map of all of the states that have enacted EV fees can be seen in **Figure 7-5**, which includes the fee that was ultimately ruled unconstitutional by the Oklahoma State Supreme Court.

Figure 7-5 EV Fees by State

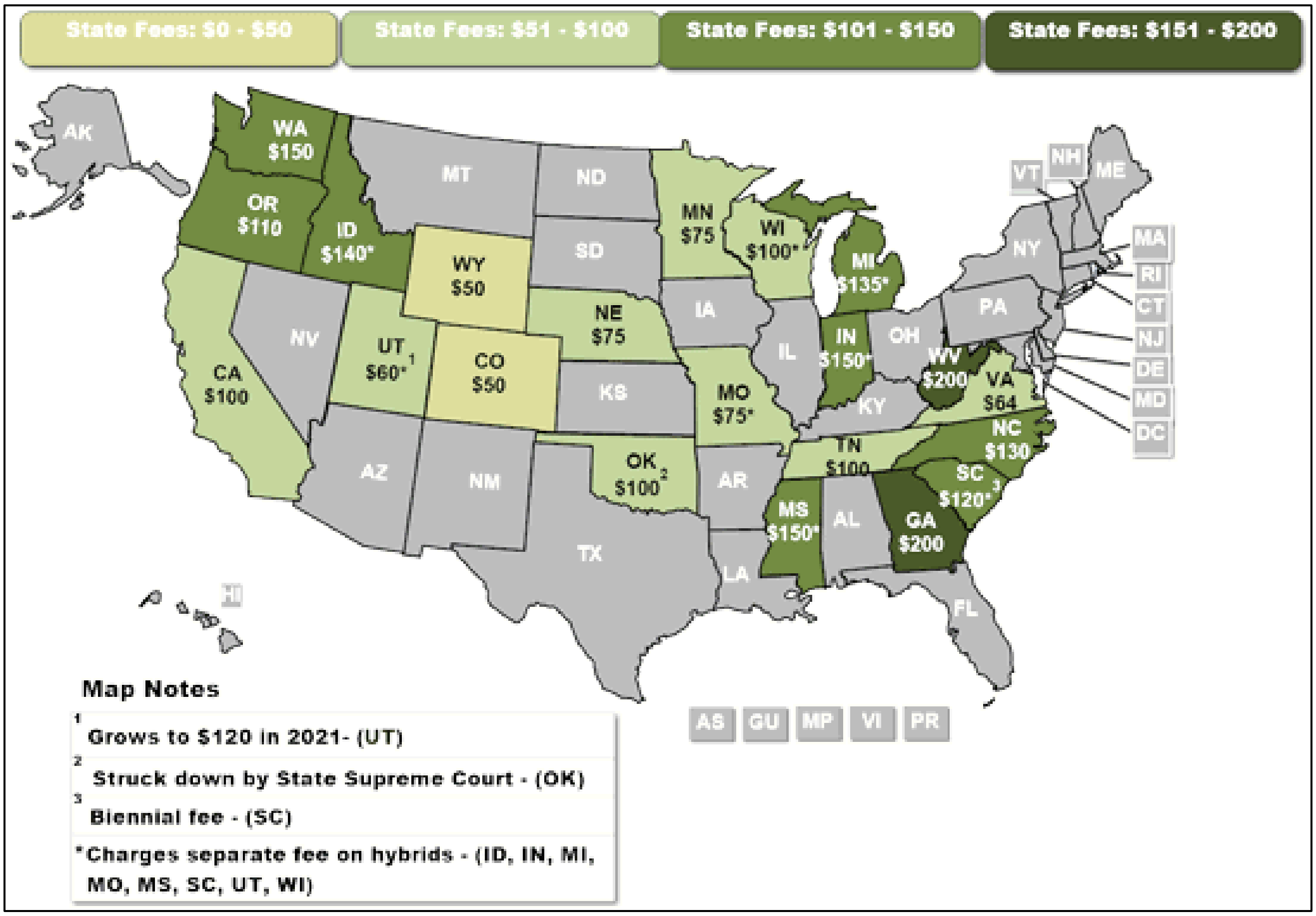


Image Source: National Conference of State Legislatures, 2019

7.2. COMPRESSED NATURAL GAS (CNG) VEHICLES

Oklahoma is third in natural gas production behind Alaska and Texas, and second in the US in terms of CNG stations. Natural gas is a low-carbon, cleaner-burning fuel, that can result in reductions of greenhouse gas (GHG) emissions. As such Oklahoma may be inclined to adopt more CNG vehicles as an alternative to vehicles that run on gasoline or diesel.

7.2.1. ADOPTION

Similar to EVs, current adoption is low, particularly for private individuals. However, unlike EVs, car manufacturers are not rushing to produce light-duty CNG vehicles, limiting the public's ability to acquire them. The lack of CNG models available has resulted in some drivers converting their diesel or gasoline-powered vehicles to run on CNG. Limited market attention on CNG vehicles makes it hard to project future adoption. Where CNG vehicles have the most potential, particularly in Oklahoma, is in government vehicle fleets.

7.2.2. CNG INCENTIVES

Signed into law in May of 2019, House Bill 2095 extends a tax credit for those who either convert their vehicles to run on CNG (or liquefied natural gas or liquefied petroleum gas) or buy vehicles that already run on those alternative fuels. The state tax credits will be available from 2020 to 2027, maximum annual effect on the state's budget is capped at $20 million. Additionally, the measure extends a tax credit, albeit for a reduced amount, to those who own equipment that delivers CNG (or liquefied natural gas or liquefied petroleum gas) to vehicles.

7.2.3. CNG INFRASTRUCTURE

Oklahoma has 101 CNG fueling stations (**Figure 7-6**), second in the US only to California. Continued pushes to increase availability of fueling stations available to the public can help in spurring adoption, however high up-front costs make it difficult for localities to recoup their investments in delivering fueling infrastructure. Such is the case in Tulsa where a decrease in public demand would hinder the City's ability to recoup its infrastructure costs (Reyes, 2018).

7.2.4. POTENTIAL IMPACT ON REVENUE

Currently CNG vehicles are subject to a $0.05 per gasoline gallon equivalent (GCE) state motor fuels tax until January 1, 2020. Despite this, in 2018 Oklahoma's CNG average cost per gallon was $2.17, compared to unleaded fuel at $2.57. [xxii] After January 1, 2020, the fuel tax for CNG vehicles will increase to match the rate for diesel fuel (US Department of Energy, n.d.). The CNG fuel tax mitigates the potential for decreases in revenue for this particular alternative fuel. A CNG vehicle reduces GHG emissions by approximately 10%.

Figure 7-6: CNG Fueling Stations in Oklahoma

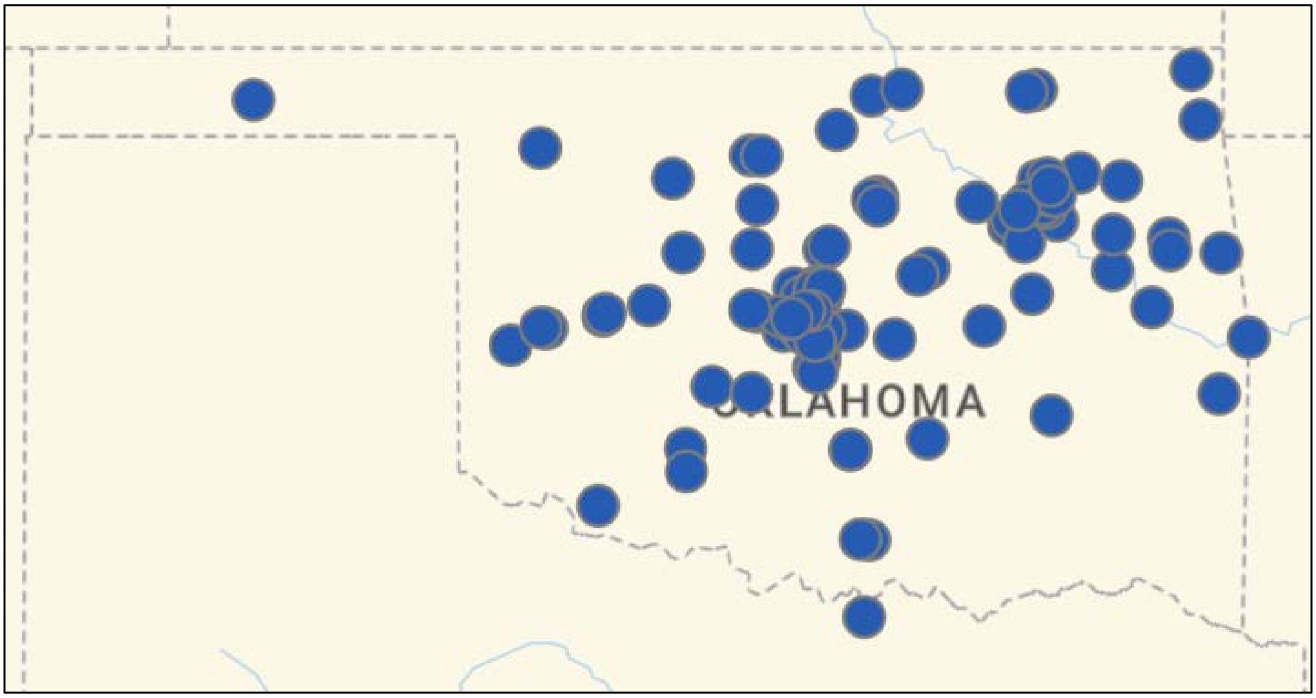
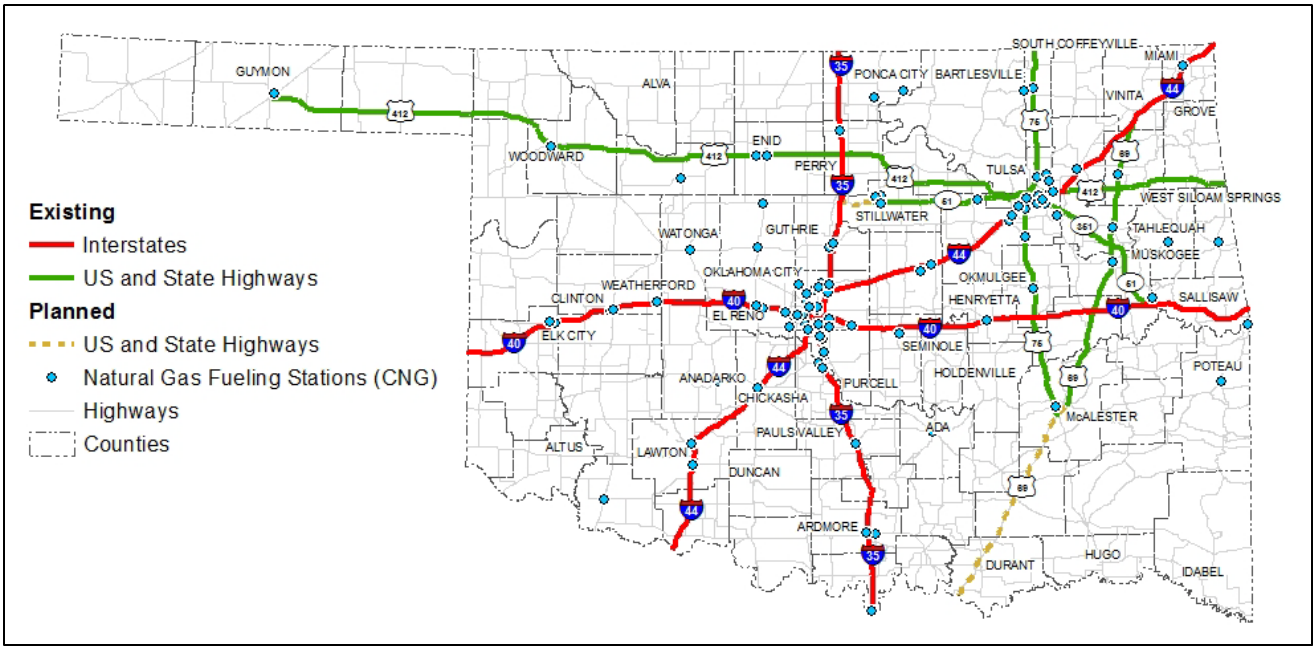


Image Source: Alternative Fuels Data Center (2019)

7.3. ALTERNATIVE FUEL CORRIDORS IN OKLAHOMA

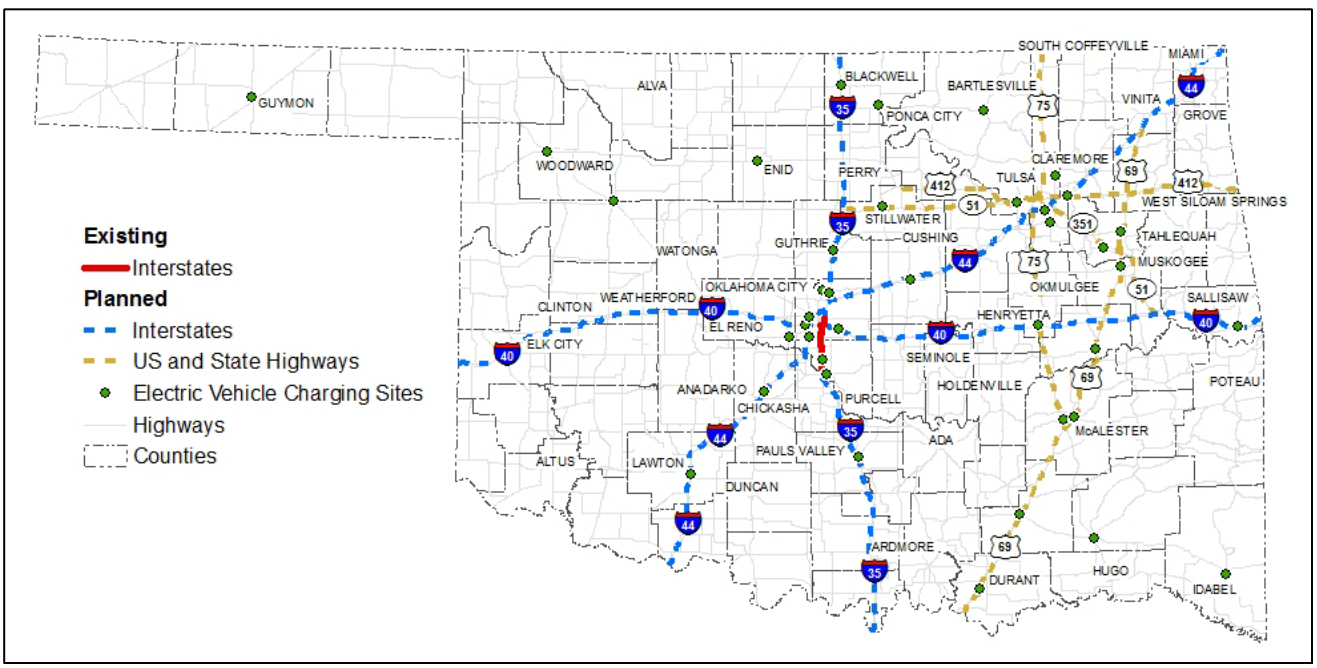
With an extensive network of electric vehicle charging stations and CNG fueling stations, Oklahoma is working to designate multiple roadways as Alternative Fuel Corridors. Alternative Fuel Corridors are Interstates, US Highways, or State Highways that are part of a nationwide effort to create an alternative fuel network. Currently, Alternative Fuel Corridor designations cover over 135,000 miles of the NHS nationwide (USDOT, 2019). **Figure 7-7** and **Figure 7-8** show the status of Alternative Fuel Corridors in Oklahoma.[xxiii]

Figure 7-7: CNG Corridors in Oklahoma



Source: FHWA Alternative Fuels Corridors, 2016-2018

Figure 7-8: EV Corridors in Oklahoma



Source: FHWA Alternative Fuels Corridors, 2016-2018

7.4. CONNECTED/AUTONOMOUS VEHICLES (CAVs)

Connected and autonomous vehicles (CAVs) are comprised of two distinct sets of technology: Connected vehicle (CV) technology and autonomous vehicle (AV) technology. CVs are able to communicate with their surroundings, including other vehicles, infrastructure, or a connectivity-enabled device. AVs are vehicles that can take on all or part of the driving functions typically performed by humans. While these two technologies have individual benefits and challenges, the benefits of connectivity and automation are significantly greater when they are combined. The technologies that will allow for broad adoption of CAVs are still being developed as detailed in the following sections. Pace of adoption in Oklahoma, and in the US in general, heavily depends on how quickly the technology advances.

7.4.1. STATUS OF TECHNOLOGY – AUTONOMOUS VEHICLES

The Society of Automotive Engineers (SAE) has defined five levels of autonomy that can be broken into two categories: driver-assist and self-driving. Level 1 and 2 driver-assist features are becoming standard options on many new vehicles and include adaptive cruise control, lane keep assist, and parking assist systems. Tesla's Autopilot falls into this category. Levels 3 through 5 include fully autonomous vehicles that can drive on their own. The difference in the levels is the areas and duration for which they are able to fully drive the vehicle, which is referred to as their operational domain. These levels are shown in **Figure 7-9.** While there are no commercial AVs readily available, there are a significant number of pilot systems currently being deployed. Many auto manufacturers have made claims regarding their readiness, with anticipated production dates, dedicated facilities, and research and development.

Waymo has started operating an autonomous driving service called Waymo One in the Phoenix metro area. While safety drivers are typically in the vehicles, there are trips with no safety drivers offered for participants in their early rider program. Participants in this program have access to features that Waymo does not make available to the entire Waymo One service, however it is a confidential program where riders are not allowed to disclose specifics to people outside of Waymo. While it exists in a limited service area of approximately 100-square-miles, it is one of the largest deployments in the country.

There have been other AV deployments in the last few years as well. Many have focused on fixed-route operations, but were open to anyone who wanted to use them. This is a different approach from the Waymo One program, which lets users choose their origin and destination within the service area but is only open to a small group. There have also been programs focused on low-speed AVs. These do not typically operate on public roads, using a trail or sidewalk instead. College campuses have seen many of these deployments. They are advantageous because the low speed and separation from other vehicles greatly reduce the safety risk. The National League of Cities has a report that summarizes many of the pilots happening across the country.

Figure 7-9 SAE Levels of Driving Automation

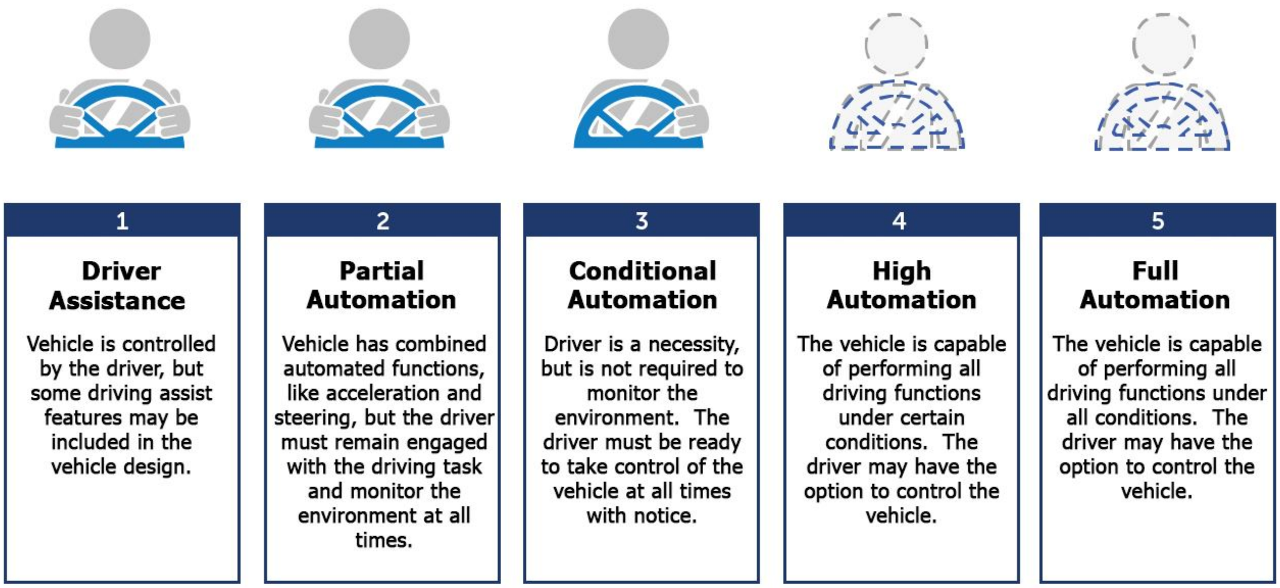


Image Source: SAE International, National Highway Traffic Safety Administration

7.4.2. STATUS OF TECHNOLOGY – CONNECTED VEHICLES

Connected vehicle (CV) technology is a much broader set of technologies compared to AVs. Anything that is communicating with the vehicle falls into this category, including route navigation and cellular or satellite connection. Vehicle-to-everything (V2X) technology is commonly considered when discussing CVs. It includes communication between vehicles and any entity that may affect the vehicle such as other vehicles, pedestrians, and infrastructure. This type of connectivity relates to vehicle automation because it can provide information with the ability to affect tactical driving decisions, such as lane changing, accelerating, breaking, and turning.

For CV technology to achieve the optimum benefit, all devices should use the same technology. For this reason, the US Department of Transportation (USDOT) issued a notice of proposed rule-making (NPRM) to mandate vehicle-to-vehicle (V2V) communication for new light vehicles and to standardize the message format. **Figure 7-10** shows a generic set-up for the vehicle-to-infrastructure communications.

Figure 7-10: Example Concept of Operations for Vehicle-to-Infrastructure Communication

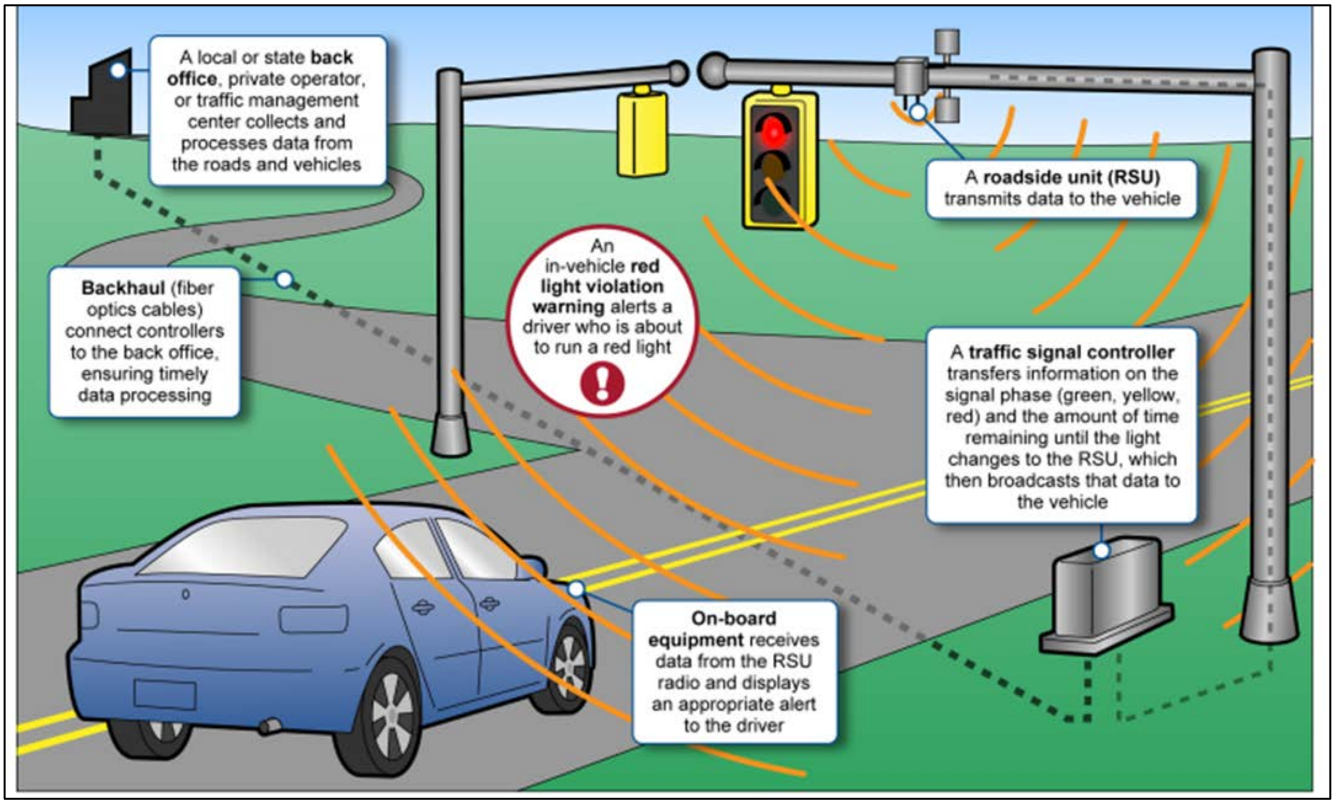


Image Source: Government Accountability Office

7.4.3. LEGISLATION ON CAVs COMPARISON WITH US/NEIGHBORING STATES

Many states have begun proposing legislation in anticipation of the arrival of CAV technology. Most current laws related to CAVs provide exclusions for following distance to allow platooning and setting the requirements for AV testing. The following is a summary of AV-related laws enacted in Oklahoma and neighboring states:

Oklahoma:

- A law allowing two-vehicle truck platooning for vehicles that are electronically controlling speed by removing the minimum following distance. Took effect July 1, 2019. 2019 OK S 189.
- The Oklahoma Driving Automation System Uniformity Act requires all laws regarding AVs to occur at the state level; cities and counties are banned from regulating AVs. 2019 OK SB365

Texas:

- Platooning is allowed if the vehicles are equipped with a connected braking system. 2017 TX H 1791
- Allows for the operation of an AV with or without a safety driver, as long as it conforms to the other requirements. 2017 TX S 2205.

Arkansas:

- Truck platooning is allowed with CV technology once the operator has filed a plan for general platoon operations. 2017 AR H 1754.
- Allows a fully autonomous vehicle to operate under pilot programs, as long as it has a "minimal risk condition" and can comply with all existing traffic laws. 2019 AR H 1561, updated with an exemption for railroad crossings. 2019 AR H 1822.

New Mexico:

- Created a committee to develop a proposal to allow AV use. 2018 NM SJM 3.
- A bill to accommodate AVs failed to pass in February 2019.

Kansas:

- None. One platoon bill failed to pass in 2018.

Missouri:

- None. Several bills related to platoons and AVs have failed, and three more are currently proposed.

7.4.4. CAV TECHNOLOGY LEADERSHIP IN CITIES

Cities around the US are taking the lead on implementing CAV technologies. The City of Tulsa created an Urban Mobility Innovation Team charged with removing barriers of entry for emerging transportation technology adoption in Tulsa, which includes CV and AV technology. A goal of the Team – made up of both policy and technology experts – is to advise business and government leaders on policy and technical issues related to adoption of CAVs. The Team will eventually inform the City's Strategic Mobility Plan (City of Tulsa, 2019).

7.4.5. TRUCK PLATOONING

Truck platooning, which entails two or more trucks maintaining close proximity to each other using technology that allows the trailing trucks to autonomously follow the lead truck, is expected to provide an early use case for CAVs because it offers a significant economic advantage for trucking and freight. States have begun allowing reduced following distances for vehicles if they are equipped with an appropriate combination of connected and autonomous features. The immediate benefit of truck platooning is simply the reduced drag on the vehicles, which increases fuel efficiency. That provision could be easily extended to fully autonomous vehicles following a manned lead vehicle. Two other reasons platooning makes sense as a test case is that it will help address the long-haul truck driver shortage the industry is currently facing, and autonomous driving is closer to being solved on a highway setting than it is in an urban setting (Adler, 2018).

Much like autonomous vehicles, many companies are getting involved in this space. Peloton was one of the first companies to begin looking at platooning, and Penske has recently announced that it is considering platooning for its fleet. Ike is an autonomous trucking company that is starting from the ground up to develop a fully autonomous truck, although they have announced no specific release date. Waymo has also begun testing autonomous trucks on Arizona freeways.

7.4.6. INFRASTRUCTURE REQUIREMENTS

For AVs, there is minimal required infrastructure. The private sector would rather not rely on the public sector for infrastructure investments or be forced to operate in a limited area. With these factors in mind, the industry is trying to develop vehicles capable of handling roads in any condition. Despite the minimal requirements, some infrastructure features do make it easier for AVs to function. Standard signage and striping with high visibility have always been important for human drivers, but they also make it easier for sensors and machine vision used by AVs to operate properly.

There are two advanced infrastructure options that could be beneficial if AV manufacturers can rely on them and choose to embrace them. The first is higher accuracy GPS networks. While traditional GPS is helpful for navigation, it lacks the precision required for locating position on a roadway or within a lane. With local correction stations on the ground, it becomes possible to achieve centimeter-level accuracy, rather than meter-level accuracy, which is precise enough to assist in driving maneuvers and decisions. Making this technology available on road networks would enable additional design decisions and sensor redundancies for AV manufacturers.

A second improvement is better mapping of the existing infrastructure and establishment of agency systems for reporting and updating changes to infrastructure. AV companies are already expending large amounts of money to develop high-resolution digital maps of the roads they will be operating on. If each AV manufacturer does this on their own, there will be a redundant cost. But if an agency manages that mapping, it could create a more efficient source and a possible revenue stream from companies that need access to that data to operate within the city. It would also be easier for the agency to keep these records updated as new construction occurs.

For CV technologies, a strong fiber infrastructure is also desirable. While many of the safety-critical V2X systems will operate through direct device-to-device communication on the roads, additional information can be collected and used for public agencies both in real time and for analysis on the traffic system later. There will still be a significant amount of data transfer between infrastructure and the transportation operations center, and that data will need a robust communications infrastructure.

7.4.7. UNMANNED AIRCRAFT SYSTEMS (UAS) AND URBAN AIR MOBILITY (UAM)

While CAVs are developing on the ground, work is also occurring in the air. A market study recently commissioned by National Aeronautics and Space Administration (NASA) looked at three use cases: last-mile package delivery, air metro (public transportation similar to busses), and air taxis. While air taxis were expected to have very limited market, both air metro and last-mile parcel delivery were projected to potentially be profitable by 2030.

There is currently technology readiness testing underway in Alaska, New Mexico, New York, Nevada, North Dakota, Texas, and Virginia to evaluate the performance of these technologies (USDOT, 2018). While air travel may be technologically more difficult than ground travel from a physics standpoint, it is significantly less complicated from a data and software standpoint.

7.5. MOBILITY AS A SERVICE

Generally speaking, mobility as a service (MaaS) entails providing transportation options as a service to be consumed as an alternative to owning a private vehicle. It typically involves the following:

- Payment and planning for transportation services is done through a single mobility operator, typically in the form of a mobile application available through a smart phone.
- Combining services from both public (e.g., transit) and private (e.g., transportation network companies, or “TNCs”, such as Uber) transportation providers.
- Offers multi-modal options specifically catered to the user (e.g., car with driver, bicycle, transit).

The framework to deliver MaaS is shown in **Figure 7-11**.

Figure 7-11: MaaS Framework

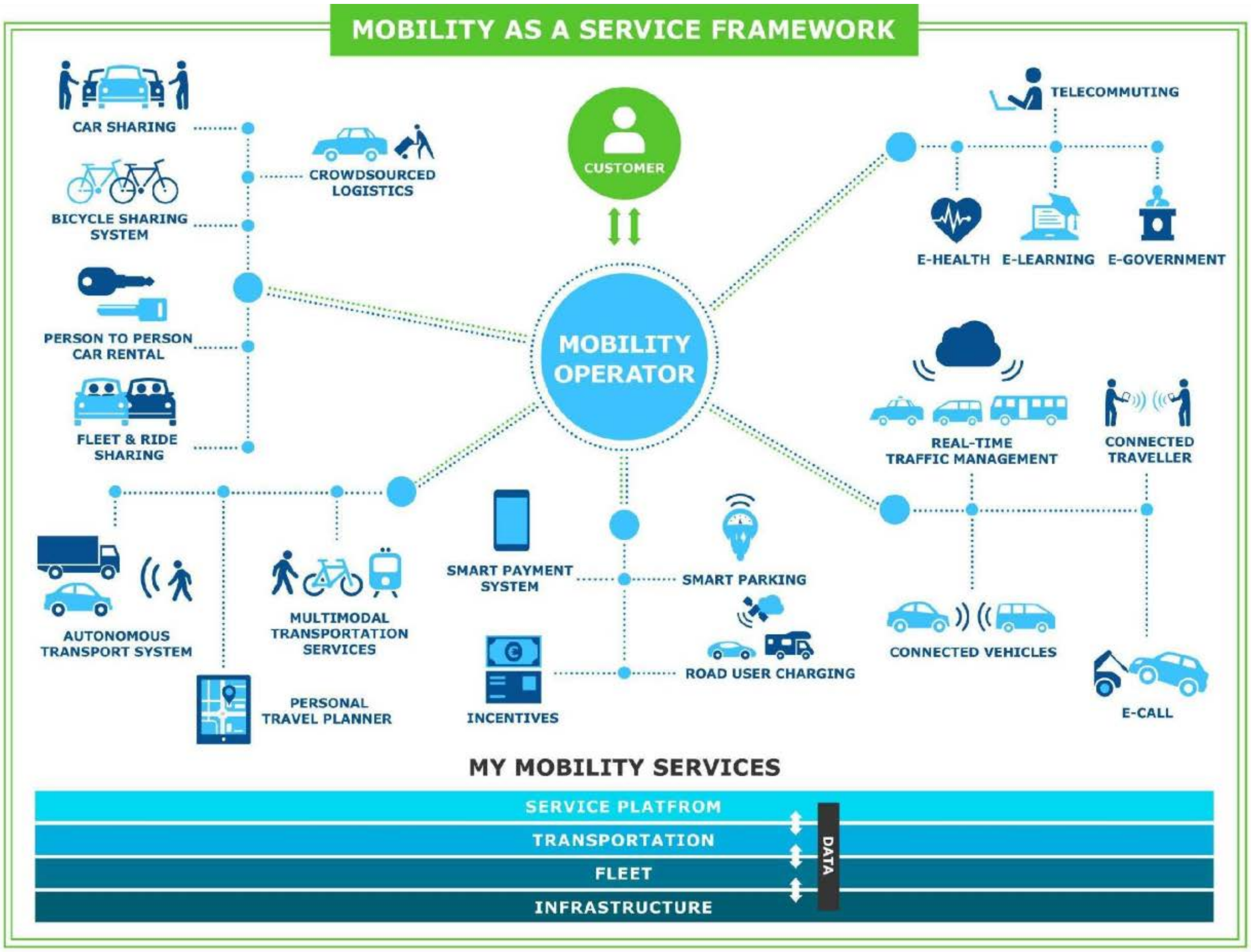


Image Source: TelematicsWire.Net

Transportation through means other than a private vehicle is not a new concept. Transit and ride-sharing services have been a staple in transportation offerings. However, those services have become limited by location (e.g., where mass transit is feasible) or specific use (e.g., paratransit). What MaaS looks to achieve is a comprehensive transportation offering for use by any individual to travel essentially anywhere. To do so, it looks to leverage multiple forms of technology. This includes mobile apps that allow users to plan and pay for transportation services, GPS to track both users and vehicles, and ultimately CAVs to offer travel through vehicles without having to pay for the cost of drivers. Adoption of MaaS in Oklahoma, and even in the US, could have significant implications in the future of transportation offerings (e.g., rural mobility options) and infrastructure (e.g., dedicated areas for MaaS user).

7.5.1. RIDE-SHARING

Ridesharing means two or more persons traveling together in a vehicle. One of the promises of MaaS is to deliver a more efficient transportation system. Its ability to make good on that promise depends heavily on users' willingness to share rides. If most MaaS users opt to ride alone in larger vehicles, that could lead to more congestion and higher VMTs. In fact, many studies have found that Uber and Lyft, perhaps the companies most commonly associated with MaaS in the US, are already contributing to increased congestion (LeBlanc, 2018).

7.5.2. MULTIMODAL TRIP PLANNING

A significant piece needed to ensure MaaS provides comprehensive multimodal trip planning is transit. For their part, transit operators are also beginning to see how MaaS can be mutually beneficial as both fill gaps in each other's transportation offerings (Comfort, 2018); MaaS can help transit riders with first or last mile connections, while transit provides an efficient option for moving large groups of people along busy corridors. For example, EMBARK in Oklahoma City provides open data that is used by third party applications to connect transit to car- and bike-sharing throughout the region. Other modes of transportation that are increasing in popularity are bikes and electric scooters, both of which Uber and Lyft have begun incorporating in their trip planning offerings.

7.6. OTHER TRENDS

Telemedicine allows doctors and other healthcare providers to treat patients remotely through telecommunication technology. It seeks to address long delays, issues of continuity of care, increasing costs for visits to the doctor, and, perhaps most importantly, unreliable transportation options to patients in both rural and urban areas (Mahar, Rosencrance, & Rasmussen, 2019).

3D printing allows for the creation of a physical object based on a digital file. Given advancements in technology, it is expected that 3D printing will have a significant impact on the freight sector, shifting freight volumes and creating new business models that use components created using 3D printing technology that cannot be made using traditional manufacturing methods (Wallenhaupt, 2019).

5G represents the latest in cellular wireless technology and is expected to be vital in leveraging innovations in transportation technology. This includes technology related to connected vehicles, real-time data reporting on telemetry, and further utilization of ITS devices. However, the speed and capacity benefits of 5G is largely urban-centric with network providers planning "low-band" 5G offerings in rural areas (Segan, 2018). The reduced rural offering comes notwithstanding the recent announcement by the Federal Communications Commission (FCC) of a $20 billion plan to expand broadband access to rural areas (an extension of an existing program) by holding the largest 5G auction in US history (Superville & Arbel, 2019). For its part, Oklahoma has in place its Broadband Initiative, which is first looking to identify broadband assets, gaps, and opportunities to eventually build the Oklahoma Community Anchor Network (OCAN).

8. TRANSPORTATION IMPLICATIONS

The trends included in the previous sections have the potential to impact Oklahoma's transportation system in varying ways. While the exact implications are not yet known, the following should be considered in transportation planning efforts.

8.1. DEMOGRAPHICS AND SOCIOECONOMIC ISSUES

- Continued declines in population are expected in Oklahoma's rural areas. Coupled with the projection that rural areas will likely have a significant share of their populations 65 and over and/or living below the poverty line, alternative mobility offerings will likely be warranted in transportation planning efforts.

- Increases in Hispanic/Latino population and international migration may help in averting population loss in rural communities (Hanson, 2016).

- There are significant gaps in transit service in both rural and urban areas, however technology, particularly MaaS and AV, may help to address transit gaps by offering alternative modes of transportation.

- The sectors with highest projected increases in terms of nominal employment are (1) Education and Health Services, and (2) Trade, Transportation and Utilities. The latter industry is fairly reliant on transportation and the movement of goods. The former includes services that may benefit from increased telecommunication technology allowing services to be offered remotely, which may place less stress on the transportation system if the technology is fully developed and utilized.

- Oklahoma residents continue to rely primarily on private vehicles for commuting, with driving alone being the dominant choice. Moreover, 48 percent have commutes longer than 20 minutes, and 12 percent have commutes that are over 40 minutes, a trend that could lead to higher VMT and congestion.

- With the rise in E-commerce comes increased needs in last mile delivery. This impacts land use in two ways; namely (1) the increase in smaller distribution centers around urban areas, and (2) the number of delivery vehicles needing access to curbs. Both entail planning around shifting freight traffic patterns.

8.2. SAFETY, SECURITY, RISK, AND RESILIENCY

- Overall, fatalities and serious injuries on Oklahoma's public roads have been trending down, however there has been a slight upward trend for incidents that fall under the combined category of non-motorized fatalities/non-motorized serious injuries (particularly in pedestrian fatalities), while the trend for fatalities at highway-rail grade crossings has been relatively flat. Further focus may be needed in terms of improving nonmotorized safety.

- With the introduction of new technologies, considerations must be given to the cybersecurity needs relative to the risks involved if bad actors gain access to information/transportation-related networks.

- Increases in intensity and frequency of severe weather-related events will need to be addressed in more robust resiliency planning efforts, including approaches to stormwater management. As mentioned previously, avoiding impacts is the first alternative explored in developing transportation solutions to these types of events, however mitigation may be the optimal strategy when avoidance is not a practical expectation. This may require updates to underlying assumptions regarding how often these types of events are likely to happen (e.g., reassessing categorization of "100-year floods").

8.3. EMERGING TRENDS

- Continued EV adoption, and improvements in vehicle fuel efficiency in general, will likely have a negative impact on gas tax revenue. Analysts estimate that in the US, state and federal tax revenue would decrease by $3 billion, or 5 percent, if EV penetration reaches 20 percent of new car sales (Institute of Energy Research, 2017). Alternative funding mechanisms, such as fees on EVs or road usage charges (RUCs), may need to be evaluated.

- The two major promises of CAV technology are (1) safety - as computers remove the risk of human driver error, and (2) increased mobility options - as the cost for providing transportation decreases with the removal of a human driver. Even if one is to assume the technology is progressing towards full automation, these promises come with questions such as:

    - While the technology is being developed, will there be safety issues as a result of the drivers transitioning from human operated vehicles to automated vehicles and relying too much on the automated features?

    - While adoption is progressing, how will AVs interact with human driven vehicles? Will AVs programmed to drive "safely" lead to more aggressive driving from human drivers, thus leading to more traffic incidents?

    - If AVs become a popular option for increased mobility, will the cost savings from not having to pay for a driver result in AVs increasing VMT and congestion as they travel to avoid parking or to look for passengers if used in MaaS (i.e. "deadhead" miles).

- Truck platooning is expected to grow, and this can help in addressing the freight industry's shortage of truck drivers. Aside from lessening the reliance on human drivers, it will also negate the impacts of current driver regulations and safety constraints that limit the number of hours that drivers can operate. However, if automation results in an increase in truck freight, it may increase the number of trucks on the road and bring a host of secondary effects related to traffic and infrastructure impacts as well.

- Many of the technology trends included in this report could benefit populations in rural areas. MaaS combined with CAVs could help alleviate the transit and mobility gap; telemedicine could reduce the need for those seeking medical services to physically visit healthcare centers; e-commerce and direct-to-door deliveries could also lessen the need to travel long distances to purchase goods. However, the ability to take advantage of the technological innovations is dependent on those areas and the users having reliable internet access / data connectivity.

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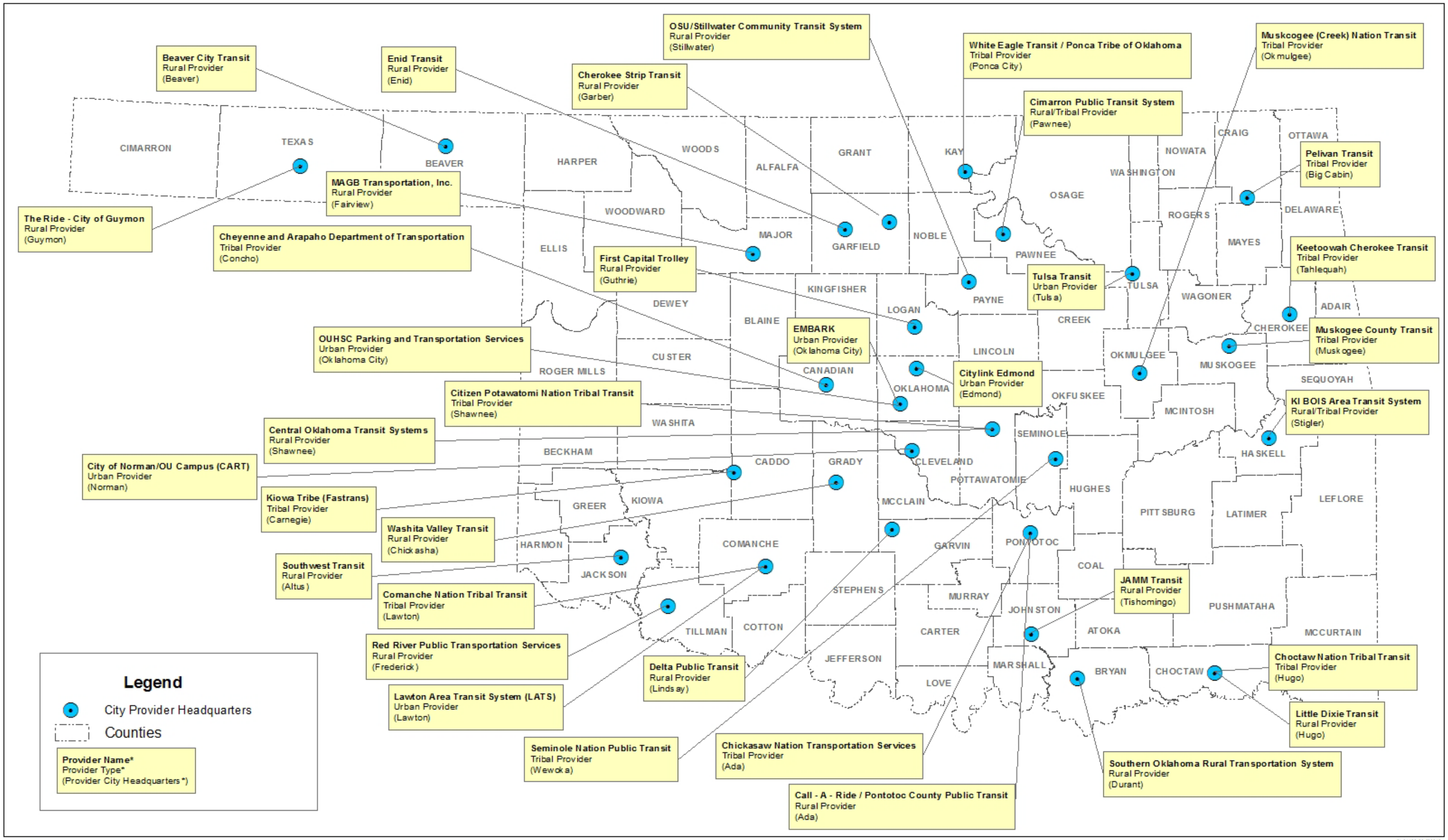
10. APPENDICES

10.1. APPENDIX A – TRANSIT SERVICE PROVIDER HEADQUARTERS



10.2. APPENDIX B – ELECTRIC VEHICLE INCENTIVE PROGRAMS

- **The EV federal tax credit**
    - Worth up to $7,500 dollars to consumers who purchase BEVs is scaled based on the size of the battery. The credit is good for the first 200,000 vehicles sold by each manufacturer. After 200,000 sales, the credit goes down to $3,750.[xxiv]
- **Oklahoma tax credit for alternative fueling infrastructure**
    - For tax years beginning before January 1, 2020, a tax credit is available for up to 75% of the cost of installing commercial alternative fueling infrastructure. Eligible alternative fuels include natural gas, propane, and electricity. The infrastructure must be new and must not have been previously installed or used to fuel alternative fuel vehicles. The tax credit may be carried forward for up to five years[xxv].
- **Oklahoma owned/operated alternative fueling infrastructure**
    - The Oklahoma Office of Management and Enterprise Services (OMES) Fleet Management Division may construct, install, acquire, operate, and provide alternative fueling infrastructure for use by state agencies and local government, and for use by the public in areas of the state where public access to alternative fuel infrastructure is not readily available. OMES must discontinue public access to their fueling stations if a privately-owned alternative fueling station opens within a 5-mile radius. Alternative fuels include natural gas, propane, ethanol, methanol, biodiesel, electricity, and hydrogen[xxvi].
- **CLEAN AIR Grants for Public fleets**
    - Offered through the Association of Central Oklahoma Governments (ACOG). Utilizes Congestion Mitigation Air Quality (CMAQ) funds for fleet conversions to clean fuel technologies and alternative fuel vehicle refueling infrastructure
- **ChargeOK Electric Vehicle Supply Equipment Grants**
    - Offered through the Oklahoma Department of Environmental Quality (DEQ). These grants are worth up to 80% of the eligible project costs of charging stations. The program is funded through the Volkswagen Environmental Mitigation Trust.

[i] The US Census bases poverty level thresholds by size of family and number of children under 18 years of age. Total family income is divided by the appropriate poverty threshold to determine poverty status.
[ii] Based on U.S. Census Bureau's American Community Survey 2017 (ACS) 5-Year estimate of 1,468,971 households in Oklahoma.
[iii] The Urbanized Area Formula Funding program (49 U.S.C. 5307) makes federal resources available to urbanized areas with a population of 50,000 or more for transit capital and operating, and for transportation-related planning.

[iv] The Formula Grants for Rural Areas program (49 U.S.C. 5311) provides capital, planning, and operating assistance to states to support public transportation in rural areas with populations of less than 50,000.

[v] The Tribal Transit Formula Grant program (49 U.S.C. 5311c) offers funding to federally recognized tribes that may use the funding for capital, operating, planning, and administrative expenses for public transit projects that meet the needs of rural tribal communities.
[vi] Urban full reporters receive or benefit from §5307 FTA funding for urban areas, and operate either: (1) more than 30 vehicles across all modes and types of service, or (2) 30 vehicles or less across all modes and types of service and operate fixed guideway and/or high intensity busway.
[vii] Urban reduced reporters receive or benefit from §5307 FTA funding for urban areas and operate 30 vehicles or less across all modes and types of service and do not operate fixed guideway and/or high intensity busway.
[viii] Rural Reporters are operators of transportation that either receive or benefit from §5311 Rural Area FTA funding.
[ix] Includes passenger trips provided by rural reporters for elderly and disabled persons under the §5310 program.
[x] Reduced Reporter (Tribes) consist of Tribes that receive §5311c Tribal Transit Formula Program funds.
[xi] Only includes trips from tribes that do *not* contract out transit service to other rural transit providers.
[xii] The HSIP is a Federal-aid program with the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads, States are required to report annually on the progress being made to advance HSIP implementation and evaluation efforts.
[xiii] FARS is a nationwide census containing data on fatal injuries suffered in motor vehicle traffic crashes created by the National Highway Traffic Safety Administration (NHTSA).
[xiv] ANSI D16.1-2007 classifies motor vehicle traffic accidents to promote uniformity and comparability of motor vehicle traffic crash statistics.
[xv] The vehicle classifications included in Large Trucks are Single-Unit Truck 2-Axle, Single-Unit Truck 3+ Axle, Bobtail (Truck Tractor), Truck/Semi, Semi/Double, Semi/Triple, and Unclassified Truck 5+ Tons.
[xvi] While PHEVs can run on gas alone, owners typically charge them the same way as BEVs. Unless differentiated specifically, use of the term EV refers to both BEVs and PHEVs in aggregate. The main difference between BEVs and PHEVs is that BEVs do not have an internal combustion engine (ICE) and thus is powered solely by a battery.
[xvii] Reference Public Law 112-240, Section 403; and 26 US Code 30D
[xviii] Oklahoma Statutes 68-2357.22
[xix] Oklahoma Statutes 74-78 and 74-130.2
[xx] Reference Oklahoma Corporation Commission RM 201800010 and Oklahoma Administrative Code 165:35-13-1
[xxi] Oklahoma raised its fuel tax in 2018 (the first increase since 1987) by 3 cents on gasoline and 6 cents on diesel, however those increases will be used to off-set the general funds that are being redirected from transportation to education.
[xxii] https://afdc.energy.gov/files/u/publication/alternative_fuel_price_report_jan_2018.pdf
[xxiii] EV corridors include only DC fast charging stations (prior to 2017 could also include Level 2 chargers), have stations located every 50 miles that are within five miles of a highway, and are open to the public (excludes Tesla facilities). CNG corridors include stations spaced every 150 miles that are within five miles of a highway, are open to the public, support fast fill, and have a 3,600-psi pressure rating (typical industry standard).
[xxiv] Reference Public Law 112-240, Section 403; and 26 U.S. Code 30D
[xxv] Oklahoma Statutes 68-2357.22
[xxvi] Oklahoma Statutes 74-78 and 74-130.2